

# Update on Transumbilical Laparoscopic-assisted Surgery in Infants and Neonates

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## Abstract

**Background:** Because of the restricted space of the peritoneal cavity and the easy mobility of abdominal and pelvic organs in infants and neonates, the boundary of minimally invasive surgery was extended to complete the operation outside the abdomen. The objective of this study was to report our experience with transumbilical laparoscopic-assisted surgery (TULS) in different abdominal pathologies in infants and neonates. **Patients and Methods:** A retrospective study was conducted on 59 patients who underwent TULS from 2014 to 2020. The study outcomes were the conversion to open approach, length of hospital stay and post-operative complications. **Results:** The most common indications were explorations for intra-abdominal testes ( $n = 15$ ) and inguinal herniorrhaphy ( $n = 13$ ). Patients who had surgery for pyloric stenosis were younger ( $1.03 \pm 0.25$  months). The average operative time was  $45.9 \pm 18.39$  min. The longest operative time was reported with surgery for liver cysts ( $94.5 \pm 10.6$  min). Oral intake was started after 48–56 h in patients who had excision of duplication cysts. The average post-operative hospital stay was  $2.6 \pm 1.52$  days. No major complications were reported. Wound infection occurred in one patient with a duplication cyst. Three patients were converted to open repair (5.1%) and no late complications were reported during the mean follow-up time of  $11.2 \pm 5.1$  months. **Conclusions:** The transumbilical approach is a safe alternative method to laparotomy in several abdominal pathologies in infants and neonates. It has a short operative time and hospital stay. The technique is associated with few complications and conversion rates.

**Keywords:** Duplication cyst, ovarian cysts, transumbilical laparoscopic-assisted surgery

## INTRODUCTION

The minimally invasive surgery became the standard of care with mutual benefits for the patients and surgeons. Laparoscopic surgery offers a quicker recovery and better cosmetic results compared to the conventional approaches.<sup>[1]</sup> Laparoscopic surgery had evolved to use natural embryonic orifices and a single incision minimally invasive procedure.<sup>[2]</sup> Endoscopic surgery in young babies is limited by the small cavities, which prolongs the operative times and increases the rate of conversion to open surgery.<sup>[3]</sup> The limited space of the abdominal cavity in infants had extended the boundary of minimally invasive surgery to complete the procedure extracorporeally. Several investigators used the transumbilical approach for appendectomy and other intra-abdominal operations in infants.<sup>[3-7]</sup>

The transumbilical laparoscopic-assisted surgery (TULS) has the benefits of the laparoscopic and open approaches. In

paediatrics, the umbilical incision provides ample space for adequate exposure with good post-surgical cosmetic results. Moreover, the conversion to the standard two- or three-port laparoscopy or open surgery is feasible if needed. The objective of this study was to report our experience with TULS in different abdominal pathologies in infants and neonates.

## PATIENTS AND METHODS

### Design

This retrospective study included 59 paediatric patients who had transumbilical single-incision laparoscopic-assisted surgery between October 2014 and January 2020 in a single

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centre by single surgeon. The Institutional Review Board approved the study, and the need for the patients' consent to participate in the research was waived.

### Data collected

We extracted the data required for this study from the electronic and paper charts. The obtained data included age at the time of surgery, the indication of operation and the operative times.

Study endpoints were the conversion to open approach, length of hospital stay and post-operative complications.

### Technique

We performed a 5- or 10-mm, an umbilical incision for the camera. We insufflated CO<sub>2</sub> into the abdomen with flow rate of 1 l/min under a maximum pressure of 7 mmHg. Then, we explored the abdominal cavity through the laparoscope. For the management of ovarian cysts, we introduced a needle through the abdominal wall under direct laparoscopic vision. We used the needle to decompress the cyst, which provided free mobility of the adnexa. We introduced the instruments through the working port, and the cyst was gradually pulled outside the abdominal cavity [Figure 1]. We used the diathermy to excise the cyst outside the body entirely and attempted ovarian-sparing procedures whenever possible. When we could not distinguish the ovarian mass from the surrounding tissues, we performed total oophorectomy with sparing of the fallopian tubes. For the hepatic cyst, we used transfixing sutures to achieve haemostasis and control leak of the hepatic tissue. Afterward, we confirmed proper haemostasis using the laparoscopic camera. We closed the wound in layers and applied a Steri-strip to the skin. For the duplication cysts [Figure 2] and intussusception [Figure 3], we brought the lesion to the wound, and we performed reduction or excision and anastomosis extracorporeal. We then returned the bowel to the abdominal cavity.

