VASCULARIZATION OF THE INTERVERTEBRAL DISC IN PATHOLOGICAL CONDITIONS

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TABLE OF CONTENTS

ABSTRACT vi
DECLARATION ix
ACKNOWLEDGEMENTS x
DEDICATION xl
PUBLICATIONS ARISING xii
AWARDS xiii
LIST OF FIGURES xiv
LIST OF TABLES xix

CHAPTER 1: INTRODUCTION 1
   1.1 Nutrition of the intervertebral disc 2
   1.2 Degeneration and age-related changes to the disc 6
   1.3 Animal models of disc degeneration 8
   1.4 This study 13

CHAPTER 2: VASCULAR PERFUSION AND QUANTIFICATION OF BLOOD VESSELS IN THE CARTILAGE END PLATE OF SHEEP DISCS 15
   2.1 Aims 16
   2.2 Introduction 16
   2.3 Methods 18
      2.3.1 Animals 18
      2.3.2 Preparation of tissue for histological examination 19
      2.3.3 Quantitative histomorphometry 20
      2.3.4 Spalteholz method 22
   2.4 Results 23
      2.4.1 General observations 23
      2.4.2 Histoquantitation 29
2.5 Discussion

2.6 Further work on the vascularity of the cartilage end plate in
the sheep model

2.6.1 Introduction

2.7 Reproducibility of the manual histomorphometric method

2.7.1 Aim

2.7.2 Method

2.7.3 Results

2.7.4 Discussion

2.8 Vascularity of normal sheep discs

2.8.1 Aim

2.8.2 Methods

2.8.3 Results

2.8.4 Discussion

2.9 Variation in vascularity along the lumbar spine of normal sheep

2.9.1 Aim

2.9.2 Methods

2.9.3 Results

2.9.4 Discussion

2.9.5 Conclusions

CHAPTER 3: VASCULARIZATION OF THE CARTILAGE END PLATE FOLLOWING AN OUTER ANNULAR TEAR

3.1 Aim

3.2 Methods

3.2.1 Induction of annular tears

3.2.2 Pathological examination of discs

3.2.3 Statistics

3.3 Results
6.5 Discussion

CHAPTER 7: CONCLUDING REMARKS

BIBLIOGRAPHY
ABSTRACT

The intervertebral disc is a remarkable structure. One of its most unusual characteristics is that it becomes almost entirely avascular after maturity, obliging the cells in the matrix to derive their nutrition by diffusion from external sources.

With advancing age, and in association with escalating pathology, significant morphological changes are found in all components of the disc. Notable amongst these changes, is the appearance of small blood vessels in the previously avascular end plates and annulus. This study has investigated the process of neovascularization of disc components, with ageing and in disease.

The aims of this study were:

(i) to develop a perfusion technique that would identify small blood vessels in the end plate of sheep discs;

(ii) to develop a reliable method for histoquantitation of these blood vessels;

(iii) to describe the development of morphological changes in human lumbar discs, with particular reference to those changes that may be involved in the sequestration of fragments;

(iv) and, to determine if vascularization of sequestrated fragments is related to symptoms of sciatica and duration of pain.

The extent of end plate vascularization in the lumbar discs of young normal sheep was established. Since prolonged acid decalcification of motion segments resulted in poor histological detail, a vascular perfusion technique using India ink was used to identify the small blood vessels in tissue sections. Perfusion revealed the patency of these vessels in the end plate. The reproducibility of the manual histoquantitation method was also established, justifying its use in subsequent studies. Finally, the extent of end plate vascularization was shown to diminish with advancing age in normal sheep.
Previous work with a sheep model showed that a small cut in the peripheral annulus resulted in progressive disc degeneration, despite healing of the outer annular fibres. In the present study, end plate vascularization increased significantly in a short time after surgery, presumably as a repair mechanism, but it appeared not to have a beneficial effect on the disc matrix. It was hypothesized that failure of repair and subsequent degeneration resulted from excessive movement of the affected motion segment. Fixation with a metal plate, however, failed to allow complete repair or arrest the degenerative process.

The development of disc lesions with advancing age was described, after histological examination of a large number of autopsy cases. Special attention was given to those changes that may contribute to the extrusion of sequestrated fragments. Vascularization of the outer annular fibres was noted, suggesting a possible role for pain production. The extent of end plate vascularization in discs with rim lesions was also determined, and compared with the sheep model.

The extent of neovascularization was assessed in a large series of extruded lumbar disc fragments, in an attempt to correlate this histological feature with clinical symptoms. Immunohistochemical localization of neurofilament protein adjacent blood vessels in some of the disc fragments suggested that they may be associated with pain symptoms.

The physical deterioration of the disc with age may be due, in part, to its inherent lack of vascularity. This study, however, has demonstrated that some components of the disc undergo neovascularization in response to physical trauma, possibly as part of a tissue repair response, although increased vascularization of the end plate did not prevent disc degeneration in the sheep model.

This study has demonstrated that vascular repair may be accompanied by ingrowth of neural tissue, providing evidence that it may be involved with
acutely painful rim lesions or with the pain that often accompanies disc herniations.