

PIG-BEL (ENTERITIS NECROTICANS).

THE RECOGNITION AND STUDY OF A GANGRENOUS ENTERITIS

IN THE HIGHLANDS OF NEW GUINEA

THESIS

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This thesis concerns the investigation of a gangrenous enteritis associated with the practice of pork feasting in the New Guinea Highlands. The disease was first noticed in subjects during laparotomy at Goroka in 1961. Pig-bel (enteritis necroticans) was defined as an acute necrotizing inflammatory disease of patchy distribution of the small bowel commencing in the upper jejunum. It was characterized clinically by severe upper abdominal pain, bloody diarrhoea and nausea with occasional vomiting. The disease progressed, if untreated, to complete segmental gangrene of parts of the small intestine with the development of mechanical ileus, oligoemic shock and severe toxæmia. A small proportion of persons with the disease survived the initial stages without treatment, but perforation and peritonitis or the development of an acute malabsorption syndrome resulted in death. The malabsorption was due to chronic small bowel obstruction by adhesive bands, stenosis by cicatrization or the development of short circuits, blind loops and rigid scarred bowel segments denuded of normal mucosa. The histopathological findings were non-specific except for the presence of angioneclerosis and thromboses in the mucosal and submucosal vessels which resulted in ischaemic and haemorrhagic necrosis. There was no apparent mechanical or vascular cause for this. Confusion in terminology with this disease and a large group of allied disorders has necessitated the designation of the specific name "Pig-bel" to the condition.

A similar disease, "Darmbrand", appeared in epidemic form in Northern Europe in the latter and post-war years, and was believed to be due to Clostridium perfringens type F. The pig-bel syndrome has been classified clinically into four groups: acute toxic, acute surgical, sub-acute surgical, and mild forms. The diagnosis was established on the history of pork consumption, the clinical features, X-ray findings, bowel appearances at operation or autopsy, the isolation of Cl. perfringens type C from a significant proportion of resected intestinal segments, and the detection of rising Cl. perfringens beta antitoxin levels in the sera of recovered patients.

In the treatment of pig-bel, it has been shown that the prognosis improved with early resuscitation with blood and bowel decompression. In patients treated surgically by bowel resection the case mortality was slightly lower. The indications for laparotomy were signs of peritonitis, failure to relieve an ileus after 24 hours, the development of "metallic" bowel sounds despite decompression and intravenous fluids, or the continuation of abdominal pain and the palpation of a tender upper abdominal bowel mass. Loss of weight, a continuing refusal of food, anaemia and symptoms of sub-acute small bowel obstruction some four weeks to six months later were also indications for operative treatment. Following the introduction of specific Cl. perfringens type C antiserum in June

of 1964, the fatality rate in severe forms of the disease fell from 43.9 per cent to 18.7 per cent. Many antibiotic combinations were tried empirically until it was found that Cl. perfringens type C was most sensitive to penicillin and tetracycline.

The following conclusions from epidemiological studies were made:

1. Enteritis necroticans has not been reported in epidemic numbers elsewhere than in North Germany and New Guinea.
2. The disease appeared in both epidemic and sporadic numbers in New Guinea and was basically confined to the Highlands region. Only two sporadic cases were reported outside the Highlands region, one of these being a Highland labourer working on the coast. Of the 210 cases reviewed only one was a European, the others all being Highland Melanesians.
3. The disease was the commonest acute abdominal condition requiring surgical treatment in Highland hospital practice during the years 1961-1964 under review.
4. The incidence of pig-bel varied from an approximate lower limit of 16 per 10,000 to a crudely estimated upper limit of 48 per 10,000 of the population.
5. Cl. perfringens beta antitoxin levels in the normal population in high and low prevalence areas differed significantly.

6. Levels of beta antitoxin in the overall native population were significantly higher than in European controls. This indicated a constant exposure to Cl. perfringens type C by the Highland populations sampled.
7. Pig-bel predominantly affected children under 10 years of age and had a sex distribution of 2.2:1 in favour of males.
8. The mortality rate in 210 cases was 36.2 per cent. This was 84.6 per cent for acute toxic forms and 42.0 per cent and 43.5 per cent for the two surgical forms of the disease respectively.
9. Some strains of Cl. perfringens isolated from cases of pig-bel have been placed, on toxicological and morphological grounds, in the type C group. As such, strains of this organism have not previously been recovered from man. As a result of this discovery, the strains of Cl. perfringens type F, believed to cause "Darmbrand", have been reclassified on toxicological grounds as a type C variety.
10. There was an increased prevalence of the disease together with other enteric infections following large scale pig-killing and feasting ceremonies. Qualitative evidence indicated that these cultural activities were involved in the epidemiology of the disease.

11. The disease was established in more than one member of a family on only three occasions. The failure of contacts to develop the disease does not favour a simple food poisoning epidemiology.
12. Pork may act as a vector in the transmission of the disease, but there was no bacteriological proof of this.
13. The origin of the suspected cause, Cl. perfringens type C, remains unknown, although it seems likely that the pigs harbour the organism. It is possible that a zoonotic transfer of the disease from pigs to man may have taken place.

It must be emphasized that some aetiological features of pig-bel remain obscure. It was established that infection with Cl. perfringens type C occurred, but the sequence of events leading up to the establishment of this infection may involve a number of mechanisms, superadded or otherwise.

The most logical cause for the gangrene seems to be invasion by clostridial organisms, in particular Cl. perfringens type C. The environmental changes induced by a dietary change and engorgement of pork and the individual's immunity probably play the most significant roles in the severe pig-bel. This situation is analagous to the enterotoxaemia of animals caused by type B, C and

D organisms of the Cl. perfringens group.

A review and study of the cultural aspects of pig-feasting have been undertaken and a suggested programme put forward to control the disease. These public health measures, if adopted, may help to reduce the prevalence of diarrhoeal diseases associated with the practice of unhygienic pork consumption. An exploratory trial of a toxoided preparation of specific perfringens beta antitoxin could also be tried in the immediate control of the disease.

The discovery of pig-bel and its likely cause, opens the way for a reappraisal of the significance of Cl. perfringens as an enteric pathogen in man. The importance of typing such strains in the diagnostic and epidemiological study of necrotizing enteritis, pseudomembranous enterocolitis and similar synonymous conditions is brought into relief by this work. Attention is also directed to the role that dietary influences may play in the aetiology of such diseases. Finally, this study is a demonstration in ecology of a disease or syndrome in man in New Guinea. In determining the pattern of disease and its control in a particular location, factors to do with man himself: his race, society, customs, attitudes, education and movements are necessary foundations upon which to build a healthier community.