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The Effects of the Operating Room Environment on the Health of Anesthesiologists in a University Hospital

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Abstract

Objective: The aim of this study was to determine the physical, biological, chemical, ergonomic, and psychological occupational exposures experienced by anesthesiologists working at such an intense tempo and effects of these exposures on employees[1] health.

Methods: A total of 160 anesthesia staff among the 225 (71%) individuals participated in the study. Participants were given a three-part questionnaire, consisting of 42 questions examining sociodemographic characteristics, chronic diseases, and physical, chemical, biological, ergonomic, and psychological exposures in the working environment. The anesthesiologists participating in the study were divided into 2 groups according to their working environment in the hospital: those who work in the operating room (OR) and those who perform anesthesia outside the operating room (NOR).

Results: While 55% and 27% of the OR group suffered from fatigue frequently and sometimes, respectively, 33% and 34% of the NOR group experienced fatigue frequently and sometimes (P = .017). In addition, varicose veins (P = .035) and vertigo (P = .02) complaints were significantly higher in the OR group compared to the NOR group. While the number of people in the OR group who stated that their mental energy was exhausted was significantly higher than the NOR group (P = .013), no significant difference was observed between the groups with regards to their physical energy (P = .15).

Conclusion: The workload and working conditions of anesthesiologists as a whole are quite harsh. Detailed studies regarding workplace environment exposures and prevention from those exposures have great importance on both employee and patient safety.

Keywords: Anesthesiologists, employee health, operating room, workplace

Bir Üniversite Hastanesinde Ameliyathane Ortamının Anestezistlerin Sağlığı Üzerindeki Etkileri

Öz

Amaç: Bu çalışmada yoğun bir tempoyla çalışan anestezi personelinin yaşadığı fiziksel, biyolojik, kimyasal, ergonomik ve psikolojik mesleksel maruziyetler ile bu maruziyetlerin çalışanların sağlığına etkisinin saptanması amaçlanmıştır.

Yöntemler: İstanbul Üniversitesi-Cerrahpaşa Tıp Fakültesi Hastanesinde 2020 yılı itibarıyla görevli olan 225 anestezi personelinden 160'ı (%71) katılmıştır. Katılımcılara sosyodemografik özellikler, kronik hastalıklar ve çalışılan ortamdaki fiziksel, kimyasal, biyolojik, ergonomik ve psikolojik maruziyetleri sorgulayan 42 sorudan oluşan, üç bölümlük anket formu dağıtılmıştır. Çalışmaya katılan anestezi personeli hastane içindeki çalışma alanlarına göre ameliyathanede çalışanlar (AÇ) ve ameliyathane dışında anestezi uygulamaları yapanlar (ADÇ) olmak üzere iki gruba ayrılmıştır.

Bulgular: AÇ grubunun %55'i sıklıkla, %27'si bazen halsizlik şikayeti yaşarken; ADÇ grubunun %33'ü sıklıkla, %34'ü bazen halsizlik yaşamaktadır, iki grubun halsizlik şikayeti arasında istatistiksel olarak anlamlı fark vardır (P = ,017). Ayrıca varis (P = ,035) ve vertigo (P = ,02) şikayetleri AÇ grubunda ADÇ grubuna göre anlamlı olarak daha yüksektir. AÇ grubunda ruhsal enerjilerinin tükendiğini ifade edenlerin sayısı ADÇ grubuna göre anlamlı olarak yüksekken (P = ,013), fiziksel enerjilerinin tükenmesi sorgulandığında gruplar arasında anlamlı fark tespit edilmemiştir (P = ,15).

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Sonuç: Bir bütün olarak anestezi çalışanlarının iş yükü ve çalışma koşulları oldukça ağırdır. İşyeri ortamı maruziyetlerine ve bu maruziyetlerin önlenmesine dönük olarak yapılacak detaylı çalışmaların hem çalışan hem de hasta güvenliği açısından önemi büyüktür.

Anahtar Kelimeler: Ameliyathane, anestezistler, çalışan sağlığı, işyeri

The operating theaters where anesthesiologists spend most of their time may adversely affect their health due to the potential risks. Anesthesiologists are exposed to various situations including physical such as noise and radiation, chemical such as gas, steam, and smoke, biological such as virus and bacteria due to the contact with patient fluids, ergonomic such as improper posture, and psychological such as long work shifts, monotony, and stressful situations that may be dangerous. In addition, they are under the threat of various accident risks such as fire and electricity in the working environment.[1]

Since the introduction of inhalation agents into anesthesia practice, various studies have shown that chronic exposure and cumulative effects of these agents may lead to genotoxic and mutagenic consequences on operating room staff.[2,3] In addition to chemical exposure, psychiatric disorders such as chronic fatigue syndrome, depression, drug, and alcohol addiction are common among the operating room staff.

