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Investigation of Preventive Practices for Surgical Fires and Burns in the Operating Rooms of Four Tertiary Hospitals

Dilek Aygin[1], Esra Usta[2], Havva Bozdemir[3], Nursen Uçar[4]

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[1]Assoc. Prof. Dr., Sakarya University, Faculty of Health Science, Sakarya, Turkey
[2]Lecturer, Duzce University, Vocational School of Health Services, Duzce, Turkey
[3]Nursing, Phd Student, [4]Nursing, Graduate Student, Sakarya University, Institute of Health Sciences, Sakarya, Turkey

Sorumlu yazar/Corresponding author:
Esra Usta,
Duzce University, Vocational School of Health Services, Konuralp Yerleşkesi, 81620, Merkez/Duzce, Turkey
Telefon/Phone: +90 380 542 1051
E-posta/E-mail: esrakillikliogluu@duzce.edu.tr

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ABSTRACT

Aim: The present study aimed to investigate surgical fires as well as the precautions taken in the prevention of fire in four training and research hospitals in the Western Black Sea Region and Eastern Marmara Region.

Method: The descriptive study was conducted with the participation of 148 nurses working in operating rooms. A questionnaire structured by the researchers was used as the data collection tool. The data was analyzed using the statistical program SPSS 21.0. Statistical comparisons were made using Kruskall Wallis, Mann Whitney U, Student t, Pearson Correlation and Chi-square tests. The confidence interval was predetermined to be <0.05.

Results: Of the nurses, the mean age was 35.00±5.88 years. Only one of the nurses had dealt with a surgical fire, but nearly half of the nurses (46.3%) referenced burns which their patients were exposed to during surgery. Regarding the prevalence of burns, 86.4% of the nurses who had faced burns defined it as a very rare situation.The mean score that the nurses obtained from the list of measures taken for the prevention of surgical fire and burns was 51.45±16.06 (min.-max.: 20-88) and their knowledge was determined to be moderate.

Conclusions: The present study determined that most operating room nurses take some precautions for fire safety, but these are insufficient and lacking.

Keywords: Operation rooms, surgical fire, nursing personnel

INTRODUCTION

Operating rooms are places where technologically advanced devices and tools are being used and many risks are found all together, which may unfavorably influence the patients'/employees' health (Andsoy, Güngör, & Nabel, 2014; Usta, 2013). Although fires are rarely encountered during surgical interventions, they are counted among the above-mentioned risks and attract a certain level of attention as they are preventable risks. The Sentinel Event Alert released in 2003 by The Joint Commission (TJC), formerly known as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), reported that 100 surgical fires occur in the United States of America (USA) per year and that one or two of them results in patient death (TJC, 2003). Although the need for enhancing awareness regarding surgical fires and taking necessary measures has been underlined, the Emergency Care Research Institute (ECRI) reported in 2013 that 650 cases of surgical fire are seen every year. The same Institute considered surgical fires to be one of the 10 leading technological dangers in health (Emergency Care Research Institute [ECRI], 2012). In Turkey, there is no official statistical data on surgical fires, and surgical fires are not part of the Service Quality Standards which have been established by the Ministry of Health within the scope of patient safety (Usta, 2013).

Heat, inflammable material and oxygen, which are the components of the fire triangle, need to be together for a fire to occur. Operating rooms are oxygen-rich places where many sources of potential risks of fire can all be found together. The basic materials for fire include: flammable solvents such as ointments and alcohol-based antiseptics, anesthesia and surgical instruments, instruments containing paper and plastic, patient hair, and stomach intestinal gases. Heat sources such as electro surgical devices, laser, fiber optic light sources and cables, defibrillators, or table lighting systems complete the fire cycle (Guglielmi et al., 2014; Kaye, Kolinsky, & Urman, 2014; Rinder, 2008).

