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FEASIBILITY AND OUTCOMES OF LAPAROSCOPIC SURGERY FOR PEDIATRIC INTUSSUSCEPTION: RISK FACTORS FOR BOWEL RESECTION

General surgery

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ABSTRACT

Background: Intussusception is a leading cause of intestinal obstruction in children. Although enema reduction is effective for most cases, approximately 20% of patients require surgical intervention. This study evaluates the usefulness and feasibility of laparoscopic surgery in these cases, with a particular focus on the intraoperative risk of bowel resection. **Methods:** We retrospectively reviewed pediatric patients who underwent surgical treatment for intussusception between 2020 and 2024. Data collected included patient demographics (age, gender, body weight), associated symptoms, duration of symptoms, white blood cell (WBC) count, operative time, and postoperative complications. **Results:** Of the 155 patients, 37 (23.8%) required surgery—29 (78.3%) due to failed enema reduction, 6 (16.3%) due to recurrence, 1 due to a suspected lead point, and 1 due to suspicious ischemic changes on ultrasonography. The mean patient age was 26.8 ± 18.9 months (range: 3.5–76.7 months) and mean body weight was 12.9 ± 3.9 kg (range: 5.4–22.2 kg). Laparoscopic surgery was successfully completed in 29 patients (78.4%). Bowel resection and anastomosis were required in 7 patients (18.9%). The mean operating time was 56.7 ± 32.8 minutes. A pathological lead point was identified in 3 patients from the bowel resection group ($p = 0.005$). Operating time and hospital stay were significantly longer in this group. No intraoperative or postoperative complications were observed. **Conclusion:** Laparoscopic surgery was successful in 78.4% of patients, resulting in shorter hospital stays and earlier resumption of oral intake. The only significant predictor for bowel resection was the presence of a pathological lead point. Therefore, laparoscopic surgery may be considered an optimal treatment approach for pediatric intussusception, except in cases presenting with initial peritonitis.

KEYWORDS

Intussusception, Laparoscopy, Small intestine

INTRODUCTION

Intussusception is a significant cause of intestinal obstruction in children, with an incidence of over 56 cases per 100,000 population. It occurs when one segment of the intestine telescopes into an adjacent segment, leading to obstruction. In most cases, the cause is idiopathic, often associated with hypertrophy of Peyer's patches following a viral infection. Approximately 10% of cases are linked to a pathological lead point, such as Meckel's diverticulum ,Polyps, duplication cysts, heterotopic pancreas, lymphoma, Peutz-Jeghers syndrome, and Henoch–Schönlein purpura. Currently, the standard treatment for intussusception involves enema reduction using air, barium, saline, or similar agents. Since the work of Ravitch and McCune, reported success rates for this non-operative approach range from 79% to 90%.[7] However, approximately 20% of patients still require surgical intervention due to failed reduction, the presence of clinical signs such as peritonitis, shock, sepsis, or pneumoperitoneum, or the identification of a pathological lead point.

Traditionally, surgical management involved manual reduction via laparotomy. Laparoscopic approaches were introduced in the late 1990s, but despite advancements in minimally invasive surgery (MIS), early reports suggested success rates of less than 50%, limiting its adoption as a standard technique.

Since 2010, laparoscopic surgery has been adopted as the first-line surgical approach for intussusception in our institution. This study aims to evaluate the feasibility and effectiveness of laparoscopic surgery and identify risk factors for bowel resection in children undergoing this procedure.

Aim of the Study

To evaluate the usefulness and feasibility of laparoscopic surgery in intussusception cases, with a particular focus on the intraoperative risk of bowel resection.

METHODS

Inclusion

We retrospectively reviewed pediatric patients who underwent surgical treatment for intussusception at Sri Siddhartha medical college, tumkur between April 2020 and December 2024. Following diagnosis, enema reduction using air or barium was initially attempted in all patients, except those presenting with signs of peritoneal irritation, who required emergency surgery.

Enema reduction was performed by an experienced radiologist, with intraluminal pressure carefully maintained between 100 and 120 mmHg. Patients who underwent successful reduction were admitted for observation for a minimum of one day.

Surgical Intervention was Indicated in the Following Cases:

1. Failure of enema reduction.
2. Suspicion of a pathological lead point.
3. Recurrent intussusception occurring more than three times.

Procedure

Laparoscopic reduction was performed using three trocars: one 5-mm umbilical trocar and two 3-mm trocars. In patients older than five years, 5-mm trocars were used for all ports. The trocars were positioned at the umbilicus, left lower quadrant, and suprapubic area. Pneumoperitoneum was maintained with an intra-abdominal pressure of less than 10 mmHg.

Once the intussusception site was identified, reduction was carefully performed using two atraumatic intestinal clamps. The proximal small bowel was then examined to identify any potential pathological lead point.

If reduction was unsuccessful, or if a suspicious lead point or bowel injury was detected, the procedure was converted to laparotomy. In such cases, the umbilical incision was extended in a semicircular fashion, and either manual reduction or bowel resection with primary anastomosis was performed as required.(Fig 1)

Fig. 1. Conversion to laparotomy for irreducible intussusception through umbilical incision.

