

Mitigating the Challenges of Laparoscopic Paediatric Surgery in Ile Ife: The Trend So Far and Lessons Learnt

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Abstract

Background: Paediatric laparoscopic surgery is fast growing worldwide, with many pathologies now being treated even in the youngest of patients. We hereby report our experience with the first 114 cases. **Objectives:** Our aim was to highlight our progress and lessons learnt practicing laparoscopic paediatric surgery in our institution. **Materials and Methods:** This is a retrospective study of the first 114 children who underwent laparoscopic surgery in our hospital. We focussed on demographics, indications, procedures performed, rate of conversion to open and complications. Records were retrieved from January 2011 to December 2019. Data were analysed using the SPSS software version 23 (SPSS Inc., Chicago, Illinois, USA). **Results:** There were 83 males and 31 females (ratio of 3:1). Age groups included infants (13.2%), 1–5 years (21.9%), 5–10 years (33.3%) and > 10 years (31.6%). There was a remarkable increase in the frequency and complexity of cases performed from an average of 5 per year between 2011 and 2015 to an average of 23.5 per year between 2016 and 2019. The conversion rate was 6%, 5 appendectomies, 1 Swenson pull-through, 1 diagnostic laparoscopy and 1 Ladd's procedure. Four complications were noted; one recurrent adhesive intestinal obstruction, one residual intra-abdominal abscess, one port site abscess and one excessive bleeding from liver biopsy requiring conversion to open surgery. **Conclusion:** We have demonstrated that the routine use of laparoscopy in children is feasible and safe in our environment. However, the need for training, endurance through a steep learning curve and the willingness to battle the technical challenges are necessary for success.

Keywords: Children, laparoscopic surgery, challenges

INTRODUCTION

Paediatric laparoscopic surgery is advancing worldwide, with many pathologies now being treated even in the youngest of patients. In Nigeria, laparoscopic surgery has not been widely adopted, with very few centres having adequately trained staffs and dedicated surgeons willing to practice paediatric laparoscopic surgery while battling the already significant challenge with managing children with surgical needs.^[1,2] It has been well established that laparoscopic surgery offers significant advantages over open surgery, vis-à-vis early post-operative recovery, less pain and good cosmetic outcome; however, the steep learning curve and the immediate cost of equipment and consumables create significant discouragement to the surgeons in the third world countries.^[3,4]

In our centre, we have successfully established laparoscopic surgery as a routine procedure for some paediatric surgical conditions.^[1,4] The aim of this study was to highlight the growth of minimal access surgery for the treatment of paediatric surgical conditions in our institution and the lessons learnt.

MATERIALS AND METHODS

This study was based on an 8-year retrospectively collected data on all children who underwent laparoscopic surgery in

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our hospital. The patients included children who presented to the paediatric surgical unit of our hospital and were offered laparoscopic surgery as a whole or part of the intervention for their presenting conditions.

Records were retrieved between January 2011 and December 2019, and relevant information was obtained. We focused on the demographics, indications, procedures performed, rate of conversion to open and complications. The data were analysed using the Statistical Package for the Social Sciences software version 23 (SPSS Inc., Chicago, Illinois, USA).

Pre-operatively, all patients were admitted for the procedure except the patients for herniotomy who presented on the day of surgery and had their surgeries as day case procedures. All patients had routine investigations done, informed consent obtained and preoperative fasting of about 4–6 h observed. Pre-operative antibiotics were given when indicated, general anaesthesia with endotracheal intubation and appropriate intra-operative monitoring were used for all patients.

Carbon dioxide pneumoperitoneum was established using the open Hasson's technique for all patients. The flow rate was at 1 L/min to achieve a maximum intra-abdominal pressure of 6–8 mmHg for infants and 2 L/min to achieve intra-abdominal pressure of about 8–10 mmHg for older children.

For appendectomies, we used two 5 mm ports and a 10 mm or 8 mm suprapubic port (for specimen extraction). This allows for adequate triangulation at the right iliac fossa. Figure 1 demonstrates the port placement, ligation of the base and the post-operative appearance of the wound.

