



# **Surgical Stress**

The Role of Psychological Factors in the Determination of Stress

Responses and Recovery from Surgery

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## Abstract

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The aim of this thesis was to examine the impact of psychological factors on stress responses to, and recovery from, surgery.

In the first study, pre-operative state-anxiety, coping and personality variables were examined in relation to intra-operative neuroendocrine responses and recovery from carotid endarterectomy surgery (n=39). Current evidence supports the view that heightened pre-operative state-anxiety and some personality characteristics contribute to poorer post-operative recovery. It is hypothesised that one of the mechanisms through which psychological stress might influence recovery is that of the neuroendocrine or “stress response” to surgery as sustained increases in neuroendocrine hormones are believed to precipitate complications.

Using hierarchical regression analysis and controlling for demographic and medical factors, pre-operative state-anxiety and emotion-focused coping were significant predictors of intra-operative cortisol response. However, this was a negative association. State-anxiety was also a significant predictor of poorer Health-related quality of life (HRQoL) one month after surgery. Trait-anxiety was associated with more complications, and poorer HRQoL one month after surgery. Task-oriented coping and a higher internal locus of control was a significant predictor of better HRQoL at three months. Conclusions from this study are that while pre-operative state-anxiety may influence some aspects of recovery, it is not pervasive. Coping and personality characteristics may be better predictors of other aspects of recovery. Additionally, there is no evidence to show that pre-operative state-anxiety is associated with a greater neuroendocrine response therefore not supporting the notion of the neuroendocrine response as an underlying mechanisms linking psychological stress to poorer recovery.

In the second study, the extent to which coping styles interact with choice and information, to effect stress responses, satisfaction, knowledge and recovery in patients undergoing colonoscopy (n=162) were examined. Studies show that stress decreases when people’s desire for information is matched with the amount of information provided and that stress increases if there is a mismatch. Patients were first randomised to a choice or no choice condition. In the no choice condition they were further randomised either to watch an educational video or not in the week prior to the procedure. Patients in the choice condition were required to choose whether or not they wanted to watch the video.

Offering patients a choice to access additional information in the form of an education video did not reduce stress responses or improve patient outcomes. Additional information, however, was associated with a greater recall of procedural information and, a reduction in cardiovascular responses following completion of the procedure. For some patients, those high in avoidance and emotion-focused coping, additional information was associated with greater pre-procedure anxiety and less control; however, no adverse effects on recovery were found. Conclusions drawn from this study are that there appears to be no additional benefits in terms of patient outcomes by allowing patients to choose whether or not they want additional information. However, exposure to the video had some significant positive outcomes for patients, including increasing their recall of knowledge about the procedure and decreasing sympathetic nervous system activity following completion of the procedure.

## Statement

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This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by any other person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Signed

Date 11/11/03

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For Margaret

## CHAPTER ONE

### Stress: definition, history and measurement perspectives

---

#### 1.0 Introduction

In 1936, Hans Selye undertook a series of historically important experiments investigating the effects of severe physical stress in rats. Physical changes that he observed in these rats included enlargement of the adrenal gland, atrophy of the immunorgans and gastric ulceration. Selye proposed that these changes had occurred in response to prolonged activation of the hypothalamic-pituitary-adrenocortical (HPAC) axis, and more specifically the prolonged secretion of cortisol. It was later recognised that the HPAC axis in addition to the sympathetic-adrenal-medullary (SAM) system was responsive not only to physical stress, but also to emotional states. The discipline of “psychoneuroendocrinology” began to emerge in the late 1960s making a significant contribution to our current understanding of the interplay between the neuroendocrine system and emotional, behavioural and cognitive functioning. It is now clear that the activity of the HPAC and SAM systems in concert with structures of the central nervous system (CNS) is essential to sustaining life and support of all our behaviours, from sleeping to responding to severe stress.

This chapter will briefly review the history of the concept of stress and the field of “psychoneuroendocrinology”. An overview of the physiological characteristics of the stress response will be covered in addition to outlining the structures of the CNS that are involved in the interplay between psychological stimulation and physiological activity.

#### 1.1 The nature and definition of stress

Stress is difficult to define, given its rather liberal use in the literature over the years. It has more generally been defined as the response of the body to internal or external threats

that disturb equilibrium or homeostasis (Chrousos and Gold 1992). Such threats can include all forms of physical, mental and emotional trauma (Walton, Barondess et al. 1994). Different disciplines have tended to adopt different approaches toward research and theoretical development of the concept of stress. Despite these differences, Cohen (Cohen, Kessler et al. 1997) argues that a common theme exists between them that allows the development of an integrated theoretical model of stress in disease and health.

*"They all share an interest in a process in which environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place persons at risk for disease." (Cohen, Kessler et al. 1997).*

Within this model of stress in disease, three different research perspectives are distinguished. Firstly, the environmental perspective emphasises the role of different environments and experiences in terms of adaptive demands. Secondly, the psychological perspective focuses on individuals' subjective appraisals of their ability to cope, and thirdly, the biological perspective accentuates the physiological systems that are activated during physically and psychologically demanding situations. Each perspective places an emphasis on a different aspect of the stress process through which environmental demands are translated into biological and psychological changes that potentially place people at risk for disease (Cohen, Kessler et al. 1997). For the purpose of this thesis, stress and its role in disease and health will be conceptualised within this framework. The focus will be on looking at stress in surgical patients from the biological and psychological perspectives. It will be assumed that, from the environmental perspective, impending surgery represents a significantly stressful situation for most people.

## 1.2 Concepts in stress research

There are a number of psychological concepts commonly used in this area of research that need to be outlined. The term *stressor* is used to refer to any agent causing a disturbance in the body's homeostasis. *Physical stressors* refer to those agents that have the capacity to directly damage body tissues and organs; such stressors as a surgical incision or chemical agents. *Psychological stressors* are those agents that challenge the body's homeostasis because of their perceived potential for harm. Impending surgery is one example of a psychological stressor. Surgery is an example of a physical stressor. In addition to this, and within the context of the definition of stress outlined earlier, surgery will be viewed as an acute and time-limited event or stressor.

## 1.3 A brief history of the concept of stress

It is Hans Selye who is most often credited with the development of the stress concept, following his identification of the role of the HPAC axis in responding to stress by releasing cortisol. As a young medical student Selye noticed in the course of his training that many patients, while presenting with quite specific symptoms relating to specific disease states, also shared a common group of symptoms which he termed a general "state of being sick". Based on these early observations he began a series of systematic experiments in 1936 that led to the eventual formulation of the General Adaptation Syndrome (GAS). Selye exposed rats to an array of different stressors including restraint, starvation, exercise, haemorrhage and extremes in temperature. In addition to this, he inflicted traumatic wounds such as burns and fractures, and injected them with foreign substances such as bacteria and impure glandular extracts (Selye 1956).

Selye's observations of these rats during exposure to these stressors has been enormously influential in shaping and driving subsequent research in this area.

He observed that all of these different treatments produced the same triad of responses, including - i) adrenocortical hypertrophy, ii) atrophy of and bleeding into the thymus gland and lymph nodes, and iii) gastric erosion. All three components are caused by prolonged activation of the HPAC axis, and secretion of adrenocorticotropin and glucocorticoids. According to Selye, during the first stage of the GAS, the alarm phase, the organism's physiological response reflects the body's initial reaction to meet the demands of the stressor. The organism becomes restless and the adrenal cortex is stimulated to secrete cortisol. During the second 'resistance' phase, symptoms disappear as the body fully adapts to the stressor, while cortisol remains elevated and stable. Finally, entry into the exhaustion phase occurs when the stressor is sufficiently extreme and prolonged to deplete the body's defences. The body's capacity to continue secreting cortisol and adapt to the stressor is lost, symptoms reappear, and the organism may eventually succumb to illness and death as the body organs and physiological reserve are broken down.

Selye's original conception of stress emphasised this reaction as a general and non-specific reaction that occurs in response to many different types of stressors. His work was also primarily concerned with responses to physical and pharmacological stressors, with little attention paid to the effects of emotional arousal on these responses. It was not until later that the effects of emotional stress were recognised as capable of eliciting an alarm reaction (Mason 1971).

Another notable figure who contributed to our current understanding of stress was Walter Cannon. Cannon is perhaps most famous for identifying the role and importance of the SAM system in the stress response, and for defining the concept of homeostasis. In his most famous publication, "The Wisdom of The Body" published in 1932, he wrote at length on the relationship of the autonomic system to the self-regulation of physiological processes and the maintenance of a steady internal state (Cannon 1932). The work of Claude Bernard,

a French physiologist who fifty years earlier had pointed out that the internal environment of a living organism must remain fairly constant despite external changes to ensure survival (Chrousos and Gold 1992), was important in the formulation of Cannon's ideas. Cannon believed that many of the physiological sub-systems in the body functioned within predetermined parameters that, if breached, would act to destabilise such systems. That is, to remain healthy, a stable internal environment must be maintained. He called this "homeostasis" derived from the Greek *homoios*, meaning similar and *stasis*, meaning position. Cannon's view emphasised the importance of functioning within these limits (Cannon 1932). Conceptually, physiologists of this era were more concerned with changes in levels than with variability or deviations outside of this range. Selye interpreted the GAS and resulting organ damage as an instance in which these homeostatic limits had been exceeded.

Selye's assumption of "non-specificity" of response was later challenged by Mason, who proposed that each stressor elicits its own distinct physiological reaction. Mason's work was important in demonstrating that changes occur in anticipation of a threat, and that they are patterned behavioural and hormonal responses that are specific to certain types of stimuli (Mason 1971; Mason 1975; Mason 1975). Mason's work represented a major theoretical shift away from Selye's doctrine of non-specificity. In light of Mason's findings, Selye was to eventually acknowledge the existence of specific as well as non-specific responses to stressors, later in his career (Selye 1974; Selye 1978).

While Selye made a significant contribution to our current understanding of stress, it is difficult to generalise the GAS concept to humans and everyday life. Selye's rats were subjected to extreme and sometimes torturous types of stressors that they would not normally encounter. In addition to this, they were subjected to these stressors in a

controlled laboratory environment, where their capacity to adapt to such a stressor, for example by running away from it, was significantly diminished (Weiner 1992).

One of the major criticisms of Selye's early work was that he did not study the behaviour of his animals (Weiner 1992). Charles Darwin had observed and documented more than seventy years earlier how animals adapt to stress in the environment. From his observations Darwin was able to argue that, in order to survive, animals must be able to respond to an ever-changing environment. Migration is an example of adaptive behaviour that ensures the continuation of the species via breeding and an adequate food supply. Similarly, the use of camouflage mechanisms assist some animals to escape predation, while hibernation is a coordinated behavioural and physiological response that allows the animal to survive particularly harsh climatic conditions. The point Darwin was making was that different environments require different responses. Failure to respond appropriately is a failure in adaptation.

Darwin's work had important implications for the study of stress in humans. It highlighted the importance of an interactionist approach to the study of stress adaptation. To gain an insight into the reality of successful adaptation, animals must be allowed to engage in a free appraisal of the environment and respond to the environment. Not all animals will respond appropriately and some may eventually perish. As Weiner (Weiner 1992) has argued, Selye overwhelmed his rats, preventing them from making a patterned response. While most researchers in this area adopt an interactionist approach today, it was not until the work of Mason and Lazarus in the 1970s that this approach was more widely acknowledged. It is precisely this new direction that has been at the forefront of the emerging field of psychoneuroendocrinology.

### **1.3.1 Cognitive theory of stress and coping**

Having established a link between the psychoendocrine system and the experience, as well as anticipation of emotion, Lazarus and Folkman developed their influential theory of stress and coping in the late '60s (Folkman 1984). A psychological stress response is generated following a series of appraisals (Folkman 1984; Lazarus 1993). This influential model recognises the importance of cognitive appraisals in emotional, physiological and behavioural responses to stressful situations. This theory proposes that cognitive appraisals (real or imagined) in the context of a stressful encounter are made with relevance to their significance for physical and/or psychological well being. The primary appraisal determines the significance of the event in terms of well being, while the secondary appraisal assesses the resources available to cope with the stress. Positive and negative emotions experienced prior to the event are associated with challenge and threat appraisals while positive and negative emotions experienced after a stressful event reflect benefit and harm appraisals. These judgements determine whether the situational demands are perceived as within or outside an individual's ability to cope. Where the individual's perception of danger exceeds their perceived ability to cope, the situation is usually appraised as threatening. Where perceptions of danger do not exceed their perceptions of their ability to cope, the appraisal is usually one of challenge. This process begins with the evaluation and synthesis of incoming sensory information in the frontal cortex. This information is processed within the context of previous experience and in the case of a threatening appraisal will result in a degree of negative emotional states such as anxiety and/or distress. Psychological stress occurs when this emotional evaluation connects with bodily response systems such as the endocrine and autonomic systems.

### 1.3.2 The emerging field of “psychoneuroendocrinology”

It was not long after these events that the field of psychoneuroendocrinology began to take shape as a legitimate and important area of research. The most significant contributions in terms of the psychobiology of stress and coping were to emerge from the laboratories of the Scandinavians (Lundberg 1984). Most notable has been the work led by Marianne Frankenhaeuser. By combining Mason’s notion of “specificity” and Lazarus’s theory of appraisal and coping, Frankenhaeuser and colleagues began a series of experiments in the 1970s on individuals under both laboratory and naturalistic conditions. This work emphasised neuroendocrine variables as indicators of behavioural and psychological arousal, and was guided by the notion that,

*“the effectiveness of psychosocial factors in arousing the sympathetic-adrenal medullary and pituitary-adrenal cortical systems is determined by the person’s cognitive appraisal of the balance between the severity of the situational demands on the one hand, and his or her personal coping resources on the other. Another key notion is that the neuroendocrine responses to the psychosocial environment reflect the emotional impact of this environment on the individual and that diverse environmental conditions may evoke the same neuroendocrine responses because they have a common psychological denominator” (Frankenhaeuser 1980).*

### 1.3.3 The distress/effort model

Frankenhaeuser (Frankenhaeuser, Lundberg et al. 1980) noted a dissociation between the SAM and HPAC response systems in relation to the psychological factors of control, distress and feelings of activation. Based on the pooled data from five studies on the same subjects under different psychosocial challenges, it was found that under conditions of

effort (ie. active coping) that were accompanied by distress, there was an increase in catecholamine and cortisol output. By comparison, effort without distress was associated with an increase in catecholamines but low levels of cortisol, and distress without effort (ie. passive coping) with an increase predominantly in cortisol (Frankenhaeuser, Lundberg et al. 1980; Lundberg and Frankenhaeuser 1980). Therefore according to this model, psychological processes associated with effort including feelings of interest, engagement and determination have tended to be associated with increases in SAM activity, while psychological processes associated with distress, including feelings of anxiety, helplessness, dissatisfaction and boredom, have tended to be associated with increased activity of the HPAC system.

Central to Frankenhaeuser's work was the concept of control and predictability. In one of these five studies, she was able to demonstrate the sensitivity of the HPAC axis to these factors by measuring catecholamine and cortisol excretion under varying conditions of control and/or predictability, as determined by the subjects themselves. She found that under conditions of low control both catecholamines and cortisol were significantly elevated, while in the high control condition catecholamines levels were elevated and cortisol levels were low (Frankenhaeuser 1975; Frankenhaeuser 1980; Lundberg and Frankenhaeuser 1980).

Support for the notion of higher catecholamine levels being associated with effort in the absence of distress can also be seen in a series of studies carried out predominantly on Swedish school and college students. Increases in adrenaline were consistently associated with emotional stability and better performance in an active coping situation (Johansson and Frankenhaeuser 1973; Johansson, Frankenhaeuser et al. 1973; Bergman and Magnusson 1979). Increases in adrenaline were also associated with superior performance by matriculation students during exam conditions, as well as being associated with lower

psychosomatic symptomatology, lower anxiety scores, and positive teacher ratings on school achievement (Rauste-von Wright, von Wright et al. 1981). These series of studies showed that increased catecholamine capacity/responsivity is associated with stress resistance and emotional stability. In support of the cortisol-negative affect relationship, elevations in cortisol have been observed during public speaking (Buchanan, al'Absi et al. 1999), in anticipation of a tooth extraction (Goldstein, Dionne et al. 1982), and under exam stress (Malarkey, Pearl et al. 1995).

Not all research, however, is consistent with this notion. Cortisol excretion levels have been positively correlated with social competence in school age children. Cortisol concentration levels increased while catecholamines decreased in those children who performed better on a number of achievement tests (Tennes and Kreye 1985; Tennes, Kreye et al. 1986). Higher cortisol levels have also been observed in air traffic controllers who have been rated as more competent and effective in their work environment (Rose, Jenkins et al. 1982). Distress and lowered competence have been associated with lower cortisol levels in hospitalised haemophiliacs (Mattsson, Gross et al. 1971). These inconsistencies suggest a more complex picture than is currently available and is likely to emerge unless the inconsistent findings are due to flawed experimental design.

#### **1.3.4 Summary**

In the previous discussion the historical progression of stress research from Selye and a predominantly biological perspective, to a more contemporary approach that incorporates psychological concepts has been outlined. Selye was essentially interested in the body's physiological response to stress, and made a significant contribution to our understanding in this area. It is apparent, however, that other factors such as emotion and coping also influence stress responses. At this point it is useful to look in more detail at the

physiology of the stress response, to better understand how the body adapts to a demanding situation and how the stress response might result in damage to the body

#### **1.4 The stress response**

The stress response, and indeed the perception of a stressor, is coordinated by a number of different structures in the brain, and can occur in a conscious or unconscious way. It usually begins as a generalised response, that develops into a more specific response as the individual has time to process and appraise the stressor and their ability to cope with it. The stress response has physiological and emotional components that often determine behaviour. While the two components of the stress response cannot be separated out, they will be dealt with separately for the purpose of the discussion presented here.

#### **1.5 Stress from the biological perspective**

To ensure an understanding of how stress can be measured, it is necessary to understand the regulation of the response itself. For this purpose, details of the biology of the stress response will begin at the level of the autonomic nervous system. Structures and processes discussed in relation to the stress response will primarily be those relevant to this thesis. Hence, the regulation and actions of cortisol, adrenaline and noradrenaline will be covered.

##### **1.5.1 The autonomic nervous system: an overview**

The autonomic nervous system (ANS) remains the principal communication system through which the brain conveys information to the rest of the body. Autonomic nerves travel from the brain down the spinal cord, and out to various structures and glands within the body. The system acts on the smooth muscle of the gastrointestinal tract; on cardiac

muscle and on exocrine glands (ie. in general it is found that they secrete directly onto a body surface or into a body cavity). It is generally referred to as an involuntary system, because we tend to have less control over many of the actions of the ANS, such as blushing and sweating-although this is not entirely correct when you consider the use of biofeedback mechanisms to alter autonomic responses. The ANS consists of the sympathetic, or “emergency”, system and the parasympathetic, or “self-sustaining”, system. The sympathetic nervous system (SNS) acts as an arousal mechanism for the entire body and prepares it for vigorous action. It predominates during muscular activity and the expenditure of energy. The parasympathetic system produces the opposite effect, and helps the body to conserve energy (Tortora 1988; Guyton and Hall 1996).

In addition to responding to emergency situations, the SNS is activated during times of excitement, for example during sexual activity. It mediates arousal, vigilance and energy mobilisation. By comparison, the parasympathetic division mediates vegetative activities such as sleep and energy storage. Most visceral organs, blood vessels and sweat glands in the body are supplied with dual antagonistic innervation, that is they act in an opposing fashion so that an organ’s response can be very accurately controlled. For example an increase in sympathetic input or a decrease in parasympathetic input can increase the heart rate, since it is the algebraic sum of the inputs that determines the organ’s response. This self-limiting quality is an important factor in modulating an appropriate response (Tortora 1988; Guyton and Hall 1996).

### **1.5.2 Hypothalamic-pituitary-adrenocortical axis**

Cortisol is the primary hormone secreted by the adrenal cortex. The release of cortisol is mediated by the HPAC axis. As well as defending against the effects of stress, the HPAC also regulates normal metabolic and diurnal activity. Cortisol secretion is

regulated principally by the hypothalamus, anterior pituitary and adrenal cortex. Once the paraventricular nucleus of the hypothalamus receives a positive signal to begin secreting cortisol it releases corticotropin releasing factor (CRF) into the portal vein, where it is carried to the anterior pituitary. Within seconds of its release, CRF stimulates the release of adrenocorticotrophic hormone (ACTH) from the anterior pituitary into the systemic circulation, where it travels to the adrenal cortex, stimulating an increase in the rate of cortisol synthesis, and subsequent release into the bloodstream (figure 1.1)(Stokes and Sikes 1991).

The release of cortisol is regulated by a number of different mechanisms. In addition to the secretion of cortisol by episodic circadian rhythms, it is also regulated by negative feedback (Thompson 1993). Cortisol circulates in the blood stream to the brain, where it binds with specialised receptor sites on neurones in regions of the hypothalamus, pituitary, hippocampus and the amygdala. Cortisol halts the secretion of ACTH above a certain set point determined by steroid receptor saturation, reflecting circulating cortisol. They restore ACTH secretion when the cortisol concentrations drop below this level (figure 1.2). LeDoux has suggested that as long as an emotional stimulus is present, it is the balance between excitatory inputs from the amygdala effectively saying “release” and the inhibitory inputs from the hippocampus saying “slow down” that determine how much CRF, ACTH and eventually, cortisol will be released. This suggests that it is the hippocampus that is the critical site for the termination of the adrenocortical stress response (Stokes and Sikes 1991; LeDoux 1996).

The primary function of cortisol is catabolic. It acts to pull energy out of the body's stored reserves, to facilitate action and arousal. While adrenaline, noradrenaline and cortisol affect various organs independently, they also act in a synergistic fashion with each

other, and hence their effects are not mutually exclusive. More specific effects of cortisol include the following:

- Cortisol increases the rate at which proteins are removed from cells and transported to the liver where they are broken down into amino acids. They are subsequently rebuilt into enzymes and used in further catabolic activity or converted to glucose.
- Cortisol increases the sensitivity of blood vessels to vessel constricting chemicals. This increases blood pressure, which can be an advantage if bleeding occurs.
- Cortisol also affects the immune system by decreasing the cells and chemicals that participate in inflammation. It does this by decreasing the number of lymphocytes and eosinophils in the blood, decreasing blood capillary permeability, stabilising lysosomal membranes, thus inhibiting the release of histamines, and by depressing phagocytosis.

While these actions assist in the prevention of localised inflammation, they unfortunately also suppress the immune system, making the individual more susceptible to infection. In addition to this, by inhibiting the production of fibroblasts which, if injured release chemicals that play a role in stimulating the inflammatory response, the regeneration of connective tissue essential in wound healing is also retarded (Tortora 1988; Guyton and Hall 1996).

The HPAC axis acts in a number of ways to assist in stress resistance. Firstly, there is the mobilisation of energy resources that are required for action. Secondly, the secretion of cortisol serves to maintain homeostasis by regulating the activity of other stress sensitive systems including the immune system, the central and peripheral catecholamine systems and the endogenous opiate system. Thirdly, the release of ACTH, CRH and cortisol also act in the brain to alter memory, learning, behaviour and emotions an effect, which is discussed later in this chapter.

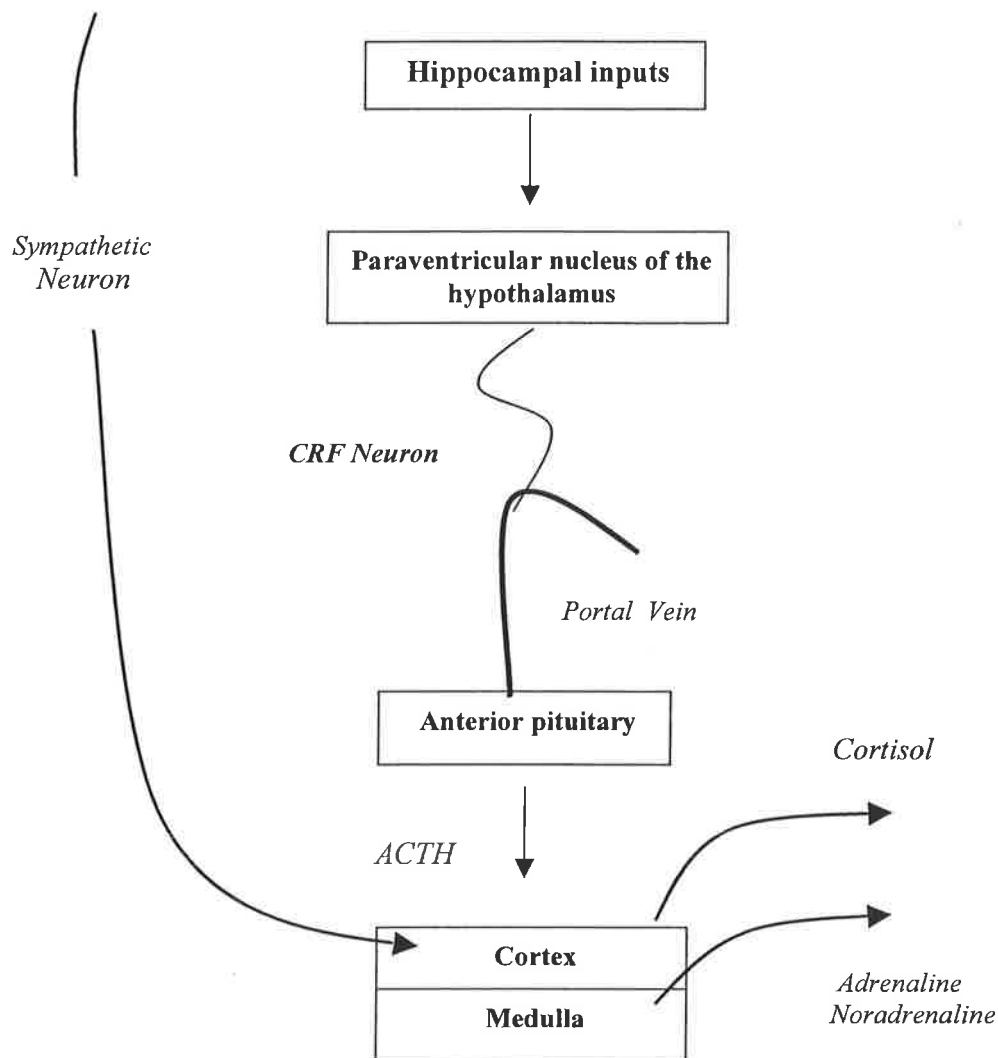


**Figure 1.1. The hypothalamic-pituitary-adrenocortical axis.**

CRF, corticotropin releasing factor; ACTH, adrenocorticotrophic hormone.

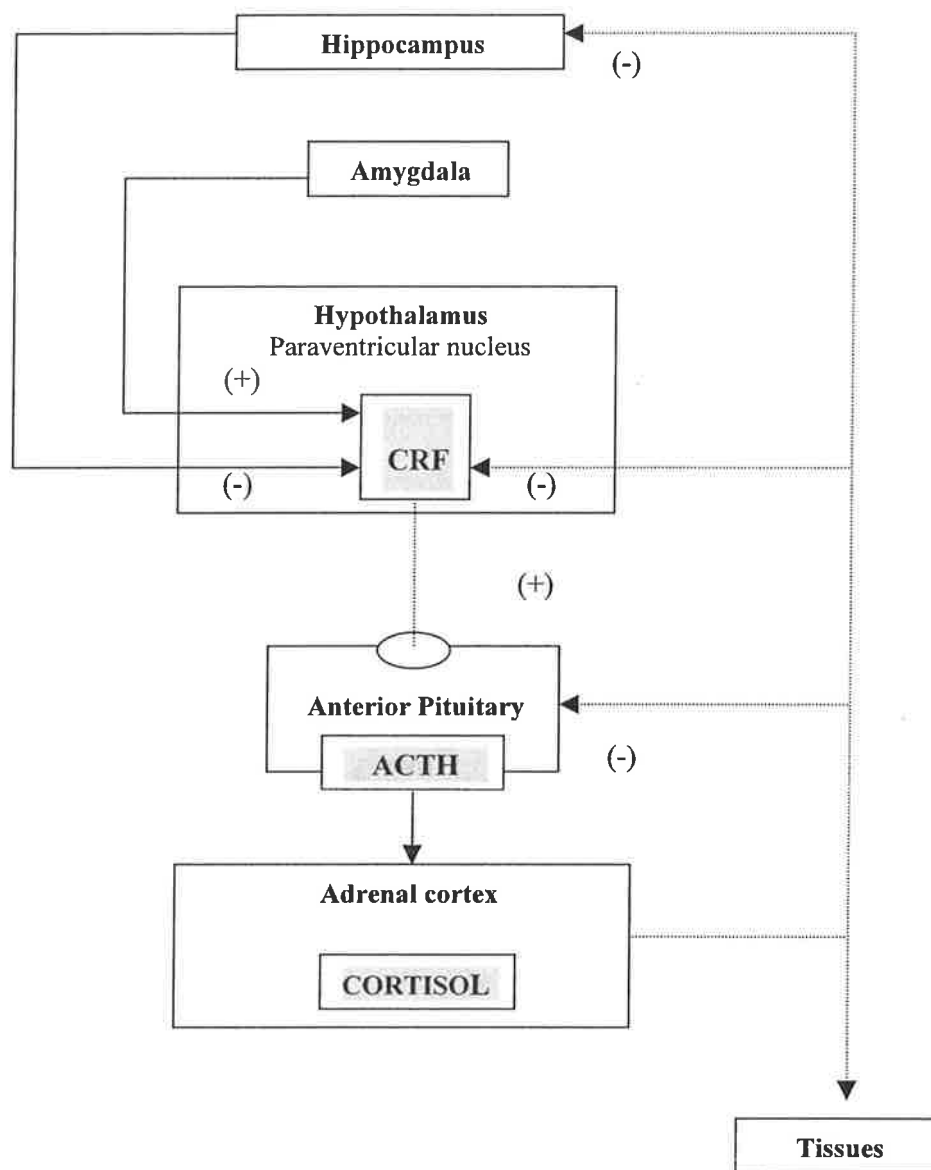


**Figure 1.2. Regulation of cortisol secretion.**

### 1.5.3 The sympathetic-adrenal medullary system (SAM)

Activation of the SAM system is more commonly referred to as the “fight-or-flight response” since its original conceptualisation by Cannon (Cannon 1932). It represents a series of reactions initiated by the hypothalamic stimulation of the sympathetic nervous system and the adrenal medulla. Almost any type of physical or psychological stress will cause the sympathetic part of the ANS - the emergency system- to increase its activity. In response to this adrenaline and noradrenaline are released from the adrenal medulla (figure 1.1) to mobilise the body for immediate physical activity in the face of danger. To this purpose the SAM system acts to supply the major organs of the body such as the brain, heart and skeletal muscles with sufficient glucose and oxygen. The activities of the SAM system are designed to rapidly increase circulation to promote catabolism for energy production, and to decrease nonessential activities such as digestion and reproduction (Tortora 1988). Bodily responses that characterise the “fight-or-flight response”, and represent the actions of adrenaline and noradrenaline, include the following: -

- An increase in heart rate and strength of contraction.
- An increase in blood supply to those organs active in the stress response (such as the skeletal muscles and brain), and a decrease in the blood supply to less important organs, achieved via the selective vasoconstriction or dilation of blood vessels.
- The production of red blood cells with increased clotting ability is increased to combat any potential bleeding.
- The conversion of glycogen to glucose in the liver and its release into the bloodstream as a ready source of energy.
- The dilation of respiratory bronchioles as the breathing rate increases, to enable catabolism as well as to eliminate carbon dioxide, a by-product of catabolism.

- A reduction in the production of mouth, stomach and intestinal enzymes, to decrease digestive activity.

The activities of the SAM system are designed to rapidly increase circulation to promote catabolism for energy production, and to decrease non-essential activities such as digestion and reproduction (Tortora 1988).

## **1.6 Stress from the psychological perspective**

To understand how the two main stress response systems (ie HPAC and SAM) respond to psychological stress, it is necessary to consider the activities of a number of structures in the cerebral cortex and limbic system that are associated with emotions and their physiological patterning. Some of the most important structures contained in the brain, that allow us to understand and respond to sensory information, include the amygdala and the hippocampus. These structures are important in the acquisition of memory and the regulation of emotional aspects of behaviour related to survival. They have intimate connections with the hypothalamus, which governs many of the body's basic biological functions, including the "fight or flight" response. An understanding of the function of these structures is therefore important in unravelling the mechanisms that underlie the interplay between psychogenic factors and health relevant bodily functions. The primary reason why psychology and biology cannot be separated when referring to the stress response is this connection between the hypothalamus and the structures of the brain that regulate our emotions and colour our perceptions, and therefore ultimately influence how we adapt to stress.

### **1.6.1 Fear, anxiety and the stress response**

The amygdala plays a central role in making the link between the experience of fear and physiological and behavioural response systems. It has repeatedly been shown to play a crucial role in emotional behaviour and, more specifically, in the experience of fear (LeDoux 1996). It is primarily responsible for the detection of danger, which according to LeDoux occurs via direct pathways from the sensory thalamus to the amygdala as well as by way of pathways from the sensory thalamus to the cortex for more thorough processing and then to the amygdala. Following the detection of danger by the amygdala, information is conveyed to the paraventricular nucleus of the hypothalamus, which initiates the stress response as outlined previously. Evidence linking an increase in activation of the HPAC axis with anxious and fearful states can be determined from a number of animal studies. By injecting CRF directly into the ventricles of rats, notable changes in their behaviour can be observed, including increases in defensiveness (Takahashi, Kalin et al. 1989), freezing (Sherman and Kalin 1986), acoustic startle response (Liang, Melia et al. 1992), and a decrease in exploratory (Berridge and Dunn 1989) and mating (Rivier and Vale 1984) behaviour. All these behaviours are characteristic of a fearful response.

