Laparoscopy in infantile intussusception: is it safe?

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Aim
To evaluate the efficiency of laparoscopy in the management of primary infantile intussusception. Our primary outcomes were to evaluate the feasibility and safety of laparoscopic reduction of infantile intussusception.
Patients and methods
This prospective study included 92 children with infantile intussusception, admitted and managed in Pediatric Surgery Unit, Tanta University Hospital, from June 2018 to June 2021. All included infants were followed up for 6 months.
Results
Our study included 92 patients with intussusception, with a mean age of 8.61 months. A total of 87 (94.56%) cases presented early within 48 h of the initial complaint and with good general condition, and five (5.43%) cases presented late and/or with bad general condition and were managed with immediate laparotomy. Moreover, 64 (69.6%) showed red currant jelly stool, and 28 (30.4%) presented with intestinal obstruction. Hydrostatic reduction was attempted in 87 stable cases. In addition, 55 (63.2%) were successfully managed using hydrostatic reduction. Recurrence occurred in four cases, and hydrostatic reduction was repeated successfully. Laparoscopic intervention was attempted in 32 (36.78%) cases after failure of hydrostatic reduction, and 27 (84.37%) were completely reduced laparoscopically. Five (15.6%) cases were converted to laparotomy, where two were manually reduced and three cases underwent bowel resection. Operative time ranged between 49 and 180 min, with a mean of 89.05 min. The mean hospital stay was 1.75 days. Mild surgical site infection occurred in 3/10 laparotomy cases and 1/27 laparoscopic cases. There was no recurrence detected within 6-month postoperative follow-up period. Scars of laparoscopy were almost invisible after 6 months compared with exploratory laparotomy.
Conclusio
n Laparoscopic reduction of idiopathic intussusception is feasible and provides minimally invasive approach with excellent results, significantly reduced hospital stay, and better cosmesis.

Keywords:
hydrostatic reduction, intussusception, laparoscopic

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Introduction

Idiopathic intussusception is one the most common causes of small bowel obstruction in children younger than 5 years [1]. Diagnosis is mainly based on clinical examination, including bilious vomiting, red currant jelly stool, and abdominal colicky pain with or without severe abdominal distension. Ultrasonography (US) is the investigation of choice, where a bowel mass with target or pseudo kidney signs are pathognomonic. Contrast enema may be needed for either confirmation of diagnosis or therapeutic combined with hydrostatic reduction. Computed tomography scan may needed in some cases [2].

Since the introduction of hydrostatic reduction by Ravitch in 1848, it became the gold standard for management of intussusception [3]. Nonoperative management of intussusception including either pneumatic reduction using air guided by C-arm or saline enema guided by US is considered the first line of treatment with an average success rate of 80% (range, 40–90%) [4]. Surgical intervention is needed in ~10–20% of cases after failed enema reduction, hemodynamic instability, and/or peritonitis [5].

With introduction of MIS, laparoscopy was initially utilized as a diagnostic modality after failed hydrostatic reduction and then laparoscopic assisted hydrostatic reduction was done; now, it is used as a definitive treatment [6,7]. Although laparoscopy shows an advantage over the open approach including less pain, better cosmesis, shorter operative time, decreased risk of adhesive bowel obstruction, and decreased hospital

stay as compared with open surgery regardless of primary pathology [8,9]. Complications such as failure of reduction, serosal tearing, and perforation have been reported [6]. Moreover, loss of tactile sensation to rule out the presence of pathologic lead-point (PLP) during laparoscopy is thought to be a negative point. Despite the mentioned advantages of laparoscopy, its feasibility has been questioned and needs good laparoscopic skills [10,11].

Patients and methods

This prospective study was carried out in the Pediatric Surgical Unit, Tanta University Hospital, during the period from June 2018 to June 2021, on 92 patients with infantile idiopathic intussusception. The study was approved by ethical committee of the Faculty of Medicine, Tanta University. A written informed consent was taken from the parents and/or guardians. The procedure was explained in details, and in a clear simple language all possible complications were explained. We included all patients with infantile idiopathic intussusception less than 2 years. Neglected patients with bad general condition, previous abdominal surgery, known primary disease, for example, lymphoma, and major congenital anomalies that may affect the outcome were excluded. All patients were subjected to thorough clinical examination and laboratory investigations as needed. Abdominal US was done for all cases to confirm the presence of intussusception. Trials of US-guided hydrostatic reduction were done in all cases except neglected ones.

