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Original

Link between Occupational Fatigue and Medical Errors in Surgical Technologists

Fatemeh Imani[1], Omid Zadi Akhuleh[2*], Ehsan Memarbashi[1], Ebrahim Nasiri[3]

[1] M.Sc. Student in Operating room, School of Allied Medical Sciences, Mazandaran University of Medical Sciences, Sari, Iran • [2] Instructor, M.Sc., Department of medical-surgical nursing and operating room, nursing and midwifery faculty, Tabriz university of medical sciences, Tabriz, Iran • [3] Assistant professor, Ph.D., Department of Anesthesiology & Operating room, faculty of Allied medical sciences, Mazandaran University of Medical Sciences, Sari, Iran • *Corresponding author: Omid Zadi Akhuleh, E-mail: Omid.zd.axule73@gmail.com, Tel:+98-938-9520481

Abstract

Background: Regarding the operating room's sensitivity and performing various invasive procedures, it is important to investigate the relationship between occupational fatigue and the occurrence of medical errors. Thus, this study was conducted to determine the relationship between occupational fatigue and medical errors among surgical technologists. **Methods:** This cross-sectional descriptive study was conducted in operating rooms of hospitals of Mazandaran University of Medical Sciences in 2019. The research population included 141 surgical technologists selected via stratified random sampling. Data were collected using the Multidimensional Fatigue Inventory (MFI) and nursing errors in the operating room questionnaire. The data were analyzed using SPSS16 software. **Results:** 82.2% of surgical technologists had moderate to severe fatigue. Non-compliance with the sterile technique with a 49.6% incidence rate was the most frequent error among participants. The findings showed that there was a significant positive correlation between the incidence of medical errors among surgical technologists with mental fatigue (r =0.160, *P*=0.04) and reduced motivation (r =0.185, *P*=0.02). **Conclusion:** The level of mental fatigue and reduced motivation among surgical technologists was directly related to the level of the incidence of medical errors. Therefore, it is recommended to implement effective programs to adjust and decrease mental fatigue and increase motivation to improve surgical technologists' performance.

Keywords: Fatigue; Medical error; Surgical technologists; Operating room

Introduction

Patient safety is one of the most important aspects of the quality of health care, and nothing contradicts the philosophy of medical care as much as harming a patient due to a medical error.[1, 2] Struggling to improve patient safety is one of the key practices that have been the focused plan of health organizations in the early 21st century. Improving patient safety is a common international priority, as many errors are currently occurring worldwide in the care and treatment of patients.[3, 4] These errors include many things such as medication errors (errors in the type or dosage of prescription medications), surgeries (the incorrect positioning, use of wrong technique, postoperative complications), incorrect diagnoses (delay in diagnosis, non-diagnosis, incorrect diagnosis), nosocomial infections, patient falls, bed ulcers, and miss diagnosis.[5] Just as a person who may make mistakes, medical professionals, who are

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skilled, knowledgeable, and attentive, may make mistakes in the process of caring for and treating patients.[6] For example, a study done at the University of Pennsylvania reported that 30% of nurses understudy had at least one error during the 28 days of the study. In the United States, there have also been approximately 2,000 deaths related to medical personnel errors among 10,000 patients in a decade.[7] Nursing errors have unfortunate consequences, such as jeopardizing the health and serious injury or disability, prolonging the course of treatment, increasing medical costs, and losing the trust of personnel and health care providers.[8] Nurses work extensively on day and night shifts. Consecutive shifts, lack of nursing personnel, night work, unpredictable patient and ward status, lack of psychological resting will cause nurses' mental fatigue, and increase the probability of job errors.[9-11] Fatigue is a relatively common symptom in primary care medicine .[12] Smith et.al. consider the fatigue as a product of mind, body, activity, and motivation, and they believe that the effects of fatigue, related to its origin, may be manifested in one of the general, mental, physical forms, reduced activity, and reduced motivation.[13]