### Statistical analysis

A descriptive analysis was used to present the data. Continuous data were presented as mean and standard deviation or median and range. Categorical data were presented as number and percent. SPSS version 26 (IBM Corp., Chicago, IL, USA) was used to perform the descriptive statistics.

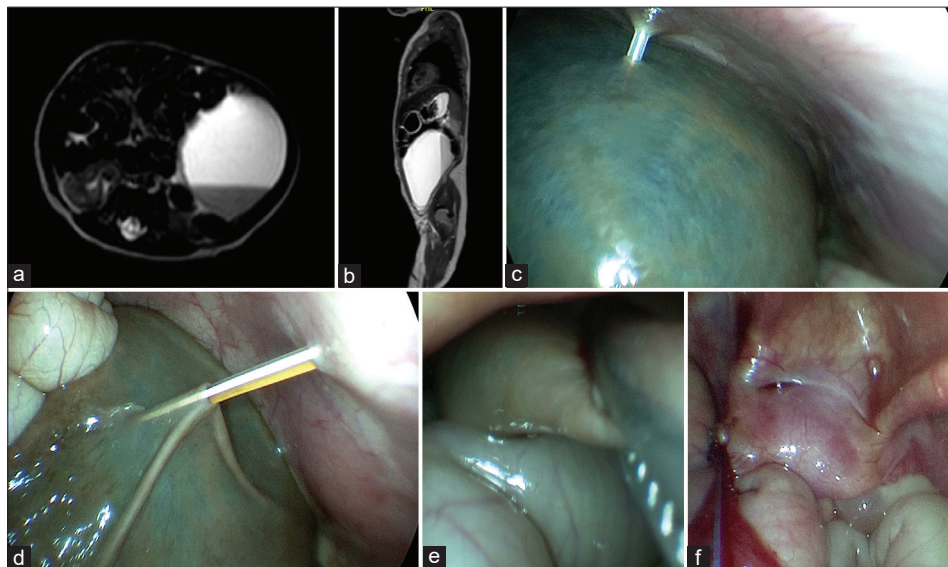
### RESULTS

A total of 59 patients had TULS. All patients had radiologic evaluation before surgery. The most common indications were explorations for intra-abdominal testes ( $n = 15$ ) and inguinal herniorrhaphy ( $n = 13$ ) and others are as shown in Table 1. Patients who had surgery for pyloric stenosis were younger ( $1.03 \pm 0.25$  months). The average operative time was  $45.9 \pm 18.39$  min. The longest operative time was reported with surgery for a liver cyst ( $94.5 \pm 10.6$  min), followed by duplication cysts ( $65.3 \pm 9.07$  min). Oral intake was started after 48–56 h in patients who had excision of the duplication cyst and after 24 h in patients who had surgery for liver cysts. The average post-operative hospital stay was  $2.6 \pm 1.52$  days. The hospital stay after surgery for a duplication cyst was 5 (4–7) days and 5 (4–6) days after surgery for a liver cyst [Table 1].

Minor complications (wound infection) were reported in one patient with a duplication cyst. Three patients were converted to open repair. The mean follow-up time was  $11.2 \pm 5.1$  months [Table 2].