### **1.6.2 Memory, learning and the stress response**

The hippocampus plays an important role in new learning and the formation of intermediate memory. Evidence suggests that it may also play a critical part in the initiation of emotionally based evaluations of events, by the initiation of long term memories. The hippocampus contains the highest concentration of corticosteroid binding sites in the brain (McEwen, Davis et al. 1979), and research tends to support a hippocampal link between cortisol and impaired learning under conditions of chronic stress. Cortisol related cognitive deficits and loss of hippocampal volume have been associated with aging (Lupien, Lecours

et al. 1994; Bremner and Narayan 1998), Cushing's disease (Starkman, Gebarski et al. 1992) and post-traumatic stress disorder (PTSD) (Bremner and Narayan 1998; Golier and Yehuda 1998). Furthermore, animal studies have shown a degeneration and shrivelling of the hippocampus following exposure to chronic stress (McEwen, Saai et al. 1993; Sapolsky 1996). In situations where the stressor is sufficiently prolonged, the evidence seems to support a link between adrenal steroids and memory loss via changes in the hippocampus. It has been suggested that neuronal loss in the hippocampus may adversely affect the regulation of cortisol output, and this could have systemic and cognitive consequences. A distinction, however, can be made between the consequences of chronic prolonged stress and acute stress. Memory can actually be enhanced by the release of adrenaline following mildly acute stress (McGaugh, Gold et al. 1975; McGaugh 1983; McGaugh 1989). Much of the evidence indicating that stress adversely affects memory comes from studies where the stress is either prolonged (ie persisting for days), or is an intensely traumatic single event, such as a rape or shooting (LeDoux 1996). Cortisol would also appear to have acute effects on cognitive functioning. Subjects injected with cortisol show poorer performance on tests of declarative memory and spatial thinking by comparison to a placebo group (Kirschbaum, Wolf et al. 1996).

### **1.6.3 Measurement indices of psychological stress**

From the previous discussion it can be seen how structures in the brain govern emotion, learning and behaviour, and how they are influenced by, and can influence the nature of the stress response. It becomes clearer following this that the measurement of stress should incorporate measures of both the physiological and psychological aspects of stress.

### *Physiological measures*

Cortisol, adrenaline and noradrenaline are not the only neuroendocrine parameters used to measure physiological changes thought to be associated with stress, however, they are the most commonly used measures. This is primarily because it has been clearly established that they play a crucial role in driving the stress response, and are therefore reliable indicators of stress. Furthermore, these hormones are perhaps the best understood in terms of their effects on other systems, such as the immune system and cardiovascular system.

Cardiovascular measures have also been used extensively as a measurement tool in stress research, although they are considered a more indirect stress measure. The primary function of the cardiovascular system is to maintain homeostasis under a variety of physical and psychological conditions. It does this by propelling blood through the body to various tissues and organs, to meet their changing metabolic demands. To accomplish this the cardiovascular system is constantly adjusting itself via the complex interaction of neural, endocrine and mechanical factors (Krantz and Falconer 1997).

Internal cardiac pacemakers, such as the sinoatrial node and the atrioventricular node control heart rate and rhythm. Electrical impulses generated by specialised cells within these nodes are responsible for the mechanical contraction of the heart muscle, which varies according to age and activity. At rest contractions will be around 60-70, dropping by about 10-20 beats per minute during sleep, or climbing to above 150 beats per minute during emotional stress or physical exercise. Changes in heart rate occur via activation of the sympathetic and parasympathetic nerve fibres innervating the heart (Krantz and Falconer 1997).

Sympathetic activation of the heart can also occur hormonally, in response to the release of adrenaline, and to a lesser extent noradrenaline, into the bloodstream from the

adrenal medulla, which act on adrenergic receptors located throughout the body's vascular bed. The two most important types of sympathetic receptors are *alpha*- and *beta*-receptors. Alpha-receptors are responsive to noradrenaline released from the prejunctional nerve terminal (not by circulating noradrenaline), whereas beta-receptors are responsive to the effects of circulating adrenaline. These receptors act to either constrict or dilate particular areas of the vasculature bed. During times of stress or "fight or flight", the net effect of stimulation of these receptors is to shift blood away from the skin and visceral organs toward the skeletal muscles (Krantz and Falconer 1997; Brownley, Hurwitz et al. 2000).

Frequently used non-invasive measures of cardiovascular function in stress research include heart rate and blood pressure. As a more general index of cardiac function, they can be used to identify increases in anticipatory arousal, such as might be experienced just prior to an invasive medical or surgical procedure. Significant elevations in these measures suggest an increase in sympathetic nervous system activity indicative of a stress reaction.

### *Psychological measures*

The psychological perspective on stress places an emphasis on the individual's perception and evaluation of a potential stressor. Where the individual perceives an inability to cope with the threat, an appraisal of stress/threat is made, and is accompanied by a negative emotional response. Appraisals of any given situation may differ between individuals according to prior learning and adequacy of coping resources. Ways in which stress is measured from a psychological perspective include the measurement of appraisal mechanisms/coping strategies, and affect/emotion.

Coping responses can be either cognitive or behavioural efforts to master, reduce or tolerate the demands created by the stressful transaction, whether they be internal or external (Folkman 1984). Theorists generally distinguish between three dimensions of

coping. Firstly, problem-focused or task-oriented coping involves efforts to directly deal with the stressful situation. This type of coping short-circuits negative emotions, either through the instigation of behaviors that potentially modify the stressor or minimize its impact such as removing oneself from the situation, or through cognitive activity that leads to a belief that the stressor can be controlled, for instance seeking out more information. Secondly, emotion-focused coping, is directed towards oneself, and involves the regulation of distressing emotions, with little attention paid to the characteristics of the situation or to the nature of the threat. Such strategies might involve the use of fantasy and self-preoccupation, relaxation, eating, accepting sympathy etc (Martelli, Auerbach et al. 1987). A third strategy is that of avoidance coping. This includes efforts to avoid the situation, such as the use of social diversion, or distracting oneself by engaging in some form of activity (such as gardening, etc). Most coping questionnaires will include measures of these three dimensions (Parker and Endler 1996).

In addition to being used as an indicator of stressor severity, affect has also become an important outcome measure in stress research. The rationale for this, according to the model described by Cohen, Kessler and Gordon (Cohen, Kessler et al. 1997), is that affect represents responses occurring after appraisal and coping, and before the physiological and/or behavioural response. When an individual is confronted with an environmental stressor an evaluation or appraisal is made of the potential threat based on his/her ability to cope with it. These emotional states can trigger both physiological and behavioural responses, and contribute to the onset of physical as well as psychiatric illness. The dark lines in the model in figure 1.3 represent this sequence of events. The model also acknowledges that benign appraisals or successful coping can also trigger physiological and behavioural responses that can put a person at risk of disease. The dashed lines in the model represent the possible bi-directional nature of this relationship, whereby mood and

physiological arousal can affect the type of appraisal made. Given that coping and affect are important concepts in the determination and experience of psychological stress, a more extensive examination of the empirical evidence on coping and affect in the context of surgery will be undertaken in a subsequent chapter.

## **1.7 Conclusion**

In this chapter I have attempted to give a general overview of the history of the stress concept, outline the physiology of the response, and discuss the measurement of stress. The early work of Selye enabled an understanding from the purely biological perspective of the basic physiology of a stress response. Selye identified that the body responds to physical stress by releasing cortisol, that if prolonged could cause significant organ damage. Following on from his work, Mason went on to identify the “fight/flight system”, and the sensitivity of the system to affective states such as the anticipation of threat. The emerging field of psychoneuroendocrinology made many contributions to understanding how the stress response is influenced by psychological factors such as coping and distress. A predominant theory in this area, the distress/effort model, associates increases in cortisol with threatening appraisals, and increases in catecholamines with challenging appraisals. In addition to this, Frankenhaeuser also observed how perceptions of control could influence HPAC and SAM functioning. Typically, low control conditions were associated with elevations in cortisol, and high control conditions with elevations in catecholamines and reductions in cortisol.

It is apparent from our current understanding of the physiology of the stress response that it can affect many different systems in the body. Increases in cortisol and catecholamines either by physical or psychological stress, can adversely affect cognitive and behavioural functioning, as well as altering other physiological systems in the body,

such as the immune and vascular systems, making us more susceptible to disease. This background information is designed to alert the reader to the importance of psychosocial factors when looking at stress. It is particularly important in the area of surgery because surgery is not only physically stressful but also psychologically stressful. It is important therefore that research in this area looks at stress from both perspectives.

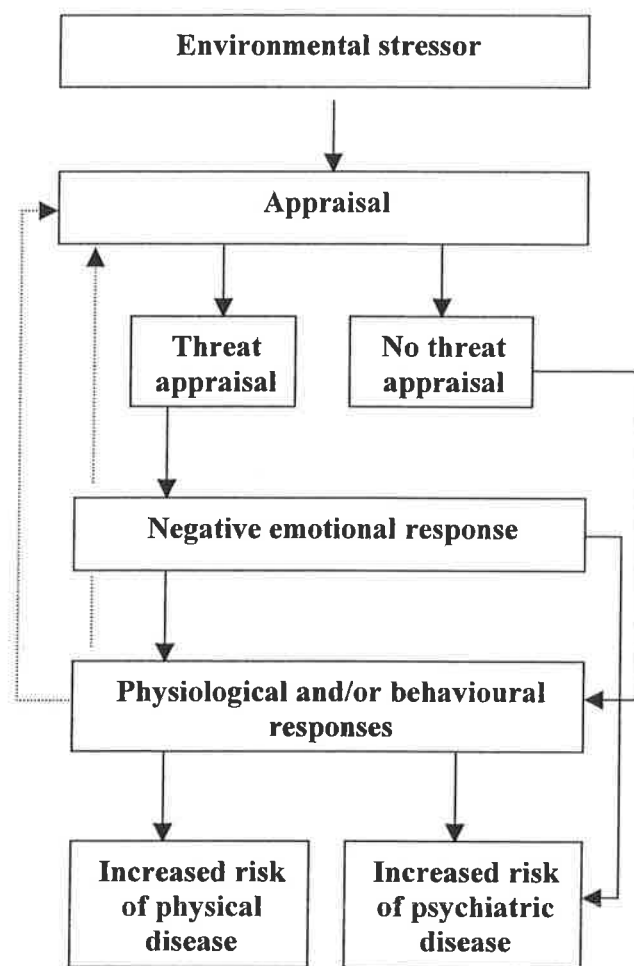


**Figure 1.3.** A model of the stress process, adapted from (Cohen, Kessler et al. 1997).

## CHAPTER TWO

### Surgical stress: current conceptualisations

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#### 2.0 Introduction

Invasive medical and surgical procedures can represent a threatening experience for many individuals (Ryan 1975). The two principal sources of surgical stress come from firstly, the physical trauma of the procedure such as the skin incision, blood loss and anaesthetic agents and secondly, from the psychological aspects of the procedure, such as the associated emotional distress and anxiety (Kincey and Satmore 1990). Management of surgical stress has therefore focused on minimising the physical trauma of surgery and minimising the emotional distress. Some success in minimising the physical trauma of such procedures has been achieved by the introduction of less invasive surgical techniques, such as laparoscopic surgery (Bolufer, Delgado et al. 1995; Glaser, Sannwald et al. 1995; Kuntz, Wunsch et al. 1998), and less toxic anaesthetic agents and modes of administration, such as the use of neural blocks (Kehlet 1989; Breslow, Parker et al. 1993; Salomaki, Leppaluoto et al. 1993; Kehlet 1997).

From the psychological perspective, the management of surgical stress has focused on subjective anxiety reduction by the use of various pre-operative intervention strategies. This approach has been popular because of a substantial literature showing an association between heightened pre-operative distress and poorer post-operative recovery (Egbert, Battit et al. 1964; George, Scott et al. 1980; Ridgeway and Mathews 1982; Naber and Bullinger 1985; Johnston 1986; Anderson 1987; Jamison, Parris et al. 1987; Martelli, Auerbach et al. 1987; Alberts, Lyons et al. 1989; Manyande, Chayen et al. 1992; Pick, Molloy et al. 1994). Studies in this area have shown these interventions to be generally

successful in reducing pre-operative distress and improving outcomes (Johnston and Vogeley 1993).

It is presumed that physiological and behavioural mechanisms explain the link between pre-operative distress and poorer post-operative recovery, and a number of theories of surgical stress have been suggested (Johnston 1986; Johnston 1988; Kiecolt-Glaser, Page et al. 1998). In this chapter the evidence pertaining to the physiological and behavioral mechanisms will be discussed.

## **2.1 Surgery as a physical stress**

Studies consistently show that the tissue damage caused by surgical trauma can evoke diffuse changes in hormonal and metabolic activity reflecting activation of the sympathetic nervous system and the HPAC axis (Ellis and Humphrey 1982; Salo 1982; Salo 1982; Hakanson, Rutberg et al. 1984; Weissman 1990; Toft, Svendsen et al. 1993). Changes have been shown to reflect the degree of surgical trauma, in that responses to minimally invasive procedures are negligible by comparison to responses to major surgical procedures (Chernow, Alexander et al. 1987). Responses to surgical stress include the release of neuroendocrine hormones and the local release of cytokines (Weissman 1990).

While acknowledged that failures in surgical technique may contribute to post-operative morbidity, the surgical stress response is now widely believed to be the primary factor contributing to the development of unspecific post-operative complications (Kehlet 1997). These complications include cardio-pulmonary and thrombo-embolic complications, nausea, vomiting, ileus, fatigue and mental dysfunction (Ellis and Humphrey 1982; Kehlet 1989; Badimon, Lassila et al. 1990; Parker, Breslow et al. 1995; Kehlet and Moesgaard 1996; Kehlet 1997). In addition to this, immune suppression is evident in surgical patients, signalled by a reduction in natural killer cell activity (Pollock, Lotzova et al. 1991), and

changes in lymphocyte populations (Tonnesen, Brinklov et al. 1987; Zellweger, Ayala et al. 1995), which may put the patient at risk of infection in the post-operative period and/or delays in wound healing. Thus the concept of “stress free anaesthesia and surgery” has arisen (Kehlet 1997).

Considerable attention has been given to the management of the “surgical stress response” by the introduction of different surgical and anaesthetic techniques. Two areas that have gained the most attention with regard to reducing the stress of surgery have been i) the development of new surgical techniques to reduce the extent of tissue trauma and ii) the use of neural blockades to block activation of the peripheral and central nervous systems. Minimally invasive surgical techniques such as laparoscopic and endoscopic techniques have proven quite successful in reducing the stress response and improving patient outcomes. Reductions in adrenaline and noradrenaline have been observed for up to two days following surgery in patients undergoing laparoscopic cholecystectomy, by comparison to those patients undergoing conventional cholecystectomy (Glaser, Sannwald et al. 1995). Laparoscopic surgery has also been associated with, reductions in cortisol in the acute post-operative phase (Bolufer, Delgado et al. 1995), less depression of cell-mediated immunity (Griffith, Everitt et al. 1995), and less post-operative fatigue (Hill, Finn et al. 1993). Patients also generally spend less time in hospital (Grace, Quereshi et al. 1991).

Reductions in the surgical stress response have also been achieved using nerve blockades with either peripheral or central (epidural/spinal analgesia) techniques to block activation of the peripheral and central nervous systems (Lui, Carpenter et al. 1995). They have proven particularly effective in lower body procedures (Breslow, Parker et al. 1993) where extradural analgesia is continued postoperatively for up to 24 hours (Tsuji, Shirasaka et al. 1987; Kehlet and Moesgaard 1996; Kehlet 1997). A significant reduction in natural

killer cell cytotoxicity has also been observed in general anaesthesia patients peri-operatively by comparison to epidural patients, suggesting that attenuation of the stress response is responsible for the change in immunological response (Koltun, Bloomer et al. 1996). These studies clearly support a positive association between the degree of surgical trauma and the magnitude of the stress response.

### **2.1.1 The stress response and post-operative mortality and morbidity**

Research also supports an association between increases in the stress response and adverse peri-operative outcomes. Catecholamine responses to lower extremity vascular surgery have been associated with hypertension and thrombotic complications in the post-operative period (Parker, Breslow et al. 1995). In this study, patients were randomised to receive either a general anaesthetic (GA) or regional anaesthesia (RA). In support of previous findings, catecholamine levels remained higher in GA patients, intra-operatively and postoperatively. Significant associations were found between noradrenaline and post-operative hypertension, and between noradrenaline and subsequent graft occlusion. Seven of the eight patients requiring re-operation for graft occlusion were in the GA group. Early cardiac morbidity was associated with marked increases in adrenaline and noradrenaline at different time points during the pre-, intra-, and post-operative periods. A similar relationship between GA and early post-operative thrombotic events has also been reported in a number of earlier studies (Tuman, McCarthy et al. 1991; Christopherson, Beattie et al. 1993).

Cortisol has also been linked to disruptions in wound healing in both animal and human subjects. Mice subjected to restraint stress healed a punch biopsy wound an average of 27% more slowly than unstressed mice. Assessment of average serum corticosterone in the stressed group was significantly higher (162.5 ng/ml) than in the non-stressed control

group (35.7 ng/ml) (Padgett et al 1998). Delays in wound healing have also been linked to psychological stress (Kiecolt-Glaser, Marucha et al. 1995; Marucha, Kiecolt-Glaser et al. 1998) and subsequent increases in cortisol (Glaser, Kiecolt-Glaser et al. 1999). In this particular study (Glaser, Kiecolt-Glaser et al. 1999), skin blisters were induced on the forearms of a group of postmenopausal women. Higher levels of stress, negative affect and salivary cortisol were associated with a reduction in cytokines at the wound site 24 hours post blistering.

### **2.1.2 Summary**

Studies consistently show that the tissue damage caused by surgical trauma results in activation of the sympathetic nervous system and the hypothalamus-pituitary-adrenal axis (Ellis and Humphrey 1982; Salo 1982; Salo 1982; Hakanson, Rutberg et al. 1984; Weissman 1990; Toft, Svendsen et al. 1993). Furthermore, these changes are positively correlated with the degree of surgical trauma (Chernow, Alexander et al. 1987), and can be attenuated by using less invasive surgical techniques and anaesthetic agents (Bolufer, Delgado et al. 1995; Glaser, Sannwald et al. 1995; Liu, Carpenter et al. 1995), with positive outcomes for the patient. There is also evidence of an association between the physiological stress response and greater post-operative morbidity. Caution may be warranted, here, as there are relatively few studies showing such an association (Tuman, McCarthy et al. 1991; Christopherson, Beattie et al. 1993; Parker, Breslow et al. 1995) and they were comparing different anaesthetic regimens, a possible confounding factor in the design of the research (Lui, Carpenter et al. 1995).

## **2.2 Surgery as a psychological stress**

There are many sources of psychological stress for a hospitalised patient. Patients may be concerned with the adverse effects or complications of diagnostic or therapeutic procedures/treatments. These might include frequent interruptions to undergo tests, sleep disturbances and reactions to medications. There are enforced life style changes to contend with, such as a change in diet and activity level. Patients often feel a loss of independence and control. Being away from one's familiar environment and separated from family and friends can also cause considerable anxiety (Koenig, George et al. 1995). In addition to this, there is the prospect of uncovering evidence of other disease (Johnston 1988; Salmon 1992). A consequence of attempting to deal with all of these different aspects of the surgical procedure is very often heightened anxiety and distress. There has tended to be some diversity in approaches to measuring stress in relation to pre-operative distress and post-operative outcomes. Some studies have relied on subjective self-reports of stress, others have considered physiological indicators of stress, and relatively few studies have utilised both subjective and physiological measures in the one study. This has resulted in some inconsistencies among findings.

### **2.2.1 Pre-operative distress and post-operative outcomes**

In this section studies utilising self-report measures of distress and their relationship to post-operative outcomes will be considered first. There is consistent evidence of a positive association between pre-operative distress and poorer post-operative outcomes. In one study of patients undergoing lumbar surgery, higher levels of pre-operative anxiety were associated with an increase in reported leg and back pain, at three days and at three months following surgery (de Groot, Boeke-S. et al. 1996; de Groot, Boeke et al. 1997). In another study (George, Scott et al. 1980) using more specific measures of recovery, patients

undergoing third molar extraction were required to complete post-operative measures of functional interference with sleeping, eating and daily activities. Healing and ratings of restrictions in mouth movement were recorded independently by the experimenter up to 4 days following surgery. Patients who expected more post-operative suffering experienced more pain and disability, and slower healing. Trait anxiety was predictive of post-operative pain and disability. Jamison (Jamison, Parris et al. 1987) also found pre-operative state and trait-anxiety to be associated with poorer physical and psychological reactions in the post-operative period. Pre-operative anxiety has been associated with poorer post-operative emotional state, and pain (Johnston 1986; Taenzer, Melzack et al. 1986; Manyande, Chayen et al. 1992; Kain, Sevarino et al. 2000).

Psychological factors predicting a better post-operative recovery in heart surgery patients have been found to include low levels of anxiety and hostility, and high levels of self-esteem, well being, vigour, social participation and social support (Jenkins, Stanton et al. 1994). Furthermore, patients with higher anxiety levels following a myocardial infarction were found to be 4.9 times more likely to experience complications during hospitalisation (Moser and Dracup 1996).

Additional evidence supporting the linear association between anxiety and post-operative recovery comes from studies evaluating the efficacy of psychosocial interventions in the pre-operative phase. Generally speaking these interventions have demonstrated positive effects on post-operative physical and emotional recovery (see reviews by Johnston, 1993; Mitchell, 2000; Rogers, 1986; and Webber, 1990) (Rogers and Reich 1986; Webber 1990; Johnston and Vogeles 1993; Mitchell 2000). Reductions in pre-operative anxiety have been associated with less post-operative distress, a lower incidence of post-operative hypertension (Anderson 1987), an increase in feelings of control (Anderson 1987; Gammon 1996) and less post-operative pain and fewer complications such as nausea,

vomiting and ileus (Tusek, Church et al. 1997). The management of surgical stress from this perspective is discussed in more detail in this chapter under the heading “pre-operative intervention strategies”.

### **2.2.2 Pre-operative distress and physiological stress responses**

In this section studies relating pre-operative distress to physiological stress responses are reviewed. Some of the earliest studies undertaken on hospitalised patients with respect to neuroendocrine responses were carried out in the late 50s and 60. Mason (Mason, Sachar et al. 1965) suggested initially that the rise in cortisol excretion observed on the first day of hospitalisation was a response to the novelty of the environment, and concluded that in general, hospitalisation was a mild to moderately disturbing experience for most of the subjects in his research. Another early study in this field was carried out by Katz (Katz, Weiner et al. 1970). He interviewed thirty women prior to breast cancer biopsy to determine their level of defence adequacy. Defence adequacy comprised three criteria. It included a measure of “affective distress”, such as the presence of anxiety, grief and despair, a measure of “disruption of function” such as the presence of anorexia, insomnia or concentration difficulties, and a measure of “impairment of defensive reserve”. This referred to the extent to which any stress superimposed on the present one could be dealt with effectively. A significant positive association was found between cortisol production rates and defence adequacy scores, indicative of higher psychiatric distress.

Changes in cortisol and catecholamines have been observed in a number of different patient populations. In a cohort of 22 patients undergoing cardiac catheterisation, significant elevations in cortisol during the procedure were observed in anxious patients by comparison to depressed and non-anxious patients (Greene, Conron et al. 1970). Pre-operative anxiety in schoolboys aged 3-5 years has been positively associated with increases

in cortisol and catecholamines prior to surgery, while in slightly older boys aged 6 to 11, anxiety was associated with increases in cortisol only (Aono, Ueda et al. 1997). In another study of children undergoing elective surgery, cortisol levels were highest during hospitalisation in those children whose coping capacity was lowest. Lower cortisol levels were observed during hospitalisation in those children with more flexible and mixed coping capacities (Knight, Atkins et al. 1979). In a randomised controlled trial, patients undergoing hip replacement were assigned to either view a pre-operative information video or not to view the tape. Patients in the video condition showed a significant reduction in pre-operative anxiety, a reduction in cortisol excretion the night prior to surgery and on the following two post-operative nights, and a reduction in intra-operative systolic blood pressure changes greater than 15%. Catecholamine excretion remained unchanged (Doering, Katzlberger et al. 2000).

While these studies seem to show a clear association between pre-operative distress and/or inefficient coping and heightened cortisol, not all studies support this finding. In a sample of 27 patients undergoing abdominal surgery, low levels of state and trait anxiety were negatively correlated with plasma cortisol and adrenaline levels pre- and post-operatively (Salmon, Pearce et al. 1989; Salmon and Kaufman 1990). In addition to this some studies have shown that some forms of pre-operative preparation may in fact increase the endocrine response during surgery and in the post-operative period. One of the earliest studies that alluded to this type of response was conducted on 70 abdominal surgery patients, and designed to investigate the response to a number of different types of pre-operative preparation (Wilson 1981). These patients were randomly assigned to one of four groups. The groups included a control group that received the usual hospital procedure, an information group that received an audiotape to listen to describing the procedures and sensations they were likely to experience, a relaxation group who also received an audio

tape with instructions on muscle relaxation, and finally a relaxation and information group who received both the taped procedures described above. Training in relaxation improved recovery scores and increased adrenaline output.

Similar results have been reported for a group of colorectal surgical patients exposed to pre-operative relaxation training (Manyande, Chayen et al. 1992). Subjects in the treatment group were given an audiotape to listen to designed to guide them through a series of relaxation techniques, while patients in the control group listened to a tape discussing general background information about the hospital. In the relaxation group elevations in adrenalins and cortisol were observed immediately prior to anaesthetic induction and immediately after surgery. There was also an associated decline in self-reports of state anxiety pre- and post-operatively for these patients by comparison to the control group. Interestingly, the effect of relaxation on endocrine responses was not apparent in all treatment group patients. There was a mix of "increasers and decreasers" in both groups with slightly more increasers in the relaxation group by comparison to the controls for cortisol (57% v 26%) and adrenalin (62% v 32%). The authors suggest that relaxation in this context may only be useful in reducing anxiety in people who are not selected for habitual anxiety.

In contrast to these findings, abdominal surgical patients instructed to visualise or imagine different aspects of the procedures associated with their surgery exhibited quite different endocrine responses from control patients (Manyande, Berg et al. 1995). Cortisol levels were lower and noradrenaline higher, in imagery patients immediately before and after surgery by comparison to control patients. State-anxiety did not differ significantly between the groups however; imagery patients reported less post-operative pain and distress.

It is apparent that there are no clearly consistent findings in the studies investigating pre-operative distress, neuroendocrine responses and recovery. Many of the reasons for this are due to methodological considerations and are discussed in more detail in chapter three “methodological considerations in studying surgical stress” but will be mentioned briefly here. While there are many studies looking at the effects of psychological factors on surgical outcomes, there are relatively few that have measured subjective and physiological stress responses at the same time. Not all studies have included measures of recovery but have merely been interested in the association between psychological factors and neuroendocrine responses. Of those studies that have been interested in recovery, there appears to be no real agreement on what constitutes recovery. A final limitation of many of these studies is a failure to control for other confounding factors that influence neuroendocrine responses such as smoking, alcohol, caffeine, medications and a general anaesthetic.

### **2.2.3 Summary**

There are without doubt a considerable number of studies showing a consistent relationship between anxiety and poorer post-operative outcomes. It is, however, difficult to explain the inconsistent findings in terms of the relationship between pre-operative distress and physiological stress responses beyond the methodological limitations of many of these studies. Contemporary theories on neuroendocrine correlates of stress, emotion and coping tend to support the view that a reduction in cortisol is indicative of superior coping (active coping strategies) and that increases in cortisol reflect increasing distress and inferior coping (Frankenhaeuser 1980; Frankenhaeuser, Lundberg et al. 1980; Lundberg and Frankenhaeuser 1980). Furthermore, cortisol responses to stress have been shown to decrease with increasing perceptions of control (Frankenhaeuser, Lundberg et al. 1980;

Lundberg and Frankenhaeuser 1980; Steptoe 1983). While this model may suitably explain the behaviour of individuals in a laboratory or occupational setting, it would appear not to generalise to the context of elderly patients facing surgery. It is difficult to explain the association between high trait anxiety and reductions in cortisol and adrenaline. It is paradoxical in relation to current beliefs regarding neuroendocrine responses, emotion and coping. Furthermore, it is implausible to suggest that trait anxious individuals are in control of the situation but not coping. Characteristically, they are more prone to experience feelings of helplessness and loss of control under stressful situations than are less anxious individuals (Eysenck 1988).

It is clear, however, that coping mechanisms and personality characteristics play a significant role in the relationships between surgery, physiological responses to surgery and recovery and require further investigation.

### **2.3 Psychological theories of adjustment to surgery**

It is apparent that psychological factors are important determinants of neuroendocrine responses to surgery and overall recovery. The relationship between these variables however is complex. A number of theories have been formulated to explain some of these relationships.

#### ***Emotional drive theory***

Early interest in the psychological aspects of surgical recovery can be traced to the work of Janis (Janis 1958) who originally postulated that patients with moderate levels of pre-operative fear would show better post-operative adjustment than patients with low or high pre-operative fear. He suggested that exposure to accurate information about the surgery induces a process he termed the “work of worry” which assists the patient in the

development of accurate expectations which in turn are conducive to better post-operative outcomes. While Janis claims to have found support for his theory most subsequent research has not. Instead the literature tends to suggest that greater pre-operative distress and anxiety is associated with a slower and more complicated recovery (George, Scott et al. 1980; Johnston 1986; Taenzer, Melzack et al. 1986; Jamison, Parris et al. 1987; Manyande, Chayen et al. 1992; de Groot, Boeke-S. et al. 1996; Moser and Dracup 1996; de Groot, Boeke et al. 1997).

### ***Accuracy of expectations theory***

A theory closely related to the emotional drive theory is the accuracy of expectations theory (Johnston and Lenenthal 1974). This theory suggests that the degree of emotional responding following surgery is a product of the difference between the expected effects of surgery and its actual impact. Accurate information, therefore, stimulates accurate expectations. Application of this theory is apparent in many clinical situations. The provision of accurate information is a part of routine preparation for patients undergoing invasive surgical or medical procedures. This practice reflects the entrenched idea that the provision of information reduces anxiety and improves recovery.

### ***The cognitive-behavioural theory***

This model proposes that it is the way in which a person thinks about or mentally prepares for surgery that ultimately affects recovery. Personal attributes such as coping styles and personality characteristics may be important determinants of post-operative recovery. Research suggests that particular coping styles may underlie adaptation to surgery (Johnston 1986; Johnston 1988).

### *The psychophysiological theory*

The psychophysiological theory of surgical stress (Johnston 1986; Johnston 1988) suggests that recovery may be impaired in anxious patients because of heightened physiological arousal associated with an increase in sympathetic nervous system activity and circulating levels of cortisol and catecholamines. Potential consequences of sustained elevations of these hormones include suppression of the immune system and increased platelet aggregation time, leaving the patient more susceptible to post-operative complications such as infection, delayed wound healing and deep vein thrombosis. Much of the evidence regarding this particular theory has been previously reviewed in this chapter. To summarise, there is evidence to show that surgery does activate the two-stress axis, and that this can be related to adverse post-operative outcomes. There is also a strong relationship between greater pre-operative distress and poorer recovery rates. There is, however, inconsistent evidence relating pre-operative distress to increases in physiological stress responses, as this model would predict.

In the following section personality characteristics and coping styles in relation to surgical adaptation will be reviewed.

## **2.4 Personality factors**

### **2.4.1 Control**

It is now well recognised in the stress and coping literature that personal control over an aversive event can affect the way in which individuals cope with that stress, both, psychologically and physiologically in a wide variety of situations (Steptoe 1983; Taylor 1983; Breier, Albus et al. 1987; Baum, Cohen et al. 1993). Furthermore, research has shown that the mere perception of control is as effective in stress adaptation as is actual control (Mineka and Henderson 1985; Endler, Speer et al. 2000). Perceived control may be

defined as the felt ability to escape/avoid, and/or modify threatening stimuli (Seligman 1975).

It can be argued that many of the procedures that are routine for hospital staff can be unpredictable and anxiety provoking for patients. This might include something as simple as a ward transfer (Krantz 1980). To some degree the hospital environment and staff can unknowingly deny patients an active role in their own illness and recovery and thereby be instrumental in fostering a degree of felt helplessness and loss of control (Salmon 1992).

“Generalised beliefs about control” refers to the extent with which people believe they can control outcomes of importance. The most widely utilised formulation is that conceived by Rotter (Rotter 1966), of internal versus external locus of control. People with an internal locus of control believe that they personally control what happens to them, while those with an external locus of control believe that fate, chance, powerful others or luck control what happens to them (Folkman 1984). Locus of control is thought to be an important predictor of whether or not an individual is likely to engage in health relevant behaviour. Thus a high internal locus of control would predict engagement in specific health behaviours, presuming the person places high value on health. Conversely, a high external locus of control might predict a lack of engagement in specific health relevant behaviours.

There is some evidence to support this. In a study of 42 patients undergoing a total knee replacement, internal locus of control was associated with a shorter time to achieve a straight leg raise (Kendell, Saxby et al. 2001). Johnson (Johnson, Leventhal et al. 1971) predicted that patients with a high internal locus of control would be more successful in controlling their environment. To demonstrate this she used analgesic use as her primary outcome measure and found that in a group of 62 female surgical patients, those with a high internal locus of control did consume significantly more analgesia during their period of hospitalisation. While she suggests this reflects their ability to control their environment, an

alternative explanation for this finding suggests that “internals” were more stressed by the surgical situation than “externals” because of an inability to exert any control over it (George, Scott et al. 1980). One such study has found a significant relationship between internal locus of control and more post-operative pain, swelling and disability in dental patients (George, Scott et al. 1980). In heart transplant patients a high external locus of control has been associated with greater anxiety and depression before and after surgery (Kugler, Tenderich et al. 1994).