Due to their sensitivity and specific occupational conditions, the medical personnel, especially the operating room personnel, experience a great deal of fatigue, and they are such risk groups and susceptible to chronic fatigue.[14] Based on the results of previous researches, it is expected that higher levels of fatigue, especially in the mental or attention deficit aspects, lead to more errors. In hospital occupations, due to their sensitive nature in terms of patients' health and safety, the relationship between fatigue with error-making and patient safety is very important.[15, 16] The relationship between fatigue with factors such as high levels of stress, shift work, excessive working hours, disruption of biological rhythms and inadequate rest and sleep, illness, reduced control over working conditions, lack of social support and continued exposure to different roles at work has been reported.[17, 18] Moek, in his review study, noted evidence of the impact of fatigue on nurses' performance and its negative consequences on patient safety.[19] Also, in one study, fatigue was reported as the most common cause of medical errors in the operating room.[20] In another study, one of the strategies for preventing medical errors was reducing fatigue, and it was suggested that ward managers should consider specific planning policies to reduce fatigue.[16] Considering the significance of fatigue as a common problem in the nursing profession, the negative impact on nurses, and the demand for occupational health care services for nurses, it was deemed worthy to investigate the relationship between this health problem and medical errors. The surgical technologists (operating room nurses) were chosen as the study population because they experience both occupational fatigue and medical errors.

Methods

This study is a descriptive-analytical study on surgical technologists working in operating room wards of educational hospitals of Mazandaran University of Medical Sciences (Imam Khomeini, Fatemeh Zahra, Zare, Bou Ali Sina, and Razi Hospitals) and the study was done by stratified random sampling method. Considering that the total number of surgical technologists was 220, the sample size was calculated to be 141 peoples. (P=0.5, q=0.5, d=0.05)

Equation (1): $$n = \frac{\frac{z^2pq}{d^2}}{1+\frac{1}{N}\left(\frac{z^2pq}{d^2}-1\right)}$$

Sampling was performed among operating room technologists of Sari hospitals in a divided manner. Thus. after calculating the sample size according to the Cochran formula and knowing the total number of surgical technologists working in the operating room wards of the studied hospitals, the sample number of each center was obtained. After calculating the share of each hospital, a random sampling was performed using a table of random numbers. The participants' informed consent and having at least one year of experience in

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the operating room were the inclusion criteria. Furthermore, those who had administrative positions were excluded from the study. The study was carried out over six months, from February to July 2019. This study's data collection instruments included three parts, demographic information questionnaire, the nursing errors in the operating room, and the standard Multidimensional Fatigue Inventory (MFI). The nursing errors questionnaire was designed by Chard (2010) and its validity and reliability were determied by content validity method and Cronbach's alpha with α=0.89, and this questionnaire was used by Valee et al. in Iran.[21, 22] The questionnaire consists of 15 items on three scales (yes, it happened =3, no idea =2 and no, 'didn't happen =1).

The standard Multidimensional Fatigue Inventory is a five-aspect questionnaire with 20 items. This questionnaire, including the dimensions of general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation, provides a deeper and more accurate understanding of fatigue, was scored based on the 5-point Likert scale (ranging from completely agree=1 to completely disagree=5). Each dimension contains four questions, and the answers were collected in a five-choice range. Therefore, each domain's total score is 4-20, and the total score of fatigue determined by summing the scores of the domains will be between 20-100. The scores 21-47 show mild fatigue, 48-74 moderate fatigue, and 75-100 severe fatigue. This questionnaire was first presented by Smet et al. and its validity and reliability in different demographic groups, such as cancer patients undergoing radiotherapy, patients with chronic fatigue syndrome, and the psychology students who are in the first year, and Medicine was evaluated. Confirmatory factor analysis showed that the questions of each dimension were descriptive of the same dimension, and the questionnaire had a good internal consistency (alpha coefficient for general, physical and mental fatigue was higher than 80% and for motivational activity reduction over 65%) (13). In Iran, Saremi et al. (2012), Saki et al. (2015), and Abbasi et al. (1395) used this questionnaire in their studies and confirmed its validity and reliability.[23-25] In the present Study, the reliability of this questionnaire was estimated at 87% using Cronbach's alpha. The questionnaires were distributed among the participants without mentioning the name in the study and the participants were assured of the confidentiality of the information. Data were entered into SPSS, version 16, and were analyzed using descriptive statistics, Pearson correlation test, and independent t-test.

Results

The results of the study showed that 83 persons (58.9%) of the participants were female and 58 persons (41.1%) of the participants were male. 130 (92.2%) of the participants had bachelor degrees and 59 (41.8%) were official employees. The mean age of surgical technologists was 33.3(6.9) years and on average they had 9.7(6.7) 'years' work experience in the operating room. Participants' demographic information is shown in Table 1.

