

Investigating the effect of using magnetic drape on preventing instruments fall during surgery in Alzahra Medical educational Center of Isfahan in 2017

Investigando el efecto del uso de la protección magnética en la prevención de caídas durante la cirugía en el Centro educativo de Alzahra Medical en Isfahan en 2017

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Abstract

Abstract: Introduction and purpose: Falling of instruments is seen as a major problem and defect in the most surgical procedures. Instruments' fall leads to increase in operating time, surgical flow disruptions, more cost and possible damage to surgical instruments. Due to the efficiency of magnetic drapes and the maintenance of instruments in the field of surgery, some of Instruments' fall and its adverse effects on the operating room efficiency are prevented. Thus, this study was undertaken to investigate the effect of magnetic drapes on the falling of instruments during neurosurgical, general, gynecological, orthopedic and urological operations.

Materials and Methods: After making and testing the magnetic drape, the clinical data were recorded by intra-operative observation using a Self Administered checklist in two groups of control and intervention during 200 neurosurgical, general, gynecological, orthopedic and urological procedures.

Results: The results of this study showed that the frequency of instruments fall in the intervention group significantly decreased ($P < 0.05$).

Conclusion: Falling of instruments frequently occur in the operating room and have a major effect on surgery flow and resource utilization. Thorough documentation of intraoperative falling of instruments provides a basis for the development of solutions for improving operating room efficiency. According to the results of present study, it can be concluded that magnetic drape had a significant effect on reducing the falling of instruments during neurosurgical, general, gynecological, orthopedic and urological procedures. So, designing and manufacturing magnetic drape is recommended for the safety and comfort of surgical team members and the removal of additional cost.

Keywords: Surgical instruments, operating room, fall, magnetic, drape.

Resumen

Introducción y propósito: la caída de los instrumentos es vista como un problema y defecto importante en la mayoría de los procedimientos quirúrgicos. La caída de los instrumentos aumenta el tiempo de operación, las interrupciones del flujo quirúrgico, más costos y posibles daños a los instrumentos quirúrgicos. Debido a la eficiencia de las cortinas magnéticas y al mantenimiento de los instrumentos en el campo de la cirugía, se evitan algunas caídas de los instrumentos y sus efectos adversos en la eficiencia de la sala de operaciones. Por lo tanto, este estudio se realizó para investigar el efecto de las cortinas magnéticas en la caída de los instrumentos durante operaciones neuroquirúrgicas, generales, ginecológicas, ortopédicas y urológicas.

Materiales y métodos: Después de realizar y probar la capa magnética, los datos clínicos se registraron mediante observación intraoperatoria utilizando una lista de verificación auto administrada en dos grupos de control e intervención durante 200 procedimientos neuroquirúrgicos, generales, ginecológicos, ortopédicos y urológicos.

Resultados: Los resultados de este estudio mostraron que la frecuencia de los instrumentos en el grupo de intervención disminuyó significativamente ($P < 0.05$).

Conclusión: la caída de los instrumentos ocurre con frecuencia en la sala de operaciones y tiene un efecto importante en el flujo de la cirugía y la utilización de recursos. La documentación exhaustiva de la caída intraoperatoria

de instrumentos proporciona una base para el desarrollo de soluciones para mejorar la eficiencia de la sala de operaciones. De acuerdo con los resultados del presente estudio, se puede concluir que la caída magnética tuvo un efecto significativo en la reducción de la caída de los instrumentos durante procedimientos neuroquirúrgicos, generales, ginecológicos, ortopédicos y urológicos. Por lo tanto, se recomienda el diseño y la fabricación de cortinas magnéticas para la seguridad y la comodidad de los miembros del equipo quirúrgico y la eliminación de costos adicionales.

Palabras clave: Aparatos quirúrgicos, quirófano, caída, magnéticos, drapeados.