Ways in which clinicians have sought to foster a sense of perceived control in patients is to provide them with pre-operative information to enable them to develop accurate expectations regarding their procedure and recovery phase. There is some evidence to suggest that this is an effective way of increasing perceptions of control. In one study of people undergoing total hip replacement, the provision of preparatory information was associated with a higher self-esteem and sense of control prior to discharge by comparison to the control groups who received the usual preparatory procedures (Gammon 1996). A similar finding has also been reported in patients undergoing cardiac surgery: providing information effectively reduced anxiety, by increasing perceptions of control (Anderson 1987).

Mahler (Mahler and Kulik 1990) has suggested that a person’s perception of control can influence surgical recovery by minimising feelings of helplessness. Some of the mechanisms by which this might operate, is through a reduction in anxiety and its associated physical changes, or by the performance of recommended recovery behaviours. In a study of 75 coronary artery bypass patients, Mahler (Mahler and Kulik 1990) found that pre-operative perceptions of control and an orientation toward behavioural involvement in health care were both reliable and independent predictors of a shorter hospital stay following surgery. Mahler concludes that

*"when surgery patients believe they can affect recovery and do want to be actively involved in their treatment, positive health outcomes follow, even in the absence of an intervention designed to facilitate active involvement" (pg 750).*

He suggests that there are risks associated with believing that one cannot personally influence recovery. A major clinical implication from of this view is that designing intervention strategies to target such passive patients would be beneficial to encourage their participation and active involvement in their recovery.

One way in which it may be possible to enhance perceptions of control in low control situations is to give patients more choice. Morris (Morris and Royle 1988) has been able to show that by giving breast cancer patients a choice of surgical procedures (simple mastectomy, or wide excision plus radiotherapy) and thereby an active role in their treatment, it is possible to reduce the clinical levels of anxiety and depression pre-operatively, and up to 2 months post-operatively, not only in the patients but also in the husbands of these patients.

While patients respond well to the provision of pre-operative information, studies suggest that other pre-surgical interventions are not quite as effective in terms of increasing control. Few studies have been undertaken to determine how patients perceive the effects of strategies which clinicians view as enhancing control. One study that has attempted to address this question found that patients were resistant to the effects of interventions seeking to increase passive or active coping with surgery (Peerbhoy, Hall et al. 1998). The results from this study show that procedures designed to increase perceptions of control or provide more control are not necessarily responded to by the patient in this way. Furthermore, the value placed on control by the patient can be quite different from that of

the clinician. Patients were more likely to interpret the active coping message of “being involved” in their care as cooperating with, or showing obedience to, authority. Similarly the use of patient controlled analgesia has been believed to increase patient satisfaction, by allowing the patient to control their pain relief (Ballantyne, Carr et al. 1993). When patients have been interviewed about their experiences of patient-controlled analgesia, control was found to be unimportant (Taylor, Hall et al. 1996). Patient-controlled analgesia tended to be valued in terms of assisting those patients who were less likely to complain of pain or request pain relief. Furthermore, for some patients not wanting the responsibility of managing their pain, it caused a degree of anxiety (Taylor, Hall et al. 1996).

#### **2.4.2 Coping styles**

A closely related concept to that of control is that of coping styles. Coping strategies are important moderators of stress reactions, and coping theory has been applied extensively to examine adaptation to a wide range of health threats, including breast cancer (Buddeberg, Sieber et al. 1996; Chen, David et al. 1996; Osowiecki and Compass 1999), dyspepsia (Cheng, Hui et al. 1999), gastrointestinal disorders (Drossman, Leserman et al. 2000), pain management in the elderly (Fry and Wong 1991), hypertension (Miller, Leinbach et al. 1989), cancer (Osowiecki and Compass 1998) and cardiac surgery (Terry 1992; Lowe, Norman et al. 2000). The coping strategies used to deal with various aspects of surgery play a key role in a patient’s psychological and physiological adjustment. Furthermore, an individual’s appraisal of the situation as controllable or uncontrollable may influence choice of coping strategy. Control, as already discussed, is important in reducing the negative effects of aversive events (Steptoe 1983; Affleck, Tenen et al. 1987). Coping has an important function in this process as a mechanism in the determination of perceptions of control. For this reason coping mechanisms are of interest to researchers looking at

adaptation to surgery and medical procedures. Studies have shown that individuals who feel personal control in coping situations are more likely, not only to have a wider repertoire of coping resources available (Parkes 1984) but also to make use of the more successful coping strategies (Aspinwall and Taylor 1992).

Research over the years has resulted in the identification of a limited number of basic coping responses. These are problem-focused coping, emotion-focused coping and avoidance coping, a definition of these strategies has previously been given in chapter one. These three dimensions continue to be included in most coping assessment tools (Parker and Endler 1996). In its simplest form, coping might be usefully described as referring to the way in which people react and respond to stressful and /or challenging situations.

*“coping strategies are those responses that are effective in reducing an undesirable “load” (i.e., the psychological burden). The effectiveness of the coping strategy rests on its ability to reduce immediate distress, as well as to contribute to more long-term outcomes such as psychological well-being or disease status” (Snyder and Dinoff 1999).*

Theorists generally distinguish between two main perspectives in relation to coping. One is a dispositional approach that assumes relatively stable person-based factors mediate the selection of coping behaviours. That is, individuals tend to respond to a range of different stressful situations using the same strategies. The second is a contextual approach that assumes more transitory situation-based factors influence people’s choices of coping responses. Historically there has been some debate about accepting a situational as opposed to a dispositional view of coping. It is, however, generally accepted that there is sufficient evidence to demonstrate that situational factors, cognitive appraisal, and personality (dispositional factors) all determine coping (Parkes 1986).

Some researchers believe that certain coping strategies are generally more adaptive than others in most situations. Thus problem-focused coping strategies are usually emphasised as more adaptive in terms of positive outcomes, and emotion-focused strategies as maladaptive (Zeidner and Saklofske 1996). For example, problem-focused coping has been negatively associated with measures of psychological symptomatology (Folkman, Lazarus et al. 1986) and positively associated with psychological well-being in depressed patients and community residents (Billings and Moos 1985). Conversely, reliance on emotion-focused strategies has been associated with poorer mental health in a longitudinal study on community residents (Aldwin and Revenson 1987).

Others argue that some coping strategies can be more effective than others depending on the characteristics of the situation; this is sometimes referred to as the “goodness of fit hypothesis”. That is, coping behaviours interact with cognitive appraisals of the stressor to predict coping outcomes. In part this may help explain why some individuals are less affected by stress than others. One of the principles outlined in Lazarus’s (Folkman 1984) theory was regarding the relations between control, appraisal and the use of problem-focused and emotion-focused coping. According to this theory problem-focused efforts are more adaptive when utilised in an environment more amenable to change, while emotion-focused coping is more adaptive in situations that are uncontrollable. Extending this notion, the goodness of fit hypothesis (Conway and Terry 1992) has been proposed to account for the relationship between control, coping strategies and outcome variables.

*“Coping effectiveness is dependent on the “match” or “goodness of fit” between coping efforts and other variables in the stress and coping process, including the individuals values, beliefs, and commitments” (Forsythe and Compas 1987).*

The goodness of fit hypothesis states that emotion-focused coping will be more adaptive in situations appraised as uncontrollable, and maladaptive in controllable situations. Problem-focused coping will be more adaptive in situations appraised as controllable and maladaptive in uncontrollable situations.

In support of this theory (Forsythe and Compas 1987), the use of problem-focused strategies where events were perceived as controllable has been associated with lower depression and anxiety, in college students. However, where problem-focused coping was employed in uncontrollable situations, levels of anxiety and depression were higher. The converse was true for emotion-focused coping. These strategies were associated with more distress in high-control situations and less distress in low-control situations.

Similarly, Vitaliano et al (Vitaliano 1990) report some support for the goodness of fit hypothesis. Using three different samples; camp counsellors, spouses of patients with Alzheimer's disease and subjects with physical health problems, problem-focused coping strategies correlated significantly more negatively with depression under conditions appraised as controllable than under conditions appraised as uncontrollable. A significantly higher positive association was also found between emotion-focused coping and depression when the situation was appraised as controllable than when it was appraised as uncontrollable. Unlike the Forsythe and Compass study, this study produced no evidence that problem-focused coping was maladaptive in situations appraised as uncontrollable, nor was there evidence to show that emotion-focused coping was adaptive in situations appraised as uncontrollable.

Conway and Terry (Conway and Terry 1992) report similar findings. In a mixed sample of university students and community residents, high levels of problem-focused coping were more adaptive in controllable situations. However, they did not find support

for the notion that problem-focused coping was maladaptive in uncontrollable situations or that emotion-focused coping was adaptive in uncontrollable situations.

More recently Endler et al (Endler, Speer et al. 2000) have reported results that tend to contradict the goodness of hypothesis. They found task-oriented coping to be adaptive under low control situations and emotion-focused coping to be maladaptive under low control situations. Given the obvious inconsistencies in the literature relating to the goodness of fit hypothesis it is suggested that it has little explanatory power. Endler (Endler, Speer et al. 2000) has suggested that it may be more prudent to focus on other factors such as the use of avoidance coping, in explaining the relationship between control, coping and adjustment.

The studies discussed in the following section will be confined to research looking at the relationship between coping with surgery and recovery from surgery. It will not include those studies evaluating pre-operative intervention strategies, these are discussed in more detail under the topic of information provision further on in this chapter.

#### *Problem-focused/task-oriented coping*

There is some evidence to show that task-oriented coping behaviours are associated with better outcomes following surgery. Use of this particular coping strategy has been associated with a faster rate of physical recovery during hospitalisation (short-term) in males, following coronary artery bypass surgery, as well as better reported quality of life 6 months after surgery (Scheier, Mathews et al. 1989). In an early study carried out by Ray and Fitzgibbon (Ray and Fitzgibbon 1981) on patients undergoing cholecystectomy, measures of arousal were used to indicate the presence of active or passive coping. They suggest high arousal represents a recognition of threat and an active orientation toward coping and control, while low arousal represents a passive orientation toward threat

resulting from denial or helplessness. The authors suggest that the arousal scale also measures the constructive process of worry described by Janis (Janis 1958) which can be separated from the deleterious effects of stress. Ray and Fitzgibbon found high arousal scores prior to surgery were associated with less pain, less analgesia, and a shorter hospital stay, and that patients tended to sleep better during hospitalisation. In a later study using the same arousal measure (Manyande and Salmon 1992) there was a significant and positive association between this measure and measures of worry, and of active coping. Furthermore, these measures were associated with better post-operative state.

#### *Avoidance coping*

Much of the research undertaken with respect to avoidance has compared this particular strategy with an opposing strategy, vigilance. These strategies are conceptually similar to a number of other strategies including monitoring/blunting, attention/rejection and denial. The basic difference is that avoidant types of strategies focus attention away from the stressor (avoidance, denial, rejection and blunting), and vigilant type strategies focus attention on the stressor (vigilance, monitoring and attention).

There is a general belief, based on research evidence that avoidance can be beneficial in terms of short-term outcomes, and vigilance in terms of better long-term outcomes (Mullen and Suls 1982; Lazarus 1983; Suls and Fletcher 1985; DeGroot, Boeke et al. 1997). Vigilance and avoidance strategies in relation to recovery were compared in a cohort of general surgical patients. Vigilance was associated with a longer hospital stay, more complications and negative psychological reactions, while patients using avoidance strategies tended to recover better (Cohen and Lazarus 1973). In patients undergoing third molar extraction, vigilance was associated with more post-operative pain, disruption to

normal functioning such as sleeping and eating, more swelling and slower healing (George, Scott et al. 1980).

One study followed children undergoing orthopaedic surgery (LaMontagne, Hepworth et al. 1996) for up to 9 months following surgery. The more vigilant child tended to display more post-operative anxiety two days following their procedure, by comparison to children employing avoidance strategies. Vigilance, however, was associated with a faster return to normal activities three months following surgery.

Avoidance, in the context of anticipating dental surgery, has been associated with a dampening of cardiovascular activity, while emotional responding was associated with heightened salivary cortisol levels (Benjamins, Schuurs et al. 1996). A dampening of cardiovascular responses during acutely stressful periods has also been observed in cardiac patients using strategies of denial (Warrenburg, Levine et al. 1989). In addition to this, denial was also associated with a reduction in self-reported anxiety. In a related study undertaken by the same research group (Levine, Warrenburg et al. 1987), denial was also found to be associated with fewer days spent in intensive care and fewer cardiac anomalies during hospitalisation. Following discharge, however, high deniers tended to be more non-compliant with medical recommendations, and to experience more days of rehospitalisation within 12 months of their procedure.

Research carried out by Krohne (Krohne, Kleeman et al. 1990) used 40 patients undergoing maxillofacial surgery, to determine the influence of (actual and dispositional) vigilant and avoidant coping strategies on state-anxiety, and free fatty acids (FFA) as indicators of stress prior to surgery. Measures were taken at four different times prior to surgery: 1) after admission to hospital, 2) after the anaesthetist's visit on the afternoon before surgery, 3) on the morning of surgery, and 4) prior to induction of anaesthesia. Results showed state-anxiety was especially low in patients employing cognitive avoidant

strategies just prior to surgery. Patients with high dispositional vigilance and low avoidance showed the most state-anxiety. Both vigilant and avoidant coping strategies were associated with lower biochemical (FFA) stress reactions by comparison to patients who employed neither strategy. Avoidance was associated with a strong biochemical stress reaction following admission to hospital; however, just prior to surgery high avoidance was associated with a lesser biochemical stress reaction by comparison to low avoidance.

These results suggest, firstly, that the cognitive strategies of vigilance and avoidance may both contribute to alleviating pre-surgical biochemical stress, as compared to the stress reactions of patients who did not utilise these strategies. Presumably, people not utilising these strategies were using a different type of coping strategy, which would appear less effective in reducing biochemical stress reactions. Or possibly they were using no coping strategies. It is suggested that instrumental or task-oriented coping employed in this type of situation could create more stress in patients pre-operatively because of an inability to change or control the situation; a characteristic of a task-oriented approach. Furthermore, an inability to engage any coping strategies would likely also create stress.

#### *Emotion-focused coping*

There have been fewer studies that have looked at emotion-focused coping in the context of surgery. From the few studies that have been done, the use of this strategy tends to be associated with poorer outcomes. In a retrospective study, 171 coronary artery bypass patients were interviewed 2 to 20 months after surgery. Use of emotion-focused coping strategies was associated with higher levels of psychological distress and low functional capacity (Ben-Zur, Rappaport et al. 2000). Similarly, more depression and dysfunction following colostomy surgery have been associated with the use of emotion-focused (Keyes, Bisno et al. 1987).

To summarise these studies, there is consistent evidence to show that avoidance strategies in the acutely stressful stage are associated with a reduction in state-anxiety levels (Warrenburg, Levine et al. 1989; Krohne, Kleeman et al. 1990), a reduction in physiological stress responses (Warrenburg, Levine et al. 1989; Krohne, Kleeman et al. 1990; Benjamins, Schuurs et al. 1996) better short term recovery (Cohen and Lazarus 1973; Levine, Warrenburg et al. 1987) and poorer long term recovery (Levine, Warrenburg et al. 1987). This supports a more general view of the use of avoidance strategies as being useful in short-term adaptation to stress but not in the longer term (Mullen and Suls 1982; Lazarus 1983; Suls and Fletcher 1985). Not only does task-oriented coping appear to also be associated with post-operative recovery in the short time after surgery (Ray and Fitzgibbon 1981; Manyande and Salmon 1992), but there is also evidence to suggest it is beneficial in terms of long term recovery (Scheier, Mathews et al. 1989). Finally, emotion-focused coping was associated with greater psychological distress and poorer short-term functional recovery, suggesting it is somewhat more maladaptive in the surgical context than are the other two types of coping strategies (Keyes, Bisno et al. 1987; Ben-Zur, Rappaport et al. 2000).

### **2.4.3 Trait-anxiety**

Trait-anxiety is considered to be a relatively stable aspect of personality, reflecting anxiety proneness (Spielberger 1975). Trait anxiety has been shown to be a reliable predictor of which patients will be most distressed pre- and post-operatively (Auerbach 1973; Spielberger, Auerbach et al. 1973; Fox, O'Boyle et al. 1989; Fox, O'Boyle et al. 1989). In a number of studies performed on dental patients trait anxiety was positively associated with pre-operative state-anxiety and intra-operative stress (Fox, O'Boyle et al. 1989; Fox, O'Boyle et al. 1989). Trait anxiety was found to account for 48% of the variance

in pre-operative state-anxiety. That is, trait anxiety is a strong predictor of patients' transient anxiety prior to surgery. But measures of trait anxiety have also been shown to predict patients' distress post-operatively (Spielberger, Auerbach et al. 1973).

Trait-anxiety corresponds to the personality dimensions of neuroticism and negative affect; essentially they are all measuring the same underlying dimension (Tellegen 1985; Watson, Clark et al. 1988; Watson, Clark et al. 1988). It has been proposed that, due to the strong intercorrelations between these personality traits and somatic complaints, they may all contribute to a single underlying dimension which has been termed "somatopsychic distress" (Watson and Pennebaker 1989) and that can be distinguished from other personality traits.

In a study by George (George, Scott et al. 1980) discussed in more detail in the section on avoidance coping, trait anxiety was significantly associated with more pain and swelling following third molar extraction. In another study, 105 males were followed for a period of five years after myocardial infarction. Controlling for biomedical and psychosocial risk factors such as age and smoking, the presence of a distressed personality (high negative affect and social inhibition) was associated with a five-fold mortality risk (Denollet, Sys et al. 1995). Neuroticism has been associated with cognitive deficits 4 to 10 days following coronary bypass surgery (Chandarana, Cooper et al. 1988), greater reported severity of illness in diabetic patients (Deary and Frier 1995), and greater impaired pulmonary functioning, following upper abdominal surgery (Boyle and Parbrook 1977).

In one study (Ramshaw and Stanley 1981), 53 coronary artery bypass patients who had undergone surgery one to two years previously were asked to report on how the operation had impacted on their lives. Incidental evidence for an association between high neuroticism and a preoccupation with physical symptoms and bodily functions emerged.

These patients had become restricted by new symptoms such as tiredness and shortness of breath. In addition to this, they reported more depression, nervousness, fear and an inability to cope. In the absence of any data relating such symptoms to an underlying physical cause these reports may reflect the propensity of those high in neuroticism to report more symptoms.

There is evidence that people high in trait-anxiety tend to report more somatic health problems (Bernstein, Garfinkel et al. 1989). Similarly, people higher in negative affect consistently report more symptoms and poorer self-perceived health even when their underlying health is not always worse (Costa and McCrae 1985; Costa and McCrae 1987; Larsen 1992). They are also prone to reporting poorer functioning on the Short Form 36 (SF-36) Health status questionnaire and more specifically, on the dimensions related to mental health (Kressin, Spiro et al. 2000).

Collectively, these studies suggest those pervasive personality characteristics of anxiety, neuroticism and negative affect are predominantly associated with poorer health outcomes following surgery or illness.

## **2.5 Pre-operative intervention strategies**

### **2.5.1 The provision of pre-operative information**

As previously mentioned, one of the important concepts in the area of surgical stress is the idea that the provision of information allows patients to formulate accurate expectations, which can reduce the stress of surgery by increasing perceptions of control. This has been the driving principle behind the introduction of pre-operative interventions. These interventions have been aimed at enhancing both cognitive and behavioural control. There has been a diversity of different approaches, including the provision of information,

behavioural instruction, teaching cognitive coping techniques, providing choices and encouraging participation, to name only a few.

There is an extensive medical, psychological and nursing literature that attests to the benefits of psychological preparation for surgery (Weinman and Johnston 1988; Alberts, Lyons et al. 1989; Johnston and Vogeley 1993). The most popular method of preparing patients for surgery is to provide them with printed information in conjunction with a verbal discussion with the relevant clinician. The provision of information has a number of principal goals. Firstly it is an integral part of the informed consent process. Patients need to know about the risks and complications and alternatives to treatment so that they can participate in treatment decisions. Secondly, the provision of information is a useful mechanism to improve patient outcomes. There is no doubt that patients want to know about their treatment (Grady, Buckley et al. 1988; Dawes and Davison 1994; Klawns and Roizen 1996) and that this is directly related to satisfaction (Edwards 1990; Williams 1993; Hardy, West et al. 1996). Some of the factors which appear to influence the effectiveness of this information include the complexity and amount of information (simple or detailed), the content (sensory or procedural), the medium in which it is delivered (written, verbal or visual), and matching the information with individual differences in information requirements (preferred ways of coping).

#### *Complexity of information*

Studies in this area tend to be inconsistent. Some studies show beneficial effects from the provision of minimal information, while others support the provision of more detailed information. One such study undertaken by Wallace (Wallace 1984b) randomly allocated women undergoing minor gynaecological surgery to one of three conditions. Control group 1 received routine care, control group 2 received routine care plus a

minimally informative booklet, and women in the experimental condition received routine care plus a maximally informative booklet. Women in the experimental group had lower scores on pre-operative fear, anxiety, blood pressure and heart rate. They showed less post-operative anxiety and pain and recovered faster. In addition to this women who had the most knowledge about their surgery tended to worry less and recover faster (Wallace 1986).

The provision of more detailed information has also been associated with a reduction in a number of side effects following minor surgery such as nausea and vomiting, shivering and general discomfort (Elsass, Eikard et al. 1987b). In addition to this, patients in the maximally informed group reported a higher congruence between what they expected to happen and their actual experience of surgery. One of the notable differences about this study was that the information was conveyed in person by the anaesthetist, not in the form of written material alone. The anaesthetist visited patients in the maximally informed group for a period of twenty minutes, while other patients only received a five-minute visit. Hence some of the effect might be attributed to the contact time with the clinician, and the fact that the patient was free to ask questions. While some positive results are reported in this study, the authors caution about adopting this approach. Their primary reason is that a considerable number of parameters were investigated and only a few differences found, therefore, they suggest, it may not be an effective strategy to increase clinician burden by expanding routine to detailed information (Elsass, Eikard et al. 1987b).

By comparison to these studies there is some evidence to suggest that the provision of minimal information may be more beneficial for patients. The provision of a simple information booklet, as compared to no information, or a complex information booklet, to women referred for a colposcopy following an abnormal cervical smear, was found to be more effective in reducing anxiety levels prior to their colposcopy (Marteau, Kidd et al. 1996). Similarly, the provision of more detailed information has been shown to have no

significant benefits in terms of patient satisfaction, anxiety or understanding of the information (Stanley, Walters et al. 1998).

### *Content of information*

Some studies have sought to determine whether the inclusion or exclusion of certain topics of information can affect patient outcomes. As stated earlier, one of the goals of information exchange between clinician and patient is to satisfy the requirements of informed consent. While this process has been developed to allow patients more autonomy with regard to treatment decisions the consent form itself has also evolved as a legal document to protect the treating clinician against prosecution in the event of complications. While clinicians are obliged to tell patients the risks associated with their treatment, some believe that it is unkind and unhelpful to distress the patient unnecessarily. No doubt part of this belief stems from the literature associating anxiety with poorer recovery, and to a more pervasive theme that all anxiety (within the hospital environment) is undesirable. To this extent, there remain some disparate views on how much information should be given to patients regarding the risks and complications of their treatment. One study looking specifically at this question randomised patients awaiting electrophysiological testing to receive either a consent that did not detail specific information regarding the risks associated with the procedure (consent A) or one that detailed the risks (consent B) (Goldberger, Kruse et al. 1997). Patients receiving consent A reported a significant decrease in anxiety following consent by comparison to consent B. More patients in group B required midazolam (medication administered to reduce anxiety) during the procedure.

Similar results have also been reported previously (Kerrigan, Thevasagayam et al. 1993). In this study patients awaiting inguinal hernia surgery were randomly assigned to receiving an information sheet containing either simple or detailed information regarding

possible post-operative complications. This study found that the provision of detailed information did not increase anxiety; however, the simplified information did significantly reduce anxiety in patients. While more subjects receiving detailed information in Goldberger's study required midazolam during the procedure, the dosage was the same for both groups in this study, and no adverse effects were noted. Both studies, therefore, support the notion that giving patients a detailed account of what can go wrong does not in fact result in a problematic increase in anxiety.

### **2.5.2 Efficacy of audiovisual information**

Over the last 30 or so years there has been an increase in the use of videotapes for patient education purposes. Videos offer some very practical benefits that other forms of information presentation do not. They can be viewed by groups of individuals, and therefore can potentially reach a larger audience, allowing clinicians to spend more time on individual teaching. Perhaps the most important benefit of video education is that it assures a standard level of teaching and a consistent core of information that is not subject to the varying abilities or opinions of different clinicians (Gagliano 1988), a concept that is relevant to the notion of informed consent.

In a literature review undertaken by Gagliano (Gagliano 1988), encompassing studies from 1975 to 1986, she concluded that "Video is as good as and often more effective than traditional methods of patient education in increasing short-term knowledge" and that "when applied to well-defined, self-limited stressful situations, role-modelling in video decreases patients' anxiety, pain, and sympathetic arousal while increasing knowledge, cooperation, and coping ability". Additional studies undertaken since 1988 support these findings of an increase in patients' knowledge about the procedure (Done and Lee 1998; Cassady, Wysocki et al. 1999; Luck, Pearson et al. 1999) being associated with a reduction

in pre-operative anxiety (Herrmann and Kreuzer 1989; Cassady, Wysocki et al. 1999; Luck, Pearson et al. 1999; Doering, Katzlberger et al. 2000). In addition to this, a reduction in cortisol pre- and post-operatively and of analgesic consumption has been observed in patients viewing a preparatory video prior to hip replacement surgery (Doering, Katzlberger et al. 2000).

Only one study appears to have shown no significant improvement in knowledge scores or anxiety levels as a result of exposure to an information video. In this study women were randomly allocated to one of four conditions to receive a simple leaflet only, a simple leaflet plus video, an expanded leaflet, or an expanded leaflet plus a video. The video was specifically aimed at assisting women with decisions regarding prenatal screening tests. The addition of a video had no significant effect on knowledge, decision making or anxiety in the women who viewed it (Michie, McClennan et al. 1997).

The success of information videos may be due to the effective use of role models. This can be demonstrated quite clearly within the context of surgery from the following studies. College students participating in a simulation study were asked to imagine how they would feel if they were hospitalised and scheduled for coronary artery bypass surgery (CABS) the following morning (Mahler, Kulik et al. 1993). The students were randomly assigned to a control condition, or to view one of three videotapes. All three tapes were designed to provide comparative information, with some slight differences. In one of the tapes, a nurse provides the information, while in the other two tapes, CABS patients provide the information. The two CABS tapes were further differentiated into a mastery tape, which provided a description of the recovery period as relatively unproblematic, and the coping tape which described the recovery period as having more ups and downs. All subjects viewing any of the three experimental tapes reported less anxiety and a greater sense of self-efficacy for performing the recommended recovery behaviours by comparison to the control

group. In addition to this, subjects who viewed the mastery tape reported less anxiety than subjects in the other two tape conditions, who did not differ from each other. It is concluded that the mastery tape had the intended effect of influencing self-efficacy beliefs. It is likely that this occurred via the process of modelling, which is watching someone similar to oneself perform the activity.

A similar effect has been demonstrated in a number of studies investigating the impact of pre-operative roommate assignment on anxiety and recovery following coronary artery bypass surgery. Pre-operative patients sharing a room with post-operative patients were generally less anxious, began ambulating sooner post-operatively, and their length of stay was shorter, compared to those pre-operative patients who shared a room with another pre-operative patient (Kulik and Mahler 1987; Kulik, Mahler et al. 1996). A possible interpretation of this result might be that the post-operative patient provides a valuable role model or source of social comparison, and therefore information, for the pre-operative patient, about what to expect after surgery. In fact, pre-operative patients would appear to prefer to share a room with a post-operative patient than with a pre-operative patient who is experiencing similar emotions such as fear prior to their surgery (Kulik and Mahler 1989).

Anderson (Anderson and Masur 1989) compared the potential of four different intervention strategies to reduce anxiety while enhancing adaptation, in adults scheduled for cardiac catheterisation. In this study, patients were randomly assigned to receive one of the following five interventions: sensory-procedural information, modelling, cognitive behavioural coping skills, modelling plus coping skills, an attention placebo control group. The results show that individuals who received active intervention strategies reported lower levels of physiological and verbal anxiety before and after catheterisation than individuals in the placebo group. Comparing the intervention groups, it was apparent that modelling was the more effective intervention strategy for this type of procedure, as subjects in these

two groups did considerably better than all the other groups when rating anxiety before and after catheterisation. Another plausible explanation as to why audiovisual education appears so effective is related to theories of conditioned fear extinction, which suggest extinction to be a positive function of the number and duration of exposures to the feared stimulus (Foa and Kozak 1986). Some support for this is evident in a study that measured anxiety in endoscopy patients as a function of the number of prior viewings of an information video. Patients were randomised to view the video either zero, one or three times. There was a general tendency for patients viewing the tape three times to exhibit less distress (Shipley, Butt et al. 1978).

These studies collectively suggest that there are a number of factors potentially operating at the same time when exposing patients to audiovisual education that contribute to their success in terms of improving patient outcomes. These factors include the use of role modelling, whereby patients can observe someone in the same situation as themselves. Viewing models that are initially fearful, or are confronted with some setbacks but overcome these obstacles, seems to be more effective than observing models who appear to master the situation without any problems (Mahler, Kulik et al. 1993). Add to this the idea of desensitisation, that encourages emotional processing of the fearful stimulus and habituation of emotional and autonomic responses. Finally, the coupling of visual information with verbal information appears to result in less anxiety, and better retention of information which ultimately translates into a shorter and less complicated hospital stay.

### **2.5.3 Interacting effects of information provision and coping styles**

Research in this area has been approached from two different perspectives, studies that have looked at ways in which people differ in information requirements, and how providing more or less information can affect outcomes, and studies that attempt to match

interventions with preferred ways of coping. Not all patients desire the same amount of information to cope with a stressful situation such as surgery (Krantz, Baum et al. 1980). In an early study conducted on female patients scheduled for abdominal surgery, the provision of more information by comparison to less information was found to interact with level of fear and be of most benefit to those patients who experienced high levels of fear pre-operatively. Thus high-fear patients who received more information exhibited better post-operative adjustment, as indicated by a reduction in length of stay, and of analgesic and sedative use, by comparison to high-fear patients who received little information (Sime 1976).

Many studies addressing the issue of information requirements have used the monitoring/blunting coping paradigm conceptualised by Miller (Miller 1987). This coping style categorises individuals into monitors (information seekers) and blunters (information avoiders) on the basis of how they deal with threatening cues. Another coping style that has also received considerable attention is the avoidance-sensitisation dimension. Generally, avoiders respond to threat with blocking and denial. They report low anxiety, and characteristically deal with stress by refusing to think about it or denying its potential threat. Sensitisers on the other hand tend to be vigilant, overly anxious, and alert to threat. They are typically information seekers (Cohen and Lazarus 1973).

In one study (Miller and Mangan 1983), forty patients undergoing colposcopy were divided into two groups according to two coping styles, information seekers and information avoiders. Half of the patients in each group were exposed to "voluminous" preparatory information, while the other half received the "usual low level" of information. The results showed that voluminous preparatory information did not decrease subjective (anxiety, tension and hand clenching) or physiological (heart rate) arousal levels, and that, overall, information avoidance was a less arousing coping style than information seeking.

Preparatory information interacted with coping style in such a way that patients were less aroused when the amount of preparatory information matched their coping style.

In a study carried out on patients preparing for cardiac catheterisation (Ludwick-Rosenthal and Neufeld 1993), subjects were randomly assigned to either a high- or low information preparation condition. When patients' desire for information was matched with the appropriate information condition they exhibited less behavioural anxiety (verbalised fear, sweating, shaking, clenched fists) and more problem-focused coping during the procedure. In a similar study carried out on patients undergoing gynaecological day surgery, patients with high information requirements who received a minimally informative booklet pre-operatively were more anxious prior to their procedure than those patients with high information requirements receiving a maximally informative booklet (Mitchell 2000).

Some studies have examined the effectiveness of intervention strategies designed to enhance the coping skills of individuals. Ridgeway and Mathews (Ridgeway and Mathews 1982) randomised 60 hysterectomy patients into three groups. One group received information about the surgical procedure and its effects, a second group was instructed in a cognitive coping technique, and the third group were given general information about the ward. Results showed knowledge to be greater in the information groups, while those instructed in cognitive coping fared better in terms of recovery, they were the least worried, and required fewer analgesics postoperatively. In a similar study Anderson (Anderson 1987) assigned CABG patients to one of two experimental groups (information only, or information plus coping skills) or a contact-control group. Both experimental groups reported less emotional distress, were judged by nurses unaware of which group the patient were randomised to, as making better physical and psychological recoveries, and had a 25% lower incidence of post-operative hypertension. More information was associated with less anxiety and an increase in feelings of control.

In a meta-analysis of 43 studies carried out to determine the relative efficacy of avoidant and nonavoidant coping strategies in facilitating adaptation, neither strategy emerged as superior to the other (Suls and Fletcher 1985). However, it was concluded that overall avoidance appeared to be associated with more positive adaptation in the short-term, while nonavoidant strategies facilitated better adaptation in the longer term. In addition to avoidance, two other types of coping are defined in the literature, problem-focused coping and emotion-focused coping (referred to briefly in chapter 1, and discussed in more detail in chapter 2). A number of studies have sought to design interventions with the intention of promoting specific types of coping, to determine how this might affect patient outcomes.