A survey of the severity of fatigue in the surgical technologists showed that 112 (79.4%) of participants experienced moderate fatigue (48-74) Figure 1.

Table 1. Demographic characteristics of surgical technologists participating in the study (n = 141)

Variables	Variable type	N(%)
Gender	Male	58(41.1)
	Female	83(58.9)
Marital status	Single	35(24.8)
	Married	106(75.2)
Employment Status	Official	59(41.8)
	Contractual	28(19.9)
	Bespoke	36(25.5)
	Project	18(12.8)
Level of Education	Associate Degree	8(5.7)
	Bachelor Degree	130(92.2)
	Master's Degree	3(2.1)

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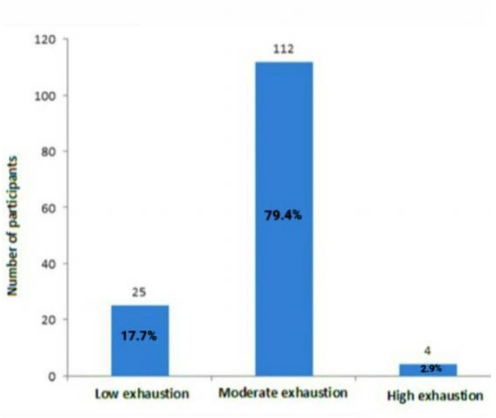

Figure 1. Frequency of fatigue severity of surgical technologists participating in the study according to the three levels of mild, moderate, and severe

Table 2. Mean and standard deviation of different dimensions of fatigue in surgical technologists.

Dimensions of fatigue	Mean(SD)
General fatigue	13.2(2.9)
Physical fatigue	11.9(3.2)
Mental fatigue	11.9(2)
Reduced motivation	11.2(4.8)
Reduced activity	8.4(2.6)
Total fatigue	56.5(10)

The mean of the total fatigue in the surgical technologists was 56.5(10). Also, survey of fatigue dimensions in surgical technologists showed that general fatigue 13.2(2.9) had the highest severity than other fatigue dimensions Table 2.

Pearson's correlation test for studying the demographic characteristics correlation with fatigue showed that only age (r = 0.387, *P*<0.001) and work experience (r =0.394, *P*<0.001) had a positive and significant correlation with overall fatigue. The overall mean and standard deviation of surgical technologists' error was 28.4(7.3) over the last year. Failure to comply with the sterile technique with 49.6% incidence was the most frequent, and foreign body retention at the surgical site and inappropriate patient positioning with 11.3% incidence had the least frequency Table 3.

The results of the correlation coefficient of fatigue score with the rate of occurrence of working error from the perspective of surgical technologists showed that among different dimensions of fatigue, the dimension of reduced motivation (r=0.185, *P*=0.02) and mental fatigue dimension (r=0.160, *P*=0.04) have a significant positive correlation with the rate of error in surgical technologists Table 4. Pearson test showed no significant relationship between overall fatigue and the rate of error in surgical technologists (*P*=0.49).

Table 3. Frequency of medical errors in surgical technologists participating in the study

Error type	Yes, it happened N(%)	No idea N(%)	No, it did not happen N(%)
Uncertainty of the site of surgery	52(36.9)	21(14.9)	68(48.2)
Uncertainty in the direction of surgery (right or left in bilateral surgeries)	55(39)	24(17)	62(44)
Improper fixing of electrosurgical pads	17(12.1)	53(37.5)	71(50.4)
Inappropriate patient position	16(11.3)	44(31.3)	81(57.4)
Incorrect dose calculation of drugs	33(23.4)	35(24.8)	73(51.8)
Incorrect counting of surgical gauzes	33(23.4)	31(22)	77(54.6)
Incorrect counting of surgical instruments	31(22)	31(22)	79(56)
Non-compliance with the sterile technique	70(49.6)	20(14.2)	51(36.2)
Improper use of equipment	55(39)	26(18.4)	60(42.6)
Reaction to blood or blood products	29(20.6)	53(37.6)	59(41.8)
Incorrect prep	43(30.5)	28(19.9)	70(49.6)
Incorrect drape	37(26.2)	27(19.2)	77(54.6)
Unaware of a patient's allergy	28(19.9)	40(28.3)	73(51.8)
Failure to recognize the correct patient	44(31.2)	33(23.4)	64(45.4)
Remaining foreign body at the surgical site	16(11.3)	36(25.5)	89(63.2)

Table 4. Survey of the correlation of different dimensions of fatigue with an error rate of surgical technologists.