Data Analysis and Statistics

Data were collected on patient demographics (age, gender, body weight), clinical presentation (associated symptoms, duration of symptoms), laboratory findings (white blood cell count), operative details (operating time), and postoperative outcomes (complications).

The study protocol was approved by the local institutional review board. To identify risk factors for bowel resection, categorical variables were analyzed using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared using the two-tailed t-test for normally distributed data. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 20 (SPSS Inc., Chicago, IL). A p-value of <0.05 was considered statistically significant.

RESULTS

Analysis of the Study Group

During the study period, intussusception was confirmed in 155 patients, with a total of 195 reduction attempts. Of these patients, 37 (23.8%; 24 males and 13 females) required surgical intervention due to the following reasons: enema reduction failure in 29 (78.3%), recurrence in 6 (16.3%), a suspicious lead point in 1, and suspected ischemic change on ultrasonography in 1 patient. Twelve patients (32.4%) were transferred for surgery after initial reduction failure, and another trial of air reduction was attempted in stable patients prior to surgery.

The mean age of the surgical cohort was 26.8 ± 18.9 months (range, 3.5–76.7 months), and the mean body weight was 12.9 ± 3.9 kg (range, 5.4–22.2 kg). Laparoscopic surgery was successfully performed in 78.4% of patients, whereas 7 patients (18.9%) required bowel resection and anastomosis.

Regarding the type of intussusception, 29 patients (78.4%) had ileocolic intussusception, and 8 patients (21.6%) had ileocecal intussusception. Conversion to open surgery was required in 7 patients due to irreducible intussusception in 4 cases, the presence of a lead point in 3 cases, and small bowel injury in 1 case.

As illustrated in Figure 1, in cases requiring conversion to open surgery, the bowel was exteriorized through an umbilical incision, followed by manual reduction or bowel resection as indicated. Postoperatively, the umbilical scar was barely visible, demonstrating favorable cosmetic outcomes (Fig. 2).

Fig. 2. The photograph of postoperative wound after 7 days.

The most common presenting symptoms were irritability or abdominal pain in 27 patients (73%), vomiting in 22 (59.4%), hematochezia in 11 (29.7%), and fever in 6 (16.2%). Regarding the duration of symptoms prior to hospital presentation, 15 patients experienced symptoms for ≤24 hours, 8 for 24–48 hours, 6 for 48–72 hours, and 8 presented more than 3 days after symptom onset. The mean white blood cell count was 12,094.4 ± 4,576.1/mm³ (range, 1,110–21,870).

The mean operative time was 56.7 ± 32.8 minutes (range, 17–180 minutes). Pathological lead points were identified in 3 patients: heterotopic pancreas, angiodysplasia, and Meckel's diverticulum. Postoperatively, oral intake was initiated the day after surgery, except for patients who underwent bowel resection, in whom oral intake began after the passage of flatus.

No intraoperative or postoperative complications were reported. The mean hospital stay was 5.4 ± 1.89 days (range, 3–10 days) (Table 1). The mean follow-up period was 96.6 ± 68.4 months (range, 3.5–215.9 months). Only one patient experienced recurrence after surgery, which was successfully managed with air enema reduction.

Analysis of the Bowel Resection Group

Among the 7 patients who required bowel resection, the mean age was 14.8 ± 15.9 months (range, 3.5–41.5 months). Four patients (57.1%) were younger than 6 months, while 2 were older than 34 months. The duration of symptoms in this subgroup was comparable to that of patients who underwent successful laparoscopic reduction.

Although irritability or abdominal pain was more common in the reduction group and vomiting or hematochezia was more frequent in the bowel resection group, these differences were not statistically significant. Notably, a pathological lead point was observed exclusively in the bowel resection group (p = 0.005).

Operative time was significantly longer in the bowel resection group compared with the reduction group (112 ± 36.8 vs. 43.8 ± 12.1 minutes, p = 0.003), as was the mean hospital stay (8.1 ± 1.1 vs. 4.8 ± 1.4 days, p < 0.001). No significant difference was found between the groups regarding white blood cell count (per mm³) .

DISCUSSION

Surgical intervention for intussusception is primarily indicated when enema reduction fails or when signs of peritoneal irritation are present. Known predictive factors for requiring surgery include patient age, duration of symptoms, length of the intussusception, and the presence of a pathological lead point. Fallon et al. reported that the need for operative management was associated with the use of hydrostatic enemas, failure of initial enema reduction, hematochezia, age <1 year, or symptoms persisting for more than 48 hours.[3] Despite multiple attempts at enema reduction, 26% of patients ultimately required surgery, with repeated reductions succeeding in only 8% of cases. Ultrasound findings such as a definable lead point, free or inter-loop fluid, and bowel wall thickening were also predictive of the need for surgical intervention.[3]

Savoie et al. reported a 79% success rate with enema reduction among 7,412 patients; however, reduction was less successful in older children due to the presence of pathologic lead points.[5] Bratton et al. observed that patients treated at specialized children's hospitals were less likely to require surgery compared with those managed at non-children's hospitals.[9] Overall, despite aggressive non-operative management, approximately 20% of intussusception cases still require surgical intervention, emphasizing the need for optimal surgical strategies for these patients.

