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Features of Technical Problems in Pediatric Rigid Bronchoscopy

Pediatrik Rijid Bronkoskopide Teknik Sorunların Özellikleri

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ÖZET

Amaç: Çocuklarda yabancı cisim aspirasyonu rijid bronkoskopi ile tedavi edilmesi gereken bir sorundur. Bu çalışmada rijid bronkoskopi sırasında yaşanan teknik problemler ve çözümleri değerlendirildi.

Yöntem: Çocuk Cerrahisi Kliniğimizde Ağustos 2019-Mart 2021 tarihleri arasında yapılan 42 olguda yabancı cisim aspirasyonu nedeniyle yapılan rijid bronkoskopide yaşanan teknik sorunlar retrospektif olarak incelendi**.**

Bulgular: Solunum yoluna yabancı cisim kaçması nedeniyle Çocuk Cerrahisi Kliniğine başvuran 42 çocuk hasta (20 kız, 22 erkek); yaş, cinsiyet, yabancı cismin niteliği ve yeri, komplikasyonlar ve yaşanan teknik sorunlar analiz edildi. Yabancı cisimlerin 3'i sağ ana bronş,7'si sol ana bronş, 4'ü trakeadan çıkarıldı. Yabancı cisimlerin 36'sı organik, 6' sı inorganikti. Sekiz olguda insan hatası, 27 olguda enstrüman hatası, 4 olguda cihaz hatası, 3 olguda birden fazla hata saptandı.

Sonuç: Alet ve cihazların yoğun kullanıldığı girişimlerde, hatalara bağlı istenmeyen olaylar ve komplikasyonlar olmaktadır. Bunları azaltmak için hata raporlarının analiz edilmesinin önleyici olduğunu düşünmekteyiz

Anahtar sözcükler: Çocuk, bronkoskopi, teknik sorun

ABSTRACT

Aim: Foreign body aspiration in the respiratory tract in children is a vital problem treated with rigid bronchoscopy (RB). In our study, technical problems and solutions of problems detected during RB were evaluated.

Methods: The technical problems experienced in rigid bronchoscopy due to foreign body aspiration in 42 cases performed between August 2019 and March 2021 in Pediatric Surgery Clinic were analyzed retrospectively.

Results: Forty-two pediatric patients (20 girls, 22 boys) admitted to the Pediatric Surgery Clinic due to foreign body inhalation into the respiratory tract; Age, gender, nature and location of the foreign body, complications and technical problems were analyzed. Three of the foreign bodies were removed from the right main bronchus, 7 from the left main bronchus, and 4 from the trachea. Of the foreign bodies, 36 were organic and 6 were inorganic. Human error was detected in 8 cases, instrument problems in 27 cases, device problems in 4 cases, and more than one error in 3 cases.

Conclusion: In attempts where tools and devices are used extensively, there are undesirable events and complications due to errors. We believe that analyzing error reports to reduce them is preventative

Keywords: Child,bronchoscopy,technical problem

INTRODUCTION

Foreign body aspiration in children It is a situation that requires evaluation and approach. Complete obstruction of the larynx and trachea, bronchial pulmonary tract obstruction up to death with atelectasis and emphysema results can be encountered. less than one-year-old 40% of accidental deaths in infants are foreign It occurs due to body aspiration (1,2). There is no definite information about the frequency of foreign body aspiration and complications in pediatric bronchoscopy in Turkey (3).

