



Conditions required for laparoscopic repair of subacute volvulus of the midgut in neonates with intestinal malrotation

Five cases

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Abstract

Background: This study aimed to evaluate the optimal conditions for laparoscopic management of neonatal subacute volvulus with malrotation.

Methods: Between 1994 and 2002, 13 neonates with midgut volvulus and malrotation entered the authors' institution. Five of these neonates met the eligibility criteria for laparoscopy: good hemodynamic parameters, no gut perforation, and no severe ischemic distress of the bowel shown on preoperative ultrasonography.

Results: The results were excellent for only three infants, associated with a shorter postoperative course. One underwent reoperation for a residual duodenal band, and one conversion to open laparotomy was necessary. The predictors of success were no difficulty identifying the abnormal anatomy, no important chylous stasis, and the learning curve of the surgeon.

Conclusions: Despite its previously reported feasibility, neonatal laparoscopy for volvulus with intestinal malrotation is appropriate only for a small number of patients. Strict selection criteria with a clear understanding of the optimal conditions for success may improve the outcome.

Key words: Laparoscopy — Intestinal volvulus — Malrotation — Newborn

Intestinal malrotation raises the risk of midgut volvulus because of a narrowed mesenteric base. Most patients with midgut volvulus present this complication in the first year of life, usually within the first 7 days. Sudden onset of bilious vomiting with a flat abdomen in the neonatal period strongly suggests this diagnosis. A severe vascular compromise imposes an urgent reduction of the volvulus by laparotomy. Subacute volvulus with

moderate vascular distress may be approached by laparoscopy [15]. This report evaluates both the risks and the optimal conditions for reducing the volvulus through a laparoscopic approach during the first month of life.

Materials and methods

Materials

Between April 1994 and July 2002, 27 patients were admitted to our institution for malrotation with midgut volvulus, 13 of whom were neonates. The diagnosis of volvulus was confirmed either with an upper gastrointestinal series or Doppler ultrasonography of the mesenteric vessels (i.e., visualized inverse relations of the vessels and the vein wrapping around the artery) [11]. The time lost by the examination was never more than 30 min.

Eight children with severe midgut volvulus presenting hemodynamic instability, major signs of intestinal distress, abdominal distension, and ultrasonographic signs of severe intestinal ischemia [12, 13] (thickened bowel wall, abrupt and complete interruption of the arterial mesenteric flow, immobility and important distension of the digestive loops) were not retained and underwent a conventional laparotomy. Five of the patients were neonates with subacute volvulus: moderate signs of intestinal distress, good hemodynamic parameters, no gut perforation, and no vascular compromise of the bowel on ultrasonography. They were thus selected for laparoscopic repair of their volvulus. Bilious vomiting with a flat abdomen was the constant preoperative symptom, and no blood was seen in the stools. The mean age was 9 days (range, 3–28 days). Weight at the time of surgery ranged from 2,900 to 4,500 g (mean, 3,500 g). All the procedures were performed on an emergency basis by the same operator (H.A.).

Anesthesia

Anesthesia was induced with inhaled or intravenous agents associated with short-acting intravenous opiates, and muscle relaxants were administered to facilitate the surgical procedure. All the patients were intubated and mechanically ventilated, with the inspired oxygen fraction setting between 50% and 70%.

Laparoscopic treatment

Under general anesthesia, the patient was in a supine position at the extremity of the operative table. The tower with monitor, camera unit,

and insufflator was placed at the right upper extremity of the table. The surgeon stood at the feet of the patient, with the first assistant on the left and the nurse on the right. A 5-mm trocar was inserted through a supraumbilical incision using an open technique. The abdomen was insufflated to 8 mmHg with carbon dioxide. A 5-mm 30° telescope was used. Three 2.5-mm operative instruments were placed: one at the xyphoid level and one in each flank at the umbilical level.

The first operative step was exploration of the abdominal cavity to confirm the diagnosis of midgut volvulus, identify its direction, and search for Ladd's bands and possible abnormal anatomy. In all cases, ultrasonography succeeded in determining the degree of vascular distress in the gut, and no child had severe intestinal ischemia at surgery.