Minimally invasive surgery (MIS) has demonstrated numerous advantages, including shorter hospital stays, reduced postoperative pain, and superior cosmetic outcomes.[10],[11] However, despite technical advances and growing surgical experience, laparoscopic approaches have not been universally adopted as first-line therapy for intussusception. Early reports showed variable success rates: Schier reported successful laparoscopic reduction in 4 of 7 cases in 1997,[11] Hay et al. reported a 70% success rate,[12] and Van der Laan et al. reported only a 30% success rate in 2001.[8] Widespread adoption of laparoscopic techniques for intussusception was delayed compared with other pediatric procedures, with improved success rates emerging only in the late 2000s.[13]–[15]

In our experience, laparoscopic reduction using atraumatic bowel graspers is inherently challenging. Manual reduction of a tight intussusception during laparotomy also poses risks, as increased traction can lead to intestinal tearing or perforation. MIS presents additional limitations due to reduced tactile feedback and the limited force that can be applied, which may complicate reduction of severe intussusceptions.

The low success rates of laparoscopic reduction in the early period are likely attributable to the limitations of MIS, particularly reduced tactile feedback and limited traction force, which has contributed to the perception among many surgeons that laparoscopic intervention should not be considered first-line therapy.

In the present study, 23.8% of patients required surgical intervention, and laparoscopic surgery was successful in 78.4% of cases, consistent with recent reports.[3],[16]–[19] Patients underwent a mean of 1.97 reduction

attempts prior to surgery, and a pathological lead point was identified in 8.1% of patients. Wei et al. reported a 13% conversion rate from laparoscopic procedure to laparotomy, which was more common in cases of long-segment intussusception.[17] Bonnard et al. noted that delayed diagnosis, symptomatic peritonitis, and the presence of a pathological lead point were significant risk factors for conversion.[14]

While previous studies suggested that younger age may predispose patients to bowel resection, our study did not find a significant age difference between the reduction and resection groups. The youngest patient in our cohort was 3.5 months old, and three additional patients were 5 months old. Park et al. reported that infants younger than 5 months may present with nonspecific gastrointestinal symptoms without hematochezia, potentially delaying diagnosis.[20] However, in our study, 40% of patients presented within 24 hours of symptom onset, and delayed presentation was not a factor. Only the presence of a pathological lead point emerged as a significant risk factor for bowel resection, consistent with recent literature.[8],[18] Therefore, we suggest that laparoscopic surgery is a reasonable approach even in patients with symptoms lasting more than 48 hours, provided there are no signs of peritonitis.

Previous studies comparing MIS and laparotomy have consistently shown that MIS is associated with shorter hospital stays and reduced analgesic requirements.[10],[21–23] Although operative times may be longer with laparoscopy, Wei et al. reported significantly earlier oral intake and shorter hospitalization compared with laparotomy.[17] In the present study, although a direct comparison with laparotomy was not performed, all patients who underwent laparoscopic procedures were able to start oral intake on the first postoperative day, highlighting a clear advantage of MIS.

Additionally, MIS may benefit patients who experience spontaneous reduction after failed enema reduction, which occurs in approximately 10–13% of cases, potentially due to smooth muscle relaxation under general anesthesia.[17],[18],[24],[25] In this study, 10.8% of patients experienced spontaneous reduction, suggesting that laparoscopic procedures with small incisions can be particularly advantageous in these scenarios.

Recurrence rates after non-surgical management of intussusception have been reported at 5–13%, whereas recurrence after surgical intervention ranges from 1–3%.[23] In line with this, previous studies reported recurrence in 6.6% and 6.25% of surgically treated patients.[10],[21] In our cohort, only one patient experienced recurrence after surgery, which was successfully managed with air enema reduction.

In this study, recurrence was observed in only one patient (5.4%). However, we did not compare recurrence rates between laparoscopic procedures and laparotomy, and further investigation is warranted to clarify any potential differences.

This study has several limitations. Many patients were referred to a tertiary children's hospital, which may have led to an overestimation of the surgical incidence. Additionally, the number of cases was insufficient to allow robust comparison between the bowel resection and reduction groups, limiting the identification of predictive factors for bowel resection. Despite these limitations, this study provides valuable insights, representing the experience of a single pediatric surgeon with extensive expertise in minimally invasive surgery.

CONCLUSION

Laparoscopic surgery for intussusception was successful in 78.4% of patients, with the presence of a pathological lead point identified as the sole predictive factor for bowel resection. The procedure was safe, provided excellent cosmetic results, and was associated with a short hospital stay and early initiation of oral intake. Excluding patients with peritonitis or severe abdominal distension with ileus, laparoscopic surgery can be considered a first-line treatment option for intussusception. In cases of irreducible intussusception, bowel or mesenteric injury requiring repair, or the presence of lead points, conversion to laparotomy should be promptly undertaken without hesitation.

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