

## Laparoscopy Approach for Non-Traumatic Acute Intestinal Perforation in Children

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## Abstract

**Background:** Non-traumatic acute intestinal perforation secondary to Enterocolitis is a severe event that requires immediate treatment. Exploratory laparotomy has been the gold standard in the past decades. Recently, several reports described that minimal invasive surgery has been successfully applied to colonic perforation in emergent settings for both adult and children. The aim of this study is to evaluate the efficacy of laparoscopy on non-traumatic intestinal perforation in children.

**Method:** Between June 2009 and September 2013, patients under 18 year-old who underwent laparoscopic surgery for non-traumatic acute intestinal perforation were enrolled. The demographics of the patients, operative details, postoperative complications and the time resuming oral intake were retrospectively collected by chart review.

**Result:** There were consecutive 7 patients, including 5 boys and 2 girls. The mean age was  $8.3 \pm 4.2$  years (range: 2-15 years). A diversity of operative procedures was undertaken, encompassing tube cecostomy in 1 case, primary repair with tube cecostomy in 1 case, primary repair in 4 cases, and appendectomy in 1 case. Conversion to laparotomy was not necessary. The time resuming oral feeding was between postoperative day (POD)  $6.3 \pm 1.4$ th (range: 5-8 days). For two cases receiving tube cecostomy, constant stool leaking beside the tube predisposed to chronic wound infection and granulomas which required further surgeries. Otherwise, there was no complication recorded, such as surgical site infection, intestinal obstruction.

**Conclusion:** Laparoscopic surgery for non-traumatic acute intestinal perforation in children is technically feasible and providing benefits of low complication rate and satisfactory cosmetic outcomes. Minimally invasive surgery could be considered as first-line approach for non-traumatic acute abdomen. For cases of solitary perforation, primary repair can be safely performed through laparoscopy.

## Introduction

Non-traumatic acute intestinal perforation in children is an urgent event, mostly secondary to bacterial Enterocolitis. Immediate surgical intervention is required. Exploratory laparotomy in conjunction with various procedures, such as primary repair, bowel resection, with/without stoma creation, has been the gold standard in past decades. In recent years, experienced surgeons turned to apply minimally invasive surgery in emergency circumstances for both adults and children [1-4]. Laparoscopy was also utilized to deal with this entity. Favorable results were reported [1,4]. The author would introduce the experience of laparoscopic approach for non-traumatic acute intestinal perforation in children. The aim of the study is to evaluate the feasibility and outcomes.

## Method

This is a retrospective study by review of medical charts. Between January 2009 and September 2013, patients under 18 year-old receiving laparoscopic surgery for non-traumatic acute intestinal perforation were included. Demographic data, operative procedures, intraoperative findings, operation time, pathogens, time to resume feeding, length of postoperative hospital stay, and complications were collected.

## Operation

Aggressive hydration was given preoperatively to maintain appropriate fluid status. The first port was placed at umbilicus by the open method. A non-traumatic troca (5 or 10 mm) was inserted under direct vision to prevent troca-related complication. Intraabdominal pressure was set between 10 and 15 mmH<sub>2</sub>O based on the age and weight. Another two ports were placed at suprapubic area (5 mm) and left lower quadrant abdomen (5 mm) (figure. 1). The first step was taken to conduct thorough peritoneal irrigation. The whole small and large bowels were carefully inspected. Bowel content was decompressed through nasogastric tubes, rectal tubes, or even perforation holes. Following identifying perforation site, the margin of perforation was refreshed. Primary repair

**Table 1:** Patient profile, operation detail, and outcomes.

No.	Age (year)	Gender	Perforation	Procedure	Operative time (min)	Pathogen	Complication	Resuming intake	Hospital stay
1	2	M	Cecum, solitary	Tube cecostomy through the perforation	140	Salmonella group D	Cecostomy wound infection and granuloma, require excision	POD 8	POD 12
2	11	F	Ascending colon, solitary	Primary repair & tube cecostomy	141	NI	Cecostomy leaking and wound granuloma, require excision	POD 5	POD 8
3	6	M	Ileum, solitary	Primary repair, extracorporeal	83	NI	Nil	POD 7	POD 9
4	8	M	Cecum, solitary	Primary repair	105	NI	Nil	POD 5	POD 7
5	15	M	Ascending colon, solitary	Primary repair	156	NI	Nil	POD 5	POD 6
6	10	F	Appendix, solitary	Appendectomy	110	Salmonella group D	Re-admission for recurrent enterocolitis	POD 6	POD 10
7	6	M	Cecum, solitary	Primary repair	121	MR-CNS	Nil	POD 8	POD14

\*NI= not identified. POD= postoperative day.

was accomplished with 3-0 or 4-0 absorbable polyfilament sutures in an interrupted fashion, either intracorporeally or extra corporeally. Tube cecostomy was taken in the first two cases for diverting of liquid bowel content. A drain tube was routinely placed.

**Result**

There were consecutive 7 patients enrolled in this study, 5 males and 2 females. The mean age was 8.3 ± 4.2 years (range: 2-15 years). Patient profiles, operative details, and outcomes were listed in table 1. The diagnosis of hollow viscous perforation was preoperatively made in 5 cases based on radiological pneumoperitoneum, while other two patients were deemed appendicitis and peritonitis. Perforation sites were located at cecum for 3 cases, ascending colon for 2 cases, ileum for 1 case, and appendix for 1 case. Operative procedures comprised tube cecostomy only through the perforation for 1 case, primary repair with tube cecostomy for 1 case, primary repair for 4 cases, and appendectomy for 1 case. Mean operative time was 122.3 ± 25.1minutes (range: 83-156 minutes). In terms of pathogens, non-typhoid Salmonella was identified in 2 cases, MR-CNS in one case,

and not identified in 4 cases. Mean time of resuming intake was on Postoperative Day (POD) 6.3 ± 1.4th (range: 5-8 days). Mean length of postoperative hospital stay was 9.4 ± 2.8 days (range: 6-14 days). With regards to morbidities, all patients were free of anastomotic leakage, Intrabdominal abscess, or troca wound infection. Cecostomy wound infection occurred in 2 out of 2 cases with tube cecostomy. Further operations were required to debride and repair cecostomy wound (Figure 2). One patient was re-admitted due to recurrent Enterocolitis.