Surgical fires usually originate from inappropriate environments and practices. Primarily, the operating room staff and secondly, the institutional authorities are responsible for the prevention of this problem. Guidelines for the prevention of surgical fires in operating rooms have been developed by various medical and surgical organizations, institutions and commissions that ground on patient safety. Generally, these guidelines stress the necessity of using risk assessment tools, establishing fire prevention algorithms, performing regular training programs to increase staff awareness, using efficient in-team communication mechanisms, and establishing comprehensive and detailed fire-evacuation plans (Association of periOperative Registered Nurses [AORN], 2005; Apfelbaum et al., 2013; Christiana Care Health System, 2017; ECRI, 2009; Jones et al., 2017).

Available literature comprises both qualitative and quantitative studies on surgical fires. After reviewing the studies from various continents, it was concluded that the level of practice and knowledge of surgical room staff in the prevention and control of fires are moderate or lower and that physical environment is not consonant enough with the standards (Jalali, Asl, Mehr, Pourafzali, & Ghasemi, 2016; Davoodiantalab et al., 2012; Mousavi, Dargahi, Hasibi, Mokhtari & Shaham, 2011). In the United States, studies focusing only on surgeons or operating room staff demonstrated that the personnel's knowledge about prevention of fires is moderate or high (Coletto, 2016; Feldman, Fuchshuber, Jones, Mischna, & Schwaitzberg, 2012; Fisher, 2015) but production of new ideas on this subject is inadequate (Coletto, 2016). Among European countries, a study from France reported that anesthesiologists' knowledge about both the prevention of fires and fire extinguishers in the operating room was low (Crumière et al., 2012). Regarding the studies performed on this subject in Turkey, it was observed that generally there are studies focusing on fire safety actions to be taken in health care institutions, after the event occurred, (Kılıç, 2009; Şimşek, Sezer, & Akıncıtürk, 2015) but

that studies concerning operating room are scarce. Andsoy et al. (2014) determined that surgical nurses' knowledge on the risks of fire is enough but they are not competent in the precautions to be taken.

In light of this data, operating room staff's having adequate knowledge on fire risks, prevention and control is obviously of critical importance in preventing fire. Accordingly, the present study aimed to investigate surgical fires as well as the precautions taken by surgical nurses for the prevention of fire in four training and research hospitals in the Western Black Sea Region and Eastern Marmara Region.

METHOD

Study Design

This study was conducted as a descriptive and cross-sectional.

Sample

The study universe comprised the nurses (n=148) working in operating rooms in training and research hospitals in A (n=52), B (n=13), C (n=51) and D (n=32) provinces. The target was to reach the whole study universe instead of sampling. 64.2% of the universe participated in the research. Finally, the study sample consisted of a total of 95 nurses excluding those who were reluctant to participate and who were on leave or on sick leave.

Data Collection

A questionnaire structured by the researchers was used as the data collection tool. The questionnaire comprised questions on socio-demographic characteristics, situations when encountering surgical fire and burn, frequency, extent of damage and injury, and measures taken to prevent surgical fires and burns. The list of questions for measures taken to prevent surgical fires and burns consisted of 25 questions. Each correct answer given to the questions in the question list was rated as 4 and evaluated over a total score of 100. The reliability of the question list was assessed by Cronbach's Alpha, which was found to be 0.79. Data was collected between April 1st and June 30th, 2015. The questionnaires were given to the nurses and they were asked to fill them in during working hours. Data was collected at the same time as checking that the questionnaires were filled correctly.

Data Analyses

The data were analyzed using the statistical program SPSS 21.0. Continuous variables were presented as mean±standard deviation and median [interquartile range], whereas categorical variables were presented as number and percentage. Kolmogorov-Smirnov test was used to assess whether the distribution of variables was normal. Statistical comparisons were made using Kruskall Wallis, Mann Whitney U, Student t, Pearson Correlation and Chi-square tests. The confidence interval was predetermined to be <0.05.

Ethical Considerations

Approval of the Düzce University Ethics Committee (Date: 17.03.2015, Decision No: 2015/3), permission of the institution where the study was to be carried out, and written consents of the nurses after being informed about the study's objective were obtained before conducting the study.

