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The results of Ramstedt's operation: room for complacency?

DEREK W GRAY FRCS†
Surgical Registrar
MICHAEL W GEAR FRCS
Consultant Surgeon
DAVID W STEVENS MRCP DCH
Consultant Paediatrician
Gloucestershire Royal Hospital, Gloucester

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Summary

The results of 101 pyloromyotomies performed from 1972 to 1980 have been analysed; 34 operations were performed using local anaesthesia and 67 using general anaesthesia. The use of local anaesthesia was not associated with any advantage related to postoperative or other complications. A high postoperative complication rate of 20% was found (excluding postoperative vomiting), and there were 2 deaths; 11 patients suffered wound infection, with Staphylococcus aureus isolated from 5 of these wounds. The use of prophylactic antibiotics active against Staphylococcus aureus is suggested.

Introduction

Ramstedt's operation for congenital hypertrophic pyloric stenosis (CHPS) is one of the commonest operations performed on infants. When the operation was first introduced it converted a condition with a previously high mortality into one which has become progressively safer. With the introduction of intravenous resuscitation techniques the mortality has become even lower *(1)*. Perhaps because of this apparent safety there have been only sporadic reviews of the results of Ramstedt's operation *(2–5)*. Until recently all the large series of results came from specialist centres, and all confirmed the very low mortality and morbidity as expected. Many cases of CHPS are treated in district hospitals rather than specialist centres and so it was of great interest when the results of Ramstedt's operation in a district general hospital were recently published *(6)*. The complication rate in this study was considerably higher than previously reported from specialist centres, the postoperative wound infection rate being 8.9% and wound dehiscence occurring in 2%. There was a high incidence of postoperative vomiting which was attributed to the use of general anaesthetic, since vomiting was seen significantly less often following the use of local anaesthesia. We present the results from a similar district general hospital (Gloucestershire Royal Hospital) where a large proportion of operations were also carried out under local anaesthesia.

Patients and methods

Since 1972 the final diagnoses of all patients admitted to Gloucestershire Royal Hospital have been entered on a computerised index. The case notes of all patients undergoing pyloromyotomy between the years 1972 and 1980 were examined. All cases on the index were located with no exclusions. The clinical features at presentation are given in Table I. Only 2 patients did not have vomiting as a presenting symptom, 1 presenting as a single episode of haematemesis, the other as failure to thrive. Haematemesis was also a presenting feature in 2 of the infants with persistent vomiting.

The diagnosis was made by history and examination with a palpable 'tumour' in most cases, but in 23 infants a barium meal examination was performed. Four of these examinations were incorrectly negative. All patients were prepared for surgery by intravenous fluid replacement to correct electrolyte abnormalities before surgery. A nasogastric tube was not routinely used. The mean delay from admission to operation was 1.98 days with a range of 0.5 to 9 days.

Anaesthetic

Local anaesthetic (LA) was used in 34 cases, and was universal policy from 1972 to 1974. From 1975 onwards 67 cases were performed under general anaesthesia (GA). This

TABLE I *Clinical features*

Total number	101
Sex	
Male	77
Female	24
Mean age at presentation	5.6 weeks (range 2–14)
Mean length of history	9.5 days (range 1–42)
Presenting symptoms	
Vomiting	99
Haematemesis	3
Diarrhoea	2
Convulsions	1
Constipation	3
Failure to thrive	2
Screaming attacks	1
Associated abnormalities	1
Signs at presentation	
Palpable tumour	83
Visible peristalsis	1

† *Address for correspondence*: Mr Derek Gray FRCS, Nuffield Department of Surgery, John Radcliffe Hospital, Headington, Oxford OX3 9DU.

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change in policy coincided with a change in consultant staff. All infants having local anaesthesia were adequately sedated preoperatively, and given a dummy filled with honey and brandy mixture during the operation. To keep a stable operating field the child was fixed to a padded crucifix. Lignocaine 0.5% was infiltrated in the line of incision. General anaesthesia was with endotracheal intubation in all cases.

Surgery

Sixty-seven operations were performed by 4 consultant surgeons, and 34 operations were performed by surgeons of registrar status. A right paramedian or rectus splitting incision was used in 90 cases, a transverse incision being used in 9 and a midline incision in 2. A Ramstedt pyloromyotomy was performed in all cases.

Postoperative care

This was in a paediatric ward under the supervision of a consultant paediatrician. Feeding commenced 2 hours postoperatively using a standard incremental regimen. Postoperative vomiting was assessed by checking both the case notes and nursing records, which included a vomit chart. Postoperative vomiting was divided into three categories of severity; (a) 1 to 3 vomits on the first postoperative day only; (b) more than 3 vomits or vomiting up to 3 days after operation; (c) vomiting for more than 3 days after operation. Other postoperative complications were obtained from both these sources, and also letters from the general practitioner.

