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Malrotation: The Postoperative Period

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Background/Purpose: There have been many reports of patients who have persistent gastrointestinal symptoms after undergoing Ladd's procedure. Postoperative return of bowel function in many of these patients seems to be delayed.

Methods: Postoperative return of bowel function after performance of a Ladd's procedure was studied retrospectively in a series of 57 children treated between 1981 and 1994. Excluded were those patients who had a malrotation in combination with an abdominal wall defect, a congenital diaphragmatic hernia, or duodenal atresia. Patients were divided in two groups; one group consisted of patients less than 1 year of age and one group of those 1 year of age and older.

Results: Nasogastric tube decompression was necessary for an average of 6.7 days in the first group and 4.3 days in the

older children ($P = .03$). A midgut volvulus delays resumption of bowel function postoperatively. Gastric tube decompression was necessary for 8.6 days ($n = 15$) compared with only 5.1 days ($n = 45$) for the group without a volvulus ($P = .003$, analysis by t test).

Conclusion: The authors recommend that a central venous line be inserted for feeding purposes when a volvulus is present at operation.

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INDEX WORDS: Intestinal malrotation, midgut volvulus, Ladd procedure.

MALROTATION is the common name for a variety of abnormalities of intestinal rotation and fixation, ranging from a mobile cecum, with the duodenojejunal junction to the right of the spine, to a complete nonrotation with an associated midgut volvulus. Many theories have been put forward regarding its embryological evolution.¹⁻⁷ Ladd's procedure as described in 1936⁸ still forms the basis for the surgical treatment of malrotation today.

There have been scarce reports that in a number of cases malrotation is associated with intestinal motility dysfunction.⁹⁻¹¹ Most studies concern case reports of patients who have persistent gastrointestinal symptoms after undergoing Ladd's procedure. Common symptoms are: persistent feeding difficulties, vomiting, diarrhea, and abdominal pain. Also, postoperative return of bowel function in many of these patients seems to be delayed. To test this hypothesis we conducted a retrospective study.

The first aim of this study, therefore, was to examine postoperative return of bowel function. The second was to discover whether recovery differs significantly for

different age groups. Finally, a review was made of persistent gastrointestinal symptoms after correction of malrotation.

MATERIALS AND METHODS

Patients

For the purpose of this study we only included cases of isolated malrotation. Malrotation occurring as a result of an extraabdominal position of the bowel on the basis of an omphalocele, gastroschisis, or congenital diaphragmatic hernia was excluded to obtain a uniform patient group. Complete or partial duodenal atresia associated with malrotation was excluded as well because the necessary duodeno-duodenostomy might interfere with postoperative resumption of bowel function.

Fifty-seven of the patients operated on for malrotation between 1981 and 1994 in the Pediatric Surgical Center in Amsterdam were included in this study. All patients underwent Ladd's procedure that included evisceration and inspection of the mesenteric root, anticlockwise derotation in case of midgut volvulus, lysis of the Ladd's bands with straightening of the duodenum along the right abdominal gutter, inversion appendectomy and placement of the cecum into the left lower quadrant alongside the sigmoid.

The patient group of 57 was divided into two groups: patients younger than 1 year (group 1, $n = 48$) and patients older than 1 year (group 2, $n = 9$). The overall age range in the whole group was from 1 day to 16 years. The median age of the infants younger than one year (group 1) at the time of operation was 8 days (mean, 32) and of the older children (group 2) median age was 5.4 years. Of 57 patients, there were 20 girls and 37 boys. Average birth weight was 3,263 g in group 1 and 2,982 g in group 2 (overall range, 1,100 to 4,480 g). Mean gestational age of all patients was 37.4 weeks (range, 27 to 42). Thirteen children, all younger than 1 year, received a central venous catheter that remained positioned for an average of 12 (range, 1 to 25) days. Associated anomalies ($n = 14$) were quite common as is reported in most studies.^{3,4,12-14}

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Surgery

From onset of symptoms it took a median of 6 days (mean, 21 days) before the operation took place for children of group 1. Symptoms could often be traced back for more than 1 year (mean, 433; median, 19.5 days) for children of the other group. A volvulus was recorded in 15 patients. The incidence of midgut volvulus was equal for both age groups. Resection of bowel could be avoided in all cases. There was no operative mortality. Two patients died during follow-up of unrelated causes. Therefore, mortality was not associated with malrotation as such.