### DISCUSSION

Laparotomy was the standard of care for the management of huge abdominal cysts in infants.<sup>[8,9]</sup> With the advancement of minimally invasive surgery, the paradigm was shifted to laparoscopic surgery. The choice of the technique depends on several factors, including the pathological diagnosis and



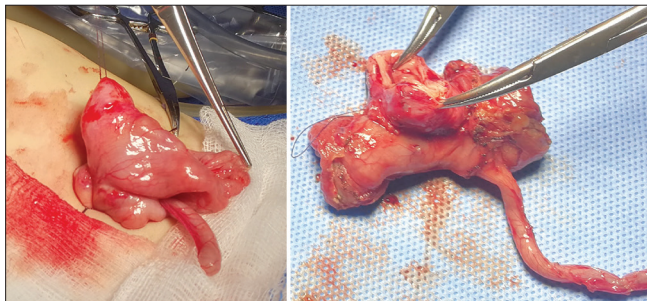
**Figure 1:** Transumbilical laparoscopic-assisted surgery for ovarian cyst. (a and b) MRI showed a huge cyst in neonate (c); aspiration of the cyst (d); collapse of the cyst with aspiration (e); retrieval of the cyst by a grasper (f); final look after excision of the cyst

the size of the lesion. Minimally invasive surgery provides better visualisation and less surgical trauma, which fastens the recovery and shortens the hospital stay.<sup>[10]</sup> Transumbilical laparoscopic surgery became increasingly popular in paediatric patients because it has the benefits of a small scar and adequate exploration of the abdominal cavity.

The ovaries in the newborn are close to the umbilical region, which makes the transumbilical laparoscopic approach technically feasible.<sup>[3]</sup> Because of this anatomical factor and the flexibility of the abdominal wall, this approach is more beneficial in children than adults.<sup>[11]</sup> Therefore, it is crucial to be able to mobilise the lesion to reach the umbilicus to perform this procedure.

TULS is cost-effective because it does not require several single-use endoscopic instruments such as retrieval bags, energy-sealing devices and staplers, which decreases the cost of surgery markedly. In addition, this technique does not require special instruments and overcome the problem of working in small cavities in children.

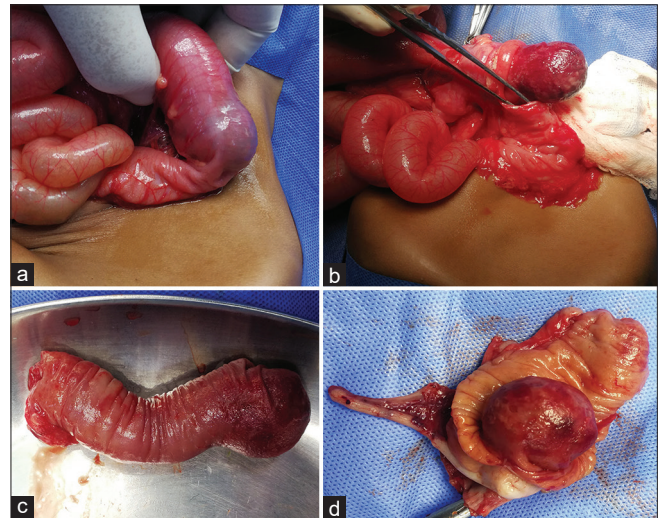
We presented our experience in the transumbilical laparoscopic approach in 59 patients with different pathologies. We used the transumbilical technique to resect Meckel diverticula, duplication cysts, reduce the intussusception and perform abdominal exploration for undescended testes. The technique has expanded to perform intestinal resection and appendectomy.<sup>[12]</sup>



**Figure 2:** Transumbilical laparoscopic-assisted surgery for duplication cyst

Most benign pathologies can be managed with this approach, and it is vital to exclude malignancy before attempt laparoscopic removal of cysts. Needle decompression should not be performed unless the cyst is benign with no solid component. The diagnosis of ovarian cyst has increased because of routine ultrasound screening during pregnancy. Small cysts (<4 cm) tend to regress spontaneously<sup>[13]</sup> with a low probability of torsion.<sup>[14]</sup>

The transumbilical laparoscopic approach was found to be associated with a shorter hospital stay,<sup>[15]</sup> fewer complication rates<sup>[16]</sup> and easy conversion to the open approach. We did not report an increase in wound infection after this procedure. This can be explained by minimal manipulation of the instruments at the umbilicus and the limited number of umbilical sutures. We used one fascial purse-string suture and three skin sutures. Excessive wound suturing leads to ischemia and impairment of wound healing.<sup>[17]</sup> The limited number of sutures decreased the operative time, and the minimal trauma to the surgical site could have contributed to the lower infection rate. The



