

## Review Article

### Laparoscopic Reduction of Intussusception in Children: Role in Primary and revisional Reduction after Failed Non-Surgical Therapies.

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#### Abstract:

**Background and objective:** With the advent of laparoscopy into pediatric surgical field and with experience gaining, as well as, improvement in instrumentation, it has been used in management of different conditions, including intussusception. However, there is no universal acceptance regarding its role in reduction of intussusception. This is due to the early reports of high conversion rate and the concern of missing a lead point. The aim of this article is to review the literatures about safety and efficacy of laparoscopy in intussusception management and the limitations as well as formulating a working algorithm for management of intussusceptions in pediatric age group up to 18 years. Up to my knowledge this is the first review article in this subject.

**Method:** A comprehensive review of the English literature in Pub Med searching engine was conducted with key words laparoscopy, intussusception, management of intussusception, minimal invasive surgery and intussusception, laparoscopic reduction of intussusception, between 1996 and 2009. The results yielded were further explored for citation regarding the role of laparoscopy in reduction of intussusception.

**Results:** The success rate increased from 57% in 1997 to 91% in 2009 while the conversion rate decreased from 43% in 1997 to 9% in 2009. The presence of a lead point and/or ischemic bowel were the main reasons for conversion in the initial reports.

**Conclusion:** Laparoscopy is a safe and efficient method for reduction of intussusception. The presence of a lead point or necrotic bowel is no more indication for conversion to open surgery. Laparoscopy should be an integral tool in the management algorithm of intussusception.

**Keywords:** intussusception reduction, laparoscopy in children, role of laparoscopy in intussusception.

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## Introduction

Intussusception is one of the main abdominal emergencies in children. Its diagnosis is usually based on the clinical features and confirmed either by U/S and /or barium enema and CT scan in rare occasion. Since the introduction of the hydrostatic reduction of intussusceptions by Ravitch in 1848, <sup>(1)</sup> it became the gold standard management. However surgical intervention is required if this and other non-operative approaches fail. This typically involves 10 to 20% of cases. <sup>(2, 3, 4)</sup> Early on, the approach has been through an open laparotomy and manual reduction of intussusception. Later, the introduction of the laparoscopy in the pediatric surgical field has added another dimension to the management of intussusception. In addition to its confirmed general benefits of less pain, better cosmesis, and low long-term risk of adhesive bowel obstruction <sup>(5,6)</sup> it also can be a diagnostic modality in certain cases, primary reduce the intussusception and in some cases to resect the pathological lead point or the damaged segment of bowel. <sup>(7,8)</sup> The laparoscope allowed the surgeons to avoid unnecessary open procedures in cases of spontaneous reduction following enema reductions, obviating the need for an open procedure in up to 30% of cases. <sup>(9)</sup> Despite of all mentioned above, its effectiveness has been questioned. <sup>(10)</sup>

## Technique

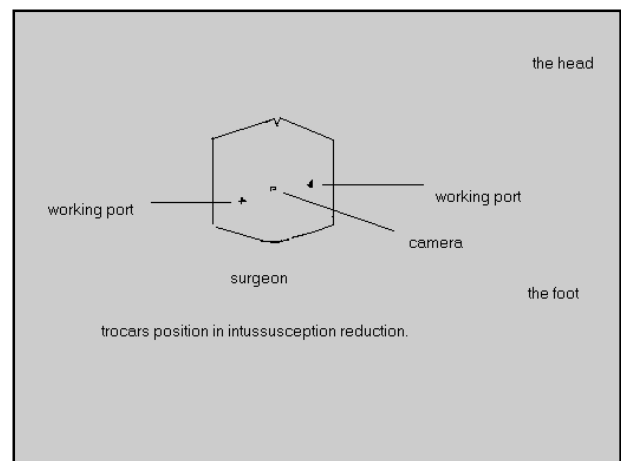
The patient is placed in supine position, near the foot of the table. The surgeon is at the patient's feet. However depending on the position of the intussusception, the surgeon may rotate to the right or the left of the table. The basic principle is for the surgeon to be in line with the camera, the intussusceptum, and the video monitor to prevent paradoxical motion while operating. <sup>(11)</sup> The abdomen is insufflated through an umbilical ring incision and a trocar is inserted to act as a camera Port., using 0 degree telescope. Two other 5 mm working ports for manipulation are placed depend on the position of the intussusception either in the right lower quadrant and the left upper quadrant or both the upper left and lower left quadrants of the abdomen. These ports position is assuming that radiological reduction has carried the intussusceptum to the right colon fig (1). Two atraumatic bowel clamps are