In the United States, at least 44,000 people die each year because of medical errors. This number is greater than the number of deaths in motor vehicle accidents (4). Mistakes in hospitals commonly occur in the operating room. It has been noted that most of these can be prevented by a systematic approach (5). Reason (6), in his study of human error, described the universal model of the accident. Accordingly,

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there should be some defense mechanisms (organization, experience, protocol, and equipment design) to prevent unwanted events. Sarker et al. (7) emphasized that the growing human-machine relationship and high-tech procedures create opportunities for new errors. In recent years, endoscopic interventions have started to be used more frequently all over the world thanks to the technological equipment that has developed. In this regard, technical problems are more experienced than in previous years. On the otherhand, fear of punishment makes healthcare professionals reluctant to report errors. Unfortunately, failing to report contributes to the likelihood of serious patient harm (8). Rigid bronchoscopy is an emergency endoscopic procedure performed in foreign body aspiration (FBA). Therefore, technical problems (often, instrument and device problems human errors; rarely, architectural problems and undetectable problems) must be carefully analyzed and shared by the entire surgical team in the centers where the procedure is performed. Because searching for solutions to technical problems during the procedure poses a serious risk to the patient. Preparation of the operating room equipment checklist and staff training is the most important preventive measures (8). The purpose of this study; on the one hand, is to analyze the technical problems that occur during the bronchoscopy process in children and to provide solutions, on the other hand, to create a standard checklist before the bronchoscopy process in the operating room of our clinic.

MATERIAL and METHOD

Approval for this study was obtained from the local Ethics Committee KAEK/2021.09.242. Between August 2019-March 2021, 42 cases of bronchoscopy due to FBA were examined retrospectively in our clinic. Age and gender of bronchoscopy cases, nature and location of foreign body, technical problems encountered, and solution times of these problems were analyzed

Bronchoscopy procedure: Bronchoscopies of all patients were performed under general anesthesia, intravenously, or by inhalation induction with monitorization. In forty-two cases, a neuromuscular blocker was used at the beginning of anesthesia, sevoflurane and a mixture of oxygen and air were used at the execution. During the procedure, ventilation was provided by connecting the apparatus with a rigid bronchoscope. Imaging Tower (monitor, light source, camera head), rigid bronchoscope, optical forceps and, if necessary, direct view and only forceps were used in the process. After the procedure, the patient was intubated and the patient, who stabilized as a result of observation, was extubated. It was followed for 2 hours and sent to the ward. Unstable patients were transferred to intensive care units.

Equipment used in the bronchoscopy process; error of tools that work with electrical energy “device problem”, problems with hand tools were called an “instrument problem” and errors by staff on duty were called “human error”. All bronchoscopy attempts were made by the same surgeon. Diagnostic bronchoscopies, flexible bronchoscopies, and bronchoscopies without technical problems were excluded from the study. The time from the beginning to the resolution of technical problems was recorded. Losses of less than ten minutes were not taken into account. A single case with more than one technical problem was not evaluated. Statistical method; Median values were used because the solution times did not show normal distribution according to the Shapiro-wilk test. The results were analyzed by the descriptive method.

RESULTS

Of the 42 cases taken in the study, 20 were girls and 22 were boys. Their ages ranged from 1 to 16 years old (Mean/std: 4.6/0.7). Thirty-one of the foreign bodies were removed from the right main bronchi (74%), 7 from the left main bronchi (2.7%), and 4 from the trachea (1%). Of the foreign bodies, 36 were organic (29 nuts, 7 pulses) and 6 were inorganic (3 needles, 2 toy pieces, 1 pencil head).

Two cases were removed by leaving them in secondary care because the foreign body could not be removed, 8 cases developed bronchospasm, 3 of them continued their treatment in the intensive care unit and were taken to the ward within 24 hours. There was no transition to open surgery and no mortality.

Device problem occurred 35% (16/45) in 16 cases; instrument problem occurred 15% (7/45) in 7 cases, and human error occurred 40% (18/45) in 18 cases. Multiple technical problems were detected in one case (device error, instrument problem, human error) (Table1)

The technical problem that caused the most time loss was the forceps fracture. Forceps fracture in two cases made a time loss of an average of 37 minutes. In addition, the prism (25 min), The Monitor (22 min), and the light source (17 min) were the equipment that caused the most time loss (Figure 1). Other time-wasting issues were position errors (14 min), Unsuitable instruments (13 min), connection error (12 min), inappropriate forceps (11 min), and device adjustment error (11 min), respectively.

