

Original Article

Comparison of Conversion Reasons in Paediatric Laparoscopic Surgery to Adult Literature

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Abstract

Introduction: The aim of this study is to evaluate and analyse the reasons for conversion to open surgery in laparoscopic cases in childhood, compared to the adult literature and differentiate the preventive measures for decreasing the rates for conversions. **Patients and methods:** The charts of 2068 patients who had appendectomy, Nissen fundoplication, cholecystectomy and splenectomy operations between 2003-2015 were reviewed retrospectively. Laparoscopic and open procedures and the cases that were converted from laparoscopy to open surgery and the reasons of conversions were analysed. **Results:** Between the years of 2003-2015, total of 2068 cases; appendectomy (1539), cholecystectomy (120), Nissen fundoplication (323) and splenectomy (86) operations were performed. Among these procedures, 181 (8.8%) of them were performed by laparotomy, 1887 (91.2%) of them were intended to be performed by laparoscopy. Among laparoscopically started cases, 1848 (97.9%) of them were completed laparoscopically and in 39 cases (2.1%) conversions were required. The conversion rates were 0.34%, 9.7%, 2.8% and 7.4% in appendectomy, Nissen fundoplication, cholecystectomy and splenectomy, respectively. **Conclusion:** Preoperative detailed and specific examinations before laparoscopic procedures can decrease the conversion rates in laparoscopic surgery. Complications do not have to be the only conversion indication and elective conversion must be performed without wasting time to avoid complications.

Key words Children; Conversion; Laparoscopy; Open surgery

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Introduction

Since the beginning of the history of surgery, a lot of time and effort has been spent searching for minimally invasive surgery. Introduction of laparoscopy is definitely one of the biggest steps. From Bozzini, who had first reported that he had viewed a bladder using his own invention "lichtleiter" to Semm, who performed first laparoscopic appendectomy in 1982, the development of new devices and less invasive methods has never stopped.¹

Because of such reasons as shorter hospital stay, less postoperative pain, fewer wound infections, quicker return to daily life, shortened feeding time, better cosmetic results and so on, laparoscopic approach is in the paediatric surgery armamentarium.^{2,3} Even though the most common

procedures in paediatric surgery such as appendectomy and Nissen fundoplication as well as splenectomy and cholecystectomy are all routinely performed laparoscopically, in some cases conversion to open surgery is unavoidable. In such cases, the rate of morbidity and complications increase.⁴

The aim of this study is to analyse and evaluate our conversion reasons and rates and compare it to paediatric and adult literature. We aimed to answer the following questions: Whether the conversion is a problem in laparoscopy or a choice to avoid complications, and what are the conversion rates and reasons in both adult and paediatric surgery.

Patients and Methods

In the charts of 2068 patients who had appendectomy, Nissen fundoplication, cholecystectomy and splenectomy operations between 2003 and 2015 were reviewed retrospectively. Laparoscopic and open procedures and the cases which were converted from laparoscopy to open surgery, the reasons and rates of conversions were analysed.

Results

Between the years 2003-2015, a total of 2068 cases of appendectomy (1539), cholecystectomy (120), Nissen fundoplication (323) and splenectomy (86) operations were performed. Among these procedures, 181 (8.8%) of them were performed by laparotomy, 1887 (91.2%) of them were intended to be performed by laparoscopy. Among laparoscopically started cases, 1848 (97.9%) of them were completed laparoscopically and in 39 cases (2.1%) conversions were required. Of these 39 cases, seven (18%) were forced and 32 (82%) were elective conversions.

In 1539 appendectomies, 1445 cases started laparoscopic and only 5 of them (0.34%) required conversion. When the conversion reasons were analysed, it was seen that conversions were required for appendicular plastron (n=2, 40%), dilated intestines (n=1, 20%), technical difficulty (n=1, 20%) and bladder injury (n=1, 20%).

When analysing 120 cholecystectomies, 13 cholecystectomies (10.8%) were performed by laparotomy, while 107 were intended to be performed laparoscopically (89.2%). Of these 107 cases, 3 were converted to open surgery due to inability to control haemorrhage (n=1, 33.3%), intraabdominal dense adhesions (n=1, 33.3%) and

iatrogenic choledochal injury (n=1, 33.3%).

Of 86 splenectomies, 19 (22%) cases were performed by laparotomy and 67 (78%) of them were started laparoscopically. In these 67 cases, 5 (7.4%) of them needed to be converted. The conversion reasons were haemorrhage (n=2, 40%), intraabdominal dense adhesions (n=2, 40%) and splenomegaly (n=1, 20%).

To perform Nissen fundoplication, in which we have the highest conversion rate; among the 323 cases, the operation was performed by laparotomy in 55 (17%) cases. 268 (83%) were started laparoscopically, but 26 (9.7%) of them required conversion at some point. The conversion reasons in Nissen fundoplication were inadequate exposure (n=8, 30.7%), redo surgery (n=6, 23%), hepatomegaly (n=5, 19.2%), unexpected cystic gastrointestinal tract (GIT) duplications (n=4, 15.4%) gastric perforations (n=2, 7.6%) and dense adhesions (n=1, 3.8%). When we analysed the patients, it was found that 14 (54%) of the patients who experienced conversion to open surgery were suffering from cerebral palsy (CP).

