



Original Research

The Effect of Technical Problems on the Operation Process in Pediatric Laparoscopy

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Abstract

Objectives: The aim of this study was to determine the technical problems in pediatric laparoscopic surgery and to evaluate its results.

Methods: The technical problems encountered in 30 laparoscopic operations performed between 3 November 2012 and 31 December 2017 were retrospectively analyzed.

Results: The technical problems experienced in 30 laparoscopic surgeries were analyzed. There were 6 splenectomies, 15 appendectomies, 1 hernioplasty, 2 ovarian cyst excisions, 4 cholecystectomies, 1 intra-abdominal exploration of the testes, and 1 varicocele surgery. The technical errors included instrument failure in 10, human errors in 8, device problems in 12, and multiple problems in 2 cases. In 5 patients, we switched to open surgery.

Conclusion: Technical problems prolong the operation, and cause a conversion to open surgery. In order to solve these problems, it is necessary to register and report these problems and take the necessary preventive measures.

Keywords: Pediatric laparoscopy; technical problems.

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Laparoscopic surgery is preferred more than open surgery because of its many advantages.^[1] The advantages of laparoscopy include lesser pain, shorter hospital stay, and better cosmetic results. The disadvantages include a long learning process and duration of the operation and an increase in cost.^[2] However, the disadvantages of laparoscopic surgery, which has undergone a more dynamic development process compared to classical surgery, have decreased rapidly.^[1] Diversified instruments make surgery easier but can also bring with it some technical problems. In our study, we aimed to reveal the technical problems affecting the duration and outcome of pediatric laparoscopic surgery.

Methods

Between 3 November 2012 and 31 December 2017, 30 patients who underwent laparoscopic surgery in our Pediatric Surgery Clinic were included in the study. The technical problems experienced during the operations, related prolonged operative time, and indications for open surgery were recorded.

Defective materials used in the operation including surgical equipment and electrical equipment and devices (hand tools such as ports, graspers, dissectors, and specimen bag) were categorized as device errors and the errors made by the laparoscopy team were defined as human errors.

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All surgeries were performed by the same experienced surgeon and 2 assistant surgeons. The length of the operation was recorded by considering the time elapsed until the problem was resolved. The problems that prolonged operative time by less than ten minutes and other unexplained problems were not evaluated. The problems that prolonged operative time by less than ten minutes and other unexplained problems were not evaluated. The operative time of the patients with multiple technical problems was not evaluated. Median values were used because the operative times did not show statistically normal distribution. Other findings were analyzed by descriptive statistics.

Results

Of the 30 patients included in the study, 16 were female and 14 were male. Their ages ranged from 5-14 years (mean±standard deviation: 8.2±2.3 years). Six splenectomies, 15 appendectomies, 1 hernioplasty, 2 ovarian cyst excisions, 4 cholecystectomies, 1 exploration of the intraabdominal testis, and 1 varicocele operation were performed.

A total of 35 technical problems were recorded. Two cases had more than one problem. Instrument problems were experienced in 40% (14/35), human errors in 26% (9/35), and device problems in 34% of the cases (12/35) (5 diathermy problems, 4 cases of image transfer system problem, 2 light source failure, and 1 insufflator failure) (Table 1).

The most frequently encountered technical problems were the device monitor and insufflator problems. Breakage of the grasper and port were the instrument-related problems and inadequate material control was the most common human error (Table 1).

One of the 2 cases with multiple problems had 3 technical problems (2 instrumentation problems, 1 human error) and the other patient had 2 instrumentation problems.

The most frequent technical issues were the device problems (median time: 25 minutes) that affected the duration of surgical procedures. Camera head failure and its replacement (35 minutes), instrument problems, and human errors (15 minutes for each) prolonged the median operative times as indicated.

Specimen bag rupture and the lack of a spare bag in the stock occurred in 2 patients, cystic artery bleeding as a result of adhesion to the vessel sealing device occurred in 1 patient, and conversion to open surgery due to the inability to receive images because of faulty screen connection was observed in 5 cases.

Discussion

The equipment and instruments used in laparoscopy are currently developing and diversifying. This facilitates an increased number of more efficient operations but also increases the rate of occurrence of technical problems.^[3]

There is not enough data in the literature on the frequency of technical problems in laparoscopic surgeries. This is due to the failure of surgeons to keep post-surgery records. Legal concerns are the most important reason for this deficiency. However, technical problems are frequently seen in laparoscopic operations.^[4] We wanted to report our own experiences and solutions in this study.

Table 1. Technical problems and results

Problems	Number of cases (n=30)	Time lost (min) (median)	Conversion to open surgery
Device problems	12	20	
Monitor/endoscope	4		
Pedal	2		2
Light source	1		
Diathermy	2		
Insufflator	3		
Instrument problem	10	15	
Hand tool	8		
Specimen bag	2		2
Human error	8	15	
Wrong instrument	2		
Empty gas tube	3		
Erroneous device adjustment	2		
Inadequate control of the stores	1		1
More than one problem	(2 cases, 5 problems)		
Total	35		5

The success of surgical procedures is affected by factors such as operating room environment, design and use of technical equipment, and communication and team coordination.^[5-9] In our study, we have focused on human errors, device-related, and instrument-related problems. There may also be hidden unexplained breakdowns in the laparoscopy equipment in addition to the causes that can be clearly determined. These malfunctions can lead to unsafe actions being committed by the patient or the personnel in direct contact with the system. Hidden problems can be caused by inefficient operating room design, the infrastructure of the building, and administrative rules.^[4] In our study, we did not consider those hidden problems whose causes we could not identify. However, this issue should be a separate study topic.

