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Research Article

The First Trocar Placement After Multiple Open Abdominal Surgeries in Children: A Preliminary Report

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Abstract

Aim: Laparoscopy is very risky in patients undergoing, multiple open abdominal surgeries. The aim of this study, to define a safe method for the first trocar placement in children with a history of multiple open abdominal surgeries. **Methods:** Children who underwent laparoscopic surgery between March 2019 and April 2020 with a history of three or more open abdominal surgeries were included in the retrospective study. Patient information was obtained from the hospital automation system. Ultrasonography was used to determine the location of adhesions preoperatively. The first trocar was placed according to ultrasonography findings, using the Hasson technique to create an air pocket with finger dissection. The patient's preoperative, perioperative, and postoperative findings are reported. **Results:** A total of 10 patients were included in the study. The median number of operations before laparoscopy was three. The most common site for the first trocar entry was Palmer's point (40%). No mortality or morbidity was observed amongst any patients. The average number of adhesions detected by USG and observed on laparoscopy were significantly positively correlated. **Conclusion:** In children with a history of multiple abdominal surgeries, abdominal wall ultrasonography for visualization of adhesions and finger dissection for the formation of an air pocket appears to be a safe method for the first trocar insertion.

Keywords: Abdominal wall; Child; Laparoscopy; Ultrasonography

Introduction

In the early days of laparoscopy, a history of previous multiple open abdominal surgeries was considered to be a relative contraindication to laparoscopic procedures, due to the possible presence of multiple adhesions that increased the risk of vital organ damage (1). However, the advancement of technology and increased user experience have led to the use of laparoscopy even in advanced procedures (2). The most important factor for performing laparoscopy in patients with extensive abdominal wall scarring and/or intra-abdominal adhesions - even after the surgeon's experience and patient-related factors that apply to all laparoscopic procedures are taken into account, is safe trocar insertion.To further reduce the negative effect of adhesion-related complications on millions of surgical patients worldwide,measures additional to more widespread use of laparoscopy are warranted (3). Ultrasonographic mapping of the intra-abdominal adhesions can aid with the safe placement of the first trocar. In large adult series, laparoscopic surgery is reported as being preferred in abdominal surgery when abdominal scarring and intra-abdominal adhesion are present (4). There are relatively fewer children undergoing laparoscopy after multiple abdominal surgeries when compared to adults and therefore reports on the management of these children are scarce with no large case series reported to date. However, it is known that laparoscopy increases comfort and is a safe method for the management of surgical pathologies in children. Less postoperative pain, shorter hospitalization, less scar tissue are some of the advantages of laparoscopy both in adults and in children (5). Children have a much higher life expectancy compared to adults and it is, therefore surgeries, important to keep the potential for the morbidity of any surgery to a minimum. Intra-abdominal adhesions following abdominal surgery can

lead to further complications. Laparoscopy is known to decrease mortality and has fewer complications is there when compared to open surgery.

The important points of the laparoscopic approach in children who underwent multiple open abdominal surgeries have not been clearly defined. The purpose of this study was to report a safe method for the first trocar placement in children with a history of multiple open abdominal surgeries, instead of our experience with a relatively large pediatric population.

Methods

Compliance with Ethical Standards

Approval for this study was obtained from the local Ethics Committee KAEK/2021.09.241.

The charts of children that underwent laparoscopic surgery at our institute between March 2019 and April 2020 with a history of three or more open abdominal surgeries were retrospectively reviewed. Patient information was obtained from the hospital automation system. Patients' age, gender, number of previous surgical procedures, indication for laparoscopic surgery, number and location of adhesions detected by ultrasonography, location of the first trocar, time spent forming air pocket, time to the first trocar insertion, surgical time, intraoperative findings of adhesions and time to discharge were recorded. Preoperative workup and preoperative trocar insertion procedures were standard in all patients. Data was collected prospectively but reviewed and analyzed retrospectively. After the decision for laparoscopic surgery, all patients underwent abdominal wall ultrasonography to evaluate the presence and extent of intra-abdominal adhesions. For standardization, the abdomen was separated into 9 different areas as shown in (Figure 1). On USG, band signs and organ sliding were noted and marked. The first trocar was placed from an area outside of these markings, following finger dissection to make an air pocket. All surgical procedures were completed by the same experienced surgeon (M.O.K). Data were analyzed using IBM SPSS Statistics (Version: 25, IBM Corp., Armonk, N.Y., U.S.A.). Demographic data were reported with descriptive statistics. The Shapiro Wilk test was used for testing the normality of data and Spearman's correlation test was used for correlation analysis. $p<0.05$ was considered as statistically significant.