Limitations

The most important limitations are that the operating room is overloaded, the nurses are busy during working hours and some of the nurses are unwilling to fill out the questionnaire.

RESULTS

Of the nurses, the mean age was 35.00±5.88 years, 82.1% were female, and 60% had an education level of undergraduate or higher degree. The participants

Table 1. Socio-demographic and working characteristics of the nurses

Socio-demographic characteristics	n	%
Province		
A	21	22.1
B	11	11.6
C	45	47.4
D	18	18.9
Age (Mean±SD years)	35.00±5.88 (min.-max.:20-55)	
Gender		
Female	78	82.1
Male	17	17.9
Educational status		
High school-associate degree	38	40.0
Postgraduate degree or higher	57	60.0
Working years	12.00±6.69 (min-max.:1-30)	
Working years in the operating room	8.00±5.55 (min.-max.:1-20)	

Table 2. Distribution of the characteristics related to surgical fires and burns

Characteristics related to surgical fires and burns	n	%
Fire in the operating room		
Yes	1	1.1
No	94	98.9
Influenced the operating room staff		
Yes	1	1.1
No	94	98.9
Burn in the patients		
Yes	44	46.3
No	51	53.7
Incidence of burn (n=44)		
Very rare (1-3/year)	38	86.4
Occasionally (5-10/year)	5	11.4
Very often (≥10/year)	1	2.3

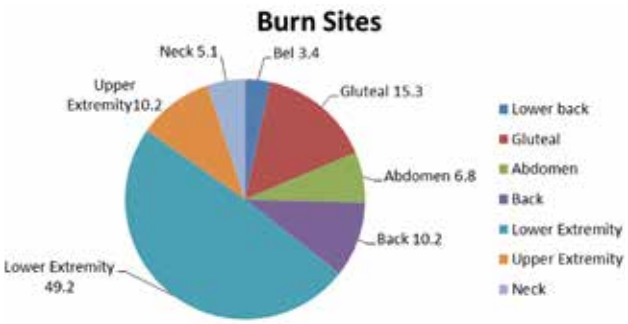

Figure 1. Distribution of burns among body sites

had been working as nurses for a mean of 12.00±6.69 years, and the mean duration of working in an operating room was 8.00±5.55 years (Table 1).

Only one of the nurses had faced a surgical fire, but nearly half of the nurses (46.3%) mentioned burns which their patients were exposed to during surgery (Table 2). The burns were primarily seen in the lower extremities (49.2%), followed by gluteal region (15.3%), upper extremities (10.2%), back (10.2%), abdomen (6.8%), neck (5.1%) and lower back (3.4%) (Figure 1). Regarding the prevalence of burns, 86.4% of the nurses who had dealt with burns defined it as a very rare situation (1-3/year) (Table 2).

The numbers and percentages concerning measures taken by the nurses to prevent surgical fires and burns are shown in Table 3. Almost all participants reported that they take the following preventive measures against fire (which the nurses have to pay attention to while preparing patients for surgery): avoiding the patient's body contacting the metal part of the surgical table (95%), checking the patient for the presence of metal implants and jewelry (93%), covering the patient after the antiseptic solution has dried (81%), avoiding fluid collection under the patient (82%), and attaching the cautery plate on the appropriate site (83%) and in a clean and dry area (90%). However, the great majority of the nurses reported that the following measures are not taken in the operating rooms: insufflating beneath the surgical cover to avoid oxygen collection (%89), applying water-soluble oils onto the hairy regions of the patient's body such as hair and beard during surgeries of the head, face, neck and upper chest (90.5%), wetting all materials used for the fixation of

Table 3. Distribution of the answers given by the nurses to the questions about preventive measures against surgical fires and burns (n=95)