The volvulus then was reduced after careful examination of the rotating direction. The likelihood of successful recovery for the ischemic portion of the gut was evaluated, and the laparoscopic approach proceeded only when full recovery seemed assured. Ladd's bands, if present, were resected, and the mesenteric base was widened to reduce the risk of revolvulation. An appendectomy was performed at the end of the procedure.

Results

Anesthetic tolerance

Insufflation of the pneumoperitoneum increased expired carbon dioxide in all the patients up to 10 mmHg, even in two of the five patients for whom the mechanical ventilation was increased to prevent hypercarbia. Positive airway pressure, related to mechanical ventilation, also increased in all the patients, but remained in a safe range with respect to the risk of lung pressure injury. No hypoxia or significant hemodynamic alterations were observed for insufflation pressure that did not exceed 8 mmHg. One patient received moderate intravenous fluid loading. Peritoneal insufflation of a cold, dry gas may have contributed to hypothermia down to 34.1°C in four of the five patients. However, none of these alterations could be considered as life-threatening, and pneumoperitoneal tolerance was good or acceptable in all cases. Four patients were extubated at the end of surgery, and one, the day after.

Surgical outcome

For the first neonate of the series, the decision to convert to laparotomy was made early because of poor visualization of the anatomy and difficulties determining the direction of rotation. There was important chylous stasis. The clockwise volvulus was reduced by more than three turns.

In three cases, the procedure was performed completely under laparoscopy. The volvulus was reduced by one to two turns. The entire procedure required 100 min (range, 90–115 min). Recovery of transit was observed within the first 24 h after surgery. Enteral feeding began on postoperative day 1 or 2. Complete feeding was begun on day 3 (range, from 2–6 days). All the patients were discharged to home within 1 week of symptom appearance (within 5 to 7 days). At this writing, the mean follow-up period has been 3 years (range, 13 months to 5 years), and no recurrence of digestive problems has been observed. In one case, the postoperative evolution was difficult, with a relapse of bilious

vomiting triggered by feeding on postoperative day 9. An ultrasonography and a gastroduodenal opacification did not show any relapse of volvulus but raised the suspicion of a residual obstacle in the third duodenal segment. The decision was made to perform a laparotomy, during which a residual band was found and easily divided. Feeding still was difficult after this procedure, and was fully tolerated only on day 10 after the second surgical correction. The total length of the hospital stay was 36 days in this case. At this writing the follow-up period is 20 months, and the child is asymptomatic.

Discussion

Laparoscopic treatment of intestinal malrotation without volvulus has been reported for both adults [9, 10] and children [3, 5, 6, 14, 16]. Conversion to an open procedure is common because of the difficulties encountered. Bass et al. [2] noted that an accurate evaluation of the abnormally positioned anatomy seems to be the main challenge. Given this difficulty, the laparoscopic approach to malrotation with midgut volvulus remains debatable, and may be even more difficult to justify in the case of very young children [15, 16]. Lessin and Luks [8] did not consider laparoscopy to be suitable for children with suspected volvulus and Gross et al. [7] estimated that this procedure may be difficult because of intestinal distension.

The clear benefits of minimally invasive surgery [1, 4], however, compel us to propose laparoscopy for neonates with volvulus on the condition that the risk is acceptable, as determined by hemodynamic stability, no intestinal perforation, no severe vascular distress, a surgeon experienced in laparoscopy, and the ability to convert quickly at any moment. The results were excellent for three of five children included in this study. A good tolerance of peritoneal insufflation and a moderate chylous stasis were two facilitating conditions. In one case, conversion was chosen because of the difficulty assessing the anatomy. This child was the first to undergo a laparoscopy for this indication, and the surgeon's learning curve at that time may have reduced the chance of success.