Human errors are important in laparoscopic surgery. Verdaasdonk et al.^[4] examined the technical problems in laparoscopic cholecystectomy performed in 30 adults. They detected 31 human-induced positioning errors, 6 installation-related issues, and 18 instrument connection errors. We did not consider position errors in our own study. However, in 10 cases (28.5%), we detected human-induced errors. In 2 of our cases, we had to switch to open surgery. These problems are generally caused by the lack of knowledge among the auxiliary staff. At the same time, surgeons should improve the solutions for technical problems during the laparoscopy training process and the number of training courses focusing on this topic should be increased.^[4]

During laparoscopic surgery, there may be more than one technical problem in the same patient. In our study, more than one technical problem occurred in 2 of the 30 evaluated cases. In one of the cases, there were 3 problems (1 human error, 2 instrumentation problems) and in the other patient, there were 2 instrumentation problems. In these cases, the operative times were prolonged by 25 minutes and 20 minutes, respectively. In our opinion, multiple technical problems can be expected with an increasing number of cases.^[3, 4]

Devices are the electrically operated, complex parts of the laparoscopy equipment. Verdaasdonk et al.^[4] classified the sources of device problems and recorded them as monitor, pedal, endoscope, light source, diathermy, insufflator, and instrument problems. Monitor and image problems, the most important of these, were reported to have occurred 24 times in 30 cases (80%). In our study, we most frequently encountered visualization problems (11%) and ignored the errors in the monitor position. Further, in the previous study, diathermy problems were the second most frequent in 10 cases (30%), but in our study, this problem was observed in only 2 cases (6%). In the previous study,

pedal problems were experienced 9 times and in our case, the pedal was disabled in 2 cases. Verdaasdonk et al.^[4] reported insufflator problems 4 times, and light source and endoscope problems 1 time. In our study, these problems occurred 3 and 2 times respectively. The device-related problems we experienced were similar to those reported in the literature in terms of variety.^[3, 4, 7]

In 13 (37%) of our surgeries, we observed an instrumentation problem that occurred due to the inferior quality of the material used. These included broken trocars, problems of opening and closing in hand tools, and rupture of the specimen bag. Verdaasdonk et al.^[4] reported only 6 instrument problems. One of the probable reasons for this difference is the purchase of cheap and poor quality materials according to the tender law for state hospitals in our country. The other is that the choice of material is often not left to the surgeons performing surgery.

Prolongation of operation time is an important result of technical problems. The everlasting problems in our study were related to devices. Three of the 4 important problems were resolved in 20 minutes and 1 in 35 minutes. Comparable solution times are available in the literature.^[1] Prolonged operation time may cause increased carbon dioxide in the patient's blood (arterial blood pCO₂ value greater than 60 mmHg increases the risk of gas embolism). This may lead to surgeons choosing to switch to open surgery.^[1] In our study, there was no transition to open surgery due to prolongation of the operative time.

Switching to open surgery is the most important factor in evaluating the success of laparoscopy. In a series of 25 cases of laparoscopy, the researchers had to switch to open surgery for technical reasons 4 times.^[1] Park et al.^[10] reported that they switched to open surgery 3 times in a study of 40 cases and Esposito et al.^[11] indicated that they had to resort to open surgery only once in a study of 54 patients. In one of these series, there was a transition to open surgery after specimen bag rupture and in others, bleeding due to diathermy problem necessitated a transition to open surgery. In our patient group, 5 patients underwent open surgery because of technical problems (diathermy problems in 2 cases and instrumentation problems in 2 cases) and human errors (n=1). These results emphasize the critical importance of identifying and minimizing technical problems.

Solving problems during laparoscopic surgery can be difficult. Therefore, prior to surgery, some approaches may prevent technical problems, such as the proper arrangement of the operating room and the all equipment, personnel training, formulating and implementing a protocol related to instruments, and creating a device checklist.^[1] The checklist can provide a cheap and quick solution to avoid

technical problems. Buzink et al.^[12] used an equipment checklist called the pro-checklist. They reported that they had created a concept of safety culture in the laparoscopy team. Verdaasdonk et al.^[4] reported a 53% reduction in technical problems due to the checklist they developed. We have conducted this study to identify our technical problems and create a personalized checklist that suits our own requirements.

As a result, it is necessary to identify and reduce technical problems for the widespread and successful application of laparoscopy. The organization and training of the laparoscopy team, the improvement and standardization of devices and instruments, and the use of an equipment checklist are important. Further research should focus on assessing the effectiveness of these measures.

Disclosures

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