Introduction

Within each operating room (OR) suite, there are many instruments used by the surgical team members. And then the falling of instrument seems to be a common incident and also a deterrent to most of the surgery. This issue is very important, which can have short and long-term effects, leading to surgical flow disruption, the imposition of additional time and costs, and the shortening the longevity of instruments. Surgical instrument fall as an interruption factor may affect negatively the surgical team's ability to remain fully engaged mentally during a case. Also, the noise caused by the moving or falling of the surgical instrument leads to distraction of the surgical team. Surgical team members should give their full attention to carrying out duties performed during critical phases². As mentioned by Wiegmann, surgical flow disruptions related to resource accessibility accounted for the remaining 8% of the observed events during 31 nonemergency cardiovascular operation³. Joshi and colleagues reported an average delay of 5.7 min after the fall of the surgical instrument⁴. As a result of prolonging the procedure, the patient is placed at a higher risk of infection or other serious complications. In addition, other surgeries may be subsequently delayed, and time wasted on the part of the surgeon and other hospital staff. Harders and colleagues found that the second most commonly recorded reason for delay in the operating room, after patient clinical condition, was the availability of instruments⁶. During surgery, contaminated instruments should be properly and completely removed from blood or tissue in the sterile field. On the other hand, the instrument dropped to the floor remains there until the completion of the surgery. Blood and foreign matter that are not removed or are allowed to dry and harden may become trapped in jaw serrations, between scissor blades, or in box locks, making final cleaning more difficult and the sterilization or disinfection process ineffective. It can cause instruments to become stiff and eventually break. Surgical instruments are a major financial investment in

every surgical facility, and processes should be in place to protect this investment. The life of a surgical instrument is dependent upon the way it is used and the care it receives. It is a responsibility for the surgical team and the operating room staff. Instruments should be handled carefully and gently to avoid possible damage caused by their becoming tangled, dented, and misaligned. During and after surgery they should be placed in an appropriate place to prevent them from falling⁷. Surgeons, assistants and scrub nurses work very closely together handling the same instruments in a confined space during surgery⁸. Consequently, one of the factors influencing the incidence of instruments fall is communication in the operating room. In recent research, verbal and non-verbal exchanges in the operating room (OR) have been evaluated; commands are delayed, incomplete, or not received at all, and frequently left unresolved⁹. Firth-Cozens found that 31% of all communications in the operative procedures represent failures, a third of which had a negative impact on the patient¹⁰. Halverson and colleagues claimed that 36% of communication errors were related to instrument utilization¹¹. Generally, there are three phases related to the use of the instruments. First, the request for a tool has to be handled, then the tool is used, and finally it is disposed of^{1,2}. An error in any of these phases can be considered as a disruption to the surgical flow. In other words, the tool request was not properly interpreted or holding the required tool was not conducted properly e.g., it was mishandled or dropped on ground¹². Because the most fallen surgical instruments include Hemostats, needle holders, Scissors and Forceps, also the majority of surgical instruments are stainless steel and stainless steel can be magnetically absorbent, therefore, the use of magnetic instrument holder will improve the efficiency and safety of the transfer of tools to the surgeon when they are needed. Thus, this study was undertaken to investigate the effect of magnetic drapes on the falling of instruments during neurosurgical, general, gynecological, orthopedic and urological operations^{3,4}.

Materials and methods

This experimental paper is divided into two sections. Firstly, Intra-operative observation of operative procedures was performed by first author over two week periods. Surgical cases were distributed across all days of the week, times within the day, surgical specialty, and surgeon within each specialty. A similar sampling scheme was used for observation in order to make a main checklist and record data sheet for two control and intervention group during study. A combination of recorded observations was used to introduce the basic checklist and categorize falling events. The topics of the self-administered checklist were classified into 6 catego-

ries: Demographic information of the surgical team, surgical position, type of instrument, stage of falling, condition followed falling of instrument during surgery, number of falls per surgical operation. In the second section, we designed and examined the particular magnetic drape for this investigation. All 20 operating rooms committed to full-time surgery in academic hospitals of Alzahra, affiliated to Isfahan University of Medical Sciences were selected by the convenience sampling method. After applying the criteria of entry and approval of participation in the study, 200 operations such as general surgeries, neurosurgeries and urology, orthopedic, obstetrics and gynaecologic surgeries were randomly assigned to two groups (control and Intervention) of 100 cases were recorded. We excluded emergency and after-hours cases. Entry criteria included being the first surgical operation of day and performing open surgery. The first author entered all falls into the database immediately after each case in both groups and the magnetic drape was successfully used during surgeries in an intervention group. The checklist validity was confirmed through a survey of 10 members of the faculty. The data were analyzed by SPSS ver.16 using descriptive and analytical statistics (Chi-square, Pearson, Fisher's exact test, and Kolmogorov-Smirnov tests) at a significance of 0.05.

A 2-week-long pilot project was initiated to introduce and test the new checklist. After revisions were made, the process was introduced into the first surgical case of the day. A total of 200 neurosurgical, general, gynecological, orthopedic and urological cases were observed during the study. The surgeries were divided into control and intervention groups. There were 512 surgeons and 200 scrub technicians who participated in the project. Surgical residents participated in all cases. There was no significant difference between the two groups in terms of age, gender, and work experience (P -value >0.05). The frequency distribution of the demographic characteristics of the population under investigation in two groups of control and Intervention is shown in (Table 1) & (Table 2). There were 55 falls (55%) during control and 19 (19%) during intervention surgeries. The results of this study showed that the frequency of instruments fall in the intervention group significantly decreased ($P<0.05$) (Table 3).