Statistical methods

Differences between locally and generally anaesthetised patients were assessed using the chi-squared test for independent samples.

Results

There were 101 Ramstedt operations performed over the 8-year period. All operations were satisfactorily completed. There were no re-operations. Operative and postoperative complications are listed in Table II. A mucosal breach was identified during the operation in 5 cases, and was repaired using catgut suture. Four of these patients suffered no further complication but 1 patient with mucosal breach subsequently died, though not from an obviously related cause.

Twenty patients suffered one or more postoperative complications (excluding postoperative vomiting). There were 2 deaths. In 1 patient there was considerable difficulty in making the diagnosis, the infant presenting aged 11 weeks with vomiting, haematemesis and convulsions. A barium meal was falsely negative and operation was finally performed 9 days after admission. At operation a mucosal breach was recorded. Postoperatively the infant developed bronchopneumonia and died. Post mortem showed no intra-abdominal complication. The second death occurred suddenly at home 5 days after discharge. The infant presented typically, and operation was uneventful, but postoperatively a wound infection developed, from which *Staphylococcus aureus* was grown. Antibiotics were given and subsequently the infant developed oral thrush. At discharge 11 days after operation all seemed well, but the child died suddenly at home in his sleep. Post mortem examination failed to find a cause of death. Postoperative wound infections occurred in 11 cases. In most cases this consisted of a stitch abscess or mild cellulitis, but 3 cases were troublesome and 1 required drainage under anaesthetic. *Staphylococcus aureus* was isolated from 5 of these wounds and treatment with ampicillin and cloxacillin was instituted. The other wounds revealed no growth on culture. Two patients suffered wound dehiscence requiring resuturing under general anaesthetic. There were 2 urinary tract infections, 1 with *Klebsiella* and 1 with *Escherichia coli*. Two infants developed chest infections, causative organism unknown. Two patients developed fever and positive blood cultures, 1 *Staphylococcus aureus*, 1 *Escherichia coli*. Neither had an obvious wound infection or other complication, and both responded satisfactorily to antibiotic treatment. Oral thrush requiring treatment was noted in 4 infants. The infant that died in hospital suffered from convulsions.

Postoperative vomiting was noted in 33 patients. Table III shows the number of patients who vomited postoperatively following GA compared with LA, along with a further analysis depending on the severity of postoperative vomiting. There is no significant difference between the locally or generally anaesthetised groups for postoperative vomiting of any severity or overall. The other postoperative complications were also analysed with respect to whether GA or LA was used. Again there were no statistically significant differences between the groups. The average postoperative stay in hospital was 6.35 days.

TABLE II *Complications*

		General anaesthetic (n = 67)		*Local anaesthetic (n = 34)*	
	Total no.	*No.*	(%)	*No.*	(%)
Operative mucosal breach	5	3	(4.4)	2	(5.8)
Postoperative wound infection	11	8	(11.9)	3	(8.8)
Wound dehiscence	2	1	(1.5)	1	(2.9)
Death	2	1	(1.5)	1	(2.9)
Urinary tract infection	2	2	(3)	0	(0)
Chest infection	2	2	(3)	0	(0)
Septicaemia	2	2	(3)	0	(0)
Oral thrush	4	2	(3)	2	(5.8)
Convulsions	1	0	(0)	1	(2.9)

(Comparison of the general anaesthetic and local anaesthetic groups by chi square test showed no significant difference in the incidence of complications).

TABLE III *Postoperative vomiting*

	General anaesthetic (n = 67)		*Local anaesthetic (n = 34)*	
	No.	(%)	*No.*	(%)
No postoperative vomiting	46	(68)	22	(64)
Postoperative vomiting of any severity	21	(31.2)	12	(35.3)
1–3 vomits, first postoperative day	9	(13.4)	7	(20.5)
>3 vomits or 1 to 3 days	2	(2.9)	0	(0)
Vomiting for more than 3 days	10	(14.9)	5	(14.7)

(Comparison of the general anaesthetic and local anaesthetic groups by chi square test showed no significant difference in the incidence of vomiting or severity of vomiting.)