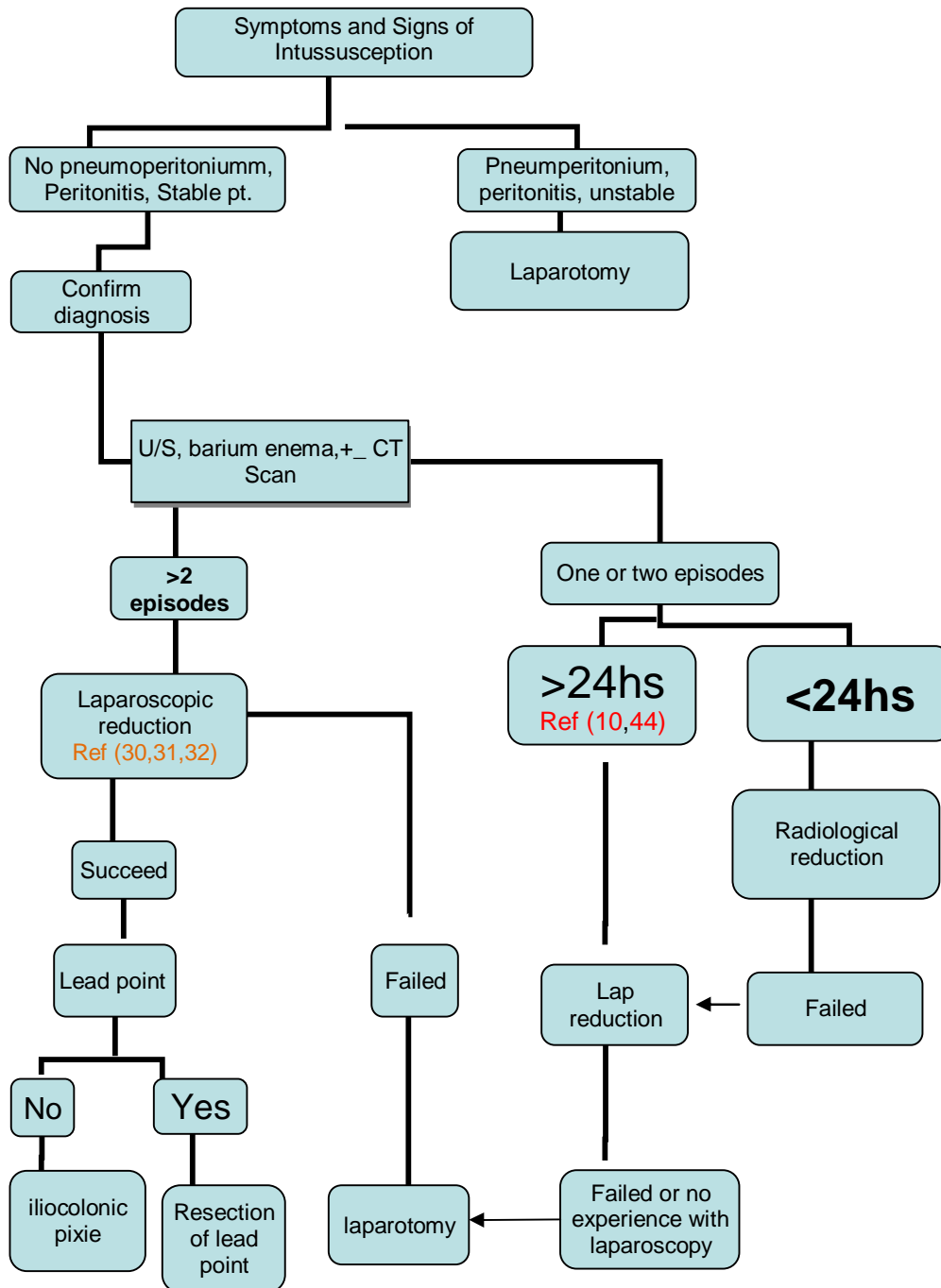
used for bowel manipulation. The reduction is achieved by traction placed on the proximal bowel (intussusceptum) out of the distal segment (the intussuscepiens)