Table 1. Determining and comparing frequency distribution work experience, gender and age of surgeons and residents in two groups

Variable		Group		Significance
		Control	Intervention	
work experience	1st year resident	28 11.2%	33 12.6%	0.77
	2nd year resident	44 17.5%	43 16.5%	
	3rd year resident	78 31.1%	78 29.9%	
	4th year resident	34 13.5%	37 14.2%	
	5th year resident	1 0.4%	5 1.9%	
	fellowship	8 3.2%	6 2.3%	
	Professor	58 23.1%	59 22.6%	
	Total	251 100.0%	261 100.0%	
age	20-30	78 31.1%	77 29.5%	0.62
	31-40	126 50.2%	126 48.3%	
	Up to 40	47 18.7%	58 22.2%	
Total		251 100.0%	261 100.0%	
gender	male	186 74.1%	194 74.3%	0.95
	Female	65 25.9%	67 25.7%	
Total		251 100.0%	261 100.0%	

Table 2. Determining and comparing frequency distribution work experience, gender and age of scrub nurses in two groups

Variable		Group		Total	Significance
		Control	Intervention		
work experience	Lowest 1 Year	5 83.3%	1 16.7%	6 100.0%	0.20
	1-2 Years	12 42.9%	16 57.1%	28 100.0%	
	Up to 2 years	83 50.0%	83 50.0%	166 100.0%	
Total		100 50.0%	100 50.0%	200 100.0%	
age	20-30	44 50.6%	43 49.4%	87 100.0%	0.80
	31-40	30 46.9%	34 53.1%	64 100.0%	
	Up to 40	26 53.1%	23 46.9%	49 100.0%	
Total		100 50.0%	100 50.0%	200 100.0%	
gender	male	23 46.9%	26 53.1%	49 100.0%	0.62
	Female	77 51.0%	74 49.0%	151 100.0%	
Total		100 50.0%	100 50.0%	200 100.0%	

Variable		Instruments Fall		Total	Significance
		No	Yes		
Group	Control	45	55	100	0.002*
		45.0%	55.0%	100.0%	
Intervention	81	19	100		
		81.0%	19.0%	100.0%	
Total		126	74	200	
		63.0%	37.0%	100.0%	

In control group 40 falls (52.6%) in supine position, 6 falls (66.7%) in lateral position, 2 falls (28.6%) in prone position and 7 falls (87.5%) in lithotomy position occurred, while in intervention group 14 falls (19.4%) in supine position, 2 falls (20%) in prone position and 3 falls (21.4%) in lithotomy position were noted. The results also showed that there was a significant difference between frequency of instruments fall in supine (P-value=0.001 <0.05) and lithotomy (P-value=0.006 <0.05) position. The type of the

falling surgical instruments was also noted. Out of a total of 55 instruments falling on the floor in control group, there were 53 falls involving instruments set like forceps, scissors, clamp, needle holders and 2 implants. And all of instruments falling on the floor in intervention group were involved instruments set. There were no significant difference in the types of instruments falling observed (P-value>0.05). During the observation period, the causes of instruments' fall in control (49.1%) and intervention (57.9%) group was related most commonly to time that the tools were left on the side of the patient body, at a reachable region, but outside the opening incision, and reused later by surgeon (Table 4). Ignoring instruments dropped on the floor was the most common condition after falling surgical instruments in both groups (Table 5). Seven surgeries had two or more falls. The results are based on Chi-square and Fisher's exact test non-parametric tests at a significance of 5% (due to the fact that the distribution of satisfactory score is not normal based on Kolmogorov-Smirnov results (P-value=0.001 <0.05)).

Variable		Group		Total	Significance
		Group	Intervention		
Fall stage	Picking up tool from mayo stand or instrument table	3	3	6	0.43
		5.5%	15.8%	8.1%	
	Arranging tools by scrub nurse	8	2	10	
		14.5%	10.5%	13.5%	
	Requesting and transferring tool between sterile team members	3	0	3	
		5.5%	0.0%	4.1%	
	Handling and utilization of tool in the sterile field	14	3	17	
		25.5%	15.8%	23.0%	
	Disposing and placing tool on the patient body, outside the opening incision	27	11	38	
		49.1%	57.9%	51.4%	
Total		55	19	74	
		100.0%	100.0%	100.0%	