Discussion

This study has similarities with that recently reported from Bath. Both were carried out at a district general hospital over a similar period. Some of the findings of that study are confirmed but others are not. The diagnosis of CHPS was made clinically in the majority of cases, but in 22% of cases a barium meal examination was performed. Clearly these X-rays are only ordered when there is a question about the diagnosis, either due to an unusual presentation, or difficulty in feeling a diagnostic 'tumour'. Doubts have been expressed about the accuracy of radiological diagnosis *(7)* and the finding that 4 cases were incorrectly negative in this study supports that view. A false negative study was performed on

one of the infants who subsequently died, delay in diagnosis certainly contributing to his death. This illustrates that a false negative rate for an investigation becomes much more dangerous if the investigation is likely to be used more on the ill patients.

The overall frequency of postoperative vomiting in this study was 32%, which is less than noted by Bristol *(6)*, but similar to previous reports. Unlike Bristol we could find no difference in postoperative vomiting between those infants that received LA and those that received GA, even on classification into three degrees of severity. We could also find no difference between the two groups with regard to the occurrence of other postoperative complications (see Table II). The postoperative complication rate in this study confirms the findings of Bristol and is higher than previously reported from specialist centres. There were 2 deaths, but 1 was almost certainly unrelated. The other mortality illustrates the dangers of delayed diagnosis.

The most frequent complication in both district hospital studies was wound infection. Our postoperative wound infection rate was 11%, with 45% of these infections being due to *Staphylococcus aureus*. Why there should be this great difference between our figures and previous reports from specialist centres is difficult to explain. If the difference in wound infection is real it implies that standards of aseptic technique are grossly inferior in district hospitals compared to specialist centres. This is a serious allegation, and unlikely to be correct, since the aseptic techniques followed in district general hospitals are based on the same principles and equipment used in specialist centres, and many of the staff are specialist centre trained. The other possible explanation lies in the difficulties inherent in retrospective studies. Several of the wound infections found in our study were not recorded on the patient's chart, and were located only after searching the nursing records and General Practitioner's correspondence. It may be considered that most of the infections were of little consequence since they consisted of no more than infection round a stitch, and might be excluded from other studies. If the infection rate is real, and there is no lapse of aseptic technique, what is causing these infections? Ramstedt's operation is not usually thought of as a contaminated operation, but it must be remembered that the occurrence of infection depends on the interaction of host defences, bacterial pathogenicity and the size of bacterial innoculum. Some bacterial contamination occurs in most 'clean' wounds, usually by skin organisms. Infants in this age group are recognised as having poor resistance to infection.

A recent (1976) study of wound infection from a specialist centre (Great Ormond Street Hospital) found 38% postoperative wound infection rate in infants aged up to 1 month and 24% infection for ages up to one year *(8)*. Although this infection rate was for all operations, with no stratification for clean and contaminated wounds, it is nevertheless surprisingly high. Perhaps we should be more surprised at the remarkably low wound infection rate previously reported for pyloromyotomy (less than 0.1%), than the infection rate reported here.

Should we be doing more to prevent these infections? It may be that most infections are so minor that no action is warranted, but in fact 5 patients did receive a course of antibiotics and 1 had a further anaesthetic. *Staphylococcus aureus* was the main offending organism, and it might be possible to prevent these infections by a single prophylactic dose of a suitable antibiotic preoperatively. Whether it is worth administering prophylactic antibiotics to all children to achieve this result is a difficult question, not answerable from this study.

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References

1 Daly AM, Conn AW. Anaesthesia for pyloromyotomy; a review. (The Hospital for Sick Children, Toronto.) Can Anaesth Soc J 1969;16:314–20.

2 Scharli A, Sieber WK, Kiesewetter WB. Hypertrophic pyloric stenosis at the Childrens Hospital of Pittsburgh 1912–1967. J Pediatr Surg 1969;4:108–14.

3 Feldtman RW, Andrassy RJ, Larsen GL, Buckley CJ. Pyloric stenosis; a 13 year experience in operative management. Am Surg 1976;42:551–3.

4 Gibbs MK, Heerden JA, Lynn HB. Congenital hypertrophic pyloric stenosis—surgical experience. Mayo Clin Proc 1975;50: 312–16.

5 Bell MJ. Infantile pyloric stenosis: experience with 305 cases at Louisville Childrens Hospital. Surgery 1968;64:983–9.

6 Bristol JB, Bolton RA. The results of Ramstedt's operation in a district general hospital. Br J Surg 1981;68:590–2.

7 Larsen GL. Limitations of roentgenographic examination in the diagnosis of infantile hypertrophic pyloric stenosis. Surgery 1966;60:768–71.

8 Doig CW, Wilkinson AW. Wound infection in a childrens hospital. Br J Surg 1976;63:647–50.