The main concern raised about this technique is the use of traction to reduce the intussusceptum and the risk of bowel wall injury. However, if the traction applied is a gentle traction, the incidence of serosal tear appears to be equal to that encountered with manual reduction. In addition to that, the presence of gas (pneumoperitonium), may aid and ease the reduction during laparoscopy. Some centers described combined technique: using with laparoscopy either air or saline enema. They claimed that this increases the rate of success. <sup>(9, 12, 13, 14)</sup> In order to decrease the rate of bowel injury during reduction, Chui et al (8) have described a "Chinese fan spread" distraction technique that utilizes the 2 bowel graspers to create an intracorporeal fulcrum to distribute the distraction forces more evenly as the surgeon does a push-pull on the intussusception. They reported less bowel injury as well as conversion rate.

## Figure 1:

One of the suggested set-up and port positions in laparoscopic reduction of intussusceptions.



**Figure 2:** Suggested algorithm for management of intussusception

### To do appendectomy or not?

The decision whether to do appendectomy or not is not clear. There is little evidence to justify removal or leaving the appendix. Those who remove it are convinced by different reasons. First, the approach to laparotomy is through a transverse infra umbilical incision which is similar to that of appendectomy. This later on may cause confusion if appendectomy was not done. Second, some authors believe that the appendix acts as a reservoir for adenovirus, which in turn, is a major predisposing factor for intussusception and recurrences, as the appendix may act as a lead point for intussusception so by doing appendectomy you remove the potential risk of recurrence. In some studies, viral inclusions were seen in the appendices from cases of intussusceptions in 45% of cases.<sup>(15, 16)</sup> Furthermore, the blood supply to the appendix often is compromised when reduction done for the intussusception which necessitate appendectomy.<sup>(17)</sup>

On the other hand, there are other reports which claim that the appendectomy stump may also act as a lead point and cause intussusception.<sup>(18, 19, 20)</sup> In the era of laparoscopy the confusion from incision site is not there. A. Bonnard and his colleagues<sup>(21)</sup> found that on 36 out of 69 patients who had an appendectomy during the procedure, 3 patients presented with recurrence compared with 4 patients out of 33 who did not have appendectomy. I personally believe that if the appendix looks normal (no congestion or ischemia), it should be left alone.

### Indications and contraindications of laparoscopy

The radiological studies revealed that, the rate of success of radiological methods decrease if the onset of symptoms is more than 24 hours.<sup>(22)</sup> In addition to that clinical signs of peritonitis, perforation, or hypovolemic shock are clear contraindications to enemas. These lead to a general consensus among pediatric surgeons that the indication for open surgery in intussusception is failure of radiological reduction and the presence of contraindications for it. However the indications for laparoscopic reduction of intussusceptions are not yet clear.

The French study group for pediatric laparoscopy (GECI) conducted a multi-centre retrospective study to elucidate this subject.<sup>(21)</sup>

Cases were collected from 7 pediatric surgical centers, between 1992 and 2005. Data analyzed included age, duration of symptoms, findings on initial assessment, and level of intussusceptum after attempted hydrostatic enema reduction, type of laparoscopic approach, operative time, and conversion to open surgery, etiology, and post operative complications. Sixty nine patients (48 males and 21 females) were reviewed. The average age of diagnosis was 2.9 years (range, 0.3-14.8). The average time from onset of symptoms to diagnosis was 2.1 days (range, 0.5-15). The authors found that the best candidate for laparoscopic management of patients with intussusceptions who have failed hydrostatic enema reduction is when the time from onset of symptoms to diagnosis is short (< 1.5 days), and in whom there are no signs of peritonitis. They added, when a pathologic lead point exists (tumor, Meckel's diverticulum, Henoch-Schonlein purpura), the risk for conversion to an open procedure was higher. Neither the number of previous episodes of intussusceptions nor the level of intussusceptum after attempted hydrostatic enema reduction appears to increase the risk of conversion to an open procedure. The limitations of the study are; it was retrospective and the procedure was done by different surgeons of different level of training (consultant, fellow and resident). These may explain why the conversion rate is high in presence of a lead point. Although this report and others<sup>(13,21,23)</sup> pointed to the presence of a lead point is contraindication to laparoscopy, however, others consider this is not true and both pathological lead point or necrotic bowel segment can be dealt with effectively with laparoscopy.<sup>(8, 24)</sup>