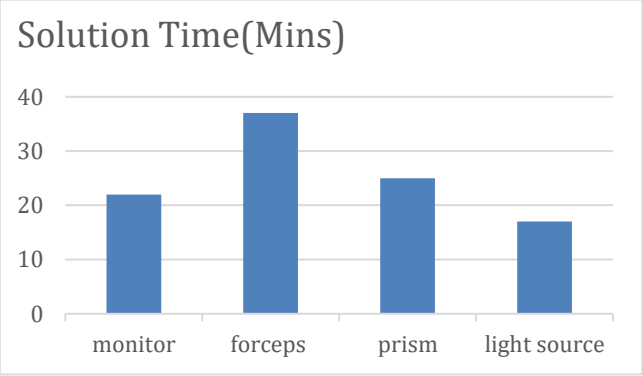

Fig. 1. Solution time of commonly seen errors

Table 1. Frequency of problems with technical equipment

Technical problems	Number of problems (n)	Case number (n=42)	Solution time (Min) median
Device problems		**16**	22
Monitor	13		22
Light source	3		17
Instruments problems		**7**	
Forceps break	2	-	37
Problem of prism	2	-	25
Other enstrument problems	3	-	11
Human errors		**18**	
Unsutiable instruments	3		13
Connection errors	4		12
Setting errors	1		11
Not in right position	10		14
Multiple errors (1 case, 3 problems)			
Total	**45**	**42**	

DISCUSSION

Foreign body aspiration (FBA) is a life-threatening problem in children. In the U.S. ranked, it is the 4th cause of death in children under 3 years old. İn the literature, 220 deaths related to the FBA are reported every year. The aspirated foreign bodies are usually organic bodies such as cores, walnuts, nuts, and inorganic bodies such as toy parts, beads. Sudden cough and bruising are the most common clinical signs. Rigid bronchoscopy is the gold standard in treatment when FBA is suspected or diagnosis is finalized (9).

Although there are different statistics about the localization of the aspirated body in scientific data, the incidence of the right main bronchus is higher (10,11). Similarly, in our study 31 of the foreign bodies were removed from the right main bronchi (74%), 7 from the left main bronchi (2.7%), and 4 from the trachea (1%). Of the foreign bodies, 36 were organic (29 nuts, 7 pulses) and 6 were inorganic (3 needles, 2 toy pieces, 1 pencil head) (8). In the literature, it has been reported that the small age of the patient, the type of foreign body (FB) (organic or inorganic), inflammation caused by FB in the bronchi, the duration of inflammation, the size of the body, its shape may increase the morbidity and mortality (12,13). Bronchospasm, pneumothorax, unilateral lung ventilation, hypoxia, and other factors that increase the risk of hypercarbia can be listed during bronchoscopy (14). We believe that technical problems that may occur during the bronchoscopy process have the potential to increase morbidity and mortality.

Devices used during bronchoscopy require installation information. Since the installation of the device requires experience, the problem often encountered in complex procedures such as bronchoscopy, is related to the devices. A monitor, camera head, and light source are used as devices in the bronchoscopy process. The most common device problem is due to the monitor. In our study, we also encountered monitor problems most often. Because the reception and transfer of the image make the monitor the central part of the process. Indeed, verdaasdonk et al.has reported monitor and image problems occurred 24 times in 30 cases (80%). In our study, monitor problems were seen in 30% of the cases. The reason for this difference may be that we use a single monitor and our staff on duty are trained during the process. But the cases in our study were made by a single surgeon. Our hospital is a center for pediatric surgery. For this reason, we believe that a study involving all surgeons will give a more accurate result. Monitor issues were often related to installation. Because the process is urgent, we solved the problems that were not solved in the first 10 minutes by changing the monitor. But even this led to a loss of time of 22 min.

