

incisional hernia) were probably related more to the surgical technique than the perforation of the duodenal mucosa. Indeed, in a recent retrospective study, surgical technique was the only variable significantly associated with subsequent wound infection.<sup>12</sup> It is vitally important to recognise a perforation in the duodenal mucosa and to repair it immediately. Mosquito artery forceps were used to prise apart the deepest muscle fibres of the pyloric, but recently the rounded end of the scalpel holder has been reported to be superior in protecting against mucosal perforation.<sup>1</sup>

Almost half of the postoperative complications in the present study were related to the wound. Meticulous attention to the technique of wound closure is essential in order to reduce this incidence. A variety of suture materials was used for abdominal wall closure, although chromic catgut was used only in the early part of the study. Recently, a move has been made towards using polydioxanone rather than the other materials. This suture, when used in a mass closure technique, seems to be effective in preventing wound dehiscence and is associated with a significantly lower wound infection rate.<sup>1 2</sup> Wound dehiscence is more common after operations done under local anaesthetic,<sup>2 3</sup> and this is related to the technical difficulty of closing a wound without adequate muscle relaxation.<sup>1</sup>

The wound infection rate in the present study is comparable with quoted rates of 5–17% from other centres.<sup>1–3 5 12</sup> The umbilicus is an important source of *S aureus* infection, and has been implicated in the aetiology of wound infection.<sup>5 13 14</sup> A preoperative dose of an anti-staphylococcal antibiotic was given in almost 70% of our patients and at operation the umbilicus was cleaned with chlorhexidine. Other authors advocate, in addition, sealing off the umbilicus with adhesive tape, but the effect of this in reducing the wound infection rate is limited.<sup>1 13</sup>

Vomiting during the first two postoperative days is common and self limiting.<sup>1–3</sup> It is thought most likely to be the result of inhibition of gastric peristalsis during the first 24 hours after operation, with or without associated gastro-oesophageal reflux.<sup>13</sup> Preoperative oesophagitis and the use of general anaesthesia have also been implicated.<sup>1 2</sup> To circumvent this early vomiting, a delayed feeding regimen was proposed whereby the infants were fasted for the first 24 hours after the operation.<sup>14</sup> As little importance is placed on this early vomiting these patients may be fed orally within the first four hours of operation, and tolerate it well provided that the feeds are introduced slowly.

No patients in the study had any long term feeding difficulties. After a complete pyloromyotomy this is normal, as the hypertrophy at the pyloric regresses at a variable rate and the pylorus achieves a normal size at about 12 weeks after operation.<sup>8</sup> Mild gastro-oesophageal reflux was evident in two children, however, but this is a recognised problem in a small proportion of patients after Ramstedt's pyloromyotomy.

The results of this study show that infants with hypertrophic pyloric stenosis can be successfully treated by general surgeons in a dis-

trict general hospital. In order to improve our results and more closely match those of regional centres, however, there are three areas that merit special attention: meticulous attention to surgical technique, the use of preoperative prophylactic antibiotics, and gentle and graduated introduction of oral feeding after operation.

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### Commentary

An article in this journal in 1988 by Zeidan *et al* reviewed the management of 106 babies with hypertrophic pyloric stenosis.<sup>1</sup> Their patients were admitted under the care of one surgeon working in two children's hospitals: Queen Elizabeth, Hackney, and the Hospital for Sick Children, Great Ormond Street. For those who may have forgotten, the final sentence in the article suggested that, '... healthy infants being treated in district general hospitals should be treated by surgeons and anaesthetists with a special interest in paediatric surgery'. This sentiment prompted the present authors to review experience in their hospital. The preoperative and postoperative management was undertaken by the paediatricians and the surgery was performed by the 'on call' surgical team. There were no operative deaths in either series. However, morbidity rates differed considerably: dehiscence was 0% compared with 4% present series, wound infection 5% compared with 15%, and duodenal perforation 8% compared with 24%. Both series showed a high degree of accuracy of clinical diagnosis and in neither series was postoperative stay prolonged. On the basis of these results, the authors conclude that pyloric stenosis can be successfully managed by general surgeons and by inference by surgeons without a particular interest in the surgery of childhood. They do not discuss whether or not they consider this optimal management.