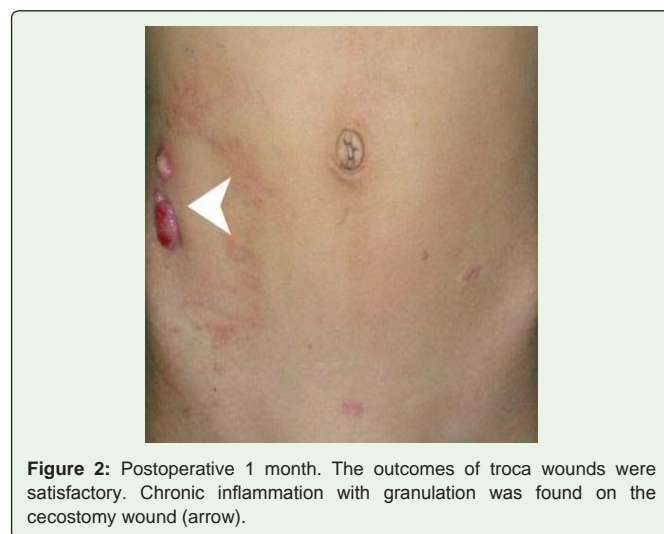
In review of literature, surgical site infection was rarely noted [3,4]. Conversion to open surgery was rarely necessary. Mean operation time ranged from 107 min to 271 min in the literature, 122.1 min in this study. Mean length of hospital stay was between 7.3 days and 15.2 days in the literature, 9.5 days in this study. There was no adhesion ileus mentioned.

**Discussion**

With boosting experiences on minimally invasive techniques, sophisticated surgeons have been expanding their visions from simple, elective settings to complicated, emergency situations,



**Figure 1:** Port and drain arrangement.



**Figure 2:** Postoperative 1 month. The outcomes of troca wounds were satisfactory. Chronic inflammation with granulation was found on the cecostomy wound (arrow).

including complicated appendicitis, perforated peptic ulcer, bowel perforation [5-7]. In dealing with non-traumatic acute abdomen, laparoscopic approach is beneficial for both diagnostic and therapeutic purposes. In this study, four out of six cases (67%) were preoperatively diagnosed hollow viscus perforation, whereas other two cases (33%) were conceived acute appendicitis (case 4) and acute peritonitis (case 6). Some authors illustrated the similar finding [3,8]. Excellent surgical views provided by high-resolution imaging system help surgeons identify lesions as well as fix the problem. Routine use of laparoscopy for non-traumatic acute abdomen is a reasonable recommendation [5]. For surgeons not so familiar with laparoscopic skills, diagnostic laparoscopy is also helpful to decide the location of incision and minimize the size of incision [4].

One of the main concerns about laparoscopy is a limited working space in a distended abdomen of a small child. The youngest patient in this study was 2 year-old. Chiang and Lee published that laparoscopic operation could be fulfilled in a patient as young as 5 month-old [3]. Abdominal distention frequently occurs in patients with Enterocolitis and peritonitis. Both intraluminal (enterocolitis) and extra luminal infection (leaked bowel content and infective ascites) cause bowel dilated and edematous, occupying massive peritoneal spaces. In our practice, after evacuating peritoneal fluid and inflammatory material, a working space could be properly created in all cases, and surgical procedures would not be hampered.

Many factors contribute to the variability of surgical procedures, comprising surgeon's preference, patient's condition, and limitation of instruments. Stoma creation was once the choice of operation. Due to the advancement of antibiotics, surgical skills, and postoperative care, primary repair is turning to be the trend for purposes of decreasing children's suffering and avoiding stoma-associated morbidities [3-5]. Recent studies reported laparoscopic primary anastomosis for acute colonic perforation in children would lessen postoperative complications [3,4]. In our experiences, all perforations were solitary. Wedge resection and primary repair became logically straightforward. The decision of the repair method could be made based on the location of the perforation.

The majority of complications in this study were associated with tube cecostomy. Tube cecostomy was used for diverting liquid stool, monitoring stool consistency, and decreasing numbers of diarrhea. The cases with cecostomy suffered from frequent stool leaking around cecostomy tube, predisposing to chronic infection, granulation formation. As described above, since primary repair has been recognized safe, tube cecostomy was abandoned in the following cases. However, in certain particular case, placing a cecostomy tube through a cecal perforation will eliminate the worry about anastomotic leakage.

In case 6, it is rare to have a perforation on appendix in terms of bacterial Enterocolitis. It was a debate to differentiate whether the etiology was Salmonellosis or concomitant appendicitis. According to operative findings, the appendix lumen was patent without being obstructed by fecalith. Ascites culture showed non-typhoid Salmonella, the same as the pathogen from blood culture. Therefore, these clues concluded that the etiology of perforated appendix was Salmonellosis rather than appendicitis.

## Conclusion

Laparoscopic approach for acute intestinal perforation secondary to Enterocolitis is technically feasible and provides benefits of less complication, satisfactory wound outcomes. For cases of solitary intestinal perforation, primary repair can be safely performed through laparoscopy.

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