Trocar Placement Technique

Following general anesthesia, patients were placed in a suitable position that was based on the location of abdominal wall scars and ultrasonography findings (Figure 1). Markings made during preoperative ultrasonography and the target organ location were used to determine an entry location for the first trocar. The Hasson technique was utilized to open an air pocket (Figure 2). The skin, subcutaneous tissue, and peritoneum were opened using a wide incision (1.5-2 cm), the incision edges were suspended and the abdomen was entered. Adhesions to the anterior abdominal wall were separated from the points accessible with the index finger and pushed to the abdomen (Figure 2). When sufficient space was created, the first 10 mm trocar was inserted and the incision was tightly narrowed with sutures up to 10 mm. The air pocket was filled with CO2 by gas insufflation. The inside of the abdomen was observed by entering with a 10 mm optic (Figure 3). A 5 mm trocar was inserted into the abdomen from the farthest point visible. The air pocket was enlarged with the atraumatic dissector entered from the second trocar. Finally, the 3rd trocar was entered from a clean area. Target organ surgery was continued under telescopic vision.

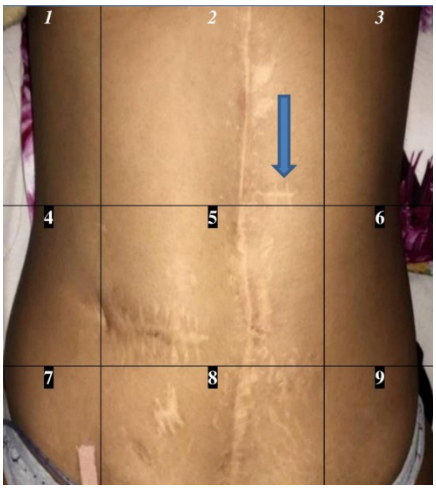

Figure 1: (Case #1) Abdominal areas for mapping of adhesions on ultrasonography. Numbers represent the nine areas of the abdomen, white numbers on black background represent areas where intra abdominal adhesions were detected on ultrasonography, blue arrow is the Palmer's point.

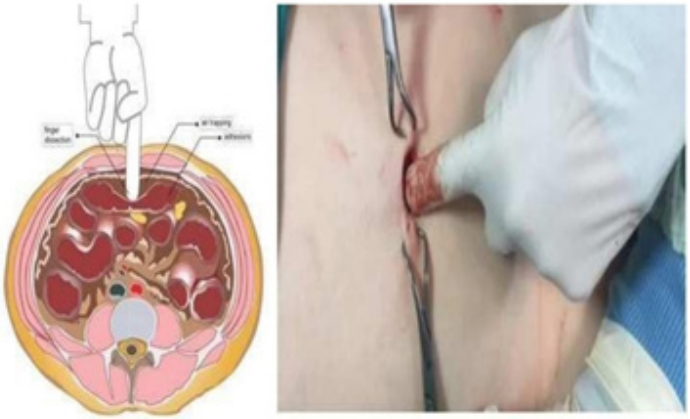

Figure 2: Air pocket formed by finger dissection.

Figure 3: Abdominal scarring and laparoscopic view of air pocket showing intraoperative adhesions from previous surgery.

Results

Four girls and six boys with an average age of 9.4 years (range 7-14 years) were included in the study. Patient data are shown in (Table 1). The median number of operations before laparoscopy was three (average 3.5±1.0). The most common site of entry used for the first trocar was Palmer's point (40%) followed by umbilicus (30%), supraumbilical (20%), and right upper quadrant (10%). The average surgical time was 102.0 ±17.0 minutes (range 75 - 130 minutes). Time from induction of anesthesia to the first trocar insertion averaged 19.0 ± 4.6 minutes (range 15 - 30 minutes). Patients have been discharged an average of 6.0 ± 1.1 days postoperatively (range 5 - 8 days). Organ sliding and band signs were observed in 89% of patients. No mortality or morbidity was observed amongst any patients. The average number of adhesions detected by USG and observed on laparoscopy were similar (4.3±1.5 vs 4.9±2.5, p=0.14) and significantly positively correlated (rho=0.947; R2 =0.89, p<0.001). Organ sliding and band signs were observed in 89% of patients.