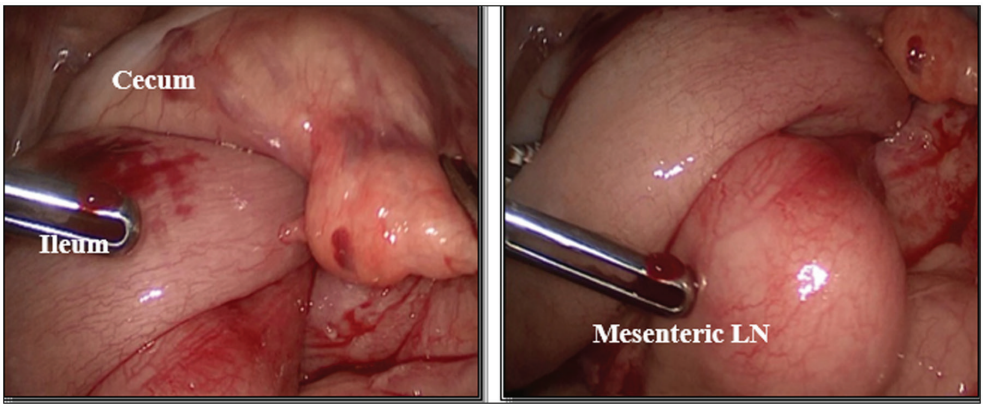
Statistical analysis

The analysis was conducted using the Statistical Package for Social Sciences (IBM SPSS Statistics) for Windows, version 26 (IBM Corp., Armonk, New York, USA). Continuous numerical variables were summarized as mean±SD. Normally distributed numerical variables were compared using independent samples *t* test, whereas abnormally distributed variables were compared with Mann–Whitney test. Categorical variables were expressed as counts and percentages, and their association with success of reduction was assessed using either Pearson's χ^2 test or Fisher's exact test. A *P* value less than 0.05 was adopted to indicate the significance of the results of statistical tests.

Operative techniques

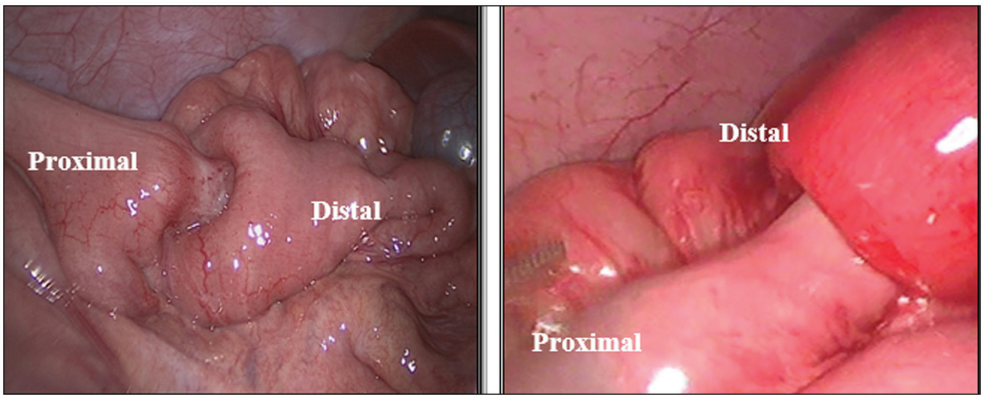
All patients kept in a supine position under general anesthesia with endotracheal intubation with muscle relaxants. A 5-mm umbilical port was introduced by an open technique to establish pneumoperitoneum. The abdomen was insufflated initially at 8–10-mmHg pressure, with a flow rate of 1.5 l/min. Laparoscopic exploration was done, and the site of bowel mass was noted. Two other 5-mm working ports for manipulation were placed depending on the position of the mass and size of the patient either in the suprapubic area (midline) and the left upper quadrant or both the upper left and lower left quadrants of the abdomen. Two nontraumatic wide jaw bowel graspers were used for bowel manipulation. By combined gentle traction of the proximal segment (intussusceptum) from the distal segment (intussuscipiens) and milking of the intussusceptum from the distal bowel with irrigation with warm saline to decrease bowel edema and help reduction, gentle manipulations were done to avoid injury of the bowel. Inspection of the bowel to assure complete reduction and absence of PLP was done before ending the procedure. After complete reduction, deflation of the abdomen and closure of port sites were done. In case of failed reduction or there was no progress for 30 min to one hour, conversion to laparotomy was done and simple manual reduction/resection and anastomosis was done. Patients were followed 6 months postoperatively for wound infection or dehiscence, recurrence, adhesive bowel obstruction, and cosmetic outcome (Figs 1–3).