Preventive measures against surgical fires and burns		Yes		No	
		n	%	n	%
1.	I avoid the patient's extremities touching metal parts of the surgical table.	95	100.0	0	0.0
2.	I check whether the patient has any metal implant andall the jewelries have been removed.	93	97.9	2	2.1
3.	I make sure that ethanol or inflammable substances are not used in the presence of electrical surgical devices and that the patient is covered after the antiseptic material has dried.	81	85.3	14	14.7
4.	I avoid fluid collection under the patient's body.	82	86.3	13	13.7
5.	I insufflate for the oxygen not to be collected beneath the surgical cover.	6	6.3	89	93.7
6.	I apply water-soluble oil onto the hairy parts such as hair and beard during the surgeries of the head, face, neck and upper chest.	9	9.5	86	90.5
7.	I keep wet all the materials used for the fixation of endotracheal tubes during pulmonary or oropharyngeal surgical interventions, orI make sure they have been wetted.	13	13.7	82	86.3
8.	I make sure that cautery plate is very close to the surgical area and has been attached to be well-contacted with the skin.	83	87.4	12	12.6
9.	I make sure that the cautery plate, which has been chosen to be appropriate in size, is placed on a dry, clean and intact area with thick muscular layer.	90	94.7	5	5.3
10.	I cover the foot switch with a fluid-proof material.	60	63.2	35	36.8
11.	I make sure that the humidity of surgical area is about 50% and that noninflammable anesthetics have been chosen instead of volatile anesthetics.	20	21.1	75	78.9
12.	I make sure/check that active electrode has been put into its case when not used during electro-surgery and that fiber optic light sources and laser device remain in standby mode when not used.	66	69.5	29	30.5
13.	I check the devices before each use and report relevant errors.	68	71.6	27	28.4
14.	In the institution I have been working at, the floor and the doors of the operating room are made of noncombustible materials.	36	37.9	59	62.1
15.	In the institution I have been working at, there is grounding connection in the electric lines, and air, oxygen and electric connections are controlled by an operated system through the ceiling.	36	37.9	59	62.1
16.	In the institution I have been working at, there are operating room fire alarm system and fire exit signboards.	75	78.9	20	21.1
17.	In the institution I have been working at, alarm buttons and fire extinguishers are checked at least once in a month.	15	15.8	80	84.2
18.	In the institution I have been working at, the devices are maintained and calibrated regularly.	61	64.2	34	35.8
19.	In the institution I have been working at, there are individuals employed particularly for fire safety.	50	52.6	45	47.4
20.	In the institution I have been working at, there is a check list for the precautions I take for fire safety, which is used before surgery.	0	0.0	95	100.0
21.	In the institution I have been working at, there are protocols for the first things to do in case of any fire and a fire evacuation plan.	39	41.1	56	58.9
22.	In the institution I have been working at, printed documentations are used to report burns during surgery.	27	28.4	68	71.6
23.	In the institution I have been working at, operating room staff are trained about surgical fires and how to use fire extinguishers by demonstrating.	39	41.1	56	58.9
24.	In the institution I have been working at, I know where the emergency exit, medical gas panels, and aeration and electric systems are found.	64	67.4	31	32.6
25.	I know the precautions to be taken for transportation and storage of inflammable substances.	28	29.5	67	70.5

Table 4. Comparison of sociodemographic and work-related characteristics of the nurses with the test scores concerning surgical fires

Characteristics	n	Test score*	Test statistics	p
Province+				
A	21	48.00[18.00]	χ^2-KW=4.383	0.22
B	11	40.00[28.00]		
C	18	60.00[30.00]		
D	45	52.00[16.00]		
Age (Mean±SDyear)++				
35.00±5.88	95	51.45±16.06	r=0.156	0.13
Gender+++				
Female	78	52.00[20.00]	U=486.50	0.09
Male	17	52.00[24.00]		
Education++++				
High school-associate degree	38	52.63±15.24	t=0.582	0.56
Postgraduate degree or higher	57	50.67±16.67		
Duration of working, year++				
12.00±6.69	95	51.45±16.06	r=0.107	0.30
Duration of working in the operating room, year++				
8.00±5.55	95	51.45±16.06	r=0.033	0.75
Presence of burn++++				
Yes	44	52.09±18.15	t=0.358	0.72
No	51	50.90±14.18		