In one such study, patients about to undergo oral surgery were randomly assigned to receive either a problem-focused, emotion-focused, or mixed-focus stress management intervention (Martelli, Auerbach et al. 1987). The problem-focused intervention contained both procedural and sensory information, while the emotion-focused intervention offered instruction in the use of relaxation, and attention redirection. The mixed-focus intervention contained elements of both of these interventions. Outcome measures included pain, satisfaction, and overall adjustment to surgery as rated by the surgeon. Overall, the most effective stress management was found to be the mixed-focus intervention. Adjustment to surgery was poorest in patients receiving the emotion-focused intervention. There was, however, an interaction between information requirements and coping interventions. Patients with low information requirements who received the emotion-focused intervention responded better to surgery on all measures than those with high information requirements receiving this intervention. The problem-focused intervention resulted in a better response to surgery in patients with high information requirements. It is suggested that emotion-focused coping may have had the poorest outcome in this particular study because it is actually more effective in influencing outcomes in high stress situations where there is little

opportunity to control the situation, such as a natural disaster. By comparison problem-focused strategies tend to work well in situations involving transitory stressors where the reality of being able to control or influence the outcome is much greater (Martelli, Auerbach et al. 1987). The fact that the mixed-focus intervention was the most effective almost certainly reflects the fact that most situations to some degree will include elements of both, and that successful coping is dependent on being able to access the appropriate coping strategy at the appropriate time.

### *Hypnosis, guided imagery and relaxation*

Other types of coping interventions that have been explored in surgical patients include the use of hypnosis, relaxation and guided imagery. Studies have reported training in hypnosis to be effective in reducing post-operative vomiting and nausea in patients undergoing breast surgery (Enqvist, Bjorklund et al. 1997), and in reducing anxiety in patients undergoing minor gynaecological day surgery (Goldmann, Ogg et al. 1988). Furthermore, one study has reported a significant increase in survival time of breast cancer patients trained in hypnosis to manage pain (Spiegel, Bloom et al. 1989).

Guided imagery is a technique involving the use of images or to achieve specific health-related goals. The use of this technique was investigated in a randomised trial of patients undergoing colorectal surgery. Patients in the treatment group were instructed to listen to a guided imagery tape three days prior to their procedure. In addition to this, music was played during surgery and in recovery. They again listened to the imagery tape postoperatively for 6 days. Patients in the control group received the standard pre-operative care. Patients using the guided imagery technique reported less anxiety pre-operatively, and less pain and analgesic use postoperatively (Tusek, Church et al. 1997; Tusek, Church et al. 1997). Using the same technique, Manyande (Manyande, Berg et al. 1995) found a similar

reduction in pain and analgesic use postoperatively, although no significant change was reported in anxiety.

Relaxation has also proven a popular coping strategy. Pre-operative training in relaxation has been associated with a significant reduction in the incidence of post-operative nausea and vomiting, and less analgesic use in patients undergoing elective breast reduction surgery (Enqvist, Bjorklund et al. 1997). It has also been associated with reduced hospital stay, less post-operative pain and an increase in strength, energy and adrenaline levels in elective abdominal surgery patients (Wilson 1981). Many studies have shown relaxation training to be effective in reducing pre- and post-operative anxiety (Manyande, Chayen et al. 1992).

#### *Benefits of a contact person*

There are a few studies that have suggested that a contact person, such as a clinician or a supportive spouse, can have a significant effect on patient recovery. For example, patients undergoing minor reconstructive surgery were allocated at random to one of two groups: one was visited by the anaesthetic nurse, who would also look after the patient on the following day, while patients in the other group were not visited. All patients received the standard information from the anaesthetist. Patients in the contact group experienced significantly fewer post-operative complaints of dizziness, shivering and vomiting and were less anxious pre- and post-operatively by comparison to the non-contact group (Elsass, Duedahi et al. 1987a). The authors suggest that a contact person such as a nurse provides a degree of emotional support that is often missing from a patient's pre-operative preparation, and that this can be very effective in reducing anxiety and improving recovery. A similar conclusion has also been drawn from an earlier study by Egbert (Egbert, Battit et al. 1963). While these two studies have focused on the effects of a clinician contact person, emotional

support could just as conceivably be effective coming from a spouse or partner. One study has shown recovery to be significantly faster in male coronary artery bypass patients who were in highly supportive marriages, by comparison to unmarried patients, and married patients with minimal support from their spouses (Kulik and Mahler 1989). A reduction in anxiety has also been observed in patients as a result of contact with visitors and contact with the investigator (Hartsfield and Clopton 1985).

### *Reviews*

There have been a number of reviews written on patient education within the last ten years. A meta-analysis of thirty eight randomised controlled trials performed by Johnston (Johnston and Vogeley 1993) addressed the relationship between different methods of psychological preparation for surgery (procedural information, sensory information, behavioural instruction, cognitive intervention, relaxation, hypnosis, or emotion-focused intervention) and a number of outcome variables including:- negative affect, pain, use of pain medication, length of stay, recovery, physiological indices and satisfaction. Procedural information and behavioural instruction were found to show the most widespread effects in terms of improvement in all outcome measures. In Webber's review (Webber 1990), she concludes that the provision of preparative procedural information and teaching of coping skills can effectively assist patients in reducing anxiety, pain, analgesic use, vomiting and length of hospital stay, while increasing psychological well being and satisfaction. She further stresses that pre-operative education is more effective when a combination of methods are used.

#### **2.5.4 Summary**

The provision of pre-operative information has two central goals. That is to inform the patient so that they are able to make choices about their treatment and also to assist in improving patient outcomes. From the clinician's point of view it is important for the patient to retain and fully understand the information. There are a number of factors that influence this process. Current practices tend to rely on the clinician, in concert with written material, to impart this information. It is apparent, however, that this may not be the most effective way of achieving the desired outcomes. There is evidence to suggest that patients have different information requirements and that when matched, result in a reduction in anxiety and better post-procedure outcomes. Furthermore, recent studies and reviews of the efficacy of audiovisual information suggest that this may be a superior medium to standard practices in imparting information.

#### **2.6 Conclusion**

Stress is undoubtedly an important concept in the context of surgery. There are two distinct sources of stress for the surgical patient. The first is related to the physical traumas of surgery, such as the skin incision, and anaesthesia, and the second to the psychological distress often associated with surgery. There is convincing evidence to show that strategies designed to reduce the physical trauma of surgery such as less invasive surgical techniques, and anaesthetic agents (Bolufer, Delgado et al. 1995; Glaser, Sannwald et al. 1995; Liu, Carpenter et al. 1995) effectively attenuate the stress response and improve patient outcomes. While there are only a few studies showing a direct relationship between the physiological stress response and greater post-operative morbidity, collectively the evidence does implicate the stress response as a mechanism in post-operative morbidity.

Surgery can also cause considerable psychological stress for a patient, particularly as an impending threat. It is often associated with feeling of anxiety, distress and loss of control. The weight of the evidence shows a strong association with pre-operative distress and poorer post-operative outcomes, however, the exact nature of the relationship is unclear. One hypothesis (Johnston 1986; Johnston 1988) suggests that recovery may be impaired in anxious patients because of heightened physiological arousal associated with an increase in sympathetic nervous system activity and circulating cortisol and catecholamine levels. The results of sustained elevations of these hormones include suppression of the immune system and increased platelet aggregation time, leaving the patient more susceptible to post-operative complications such as infection, delayed wound healing and deep vein thrombosis. Unfortunately the paradoxical relationship between pre-operative anxiety and neuroendocrine responses to surgery reported by a few researchers (Wilson 1981; Salmon, Pearce et al. 1989; Salmon and Kaufman 1990; Manyande, Chayen et al. 1992) makes this theory controversial.

A second theory suggests that certain dispositional personality characteristics may influence recovery (Johnston 1986; Johnston 1988). It is the way in which a person thinks about or mentally prepares for surgery that ultimately affects recovery. Personal attributes such as coping styles and personality characteristics may be important determinants of post-operative recovery, particularly those coping styles adopted by anxious individuals. For example, emotion-focused coping, which tends to be associated with trait-anxiety, has also been associated with greater psychological distress and poorer short-term functional recovery (Keyes, Bisno et al. 1987; Ben-Zur, Rappaport et al. 2000), suggesting that it is somewhat more maladaptive in the surgical context than task-oriented or avoidance coping. Avoidance coping strategies appear to be more adaptive in short-term adaptation to surgery (Cohen and Lazarus 1973; Levine, Warrenburg et al. 1987; Warrenburg, Levine et al. 1989;

Krohne, Kleeman et al. 1990; Benjamins, Schuurs et al. 1996), but maladaptive in long-term recovery (Levine, Warrenburg et al. 1987). Task oriented coping has been associated with better short- and long-term post-operative recovery (Ray and Fitzgibbon 1981; Scheier, Mathews et al. 1989; Manyande and Salmon 1992).

Finally, there is the accuracy of expectations theory (Johnston and Lenenthal 1974). This theory suggests that the provision of accurate information prior to surgery stimulates accurate expectations. The provision of information is a part of routine preparation for patients undergoing invasive surgical or medical procedures. This practice is based on the entrenched idea that the provision of information reduces anxiety, increases perceptions of control, and therefore improves recovery. Some of the problems associated with this process relate to different information requirements of some patients, and the best way of imparting that information. Some patients prefer more information, while other patients prefer less. The stressfulness of the procedure can be increased if there is a mismatch of information requirements.

In this chapter I have attempted to outline some of the important psychological factors that can influence the recovery of surgical patients. It is clear that coping mechanisms, personality characteristics and the provision of pre-operative information all play significant roles in the relationships between surgery, stress responses and recovery. These factors will be the focus of further examination in the two studies reported in this thesis.

## **CHAPTER THREE**

### **Methodological considerations in studying surgical stress**

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#### **3.0 Introduction**

Prior to introducing the studies, some of the methodological problems associated with studies in this area will be briefly discussed. As in many areas of research, inconsistencies among findings can in part be attributable to methodological problems. An attempt has been made to address many of these issues in the design and analysis of the two studies reported in this thesis.

#### **3.1 Measuring recovery**

A significant problem in this area of research has been a lack of clarity of definition about the process of recovery. Johnston (Johnston 1984) has argued convincingly that many measures used as indicators of surgical recovery are unreliable. For example, measuring a person's recovery by looking at return to work could largely depend on the type of work they do. Length of stay and re-hospitalisation could be subject to hospital policies affecting bed allocation, while self care at home may be determined by availability of support networks and carers. In addition to this, recovery is usually assessed from only one or two measures, and often confined to the period of hospitalisation.

According to this argument, recovery should be conceived as a multi-dimensional, and not a unitary process. This premise is based on the lack of correlation between current measures of recovery. In an attempt to show these failings more clearly, Johnston selected a wide range of post-operative variables commonly used as outcome measures for surgical patients. She obtained data for 16 measures, from 59 patients undergoing gynaecological

surgery, 2 and 7 days post-operatively. Using principal components analysis, three separate factors were extracted. The first factor 'wellbeing', included self-ratings of physical functioning, independent self-care, and positive mood state. It was the only dimension to show change over time, and therefore potentially might be reflecting the process of recovery. The other two factors, described as 'attitudes' and 'distress,' failed to show change over time. Johnston suggests this may be because they better reflect the cognitive and emotional state of the person and not a process of recovery.

It is clear from this study that recovery does appear to be multifaceted, and that care should be taken when making inferences about recovery. Recovery measures ideally should aim to cover as many dimensions as possible. One approach to this problem might be to classify recovery according to the IDC (International Classification of Diseases) by separating the consequences of disease from the disease process. The consequences of disease are classified at three levels of human experience and behaviour. The first is impairment, and represents a disturbance in the structure, appearance or function at organ level. The second is disability and represents disturbances in activity or function at the level of the individual. The third is handicaps, and represents disturbances in the individual's interaction and adaptation to the social and physical surroundings. An approach like this could provide a useful structure for the measurement of recovery. Such an approach is likely to reveal individual variation in the relationships between dimensions, and progression along each dimension as a consequence of different surgical procedures and individual differences.

There exist in the literature examples of studies that have shown such effects. Magni (Magni, Unger et al. 1987) followed a cohort of heart surgery patients for a period of 12 months post-operatively. He found psychosocial adjustment to be independent of surgical improvement. That is, there was no correlation between the success of the

operation as assessed by the surgeon and psychological distress or quality of life at follow-ups. Similar results have previously been reported (Horgan, Davies et al. 1984). In a sample of 68 coronary artery surgery patients, 7-29% showed deterioration in specific areas of psychosocial functioning, such as coping ability, social activities, self confidence and sexual life. Again, there was no correlation between reduced psychosocial functioning and unsatisfactory physical outcome. Gundle (Gundle, Reeves et al. 1980) report a similar trend in a cohort of 30 coronary artery surgery patients. Despite good physiological outcomes in patients, up to 83% suffered from social and sexual problems at follow up. A smaller proportion reported low self-esteem, distortions of body image and depression. Overall, poor post-operative adaptation was found to be associated with pre-operative symptoms of cardiac disease, such as angina, that persisted for more than eight months. Gundle et al conclude that, for these patients, the experience of surgery serves to reinforce an already damaged self-concept, rather than to repair it.

These studies highlight a number of important issues. Firstly they support Johnston's argument that improvement at one level, such as impairment, does not predict improvement at another level, (in these cases, the level of handicap). Secondly, they highlight the importance of assessing recovery beyond the confines of a patient's hospitalisation. Such short follow-ups have proven to be a limitation of much of the existing research in this area. While shorter follow up periods may be convenient, they almost certainly fail to pick up psychological problems that grow out of a prolonged period of rumination. Thirdly, Gundle et al's study draws our attention to the caution with which one should proceed, in attributing psychological disturbances to a surgical event. A proportion of the population is likely to suffer such disturbances in the absence of surgery, and should be assessed prior to surgery. Similarly we should not assume that psychological damage related to illness that has developed over a protracted period of time, perhaps in response to persistent pain or

disability, will disappear following surgery to alleviate such symptoms. Finally, it would appear that it is essential to include psychosocial factors in studies assessing the merits of surgical procedures and, in fact, in all aspects of recovery and adjustment following a health crisis.

### **3.2 Measuring surgical stress**

Many of the studies in the area of surgical stress have failed to take multiple measures of stress. Instead, research has tended to fall into two distinct categories. These are, firstly, studies that have been undertaken predominantly by surgeons and anaesthetists interested in reducing the physical stress of surgery. In these studies physiological parameters have been primarily used, not only as indicators of stress but also as outcome measures. The second category of studies is that of those undertaken by social scientists and nurses, who have predominantly used subjective self-reports of stress, such as anxiety scores, in the absence of more objective physiological measures. There have been relatively few studies that have used both subjective and physiological measures of stress. More studies on surgical patients, which incorporate multiple measures of stress, are required before it is possible to determine the exact nature of the interaction between neuroendocrine responses, psychological factors and recovery.

#### **3.2.1 Identification of confounding factors**

Another inherent problem with many of these studies is the failure to control for confounding factors. These include, not only factors known to affect neuroendocrine responses, but also factors affecting post-operative morbidity and mortality. Factors known to have a significant effect on post-operative morbidity and mortality include co-morbidities (i.e., coexistent disease), age, alcohol consumption and the number of prior surgical

episodes. It has been well established that the presence of coexistent disease states can significantly increase the risk of complications, and lengthen hospital stay (Hall, Tarala et al. 1991; Greenfield, Apolone et al. 1993; Cullen, Apolone et al. 1994). Accordingly, a number of assessment tools are routinely used to determine a patient's suitability for surgery. This information can then be used by the clinician to treat the patient prophylactically, where possible, to reduce the chances of an adverse outcome (Bullingham and Strunin 1995). More recently, alcohol abuse has been recognised as an important pre-operative risk factor. Patients consuming more than 60g of alcohol a day were more likely to develop post-operative complications, including cardiac problems, bleeding and infection. In addition to this they show an amplified neuroendocrine response to surgery, possibly related to alcohol withdrawal (Tonnesen, Petersen et al. 1992). Age and prior surgery have also been associated with aspects of poorer recovery such as post-operative hospital stay, and pain (Boeke, Duivenvoorden et al. 1991; Boeke, Stronks et al. 1991).

In addition to pre-operative risk factors there are a number of intra-operative risk factors that significantly influence the "surgical stress response". As stated previously, the stress response is related to the magnitude of surgical injury (Chernow, Alexander et al. 1987). Heat loss during surgery may be a significant risk factor, leading to cardiac complications. Forced air warming during surgery has been associated with a reduction in noradrenaline levels, systolic, mean and diastolic arterial blood pressures (Frank, Higgins et al. 1995). Furthermore, the prevention of intra-operative hypothermia has been related to a reduction in post-operative wound infection and hospital stay in colorectal patients (Kurz, Sessler et al. 1996). The use of blood transfusions in response to blood loss during the peri-operative period has been shown to increase the risk of infective complications due to immunosuppression (Nielsen 1995).

### **3.3 Considerations in the measurement of cortisol and catecholamines**

Cortisol and catecholamines have been used as a measure of stress in this thesis and therefore require a brief discussion about measurement issues.

#### **3.3.1 Sample source**

There are a number of different ways that cortisol and catecholamine measures can be obtained. They can be obtained via plasma, urine or saliva. Plasma and saliva samples are generally used as measures of acute states, providing information within a distinct time frame. For example, such measures might be used in assessing an individual's response to public speaking, or exposure to a violent movie. By comparison, long-term urine samples, such as a twenty-four-hour urine save, allow the researcher to integrate all the day's activities. This method of collection is particularly useful in situations of chronic or prolonged stress such as hospitalisation, and is also preferable where links between sustained activation of the HPAC axis and other systems such as the immune response system are trying to be established (Baum and Grunberg 1997).

#### **3.3.2 Handling and storage**

Cortisol is an extremely stable compound, allowing urine samples to remain at room temperature for a number of days prior to assaying. Catecholamines require the addition of a preservative to the urine save, as they tend to break down quite rapidly following excretion. There is considerable variation in the recommended procedures, and advice was sought from the Department of Clinical Chemistry at The Queen Elizabeth Hospital. It was recommended that dilution with acetic acid (33%) be used.

### **3.3.3 Assays**

The two most frequently used assay techniques include radioimmunoassay (RIA) and high-performance liquid chromatography (HPLC). RAI assays are based on the binding of an antibody to the compound being measured. They involve adding a pre-determined amount of highly specific antibody and radioactively labelled hormone (cortisol) to a standard amount of sample. The hormone in the sample and the radioactivity labelled hormone then compete for binding sites on the antibody. The hormone of interest is then quantified by separating out the portion of the sample that is bound to the antibody and measuring the radioactivity with a gamma counter (Lovallo and Thomas 2000). This technique is reported to be sensitive and specific, highly reliable and valid (Baum and Grunberg 1997). HPLC exposes the sample to extremely high pressure that effectively separates out the hormone, which is then compared with known standards. Concentrations of the hormone are usually determined by electron capture. This technique has also been validated extensively and is reliable (Baum and Grunberg 1997). Procedures used in the assaying of the data for this thesis are discussed in more detail in the method sections of relevant chapters.

### **3.4 Summary**

In this chapter a number of important methodological considerations specific to the area of surgical stress have been discussed. One area of concern is that there exists no general consensus on what constitutes recovery. This ultimately leads to measurement problems and inconsistent findings. Often, studies utilise too few measures that may also be unreliable. In Johnstons' discussion on this topic she offers a reasonable paradigm in which to measure recovery on a number of different dimensions.

Similarly, it can be argued that many studies have failed to measure stress on both a subjective (self-reports), and objective (physiological) level. There has been a tendency for use of one or other of these measures, possibly contributing to the current inconsistencies in the literature related to the relationship between psychological factors and intra-operative neuroendocrine responses. Identification of demographic and medical confounders is also necessary so that these can be controlled for in the analysis.

Where appropriate all of the factors identified in this chapter have been addressed in the design of this research.

### **3.5 Research aims**

This thesis reports on two studies regarding surgical stress using two different patient populations. Outcome measures differ between the two populations; however, a similar approach has been adopted in both studies. This includes measuring recovery extensively to cover a range of different dimensions. Measures of stress have included both subjective self-reports of stress, and physiological indicators of stress. All possible confounders have been controlled for either in the initial selection of the patient population or in the analysis.

Drawing on questions generated from the literature review in this area the first study was undertaken to examine;

- (a) The role of pre-operative state-anxiety in the determination of intra-operative neuroendocrine responses
- (b) The role of pre-operative state-anxiety in the determination of clinical, cognitive and social and emotional recovery following surgery
- (c) The role of personality and coping factors in the determination of intra-operative neuroendocrine responses

- (d) The role of personality and coping in the determination of clinical, cognitive and social and emotional recovery following surgery.

In the second study, which looked at a cohort of patients undergoing colonoscopy, the interacting effects of coping, choice and information on stress responses, patient satisfaction, knowledge about the procedure and recovery was examined.

## CHAPTER FOUR

### **The role of psychological factors in the determination of intra-operative neuroendocrine responses and recovery from surgery in patients undergoing carotid endarterectomy**

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#### **4.0 Introduction**

Surgery and invasive medical procedures represent a time of psychological and physical trauma for patients (Ryan 1975; Kincey and Satmore 1990; Salmon 1992; Salmon 1993; Mitchell 1997). The weight of the evidence shows a linear relationship between heightened pre-operative anxiety and poorer recovery (Egbert, Battit et al. 1964; George, Scott et al. 1980; Ridgeway and Mathews 1982; Naber and Bullinger 1985; Johnston 1986; Taenzer, Melzack et al. 1986; Anderson 1987; Jamison, Parris et al. 1987; Martelli, Auerbach et al. 1987; Alberts, Lyons et al. 1989; Manyande, Chayen et al. 1992; Pick, Molloy et al. 1994; Moser and Dracup 1996; Kain, Sevarino et al. 2000); however the underlying mechanism is unclear. Psychological stress has a number of physical effects ranging from increased sympathetic-adrenal-medullary activity to increased susceptibility to disease. Therefore, it is possible that psychological stress may negatively affect recovery via activation of the sympathetic-adrenal-medullary system. However, studies measuring activation of this system in relation to pre-operative anxiety are inconsistent. Some show a positive association (Mason, Sachar et al. 1965; Greene, Conron et al. 1970; Katz, Weiner et al. 1970; Aono, Ueda et al. 1997; Doering, Katzlberger et al. 2000), others an inverse relationship (Wilson 1981; Salmon, Pearce et al. 1989; Salmon and Kaufman 1990; Manyande, Chayen et al. 1992; Salmon 1992). Furthermore, the role of more stable personality characteristics and coping mechanisms in mediating stress responses and recovery from surgery is less well understood. The study reported in this chapter attempts to

better define the connection between psychological factors, stress responses and post-operative recovery.

The results will be presented in two sections. In the first part of the analysis, the contribution of pre-operative state-anxiety to intra-operative neuroendocrine responses and recovery will be examined. In the second part, the contribution of coping styles and personality traits to intra-operative neuroendocrine responses and recovery is explored.

#### **4.1 Carotid endarterectomy**

Carotid endarterectomy surgery involves the removal of plaque that forms on the walls of the common carotid arteries, leading to a narrowing of the artery and a reduction in blood flow to the brain. Patients are usually diagnosed following the occurrence of a transient ischaemic attack (TIA), or minor stroke. TIAs are episodes of focal neurological symptoms lasting less than 24 hours, whereas strokes are characterised by symptoms lasting longer than a day. The surgery is performed because it has proven effective in reducing the risk of stroke by approximately 16.5% over two years in patients with a stenosis greater than 70% who present with a TIA (Collaborators 1991). Asymptomatic patients with a stenosis of greater than 60% have a 1% reduction per year in stroke risk, by comparison to patients receiving medical treatment only (Perry, Szalai et al. 1997).

This procedure involves the removal of atherosclerotic plaque from the right or left internal carotid arteries. These arteries are the predominant blood supply to the anterior two thirds of the cerebral hemisphere on the same side. Local or general anaesthesia may be used. Following exposure of the artery, clamps are placed either side of the stenosis to stop the blood supply while the plaque is being removed. Patients may require the insertion of a shunt to ensure an adequate blood supply to the brain. For patients having this procedure under a local anaesthetic shunting may not be required, if the patient remains conscious

when clamping occurs. One of the advantages of a local anaesthetic is that the surgeon and anaesthetist are able to monitor the patient's neurological status. In the event of a loss of consciousness, immediate action can be taken to minimise the potential brain damage from a stroke. A patch may sometimes be placed on the artery at the incision site, which can extend the procedure time. Decisions to perform the procedure under a local or general anaesthetic, to shunt and patch, are usually made in accordance with the surgeons preferred way of performing the procedure.

This particular patient population was chosen for this study for a number of reasons. Firstly, the procedure is performed under a local anaesthetic, and more specifically, a deep cervical plexus block. This overcomes the potential confounding effects of a general anaesthetic on neuroendocrine measures. Secondly, while the procedure is physically not very invasive it carries a significant risk of perioperative complications making it considerably stressful for the patients, psychologically. High complication rates remain a common feature of this procedure and can range from 2% to 11% (Baird and Pieroth 2001).

## **4.2 Methods**

### **4.2.1 Procedure**

Permission to conduct this study was sought through the hospital's Ethics of Human Research Committee. Participants were identified either via a referral from the treating surgeon or from the elective surgery booking list. They were then contacted by phone and arrangements made to visit them in their home. During this visit the research was fully explained to them, and informed consent obtained from those agreeing to participate. Patients were instructed on how to undertake their first 24-hour urine save (T1), and left with a set of questionnaires to complete. Clear instructions were given with regard to those questionnaires as to which could be completed at any time in the days preceding surgery,

and which were to be completed on the evening prior to surgery. During this visit patients also underwent their first session of cognitive testing. This testing involved the administration of a number of neuropsychological tests, which lasted approximately forty minutes and are described in more detail in the section on measures.

Patients were admitted at 7am on the day of their surgery to the “Day of Surgery Unit” and instructed to bring their completed questionnaires and urine save with them. From here they were taken to the anaesthetic induction room at around 8am, at which time a second 24-hour urine save (T2) was commenced. This urine save was undertaken with the assistance of the theatre and recovery staff following instructions from the principal investigator. At midday on the day following their procedure they were seen again by the principal investigator and measures of physical recovery obtained. Patients are usually discharged on the third day following the procedure, provided there were no complications.

Seven to ten days following discharge patients were again visited in their homes. A second session of neuropsychological testing was undertaken, and patients were again asked to rate their general physical recovery. At one month following discharge measures of quality of life were completed. Patients were again followed up at three months following discharge, with measures of quality of life and cognitive functioning being obtained.

#### **4.2.2 Subjects**

Between April 1998 and February 2000, 113 patients underwent carotid artery surgery at The Queen Elizabeth Hospital. This hospital services an area with a large population of non-English speaking people, as well as servicing regional country areas. Patients were excluded from participation based on the following criteria:- i) they demonstrated communication difficulties or could not complete the questionnaires either due to ethnicity or cognitive impairment, ii) had taken in the last six months (or were

currently taking) psychotropic and/or steroid based medications which might interfere with neuroendocrine function or, iii) lived outside a 50 kilometre radius of the hospital. As a teaching hospital it is also subject to regular changes in trainee surgical staff. These factors to some degree made the recruitment of patients more difficult than initially anticipated. From the 113 patients there was a final sample size was 39. Patients excluded were:-

- 16 patients because they spoke insufficient English
- 25 lived outside a 50-kilometer radius of the hospital
- 8 patients who were currently taking, or had in the past six months been taking, steroid-based medications or psychotropic medications
- 6 patients were too impaired cognitively and/or physically to participate
- 6 patients could not be asked to participate due to inadequate time allowed for them to complete the study requirements prior to surgery
- 13 patients refused.

#### **4.2.3 Materials**

##### **(i) Demographic measures**

All information regarding the patient's age, sex, marital status, living arrangements and education level was obtained at the time of consent. Marital status was recorded as "married" or "not married". Living arrangements was recorded as living alone, or with another person such as a spouse or partner, or another family member, or with a boarder or friend. Level of education was recorded in years, and included formal education only. Trade certificates were not included.

**(ii) Clinical and procedural measures**

In addition to this, patients were asked about alcohol, cigarette and caffeine use. Caffeine was recorded as milligrams consumed per day, assuming an average cup of coffee contains 250mgs of caffeine. Alcohol was recorded as grams per day, based on standard measures, and cigarette use as either “a current smoker” or “non-smoker”. All relevant information pertaining to the patient’s medical history, current treatment and presenting symptoms was obtained by direct interview, and from the case notes. Presenting symptoms were classified as either asymptomatic or symptomatic, or as having had a stroke diagnosed on neuroimaging. Asymptomatic patients include those patients diagnosed with a stenosis in the absence of any presenting symptoms. Symptomatic patients include those patients who presented with hemispheric symptoms, including; contralateral weakness, amaurosis fugax (visual disturbance) and disturbances of speech, as well as more non-specific symptoms such as dizziness and collapse. Stroke patients included all those patients showing evidence of a minor stroke on neuroimaging within a three-month period prior to surgery.

The Charlson Comorbidity Index was used to measure the presence of co-existent disease states. The scale assigns weights to each condition, based upon severity. The total score equals the sum of these weights (Charlson, Pompei et al. 1987). ASA (American Society of Anesthesiologists) physical status classification was also recorded. This classification ranges from I to V, with I representing a healthy individual and V representing a patient in imminent danger of dying (Sabiston 1986). The number of surgical episodes in the last ten years was also recorded.

Information collected relating to the surgical procedure included the duration of surgery, recorded in minutes, the supervising surgeon, and whether the patient required shunting during the procedure. Blood loss was not recorded, primarily because the data

obtained from the case notes was unreliable, due to a considerable amount of missing data. This was not considered problematic, as blood loss from the procedure is usually minimal.

### **(iii) Psychological measures**

*Pre-operative state-anxiety recorded on the evening prior to surgery: -*

*State-anxiety* was measured using the *State-Trait Anxiety Inventory for Adults (STAI)* originally developed by Spielberger, (Spielberger, Gorsuch et al. 1983). This scale comprises two separate 20 item self-report scales measuring state and trait anxiety. Trait anxiety refers to a person's propensity to habitual or dispositional anxiety, while state anxiety measures transient fluctuations in anxiety. On each scale, scores range from 20-80, with higher scores indicative of greater subjective feelings of anxiety. The test re-test reliability of the T-Anxiety scale is relatively high with coefficients ranging from .73 to .86. The State-Trait anxiety scales both show highly satisfactory internal consistency with alpha coefficients reported to be greater than .90 in samples of working adults, students, and military recruits (Spielberger, Gorsuch et al. 1983). The trait anxiety scale shows good construct validity in distinguishing between normal and psychiatric patients for whom anxiety is a major symptom. The concurrent validity of the trait scale with other trait anxiety measures including the Taylor Manifest Anxiety Scale and the IPAT Anxiety Scale ranges from .73 to .85 (Spielberger, Gorsuch et al. 1983).

*Trait measures of personality and coping recorded in the week prior to surgery: -*

*Trait anxiety* was measured using the *State-Trait Anxiety Inventory for Adults (STAI)*, previously described.

*Coping* was measured using the *Coping Inventory for Stressful Situations (CISS)*.

This is a 48 item self-report questionnaire that assesses the coping dimensions of task-oriented coping, emotion-oriented coping and avoidance-oriented coping. The avoidance scale consists of two subscales, distraction and social diversion. For the three main dimensions scores range from 16 to 80. The distraction subscale ranges from 8 to 40 and the social diversion subscale from 5 to 25. Higher scores represent a greater degree of coping activity for that particular dimension (Endler and Parker 1990). Overall, the alpha coefficients of reliability for this scale are highly satisfactory. On measures of internal consistency for male and female adults respectively they range from .90 to .87 on the task scale, from .87 to .88 on the emotion scale and from .81 to .82 on the avoidance scale. Test-retest reliabilities measuring the stability of the CISS scales over time were moderate to high. For male and female adults they range from .73 to .72 on the task scale, from .68 to .71 on the emotion scale and from .55 to .60 on the avoidance scale. The scale has also demonstrated highly satisfactory construct validity (Endler and Parker 1990).

*Recovery locus of control (RLOC)*: - This is a nine-item scale, which provides a measure of the internality (5 items) and externality (4 items) of a person's perceptions of control over his or her recovery. A 5-point scale is used to rate subject responses to a given statement ranging from 1 'strongly agree' to 5 'strongly disagree'. The score derived from this questionnaire reflects the strength of the respondent's internal locus of control. Scores range from 9 to 45. Thus a high score represents a strong internal locus of control while a low score represents a strong external locus of control (Partridge and Johnston 1989).

In terms of construct validity, the items for this scale were derived from a content analysis of statements made by 34 stroke patients and 24 people with wrist fractures about their control over their recovery. Fourteen statements were extracted and rated by ten

judges (physiotherapists and psychologists) in terms of whether they represented internal or external beliefs or neither. The final nine items represent those items for which complete agreement was found. The alpha coefficients of reliability for the internal consistency of this scale ranged from .49 to .75 for external items and .49 to .80 for internal items (Partridge and Johnston 1989).

#### **(iv) Neuroendocrine measures**

*Cortisol, adrenaline and noradrenaline* were obtained with two 24-hour urine saves. The first save was undertaken three to four days prior to surgery at home. This was obtained as a baseline measure to control for individual variation in the analysis. The second 24-hour urine save was commenced at the time of anaesthetic induction. It therefore captured responses during the procedure in addition to recovery.

All biochemical assays were done at the Institute of Medical and Veterinary Science, the Queen Elizabeth Hospital Division, Department of Clinical Chemistry. A dilute Acetic Acid (33%) was added to the urine save containers to preserve the catecholamines, as these break down quickly once they have left the body. Assays were performed according to the following protocols.

Urine Free Cortisol (UFC) was measured on the Bayer ACS-180 SE automated immunoassay analyser using a competitive chemiluminescent assay. Cortisol in the sample competes with acridinium ester-labelled cortisol for binding to a polyclonal rabbit anti-cortisol antibody complex coupled to a solid phase. After a five-minute incubation the solid phase is separated magnetically, and chemiluminescence generated by addition of hydrogen peroxide in an alkaline environment. The cortisol concentration is inversely proportional to the light emitted, and is interpolated from a stored master curve. With the exception of the

synthetic steroid Prednisolone, the method is without significant interference from other steroids.