Instrument errors have been reported in the literature at different rates. In a study in the literature (12), the authors reported that 37% of their surgeries had an instrument problem, and this was all related to the quality of the material used. Another study reported this rate as 20% (15). In our study, instrument problems were 15%. The most common were quality problems due to breakage and bending during the use of tools. Hospital management's purchase of cheap and poor quality materials and the choice of materials is often not left to surgeons performing the surgery. In addition, the wear of tools during assistant training, untrained and careless nurses, and auxiliary staff responsible for maintenance and protection of tools can be another cause.

Human error is another problem in endoscopic surgery. Verdaasdonk et al. found 31 position errors, 6 installation errors, and 18 connection errors during 30 laparoscopic surgery procedures. We identified 18 human errors in our series (40%). This rate was the highest of all problems. Among them, we found the most frequent position errors (24%). It has also been reported in the literature that position errors are the most common errors (16). The positioning of equipment is often related to monitors. Proper placement of screens requires extensive planning. Regardless of the mounting system, monitors must usually be placed before the surgeon can begin work. Surgeons share the view that two monitors are essential both for ergonomic reasons and to ensure optimal vision. However, for logistical reasons, a second monitor is not always available, and the repositioning of monitors that are present after the surgeon initiates the procedure is also recorded as a procedural event. But it takes time to rectify and distorts concentration. Although human

errors are found at the highest rate in our series, we believe that they can be corrected quickly and cheaply with only personnel training. For this purpose, we recommend continuing education seminars in the hospital and operating room.

The longest-running problems in our study were the problems of devices. 3 of the four key issues belong to the devices and have been solved in more than 20 minutes. Similar resolution times are available in the literature (17). During emergency surgery, technical problems can be difficult to solve. For this reason, some approaches before operations can contribute to the Prevention of problems. For this purpose, all technical parts should be reviewed, if necessary, before the operation to confirm that there is no equipment problem, personnel training, instrument, and device checklist, and a protocol should be established within this framework. In particular, the checklist can provide an effective solution in preventing technical problems. Sonia Buzink et al.(16) used an equipment checklist they called‘ pro-check". However, they report that they have established a culture of safety in the laparoscopy team. Verdaasdonk et al., reported a 53% reduction in technical problems thanks to the checklist they developed. We are preparing our checklist based on our technical problems. That's one of the goals of our work. We believe that each surgical branch should prepare its error reports. Because technical error reporting has a close relationship with local conditions.

Reason, in his book “Human Errors”, described barriers to the prevention of risky events in the “universal accident model” that he defined after the nuclear accident on a Pacific island in 1979. This model is frequently used in the aviation sector and is also a good model for preventing errors in operating room conditions. It is used to develop and implement strategies that will improve the effectiveness and safety of surgical procedures. In the same way, in nuclear power plants and the aerospace sector, where safety conditions are very important, these strategies have had an extraordinarily positive impact on safety and efficiency. This study, from our point of view, has shown that most technical problems can be prevented by some measures and the main causes that make up the problem are revealed. Classical education and training are focused on solving patients ' medical problems, not solving problems related to technical equipment that a surgeon may encounter during endoscopic surgery. In other words, although the surgeon who will perform the intervention knows the medical treatment very well, he has very little knowledge of the equipment. We believe that this is a significant lack of surgical training. This topic should be added to the surgical training as a training module.

CONCLUSION

To conclude, for FBA in children, performing a bronchoscopy is vital. Technical problems that occur during the procedure disrupt the process and increase the risk of complications by extending the time. Therefore, to avoid technical problems during bronchoscopy, teamwork awareness, use of quality materials, surgeons have a say in the purchase of hospital materials, preparation of checklists before the procedure, training of operating room personnel, including doctors, can provide a quick and cheap solution.

Study Limitation

Our study has some limitations. Our case number was limited to 42. However, more technical problems can be detected in larger case series. Hidden technical problems such as hospital infrastructure and operating room architectural design could not be investigated.

Declarations

Conflict of interest: None.

This study was performed in line with the principles of the Declaration of Helsinki.

Consent to participate: Informed consent was obtained from legal guardians.

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