Another situation in which early laparoscopy is recommended is in case of recurrent intussusceptions (i.e. > 2); for diagnostic purpose to rule out the presence of a lead point as well as to deal with it laparoscopically if it is there.<sup>(25, 26, 27)</sup>

The contraindications to laparoscopy procedure include uncorrected coagulopathy, hemodynamic instability, and severe cardiopulmonary disease and severe abdominal distension. Peritonitis is still considered, by some authors, to be a contraindication to the laparoscopic approach because the theoretical risk of enhanced

bacteremia and endotoxemia by pneumoperitoneum. (28, 29, 30)

To sum up, I believe that laparoscopy is indicated if: (1) radiological methods for reduction failed or there are contraindications for them. (2) if investigations revealed presence of a lead point. (3) Recurrent intussusceptions (more than tow and (4) in case of late presentation > 24h.

reports let critics have questioned the benefit of laparoscopy. However, with expanding experiences, expertise and armamentarium the success rate has increased up to 85-87% in 2007, and up to 91% in 2009 (see table no 1).

In a study comparing open and laparoscopic reduction of intussusceptions, Teitelbaum D. H et al (23) found that, intraoperative complications occurred only in the cases where bowel necrosis was present

**Table (1):** The success and conversion rates in the previous studies

Authors	Total no. of patients	Success rate	Conversion rate	Lead points
Fraser JD et al 2009.(24)	22	91% (20 pts.)	9% (2)	9
Bonnard A et al.2008	69	68.1%	(31.9%) 22	4
Chui CH . et al 2007 (8)	14	86 (12 pts.)	14% (2)	5
Burjonrappa S.C. 2007. (7)	6	85%	15% (1)	2
Cheung S.T. et al.2207.(31)	15	86.7%	13.3 (2)	N/M*
Gerstte J.T. et al 2007 (32)	18	72%	28% (5)	6
Teitelbaum D.H. et al.2005 .(23)	16	87.5%	12.5 (2)	2
Poddubnyi IV et al 2003.(13)	126	86.7%	13.3 (16)	N/M
Bax NM. et al. 2001. (10)	10	30(3 pts)	70(7 pts)	nm
Lai IR et al 2000.(42)	2	100%	-	N/M
Hay SA et al "1999".(9)	20	*40+30%	30% (6 pts.)	N/M
Schier F. 1997.(12)	7	57% (4 pts).	43% (3 [pts)	1
Cuckow et al.1996.(43)	1	succeed	-	N/M

\*N/M= not mentioned.

### Safety and efficacy

Several authors have declared the safety and efficacy of laparoscopy in management of intussusceptions. (10, 13, 24)

Being laparoscopy new modality introduced in pediatric surgical field, the success rate in the initial reports was low. In 1997, Schier reported 75% success rate in his series of patients (4/7 patients). (15) In Baxs series, (10) surgical intervention was required in 35 out of 72 patients with intussusceptions treated in the period from 1990 to 2000, 10 of them had undergone laparoscopic approach with success in 3 only. This low success rate in the initial

and resulted in a 12.5% (2/18) conversion rate to open. Postoperative complications between the open and laparoscopic groups were not significantly different in this study, (P= 0.637). The open group experienced one wound infection and one recurrence (2/25), and the laparoscopic group experienced one urinary tract infection and one recurrence (2/18).

Sing T et al (31) reported their experience with 15 children who underwent laparoscopic reduction of intussusception. The success rate was 86.7% (12 of 15) with no intra or post operative complications. Another study Sing came from Canada matched the results of Sing T et al. (32)

At the start of use of laparoscopy in intussusception management, the presence of a lead point or necrotic bowel was an indication for conversion to open surgery. However, the improvement in the instrumentation and surgical skills had made it a safe and efficient method to deal with these problems without significant increase in mortality or morbidity.<sup>(24)</sup>

### Length of hospital stays and cost effect

Burjonrappa SC,<sup>(7)</sup> found that the length of stay was 6 days for laparoscopic reduction while it was 7 days for laparotomy which was statistically insignificant ( $p=0.66$ ). However in the remaining studies (see table no 2), the lengths of stay were shorter and statistically significant.

