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Is laparoscopic pyloromyotomy superior to open surgery?

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Abstract
Background: We set out to determine whether laparoscopic pyloromyotomy (LPM) is superior to open pyloromyotomy (OPM) in babies with hypertrophic pyloric stenosis (HPS).
Methods: We performed a retrospective study of 36 LPM and 36 OPM. Both groups were comparable in terms of sex, age and weight on admission, and blood pH on admission and prior to surgery. In the LPM group, three trocars were used; in the OPM group, a small right upper quadrant transverse muscle-cutting laparotomy was carried out.
Results: LPM produces a better cosmetic result, seems to produce less postoperative discomfort, and results in the absence of conversion in a shorter hospital stay. However, the duration of the operation was significantly longer (32 versus 18 min). Moreover, LPM clearly entailed more complications (three mucosal perforations against two, and two reoperations against none in the open group).
Conclusions: The actual series does not favor the laparoscopic approach over the open one, in view of the relatively high complication rate. Babies who are operated laparoscopically, however, seem to have less postoperative discomfort, a shorter hospital stay, and a better cosmetic result. As we are confident that the complication rate and duration of the operation will drop with further experience, we will continue to do LPM. LPM is not easy and should only be carried out when substantial experience has been gained in the field of pediatric laparoscopic surgery.

Key words: Hypertrophic pyloric stenosis — Laparoscopy — Children

In 1906, Nicoll reported on V-Y pyloroplasty without opening the mucosa in children suffering from hypertrophic pyloric stenosis (HPS) [4]. Fredet and Guillemot adopted the extramucosal technique in 1907, but they used a longitudinal incision instead of a V incision [3]. Weber also used this technique in 1908 [10]. It was Ramstedt who, in 1912, introduced the longitudinal splitting of the seromuscular layer without suturing [5]. Since Ramstedt, the treatment of HPS has remained essentially the same; longitudinal pyloromyotomy without suturing is still the treatment of choice.

What has changed, however, is the way in which the abdomen is opened. Fredet and Guillemot used an upper midline laparotomy, Robertson an oblique muscle splitting incision in the right hypochondrium [7], Rickham a transverse incision in the right hypochondrium [6], and Tan and Bianchi a circumumbilical incision [9]. In 1991, Alain et al. introduced a laparoscopic approach [1].

We started to do laparoscopic pyloromyotomies in 1993. Herein we report the results.

Materials and methods

In the period from October 1993 till July 1996, 36 pyloromyotomies were initiated laparoscopically (LPM). These 36 LPM were compared in a nonrandomized way with 36 open pyloromyotomies (OPM) done in the period from January 1990 till July 1996. Both groups were compared regarding sex, age and weight on admission, blood pH on admission and just before surgery, the number and nature of complications, duration of the operation, and duration of the postoperative hospital stay. Data were analyzed statistically using either Student's *t*-test or the chi-square test.

Surgical techniques

Laparoscopic pyloromyotomy

The patient lies supine with the head up and the legs down on a short operating table. The legs are enveloped with the lower part of the table cloth in order to prevent the patient's slipping downward during surgery. The video tower is at the upper end of the table, on the right of the patient's head. The surgeon stands at the bottom end of the table with the assistant at his left side and the scrub nurse at his right side.

A 6-mm cannula is inserted in an open way through the inferior umbilical fold to hold a 5-mm scope. Under view, a 4.5-mm cannula is inserted pararectally at umbilical level for a 4-mm bowel grasper. In the left hypochondrium, halfway between the costal margin and the umbilicus, another 4.5-mm cannula is introduced for the pyloromyotome and later for the pylorus spreader. CO_2 is insufflated at a pressure of 5 mmHg and a flow of 2 L/min.

The duodenum is grasped just distal to the pylorus olive, and an inci-

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sion is made in the avascular plane from just proximal to the prepyloric vein well into the antrum. The seromuscular layer is then separated with the spreader. The mucosa is inspected for perforation by nasogastric insufflation of air. The air is aspirated from the stomach, and the trocars are removed under scopic control. The infraumbilical fascia is closed with one vicryl suture, and the skin is closed with strips.

Open pyloromyotomy

We used a small transverse rectus muscle cutting incision in the right hypochondrium. The greater curvature of the stomach is grasped and the pyloric olive luxated into the wound. A long myotomy is performed from just proximal from the prepyloric vein up into the antrum. The mucosa is checked for possible damage, and the abdomen is closed in one layer with 000 vicryl.

Postoperative care

Most of the patients in both groups received paracetamol suppositories for pain control only. On the day of surgery, no enteral feedings were given. The day after surgery, the patient was allowed to drink half the calculated needs; the remaining fluid need was given intravenously. The 2nd day, the infant was put on full oral nutrition. If no vomiting occurred, the infant was discharged.

Results

No significant differences were noted between the two groups regarding sex, age at surgery, body weight on admission, and blood pH on admission or just before surgery.

Mucosal perforation occurred in three patients of the LPM group and two patients of the OPM group. All perforations in the LPM group led to a transverse right upper quadrant minilaparotomy, as in the open group. One of these patients developed a wound dehiscence, requiring repeat surgery and prolonged hospital stay due to wound infection. In two of the patients of the LPM group, the laparoscopic approach was abandoned, once because of insufficient experience of the surgeon and once because of poor view due to bowel distension.