*Median [Interquartile Range], Mean±SD, +Kruskall Wallis, ++Pearson Correlation, +++Mann Whitney U, ++++Student t

Table 5. Factors associated with the items of preventive measures for surgical fires and burns

Preventive measures taken for surgical fires	Associated factors	Statistics*
	Incidence of burns	
I make sure that cautery plate is very close to the surgical area and attached well-contacted with the skin.		
Yes (n=83)	42.2	p=0.03
No (n=12)	75.0	
	Incidence of burns in the lower extremity	
I make sure that cautery plate is very close to the surgical area and attached well-contacted with the skin.		
Yes (n=83)	26.5	p=0.04
No (n=12)	58.3	
	Incidence of burns in the lower extremity	
I ensure that the cautery plate chosen appropriate in size has been placed in dry, clean and intact area with thick muscle layer.		
Yes (n=90)	27.8	p=0.03
No (n=5)	80.0	

*Chi-square

endotracheal tubes (86.3%), and checking whether non-inflammable anesthetics have been chosen when humidity is elevated (78.9%).

With regard to the regulations for the prevention of fires such as architecture of the operating room and fire alarm system, less than half of the nurses responded with "yes" to the following propositions: "the floor and the doors of the operating room have been made of noncombustible materials (37.9%)" and "air, oxygen and electrical connections are controlled by an operated system through the ceiling (37.9%)". Of the nurses, 64.2% stated that the devices used in operating rooms are calibrated regularly and 15.8% stated that fire alarm buttons and fire extinguishers are checked at least once a month. All the nurses reported that there is no preoperative

check list for fire safety in their operating rooms, 71.6% reported that there is no printed documentation to report burns during surgery, and 32.6% reported that they do not know where the emergency exit, medical gas panels, aeration and electric systems are found.

The mean score that the nurses obtained from the list of measures taken for the prevention of surgical fire and burns was 51.45±16.06 (min.-max.: 20-88) and their knowledge was determined to be moderate. No statistically significant relationship was determined between mean score and the nurses' age, gender, education status, length of service, duration of working in an operating room, and dealing with fire ($p>0.05$) (Table 4). However, evaluation of specific questions on the list revealed that the incidence of burns in those that attach the cautery plate very close to the surgical site and in good contact with the skin was 42.2% and the incidence of burn in the lower extremities was 26.5%, whereas the incidence of burn in those that do not pay any attention to this process was 75.0% and the incidence of burns in the lower extremities was 58.3%. Likewise, the incidence of burns in the lower extremities in those that chose a cautery plate appropriate in size and attached to a dry, clean and intact area with a thick muscle layer was 27.8%, whereas it increased to 80% in those not paying any attention to this (Table 5).

DISCUSSION

This study was conducted to determine the knowledge and behaviors of surgical nurses concerning the prevention of surgical fires and burns. As the studies on this subject are not of an adequate number in Turkey, this study was carried out with the intention that it would contribute to the improvement of operating room staff's awareness of surgical fires, the development of institutional policies on this subject, and the planning and implementing of training programs.

Fires, which appear as preventable situations in operating rooms with high risks for both the patient and the workers, still happen. There is a shortage of available statistical data on this subject in Turkey. In the US, where the statistics are believed to be reliable, it is reported that 20-30 patients or employees are injured annually, and 1-2 of them even die, as a result of surgical fires. Of the patients involved, burns occur to the airway in 34%, to the head and face in 28%, and to other regions in 38% (TJC, 2003). In this study, one of the nurses stated that she had encountered surgical burns, and nearly half of the nurses stated that their patients had been exposed to burns during surgery. The fact that these nurses define it as a very rare occurrence (1-3/year) is pleasing. The lower extremities were the leading sites for burns during surgery (49.2%); nevertheless, none of the nurses reported airway burns, contrary to the data from TJC (TJC, 2003).