Figure 1



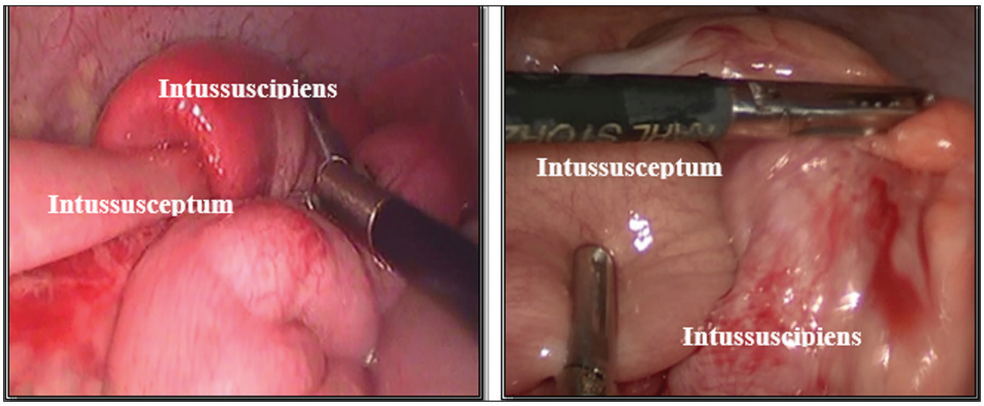
Ileo-colic intussusception.

Figure 2



Ileo-ileal intussusception.

Figure 3



Gentle traction of the proximal intussusceptum out of the distal intussuscipiens.

Results

Our study included 92 patients with intussusception with a mean age of 8.61 months, with male predominance (71 cases). A total of 28 (30.4%) cases presented with early mild symptoms, 64 (69.6%) cases showed red currant jelly stool, and five (5.4%) cases presented with delayed symptoms (severe dehydration and sepsis).

Hydrostatic reduction was attempted in stable cases (87 cases, 94.5%), and five (5.4%) cases with delayed presentation underwent immediate laparotomy. Recurrence of intussusception after hydrostatic reduction was encountered in four (7.3%) cases, and redo hydrostatic reduction was done with a success rate of 100% (Table 1).

Of 87 cases, 55 (59.78%) cases were successfully managed using hydrostatic reduction. Laparoscopic reduction was attempted in 32 (58.18%) cases, where 27 (84.37%) cases were completed laparoscopically and five (18.51%) cases were converted to laparotomy, comprising two cases that were reduced manually and three cases that had bowel resection (Fig. 4).

The mean operative time in neglected cases with immediate laparotomy (n=5) was 123.00 ± 1.95, whereas the mean operative time in cases with laparoscopic reduction (n=27) was 74.78 ± 32.43 (Table 1).

The mean hospital stay was 1.75 ± 1.2 days in all cases. A significant difference was observed in hospital stay in patients who underwent laparoscopic reduction (mean 2.22 ± 0.80) compared with patients who underwent laparotomy (mean 5.40 ± 1.14).

No major intraoperative complication occurred. Conversion to laparotomy after laparoscopic reduction trial was done in five cases owing to failure of reduction only without complications. We found no correlation between age and weight of patients and the success of hydrostatic or laparoscopic reduction; however, the period of symptoms significantly affected the success of reduction whether hydrostatic or laparoscopic.

Surgical site infection (SSI) was encountered in 2/5 (40%) cases of immediate laparotomy and in 5/32 (15.6%) cases of laparoscopic reduction trial. SSI was observed in umbilical port in 4/23 (14.8%) cases