Moreover, operating room activities include an intense sense of responsibility and stress due to the irregular working hours are important risk factors for both the development and worsening of various cardiovascular diseases.[4]

Cerrahpasa Medical Faculty Hospital (XMF) has a training and research hospital that includes almost all of the clinical branches determined by the Medical Specialization Commission. An average of 2600 cases are operated annually in 34 operating rooms of the hospital. XMF is one of the leading healthcare institutions in terms of number of cases undergoing surgery and workload. The aim of this study was to determine the physical, biological, chemical, ergonomic, and psychological occupational exposures experienced by anesthesiologists working at such an intense tempo and the effects of these exposures on employees' health.

Methods

This study was conducted in XMF between December 2019 and February 2020, after obtaining the approval of the İstanbul University-Cerrahpaşa Ethics Committee (Date: November 15, 2019, number: 38082516-900-176105). A total of 160 anesthesia staff among the 225 (71%) individuals participated in the study. XMF anesthesia staff consisted of specialist physicians, research assistants, nurses, anesthesia technicians, and auxiliary staff. Participants were given a three-part questionnaire, consisting of 42 questions examining sociodemographic characteristics, chronic diseases, and physical, chemical, biological, ergonomic, and psychological exposures in the working environment and were asked to answer all of the questions. Participants filled in the questionnaire themselves under the supervision of the person who handed out the form. The questionnaires of 6 participants were excluded from the study as they did not complete the questionnaire, and the remaining 154 (68%) participants' forms were included in the analysis. The anesthesiologists participating in the study were divided into 2 groups according to their working environment in the hospital: those who work in the operating room (OR) and those who perform anesthesia outside the operating room (NOR) (We called this group NOR to avoid potential confusion with the OR group). Of the 154 personnel participating in the study, 84 were in the OR group and 70 were in the NOR group.

Statistical analysis

The variables of the study were of 2 separate types, continuous and categorical. Continuous variables were expressed as mean and standard deviation, as well as minimum and maximum values in parentheses, while categorical variables were expressed as frequency, as well as percentage values in parentheses. *t*-Test or Mann—Whitney U-test was used depending on the distribution of data in the intergroup comparison of continuous variables. Categorical variables were tested with chi-square test. A *P* value equal to or lower than .05 was assumed as statistically significant. The data of the study were analyzed with Statistical Package for the Social Sciences (IBM SPSS Corp., Armonk, NY, USA) version 25.0.

Results

The female and male ratio of the OR and NOR groups was 52 (62%)/32 (38%) and 36 (51%)/34 (49%), respectively. The mean age of OR and NOR groups was 33.4 ± 8.5 and 37.0 ± 9.0, respectively ($P = .001$). Working time in the profession and institution was significantly higher in the NOR group ($P = .017$ and $P = .026$, respectively). While 74% of the OR group were doctors and 18% were anesthesia technicians, 41% of the NOR group were nurses, 20% were civil servants, and only 19% were doctors ($P < .001$). Working hours of the OR group per week were significantly longer ($P < .001$). The mean weekly working time was 56.9 ± 14.1 and 45.6 ± 7.53 hours in the OR group and NOR group, respectively. The mean weekly working time of the OR group in the operating room was 48.8 ± 12.4 hours (Table 1).

While there was no difference between the 2 groups in terms of smoking, the pack/year used was significantly higher in the OR group ($P = .033$). When occupational risks were questioned according to the groups, the 3 most important risks were radioactive (28.6%), psychological (25%), and ergonomic (16.7%) hazards in the OR group, while psychological hazards were in the first place with 42.9% in the NOR group and this was followed by chemical hazards with 30% and radiation with 24.3% (Table 2). Depression was the most frequently reported chronic disease in the OR group (13.1%), while in the NOR group, thyroid diseases are in the first place (10%) (Table 3).

While 55% and 27% of the OR group suffered from fatigue frequently and sometimes, respectively, 33% and 34% of the NOR group experienced fatigue frequently and sometimes ($P = .017$). In addition, varicose veins ($P = .035$) and vertigo ($P = .02$) complaints were significantly higher in the OR group compared to the NOR group.

The opportunity of going outdoors was significantly higher in the NOR group compared to the OR group ($P < .001$).

Table 1. Demographic Characteristics of the Groups

	NOR, (*n* = 70, %)	OR, (*n* = 84, %)	*P*
Gender			
Female	36 (51)	52 (62)	.191
Male	34 (49)	32 (38)	
Age	36.7 ± 8.5	33.4 ± 8.4	**.001**
Marital status			
Married	47 (68)	47 (56)	.124
Single	22 (32)	37 (44)	
Smoking			.282
Yes	27 (39)	23 (27)	
No	42 (60)	58 (69)	
Quit	1 (1)	3 (4)	
Package/year	14.5 ± 10.9	7.0 ± 4.1	.033
Working time in the profession	12.1 ± 8.4	9.5 ± 8.6	.017
Working time in the institution	10 ± 0 ± 8.0	7.8 ± 8.2	.026
Working unit			
Technician/ technical personnel	3 (4)	15 (18)	
Nurse/health officer	29 (41)	3 (4)	
Phsician	13 (19)	62 (74)	**<.001**
Officer/servant	14 (20)	2 (2)	
Other	11 (16)	2 (2)	
Weekly working time	45.6 ± 7.53	56.9 ± 14.1	**<.001**
Weekly operating room working time	-	48.8 ± 12.4	

Continuous variables are shown as mean ± standard deviation, and categorical variables are shown as percentage.
NOR, those who perform anesthesia outside the operating room; OR, those who work in the operating room.