Urine Catecholamines (the biogenic amines, noradrenaline and adrenaline) were measured by high performance liquid chromatography (HPLC) following cation exchange, and alumina chromatography according to the method of Pillai DN (Pillai 1986), but modified to use a phosphate/citrate pH 4.5 mobile phase. A series of commercially prepared standards were analysed simultaneously and all samples included an internal standard to correct for procedural losses. Unknown sample values were interpolated from a dose-response relationship derived from the standards, and the chromatograms were visually inspected for interference. Interference may arise from the presence of certain therapeutic drugs but is usually detectable by visual inspection.

#### **(v) Recovery measures**

##### *Clinical recovery*

Four measures of clinical recovery were recorded.

1. *Length of postoperative stay* recorded in days.

2. *Adverse events* occurring during hospitalization were recorded using IDC-10 codes. These codes are assigned following discharge and are used to identify any adverse events occurring during hospitalization.

3. *Recovery inventory*, this is a brief questionnaire designed by the principal investigator to measure the patient's physical recovery. Patients were asked to indicate how various aspects of their body, such as sleeping, appetite and concentration, were functioning at the

moment, using a rating scale from “1 (very poor) to 6 (excellent)”. Measures were completed in the week prior to surgery, to obtain a baseline measure, then on the first post-operative day, and again, 7 days following surgery (Appendix 1).

4. *Pain frequency.* Patients rated pain frequency (i.e., “how often are you experiencing pain”) using a scale from “0 (no pain) to 10 (constant pain)”. Baseline measures of pain were assessed in the week prior to surgery and assessments were made again on the first post-operative day and on day 7 post-operatively.

#### *Social and emotional recovery*

Measures of social and emotional recovery were obtained in the week prior to surgery as baseline measures and by post at one and three months after surgery. Two measures were used.

1. *Life satisfaction:* - was measured using the Life Satisfaction Scale (LSES) (Salamon and Conte 1998). This scale was chosen as a measure of quality of life because it has been specifically designed for the elderly population. It is a 40 item self-report questionnaire that measures the degree of satisfaction on eight different dimensions of subjective wellbeing. These include:-

1. Daily activities
2. Meaning: assesses attitude toward one’s present life situation, feeling useful, having a purpose.
3. Goals: determines relative satisfaction with one’s present stage of development in comparison to previous life stages.
4. Mood: assesses optimism and positive affect.

5. Self-concept: determines the degree of self-regard and favourable self-appraisal.
6. Health: an assessment of physical well-being.
7. Finances: assesses financial security.
8. Social contacts: assesses perceived satisfaction with one's social life.

On each dimension scores can range from 5-25, with higher scores representing better subjective well-being. In addition to this, a total life satisfaction score can be calculated. This scale exhibits satisfactory internal consistency with reliability coefficients on the eight subscales ranging from .60 to .79 and .93 for the total score. It also shows adequate construct validity as measured against the Beck Depression Inventory, the Geriatric Depression Scale and other health questionnaires (Salamon 1988).

2. *Health Related Quality of Life (HRQoL)* was measured using the Australian version of the MOS 36 Item Short-Form Health Survey (SF-36). The SF-36 is a brief general health status measure, whose validity and reliability in discriminating between patient populations has been confirmed in the United States (McHorney, Ware et al. 1994) and Australia (McCallum, 1995). The questionnaire measures the following eight dimensions of health:

1. Physical Functioning (PF): a measure of the individual's ability to perform physical activities
2. Role-Physical (RF): a measure of limitations in usual role activities such as work and other daily activities because of physical health problems
3. Bodily Pain (BP): a measure of intense bodily pain and its effect on other activities
4. General Health Perception (GH): a measure of perceived health
5. Vitality (V): a measure of energy and fatigue
6. Social Functioning (SF): a measure of limitations in social activities due to physical or emotional problems

7. Role-Emotional (RE): a measure of limitations in usual role activities because of emotional problems

8. Mental Health (MH): a measure of feelings of anxiety and depression.

In addition these scales can also be combined to represent two summary scores. The Physical component summary score (PCS) is a global estimate of physical functioning, and the mental component summary score (MCS) a global estimate mental health. Scores range from 0 to 100, with higher scores indicative of better health status and functioning (McHorney, Ware et al. 1994).

### *Cognitive recovery*

A number of neuropsychological tests were used to measure cognitive recovery. Measures were obtained in the week prior to surgery, and again at three months following surgery. Assessments were undertaken at the patient's home.

*The Benton Visual Retention Test (BVRT):* - tests visual memory, visual perception, and visuoconstructive abilities. There are three alternative forms of the BVRT of roughly equal difficulty. Each form consists of 10 designs, which are shown to the patient for 10 seconds. The design is then covered up and the patient is required to reproduce the design from memory. This test concerns right hemisphere function (Benton 1974; Spreen and Strauss 1991).

*The Rey Auditory Verbal Learning Test (RAVLT):* - assesses immediate memory span, verbal learning and susceptibility to interference. The test consists of 15 nouns that are read aloud for five consecutive trials. Following each trial the patient repeats back as many of the words as he/she can remember. This is followed by an interference list

of 15 different nouns that are read out aloud and once again the patient is required to repeat back as many of the words as he/she can remember. Immediately following this, recall of the first list of 15 nouns is tested without repeating these words to the patients. Three scores are derived from this test. An indication of immediate memory is the number of words recalled following the first presentation of the 15 words. Overall verbal learning is the total number of words recalled over the first five trials and memory retention is the total number of words recalled from the first list of 15 words following presentation of the interference or second list of 15 words (Spreen and Strauss 1991).

*Controlled Oral Word Association (Word Fluency):* - a test of language. Patients are required to produce spontaneously as many words as they can beginning with a given letter of the alphabet within a limited amount of time. The score for this test simply represents the total number of words produced (Spreen and Strauss 1991).

*Premorbid IQ* was measured using the North American Adult Reading Test (NAART), which provides an estimate of premorbid intelligence. The test consists of a list of 61 irregularly spelled words. Subjects are required to read and pronounce each word. An estimate of IQ is determined by the number of errors the subject makes. This test has been validated against the WAIS-R, and was chosen because of its brevity in administration by comparison to other standard measures of intelligence (Blair and Spreen 1989; Spreen and Strauss 1991).

#### **4.3 Statistical analysis**

Data were initially screened to determine skewness. Transformations were applied where required to normalize the distribution. Neuroendocrine measures are expressed as

excretion rate per mg of creatinine, to control for possible compliance problems associated with urine saves undertaken at home. A paired samples t-test was used to determine changes in neuroendocrine excretion rates from baseline (T1) to surgery (T2). Pearson product-moment correlations, one-way analysis of variance, independent t-tests and chi-square were used to identify relationships between variables.

Hierarchical multiple regression analysis was used to determine the contribution of psychological variables to intra-operative neuroendocrine responses and recovery. This analytical strategy has the advantage of taking into account the relationships among the psychological variables to determine their unique and additive effects, over and above those accounted for by demographic and medical factors, to intra-operative neuroendocrine responses and recovery. In all analyses, demographic and medical variables were entered in the first step of the analysis and limited only to those variables that demonstrated a significant association at  $p \leq .05$  with the dependent variable. This strategy was chosen due to the small sample size. Separate analyses were run firstly, to determine the contribution of pre-operative state-anxiety on outcomes measures and secondly, to determine the contribution of stable dispositional characteristics (trait-anxiety, locus of control and coping) to intra-operative neuroendocrine responses and recovery. These analyses differed slightly. Pre-operative state-anxiety was forced into the second step on all regression analyses, regardless of the strength of its association with the dependent variable. This method was chosen to specifically address the question; to what degree does pre-operative state-anxiety influence neuroendocrine responses and to what degree does pre-operative state-anxiety influence different aspects of recovery. There is a considerable amount of literature looking specifically at the role of pre-operative state-anxiety on recovery, however, whether state-anxiety affects all aspects of recovery remains unclear. It is useful

to know what areas of recovery are affected by state-anxiety, given that it is more likely to be amenable to modification in the pre-operative stage.

In determining the contribution of dispositional psychological factors to stress responses and recovery, only those characteristics that demonstrated a significant association with the dependent variable were entered into the second step of the analyses as a block. Again this strategy was chosen to compensate for the small sample size. These characteristics, while less amenable to change still provide valuable information about personality types and coping mechanisms that play a role in the modification of stress responses to surgery and recovery from surgery. All analyses were performed using SPSS version 10.

#### **4.4 Results**

Data were examined to determine skewness. Table 4.1 shows the variables that were transformed. The skewness statistic was used to decide the criteria for transformation. All the variables in table 4.1 were skewed to the left and responded well to square root transformations. Length of stay was also heavily skewed (3.9). This was due to the presence of a number of extreme outliers. Rather than remove these from the data set and lose valuable information pertaining to the aims of the study, this variable was recoded. Patients falling outside the 95% confidence intervals (3.32 – 6.12) above the median of 3 days were coded as an extended length of stay and the rest as normal length of stay. Two categories of patients were created, those who stayed between 3 and 6 days (n=34) and those that stayed between 7 and 25 days (n=5). In addition to this alcohol was recoded to drinkers and non-drinkers. This data was skewed (1.6) due to a large proportion of patients (74%) reporting to be non-drinkers.

| <b>Variable</b>            | <b>Skewness statistic<br/>prior to<br/>transformation</b> | <b>Skewness statistic<br/>following<br/>transformation</b> |
|----------------------------|-----------------------------------------------------------|------------------------------------------------------------|
| Trait-anxiety              | 2.05                                                      | 1.49                                                       |
| State-anxiety              | 1.08                                                      | .67                                                        |
| Pain at baseline           | 1.19                                                      | .32                                                        |
| Pain day 7 postoperatively | 1.07                                                      | .20                                                        |
| Cortisol (T2)              | 1.17                                                      | .66                                                        |
| Adrenaline (T2)            | 1.34                                                      | .20                                                        |
| Noradrenaline (T2)         | 1.35                                                      | .58                                                        |

**Table 4.1.** Skewness statistics for transformed variables (n=39).

#### **4.4.1 The demographic, clinical, procedural and psychological profile of the patient group**

The demographic, clinical and procedural profile of the patient group is shown in table 4.2. The majority of patients were older males with less than 11 years of formal education. The mean Charlson index score was 2.1, reflecting the presence of co-existent disease in the majority of patients. Just over 70% of patients lived either with a spouse or family member. Most patients had a surgical risk rating of III (multiple systemic disease with no definite functional limitations) and had experienced one or more surgical interventions in the last ten years. The same surgeon performed approximate 72% of the procedures. Approximately 52% of patients were currently taking medication to control hypertension. Summary statistics for the psychological measures are shown in table 4.3.

| Variable (N= 39)                | N  | %  | M     | SD    |
|---------------------------------|----|----|-------|-------|
| Males (%)                       | 27 | 69 |       |       |
| Age at study entry (years)      |    |    | 71.9  | 6.1   |
| Formal education (years)        |    |    | 10.8  | 2.7   |
| Living alone                    | 11 | 28 |       |       |
| Charlson Index of co-morbidity  |    |    | 2.1   | 1.1   |
| Surgical risk (ASA) (%) II      | 7  | 18 |       |       |
| III                             | 30 | 78 |       |       |
| IV                              | 2  | 5  |       |       |
| Co-existent disease             |    |    |       |       |
| Hypertension                    | 23 | 59 |       |       |
| Chronic ischaemic heart disease | 12 | 31 |       |       |
| Type 2 diabetes                 | 11 | 28 |       |       |
| Hypercholesterolaemia           | 8  | 20 |       |       |
| Presenting symptoms             |    |    |       |       |
| Asymptomatic                    | 8  | 21 |       |       |
| Symptomatic                     | 25 | 64 |       |       |
| Stroke                          | 6  | 15 |       |       |
| Antihypertensive medication     | 20 | 51 |       |       |
| Smoker                          | 9  | 25 |       |       |
| Prior surgical episodes         |    |    | 1.6   | 1.5   |
| Caffeine (mgs/day)              |    |    | 275.7 | 272.7 |
| Alcohol (mgs/day)               |    |    | 9.1   | 17.4  |
| Procedure time (minutes)        |    |    | 130.6 | 27.7  |
| Shunt                           | 8  | 21 |       |       |
| Surgeon 1 (S1)                  | 28 | 72 |       |       |
| Surgeon 2 (S2)                  | 7  | 18 |       |       |
| Surgeon 3 (S3)                  | 4  | 10 |       |       |

**Table 4.2.** Demographic and medical characteristics of CEA patients (n=39).  
M = mean, SD = standard deviation, N = number, % = percent.

| <b>Variable (N=39)</b>      | <b>M</b> | <b>SD</b> |
|-----------------------------|----------|-----------|
| Pre-operative state-anxiety | 38.1     | 13.2      |
| Trait-anxiety               | 33.5     | 9.9       |
| Task-oriented coping        | 58.5     | 12.4      |
| Recovery locus of control   | 36.9     | 3.7       |
| Emotion-focused coping      | 34.4     | 11.4      |
| Avoidance coping            | 39.8     | 13.1      |

**Table 4.3.** Psychological profile of the patient population.  
M = mean, SD = standard deviation.

#### 4.4.2 Changes in neuroendocrine responses from baseline to surgery.

Significant increases from baseline to surgery occurred in cortisol,  $t(38) = 13.76$ ,  $p \leq .001$  and adrenaline,  $t(38) = 9.40$ ,  $p \leq .001$ . Changes in noradrenaline were not significant. Means and standard deviations are shown in table 4.4. Closer analyses of noradrenaline measures showed that in some patients 16 (41%) there was a decrease in noradrenaline excretion from baseline to surgery and in others 23 (59%) an increase. Noradrenaline is particularly sensitive to physical activity. Because patients are immobilised during surgery, a possible explanation for this unexpected finding may be that some patients were more active on the day of their baseline urine save.

| <b>Neuroendocrine measure</b> | <b>Baseline</b> |           | <b>Intra-operative</b> |           |
|-------------------------------|-----------------|-----------|------------------------|-----------|
|                               | <b>M</b>        | <b>SD</b> | <b>M</b>               | <b>SD</b> |
| Cortisol                      | 5.59            | 0.95      | 10.94                  | 2.54      |
| Adrenaline                    | 1.57            | 0.42      | 2.64                   | 0.80      |
| Noradrenaline                 | 4.73            | 0.76      | 5.02                   | 1.31      |

**Table 4.4.** Means and standard deviations for neuroendocrine measures.  
M = mean, SD = standard deviation.

#### **4.4.3 Contribution of pre-operative state-anxiety to intra-operative neuroendocrine responses.**

##### *Intra-operative neuroendocrine responses*

Controlling for baseline cortisol, intra-operative cortisol was significantly negatively associated with state-anxiety ( $r = -.60, p \leq .001$ ). A similar direction of associations occurred with adrenaline ( $r = -.18$ ) and noradrenaline ( $r = -.14$ ); however, these correlations were not significant. Intra-operative neuroendocrine responses were also significantly associated with a number of demographic and medical variables (table 4.5). Higher intra-operative cortisol was associated with being female,  $t(37) = 3.61, p = .01$ , lower caffeine consumption and being a non-drinker,  $t(37) = 2.54, p = .02$ . Higher intra-operative adrenaline was also associated with being a non-drinker,  $t(37) = 3.6, p = .04$ . Higher intra-operative noradrenaline was associated with greater age and being a non-drinker,  $t(37) = 2.75, p = .009$ .

The results of the regression analysis shown in table 4.6. A significant proportion (46%) of the variance in intra-operative cortisol could be explained by demographic and medical variables controlled for in step 1. In addition to this, pre-operative state-anxiety contributed a further 12% to the explained variance in intra-operative cortisol that was significant. Pre-operative state-anxiety contributed 5% to the explained variance in adrenaline responses, however this was not significant. This was over and above the 11% explained by alcohol use. Only 2% of the variance in intra-operative noradrenaline responses could be attributed to pre-operative state-anxiety. A significant proportion of the variance in noradrenaline responses (37%) was explained by age and alcohol consumption.

|                      | 1     | 2       | 3      | 4       | 5     | 6       | 7    | 8      | 9     | 10   | 11   | 12    | 13   | 14   |      |     |     |
|----------------------|-------|---------|--------|---------|-------|---------|------|--------|-------|------|------|-------|------|------|------|-----|-----|
| <i>Endocrine</i>     |       |         |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 1. Cortisol          | -     |         |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 2. Adrenaline        | .57c  | -       |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 3. Noradrenaline     | .45b  | .51c    | (.39b) | -       |       |         |      |        |       |      |      |       |      |      |      |     |     |
| <i>Demographic</i>   |       |         |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 4. Age               | .35a  | (.27)   | .25    | (.17)   | .49b  | (.50b)  | -    |        |       |      |      |       |      |      |      |     |     |
| 5. Sex               | .51c  | (.48b)  | .12    | (.16)   | .22   | (.17)   | .18  | -      |       |      |      |       |      |      |      |     |     |
| 6. Living status     | -.22  | (-.16)  | -.08   | (-.02)  | -.16  | (-.07)  | -.22 | -.32b* | -     |      |      |       |      |      |      |     |     |
| 7. Education         | -.02  | (-.09)  | -.10   | (-.17)  | .05   | (-.01)  | .03  | -.11   | -.22  |      |      |       |      |      |      |     |     |
| <i>Clinical</i>      |       |         |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 8. Charlson index    | .11   | (.13)   | -.16   | (.05)   | -.12  | (-.12)  | -.01 | .02    | .18   | -.14 | -    |       |      |      |      |     |     |
| 9. Antihypertensives | .08   | (.08)   | -.16   | (.18)   | -.04  | (-.08)  | .03  | -.21*  | -.02* | .14  | -.13 | -     |      |      |      |     |     |
| 10. Smoker           | .24   | (.32)   | .07    | (.23)   | -.24  | (-.19)  | .24  | -.10*  | -.06* | .24  | -.12 | -.06* | -    |      |      |     |     |
| 11. Prior surgeries  | .23   | (.15)   | .02    | (.09)   | -.11  | (-.08)  | .18  | .01    | -.28  | -.02 | .32b | -.11  | -.03 | -    |      |     |     |
| 12. Caffeine         | -.43b | (-.41b) | -.21   | (-.23)  | -.08  | (-.09)  | -.31 | -.14   | .36b  | .12  | -.06 | -.21  | .23  | -.21 | -    |     |     |
| 13. Alcohol          | -.39a | (-.34a) | -.33a  | (-.47b) | -.41b | (-.44b) | -.12 | -.26*  | -.02* | .07  | -.02 | .13   | -.10 | .23  | .02  | -   |     |
| <i>Procedural</i>    |       |         |        |         |       |         |      |        |       |      |      |       |      |      |      |     |     |
| 14. Time             | -.01  | (-.03)  | -.11   | (-.26)  | .02   | (-.10)  | -.01 | -.17   | .07   | .17  | -.01 | .25   | -.03 | -.04 | .25  | .15 | -   |
| 15. Shunting         | .05   | (.03)   | -.19   | (-.24)  | -.21  | (-.25)  | -.15 | -.35b* | -.04  | .31a | .00  | .33b* | -.17 | -.17 | -.14 | .15 | .14 |

**Table 4.5** Correlations between intra-operative neuroendocrine responses and demographic and medical variables.

Smoke 1 = no, 2 = yes, Sex 1 = male, 2 = female, living arrangements 1 = alone, 2 = not alone, antihypertensives 1 = yes, 2 = no, shunt 1 = yes, 2 = no, alcohol 1 = non drinkers, 2 = drinkers.

$a = p \leq .05$ ,  $b = p \leq .01$ ,  $c = p \leq .001$ , \* Phi statistic

Controlling for baseline neuroendocrine measures, partial correlations are shown in brackets.

| Variables                            | R <sup>2</sup> | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
|--------------------------------------|----------------|-----------------------|----------|-------|-------------------|
| <u>Intra-operative cortisol</u>      |                |                       |          |       |                   |
| Step 1. Demographic/Medical          | .46            |                       | 9.87***  | 3, 35 |                   |
| Caffeine                             |                |                       |          |       | -.22              |
| Sex                                  |                |                       |          |       | .31*              |
| Alcohol                              |                |                       |          |       | -.27*             |
| Step 2. State-anxiety                | .58            | .12                   | 9.65**   | 1, 34 | -.39**            |
| <u>Intra-operative adrenaline</u>    |                |                       |          |       |                   |
| Step 1. Demographic/Medical          | .11            |                       | 4.65*    | 1, 37 |                   |
| Alcohol                              |                |                       |          |       | -.32*             |
| Step 2. State-anxiety                | .16            | .05                   | 1.95     |       | -.21              |
| <u>Intra-operative noradrenaline</u> |                |                       |          |       |                   |
| Step 1. Demographic/Medical          | .37            |                       | 10.34*** |       |                   |
| Age                                  |                |                       |          |       | .42**             |
| Alcohol                              |                |                       |          |       | -.35*             |
| Step 2. State-anxiety                | .39            | .02                   | 1.53     |       | -.17              |

**Table 4.6.** Regression analyses with pre-operative state-anxiety and demographic and clinical variables as predictors of intra-operative neuroendocrine responses (n=39).

<sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation

\*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\* $p \leq .001$ .

#### 4.4.4 Contribution of pre-operative state-anxiety to recovery

##### *Clinical recovery*

##### *(1) Length of stay*

Length of stay was significantly associated with complications. More patients in the extended length of stay group had complications (60%) compared to those in the normal length of stay group (8.8%),  $\chi^2 (1) = 8.77$ ,  $p = .02$ . Controlling for complications, no significant differences in pre-operative state-anxiety were found between those patients

experiencing a longer hospital stay (mean: 6.07 and standard deviation: 0.99) and those discharged within 6 days (mean: 6.27 and standard deviation: 1.35).

### *(2) Physical recovery*

Overall, there was a significant decline in patient's ratings of physical recovery on the first post-operative day; however, by day 7 ratings had improved to be close to pre-operative values [ $F(1, 36) = 33.2, p \leq .001$ ] (table 4.7). Controlling for baseline measures of physical recovery, there were no significant associations between physical recovery on day 1 and any demographic or medical variables. Poorer ratings on day 7 were significantly associated with increased length of stay, [ $F(2, 35) = 6.79, p = .01$ ] and greater age ( $r = -.35, p = .04$ ). There was no significant association between state-anxiety and physical recovery on day 1 ( $r = -.16$ ) or day 7 ( $r = .09$ ).

Results of the regression analysis are shown in table 4.8. Only 6% of the variance in physical functioning on the first post-operative day could be explained by pre-operative state-anxiety, however this was not significant. Age and length of stay were the most significant predictors of poorer reported physical recovery on day 7, contributing up to 30% of the variance in scores.

### *(3) Pain*

Overall there was a slight increase in pain frequency on the first post-operative day; however, these changes were not statistically significant (table 4.7). Controlling for baseline measures of pain, no significant associations were found between pain on day 1 and day 7 post-operatively and any demographic or medical variables. Correlations between state-anxiety and pain on day 1 ( $r = .01$ ) and day 7 ( $r = .15$ ) were low and not significant. Results of the regression analysis are shown in table 4.8. Pre-operative state-

anxiety had no notable effect on pain on day one. It explained up to 7% of the variance on day 7, however, this was not significant.

| Recovery measures | Baseline |     | Post-operative day 1 |     | Post-operative day 7 |     |
|-------------------|----------|-----|----------------------|-----|----------------------|-----|
|                   | M        | SD  | M                    | SD  | M                    | SD  |
| Physical recovery | 61.2     | 7.9 | 50.5                 | 7.6 | 58.5                 | 7.8 |
| Pain frequency    | 2.6      | 3.1 | 3.4                  | 2.9 | 2.8                  | 3.1 |

**Table 4.7.** Means and standard deviations of measures of physical recovery and pain. M = mean, SD = standard deviation.

#### *(4) Complications*

During hospitalisation six people experienced a complication. These included hemorrhage into the wound site (n=2), pneumonia (n=2), urinary retention (n=1) and a stroke (n=1). No significant differences between the groups (complications v no complications) were found on any of the demographic variables. There were also no differences between the groups on any clinical measures. No significant differences were found between the groups on any of the neuroendocrine measures. There was no significant difference on measures of pre-operative state-anxiety in patients experiencing complications (mean 36.7 and sd 11.5) than those patients who were complication free (mean 38.4 and sd 13.6).

|                             | Post-operative day 1 |                       |          |       |                   | Post-operative day 7 |                       |          |       |                   |
|-----------------------------|----------------------|-----------------------|----------|-------|-------------------|----------------------|-----------------------|----------|-------|-------------------|
|                             | R <sup>2</sup>       | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> | R <sup>2</sup>       | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
| <u>Physical recovery</u>    |                      |                       |          |       |                   |                      |                       |          |       |                   |
| Step 1. Demographic/Medical |                      |                       |          |       |                   | .30                  |                       | 7.43**   | 2, 35 |                   |
| Age                         |                      |                       |          |       |                   |                      |                       |          |       | -.38*             |
| Length of stay              |                      |                       |          |       |                   |                      |                       |          |       | -.39*             |
| Step 2. State-anxiety       | .06                  |                       | 2.14     | 1, 36 | -.24              | .30                  | .00                   | .04      | 1, 34 | .03               |
| <u>Pain</u>                 |                      |                       |          |       |                   |                      |                       |          |       |                   |
| Step 1. State-anxiety       | .00                  |                       | .003     | 1, 36 | .04               | .07                  |                       | 2.61     | 1, 35 | .26               |

**Table 4.8.** Regression analysis with pre-operative state-anxiety, and demographic and medical variables as predictors of physical recovery and pain (n=38). <sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation

\*  $p \leq .05$ , \*\*  $p \leq .01$ .

## *Social and emotional recovery*

### *(1) Life satisfaction*

Means and standard deviations for life satisfaction (total score) and the two component scores of the SF-36 are shown in table 4.9. No significant differences were found between the three measurement points on any of the dimensions of health.

| Variables            | Baseline (n=39) |      | 1 month (n=37) |      | 3 months (n=37) |      |
|----------------------|-----------------|------|----------------|------|-----------------|------|
|                      | M               | SD   | M              | SD   | M               | SD   |
| Life satisfaction    | 143.1           | 13.8 | 145.8          | 15.9 | 143.4           | 15.6 |
| Physical functioning | 39.7            | 10.5 | 41.2           | 9.4  | 39.2            | 10.0 |
| Mental functioning   | 50.2            | 10.1 | 50.4           | 9.2  | 50.8            | 10.2 |

**Table 4.9.** Means and standard deviations for scores on life satisfaction and health-related quality of life. M = mean, SD = standard deviation.

Controlling for baseline scores, life satisfaction was significantly associated with length of stay at one month, [ $F(2, 34) = 6.45, p = .02$ ]. Lower satisfaction was reported in those patients who had a longer hospital stay (mean: 126.8 and sd: 17.7) by comparison to patients discharged within 6 days (mean: 148.1 and sd: 14.2). Associations between state-anxiety and life satisfaction at one month ( $r = -.25$ ) and three months ( $r = -.16$ ) were low to moderate but failed to reach significance.

Results from the regression analysis are shown in table 4.10. Greater pre-operative state-anxiety was a significant independent predictor of poorer reported life satisfaction at one-month and three months following surgery, explaining between 10% and 11% of the variance in scores.

*(2) Health-related quality of life*

Poorer physical functioning at one month was significantly associated with being older ( $r = -.36$ ,  $p = .03$ ). No significant associations for physical functioning at three months were found with any demographic or medical variables. Associations with pre-operative state-anxiety and physical functioning at one month ( $r = -.10$ ) and three months ( $r = .23$ ) were not significant. Poorer mental functioning at one month was associated with a longer hospital stay, [ $F(2, 34) = 9.68$ ,  $p = .004$ ], being a male [ $F(2, 34) = 7.1$ ,  $p = .01$ ] and having complications [ $F(2, 34) = 4.38$ ,  $p = .04$ ]. There were no significant associations with mental functioning at three months. Pre-operative state-anxiety was significantly associated with poorer mental functioning at one month ( $r = -.38$ ,  $p = .02$ ) but not at three months ( $r = -.02$ ).

Results from the regression analysis are shown in table 4.10. Pre-operative state-anxiety failed to make a significant contribution to physical functioning scores. Older age was the best significant independent predictor of physical functioning one month after surgery, explaining 11% of the variance in scores. Pre-operative state-anxiety had a significant impact on mental health scores at one month contributing 28% over and above the 29% of variance explained by demographic and clinical factors. Only 7% of the variance in mental functioning at three months could be explained by pre-operative state-anxiety, however this was not significant.

|                             | One month following surgery |                       |          |       |                   | Three months following surgery |                       |          |       |                   |
|-----------------------------|-----------------------------|-----------------------|----------|-------|-------------------|--------------------------------|-----------------------|----------|-------|-------------------|
|                             | R <sup>2</sup>              | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> | R <sup>2</sup>                 | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
| <u>Life satisfaction</u>    |                             |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical | .18                         |                       | 7.66**   | 1, 35 |                   |                                |                       |          |       |                   |
| Length of stay              |                             |                       |          |       | -.37*             |                                |                       |          |       |                   |
| Step 2. State-anxiety       | .28                         | .10                   | 4.64*    | 1, 34 | -.32*             | .11                            |                       | 4.30*    | 1, 35 | -.33*             |
| <u>Physical functioning</u> |                             |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical | .11                         |                       | 4.15*    | 1, 35 |                   |                                |                       |          |       |                   |
| Age                         |                             |                       |          |       | -.35*             |                                |                       |          |       |                   |
| Step 2. State-anxiety       | .13                         | .02                   | .87      | 1,34  | -.15              | .02                            |                       | .84      | 1, 35 | .15               |
| <u>Mental functioning</u>   |                             |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical | .29                         |                       | 4.53**   | 3, 33 |                   |                                |                       |          |       |                   |
| Length of stay              |                             |                       |          |       | -.25              |                                |                       |          |       |                   |
| Sex                         |                             |                       |          |       | .09               |                                |                       |          |       |                   |
| Complications               |                             |                       |          |       | -.25              |                                |                       |          |       |                   |
| Step 2. State-anxiety       | .58                         | .28                   | 21.29*** | 1, 32 | -.55***           | .07                            |                       | 3.34     | 1, 35 | -.30              |

**Table 4.10.** Regression analysis with pre-operative state-anxiety, and demographic and medical variables as predictors of life satisfaction and health-related quality of life (n=37). <sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation.

\*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\* $p \leq .001$

### *Cognitive recovery*

Means and standard deviations for performance at the three time periods are shown in table 4.11 for all measures of cognitive performance. While there are some slight deviations in scores, overall no significant differences were found for any measures of cognitive functioning across the three time periods.

| Cognitive measure         | Baseline (n=39) |      | 7 days (n=38) |      | 3 months (n=37) |      |
|---------------------------|-----------------|------|---------------|------|-----------------|------|
|                           | M               | SD   | M             | SD   | M               | SD   |
| Verbal fluency            | 25.4            | 12.2 | 26.8          | 13.3 | 31.0            | 11.5 |
| Visual Retention (errors) | 7.9             | 3.2  | 9.4           | 4.6  | 7.6             | 4.0  |
| Verbal learning           |                 |      |               |      |                 |      |
| Immediate memory          | 3.4             | 1.4  | 4.1           | 1.3  | 4.6             | 1.9  |
| Overall learning          | 33.0            | 9.7  | 31.0          | 7.6  | 35.2            | 10.9 |
| Retention                 | 5.3             | 3.6  | 5.0           | 3.0  | 5.7             | 3.7  |

**Table 4.11.** Means and standard deviations for measures of cognitive functioning. M = mean, S = standard deviation.

#### *(1) Verbal Fluency*

Controlling for baseline measures of verbal fluency, education ( $r = .44$ ,  $p = .007$ ) was significantly associated with better performance at one week. Verbal fluency at 3 months was significantly associated with sex, [ $F(2, 34) = 4.4$ ,  $p = .04$ ]. Males (mean; 32.3 and sd; 10.9) were doing slightly better than females (mean; 27.4 and sd; 11.2). Correlations with state-anxiety at 7 days ( $r = .04$ ) and 3 months ( $r = .24$ ) were not significant. Results of the regression analysis are shown in table 4.12. Pre-operative levels of state-anxiety did not affect verbal fluency seven days following surgery. There was no significant effect of state-anxiety on verbal fluency at three months, explaining only 5% of the variance in scores.

### *(2) Visual retention*

Controlling for baseline measures of functioning, performance on measures of visual retention at seven days was significantly associated with sex [ $F(2, 35) = 7.89, p = .008$ ]. Females (mean; 11.8 and sd; 4) tended to make more errors than males (mean; 9.2 and sd; 5). Correlations with state-anxiety at 7 days ( $r = .08$ ) and three months ( $r = .11$ ) were low and not significant. Results of the regression analysis are shown in table 4.12. Pre-operative state-anxiety explained between 2% and 4% of the variance in performance on the visual retention test at 7 days and three months. This was not significant.

### *(3) Verbal learning*

#### *Immediate memory*

Controlling for baseline measures of immediate memory, performance at seven days was significantly associated with complications [ $F(2, 35) = 4.92, p = .03$ ]. Scores on immediate memory were lower in patients experiencing complications (mean; 3 and sd; 1.2) than those patients who were free of complications (mean; 4.4 and sd; 1.3). Associations with state-anxiety at 7 days ( $r = -.08$ ) and three months ( $r = .14$ ) were unremarkable.

Results of the regression analysis are shown in table 4.12. Pre-operative state-anxiety made no significant contribution to explaining the performance on tests of immediate memory at 7 days and at three months. Complications were a significant predictor of performance at 7 days, contributing to 20% of the explained variance in scores.