There are recurrent themes in publications dealing with pyloric stenosis. These relate to diagnostic methods, operative detail, surgical complications, and postoperative management.<sup>2-6</sup>

The diagnosis can be made clinically in over 90% of patients.<sup>1</sup> With the advent of ultrasound diagnosis, however, it seems unlikely that many test feeds will be repeated. It remains to be seen whether ultrasound will prove accurate when the clinical diagnosis is in doubt. Many radiologists will feel more comfortable using a contrast study. Few would agree with a decision to operate on the basis of clinical suspicion alone.

The number of incisions recommended for the operation testify to the fact that none is entirely trouble free. A short, midline epigastric incision is easy to make and to close, and gives a superior cosmetic result to the more common transverse incision. Recent experience with the supraumbilical Bianchi incision suggests that access is no more difficult and the cosmetic result is incomparable.<sup>6</sup> Proximity to the umbilicus may, in theory, increase the risk of infection.

There is general agreement that the pyloromyotomy should remain extramucosal. With a finger invaginating the distal end of the pylorus, an incision is made from the pylorus to the antrum of the stomach. The peritoneum and superficial muscle fibres are divided and the muscle is then spread with a mosquito forceps or pyloric spreader. The tumour splits cleanly along the length of the incision. At the distal end, the split may become oblique, thereby indicating the myotomy is complete at that level. It is unnecessary to divide every fibre and attempts to do so frequently result in duodenal perforation. Having seen the inside of more than one duodenum, I now split the tumour widely and leave the distal end alone. Our experience with repeat pyloromyotomies has shown that the initial operation was usually on the antrum proximal to the tumour. In a few instances, a very short and inadequate myotomy had been performed. Contrary to popular belief, serious haemorrhage can and does occur from the tumour. It is worth waiting a few minutes to ensure that this does not occur.

Wound dehiscence on the second postoperative day is due to suture failure or sutures cutting through. Either way, a change of technique will obviate the problem. Babies with pyloric stenosis seem to have more trouble with their wounds than other neonates or infants. Mass closure using an absorbable suture (other than catgut) seems the best option.<sup>7</sup>

Retrospective reviews do not give a true record of wound infection, particularly those that have occurred outside hospital. The true rate is much higher even when note keeping is obsessional. A recorded rate of 15% is, therefore, of some concern. Surgical technique encompasses many factors. Rao and Youngson (albeit retrospectively) showed that one surgeon's technique resulted in a much lower

infection rate (one in 70 patients) than that of his colleagues.<sup>7</sup> Antibiotic usage in the present series was associated with a lower infection rate: 9% compared with 29%.

Postoperative feeding regimens for pyloric stenosis have a long history.<sup>8</sup> No two regimens are the same—a glowing tribute to their overall value. It has been known for many years that gastric peristalsis is abolished for about 24 hours after pyloromyotomy.<sup>9 10</sup> It is acknowledged that there is no rush to operate and the surgery is not performed as an emergency. Postoperative feeding is not an emergency either. Feeding regimens come from a time when venous access was non-existent. There is neither science nor logic in feeding a baby with an inert stomach. Delayed feeding does not delay discharge.<sup>11</sup> My own practice is to introduce full strength feeds 24–30 hours after surgery. In the absence of vomiting, the baby may be discharged at any time thereafter.

The Ramstedt operation is a straightforward procedure and gives excellent results when performed correctly; it is difficult to perform incorrectly. However, there is more to the management of these babies than the pyloromyotomy. In all branches of surgery, good results come from the consistent application of high standards with critical assessment of the outcome. Only then can specific problems be identified and overcome. There seems little point in diluting experience with relatively uncommon conditions like pyloric stenosis. Concentrating the experience in the hands of fewer people would surely improve results. Over a 16 year period, Jacoby, a paediatrician, operated on 104 babies with pyloric stenosis.<sup>12</sup> He had a single duodenum perforation and a single burst abdomen. No patient had a general anaesthetic. Can surgeons really be satisfied with less satisfactory results?

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