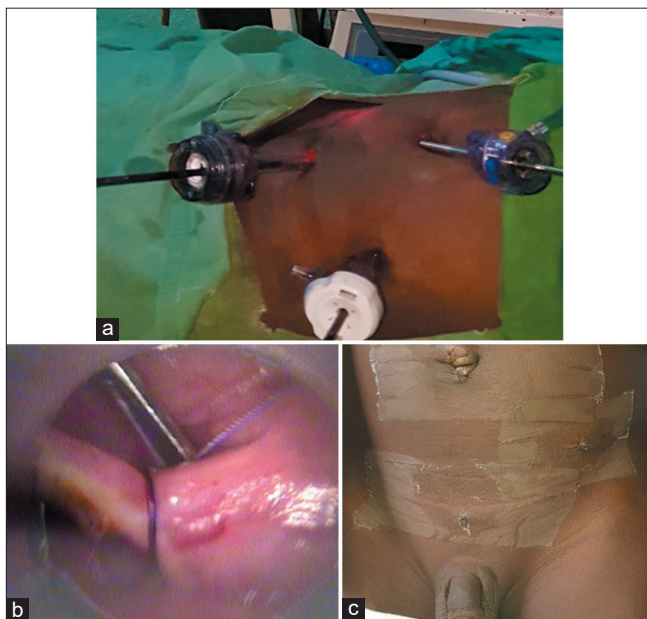


Figure 1: Laparoscopic appendectomy, (a) port placement, (b) tying the base of the appendix, (c) post-operative appearance (intra-operative picture from paediatric surgery unit OAUTHC)

Laparoscopic-assisted orchidopexy was done using three 5 mm ports. The port placement, intra-operative steps and post-operative appearance are illustrated in Figure 2.

Figure 3 demonstrates the port placement, clipping of recto-bladder neck fistula, siting of neo-anus and the post-operative appearance for laparoscopic-assisted pull-through for high anorectal malformation (ARM), whereas Figure 4 demonstrates the port placement and ligation of the deep ring for laparoscopic needle-assisted herniotomy.

Telescopes used were 4 mm 30°, 5 mm 0°, 10 mm 30° and 10 mm 0°, as appropriate for the procedure. All working instruments were 5 mm and a 3 mm needle holder. No other 3 mm instrument was available, 10 mm or 12 mm instruments were not used in any procedure.

RESULTS

A total of 114 laparoscopic surgeries performed in children were analysed. There were 83 males and 31 females with an approximate male-to-female ratio of 3:1. Overall, laparoscopic herniotomy was the highest number of procedure performed, followed by appendectomies, orchidopexy and diagnostic laparoscopies [Table 1].

Most of the patients were within the age of 5–10 years (33.3%) and >10 years (31.6%). About 13.2% were infants and about 21.9% were between 1 and 5 years [Table 2].

The lesser number of infants is a reflection of the challenge we have with unavailability of 3 mm instruments and ports,

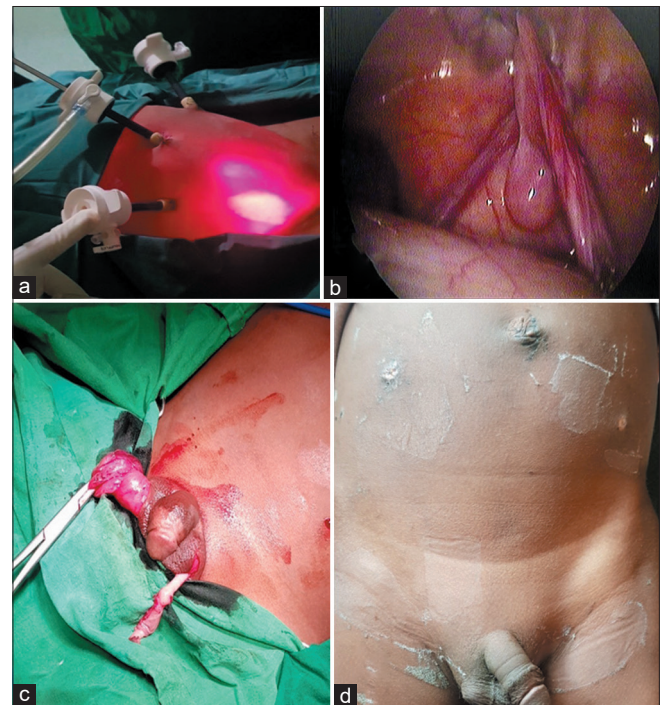


Figure 2: Laparoscopic-assisted orchidopexy, (a) port placement, (b) testis mobilised, (c) both testis exteriorised, (d) post-operative appearance (intra-operative picture from paediatric surgery unit OAUTHC)