#### *Overall learning*

Controlling for baseline functioning, poorer performance on overall learning one week after surgery was significantly associated with older age ( $r = -.34, p = .04$ ) and

education ( $r = .34$ ,  $p = .04$ ). Pre-operative state-anxiety was marginally significantly associated with scores at 7 days ( $r = .33$ ,  $p = .06$ ) but not with scores at 3 months ( $r = -.01$ ).

Results of the regression analysis are shown in table 4.12. Performance at one week was more likely to be affected by age and education level, explaining 26% of the variance in the scores. Pre-operative state-anxiety only contributed a further 1% to 2% to the explained variance in scores.

#### *Memory retention*

Controlling for baseline scores, intra-operative noradrenaline was significantly associated with scores at 7 days ( $r = -.37$ ,  $p = .03$ ). Associations with pre-operative state-anxiety at 7 days ( $r = .06$ ) and three months ( $r = .13$ ) were not significant. Results of the regression analysis are shown in table 4.12. Higher intra-operative noradrenaline was a significant predictor of poorer scores on memory retention 7 days following surgery, explaining 21% of the variance. State-anxiety failed to have any significant effect on memory retention scores.

|                                  | Seven days following surgery |                       |          |       |                   | Three months following surgery |                       |          |       |                   |
|----------------------------------|------------------------------|-----------------------|----------|-------|-------------------|--------------------------------|-----------------------|----------|-------|-------------------|
|                                  | R <sup>2</sup>               | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> | R <sup>2</sup>                 | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
| <u>Verbal fluency</u>            |                              |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical      | .27                          |                       | 13.53*** | 1, 36 |                   | .04                            |                       | 1.47     | 1, 35 |                   |
| Education                        |                              |                       |          |       | .51***            |                                |                       |          |       |                   |
| Sex                              |                              |                       |          |       |                   |                                |                       |          |       | -.15              |
| Step 2. State-anxiety            | .28                          | .01                   | .16      | 1, 35 | .03               | .09                            | .05                   | 1.69     | 1, 34 | .22               |
| <u>Visual retention (errors)</u> |                              |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical      | .09                          |                       | 3.74     | 1, 36 |                   |                                |                       |          |       |                   |
| Sex                              |                              |                       |          |       | -.34*             |                                |                       |          |       |                   |
| Step 2. State-anxiety            | .11                          | .02                   | .77      | 1, 35 | -.14              | .04                            |                       | 1.29     | 1, 35 | -.19              |
| <u>Immediate memory</u>          |                              |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical      | .12                          |                       | 5.04*    | 1, 36 |                   |                                |                       |          |       |                   |
| Complications                    |                              |                       |          |       | -.35*             |                                |                       |          |       |                   |
| Step 2. State-anxiety            | .13                          | .01                   | .26      | 1, 35 | -.08              | .01                            |                       | .41      | 1, 35 | .11               |

**Table 4.12.** Regression analysis with pre-operative state-anxiety, and demographic and medical variables as predictors of cognitive recovery. <sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation. \*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\*  $p \leq .001$ .

|                               | Seven days following surgery |                       |          |       |                   | Three months following surgery |                       |          |       |                   |
|-------------------------------|------------------------------|-----------------------|----------|-------|-------------------|--------------------------------|-----------------------|----------|-------|-------------------|
|                               | R <sup>2</sup>               | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> | R <sup>2</sup>                 | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
| <u>Overall learning</u>       |                              |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical   | .22                          |                       | 4.99*    | 2, 35 |                   |                                |                       |          |       |                   |
| Age                           |                              |                       |          |       | -.40*             |                                |                       |          |       |                   |
| Education                     |                              |                       |          |       | .25               |                                |                       |          |       |                   |
| Step 2. State-anxiety         | .23                          | .01                   | .53      | 1, 34 | .11               | .02                            |                       | .67      | 1, 35 | -.14              |
| <u>Memory retention</u>       |                              |                       |          |       |                   |                                |                       |          |       |                   |
| Step 1. Demographic/Medical   | .21                          |                       | 9.36**   | 1, 36 |                   |                                |                       |          |       |                   |
| Intra-operative noradrenaline |                              |                       |          |       | -.50**            |                                |                       |          |       |                   |
| Step 2. State-anxiety         | .23                          | .02                   | 1.17     | 1, 35 | -.17              | .01                            | .01                   | .17      | 1, 35 | -.07              |

**Table 4.12.** Continued.

<sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation. \*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\* $p \leq .001$ .

#### **4.4.5. Contribution of coping and personality to intra-operative neuroendocrine responses and recovery.**

In this analysis the same demographic and medical variables identified in the previous analysis as related to each dependent variable were entered into the first step of the hierarchical regression analysis. In the second step, only those coping and personality variables that correlate at  $p \leq .05$  were entered into the second step. In the previous analysis, state-anxiety was forced into all analyses regardless of the strength of its association with the dependent variable. This was specifically done to determine the exact nature of the contribution of pre-operative state-anxiety to the different dimensions of recovery. Because less is known about the contribution of personality and coping to recovery, this analysis is more exploratory in its attempt to identify which traits contribute to recovery. Therefore only those traits that are significantly associated with the dependent variable will be examined in the regression analysis. The contribution of the step 1 demographic and medical variables are not shown in the results section because it has already been documented in the previous section and will be unchanged. Only the contribution of the step 2 variables is shown.

##### *Intra-operative neuroendocrine responses*

Controlling for baseline neuroendocrine measures, partial correlations were determined between intra-operative neuroendocrine responses and all measures of coping (emotion-focused, task-oriented and avoidance) and measures of personality (trait-anxiety and recovery locus of control). Only one significant association emerged between intra-operative cortisol and emotion-focused coping ( $r = -.40, p = .01$ ). Results from the regression analysis are shown in table 4.13. Greater use of emotion-focused coping

strategies was a significant predictor of a reduction in intra-operative cortisol contributing a further 11% to the explained variance, over and above the 46% explained by demographic and medical factors.

### *Recovery*

#### *(1) Clinical recovery*

No significant associations occurred between coping and personality variables and length of stay or physical recovery. Controlling for baseline measures of pain, no significant associations were found between pain frequency on the first post-operative day and measures of personality and coping. Greater pain on day 7 was associated with greater use of avoidance coping ( $r = .45$ ,  $p = .005$ ) and greater use of task-oriented coping strategies ( $r = .33$ ,  $p = .05$ ). Together these two coping mechanisms explained 24% of the variance in pain scores seven days following surgery. Most of this can be attributed to the use of task coping as indicated by the significance of beta (table 4.13). Only trait-anxiety was significantly associated with complications,  $t$ , (37) = -2.24,  $p = .03$ . Trait-anxiety was greater in patients with complications (mean; 41.5 and sd; 14.92) than in those patients without complications (mean; 32.1 and sd; 8.3).

### *Life satisfaction and health-related quality of life*

Controlling for baseline measures, greater life satisfaction at three months was associated with greater use of task-oriented coping strategies ( $r = .34$ ,  $p = .04$ ). Better physical functioning at three months was positively associated with a higher internal recovery locus of control ( $r = .47$ ,  $p = .004$ ). Poorer mental functioning was associated with greater trait-anxiety at one month ( $r = -.50$ ,  $p = .002$ ), and better mental functioning with greater use of task-oriented coping strategies at three months ( $r = .47$ ,  $p = .003$ ).

Results of the regression analysis are shown in table 4.13. Only 4% of the variance in life satisfaction at three months was explained by task-oriented coping, which was not significant. A higher internal locus of control was a significant predictor of better physical functioning at three months, contributing up to 18% of the explained variance in scores. Trait-anxiety was a significant predictor of poorer mental functioning at one month, while task-oriented coping was a significant independent predictor of better mental functioning at three months. These factors explained between 26% and 35% of the variance in scores.

#### *Cognitive recovery*

Controlling for baseline measures of cognitive functioning, no significant associations were found between measures of cognitive recovery and any of the coping or personality variables.

| Variable                                | R <sup>2</sup> | R <sup>2</sup> change | F change | df    | Beta <sup>a</sup> |
|-----------------------------------------|----------------|-----------------------|----------|-------|-------------------|
| <u>Neuroendocrine measures</u>          |                |                       |          |       |                   |
| <i>Intra-operative cortisol</i>         |                |                       |          |       |                   |
| Emotion-focused coping                  | .57            | .11                   | 8.79**   | 1, 34 | -.43**            |
| <u>Recovery indices</u>                 |                |                       |          |       |                   |
| <i>Pain on day 7</i>                    |                |                       |          |       |                   |
| Avoidance coping                        | .24            | .24                   | 5.22*    | 2, 34 | .18               |
| Task coping                             |                |                       |          |       | .41*              |
| <i>Life satisfaction at 3 months</i>    |                |                       |          |       |                   |
| Task-oriented coping                    | .04            |                       | 1.48     | 1, 35 | .20               |
| <i>Physical functioning at 3 months</i> |                |                       |          |       |                   |
| Recovery locus of control               | .18            |                       | 7.68**   | 1, 35 | .42**             |
| <i>Mental functioning at 1 month</i>    |                |                       |          |       |                   |
| Trait-anxiety                           | .64            | .35                   | 31.3***  | 1, 32 | -.65***           |
| <i>Mental functioning at 3 months</i>   |                |                       |          |       |                   |
| Task coping                             | .26            | .26                   | 11.99*** | 1, 35 | .51***            |

**Table 4.13.** Regression analysis with coping and personality variables as predictors of intra-operative neuroendocrine response and recovery.

<sup>a</sup> Standardised (betas) regression coefficients are based on the final regression equation, \*  $p \leq .05$ , \*\*  $p \leq .01$ , \*\*\* $p \leq .001$ .

#### 4.5 Summary

In this study a number of hypothesis drawn from theories of adjustment to surgery were examined. According to the psychophysiological model of surgical stress, a number of positive associations should emerge. Firstly, it was expected that neuroendocrine responses to the physical trauma of surgery would increase. This study found that there was a significant increase in cortisol and adrenaline in patients during there surgical procedure.

Secondly, it was expected that a positive association between pre-operative state-anxiety and neuroendocrine responses to surgery should exist. Paradoxically heightened pre-operative state-anxiety showed a negative association with intra-operative neuroendocrine responses, the strongest association occurring between state-anxiety and cortisol. Pre-operative state-anxiety was therefore associated with a reduction in intra-operative cortisol. This is consistent with the findings of Salmon (Salmon, Evans et al. 1986; Salmon, Pearce et al. 1989; Salmon and Kaufman 1990).

Thirdly, the psychophysiological model of surgical stress suggests that heightened pre-operative distress and heightened intra-operative neuroendocrine responses would be associated with poorer recovery. This study found little evidence of an association between intra-operative neuroendocrine responses and poorer recovery, except on one measure of cognitive recovery. Of the four measures of clinical recovery taken in the seven days following the procedure there were no significant associations between pre-operative measures of state-anxiety, complications, length of stay, physical recovery and pain. Length of stay was more likely to be determined by whether or not the patient experienced complications. Similarly, poorer physical recovery was much more likely to be determined by older age and a longer hospital stay.

Greater pre-operative state-anxiety however, did emerge as a significant predictor of poorer reported life satisfaction one-month following surgery, in addition to less satisfaction being related to a longer hospital stay. On measures of health-related quality of life, older age was the most significant predictor of poorer physical functioning at one month, state-anxiety had little impact on these scores. By comparison, state-anxiety had a significant impact on poorer mental functioning at one month, accounting for up to 28% of the variance in scores. Poorer mental functioning was also associated with a longer hospital stay and

being male. At three months only 7% of the variance in these scores could be attributed to pre-operative state-anxiety.

State-anxiety had little to no effect on measures of cognitive recovery. Cognitive recovery was more likely to be influenced by demographic and medical factors such as age, education, and length of stay, sex and complications. Only on measures of memory retention at 7 days was there an association between poorer retention and heightened intra-operative noradrenaline.

Finally, the cognitive-behavioural model of surgical stress proposes that personal attributes such as coping styles and personality characteristics may be important determinants of post-operative recovery such that particular coping styles utilized by anxious individuals may underlie adaptation to surgery. This study found that the use of emotion-focused coping was positively associated with heightened pre-operative state-anxiety and negatively associated with cortisol, suggesting that this particular coping strategy may be adaptive in moderating physiological stress responses to surgery, but maladaptive by maintaining heightened subjective distress.

On measures of clinical recovery, patients reporting higher levels of trait-anxiety were more likely to experience complications, while avoidance and task-oriented coping strategies were associated with more pain on day seven. These personality characteristics therefore appear better predictors of pain than pre-operative state-anxiety, given there were no associations between pre-operative state-anxiety and pain.

A higher internal locus of control was a much better predictor of physical functioning at three months than state-anxiety, explaining up to 18% of the variance in scores. Trait-anxiety was significantly associated with poorer mental functioning at one and three months, while task-oriented coping was associated with greater life satisfaction and better

mental functioning at three months. Cognitive recovery was unaffected by coping and personality characteristics.

These results show that while pre-operative state-anxiety may influence some aspects of recovery, coping and personality characteristics may be better predictors of other aspects of recovery.

## CHAPTER FIVE

### **Interacting effects of coping, choice and information on stress responses, satisfaction, knowledge and recovery in patients undergoing colonoscopy.**

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#### **5.0 Introduction**

There is an extensive medical, psychological and nursing literature attesting to the benefits of psychologically preparing patients for invasive medical procedures by the provision of accurate information (Weinman and Johnston 1988; Alberts, Lyons et al. 1989; Johnston and Vogele 1993). The provision of information has a number of principal goals. Firstly it is an integral part of the informed consent process. Patients need to know about the risks and complications and alternatives to treatment so that they can participate in treatment decisions. Secondly, the provision of information is a useful mechanism to improve patient outcomes. There is no doubt that patients want to know about their treatment (Grady, Buckley et al. 1988; Dawes and Davison 1994; Klawns and Roizen 1996), and that this is related to satisfaction (Edwards 1990; Williams 1993; Hardy, West et al. 1996). The most widely adopted method is to provide patients with written information in addition to the verbal information usually presented by the clinician at the time of consent. There are some inherent problems with this process. There are no guarantees that people will read and understand the written information, and certain core information may be missed due to clinician variability.

The use of audiovisual information shows considerable promise in overcoming some of these problems. In a recent review of studies from 1975 to 1986 (Gagliano 1988) it was concluded that video information was often more effective than traditional methods of patient education in increasing short-term knowledge, cooperation and coping ability while

decreasing anxiety, pain, and sympathetic arousal. Additional studies undertaken since 1988 support these findings of an increase in patients' knowledge about the procedure (Done and Lee 1998; Cassady, Wysocki et al. 1999; Luck, Pearson et al. 1999) and a reduction in pre-operative anxiety (Herrmann and Kreuzer 1989; Cassady, Wysocki et al. 1999; Luck, Pearson et al. 1999; Doering, Katzlberger et al. 2000) to the use of audiovisual material. In addition to this, a reduction in cortisol pre- and post-operatively has been observed in patients viewing a preparatory video prior to hip replacement surgery (Doering, Katzlberger et al. 2000). A second problem inherent in the process of information disclosure relates to variability in patient's desire for information. Studies show that stress decreases when people's desire for information is matched with the amount of information provided and that stress increases if there is a mismatch (Miller and Mangan 1983; Ludwick-Rosenthal and Neufeld 1993; Mitchell 2000). One way to ensure people are able to satisfy their information requirements would be to allow them to choose how much information they want to be exposed to. Presuming that people know what they want, this might offer a practical solution to the problem. According to contemporary theories of stress and coping, successful adaptation should be evidenced by less procedural stress, an increase in perceptions of control, and better recovery.

This study represents an extension of an earlier study that sought to specifically determine whether video information by comparison to standard methods of information disclosure was superior in terms of reducing state anxiety and improving patients retention of information (Luck, Pearson et al. 1999). Results show that exposure to the video information did significantly reduce pre-procedure state-anxiety and improve their knowledge about the procedure. The study reported in this thesis extends this original study by looking at the effects of offering patients a choice of accessing additional information

regarding their scheduled procedure, on patient outcomes and stress responses. In addition to this it examines the role of coping and trait anxiety in adaptation to this procedure.

A colonoscopy is a diagnostic procedure that is commonly used to screen for bowel problems. A flexible fibre-optic endoscope allows visualisation along the entire length of the large bowel. Patients prepare for the procedure by undergoing a bowel-cleansing regimen in the day prior to the procedure. They are given a light anaesthetic to induce sleep for the duration of the procedure, which usually lasts from 10 to 20 minutes. It is performed in the Day Surgery Unit and patients are usually only in hospital for 3 to 4 hours.

## **5.1 Methods**

### **5.1.1 Procedure**

Individuals eligible for the study were adults referred to the Day Surgery Unit of The Queen Elizabeth Hospital who were scheduled to undergo a colonoscopy, and who were able to give written informed consent. Patients were approached to participate in the study while attending pre-anaesthetic clinic in the week prior to their scheduled procedure. All participants enrolled in the study, therefore, received the standard surgical and anaesthetic information in consultation with a nurse and anaesthetist. This included the provision of a standardised information sheet about colonoscopy. This study was approved by the institutional Ethics of Human Research Committee.

This study used a double randomisation design in which the principal investigator was aware of the first randomisation condition (choice v no choice) prior to seeing the patient. This was necessary, as the two conditions required different verbal instructions from the investigator. Patients randomised to the choice condition were instructed that they were free to view the video as an extra source of information if they would like to. Patients randomised to the no-choice group were instructed that they would be randomly allocated to

view or not to view an educational video. Random numbers were used to generate a sequence of group assignments for both randomisation conditions. Group assignments were marked on a card in a sealed envelope. The investigator prior to talking with the patient opened envelopes containing assignment to the choice/no choice condition. Envelopes containing assignment of no choice patients to the video/no video condition were opened following the completion of questionnaires at the pre-anaesthetic clinic visit.

Patients completed the Spielberger state-anxiety questionnaire (STAI). They were also asked to rate how much control they felt they had over the situation. Finally patients were given a manilla envelope containing two questionnaires to complete at home and bring with them on the day of their colonoscopy. These questionnaires included the CISS, and trait versions of the STAI. Patients randomised to view the video and those who chose to view the video did so in a separate room on the day of their pre-anaesthetic visit. A well-known Australian actor narrated the ten-minute video in non-medical language. The procedure was discussed with a colonoscopist and patient at various stages before, during and following the procedure (Institute 1997). On the day of their procedure, patients were seen prior to their procedure, and once again rated their level of state anxiety and perceptions of control. In addition to this they completed a knowledge questionnaire about the procedure, and rated their level of satisfaction with the information provided.

Following their procedure patients usually remain in stage 1 recovery until their vital signs are stable. They are then transferred to stage 2 where providing they have voided and tolerated some food and fluids they are usually ready to be discharged within about 30 minutes.

### **5.1.2 Subjects**

Between March 1998 and June 2000, 305 patients scheduled to undergo colonoscopy were approached to participate in the study. 65 patients refused to participate, 31 were judged as unable to complete the questionnaires either due to limited English or to cognitive impairment, and a further 12 patients were excluded because they had previously seen the video. Following randomisation, 8 patients' procedures were cancelled, and 23 patients refused to participate any further in the study on the day of their procedure. Patients who refused were evenly distributed between the randomisation groups. This left 166 patients in the study. Of the remaining 166 patients 24 patients had their procedure performed earlier than originally scheduled, resulting in missing pre-procedure data for these patients. They were consequently excluded from the study (figure 5.1).

### **5.1.3 Materials**

#### **(i) Demographic, clinical and procedural information**

All information regarding demographic, clinical or procedural details was obtained by direct interview or from the patients' medical records. Demographic information included age, sex, marital status, living arrangements and education level. Clinical information included ASA ranking, a Charlson comorbidity score, and number of prior surgical episodes. The reader is referred to chapter four for an explanation regarding these variables. Additional clinical variables not previously described include whether or not the patient has had a colonoscopy before. This was recorded as yes or no. Indications for having a colonoscopy included the presence of rectal bleeding, abdominal pain, a history of prior cancer or polyps, a family history of bowel cancer or abnormal barium enema. Procedural information included procedure time and supervising consultant.

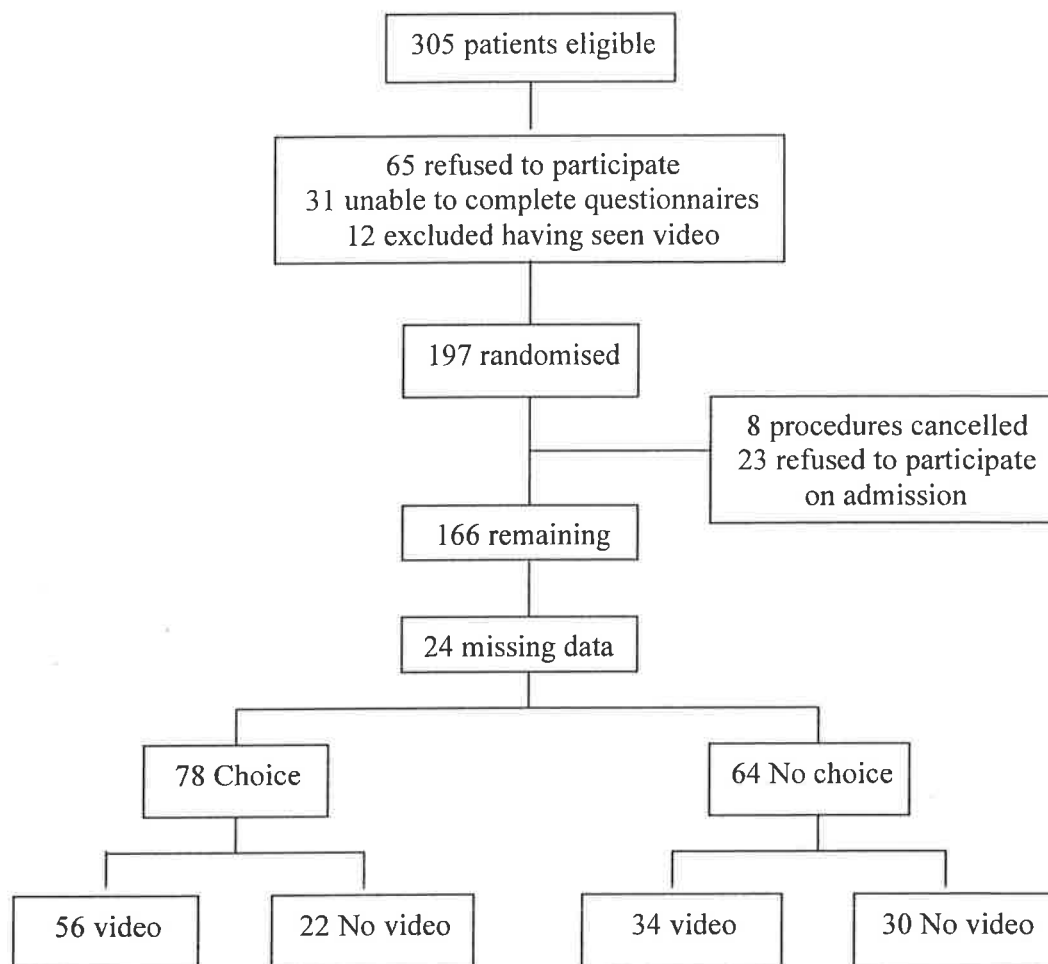


**Figure 5.1.** Randomisation of colonoscopy patients.

**(ii) Psychological measures**

*Subjective self-reports of:-*

*State-anxiety* was measured using the State-Trait Anxiety Inventory for Adults (STAI). State-anxiety was measured at the pre-admission visit (T1) a week before the

procedure and again on the day of admission approximately 10 to 20 minutes prior to the procedure (T2).

*State-control* was measured by asking patients to indicate the level of control they felt they had over their present circumstance on a scale ranging from “1 (I feel totally helpless) to 7 (I feel in complete control)”.

*Dispositional measures of coping and personality:-*

*Coping* was measured using the Coping Inventory for Stressful Situations (CISS) previously described.

*Trait-anxiety* was measured using the STAI, also previously described.

**(iii) Cardiovascular measures:-**

*Heart rate (HR)* and *systolic blood pressure (SBP)* were measured at the time of the patients' pre-admission visit (T1), on the day of admission just prior to commencement of the procedure (T1) and immediately following the procedure (T3).

**(iv) Patient satisfaction and knowledge**

A *knowledge* questionnaire designed specifically for the purpose of the pilot study referred to in the introduction was used again in this study. The questionnaire measured knowledge in three areas: the purpose of the procedure (maximum of 4 points, items 1,2 and 3), procedural knowledge (maximum of 5 points, items 4, 5, 7, 8 and 9), and knowledge of possible complications (maximum of 3 points, item 6).

*Patient satisfaction* with the information provided was measured by asking patients to indicate on a scale ranging from a) “totally satisfied” (score of 5) to e) “totally unsatisfied” (score of 1) how satisfied they were with the information given to them prior to their colonoscopy.

**(v) Procedural and recovery measures**

*Procedure time* was recorded in minutes

*Anaesthetic agents:-*

*Midazolam:-* milligrams of midazolam per kilogram of body weight were recorded retrospectively using the anaesthesia record. This is an anxiolytic agent used to reduce arousal during anaesthetic induction and during the procedure. A higher dose of midazolam is indicative of heightened arousal at induction as judged by the anaesthetist.

*Propofol:-* milligrams of propofol per kilogram of body weight were recorded retrospectively using the anaesthetic records. Propofol is primarily used to maintain sedation.

*Recovery score:-* This score is an assessment of vital signs, ambulating, nausea/vomiting, pain and bleeding. A maximum score of 10 is indicative of better functioning in these areas. This score is recorded on arrival in stage 2 recovery.

*Time spent in stage 1 recovery:-* this was recorded in minutes.

*Complications:-* included the occurrence of excessive pain, requiring analgesia, the presence of any nausea or vomiting, dizziness, cardiac anomalies such as episodes of hypo or hypertension, headaches and bleeding.

## **5.2 Statistical analyses**

Demographic, clinical and procedural characteristics of the four groups were compared using chi-square for discrete variables, and one way analysis of variance for normally distributed continuous variables. Pearson product moment correlations (and phi coefficients for dichotomous variables), Student's t-tests and analysis of variance were used to look at relationships between all variables. To determine the effects of the two treatment conditions and coping mechanisms on outcome variables, univariate analysis of variance was used. Coping was recoded into "low" and "high" groupings based on a median split. The choice, video and coping conditions were entered as between-subjects' factors. 26 patients had missing data for coping measures. Clinical, procedural and demographic confounders were entered into the analysis where identified. All analyses were performed using SPSS version 10.0.

## **5.3 Results**

### **5.3.1 Demographic and medical characteristics of the patient groups**

The demographic and medical details of the sample are shown in table 5.1. There were no significant differences between the groups on any patient characteristic. Patients in the four different groups were well matched with respect to demographic characteristics. Most patients were aged in their mid to late 50s. There was an even proportion of males and females, and less than 30% of patients were living alone. Patients in the four groups were well matched for education also. The majority of patients had an ASA rating of II and a relatively low Charlson index score, indicating a lower incidence of co-existent disease. Between 40 and 50% of patients had had a prior colonoscopy. The most common indication for a colonoscopy was the presence of bleeding. Altogether, ten surgeons

performed the 142 procedures. The distribution of procedures by all surgeons across the four groups was comparable.

### **5.3.2 Associations between treatment groups and all other variables**

Correlations between all variables are shown in table 5.2. Few variables correlated significantly with the choice condition. The significant association with video condition reflects the difference in the number of people choosing to view the video. When given a choice approximately 72% of patients preferred to see the video. Additional information in this form would therefore appear to be suited to the majority of the patient population. There was also a significant negative association with state-anxiety at pre-admission. People in the choice condition reported greater state-anxiety at their pre-admission visit,  $t(140) = 2.23$ ,  $p = .03$ , (choice; mean 31.0 and sd 12.1 v no choice; mean 26.9 and sd 9.2). Remembering that anxiety was measured following patients becoming aware that they had been given a choice, rather than reducing anxiety, this association suggests that it made patients more anxious. All other correlations with the choice condition were low showing very little association.

There was a significant association between number of prior surgeries and video condition. Patients who viewed the video had had less prior surgery than those not viewing the video,  $t(140) = -2.1$ ,  $p = .04$ , (video; mean 2.0 and sd 1.3 v no video; mean 2.6 and sd 1.6). This possibly reflects a desire for more information by those with less experience of surgery. Having seen the video was also significantly associated with a reduction in cardiovascular responses following completion of the procedure.

Trait-anxiety was positively associated with measures of state-anxiety and negatively associated with measures of control, as expected. Task coping was negatively

associated with trait-anxiety. Emotion-focused coping was positively associated with measures of state and trait anxiety and negatively associated with measures of control.

| Variable                           | Choice condition (n=78) |      |    |        |                 |      |    |        | No-choice condition (n=64) |      |    |        |                 |      |    |        | P value |
|------------------------------------|-------------------------|------|----|--------|-----------------|------|----|--------|----------------------------|------|----|--------|-----------------|------|----|--------|---------|
|                                    | Video (n=56)            |      |    |        | No-video (n=22) |      |    |        | Video (n=34)               |      |    |        | No-video (n=30) |      |    |        |         |
|                                    | M                       | SD   | N  | (%)    | M               | SD   | N  | (%)    | M                          | SD   | N  | (%)    | M               | SD   | N  | (%)    |         |
| Age in years                       | 60                      | 13.8 |    |        | 59.1            | 15.1 |    |        | 57.5                       | 15.6 |    |        | 57.3            | 15.3 |    |        | .82     |
| Education in years                 | 9.7                     | 2.6  |    |        | 10.2            | 2.3  |    |        | 10.7                       | 3.0  |    |        | 10.0            | 2.5  |    |        | .32     |
| Males                              |                         |      | 27 | (48.2) |                 |      | 9  | (40.9) |                            |      | 16 | (47.1) |                 |      | 14 | (46.7) | .95     |
| Live alone                         |                         |      | 10 | (17.9) |                 |      | 8  | (36.4) |                            |      | 5  | (14.7) |                 |      | 8  | (26.7) | .20     |
| Charlson Index                     | 0.45                    | 0.66 |    |        | 0.32            | 0.48 |    |        | 0.42                       | 0.61 |    |        | 0.32            | 0.55 |    |        | .70     |
| ASA I                              |                         |      | 10 | (17.9) |                 |      | 3  | (13.6) |                            |      | 11 | (32.4) |                 |      | 8  | (26.7) | .57     |
| II                                 |                         |      | 41 | (73.2) |                 |      | 18 | (81.8) |                            |      | 20 | (58.8) |                 |      | 19 | (63.3) |         |
| Prior colonoscopy                  |                         |      | 23 | (41.1) |                 |      | 10 | (45.5) |                            |      | 14 | (41.2) |                 |      | 16 | (53.3) | .72     |
| <i>Indications for colonoscopy</i> |                         |      |    |        |                 |      |    |        |                            |      |    |        |                 |      |    |        |         |
| Rectal bleeding                    |                         |      | 22 | (39.3) |                 |      | 4  | (18.2) |                            |      | 14 | (41.2) |                 |      | 7  | (23.3) | .44     |
| Abdominal pain                     |                         |      | 12 | (21.4) |                 |      | 4  | (18.2) |                            |      | 3  | (18.8) |                 |      | 6  | (20)   |         |
| Prior cancer                       |                         |      | 9  | (16.1) |                 |      | 6  | (27.3) |                            |      | 6  | (17.6) |                 |      | 5  | (16.7) |         |
| Routine screening*                 |                         |      | 13 | (23.2) |                 |      | 8  | (36.4) |                            |      | 11 | (32.4) |                 |      | 12 | (40)   |         |
| Procedure time                     | 20.7                    | 9.3  |    |        | 25.2            | 13.9 |    |        | 23.4                       | 9.4  |    |        | 22.3            | 10.0 |    |        | .30     |
| Surgeons **                        |                         |      | 10 | (100)  |                 |      | 8  | (80)   |                            |      | 8  | (80)   |                 |      | 9  | (90)   |         |

**Table 5.1.** Demographic and medical characteristics of the colonoscopy treatment groups. \* Due to family history of cancer, prior polyps or abnormal barium enema, \*\* Ten different surgeons performed the total number of procedures. This figure represents what proportion of these surgeons performed procedures in each of the groups.