Discussion

In this study of 2068 cases, we found that similar conversion rates and causes were observed between paediatric and adult literature in laparoscopic appendectomy, cholecystectomy and splenectomy. The results of the laparoscopic Nissen fundoplication, conversion rates and causes were similar to the paediatric literature but conversion rates were higher compared to adult literature and there were different conversion reasons in adult literature besides few similar ones.

It is well known that there are physiological and anatomical differences between paediatric and adult surgery. Preoperative and postoperative complications and reasons of conversion to open surgery may be different in adults and children. For adults, important risks are mostly related to chronic diseases as hypertension, diabetes, lung diseases and vascular diseases. On the other hand, for children the main risks are related to physiological responsive mechanisms such as hypothermia – especially for newborns, even though these procedures are not newborn surgeries, fluid and electrolyte instability and whether they can tolerate the anaesthesia and continuous surgery. The tissues of children are thinner and weaker so the vessels and organs are more vulnerable to the trauma during the surgery. Besides these well-known differences, we tried to show the reasons related with the laparoscopic operations for

conversions.

The conversion rate of laparoscopic appendectomy in this study was 5/1445 (0.34%). The reason for one of these conversions was a complication and the rest were chosen in order not to prolong the surgery time and to perform a safer surgical procedure. Our conversion rate was lower than the adult literature.

Conversion rates from laparoscopic to open appendectomy range from 0 to 23% and is decreasing in the adult literature.⁵ Common reasons of conversion in appendectomy were dense adhesions, fibrosis, acute inflammation, location of appendix vermiformis, iatrogenic injuries, technical difficulties, peritonitis, abscess, long duration of the symptoms, base necrosis, bleeding, difficulties in identifying the organs, older age and comorbidities.⁶⁻⁸ Perforation was one of the main reasons of conversion in adult literature.⁶⁻⁸

Laparoscopic appendectomy is one of the most common laparoscopic procedures in paediatric surgery. There are also some conversions in this procedure too but the conversion rate is decreasing with time. The conversion rate varies between 0-32.9 in the paediatric literature.^{3,4,6,9}

We started 268 Nissen funduplications by laparoscopy but in 26 (9.7%) cases, conversion was required. Conversion reasons were; inadequate visualisation in 8, hepatomegaly in 5, hardened laparoscopic manipulations because of redo surgery in 6, unexpected other gastrointestinal pathologies (gastrointestinal cystic duplications) in 4, gastric perforations in two and dense adhesions in one patient.

The highest rate of conversion in our series was in Nissen fundoplication. The latter acceptance in laparoscopy for Nissen fundoplication in children and lack of experience can be the reasons for this high rate (27/268, 9.7%).

In adult surgery, conversion rates vary between 2.2 and 16% in Nissen fundoplication.^{2,10,11} The most common reasons were bleeding, hiatal hernia, adhesions, gastric perforations, anaesthetic complications, oesophageal complications, peri-oesophagitis, enlarged liver, inability of closing crura, obesity, splenic injuries and technical difficulties.¹¹

In the paediatric literature, the conversion rate was between 0-22%.¹²⁻¹⁴ The most common reasons were dense adhesions, bleeding (from short gastric arteries and liver), extreme scoliosis, previously placed gastrostomy tube, patient's inability to tolerate pneumoperitoneum and gastric perforations.^{12,14,15}

Even though obesity is one of the major conversion reasons in adult surgery, since children with gastroesophageal reflux tend to have malnutrition and be

physically retarded, obesity was not an important reason for conversions in our patients.

Dense adhesions, on the other hand, as it is in all laparoscopic procedures, is one of the important conversion reasons.

High conversion rates do not mean unsuccessful surgery. We tried to start all the cases with laparoscopy, but if the diagnostic laparoscopy reveals a condition, which leads us to laparotomy, we do not hesitate and convert to open surgery at the beginning of the surgery. Conversions due to the inadequate visualisation, hepatomegaly and redo surgeries can be explained by this approach. With this approach we think we can reduce our complication rate, operating time and other morbidities.

For the preoperative preparation, we perform 24-hour pH monitoring and upper gastrointestinal contrast studies before Nissen fundoplication. If further investigations were performed, the unexpected conditions (cystic duplications) could be revealed before surgery via ultrasound or computed tomography imaging.

In this study there were three conversions in 107 laparoscopic cholecystectomies (n=3, 2.8%). One of the conversions was a result of an inability to control the haemorrhage, one was for choledochal injury and one was due to the severe adhesions of the gallbladder.