coupled with the inertia on the part of anaesthetists to take these group of patients for laparoscopic surgeries for fear of anaesthesia complications and potential prolonged surgery time. It is worth mentioning that the few infants we operated were as a result of excellent coordination between the surgeons and willing anaesthetists to ensure the success of the procedures.

Appendectomies were more common amongst patients older than 10 years, and herniotomies were more frequent amongst patients between 5 and 10 years of age. Figure 5 shows the case distribution in relationship with the age groups.

From 2011 to 2015, we had an average of five procedures per year; however, from 2016 to 2019, the number of laparoscopic

surgeries increased to an average of 23.5 procedures per year. This is demonstrated in Figure 6.

Table 3 demonstrates the increasing number of cases and frequency of advanced procedures over the years. In the first 3 years (2011–2015), only diagnostic procedures and a few appendectomies were done. This increased between 2014 and 2016 with the addition of gonadectomy and herniotomy of which are still procedures requiring basic skills. We noted a remarkable increase in advanced cases from 2017 to 2019, these included; Ladd’s procedure, Swenson pull-through for Hirschsprung disease, laparoscopic-assisted pull-through for high ARM, gastrojejunostomy, mesenteric cystectomy, cholecystectomies and adhesiolysis.

We converted eight cases to open surgery, with a percentage conversion rate of about 7%. These included one Ladd’s procedure, one Swenson pull through, one diagnostic laparoscopy and five appendectomies [Table 4].

We recorded four complications, making a complication rate of 3.5%. The complications included a recurrent appendiceal abscess following laparoscopic removal of a perforated appendix, a port site infection of specimen extraction site following laparoscopic appendectomy, excessive primary haemorrhage from liver biopsy requiring conversion to open

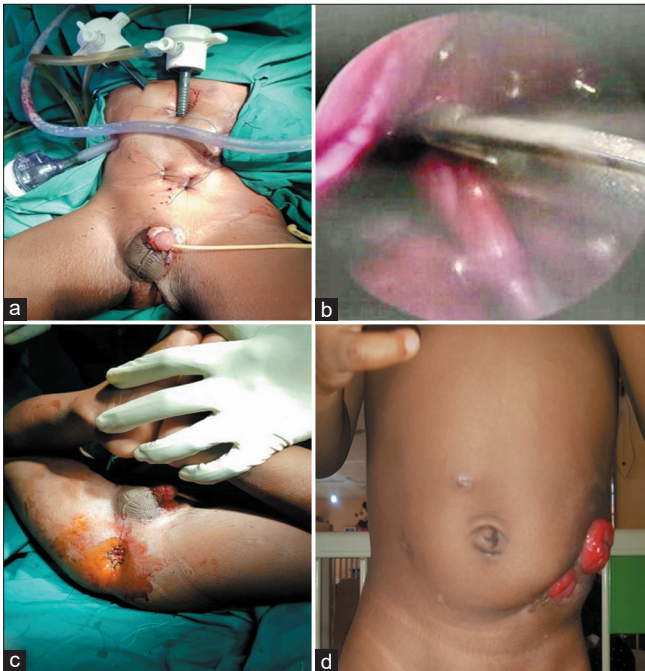


Figure 3: Laparoscopically assisted pull-through for high anorectal malformation. (a) Port placement, (b) clipping the fistula, (c) neo anus appearance, (d) post-operative appearance, child awaiting colostomy closure (Intra-operative picture from paediatric surgery unit OAUTHC)