| <i>Variable</i>           | <b>1</b> | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> | <b>6</b> | <b>7</b> | <b>8</b> | <b>9</b> | <b>10</b> | <b>11</b> | <b>12</b> | <b>13</b> | <b>14</b> | <b>15</b> | <b>16</b> |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1. Choice condition       | -        |          |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 2. Video condition        | .19b     | -        |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 3. Age                    | -.08     | .03      | -        |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 4. Sex                    | -.01     | -.03     | -.13     | -        |          |          |          |          |          |           |           |           |           |           |           |           |
| 5. Education              | .09      | .14a     | -.36d    | .03      | -        |          |          |          |          |           |           |           |           |           |           |           |
| 6. Charlson               | -.04     | -.10     | .44d     | .01      | -.23c    | -        |          |          |          |           |           |           |           |           |           |           |
| 7. Prior colonoscopy      | -.05     | -.09     | -.24c    | .08      | .00      | .00      | -        |          |          |           |           |           |           |           |           |           |
| 8. Prior surgeries        | .05      | .18b     | .15b     | .08      | .02      | .00      | -.22c    | -        |          |           |           |           |           |           |           |           |
| 9. Anxiety [T]            | -.11     | -.11     | -.02     | .17a     | -.06     | -.11     | -.03     | .02      | -        |           |           |           |           |           |           |           |
| 10. Task coping           | .10      | -.02     | .03      | .02      | -.11     | .12      | -.08     | .04      | -.21b    | -         |           |           |           |           |           |           |
| 11. Emotion coping        | -.07     | .01      | -.14     | .17a     | -.04     | -.01     | -.03     | .02      | .67d     | .07       | -         |           |           |           |           |           |
| 12. Avoidance coping      | .00      | -.05     | -.11     | .17a     | -.15     | -.17a    | -.01     | -.08     | .07      | .37d      | .20b      | -         |           |           |           |           |
| Time 1 [PAC]              |          |          |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 13. Anxiety               | -.19b    | -.07     | .03      | .33d     | .01      | .00      | .17b     | -.04     | .49d     | -.06      | .28c      | -.01      | -         |           |           |           |
| 14. Control               | .09      | .10      | .16a     | -.21b    | -.16a    | .02      | -.21b    | .17b     | -.25c    | -.05      | -.24c     | -.10      | -.47d     | -         |           |           |
| 15. Heart rate            | .10      | .05      | .10      | .16a     | .08      | .07      | -.16a    | .01      | .11      | .02       | .07       | .03       | .10       | .00       | -         |           |
| 16. Systolic bp           | -.08     | -.01     | .46d     | -.06     | -.16a    | .30d     | -.18b    | -.01     | .05      | .12       | .01       | -.09      | .08       | .19b      | .16a      | -         |
| Time 2 [Admission]        |          |          |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 17. Anxiety               | -.06     | .03      | -.11     | .31d     | .03      | -.10     | .07      | -.08     | .32d     | -.03      | .26c      | .09       | .56d      | -.37d     | .04       | -.14      |
| 18. Control               | .04      | .00      | .09      | -.28d    | -.16a    | .09      | -.04     | .04      | -.23b    | -.11      | -.30d     | -.17a     | -.28d     | .40d      | -.02      | .10       |
| 19. Heart rate            | .03      | .12      | .28c     | .21b     | -.04     | .22b     | -.13     | .00      | .17a     | .02       | .05       | .06       | .14       | -.02      | .64d      | .16a      |
| 20. Systolic bp           | .09      | -.02     | .34d     | -.04     | -.16a    | .24c     | -.22b    | .04      | -.02     | .15       | .00       | -.03      | .06       | .24c      | .17a      | .66d      |
| 21. Knowledge             | .09      | -.12     | -.39d    | .13      | .14a     | -.30d    | .03      | -.05     | -.02     | .00       | -.04      | .04       | .05       | -.13      | -.11      | -.48d     |
| 22. Satisfaction          | .00      | .09      | -.13     | .02      | -.08     | -.03     | -.08     | .09      | -.05     | .05       | .04       | .05       | -.22c     | .17b      | .07       | .07       |
| Time 3 [End of procedure] |          |          |          |          |          |          |          |          |          |           |           |           |           |           |           |           |
| 23. Heart rate            | .00      | .18b     | .07      | .17b     | .20b     | .08      | -.07     | .04      | -.02     | -.07      | -.10      | -.04      | .00       | -.07      | .39d      | -.01      |
| 24. Systolic bp           | .13      | .21b     | .31d     | -.04     | -.08     | .30d     | -.12     | .06      | -.06     | .07       | -.06      | -.09      | -.08      | .12       | .12       | .43d      |
| 25. Midazolam             | .09      | -.10     | -.17a    | .20b     | .07      | .06      | .21b     | -.13     | -.06     | .15       | -.07      | -.06      | -.08      | -.08      | -.05      | -.05      |
| 26. Propofol              | .09      | .01      | -.25c    | .22b     | .12      | -.03     | .06      | .10      | .02      | .03       | .14       | .20a      | .20b      | -.37d     | .05       | -.21b     |
| 27. Recovery time         | -.08     | .00      | .10      | -.11     | -.04     | .07      | .05      | .15      | .02      | -.13      | -.09      | .00       | .02       | .11       | -.07      | -.12      |
| 28. Recovery score        | .01      | -.09     | -.07     | -.03     | .21b     | -.13     | -.09     | -.18b    | .16      | -.01      | .06       | -.02      | .09       | -.12      | -.04      | .05       |
| 29. Complication          | -.03     | .06      | -.12     | -.04     | -.06     | -.09     | .09      | .07      | -.07     | .04       | .02       | -.14      | -.04      | .12       | -.06      | .01       |
| 30. Procedure time        | .04      | .08      | -.18b    | .14      | .05      | .11      | .06      | .05      | .09      | .04       | .13       | .01       | .13       | -.22c     | .01       | -.04      |

| <i>Variable</i>           | 17    | 18    | 19   | 20    | 21   | 22   | 23   | 24    | 25   | 26   | 27   | 28   | 29  |
|---------------------------|-------|-------|------|-------|------|------|------|-------|------|------|------|------|-----|
| Time 2 [Admission]        |       |       |      |       |      |      |      |       |      |      |      |      |     |
| 17. Anxiety               | -     |       |      |       |      |      |      |       |      |      |      |      |     |
| 18. Control               | -.54d | -     |      |       |      |      |      |       |      |      |      |      |     |
| 19. Heart rate            | .13   | -.03  | -    |       |      |      |      |       |      |      |      |      |     |
| 20. Systolic bp           | -.04  | .13   | .17a | -     |      |      |      |       |      |      |      |      |     |
| 21. Knowledge             | .26c  | -.11  | -.08 | -.27c | -    |      |      |       |      |      |      |      |     |
| 22. Satisfaction          | -.20b | .23c  | .03  | .06   | .16a | -    |      |       |      |      |      |      |     |
| Time 3 [end of procedure] |       |       |      |       |      |      |      |       |      |      |      |      |     |
| 23. Heart rate            | .19b  | -.11  | .43c | .10   | .07  | .03  | -    |       |      |      |      |      |     |
| 24. Systolic bp           | -.05  | .04   | .10  | .36d  | -.12 | .09  | .24c | -     |      |      |      |      |     |
| 25. Midazolam             | -.01  | .02   | .08  | -.11  | .12  | .05  | .11  | -.01  | -    |      |      |      |     |
| 26. Propofol              | .08   | -.11  | -.01 | -.18b | -.06 | -.01 | .04  | -.07  | -.11 | -    |      |      |     |
| 27. Recovery time         | .11   | .03   | .10  | .00   | -.11 | .04  | .17a | -.19b | .18a | -.10 | -    |      |     |
| 28. Recovery score        | .08   | -.15  | .00  | .08   | .06  | -.12 | -.01 | .05   | .02  | -.04 | -.12 | -    |     |
| 29. Complication          | -.02  | -.09  | -.09 | .02   | -.02 | -.03 | -.10 | -.01  | .01  | .00  | .10  | -.07 | -   |
| 30. Procedure time        | .25c  | -.15a | .07  | -.05  | .10  | .08  | .03  | .06   | .12  | .36d | -.03 | -.06 | .06 |

**Table 5.2.** Correlations between all variables.

Choice condition 1 = choice, 2 = no choice, video condition 1 = video, 2 = no video, sex 1 = male, 2 = female, complications 1 = no complications, 2 = complications, prior colonoscopy 1 = yes, 2 = no, a =  $p < .10$ , b =  $p < .05$ , c =  $p < .01$ , d =  $p < .001$ .

### 5.3.3 Interacting effects of coping, choice and information on state-anxiety and state-control

#### *State-anxiety*

Associations between state-anxiety and all other variables are shown in table 5.2. State-anxiety at both measurement times was significantly associated with trait-anxiety and sex. Females were generally more anxious than males at pre-admission,  $t(140) = 4.15, p \leq .001$ , and on the day of the procedure,  $t(140) = 3.85, p \leq .001$ . Means and standard deviations are shown in table 5.3. Patients who had previously undergone a colonoscopy were also less anxious on the day of their pre-admission visit (T1),  $t(140) = 2.03, p = .05$ , (prior colonoscopy; mean 27.0 and sd 8.8 v no prior colonoscopy; mean 30.8 and sd 12.3).

|                    | Males (n=66) |     | Females (n=76) |      |
|--------------------|--------------|-----|----------------|------|
|                    | M            | SD  | M              | SD   |
| State-anxiety (T1) | 25.2         | 6.7 | 32.5           | 12.8 |
| State-anxiety (T2) | 29.3         | 8.2 | 36.2           | 12.5 |

**Table 5.3.** Means and standard deviations for state-anxiety scores in males and females. M = mean, SD = standard deviation.

#### *State-anxiety on the day of the pre-admission visit (T1)*

Controlling for trait-anxiety, sex and prior procedure significant interaction effects were found for avoidance and emotion-focused coping. There was a significant interaction between choice and avoidance coping [ $F(5, 107) = 8.11, p = .005$ ]. High-avoiders tended to report greater anxiety under choice conditions than under no-choice conditions (figure 5.2). See means and standard deviations in table 5.4.

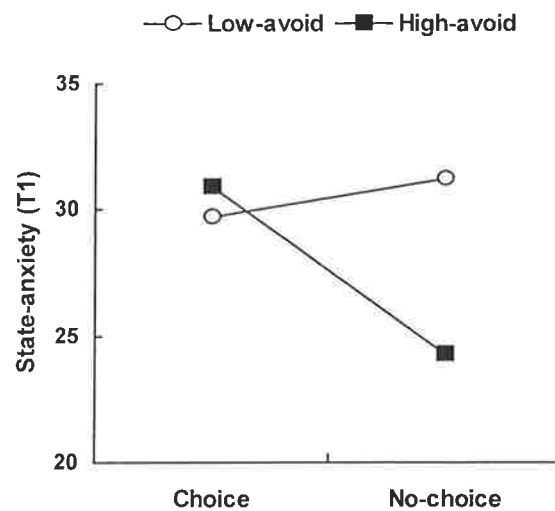


**Figure 5.2.** State-anxiety at T1 in high- and low-avoidance groups, according to choice conditions.

| Low-avoidance |      |                  |      | High-avoidance |      |                  |     |
|---------------|------|------------------|------|----------------|------|------------------|-----|
| Choice (n=37) |      | No-choice (n=20) |      | Choice (n=35)  |      | No-choice (n=24) |     |
| M             | SD   | M                | SD   | M              | SD   | M                | SD  |
| 29.7          | 13.2 | 31.2             | 12.3 | 30.9           | 11.7 | 24.3             | 5.7 |

**Table 5.4.** Means and standard deviations for state-anxiety at T1 in high- and low-avoidance groups according to choice condition. M = mean, SD = standard deviation.

#### *State-anxiety prior to the procedure (T2)*

There was a significant choice X video X avoidance coping interaction on measures of state-anxiety on the day of the procedure [ $F(9, 103) = 12.98, p = .001$ ]. Means and standard deviations are shown in table 5.5. High-avoiders tend to report greater state-anxiety when

choosing not to watch the video than when randomly allocated to the no-video condition (figure 5.3). The converse is true for low-avoiders (figure 5.4).

|           | Low-avoidance |      |          |      | High-avoidance |      |          |      |
|-----------|---------------|------|----------|------|----------------|------|----------|------|
|           | Video         |      | No-video |      | Video          |      | No-video |      |
|           | M             | SD   | M        | SD   | M              | SD   | M        | SD   |
| Choice    | 34.9          | 11.2 | 26.5     | 7.1  | 32.0           | 9.1  | 43.8     | 11.3 |
|           | (n=21)        |      | (n=11)   |      | (n=25)         |      | (n=8)    |      |
| No-choice | 31.0          | 8.4  | 37.9     | 13.9 | 34.3           | 11.7 | 27.8     | 7.1  |
|           | (n=13)        |      | (n=11)   |      | (n=12)         |      | (n=12)   |      |

**Table 5.5.** Means and standard deviations for state-anxiety at T2 in high- and low-avoidance coping groups, according to video and choice conditions.  
M = mean, SD = standard deviation.

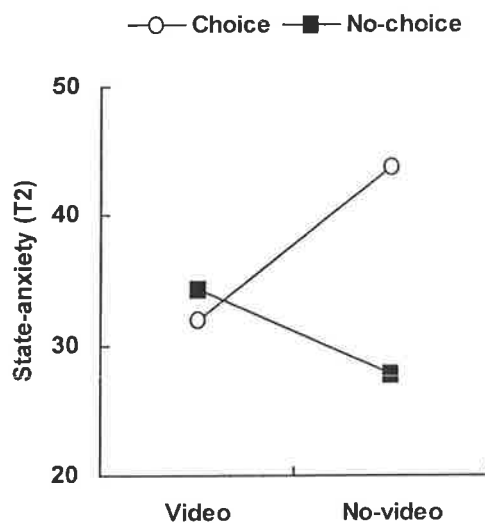


**Figure 5.3.** State-anxiety at T2 in high-avoidance copers, according to choice and video conditions.

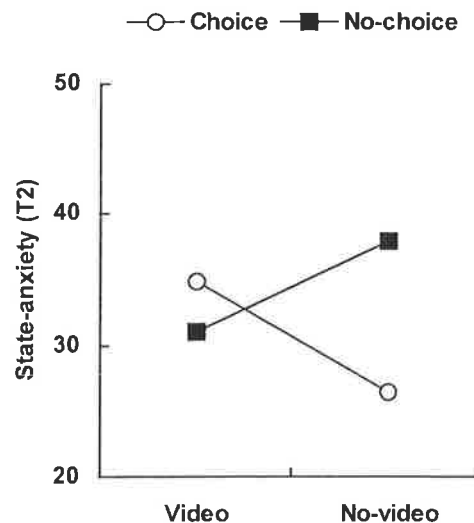


**Figure 5.4.** State-anxiety at T2 in low-avoidance copers according to choice and video conditions.

There was also a significant video X emotion-focused coping interaction [ $F(5, 107) = 4.59, p = .03$ ]. Patients high in emotion focused coping were considerably more anxious on the day of their procedure if they had previously seen the video than those who had not seen the video. Patients low in emotion-focused coping were less anxious if they had seen the video (figure 5.5). Means and standard deviations are shown in table 5.6.

| Low-emotion focused |     |                 |      | High-emotion focused |      |                 |      |
|---------------------|-----|-----------------|------|----------------------|------|-----------------|------|
| Video (n=37)        |     | No-video (n=20) |      | Video (n=34)         |      | No-video (n=22) |      |
| M                   | SD  | M               | SD   | M                    | SD   | M               | SD   |
| 30.3                | 8.4 | 33.8            | 11.7 | 36.1                 | 10.9 | 32.5            | 12.4 |

**Table 5.6** Means and standard deviations for state-anxiety at T2 in high- and low- emotion focused coping groups according to video condition. M = mean, SD = standard deviation.

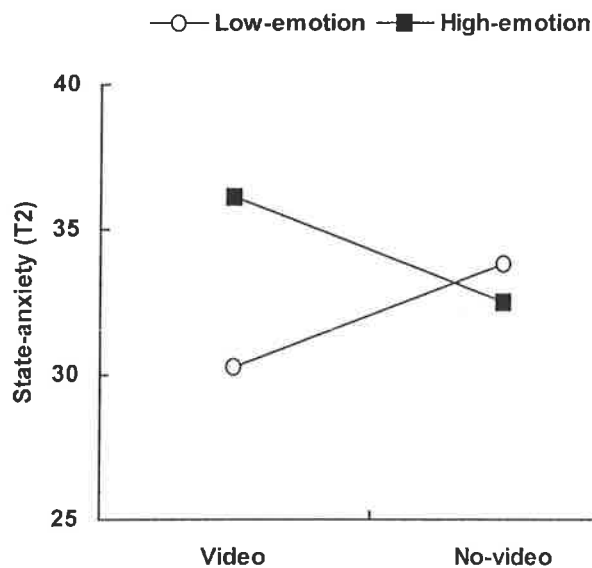


**Figure 5.5.** State-anxiety at T2 in high- and low-emotion focused coping groups, according to video condition.

### *State control*

State-control was negatively associated with trait-anxiety and sex (table 5.2). Females were more likely to report less control at pre-admission,  $t(140) = 2.5$ ,  $p = .01$ , and on the day of the procedure,  $t(140) = 3.43$ ,  $p = .001$ . Means and standard deviations are shown in table 5.7. Greater control on the day of the pre-admission visit (T1) was also associated with having had the procedure before,  $t(140) = 2.5$ ,  $p = .01$ , (prior colonoscopy; mean 5.7 and sd 1.5 v no prior colonoscopy; mean 5.0 and sd 1.9).

|                    | Males (n=66) |     | Females (n=76) |     |
|--------------------|--------------|-----|----------------|-----|
|                    | M            | SD  | M              | SD  |
| State-control (T1) | 5.7          | 1.6 | 4.9            | 1.9 |
| State-control (T2) | 5.4          | 1.4 | 4.6            | 1.6 |

**Table 5.7.** Means and standard deviations for state-control scores in males and females. M = mean, SD = standard deviation.

### *State-control on the day of the pre-admission visit (T1)*

Controlling for these factors, there was a significant interaction between choice, video and avoidance on measures of control at T1 [ $F(10, 102) = 5.72$ ,  $p = .02$ ]. Means and standard deviations are shown in table 5.8. Patients high in avoidance reported more control when randomised not to see the video and less control when choosing not to see the video (figure 5.6). Patients low in avoidance on the other hand reported greater control when making a choice not to see the video (figure 5.7).

|           | Low-avoidance |     |          |     | High-avoidance |     |          |     |
|-----------|---------------|-----|----------|-----|----------------|-----|----------|-----|
|           | Video         |     | No-video |     | Video          |     | No-video |     |
|           | M             | SD  | M        | SD  | M              | SD  | M        | SD  |
| Choice    | 5.1           | 1.9 | 6.2      | 1.3 | 5.3            | 1.7 | 3.4      | 2.0 |
|           | (n=21)        |     | (n=11)   |     | (n=25)         |     | (n=8)    |     |
| No-choice | 5.2           | 1.4 | 5.3      | 1.7 | 5.2            | 2.0 | 6.2      | 1.7 |
|           | (n=13)        |     | (n=11)   |     | (n=12)         |     | (n=12)   |     |

**Table 5.8.** Means and standard deviations for state-control at T1 in high- and low- avoidance coping groups according to video and choice conditions. M = mean, SD = standard deviation.

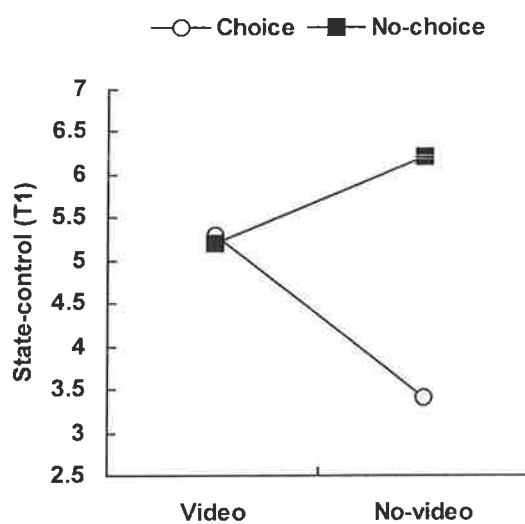


**Figure 5.6.** State-control at T1 in high-avoidance copers, according to choice and video conditions.

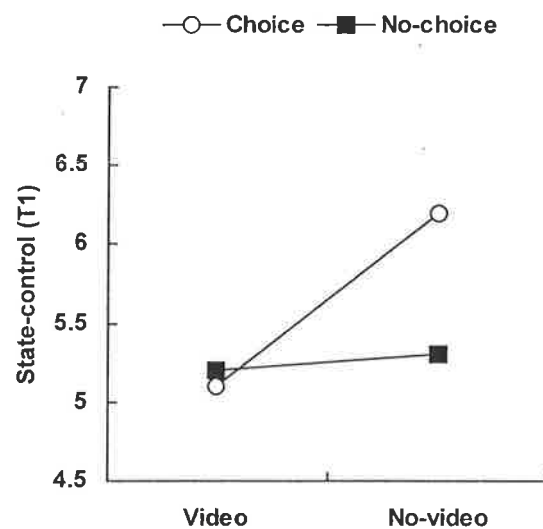


**Figure 5.7** State-control at T1 in low-avoidance copers, according to choice and video conditions.

*State-control on the day of the procedure*

There was a significant choice X video X avoidance coping interaction [ $F(9, 106) = 8.6, p = .005$ ]. Given a choice, high-avoiders report less control when choosing not to watch the video. However under circumstances where they have no choice, randomisation to the no-video condition was associated with greater control (figures 5.8 and 5.9). Means and standard deviations are shown in table 5.9.

There was also a significant video X emotion-focused coping interaction [ $F(5, 107) = 3.79, p = .05$ ]. High-emotion focused copers reported less control having seen the video by comparison to not having seen the video (figure 5.10).

|           | Low-avoidance |     |          |     | High-avoidance |     |          |     |
|-----------|---------------|-----|----------|-----|----------------|-----|----------|-----|
|           | Video         |     | No-video |     | Video          |     | No-video |     |
|           | M             | SD  | M        | SD  | M              | SD  | M        | SD  |
| Choice    | 4.8           | 1.4 | 5.9      | 0.8 | 4.8            | 1.4 | 3.6      | 1.4 |
|           | (n=21)        |     | (n=11)   |     | (n=25)         |     | (n=8)    |     |
| No-choice | 5.7           | 1.3 | 5.0      | 1.6 | 4.8            | 1.6 | 5.5      | 1.5 |
|           | (n=13)        |     | (n=11)   |     | (n=12)         |     | (n=12)   |     |

**Table 5.9.** Means and standard deviations for state-control at T2 in high- and low- avoidance coping groups, according to video and choice conditions. M = mean, SD = standard deviation.

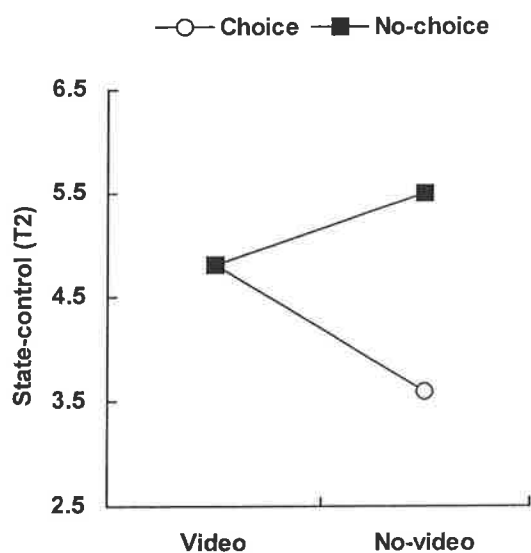


**Figure 5.8.** State-control at T2 in high-avoidance copers, according to choice and video conditions.

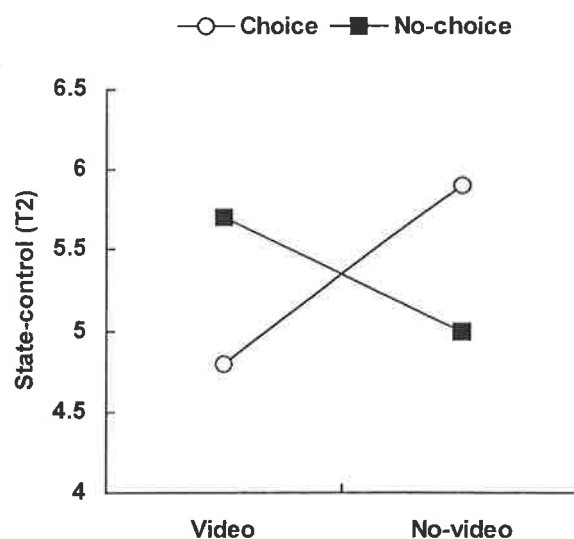


**Figure 5.9.** State-control at T2 in low-avoidance copers, according to choice and video conditions.

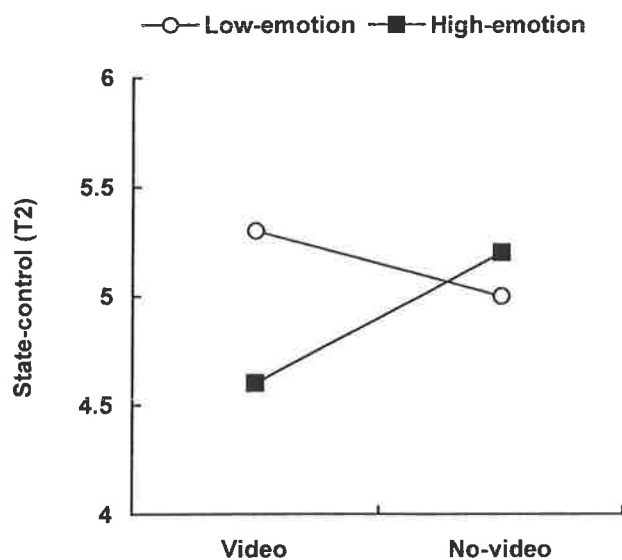


**Figure 5.10.** State-control scores at T2 in high- and low-emotion focused coping groups, according to video condition.

### 5.3.4 Interacting effects of coping, choice and information on cardiovascular measures

In determining treatment effects on cardiovascular measures, only measures taken on the day of admission (T2), and following completion of the procedure (T3), have been included in the analysis. Measures taken at the pre-admission (T1) visit were taken prior to the patient becoming aware of their study condition. Means and standard deviations are shown in table 5.10.

*Heart rate:* Heart rate was significantly positively associated with age, co-morbidities and sex (table 5.2). Females had higher heart rates at T2,  $t(140) = 2.4$ ,  $p = .02$  and T3,  $t(140) = -2.0$ ,  $p = .05$ . Means and standard deviations are shown in table 5.11. Included as covariates, no significant treatment effects were found for HR at T2. There was a significant main effect of video on HR following completion of the procedure [ $F(6, 135) = 4.78$ ,  $p = .03$ ]. HR was lower in patients who watched the video by comparison to those who did not view the video (video; mean 67.7 and sd 10.3 v no video; mean 72.0 and sd 14.4).

There was also a significant interaction effect between the choice and video conditions on HR following completion of the procedure [ $F(6, 135) = 5.31$ ,  $p = .03$ ] (figure 5.11). Patients in the choice condition who watched the video showed a significant reduction in HR by comparison to patients choosing not to watch the video.

|                                | Choice-condition |      |          |      | No-choice |      |          |      |
|--------------------------------|------------------|------|----------|------|-----------|------|----------|------|
|                                | Video            |      | No video |      | Video     |      | No video |      |
|                                | M                | SD   | M        | SD   | M         | SD   | M        | SD   |
| <i>Heart rate</i>              | (n=56)           |      | (n=22)   |      | (n=34)    |      | (n=30)   |      |
| Admission (T2)                 | 74.5             | 11.2 | 79.1     | 12.9 | 76.0      | 11.1 | 77.1     | 13.2 |
| End of procedure (T3)          | 66.6             | 10.1 | 76.0     | 16.7 | 69.4      | 10.5 | 69.1     | 11.8 |
| <i>Systolic blood pressure</i> | (n=56)           |      | (n=22)   |      | (n=34)    |      | (n=30)   |      |
| Admission (T2)                 | 136.9            | 17.9 | 130.3    | 20.5 | 137.1     | 25.6 | 140.2    | 22.0 |
| End of procedure (T3)          | 109.2            | 17.8 | 118.0    | 15.1 | 113.6     | 27.1 | 121.3    | 21.9 |

**Table 5.10.** Means and standard deviations for cardiovascular measures, according to choice and video conditions. M = mean, SD = standard deviation.

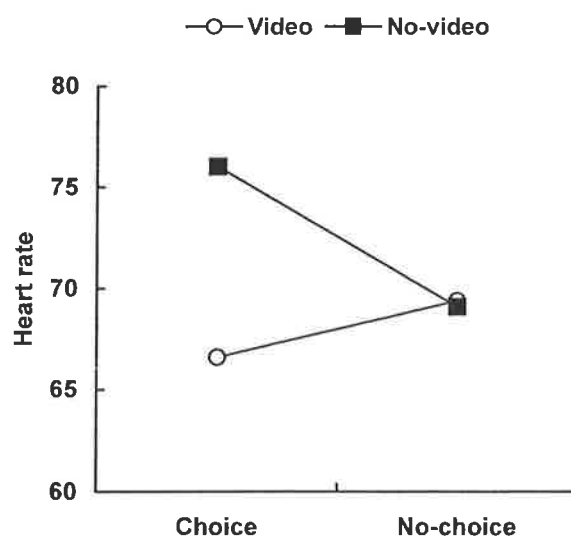


**Figure 5.11.** Interacting effects of choice and video conditions on heart rate following completion of the procedure (T3).

| Variable        | Males |      | Females |      |
|-----------------|-------|------|---------|------|
|                 | M     | SD   | M       | SD   |
| Heart rate (T2) | 73.6  | 11.8 | 78.4    | 11.6 |
| Heart rate (T3) | 67.1  | 11.7 | 71.1    | 12.2 |

**Table 5.11.** Means and standard deviations for heart rate in males and females. M = mean, SD = standard deviation.

#### *Systolic blood pressure:*

Clinical, demographic and procedural factors associated with elevated SBP included greater age and more co-morbidities (table 5.2). Elevations in SBP at T2 were also associated with having had a prior colonoscopy,  $t(140) = 2.55$ ,  $p = .01$ , (prior colonoscopy; mean 141.6 and sd 17.1 v no prior colonoscopy; mean 132.7 and sd 20.0). Controlling for these variables in the analysis, no significant treatment effects were found for SBP on the day of admission (T2). There was a significant main effect of video on SBP following completion of the procedure,  $[F(6, 135) = 6.96, p = .009]$ . Patients viewing the video had lower SBP readings than those not viewing the video (video; mean 110.9 and sd 21.7 v no video; mean 119.9 and sd 19.2).

### **5.3.5 Interacting effects of coping, choice and information on knowledge and patient satisfaction**

#### *Knowledge scores*

Greater age and more co-morbidities were consistently associated with poorer knowledge (table 5.12). Controlling for age and co-morbidities, no significant treatment effects

were found on measures of knowledge about the purpose of the procedure or knowledge about the procedure itself. There was a main effect of video on knowledge about complications [ $F(5, 136) = 3.97, p = .05$ ]. Patients who viewed the video reported better knowledge about complications than did those not viewing the video. There was also a significant main effect for video on total knowledge score [ $F(5, 136) = 4.42, p = .04$ ]. Means and standard deviations are shown in table 5.13. No relationships were found between coping and knowledge scores.

|               | <b>Purpose of the<br/>procedure</b> | <b>The<br/>procedure</b> | <b>Complications</b> | <b>Total<br/>score</b> |
|---------------|-------------------------------------|--------------------------|----------------------|------------------------|
| Age           | -.20*                               | -.46***                  | -.19*                | -.39***                |
| Comorbidities | -.25**                              | -.24**                   | -.12                 | -.30***                |

**Table 5.12.** Correlations between knowledge scores, age and comorbidities.  
 $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

#### *Patient satisfaction with information*

No significant main effects of choice or video condition were found with regard to patient satisfaction measures. Means and standard deviations are shown in table 5.14.

| <b>Variable</b>       | <b>Video (n==90)</b> |           | <b>No-video (n=52)</b> |           |
|-----------------------|----------------------|-----------|------------------------|-----------|
|                       | <b>M</b>             | <b>SD</b> | <b>M</b>               | <b>SD</b> |
| Complications         | 2.2                  | 1.1       | 1.9                    | 1.2       |
| Total knowledge score | 9.4                  | 2.2       | 8.8                    | 1.8       |

**Table 5.13.** Means and standard deviations for knowledge scores according to video condition. M = mean, SD = standard deviation.

|              | Choice       |     |                 |     | No-choice    |     |                 |     |
|--------------|--------------|-----|-----------------|-----|--------------|-----|-----------------|-----|
|              | Video (n=56) |     | No-video (n=22) |     | Video (n=34) |     | No-video (n=30) |     |
|              | M            | SD  | M               | SD  | M            | SD  | M               | SD  |
| Satisfaction | 4.4          | 0.7 | 4.6             | 0.7 | 4.4          | 0.7 | 4.4             | 0.6 |

**Table 5.14.** Means and standard deviations for patient satisfaction, according to choice and video conditions. M = mean, SD = standard deviation.

There were however a number of interactions with coping variables. There was a significant choice X avoidance interaction [ $F(3, 112) = 6.4, p \leq .02$ ]. High-avoidance copers were less satisfied with the information when made to choose and more satisfied in the no-choice condition. The converse was true of low-avoidance copers (figure 5.12). Means and standard deviations are shown in table 5.15.

There was also a significant choice X video X emotion-coping interaction [ $F(7, 108) = 5.15, p \leq .03$ ]. High emotion-focused copers reported greater satisfaction with the information when able to choose not to see the video. They were least satisfied when randomised not to see the video in the no-choice condition (figures 5.13 and 5.14). Means and standard deviations are shown in table 5.16.

| Low-avoidance |     |                 |     | High-avoidance |     |                 |     |
|---------------|-----|-----------------|-----|----------------|-----|-----------------|-----|
| Video (n=34)  |     | No-video (n=24) |     | Video (n=33)   |     | No-video (n=25) |     |
| M             | SD  | M               | SD  | M              | SD  | M               | SD  |
| 5.3           | 1.4 | 5.0             | 1.8 | 4.6            | 1.4 | 5.2             | 1.3 |

**Table 5.15.** Means and standard deviations for patient satisfaction in high- and low-avoidance coping groups, according to choice condition.