Case #	# of Previous Surgeries	Medical History and Previous Abdominal Surgeries	Indication for laparoscopy and name of procedure	Entry position of the first trocar	# of adhesions on USG	# of adhesions on laparoscopy	Time (m) from induction to the first trocar placement	Total surgical time (m)	Total hos pitali zation time (days)
1	6	Extrofia vesica Extrofia vesica closure, bladder augmentation, Mitrofan of procedure, volvulus (resection and anastomosis), anastomosis leak (laparatomy), colostomy opening and closure	Recurrent Cholecystitis and Pancreatitis Cholecystectomy	P	6	9	30	130	8
2	4	Thalassemia Major Splenectomy, perforated appendicitis, bridectomy due to ileus	Cholelithiasis Cholecystectomy	P	4	5	15	120	5

3	3	Hematological Disease Partial splenectomy, bridectomy due to ileus (twice)	Recurrent Cholecystitis due to Cholelithiasis Splenectomy	U	4	3	20	110	6
4	3	Hirschsprung Disease Colostomy, Rehbein, colostomy closure	Ovarian Cyst Cystectomy	SU	3	3	15	110	7
5	3	Pyeloplasty, ureterostomy, Lich Gregoir	Appendectomy	U	5	6	15	75	5
6	4	Neurogenic Bladder Vesicostomy, bladder augmentation, Mitrofanoff procedure	Nefrectomy	P	4	4	20	80	6
7	3	Hirschsprung Disease Colostomy, Duhamel, colostomy closure	Ovarian cyst excision	RUQ	5	5	15	90	7
8	3	Intestinal perforation due to VP shunt Colostomy, VP shunt revision, colostomy closure	VP shunt cyst excision	U	7	9	20	100	5
9	3	Anal atresia Colostomy, PSARP (abdominal approach), colostomy closure	Splenectomy	SU	2	2	20	100	5
10	3	Hirschsprung Disease Colostomy, Rehbein, Colostomy closure	Appendectomy	P	3	3	20	105	6

Table 1: Data of patients included in study. (P: Palmer's Point, U: Umbilical, SU: Supraumbilical, RUQ: Right Upper Quadrant).

Discussion

Laparoscopic procedures continue to gain popularity in pediatric surgical practice. Advances in technology and increasing experience amongst surgeons have led to more complex procedures being performed with laparoscopy. A history of multiple open abdominal surgeries was until recently considered a relative contraindication to laparoscopy. In such patients, laparoscopy has not been widely adopted or accepted as the routine due to concern that the presence of intra-abdominal adhesions may lead to organ damage. Factors affecting the decision to perform such difficult procedures are the surgeon's level of experience, patient-related factors, and the nature of previous operations. There exists no numerical measurement system used to define a surgeon as being "experienced" in laparoscopy. Some authors associated a surgeon's experience in laparoscopy with the number of operations performed, the rate of conversion from laparoscopic to open surgery, the surgeon's complication rate, and duration of operations (5). In our series, all laparoscopic procedures were performed by a single surgeon with an experience of more than 1500 laparoscopic cases over 15 years, with serious mortality or morbidity.

Patient-related factors affecting the outcome of laparoscopy are scarring secondary to previous open abdominal surgery and the presence of intraabdominal adhesions (6). Extensive skin scars are an important problem in patients who have undergone multiple open abdominal surgeries. To our knowledge, there are very scarce studies regarding skin scars and their effect on laparoscopy in the pediatric population. However, our own clinical experience has shown that skin scars are more important in the pediatric population due to a narrow and shallow intraabdominal area and the continuation of growth, which is a dynamic process. Scarring leads to impairment of vascular supply and can lead to atrophy. The abdominal wall is an important structure protecting intraabdominal organs and any pressure change reflecting on the anterior abdominal wall poses a risk in these patients. Being able to perform laparoscopic procedures in the high-risk group of patients included in this study is important in not furthering and keeping abdominal skin scarring to a minimum. The same authors reported that intraabdominal adhesions show similar histopathological features as abdominal skin scars. A correlation exists between the density of abdominal wall scar tissue and the extensiveness of intraabdominal adhesions.

Previous studies have reported the signs of intraabdominal adhesions in patients due to undergoing laparoscopic procedures to be organ sliding, band sign, and taut bands on the abdominal wall seen during patient's respiration on ultrasonography (7,8). Kolecki, reported the sensitivity and specificity of ultrasonography in detecting safe zones for incisions to be 92% and 90% respectively, in 110 adult patients due to undergoing adhesiolysis. In the literatüre, 25 articles reported on 1609 adult patients and assesed abdominal areas end degrees of adhesions. According to this study: Visceral slide assessment with ultrasound has a high negative predictive value for the absence of periumbilical bowel adhesions in patients at risk for adhesions and can function as a useful tool to detect adhesion-free areas to allow for safe laparoscopic entry. On the other hand,it can be used in tomography or magnetic resonance,but is expensive (9). To our knowledge, there is no such study to date reporting similar data in the pediatric population. We observed organ sliding and band signs in 89% of our patients. Safe zones reported in our study are similar to those reported previously in adult patients. In a group of patients undergoing surgery from the left upper quadrant, Agarwala, et al. (5). Reported that umbilical area adhesions were observed in 54.9% of patients, suggesting therefore that left upper quadrant entry was safer than umbilical entry. Rafii, et al. (10) reported that left upper quadrant entry findings were similar to umbilical entries. It can generally be said that entry into the abdominal cavity from a location distant from previous scars is ideal. For this purpose, the right and left upper or lower quadrants can be utilized (11). This is very useful when in a setting where a parietal anterior abdominal wall USG is not available. In our series, the first entry points were mostly supraumbilical.