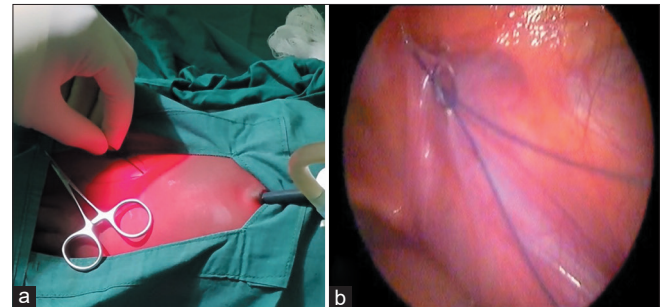


Figure 4: Laparoscopic needle-assisted herniotomy. (a) Port and needle placement, (b) ligating the deep ring (Intra-operative picture from paediatric surgery unit OAUTHC)

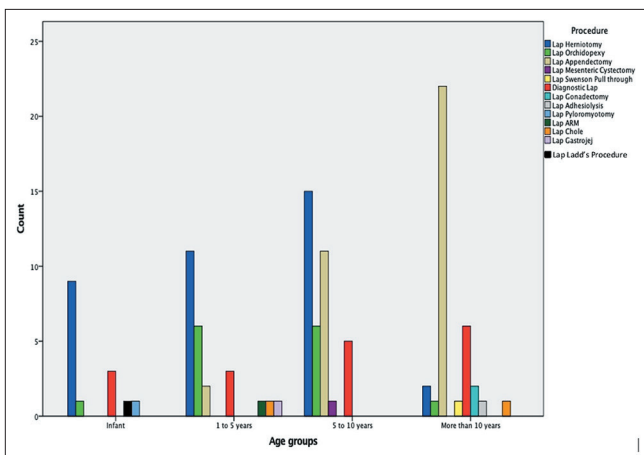


Figure 5: Distribution of cases amongst age groups

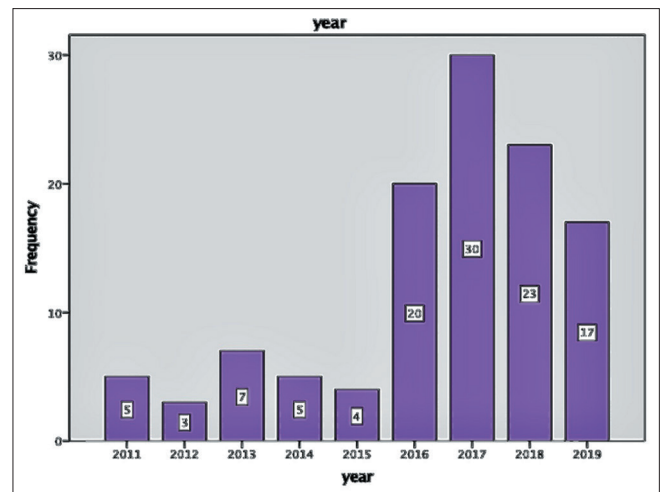


Figure 6: Number of procedures per year

Table 1: Sex and case distribution

Procedure	Sex		Total
	Male	Female	
Mesenteric cystectomy	1	0	1
Swenson pull-through	1	0	1
Ladd procedure	1	0	1
Adhesiolysis	1	0	1
Pyloromyotomy	1	0	1
Laparoscopically assisted pull-through for high ARM	1	0	1
Gastrojejunostomy	1	0	1
Gonadectomy	0	1	1
Cholecystectomy	1	1	2
Orchidopexy	13	0	13
Diagnostic laparoscopy	15	4	19
Appendectomy	23	12	35
Herniotomy	25	12	37
Total	83	31	114

ARM: Anorectal malformation

Table 2: Age groups and frequency

	Frequency (%)
Infant	15 (13.2)
1- 5 years	25 (21.9)
5- 10 years	38 (33.3)
>10 years	36 (31.6)
Total	114 (100)

surgery and a recurrent intestinal obstruction in a 12-year-old boy with adhesive intestinal obstruction [Table 3]. The port site infection was treated with antibiotics and daily wound dressing, while the other three patients had open exploration and adequate treatment.