Fatigue Error		General fatigue	Physical Fatigue	Mental fatigue	Reduced motivation	Reduced activity
Error score 28.4(7.3)	The correlation coefficient	-0.082	0.07	0.160	0.185	0.143
	P-value	0.3	0.35	0.04	0.02	0.09

*significant at level of 5%

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Discussion

In the present study, the overall mean of occupational fatigue score in surgical technologists was 56.5(10), which was 82.2% of surgical technologists had moderate to severe fatigue. These results are consistent with the results of Hooper et al.[26] and Sarfo et al.[27] According to the findings of this study, it seems that surgical technologists experience a great deal of fatigue; thus, awareness of the factors that cause fatigue, the use of fatigue reduction strategies, and the appropriate conditions for the use of these strategies to reduce the severity of fatigue in surgical technologists are recommended. In the present study, it was tried to determine the role of some of the factors contributing to fatigue. It was found that the age and work experience of surgical technologists had a significant positive correlation with fatigue. This is consistent with the studies by Mohammadi et al.[28], Yoder et al.[29], and Mendes et al.[30] The overall mean of incidence of work-related errors in surgical technologists over the last year was 28.4(7.3) (moderate severity), which is consistent with the study by Saki et al.[24] In the present study, "non-compliance with sterile technique" with a rate of 49.6%, was reported as the most common error by surgical technologists in the last year. In Tifouri and Valiee study performed on operating room nurses, the most error was related to non-compliance with the sterile technique.[22] Also, in the study by Azarabad et al. with the purpose of investigating the frequency of nursing errors among operating room students, the highest error was reported due to non-compliance with sterile techniques.[20]

Attention to sterile techniques is considered as the basis of modern surgery. Patients in the sterile field center and surgical site are the most important part of the sterile field, and strict observance of sterile techniques is essential to maintain patient safety and prevent surgical site infection.[31] Therefore, to reduce and prevent these errors in operating room wards, retraining courses in the form of lectures or workshops, especially on the principles of sterile techniques, are necessary to increase the scientific level of surgical technologists.

In the present study, age and sex had no significant contribution to the occurrence of errors, which was consistent with the study by Rahimian et al.[32] The results of the present study on the relationship between fatigue and the incidence of error in the operating room showed that there was a significant and positive correlation between occupational errors and two aspects of fatigue including mental fatigue and reduced motivation. The nature of the surgical 'technologists' occupation requires a great deal of attention and focus on invasive procedures. Therefore, it is natural that the change in mental ability level is associated with a change in the type and quality of medical error in such a way that a decrease in attention and concentration results in a longer duration of hospitalization and transfer to intensive care units. Saremi's study (23) and the study by Saki et al.[24] also reported a significant relationship between mental fatigue and the incidence of significant medical errors, which is consistent with the results of the present study. On the other hand, motivation is very important in the nursing profession because the nature of its activities requires that its practitioners carry out their duties with great interest; since surgical technologists deal with the 'patients' life, decrease, or lack of motivation will have many adverse effects on the quality of health care and thus on the health of patients. Failure to pay attention to the occupational motivation of surgical technologists can decrease job satisfaction and ultimately decrease the quality of health services and increase the incidence of errors and mistakes.[33] Using the self - administration reports of surgical technologists regarding the occurrence of medical errors in the last 12 months is associated with recall bias and is the most important limitation of this study. Moreover, due to the limitation of the statistical society

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(surgical technologist), a small number of samples participated in this study and these two limitations may be due to the insignificance of the relationship between total fatigue and medical error rate.

Conclusion

In this study, it was found that mental fatigue and reduced motivation probably have a decisive role in the occurrence of occupational errors in surgical technologists. Therefore, it is necessary that managers and decision-makers pay more attention to job difficulties and consider motivational incentives which can reduce occupational fatigue in surgical technologists.

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Conflict of interest

There is no conflict of interest among the authors of the article.

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