This short series suggests that the reported approach is technically feasible for neonates. Nevertheless, the difficulties and risks should not be minimized. The first consideration is for the use a neonatal laparoscopic procedure in an emergency. In this situation, the anesthesiologists' evaluation of the risks associated with a pneumoperitoneum in an infant with ischemic distress of the gut, even if moderate, is critical. Hemodynamic instability, difficulties with ventilation or any increased risk related to the insufflation should indicate that the standard surgical approach should be preferred.

The main difficulties, however, are technical. The working space is reduced in the abdominal cavity of a neonate, especially when there is intestinal distension. An 8-mmHg insufflation increases the space for work, but it remains limited. In this study, the maximal space between the abdomen wall and the gut was 3 cm at the

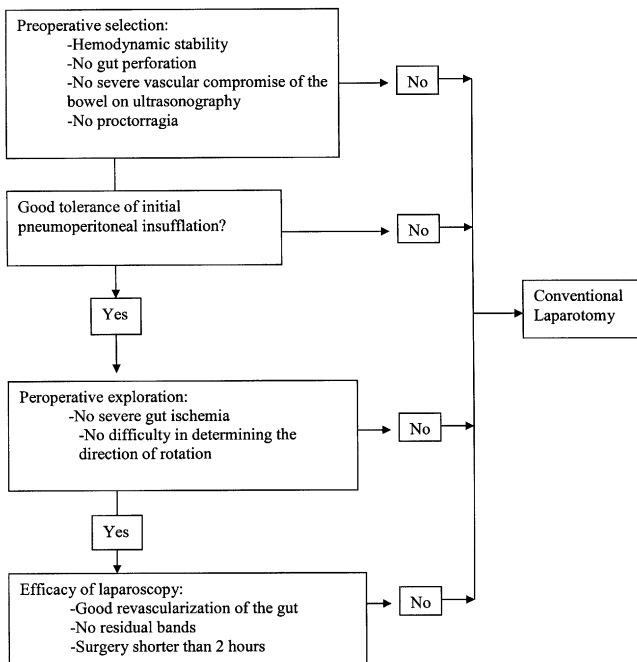


Fig. 1. Decisional algorithm for indication of laparoscopy in subacute volvulus of the gut in neonates.

umbilicus and 2 cm at the xyphoid level. An insufflation pressure higher than 8 mmHg was associated with hypoxia and moderate tachycardia in our experience, and we advocate this pressure as a limit with this indication. Suturing of the ports reduces air leaks and avoids excessive cooling of the neonate. A 30° camera optimizes the visibility.

The reduction of the volvulus is the main challenge. The determination of clockwise or anticlockwise rotation is necessary before any mobilization. The reduction should be proceed very cautiously, and must be stopped immediately if bowel coloration darkens during manipulation. The gut is fragile, so grasping of the ischemic segments should be avoided. Moreover, the extremities of the instruments may at times be out of the visual field during the reduction.

Another problem is the timing for the volvulus reduction and the Ladd's band section [3]. In three cases, the bands had to be dissected first to allow easier reduction of the volvulus. In the two others cases, reduction of the volvulus first was necessary to expose the bands. This decision thus must be made on a case-by-case basis. In any case, a satisfying recoloration of the gut is the strongest justification for continuing the procedure solely by laparoscopy. In contrast, questionable bowel vitality should not cause hesitation: conversion to open laparotomy should be immediate.

The risk of an incomplete procedure may be a negative point: residual mesenteric torsion or remaining Ladd's bands can occur, as in one case of our series that required a delayed laparotomy, fortunately without the need for intestinal resection.

We conclude that midgut volvulus with malrotation can be managed laparoscopically in carefully selected neonates (Fig. 1). This short series highlights the need for well-defined indications, as well as excellent technical understanding. The technical and anesthetic difficulties, the need to convert to laparotomy in some cases, the possibility of residual bands or volvular relapse, and the risk of perforation should be taken into account before a decision to proceed with laparoscopic treatment of midgut volvulus during the neonatal period. A randomized trial and comparison with laparotomy using Ladd's procedure is needed.

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