This short hospital stay will decrease the overall cost of the procedure.<sup>(31)</sup> Although during the laparoscopic surgery the usage of disposable equipment increases the operating room expenses. This can be decreased by using reusable instruments.<sup>(33, 34)</sup> Teitelbaum DH et al,<sup>(23)</sup> found that the total hospital charges were lower in laparoscopic side (\$8171+-2595) compared to open group (\$11,672+\_ 5466), although that was statistically not significant ( $P= .088$ ).

**Table (2):** The length of hospital stay in laparoscopic procedures vs. open in days

SERIES	LAP (days)	OPEN (days)	P VALUE
Teitelbaum D.H. et al 2005.(23)	3 ± 1.31	4.52 ± 1.98	0.005
Burjonrappa SC 2007.(7)	6	7	0.66
Cheung S.T. et al 2007.(31)	3	8	0.0001
Gerstle J.T. et al 2007.(32)	4.8 ± 3.5	9.1 ± 7.5	0.02

\*The authors compared those who treated by pneumatic and laparoscopic against those underwent laparotomy.

### Recurrent intussusception

The recurrence rate has been reported to be 5 to 13% in non-operative reduction and 1 to 3% in open surgery.<sup>(35, 36)</sup> There is no data available on the recurrence rate after laparoscopic reduction based on long-term follow up. What was reported usually based on short-term follow up. Sing T et al reported one recurrence of 15 patients who were treated laparoscopically. The recurrence happened in the second day post operative and was treated by radiological method and there was no lead point. Teitelbaum DH et al<sup>(23)</sup> also found one recurrence in their series. Based on suggestive radiological study, that child was managed by open exploration which revealed small subserosal duplication in terminal ileum. Fifty percent of children who develop recurrent intussusception will present within 48 hr, although recurrences have been reported up to 18 months. The reported incidence of lead points causing recurrent intussusceptions varies between 8 to 12 %.<sup>(37, 38, 39, 40)</sup>

The best method to manage recurrent intussusceptions is still debated. Several methods have been described including radiological reduction, surgical resection, and iliocolonic pexie. Some authors have recommended hydrostatic reduction as the first line for treatment of recurrent intussusceptions, citing a 62.8% success rate for recurrent episodes and 68.9% for the initial episode. They have recommended recurrent intussusceptions to be treated surgically when there is; more than one episode of recurrence, in patients over 2 years of age, and if a pathological lead point is suspected.<sup>(41)</sup>

Similarly, Chang YT et al,<sup>(26)</sup> stated that in cases of multiple recurrences (i.e. more than 2), the presence of a lead point should be suspected and operative therapy should be strongly considered over hydrostatic reduction. However when surgery indicated, laparoscopy is the best initial choice. They treated 6 children with multiple recurrences of ileocolic intussusception by appendectomy and ileocolonic pexie after successful hydrostatic reduction with no recurrence in the follow up period (2 months). Another report which demonstrated that, ileocolonic pexy is good choice came from Germany for a child aged 1 1/2 year with 3 recurrences treated in the same way and there was no further recurrence within 1 year follow-up period.<sup>(25)</sup> On the other hand, if there is a lead point, it should be managed by

surgical resection of it or of the involved bowel if necessary which can be done safely with laparoscopy. <sup>(27)</sup> The conventional method (open surgery) should be reserved to situations where there is no experience with laparoscopy, difficulty with laparoscopy or complication of laparoscopy.

### Conclusion

Laparoscopy is a safe and reasonable approach for pediatric intussusception even in the presence of bowel resection.

Most of the lead points can be diagnosed and dealt with by laparoscopy. However, still some of intraluminal lead points may be missed as most of tactile cues are lost with laparoscopy. It is now an integral tool in the management algorithm of certain diseases in pediatrics and I believe that its role will be further expanded in intussusception management in the future.

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