In the AORN (2013) recommendations for perioperative standards and practices, the first title concerning fires in the operating room is as following: "Potential risks related to fire safety in the operating room should be determined and safe practices for communication, prevention, extinction and evacuation should be created and implemented" (Hughes, 2013). Determining potential risks and then taking necessary measures will both provide patients' and employees' safety and prevent financial loss. However, all the nurses stated that they do not have a check list to be used before surgery to take measures for fire safety. Umar (2014) emphasized that risk assessment tools need to be used for fire. Therefore, improving the awareness of both employees/institutions and academicians appears to be a necessity.

The second step in fire safety is to take necessary measures. The present study determined that the nurses have a moderate level of knowledge and behavior (51.45±16.06; min-max: 20-88) concerning the prevention of surgical fires and burns. Although a standard measuring tool has not been used in the studies on this subject, Andsoy et al. (2014) reported that they have adequate knowledge of the risks of fire but not about the measures need to be taken. Sarp

and Islek (2006) determined that hospital staff take measures against fire but do not have adequate knowledge of preventive measures. Reviewing the studies at country levels, it was found that the operating room's staff's (surgeon, nurse, anesthesiologist) level of knowledge was low in Iran and France (Crumière et al., 2012; Davoodiantalab et al., 2012; Jalali et al., 2016; Mousavi et al., 2011) but high in the USA (Coletto, 2016; Feldman et al., 2012; Fisher, 2015).

Electro-surgery devices, laser, and fiber optic light sources used in operating rooms are the main sources of heat for fire. Sentinel event analysis performed by ECRI indicated that 68% of burns result from electro-surgery and 13% result from laser (ECRI, 2009). Likewise, systematic reviews conducted by Hempel et al. (2015) and by Mehta et al. (2013) on patient safety and surgical fires identified electro-surgery devices as the sources of fire in 90% of cases. Within this context, safe usage of electro-surgery devices appears to be a basic precaution for the prevention of fires. Moreover, in this study, it was determined that attaching the cautery plate very close to the surgical area in such a way as to be in good contact with the skin has significantly reduced both occurrence of fire and presence of fire in the lower extremities. In addition, attaching the cautery plate on a clean, dry and intact area with a thick muscle layer also reduced the incidence of fire in the lower extremity. In general, the great majority of nurses had adequate knowledge on safe usage of electro-surgery devices and implementing the precautions. However, the fact that only 6% of the nurses knew and implemented the option "I insufflate beneath the surgical cover for oxygen not to be collected" indicates that they were incompetent in practices related to oxygen use, which is another source of fire.

Choudhry et al. (2017) investigated hospital records on surgical fires considered by law as malpractice, and determined that 51% of burns occur to the patient's head, face, neck, upper chest or airway. Covering the scalp hair and body hair with water-based gels is recommended to prevent burns during surgeries to the head and neck regions as they might serve as sources of fuel, and using wet materials in fixating endotracheal tubes is recommended to reduce the risk of burns during airway surgeries (AORN 2005; Apfelbaum et al., 2013; ECRI, 2009). However, 90.5% of the nurses in this study reported that they did not apply water-based gels onto the hairy areas such as hair and beard and 86.3% of the nurses reported that they did not use wet materials in fixating endotracheal tubes and that they did not know these preventive measures.