Prolonged vomiting occurred twice in each group. In contrast to none of the patients of the OPM group, two of the patients of the LPM group needed a repyloromyotomy. One patient was reoperated during the same admission, the other during a repeat admission 3 weeks later. Wound problems occurred twice in the nonconverted LPM group and once in the OPM group. One wound infection in the nonconverted LPM was minor and did not require treatment; the other one was more serious, requiring antibiotic treatment.

The mean duration of the operation in 31 patients of the LPM group was 33.2 ± 14.4 min. If we exclude the five patients who had a conversion to an open operation, the mean duration of the operation was 32.3 ± 14.1 min. In contrast, the mean duration of the operation for the 21 patients in the OPM group ($n = 21$) was 18.9 ± 9.3 minutes. The difference between the LPM and OPM groups is statistically significant ($p < 0.05$).

The mean postoperative hospital stay (not including the day of surgery) for 28 patients of the LPM was 2.9 ± 1.2 days and 3.1 ± 1.4 days for 35 patients of the OPM group; the difference was significant ($p < 0.05$). The values are not known for three patients of the LPM group and one patient of the OPM group. All four patients were discharged early to another hospital. Five more patients of the LPM group have been excluded, four because of conversion and one because of a repyloromyotomy during the same admission. If the latter five patients are not excluded, then no significant differences between both groups are present (3.0 ± 3.4 days for the LPM group against 3.1 ± 1.3 days for the OPM).

The nurses reported that infants operated on laparoscopically appeared to have less postoperative discomfort than the infants that had a classical approach, but their surmise may merely represent bias.

Discussion

That infants operated on laparoscopically have less postoperative discomfort is difficult to prove. Easier to prove is the cosmetic superiority of the laparoscopic approach—at least when compared with a classical approach using a small transverse upper quadrant laparotomy. We have no personal experience with the transumbilical approach. LPM without need for conversion resulted in a shorter postoperative hospital stay. Even when the cases in which conversion has taken place are included, the hospital stay in the LPM group is not longer than in OPM group. Moreover, one patient of the LPM group stayed for 27 days because of dehiscence of the wound after conversion! Although wound infection can occur after LPM, a complete wound dehiscence requiring immediate surgery, as in OPM, is not likely to occur in a nonconverted LPM.

But are all these more or less proven (or not proven) advantages of LPM substantive enough to justify its continuance? The disadvantages of the laparoscopic approach are the longer duration of the operation, the possible consequences of CO_2 insufflation, and the higher complication rate. At least in our hands, mucosal damage occurred in 8.3% of the LPM group. The incidence of mucosal perforation in Alain et al.'s original series of 20 patients was 5% [1], but with further experience, this dropped to 2.8% [2]. In our OPM group, the incidence of mucosal damage was 5.5%. A perforation incidence between 0.5 and 8.5% has been reported [8]. Two children in our LPM group needed a repyloromyotomy against none of the children in the series of Alain et al. [2]. The incidence of an inadequate pyloromyotomy for HPS in general varies between 0 and 1.1% [8].

In the LPM group, there were two wound infections; one was minor, but the other one required antibiotics. As has already been said, the one dehiscence that occurred was in a patient in whom the operation needed to be converted because of mucosal perforation. In the OPM group, there was one wound that leaked somewhat after surgery. The incidence of wound infection after an OPM in a specialist center varies from 0.2 to 11.8% and of wound dehiscence from 0 to 2.5% [8].

Even today, after we have gained quite a lot of experience in the field of major laparoscopic surgery in children, we feel that the laparoscopic pyloromyotomy is not an easy operation. The working distance is small and the optimal depth and length of the initial incision is difficult to judge. It is important that spreading is only commenced after the

tip of the spreader has reached the mucosa; otherwise the spreading will be traumatic and insufficient. It is of interest to note that two of the three mucosal injuries in the laparoscopic group arose at the stomach site and not at the duodenal site. Mucosal tearing at the stomach site always occurred during repeat spreading in an attempt to elongate the myotomy, which was perhaps not necessary. It seems that we tried to make the myotomy too long at the stomach site.

In both laparoscopic cases that needed to be reoperated, the surgeon doing the primary operation was not entirely happy at the end of the procedure. In one child, the pyloromyotome appeared blunt, and several cuts had to be made in the seromuscular layer, resulting in several shallow myotomies and incomplete spreading. In the second child, the pyloric olive was very big and very hard. Spreading of the tumor was difficult, and a too-short pyloromyotomy was carried out. The lesson to be learned is that when the surgeon is not entirely happy at the end of a laparoscopic pyloromyotomy, conversion should take place. It is our experience that conversion does not add much time to the total duration of the operation.

Since the children operated on laparoscopically seem to have less postoperative discomfort, a shorter hospital stay (at least when no conversion is needed), and a better cosmetic result, we will continue to do LPM. We realize that we have had a relatively high complication rate in LPM, but we are confident that it will drop with further experience.

Those colleagues who would like to start with LPM should try to keep the learning curve as small as possible. This can be achieved by learning the procedure from experienced colleagues. Moreover, one should only embark on LPM when enough experience has been gained in other fields of pediatric laparoscopic surgery. Lastly, when during LPM there is the slightest hesitation about the quality of the procedure, conversion should be carried out.

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