In the adult literature, the most common conversion reasons in cholecystectomies were haemorrhage, adhesions, technical problems, inadequate visualisation, inability to create pneumoperitoneum, spilled stones, bowel injuries, bile duct injury, gallbladder malignity, and common bile duct exploration.¹⁶⁻¹⁸ Some authors divided conversions in two groups as elective and enforced. Of 81 conversions in 1238 cases (6.5%), 73 conversions were elective and 8 of them were enforced.¹⁸ As reported by many authors, the rate of conversion was between 0-7.5% in the adult literature.^{16,17,19} But none of them divided the conversion as Shamim did.¹⁸

In the paediatric literature, there are fewer articles studying this issue than the adult literature. The common reasons for conversion were similar such as bleeding, adhesions, not being able to clarify the anatomical structures. The rate was also similar as it was between 0-4%.^{20,21}

In adults, the main thought was that if there was a history of previous biliary disease, large stones, ongoing inflammatory process, scarred and fibrosed gall bladder and if the patient was old, laparoscopic procedure will be harder. In paediatric surgery, generally there are not comorbidities and fibrosis and scars as much as in the adult population.

Instead of these conditions, one should be aware of working in a smaller area. Due to the thinner vessels and bile ducts, the dissection is harder. It is difficult to expose anatomical structures properly and variations are as common as in adult population.

There are also adult studies, which aim to predict the conversion risks in laparoscopic cholecystectomy. In one study, the authors have claimed that the predisposing factors for conversion can be predicted before or during the surgery. Jethwani et al revealed the thickness of the gallbladder is relevant with high conversion rates and it can be measured before the operation via ultrasound imaging.²² Thus the surgeon can be aware of a difficult procedure and, depending on the patient's status, even open surgery can be performed initially. Knowing the difficulty predictors and knowing his/her own abilities and technological facilities gives the surgeon the chance to make better decisions.

In our 67 splenectomies, there were 5 conversions (7.4%). (Two haemorrhage from hilum, two for severe adhesions and one for massive splenomegaly).

The conversion rate in adult literature for splenectomy varies between 3 and 22.5%.^{23,24} Bleeding from the splenic pedicle and splenic artery is the most common reason of conversion in the literature.²⁴ Besides bleeding from hilum, massive splenomegaly, dense adhesions and bleeding from splenic parenchyma are other common conversion reasons.^{23,25,26}

Conversion rates vary also in the paediatric literature. The most common reasons are bleeding, splenomegaly and adhesions as they were in the adult literature. In addition to these, technical aspects are conversion reasons worth mentioning.²⁷ The conversion rate in the paediatric literature for splenectomy is between 1.7 and 6%.²⁷⁻²⁹

Our conversion rate (7.4%) and reasons (bleeding, adhesions and splenomegaly) are similar to both the adult and paediatric literature.

Among all minimally invasive advantages, laparoscopy also has an advantage of facilitating the visualisation of the whole abdomen properly and gives us opportunity to repair minor complications with proper approach.²⁵ Other than these, since the haemorrhage can be very rapid and life threatening, the surgical team must always be aware of such risk and be ready for laparotomy immediately.²⁶ We think the surgeon's choices and judgement during a laparoscopy session can be decisive. Especially the insistence of surgeon on laparoscopic procedure can cause more problems for the patient.

Another point of view is the cost of the operation. Pomp et al also claimed that when one converts an operation to

open which you started laparoscopically, you combine the high costs of laparoscopic equipment with patient's long hospital stay. So it becomes the most expensive method.³⁰

In 39 conversion-required cases, only seven of them (18%) were forced. Thirty two of them were electively converted. The reason why we had low intraoperative complication rates during our laparoscopic cases is our routine of converting directly if we had no proper exposure or the adhesions or other pathologies will prolong our surgery time much more than it would cost. Even though this study shows that our conversion rate is higher in Nissen fundoplication, prolonged anaesthesia time and unnecessary dissections are avoided by this approach.

The highest conversion rate in our series is in Nissen fundoplication. When the conversion rates are analysed, it can be seen that 24 of the conversions were elective. We have only two conversions due to the complications in Nissen fundoplication (two gastric perforations) (n=2, 0.74%). On the other hand, in the appendectomy, which was the first laparoscopic procedure we performed in our clinic, we have the lowest conversion rate (n=5, 0.36%). This low rate can be explained by the existence of common appendectomy procedures in paediatric surgery that allow the surgeons to develop their minimally invasive surgery skill set. The higher number of our conversions in Nissen fundoplication than our appendectomy, cholecystectomy and splenectomy is due to our policy on laparoscopy for the past thirteen years. After a diagnostic laparoscopic glance, if the case does not seem to be appropriate for laparoscopy, conversion is performed quickly.

Besides, preoperative detailed analysis of the relations between the organs and diameters of the liver, fundus and oesophagus may direct us to understand the situation better before the operations.

One of the aims of this study is to attract attention to differences of paediatric laparoscopic procedures since many paediatric procedures are performed by general surgeons all over the world.

Conclusion

Even though the surgical procedures are done by similar techniques, the conversion rates and reasons in paediatric surgery show difference in paediatric and adult surgery with some similarities.

Preoperative detailed and specific examinations before laparoscopic procedures can decrease the conversion rates in laparoscopic surgery. Complications do not have to be

the only conversion indication and elective conversion must be performed without wasting time in order to avoid complications.

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