In addition to the measures taken by the operating room staff before or during surgery, the precautions that the institutions should take include: architecture of the operating theatre, presence of efficient fire alarm systems and fire exit notices, assigning individuals special roles for fire safety, and the presence of relevant protocols and evacuation plans to be applied in case of fire, which are necessary to minimize fire-related damages (AORN, 2005; Kaye, 2014; Kılıç, 2009; Pollock, 2004; Umar, 2014). In this study, most of the nurses stated that the floor and the doors of the operating room were not made of non-combustible materials and did not take persons specially assigned to fire safety. However they also stated that alarm system, fire exit signs, written protocols for the first things to be done in case of fire, and evacuation plans exist. These findings are consistent with the results of the study conducted by Andsoy et al. (2014). Operating rooms constructed of high-quality and convenient materials in accordance with scientifically proven architectural plans are critical in preventing fires. Attention should be paid to the materials used in the construction of operating rooms being fire-resistant. Fire alarms, smoke alarms and heat sensors should exist hospital-wide and be centrally monitored; however, only visual, flashing warning light systems should be used in operating rooms. Fire exit notices should be in the correct places and large enough to be seen by everyone, relevant individuals should be assigned for taking preventive measures against fire in operating rooms and printed protocols about the things to do in case of fire and evacuation plans should exist in hospitals. Concerning

fire safety in Turkey, the regulation on the Protection of Buildings against Fire was put into force in 2002 and amended in 2015. Although this regulation comprises general and certain specific provisions, they are considered inadequate (Balık & Beceren, 2015; Kılıç, 2009). The fact that fire evacuation plans and protocols, and specially trained fire awareness staff were lacking in the majority of operating rooms involved in this study indicates that managers do not have good awareness on this subject and it is not considered important. Within this context, specific teams should be established, and the employees need to be trained.

Even though institutional precautions have been taken to prevent fire, control mechanisms should be established to maintain these precautions. In this study, more than half of the nurses stated that devices were maintained and calibrated regularly. This is a favorable approach as the great majority of fires originate from electrical devices. However, only 15.8% of the nurses reported that fire alarm buttons and fire extinguishers were checked once a month. According to the fire protection standard Code No 11602-2, which was prepared by the Turkish Standards Institute, portable fire extinguishers need to be checked by experts in that field and reported on monthly (Türk Standartları Enstitüsü [TSE], 2015). Thereby, we can say that control and maintenance are inadequate even though necessary precautions have been taken in operating rooms.

Employees' education is mandatory to determine the risks necessary for fire safety in the operating rooms, to take precautions, and to establish safety practices for fire extinction and evacuation. However, in this study it was determined that some of the nurses did not know how to make an emergency exit or where gas, electricity and ventilation panels were located and how flammable materials were stored or transported. They also reported that they were not trained in the use of fire extinguishers in their institutions. These outcomes are further indication of operating room staff's need for education. In such training programs, the primary target population must be the surgical team. Surgical fires become preventable situations when the surgeon in the surgical team brings the heat source under control, the anesthesiologist or anesthesia technician brings the oxygen source under control, and the nurse brings inflammable sources under control. In addition, the personnel must be trained on the locations of emergency exits, gas, electric and ventilation panels in the institution and how to switch them off, using fire alarm systems, storage of inflammable materials, using fire extinguishers, and evacuation plans. Training must be performed via demonstrations instead of didactic techniques. These training programs should be measurable to evaluate whether the final target has been achieved. The responsibilities of the fire team members established by the institutional authorities must be specified and operability of evacuation plans should be monitored by practices at regular intervals (AORN, 2005; Kaye et al., 2014; Pollock, 2004; Spruce, 2016; Umar, 2014).

CONCLUSION AND RECOMMENDATION

In conclusion, this study determined that most of the operating room nurses took a number of precautions for fire safety, but these were insufficient and lacking. Moreover, it was determined that institutional awareness is low, and printed protocols and evacuation plans are inadequate. Accordingly, the use of risk assessment tools in all surgical interventions needs to become an organizational culture, operating room staff need to be trained on the risks and precautions concerning fire, these training programs need to be repeated at regular intervals and evaluated, physical structure/equipment, tools and control mechanisms conforming with set standards need to be established where practical, printed protocols and emergency plans need to be established, and personnel need to be involved in these plans. Moreover, it is thought that systematic and well-hypothesized studies with a large sample size would contribute to further understanding of the current situation, the development of relevant practices, and the increment of the evidence.

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