DISCUSSION

The incorporation of minimal access surgery into paediatric surgical practice is a step further in the practice of laparoscopy in our institution, particularly after the general surgeons have fully adopted and institutionalised laparoscopic surgical practice, being way ahead of paediatric surgeons.^[5] However, we have been constantly challenged by the steep learning curve, especially when the patients are infants and neonates due to the significantly smaller working space; unavailability of adequately trained team including surgeons, anaesthetists and nurses, as well as unavailability of equipment that are suitable for children.^[6]

Despite these challenges, we have managed to perform several procedures, using the available instrumentation, expertise, fabrication and modification of some equipment.

The rapid increase in the number of patients operated noted from 2016 was due to the introduction of a surgical skill dry laboratory for laparoscopic surgery in the institution. This remarkably helped the surgeons and the residents to improve on

Table 3: Number and type of procedures every 3 years

Procedures	Year			Total
	2011-2013	2014-2016	2017-2019	
Appendectomy	7	10	18	35
Diagnostic laparoscopy	8	9	2	19
Herniotomy	0	9	28	37
Orchidopexy	0	0	13	13
Mesenteric cystectomy	0	0	1	1
Swenson pull through	0	0	1	1
Gonadectomy	0	1	0	1
Ladd's procedure	0	0	1	1
Adhesiolysis	0	0	1	1
Pyloromyotomy	0	0	1	1
High ARM	0	0	1	1
Cholecystectomy	0	0	2	2
Gastrojejunostomy	0	0	1	1
Total	15	29	70	114

ARM: Anorectal malformation

Table 4: Rate of conversion to open and complications

Procedure	Conversion to open		Total	Complications		Total
	No	Yes		No	Yes	
Herniotomy	37	0	37	37	0	37
Orchidopexy	13	0	13	13	0	13
Appendectomy	30	5	35	33	2	35
Mesenteric cystectomy	1	0	1	1	0	1
Lap Swenson Pull through	0	1	1	1	0	1
Diagnostic laparoscopy	18	1	19	18	1	19
Gonadectomy	2	0	2	2	0	2
Adhesiolysis	1	0	1	0	1	1
Ladd's Procedure	0	1	1	1	0	1
Pyloromyotomy	1	0	1	1	0	1
High ARM	1	0	1	1	0	1
Cholecystectomy	2	0	2	2	0	2
Gastrojejunostomy	1	0	1	1	0	1
Total	105	8	114	110	4	114

ARM: Anorectal malformation

the surgical skills. Starting with the simplest procedures such as diagnostic laparoscopy, appendicectomies and herniotomies, the surgeons started growing in skill and were now able to perform more complex procedures. This also accounted for the higher number of laparoscopic herniotomies and appendectomies. The increase in the complex cases performed is a testament of how significantly the skills have improved over the years.

The rate of conversion in this series was slightly higher than the reviewed literatures.^[5,7] This is likely due to the steep learning curve, which we hope to surmount very soon as we continue to develop our laparoscopic surgery expertise.

Five laparoscopic appendectomies were converted to open. This was due to the presence of severe adhesions following late presentation making it unsafe to dissect the appendix laparoscopically without injuring the surrounding bowel; also in one of the patients, the appendix was not found due to autolysis, and open surgery was done to ensure it was not missed. Several literatures agrees that the most common reason to convert laparoscopic appendectomy is complicated appendicitis; otherwise most appendicitis can be successfully treated laparoscopically.^[6,8-10]

A patient with Hirschsprung disease was converted to open surgery after laparoscopic biopsy for frozen section was done. This was due to the inability of the surgeons to make progress and lack of adequate vessel sealing energy device to safely complete the intracorporeal dissection. Vessel sealing energy devices are the gold standard in any form of laparoscopic bowel resection and pull-through surgeries. Although some surgeons use electrocautery, especially hook electrodes and bipolar electrodes depending on their level of expertise, significant risks of injury to surrounding structures exist.