Variable		group		Total	Significance
		Control	Intervention		
Fall condition	To request alternative tool as single instrument	4	0	4	0.61
		7.3%	0.0%	5.4%	
	To request alternative tool as instrument set	5	1	6	
		9.1%	5.3%	8.1%	
	To request resterilization of contaminated tool	1	0	1	
		1.8%	0.0%	1.4%	
	Ignoring tool dropped on the floor and to replace it with present instruments	45	18	62	
		80.0%	94.7%	83.8%	
Total		55	19	74	
		100.0%	100.0%	100.0%	

To our knowledge, no scientific data evaluating the effect of instrument holders and magnetic drapes on preventing instruments fall during surgeries. The studies evaluating the incidence of accidental fall of instruments during elective and emergency caesarean section and orthopaedic procedures have led to analyse and compare statistically the occurrence instrument fall, which can be applied in a modified manner to studies similar to ours.

In the study by Joshi et al⁴, which was conducted at V. C. S. G. G. Medical Sciences and Research Institute) Srinagar, Pauri Garhwal, India, 362 randomly chosen emergency and elective caesarean sections was observed. The results showed that gynaecological instruments fall in one-sixth of elective caesarean sections and in approximately every second emergency caesarean sections. The operating surgeon and his/her first assistant were responsible for 83.64% of instrument falls in the operating room. This is practically the same as the study performed on accidentally falling instruments during orthopedic surgery in 2008 by Khan et al. Their analysis reveals that orthopedic instruments fall in one third of elective procedures and in approximately every second trauma orthopedic one. Also, more than 80% of instrument/implant falls in the operating room occurred as a result of the operating surgeon and his/her first assistant¹³. In both previous studies, the nature of instrument falling during surgery indicates that falls are more common with smaller instruments (like forceps) and with instruments having a steel handle.

Our study concluded that to prevent instruments from falling from the surgical field, the scrub person may place a magnetic pad on the drapes below the incision site when the patient is placed in especially supine and lithotomy position. However, the scrub nurse has also created a small area on drape with the magnetic drape dedicated for the 4-5 most frequently and currently used tools (Figure 1). These instruments are placed in a particular order. In this example the scrub nurse places the instrument anticipated to be used next, nearest to the surgeon.

Figure 1. Use of the magnetic drape during surgery with lithotomy position



After use, the items are placed back in the magnetic zone, and the scrub person retrieves them. This technique eliminates hand-to-hand passing of sharps between the surgeon and the scrub person, so that no two individuals touch the same sharp at the same time and prevents instruments lying on the surgical field from sliding to the floor. Rahmati and colleagues confirmed that the use of needle magnet within surgical field may reduce the chances of sharps injury during surgery¹⁴. The evidence from our study suggests that it's better to remove instruments from the surgical field after use, and return them to the Mayo stand or instrument table promptly. But according to Svensson and colleagues' findings, the use and handling of instruments is embedded in a complex weave of multiple interrelated activities and responsibilities. For example, the passing is done in relation to other distinct and parallel activities¹⁵. Because the scrub nurse does not just respond to a request by quickly removing and passing the correct instrument, he/she can define a location on the surgical field where instruments are placed on a magnetic drape, from which the surgeon or assistant can retrieve them. The findings of our study illustrate conditions underlying the causes of falling instruments during surgeries in general. Finally, we suggest that further investigations are needed to estimate the association between falling of instruments and perioperative delay, additional subsequent delays, errors, system deficiencies, longevity of instruments and cost-effectiveness^{6,7}. We aware that our research may have limitations. First, all surgical team members, type of surgeries, duration of surgeries are different between two groups. Another important limitation is the way in which falling of instruments were recorded. There is no established classification in the literature^{8,9,10}; thus, we developed our own checklist. We hope that the data from this study can be used to show that falling of instruments does happen frequently and to elevate awareness about them so that appropriate surgical instrument holders like magnetic drapes can be used to prevent them.

Conclusions

Surgical operations where nurses and surgeons routinely pass instruments to one another. The key to the successful accomplishment of a surgical intervention is the timely availability and efficiency of tools. Surgical instruments not working properly or not immediately available may delay procedures, interrupt other activities or sometimes even endanger the safety of the patient. The handling and exchange of instruments during the surgical operation raises issues that may bear upon the development of technologies. A magnetic drape is one of new surgical technology that it is necessary to position a magnetic instrument pad over the top drape to serve as a neutral zone, and also to retain

any instruments that are placed on the drape. In conclusion, the use of the magnetic drape will make the surgical procedures more proficient, decrease loss and improve the transfer of instruments to the surgeon by keeping them in a safe but reachable distance maximizing the organization of the surgery.

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