The skin and underlying tissue in scarred areas of the abdominal wall are generally too hard for the first trocar entry. There is also a high probability that intra-abdominal organs may have adhered under the scarred areas. Forty percent of intestinal damage due to trocar entry is reported to occur on the first trocar entry. A report from Sweden of over 14,000 adult patients reported an incidence of 0.182% for organ damage by trocar entry in patients undergoing laparoscopic surgery (12). Of these patients, 60% had a history of previous abdominal surgery. Laparoscopy resulted in organ damage in no patient in our study. We believe this is due to USG mapping of adhesions before laparoscopy and our use of the Hasson technique followed by finger dissection creating an air pocket before the first trocar entry. Case 1 from our series was a patient who had undergone a series of complex surgical procedures (Figure 1). The patient had a large vertical incision on the midline. There were several hard scars on the left and right sides of the abdomen. In this patient, the possibility of adhesions was managed first by performing a 2 cm mini-laparotomy from which finger dissection was utilized to form a space for the air pocket.

We utilized the Hasson technique in all of our patients. This technique can be utilized for the first trocar entry, in an area away from previous incision scars. Operation space is an important factor for the success of laparoscopic procedures. The intra-abdominal area provides a suitable area in this aspect. For some procedures, it is necessary to utilize techniques that first allow the formation of a space for insufflation. The balloon technique for retroperitoneal

access as well as foley catheter, condom, and glove finger techniques have been previously defined (13). Balloon dissection is difficult to use in patients who have undergone previous open abdominal surgery. On the other hand, waiting for five minutes after balloon inflation helps stop capillary bleeding through compression. However, the same effect is not feasible when opening fibrotic adhesions. Finger dissection, as used in our patients, gives better feedback to the surgeon allowing a more controlled method for dissection of stronger/harder fibrotic bands. Any bleeding was controlled with compress and we were able to open all adhesions in all patients using this technique.Following the first trocar entry and pneumoperitoneum, any complications from previous surgical procedures must be managed. We observed that soft and smaller adhesions opened with carbon dioxide insufflation, allowing clear intraabdominal telescopic visualization. Apart from and following any potential damage from the first trocar entry; coagulation damage, organ damage secondary to adhesiolysis, and serosal damage due to scissor use may also occur (13). In a report similar to our study Jaggy, et al. (14) and preffering the palmer's point of found that ultrasonic adhesion mapping the first trocar entry reduced intra-abdominal organ damage. A large meta-analysis (115) of over 325,000 patients reported intestinal damage in 430 patients (0.13%). While 61% of intestinal damage was detected intra-operatively, damage in the remaining patients was detected within the first four postoperative days and sometimes even later (12). It is therefore especially important in these patients to consider close follow-up with intra-abdominal mortality in mind. We observed no organ damage in the per-operative or postoperative period in any of our patients.Time to the first trocar entry and surgical time was within acceptable limits by the performed surgery in our study. The longest time to the first trocar placement was 30 minutes in a patient that underwent multiple serious abdominal surgeries. This time is comparable to other laparoscopic splenectomy series. In general, laparoscopic procedures have historically come under scrutiny due to long operation times. However, increased experience and the use of equipment such as vessel sealing devices have led to the shortening of these times. It has been suggested that as the learning curve progresses that surgical times will decrease with this technique.

Laparoscopic methods generally provide more comfort with less postoperative pain and shorter hospital stay. Postoperative analgesic needs of our cases were met with meperidine, but in the literature, analgesia was generally provided with morphine sulfate. The average discharge time of our patients was 6 days. We expect that this period will shorten with the increase of our experience in such cases. Numerous data in the literature regarding the need for postoperative analgesics and the shortening of discharge times have shown that the laparoscopic method is superior to the open method.

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Study Limitation

Our study has some limitations. Although we report our experience with only 10 patients, it should be kept in mind that pediatric patients that have undergone three or more intraabdominal surgical procedures are extremely rare when compared to the adult population. However, our study has strengths: He is one of the few reports in the pediatric population and we aimed to provide our experience as a preliminary report, to pave the way for future prospective studies in similar patients.

Conclusion

To conclude; the success of laparoscopy following multiple open abdominal procedures is based on the successful placement of the first trocar. The placement of the first trocar can be aided through preoperative USG to determine the areas where adhesions exist and through the formation of an air pocket at a safe entry point. This and similar techniques can be used to make laparoscopy a more widely utilized modality in patients with a history of multiple open abdominal surgical procedures.

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