A 2-month old boy with malrotation who was scheduled for laparoscopic Ladd's procedure was converted to open due to difficulty in defining the anatomy of the anomaly laparoscopically. This is also another example of the steep learning curve in small children and the need for more exposure to laparoscopic surgery to allow the surgeons to build confidence and mastery. This was the very first laparoscopic Ladd's procedure attempted in the centre. Reddy *et al.*^[11] noted that one of the reasons for converting laparoscopic Ladd's procedure is a difficult anatomy. It is worthy of note that laparoscopic Ladd's procedure is now the treatment of choice for symptomatic malrotation syndrome.^[11,12]

One patient undergoing laparoscopic-assisted orchidopexy was completed by open groin exploration because the vas deference and testicular vessels were seen laparoscopically going into the deep ring despite the inability to palpate the testis externally. Conversion to open surgery for laparoscopic orchidopexy is not common in literature; however, when it occurs, the reasons are widely varied. These may include severe adhesions from previous surgeries holding down the testis, transection of the vas deference, bowel injury and absence of the testis with the vas and vessel entering into the deep ring (as in the index case).^[13]

A diagnostic laparoscopy was converted due to the inability to effectively control haemorrhage following biopsy of a hepatic mass. Bleeding following laparoscopic liver biopsy is a known complication that may necessitate conversion to open surgery to achieve surgical haemostasis and can occur with a frequency as high as in 4% of patients.^[14,15] It is important to note that conversion to open surgery is not failure of laparoscopy. This was also recorded as a part of the complications in our report.

Of the four complications recorded in this review, two of them were from complicated appendicitis, one from adhesive bowel obstruction and one from diagnostic laparoscopy and liver

biopsy. One of the appendectomies had a port site infection and the other had a residual abscess requiring re-exploration. Wani *et al.*^[6] noted that port site infection is the most common complication of laparoscopic appendectomy and is more frequent with complicated appendicitis. The index port site infection occurred at the site of specimen extraction.

The residual appendiceal abscess occurred in one of the patients who had ruptured appendicitis. In the past, complicated appendicitis (ruptured appendicitis, appendiceal abscess, appendiceal phlegmon and appendiceal mass) was relative contraindications for laparoscopic appendectomy; however, with improving expertise, the advent of newer and more advanced equipment, many surgeons now routinely treat them laparoscopically with superior outcomes compared to open surgery.^[16] Despite this, it has also been seen to have the highest conversion rates and post-operative complications, especially post-operative intra-abdominal abscess.^[16,17]

The patient with recurrent intestinal obstruction presented initially with adhesive intestinal obstruction following a conservatively managed appendicitis of 6 months before onset symptoms. The initial laparoscopic intervention revealed an adhesive band causing a volvulus. This was detorsed laparoscopically, adhesive bands were divided and an appendectomy was also done. The patient had a relief of symptoms and was discharged on oral feeds. However, the patient re-presented 1 month later with features of partial intestinal obstruction. He was then offered an open laparotomy, and a few obstructing adhesive bands were noted which were also divided. The patient was discharged on oral feeds on 5th-day post-operation. The authors are of the opinion that the reason for recurrence of symptoms was recurrent adhesion considering the duration before symptoms recurred. Albatany *et al.*^[18] noted that laparoscopic adhesiolysis is very safe and effective; however, recurrence can occur due to incomplete adhesiolysis or reformation of new adhesive bands.

Lessons learnt

This study has re-emphasised the role of training and re-training of not only the operating surgeons but also the residents and peri-operative nurses in the field of laparoscopic surgery, as this will significantly improve the efficiency and safety of the procedures.^[19] It must be emphasised that even the anaesthetists also require more experience on the anaesthetic uniqueness of laparoscopic surgery and the challenges with children as it differs from adults.^[20,21]

In our experience, careful patient selection was key to recording success. It is unwise to start with complex procedures in the early career of paediatric minimal access surgery as this will lead to an increase in conversion rates and therefore more risk of complications. However, when complex cases are to be attempted, careful planning of procedure, updating of skills in the dry laboratory and if possible, wet laboratories are necessary before such procedures are attempted.^[6]

Our practice was significantly limited by a lack of adequate instrumentation. It is still an uphill task to get the hospitals to invest in paediatric minimal access surgery, as the direct cost to the patient is still very significant, making it virtually unaffordable to many patients in our community. We hope that this study will serve as an added evidence to encourage the government and investors to invest in paediatric minimal access surgery in our teaching hospitals.

CONCLUSION

We have demonstrated that the routine use of laparoscopy in children is feasible and safe in our environment. However, the need for training, endurance through a steep learning curve and the willingness to battle the technical challenges are necessary for success.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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