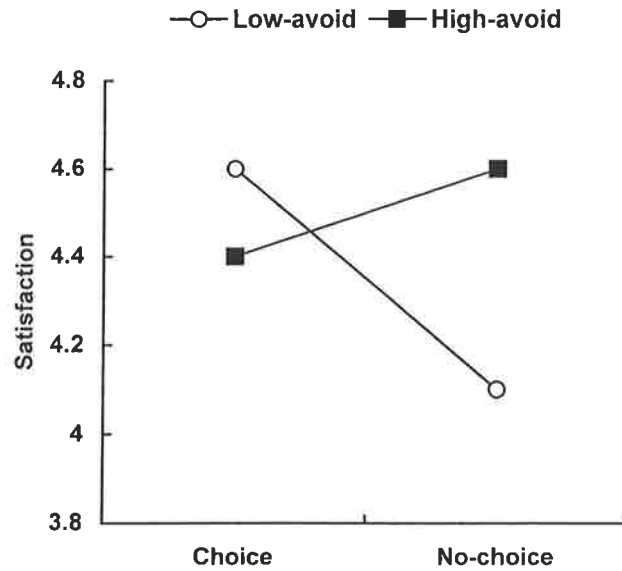


**Figure 5.12.** Satisfaction in high- and Low-avoidance coping groups, according to choice condition.

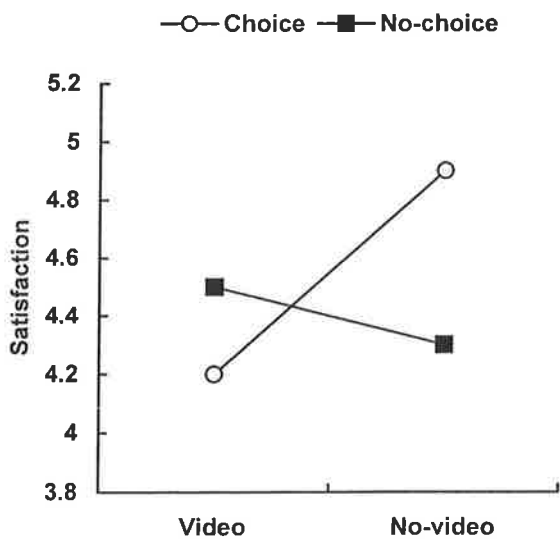


**Figure 5.13.** Satisfaction in high-emotion focused copers, according to choice and video conditions.

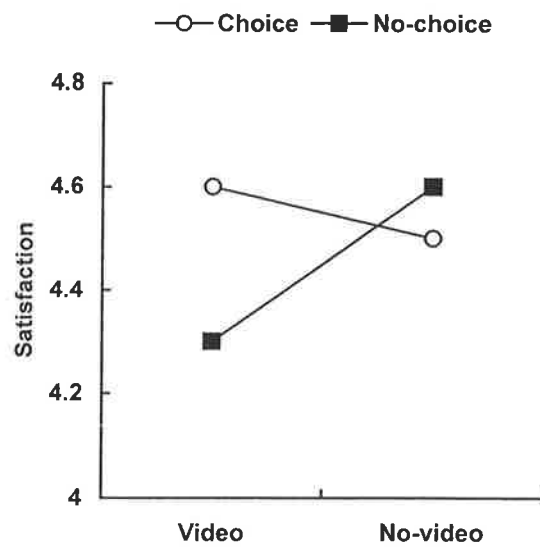


**Figure 5.14.** Satisfaction in low-emotion focused copers, according choice and video conditions.

|           | Low-emotion |     |          |     | High-emotion |     |          |     |
|-----------|-------------|-----|----------|-----|--------------|-----|----------|-----|
|           | Video       |     | No-video |     | Video        |     | No-video |     |
|           | M           | SD  | M        | SD  | M            | SD  | M        | SD  |
| Choice    | 4.6         | 0.7 | 4.5      | 0.7 | 4.2          | 0.8 | 4.9      | 0.3 |
|           | (n=22)      |     | (n=10)   |     | (n=26)       |     | (n=9)    |     |
| No-choice | 4.3         | 0.7 | 4.6      | 0.7 | 4.5          | 0.5 | 4.3      | 0.6 |
|           | (n=16)      |     | (n=10)   |     | (n=9)        |     | (n=14)   |     |

**Table 5.16.** Means and standard deviations for satisfaction in high- and low-emotion focused coping groups, according to video and choice conditions. M = mean, SD = standard deviation.

### 5.3.6 Interacting effects of coping, choice and information on procedural and recovery measures.

#### *Anaesthetic requirements*

##### *Propofol*

Higher propofol requirements were associated with being younger and being female,  $t(111) = -2.3$ ,  $p = .02$ , (females; mean 2.4 and sd 1.7 v males; mean 8 and sd 1.1) (table 5.2).

Controlling for age and sex, no significant effects were found. Means and standard deviations are shown in table 5.17.

##### *Midazolam*

Significant associations with increased Midazolam requirements were being female,  $t(115) = -2.2$ ,  $p = .03$ , (females; mean 2.8 and sd 2.5 v males; mean 1.9 and sd 1.4). In addition to this, having the procedure for the first time was also associated with higher midazolam

requirements,  $t(115) = -2.3$ ,  $p = .02$ , (prior colonoscopy; mean 1.9 and sd 1.6 v no prior colonoscopy; mean 2.8 and sd 2.3). Controlling for these factors, no significant effects were found. Means and standard deviations are shown in table 5.17.

#### *Procedure time*

Procedure time was significantly negatively associated with age (table 5.2). It was also significantly associated with propofol, which is expected given that propofol is used to maintain sedation therefore only age was controlled for in the analysis. No significant effects were found. Means and standard deviations are shown in table 5.17.

#### *Recovery score*

Poorer recovery scores were associated with fewer years of formal education and a greater number of prior surgical episodes (table 5.2). No significant treatment or coping effects were found when these factors were controlled for. Means and standard deviations are shown in table 5.17.

#### *Time spent in recovery*

There were no significant main treatment or coping effects on recovery time. Means and standard deviations are shown in table 5.17.

### Complications

There were no significant associations between complications and any clinical, procedural and demographic variables. No treatment (table 5.18) or coping effects were found using chi-square analysis.

|                | Choice |      |          |      | No-choice |      |          |      |
|----------------|--------|------|----------|------|-----------|------|----------|------|
|                | Video  |      | No-video |      | Video     |      | No-video |      |
|                | M      | SD   | M        | SD   | M         | SD   | M        | SD   |
| Propofol       | (n=44) |      | (n=20)   |      | (n=26)    |      | (n=23)   |      |
|                | 1.9    | 1.1  | 2.2      | 1.9  | 2.5       | 1.7  | 2.1      | 1.4  |
| Midazolam      | (n=44) |      | (n=20)   |      | (n=38)    |      | (n=25)   |      |
|                | 2.3    | 2.0  | 2.1      | 1.9  | 3.0       | 1.4  | 2.2      | 1.7  |
|                | (n=50) |      | (n=22)   |      | (n=28)    |      | (n=26)   |      |
| Recovery time  | 44.1   | 12.2 | 43.9     | 13.3 | 41.8      | 10.4 | 42.6     | 11.2 |
| Recovery score | 9.8    | 0.5  | 9.8      | 0.5  | 9.9       | 0.3  | 9.8      | 0.4  |
|                | (n=56) |      | (n=22)   |      | (n=34)    |      | (n=30)   |      |
| Procedure time | 20.7   | 9.3  | 25.2     | 13.9 | 23.4      | 9.4  | 22.1     | 8.5  |

**Table 5.17.** Means and standard deviations for other outcomes measures.

M = mean, SD = standard deviation.

|                  | Choice |         | No-choice |         |
|------------------|--------|---------|-----------|---------|
|                  | Video  |         | Video     |         |
|                  | (n=56) |         | (n=34)    |         |
| Complications    | 8      | (14.3%) | 3         | (13.6%) |
| No complications | 48     | (85.7%) | 32        | (94.1%) |

**Table 5.18.** Number of patients with and without complications, according to choice and video conditions.

## 5.4 Summary

The accuracy of expectations theory of adjustment to surgery suggests that the degree of emotional responding to surgery is a product of the difference between the expected effects of surgery and its actual impact. Accurate information therefore stimulates accurate expectations. The provision of accurate information is a part of routine preparation for patients undergoing invasive surgical or medical procedures. This practice is entrenched in the idea that the provision of information reduces anxiety and improves recovery. However, it is well established that people have different information requirements, and by matching these requirements there can be additional benefits in reducing anxiety and improving outcomes.

In this study, the extent to which coping styles interact with choice and information to effect stress responses, satisfaction, knowledge and recovery in patients undergoing colonoscopy was examined. There are a number of key findings from this study. Firstly, of those patients randomized to the no-choice condition, 72% wanted to watch the video, showing that a large majority of patients preferred access to extra information over and above the standard information they receive during the consent process. A preference for watching the video was also associated with less prior surgical experiences, including no prior colonoscopy.

There did not appear to be many benefits from allowing people to choose whether they wanted to watch the video or not. Offering patients a choice did not have the desired effect of reducing anxiety and increasing control as expected. Overall, there was an increase in state-anxiety on the day of the pre-admission visit associated with randomization to the choice condition. This was particularly pronounced in patients high in avoidance who experienced the greatest anxiety and least control on the day of their procedure when choosing not to watch the video. By comparison they tended to report less anxiety and more control when randomized

not to watch the video. Why patients high in avoidance become more anxious under choice conditions is not immediately clear. One possibility is that while these patients are happy to avoid additional information they may lack some confidence in making this decision. Within the context of consenting to a surgical procedure, they may be happier to leave the decision about how much information they need to know up to the clinician. In addition to measures of anxiety and control indicating that patients high in avoidance were more stressed in the choice condition, they also reported less satisfaction with the information provided in the choice condition by comparison to the no choice condition.

While choice had no immediate impact on measures of anxiety and control in patients high in emotion-focused coping, it did influence satisfaction. Patients high in emotion-focused coping reported greater satisfaction when they were able to choose not to see the video. This makes sense given that these patients reported less anxiety and more control on the day of their procedure if they had not previously watched the video.

There were a number of advantages to watching the video. Firstly, it was associated with a reduction in cardiovascular responses following completion of the procedure, indicative of a more relaxed state. Secondly, there was a clear effect of watching the video on improving patients' knowledge about the procedure.

## CHAPTER SIX

### General conclusion and discussion

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#### 6.0 Introduction

The two studies presented in this thesis have sought to explore at a general level the impact of psychological factors on stress responses to and recovery from a number of different surgical procedures. In the first study, a number of theories drawn from the psychophysiological model of surgical stress and the cognitive behavioural theory of adjustment to surgery were examined. In the second study, the interacting effects of coping styles and information provision on adjustment to colonoscopy were examined.

#### 6.1 Summary and discussion of findings from study one

There are a number of important findings from the study of stress reactions in CEA patients. Firstly, in support of prior research that has established a positive association between the tissue damage caused by surgery and an increase in neuroendocrine responses (Ellis and Humphrey 1982; Salo 1982; Salo 1982; Hakanson, Rutberg et al. 1984; Weissman 1990; Toft, Svendsen et al. 1993), overall increases in intra-operative cortisol and adrenaline were also evident in CEA patients. Although no significant change in noradrenaline occurred this might be explained by the fact that noradrenaline is particularly sensitive to physical activity. Because patients were immobilized during surgery, a possible explanation for this unexpected finding may be that some patients were more active on the day of their baseline urine save.

A second key finding adds to the body of conflicting evidence regarding the relationship between pre-operative state-anxiety and neuroendocrine responses to surgery.

According to the psychophysiological model of surgical stress, it was expected that greater pre-operative state-anxiety would be associated with heightened neuroendocrine responses to surgery. The model suggests that underlying physiological mechanisms might logically explain the strong link between greater pre-operative state-anxiety and poorer post-operative outcomes. While some studies have reported a clear positive association between pre-operative distress and elevations in cortisol either pre-operatively (Katz, Weiner et al. 1970; Doering, Katzlberger et al. 2000) or during surgery (Greene, Conron et al. 1970), others have reported quite paradoxical responses (Wilson 1981; Salmon, Evans et al. 1986; Salmon, Pearce et al. 1989; Salmon and Kaufman 1990; Manyande, Chayen et al. 1992; Salmon 1992). These more recent studies have shown that people who report greater pre-operative state-anxiety have a more blunted neuroendocrine response to surgery, by comparison to their less anxious counterparts. The findings from the first study reported in this thesis tend to concur with these findings. All intra-operative neuroendocrine measures were negatively associated with pre-operative state-anxiety. The strongest association occurring between intra-operative cortisol and pre-operative state-anxiety. Pre-operative state-anxiety contributed up to 12% of the variance in cortisol responses over and above that accounted for by medical and demographic factors.

What are some of the possible explanations for this? According to contemporary theories of stress and coping, dispositional factors such as trait-anxiety and coping styles are important determinants of affective states in the face of threat. Therefore it is likely that they also should influence neuroendocrine responses to surgery. Part of the purpose of this work was to look more closely at these factors to determine how they might also contribute to intra-operative neuroendocrine responses. It was expected that trait-anxiety would be associated with state-anxiety, however emotion-focused coping showed a stronger association with

cortisol responses to surgery than trait-anxiety, contributing up to 11% to the explained variance. Emotion-focused coping is therefore also associated with a more blunted neuroendocrine response to surgery.

According to the distress/effort model of coping, a reduction in cortisol is indicative of superior coping (active coping strategies) and that increases in cortisol reflect increasing distress and inferior coping (passive coping) (Frankenhaeuser 1980; Frankenhaeuser, Lundberg et al. 1980; Lundberg and Frankenhaeuser 1980). Furthermore, cortisol responses to stress have been shown to decrease with increasing perceptions of control (Frankenhaeuser, Lundberg et al. 1980; Lundberg and Frankenhaeuser 1980; Steptoe 1983). This model seems to lack applicability in the context of surgery or more specifically, does not adequately explain the results reported in this study. There were no significant associations between neuroendocrine responses and measures of control or active coping measures (task oriented coping). Furthermore, emotion-focused coping, which is generally considered a passive form of coping, was associated with a reduction in cortisol responses and not an increase, as predicted by the model. Despite the results not concurring with this particular model of coping, they do support results from an early study in which heightened distress and lowered competence was associated with lower cortisol levels in hospitalised haemophiliacs (Mattsson, Gross et al. 1971).

Another possible explanation for these findings relates to the construct of worry. Worry has been associated with surgery since the early work of Janis (Janis 1958) as previously discussed. Worry correlates highly with measures of trait anxiety (Davey, Hampton et al. 1991; Davey 1994) and state anxiety (Metzger and Miller 1990). Interestingly episodes of worry are not associated with raised levels of physiological arousal (Borkovec and Hu 1990;

Borkovec, Lyonfields et al. 1993). Induced episodes of worry actually inhibit the usual cardiovascular response that is observed during exposure to subsequent fearful imagery (Foa and Kozak 1986). Furthermore, chronic worriers exhibit a restricted range of variability in autonomic responses to environmental challenge (Hoehn-Saric and McLeod 1988; Borkovec 1994). This recent finding that chronic worry and generalised anxiety disorder are associated with a reduction in heart rate variability (Thayer, Friedman et al. 1996) is important given that reduced heart rate variability has also been linked to a number of different disease states (Kubzansky, Kawachi et al. 1997).

It is interesting that worry is associated with a reduction in cardiovascular activation and a reduction in heart rate variability in the face of threat and could help to explain why high anxiety patients experience a reduction in endocrine responses in the surgical context. It is acknowledged that they represent different physiological measures, however, the strong association that worry has with trait-anxiety and that state-anxiety has with reductions in cortisol responses (as reported in this study) suggests a plausible explanation. It may be that the worry associated with impending surgery is acting to inhibit neuroendocrine responses to surgery. Under certain circumstances where the fight or flight response is not required, worry could be seen to be adaptive. Characteristics of such a situation might include the anticipation of events that are inherently distressing but also inevitable. The individual is powerless to change the course of events and in the case of surgery may not want to, however, this does not detract from the inherent fear associated with surgery. Preparation to run or fight in such situations would be pointless. Within this context the use of emotion focused coping strategies might also appear beneficial in reducing intra-operative cortisol, given that heightened intra-operative neuroendocrine responses are associated with more post-operative morbidity and

mortality. However, the use of this particular coping strategy is also associated with higher levels of state-anxiety. Perhaps the most important question remains to determine the actual affect of pre-operative state-anxiety on recovery, which was also the focus of this first study and is discussed further on in this chapter.

Another possible explanation for the paradoxical neuroendocrine, state-anxiety relationship, relates to the concept of “allostatic load” and hypocortisolism (McEwen and Stellar 1993; McEwen 1998). Allostasis refers to the body’s capacity to increase or decrease vital functioning of diverse physiological systems to a new steady state on challenge. This chronic over or under-activation of these systems can result in ‘wear and tear’, known as allostatic load. According to this model hypocortisolism is a type of allostatic load that results from underactivity. An inadequate cortisol response to stress is considered maladaptive because it can lead to an increase in other systems such as the immune system, which is normally counter-regulated by cortisol. It is suggested by McEwen (McEwen 1998) that constant anticipation and worry, characteristics associated with high trait anxiety, are a form of chronic stress that may contribute to allostatic load. Evidence to support the idea that hypocortisolism is maladaptive comes from studies linking it to a number of different disease states including fibromyalgia, rheumatoid arthritis, post-traumatic stress disorder (PTSD), (Heim, Ehlert et al. 2000) and schizophrenia (Jansen, Gispen-de Wied et al. 1998). In addition to this, severe anxiety has been found to be a reliable marker for increased susceptibility to coronary heart disease and overall future illness (Russek, King et al. 1990).

A challenge in relating this model to these results, lies in the fact that physiological changes contributing to chronic forms of illness happens over a long period of time, whereas this study looked at individuals over a period of three months. It may be that the differences

evident in HPA axis functioning in relation to dispositional anxiety reflect underlying structural damage, making these patients more likely to experience poorer post-operative recovery. This model might offer a plausible explanation for the relationship between blunted cortisol responses in highly anxious individuals and poorer post-operative recovery. Although this study found no evidence of a relationship between neuroendocrine responses and post-operative recovery, it was a small sample. Furthermore, it is likely that different types of procedures might confer different results.

It was stated earlier that an important part of this study was to determine the contribution of pre-operative state-anxiety to recovery. A major problem with many studies in this area has been a failure to measure many aspects of recovery. Convenience measures of perhaps one or two indices have tended to be used over a short period of time. In attempting to address some of the criticisms of prior studies, recovery was measured at three different levels and patients were followed up for three months. Clinical recovery was assessed in the seven days following surgery using four different measures. These included length of stay, self-reported physical recovery, pain and complications. Social and emotional recovery was assessed using a life satisfaction measure and a health-related quality of life measure. These measures were taken over a longer period of time, from one to three months following surgery. Finally, the patients' cognitive recovery was measured using a series of cognitive tests over the same time period as their social and emotional recovery.

Pre-operative state-anxiety had no immediate impact on any measures of clinical recovery. Length of stay was more likely to be determined by the occurrence of complications. Overall patients tended to report a decline in their physical recovery on the first post-operative day but had returned close to pre-operative status by day seven. While carotid endarterectomy

surgery carries considerable risk, patients would not be expected to experience the sought of post-operative problems that someone having major abdominal surgery might.

Pain and complications were however, influenced by coping and personality factors. Trait-anxiety was associated with the occurrence of complications. Of the coping measures, task-oriented and avoidance coping were predictive of greater reported pain seven days following surgery accounting for approximately 24% of the explained variance in pain reports.

Measures of social and emotional recovery tended to show a greater number of associations with psychological factors than any of the dimensions of recovery. Pre-operative measures of state-anxiety were predictive of poorer reported life satisfaction at one and three months and poorer reported mental functioning at one month. There was no association between pre-operative state-anxiety and physical functioning.

On measures of personality, trait-anxiety was predictive of poorer mental functioning at one month. By comparison better-reported life satisfaction at three months was associated with greater use of task-oriented coping and better physical functioning at three months was associated with a higher recovery locus of control scores. Caution may be warranted when interpreting these results due to the propensity for people high in anxiety to report more somatic health problems (Bernstein, Garfinkel et al. 1989). Similarly, people higher in negative affect consistently report more symptoms and poorer self-perceived health even when their underlying health is not always worse (Costa and McCrae 1985; Costa and McCrae 1987; Parker, Bagby et al. 1989; Larsen 1992). People high in trait-anxiety are also prone to reporting poorer functioning on the SF-36 and more specifically on the dimensions related to mental health (Kressin, Spiro et al. 2000) as our data also reflect. While some of the variance in the HRQoL scores might be associated with these particular personalty traits, given that

patients high in trait-anxiety were also more likely to experience more complications in the immediate post-operative period, reported HRQoL is also likely to reflect the impact of an underlying health problem.

Finally there were no associations between measures of cognitive recovery and any psychological variables. Cognitive functioning at least in the immediate post-operative period was more likely to be associated with demographical and medical factors such as length of stay, complications, sex, and education.

How do these results agree with other studies? Task-oriented coping has tended to be consistently associated with better post-operative outcomes not only in the short term but also in the long term including: a faster rate of physical recovery during hospitalisation and better reported quality of life 6 months post surgery (Scheier, Mathews et al. 1989). The findings from this study do show a positive association between task-oriented coping and greater reported life satisfaction at three months and better mental functioning at three months. There was however, no evidence to associate it with better short-term recovery.

According to the literature avoidance coping in the context of surgery has been associated with better outcomes in the short-term (Cohen and Lazarus 1973; Levine, Warrenburg et al. 1987), including a reduction in state-anxiety levels (Warrenburg, Levine et al. 1989; Krohne, Kleeman et al. 1990) and a reduction in physiological stress responses (Warrenburg, Levine et al. 1989; Krohne, Kleeman et al. 1990; Benjamins, Schuurs et al. 1996), and poorer long-term recovery (Levine, Warrenburg et al. 1987). Results from this study contradict these findings. Avoidance coping was associated with more reported pain on day seven. Furthermore, its association with pre-operative state-anxiety was low and not

significant ( $r = -.05$ ) and there was no evidence of an association with poorer long-term recovery.

Locus of control is thought to be an important predictor of whether or not an individual is likely to engage in health relevant behaviors. Thus, a high internal locus of control would predict engagement in specific health behaviors. Conversely, a high external locus of control might predict a lack of engagement in specific health relevant behaviors. Consistent with this theory, a high internal locus of control has been associated with a faster rate of functional recovery in patients undergoing total knee replacement (Kendell, Saxby et al. 2001) and a high external locus of control with greater anxiety and depression before and after cardiac transplant surgery (Kugler, Tenderich et al. 1994). Inconsistent with this theory is a study showing an association between a high internal locus of control and more post-operative pain, swelling and disability in dental patients (George, Scott et al. 1980). Results from the study reported here tend to be consistent with a high internal locus of control and better post-operative recovery, although only one significant association emerged between locus of control and recovery. It was associated with better physical functioning at three months.

Overall the results presented here highlight a number of important issues in the consideration of surgical stress. Firstly, they concur with Johnston (Johnston 1984), that recovery is multidimensional and should be measured on a variety of different levels. Different areas of recovery would appear to be influenced in different ways by different demographic, medical and psychological factors. Secondly, they point to the misguided assumption drawn from the psychophysiological theory of surgical stress, that pre-operative anxiety is necessarily associated with heightened neuroendocrine responses to surgery and contributes to poorer outcomes via a physiological mechanism. The fact that intra-operative neuroendocrine

responses are reduced in states of heightened pre-operative anxiety and that there is a lack of association between neuroendocrine responses and complications are contrary to this theory. It cannot therefore be maintained that activation of the SAM and HPAC systems link heightened pre-operative state-anxiety to poorer post-operative outcomes. It is apparent that psycho-endocrine interactions in surgical patients differ from those of other sorts of stress. Thirdly, they show that pre-operative state-anxiety is not pervasive in a generally poorer outcome for surgical patients. It predominantly affects measures of life satisfaction and health-related quality of life. Finally, the results support the role of coping and trait-anxiety in contributing to post-operative recovery, and suggest that predispositional measures of coping and personality may be better predictors of some areas of recovery than pre-operative state-anxiety.

## **6.2 Summary and discussion of results from study two**

In the second study a different type of question was being examined in relation to surgical stress. More specifically, it looked at the extent to which coping styles interact with choice and information to effect stress responses, satisfaction, knowledge and recovery in patients undergoing colonoscopy? The provision of pre-operative information is central to preparing patients for surgery, however it is known that patients have different information requirements (Krantz, Baum et al. 1980), and that a mismatch of information can increase anxiety and stress (Ludwick-Rosenthal and Neufeld 1993; Mitchell 2000). This study assumed that patients were aware of their information requirements and that by allowing them to choose to access extra information they would be able to satisfy their particular coping preferences.

Generally findings from the colonoscopy study suggest that particular coping styles interact with the choice and information conditions but that the effects seem to be

predominantly related to perceptions of control, state-anxiety and satisfaction. No interactions with other patient outcomes were found. Patients high in avoidance experienced greater anxiety and less control when exposed to the video by comparison to low-avoidance patients. However, offering them a choice did not have the desired effect of reducing anxiety and increasing control as expected. Giving high-avoidance patients a choice increased anxiety. By choosing not to see the video, patients high in avoidance reported the greatest anxiety and least control on the day of their procedure. The converse is true of people low in avoidance. Similarly patients high in emotion-focused coping also reported more anxiety and less control on the day of their procedure following exposure to the video, by comparison to those patients low in emotion-focused coping. Choice had no significant impact on this relationship.

In addition to measures of anxiety and control indicating that patients high in avoidance were more stressed in the choice condition, they also reported less satisfaction with the information provided in the choice condition by comparison to the no-choice condition. Patients low in avoidance reported less satisfaction in the no choice condition. While the ability to choose had no effect anxiety and control on high emotion copers it did influence satisfaction. Patients high in emotion-focused coping reported greater satisfaction when they were able to choose not to see the video.

It was expected based on prior studies (Miller and Mangan 1983) that patients high in avoidance would feel greater control and less anxiety when not being exposed to the video. The results support this. Avoiders typically respond to threat with blocking or denial. They characteristically deal with threat by refusing to think about it or denying its potential threat. It was also expected that by allowing patients to choose their information requirements that this would also promote greater control and reduce anxiety, however, in stead it had the effect of

increasing anxiety and reducing control. A possible explanation for this might be that high avoiders prefer to leave it up to the treating clinician to make the decision about how much information needs to be disclosed. They may trust that clinicians have a considerable knowledge regarding their specialty and are happier to allow them to take control, which in turn fosters a degree of confidence, and control in the patient. By offering avoiders a choice, this may lead them to believe that not all the information has been disclosed; hence they become even more anxious when they made a choice not to see the video. This is also supported by the fact that high-avoiders reported less satisfaction with the information provided. They may simply prefer that the information be disclosed during the clinician patient interaction. Patients high in emotion-focused coping behaved in a similar way to those high in avoidance, feeling more anxious and less control following exposure to the video but they differed by feeling more satisfaction when they were able to choose not to see the video.

According to the goodness of fit hypothesis, emotion-focused coping should be more adaptive in situations appraised as uncontrollable and maladaptive in controllable situations. Problem-focused coping should be more adaptive in situations appraised as controllable and maladaptive in uncontrollable situations (Conway and Terry 1992). There is no evidence from this study that problem-focused (task-oriented) coping had any effect what so ever on any outcomes. It was expected that high emotion-focused individuals might report less distress in uncontrollable situations. This was not the case. Emotion-focused coping was associated with greater anxiety and less control. Given that it had no other discernable effects on other outcome variables (except satisfaction) relating to recovery it could not been seen as maladaptive in terms of the patients' well-being in the context of this procedure. These results are not surprising given that there are substantial inconsistencies in the literature relating to the

goodness of fit hypothesis suggesting it lacks a considerable degree of explanatory power (Endler, Speer et al. 2000).

Overall there was a general trend for patients who had watched the video to exhibit a reduction in heart rate and blood pressure following completion of the procedure. This supports prior research reporting reductions in physiological stress responses following exposure to an educational video (Gagliano 1988; Doering, Katzlberger et al. 2000). It is also clear from the study is that there was a significant advantage in showing patients the video in terms of increasing their knowledge about the procedure. Patients were able to recall more general information and information regarding complications on the day of their procedure if they had seen the video in the week prior. This supports prior findings in the efficacy of audiovisual education (Gagliano 1988; Done and Lee 1998; Cassady, Wysocki et al. 1999; Luck, Pearson et al. 1999).

In conclusion, there appears to be no additional benefits in terms of patient outcomes by allowing patients to choose whether or not they want additional information. However, exposure to the video had some significant positive outcomes for patients, including increasing their recall of knowledge about the procedure and decreasing sympathetic nervous system activity following completion of the procedure.

### **6.3 Limitations**

An obvious limitation of the first study was the small sample size. A larger sample size would have made the regression analysis more powerful. This particular population was chosen for a very specific reason, that being to address some of the methodological problems apparent in previous studies. Particular attention was paid to the need to measure recovery on a

number of different levels in line with Johnston's suggestions (Johnston 1984), and to measure stress not only at a subjective level but also at a physiological level while controlling for the confounding effects of demographic and medical characteristics in the analysis. To address these issues a fairly stringent exclusion criteria was required. The study was undertaken in an area that services a large population of non-English speaking people from a lower socio-economic status with limited education. To ensure the reliability of the cognitive measures of recovery and the self-report questionnaires many patients were therefore not eligible to participate, resulting in an overall small sample size by comparison to the total number of operations performed during the recruitment period.

Caution is also warranted in terms of the generalisability of the results. The results obtained may differ according to different socio-economic pockets and different types of surgical procedures. It is reasonable to hypothesize that the relationships between psychological factors, physiological responses and recovery will vary considerably according to the type of surgery and the degree of trauma involved. For example, surgery involving the loss of a limb will be associated with considerably more physical trauma and a different set of worries and stressors than a simpler procedure such as an appendicectomy.

A limitation of the second study also relates to sample size. Some of the sub groups in the analysis were quite small limiting the confidence in the interpretation of the results. A larger sample size would address this issue.

#### **6.4 Summary of key findings**

- There was an increase in intra-operative cortisol and adrenaline associated with the tissue damage caused by surgery.

- Contrary to a generalized belief that heightened pre-operative state-anxiety is associated with a robust sympathetic nervous system response; results show a paradoxical lowering of cortisol in more anxious individuals.
- Emotion-focused coping was also a significant determinant of a lowering of intra-operative cortisol.
- Pre-operative state-anxiety was associated with poorer reported social and emotional recovery but failed to be associated with measures of clinical or cognitive recovery.
- Trait anxiety was associated with more complications. In addition to this it was also associated with poorer mental functioning following surgery. There were no associations with cognitive recovery.
- Patients with a higher internal recovery locus of control reported better physical functioning following surgery.
- Task coping was associated with greater life satisfaction and better mental health following surgery.
- Avoidance and task-oriented coping were predictive of greater pain seven days following surgery
- Pre-operative state-anxiety, coping and personality factors had no effect on measures of cognitive recovery.
- Patients high in avoidance and emotion focused coping tended to report greater pre-procedure anxiety and less control when exposed to additional information in the form of an educational video.
- Offering patients a choice to access additional information had no additional benefits in regard to reducing stress responses and improving patient outcomes. The results suggest

that for some patients (high avoiders) offering them a choice of additional information increased anxiety and decreased control.

- Showing patients the video had a clear advantage in terms of increasing their knowledge about the procedure and reducing their cardiovascular stress responses following completion of the procedure.

## **6.5 Implications for future research**

Despite some of the limitations of these two studies the findings are important in generating hypotheses for future research. These data support the use of psychological theories in relation to personality characteristic and coping in the study of adjustment to surgery. The impact of psychological factors on stress responses and recovery from surgery is complex and remains unclear, warranting further investigation. Psychological factors clearly have an impact on intra-operative neuroendocrine responses to surgery, although not in the way traditionally believed. The question remains open as to the underlying physiological mechanism relating heightened pre-operative state-anxiety to poorer post-operative outcomes. One obvious line of future research would be to investigate immunological mechanisms and to look at different surgical populations, possibly with higher mortality and morbidity rates. The direction of the relationship between psychological factors and intra-operative neuroendocrine responses also needs to be further clarified in larger studies.

Furthermore, future research in the area of surgical stress should endeavor to measure as many aspects of recovery as possible, as it is clear that not all areas of recovery may be affected in the same way by heightened pre-operative state-anxiety. In the absence of any detrimental affects of pre-operative state-anxiety on recovery, at least for some procedures, a degree of pre-

operative state-anxiety may confer an advantage in terms of lowering intra-operative stress responses. Similarly, other measures of personality and coping should be considered, as they also appear to have differential effects on recovery and stress responses.

The provision of pre-operative information is an integral part of the informed consent process and impacts on both surgeons and nurses. In preparing patients for surgery there exists a grey area between how much the patient wants to know and how much the clinician is willing to tell. In an attempt to satisfy both parties and meet the needs of a busy Day Surgery Unit the idea of giving patients a choice was investigated. Data suggest that allowing patients to choose whether or not they would like additional information in the form of an educational video did not confer any benefits for the patient as expected. The data show that most patients preferred more information and that there were considerable benefits in terms of knowledge gain from watching the video. The use of role models and interactive mediums of information disclosure requires further investigation.

## Appendix 1

### General Recovery Questionnaire

This questionnaire is designed to document your physical recovery from surgery. It contains a number of questions relating to physical activity and pain.

Please use the rating scale below to indicate how your body is recovering from your surgery. Choose a number from 1-6 and place it in the space provided next.

| 1            | 2                                              | 3    | 4    | 5            | 6         |
|--------------|------------------------------------------------|------|------|--------------|-----------|
| very<br>poor | poor                                           | fair | good | very<br>good | excellent |
| _____        |                                                |      |      |              |           |
|              | Sleep                                          |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Appetite                                       |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Energy                                         |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Strength                                       |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Bowel condition                                |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Stomach condition                              |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to feed your self                 |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to urinate                        |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to wash yourself                  |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to get out of bed and move around |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to do things for yourself         |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Your ability to concentrate                    |      |      |              |           |
| _____        |                                                |      |      |              |           |
|              | Interest in your surroundings                  |      |      |              |           |

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