Table 1 Comparison between different management modalities

	All patients (*N*=92)	Immediate laparotomy (*N*=5)	Hydrostatic reduction (*N*=87)			Laparoscopic reduction (*N*=32)		
			Failed (*N*=32)	Succeeded (*N*=55)	*P*	Failed (*N*=5)	Succeeded (*N*=27)	*P*
Age (months)								
Mean±SD	8.61±2.37	8.50±2.42	8.73±1.75	8.55±2.70	0.707[a]	8.40±2.13	8.80±1.71	0.689[a]
Minimum–maximum	6.00–24.00	6.00–11.50	6.00–13.00	6.00–24.00		6.00–10.50	6.50–13.00	
Body weight (kg)								
Mean±SD	7.46±1.70	7.80±2.80	7.37±1.37	7.48±1.77	0.776[a]	6.70±1.30	7.50±1.37	0.280[a]
Minimum–maximum	4.30–15.00	4.50–11.00	5.00–10.50	4.30–15.00		5.50–8.50	5.00–10.50	
Sex [*n* (%)]								
Female	21 (22.8)	0	8 (25.0)	13 (23.6)	0.886[b]	1 (20.0)	7 (25.9)	1.000[d]
Male	71 (77.2)	5 (100.0)	24 (75.0)	42 (76.4)		4 (80.0)	20 (74.1)	
Red currant [*n* (%)]								
No	28 (30.4)	0	14 (43.8)	14 (25.5)	0.078[b]	2 (40.0)	12 (44.4)	1.000[d]
Yes	64 (69.6)	5 (100.0)	18 (56.3)	41 (74.5)		3 (60.0)	15 (55.6)	
Delayed presentation [*n* (%)]								
No	87 (94.6)	0	32 (100.0)	55 (100.0)	NA	5 (100.0)	27 (100.0)	NA
Yes	5 (5.4)	5 (100.0)	0	0		0	0	
Operative time								
Mean±SD	89.05±37.05	123.00±10.95				132.20±15.94	74.78±32.43	0.001*[c]
Minimum–maximum	49.00–180.00	110.00–140.00				120.00–160.00	49.00–180.00	
SSRI [*n* (%)]								
No	85 (92.4)	3 (60.0)	27 (84.4)	55 (100.0)	0.005*[d]	4 (80.0)	23 (85.2)	1.000[d]
Yes	7 (7.6)	2 (40.0)	5 (15.6)	0		1 (20.0)	4 (14.8)	
Hospital stay (days)								
Mean±SD	1.75±1.20	5.40±1.14	2.34±0.79	1.07±0.26	<0.001*[c]	5.40±1.14	2.22±0.80	0.001*[c]
Minimum–maximum	1.00–7.00	4.00–7.00	2.00–5.00	1.00–2.00		4.00–7.00	2.00–5.00	
Recurrence and redo [*n* (%)]								
No	88 (95.7)	5 (100.0)	32 (100.0)	51 (92.7)	0.292[d]	5 (100.0)	27 (100.0)	NA
Yes	4 (4.3)	0	0	4 (7.3)		0	0	

*Significant.

of laparoscopic reduction and in exploratory incision in only one case of conversion. All SSI was treated by systemic and local antibiotics with no subsequent morbidities.

Discussion

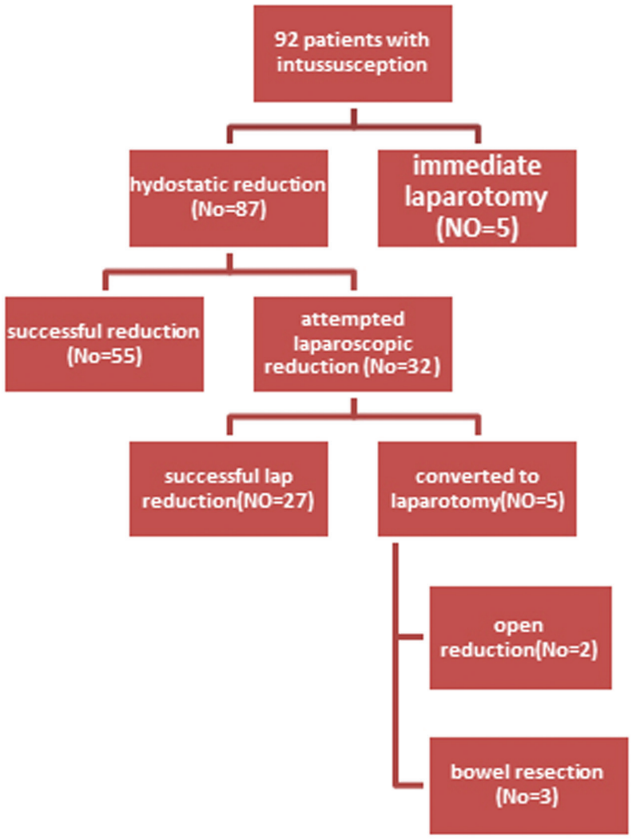
Infantile intussusception is a common pediatric problem in infants and children [2]. Hydrostatic or pneumatic reduction is considered the first line of treatment with a good success rate. Daneman and Alton [12] reported a high success rate (about 85%) for pneumatic reduction of infantile intussusception [13]. A debate is still present regarding the optimal operative approach (laparotomy or laparoscopy) after failure of nonoperative reduction. Conventional laparotomy was considered the standard approach. However, over the past decades, advances in minimally invasive surgery were reflected into the management of infantile intussusception. Laparoscopic reduction may be attempted without a significant increase in mortality or morbidity [14].