Postoperative Management and Statistical Analysis

Gastric tube decompression was accomplished by free gravity drainage. Patency was checked every hour. Nasogastric tube decompression was discontinued when output was less than 1 mL/h. Oral feeding was started gradually thereafter. Antibiotics were not routinely administered. The unpaired Student's *t* test, assuming equal variance, was used to compare different patient subgroups.

RESULTS

Nasogastric tube decompression was necessary for 6.7 ± 3.6 (mean $\pm$ STD; range, 1.5-16; median, 6) days in group 1, and 4.3 ± 1.9 (mean $\pm$ STD, range, 2 to 8) days in group 2. Resumption of bowel function as indicated by time of gastric tube decompression was faster in the group of older children ($P = .03$). The first postoperative defecation took place on average after 6.2 days in group 1, and 4.1 days in group 2. Again recovery of bowel function tended to be earlier in the second group, although this was not significantly different ($P = .09$). Mean hospital stay postoperatively was 26 days in group 1 and 8 days in group 2 (median, 16 and 7 days, $P = .08$). Table 1 lists the postoperative recovery for various patients groups.

Postoperative return of bowel function is correlated ($P = .003$, Table 1) with the presence of a midgut volvulus at operation. Gastric tube decompression was then necessary for an average of 8.4 days ($n = 15$) as compared with only 5.5 days ($n = 42$) for the group without a volvulus. Nasogastric tube decompression, postoperative defecation, or incidence of complications were not significantly different in the group with associated anomalies.

Direct postoperative complications were seen in 13 patients. Six of these patients were part of the subgroup with a volvulus. Late complications were seen in 17 children (two patients with volvulus). Table 2 lists the

Table 2. Postoperative Complications

	No.
Infection	
Wound infection	4
Sepsis	3
Reoperation	
Volvulus of the cecum	1
Recurrence of midgut volvulus	1
Bowel obstructions caused by adhesions	3
Insertion of a central venous catheter	2
Abdominal wall cyst	1
Wound dehiscence	1
Persistent gastrointestinal symptoms	
Constipation	6
Intractable diarrhea, unassociated with infection	1
Abdominal pain or cramps	2
Vomiting	3
Feeding difficulties	1
Other	
Bowel obstruction, nonoperative treatment	3
Thrush	2
Enteritis and iron deficiency anemia	1

various complications. Eight children underwent reoperation. Both a complete recurrence of midgut volvulus and a volvulus of the cecum were observed. Thirteen patients had persistent (more than 6 months) gastrointestinal symptoms after the operation. Symptoms were constipation ($n = 6$), abdominal pain or cramps ($n = 2$), vomiting ($n = 2$), diarrhea ($n = 1$), and feeding difficulties ($n = 2$).

DISCUSSION

The situation feared most at the time of operation is volvulus with necrotic bowel. The then necessary resection of bowel is associated with a higher incidence of mortality and complications. We observed that the presence of a midgut volvulus at operation delays postoperative return of bowel function. Volvulus results in vascular compression, which could be an important factor in late resumption of bowel function.

Intestinal dysmotility could be another explanation for late resumption of bowel function. Intestinal dysmotility as a postoperative complication has been reported by Coombs et al,⁹ Jolley et al,¹⁰ and Devane et al.¹¹ Passage can be either too slow or too fast and appears to be caused by an abnormal motor activity of the small intestine. Thirteen of our patients remained symptomatic regarding their gastrointestinal tract after operation. Symptoms that continued for more than 6 months included vomiting, obstipation, diarrhea, and abdominal pain or cramps. Intestinal dysmotility may have played an important role in these cases. It is important to realize that a large group of children will have persisting gastrointestinal symptoms after operation. Malrotation may not only be a pure anatomical abnormality, but it may be associated with functional abnormalities as well.

Table 1. Postoperative Recovery

Patients	No.	Nasogastric Tube Decompression
		(days, <i>P</i> value)
All	57	6.3
Group 1	48	6.7
Group 2	9	4.3 (.03)
Volvulus	15	8.4
No volvulus	42	5.6 (.003)

NOTE. Statistical analysis by *t* test, $\alpha = .05$.

CONCLUSIONS

The presence of a volvulus at the time of operation is an important predictor of a delay in resumption of bowel function postoperatively. We suggest insertion of a central venous catheter preoperatively if a volvulus is present.

Gastrointestinal symptoms developed in one quarter of all patients for at least 6 months postoperatively. Performing Ladd's procedure does not guarantee a child is "cured." We advocate that these children be monitored carefully after surgery.

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