**Figure 3:** Transumbilical laparoscopic-assisted surgery for intussusception. (a) trial of manual reduction (b) exploring the lead point after failure of reduction (c and d) specimen after resection and anastomosis

**Table 1: Pre-operative, operative and post-operative data described according to the indications of surgery**

	n (n=59)	Sex (male/female)	Mean ± SD		Post-operative oral intake (h) range	Hospital stay (days) median (range)
			Age (months)	Operative time (min)		
Ovarian cyst	8	0/8	2.71±2.4	37.7±11.74	4- 6	1
Duplication cyst	3	2/1	6.66±2.51	65.3±9.07	48- 56	5 (4- 7)
Hirschsprung disease biopsy	12	7/5	5.33±2.90	29.58±6.90	24- 30	3.5 (2- 6)
Mesenteric cyst	2	1/1	8±1.4	51±4.94	24	2.5 (2- 3)
Intra-abdominal testes/vanish testes	15	15/0	9.6±1.35	23.4±4.80	4- 6	1
Intussusception	2	1/1	11.5±0.70	38±4.24	24	2
Pyloric stenosis	4	3/1	1.03±0.25	40.66±4.5	6	2 (1- 2)
Meckel diverticulum	1	1/0	10	41	30	3
Inguinal herniorrhaphy	13	7/6	6.84±3.0	45.76±9.34	4- 6	1
Liver cyst	2	1/1	3.5±2.12	94.5±10.6	24	5 (4- 6)

SD: Standard deviation

**Table 2: Post-operative complications according to the indications of surgery**

	<i>n</i> ( <i>n</i> =59)	Major complications	Minor complications (%)	Conversion rate (%)	Late complications
Ovarian cyst	8	0	0	1 (12.5)	0
Duplication cyst	3	0	1 (33.33)	0	0
Hirschsprung disease biopsy	12	0	0	0	0
Mesenteric cyst	2	0	0	0	0
Intra-abdominal testes/vanish testes	15	0	0	0	0
Intussusception	2	0	0	0	0
Pyloric stenosis	4	0	0	1 (25)	0
Meckel diverticulum	1	0	0	0	0
Inguinal herniorrhaphy	13	0	0	0	0
Liver cyst	2	0	0	1 (50)	0

approach was associated with a shorter operative time, which can be attributed to extracorporeal dissection and the use of a minimal number of sutures for wound closure.<sup>[18]</sup>

Additional laparoscopic ports are usually required in most patients. This is because the laparoscopy has a limited, rigid channel that allows the insertion of one instrument, and in complicated cases, the technique becomes less effective. However, minimally invasive percutaneous internal ring suturing can be performed through a single-incision laparoscopy. The technique is facilitated with the mobile intestine, which can be extruded outside the abdominal cavity to complete the procedure.

Attwood originally described the laparoscopic treatment of Meckel's diverticulum.<sup>[19]</sup> The transumbilical laparoscopic approach is suitable for Meckel's diverticulectomy, small intestinal exploration and bowel anastomosis outside the abdominal cavity.<sup>[20]</sup> Rare complications of the approach were reported in the neonates, such as intestinal perforation and wound infection.<sup>[21]</sup> We did not report any major short (bleeding, anastomotic leak, bowel perforation and peritonitis) or long-term (incisional/umbilical hernia, adhesion) complications in our series, and one patient had a wound infection after surgery for a duplication cyst. Our reported conversion rate was 5%, which is consistent with the published series (2%–11%).<sup>[22,23]</sup>

This report indicates that TULS is feasible in infants and neonates. The mobility of the intestine and the proximity to the umbilicus make the approach an attractive option in children. We had a 5% conversion rate, and no major complications were reported in our patients.

### Study limitations

Limitations of the study include the single-centre experience, the retrospective design and the small patient number. The pre-operative diagnosis of either complicated or simple cysts was not available. In addition, the choice of the approach depends on the surgeon's experience.

### CONCLUSIONS

The transumbilical approach is a safe alternative method to laparotomy in several abdominal pathologies in infants and

neonates. It has a short operative time and hospital stay. The technique is associated with few complications and conversion rates.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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