In the present study, we tried to evaluate the feasibility and safety of laparoscopic reduction of infantile idiopathic intussusception after failure of hydrostatic reduction.

Our study included 92 patients presenting with idiopathic intussusception. Age was ranged between 6 and 24 months, with male to female predominance. Five (5.43%) cases presented late, and immediate laparotomy was done. A total of 55 (63.2%) children were successfully reduced by warm saline enema. Laparoscopic surgical simple reduction was successful in 27/32 (84.37%) cases, whereas laparoscopy approach failed in five (15.6%) cases and laparotomy was done, with resection and re-anastomosis being done in three cases, whereas the remaining two cases were reduced.

Apelt *et al.* [15] in a systematic review reported that the success rate of laparoscopic reduction was more than 70% with a low rate of intraoperative (0.4%) and postoperative complication (2.9%), whereas in the study by Hill *et al.* [16], laparoscopic reduction was

Figure 4



Algorithm of management.

attempted in 70% (*n*=65) and was successful in 68% of the time (*n*=44).

During laparoscopic reduction, we used a combined gentle traction and counter traction, milking of intussusceptum, irrigation with warm saline, and/or all. The only disadvantage of laparoscopy is loss of tactile sensation of PLP and use of instruments instead of our hands, which may lead to serosal tears and bowel injury, but we still find that it is feasible and safe with enough experience and patience.

The operative mean time in the current study was calculated from skin incision to skin closure. The mean operative time was 74.78 ± 32.43 min in cases that were successfully completed laparoscopically, which was noted to be significantly shorter than in cases managed by laparotomy from the start (mean 123.00 ± 10.95). Wei *et al.* [17], reported 23 and 35 patients in laparoscopic and open group, respectively. The mean operative time was significantly longer in the laparoscopy group (70.4 ± 37.7 vs. 47.3 ± 15.1 min, *P*=0.01) owing to early use of laparoscopy and little experience. Hill *et al.* [16] in a study of 92 patients treated for intussusception (65 in laparoscopy group and 27 in the open group) reported that the operative time was shorter in the laparoscopy group (50.3 ± 35.1 min) than the open group (65.78 ± 29.1 min).

We reported a significantly shorter hospital stay in favor laparoscopic reduction. In our study, the cases that responded to hydrostatic reduction were discharged the next day, with a mean hospital stay of 1.07 ± 0.26 days. The mean hospital stay was 2.22 ± 0.80 days in cases of laparoscopic reduction, whereas the cases that underwent urgent laparotomy stayed in the hospital for 4–7 days, with a mean of 5.40 ± 1.14. In the study by Hill *et al.* [16], the median length of postoperative hospital stay was 1 day, with a range of 1–15 days for the laparoscopy group and 3 days with a range of 1–6 days for the open group (*P*=0.001).In our study, five (15.6%) cases failed to be reduced laparoscopically and were converted to open approach. Two of them were successfully reduced by manual reduction and the other three cases needed bowel resection. To our mind, this finding indicates the feasibility of laparoscopy in reduction of intussusception and conversion mainly owing to bowel ischemia and the need for bowel resection. Houben *et al.* [18], reported a conversion rate from a laparoscopic approach to an open intervention of 35%. In a study conducted by Bonnard *et al.* [19] on 69 patients, 21 patients required conversion to open surgery (31.9%). Eleven of these were converted because of failure of laparoscopic reduction.

In the current study, no major intraoperative complications were noted. Minor postoperative SSI was noted in seven cases, including 3/10 in open cases and 4/23 in umbilical port in laparoscopy cases; all were treated by local and systemic antibiotics, with no further morbidities. Apelt *et al.* [15] recorded only one intraoperative complication, which was a case of iatrogenic visceral perforation (0.4%). Postoperative complications were reported in the laparoscopy group, one of which experienced a postoperative intestinal perforation; it is unclear from the data whether this corresponded to a missed intraoperative perforation or represented a separate event. Moreover, there were two cases of postoperative wound infection and one case of port site hernia.

After a mean follow-up period of 6 months, there were no detected cases of recurrence in either laparoscopic or open approaches.

Conclusion

Despite the short duration of follow-up for most of the patients, laparoscopic reduction of idiopathic intussusception is feasible and provides minimally invasive approach with excellent results, significantly reduced hospital stay, and better cosmesis.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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