While the number of people in the OR group who stated that their mental energy was exhausted was significantly higher than the NOR group ($P = .013$), no significant difference was observed between the groups with regards to their physical energy ($P = .15$). The use of recreational substances and antidepressants was not different between the groups ($P > .05$). In addition, the proportion of people with suicidal thoughts was similar in both groups ($P = 1$) (Table 4).

While the rate of those complaining about dry hands in the OR and NOR groups was 68% and 37%, respectively ($P = .001$). However, there was no significant difference between the 2 groups in terms of disease rates such as infectious disease, respiratory tract infection, and elevation in liver enzymes ($P = .502$, $P = .881$, and $P = .597$, respectively).

Table 2. Occupational Hazards by Groups

	NOR (%)	OR (%)
Ergonomic	14 (20)	14 (16.7)
Illumination	5 (7.1)	2 (2.4)
Noise	10 (14.3)	8 (9.5)
Temperature	5 (7.1)	1 (1.2)
Radiation	17 (24.3)	24 (28.6)
Chemical	21 (30)	12 (14.3)
Biological	14 (20)	13 (15.5)
Psychologic	30 (42.9)	21 (25)
Other	3 (4.3)	2 (2.4)

NOR, those who perform anesthesia outside the operating room; OR, those who work in the operating room.

There was no statistically significant difference in infertility rates between the 2 groups ($P = .369$). On the other hand, the rate of spontaneous abortion in the NOR and OR groups was 5.9% and 27.8%, respectively ($P = .17$; Table 5).

Discussion

The study was conducted in one of Turkey's oldest and largest university hospital, and the targeted population was mostly achieved (71%). XMF is an institution that has been able to maintain the title of the most preferred medical school for years in university entrance exams and has a very high

Table 3. Known Chronic Disease History Numbers and Rates Between Groups

Chronic Diseases	NOR (%)	OR (%)
Hypertension	2 (2.9)	2 (2.4)
DM	3 (4.3)	2 (2.4)
Asthma, COPD	3 (4.3)	3 (3.6)
IHD	1 (1.4)	0 (0)
CVD	0 (0)	0 (0)
Thyroid disease	7 (10)	8 (9.5)
Immunodeficiency	0 (0)	0 (0)
CRD	0 (0)	0 (0)
Liver diseases	0 (0)	1 (1.4)
Depression	5 (7.1)	11 (13.1)

NOR, those who perform anesthesia outside the operating room; OR, those who work in the operating room; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; IHD, ischemic heart disease; CVD, cerebrovascular disease; CRD, chronic renal disease.

Table 4. Psychological Evaluation of the Groups

	NOR (%)	OR (%)	*P*
Adequate daylight intake			
Yes	7 (10)	11 (13)	
Insufficient	21 (30)	12 (14)	.06
No	42 (60)	61 (73)	
Possibility to go outdoors			
Often	4 (6)	2 (2)	
Rarely	50 (71)	22 (26)	**<.001**
No	16 (23)	60 (71)	
Mental energy depletion			
Always/often	36 (52)	63 (75)	
Sometimes	27 (39)	17 (20)	**.013**
Rarely/never	6 (9)	4 (5)	
Physical energy depletion			
Always/often	39 (57)	60 (71)	
Sometimes	23 (33)	18 (21)	.157
Rarely/never	7 (10)	6 (7)	
Use of recreational substance			
Always/often	0 (0)	0 (0)	
Sometimes	1 (1)	2 (2)	1
Rarely/never	68 (99)	82 (98)	
Use of antidepressant			
Yes	15 (22)	26 (31)	
No	51 (74)	57 (69)	.08
Do not remember	3 (4)	0 (0)	
Suicidal thoughts			
Often	0 (0)	1 (1)	
Rarely	5 (7)	5 (6)	1
No	64 (93)	78 (93)	

NOR, those who perform anesthesia outside the operating room; OR, those who work in the operating room.

Table 5. Pregnancy History of the Groups

	NOR	OR
Pregnancy	17 (48.6%)	18 (51.4%)
Healthy kids		
1	6	14
2	5	2
3	1	0
4	0	1
Spontaneous abortion		
Once	1	2
Twice	0	3
Low birth weight		
Twice	1	0
Preeclampsia		
Once	0	1
Premature		
Once	1	0

NOR, those who perform anesthesia outside the operating room; OR, those who work in the operating room.

recognition throughout the country. As a tertiary referral hospital of the faculty, patients are referred to the hospital from all over Turkey. Case density and diversity are high enough to represent the individual exposures experienced by anesthesiologists in the country. In the study, the staff working in anesthesiology field were asked for their subjective evaluations, they were not requested to prove it, or the accuracy of their statements was not required to be confirmed with those reflected in official records. Although this situation can be considered as a limitation, people's perception of threat is a determinant of their health conditions. As one of our striking findings, for instance, physical and mental stress have not been questioned by a standard scale. Instead, we preferred to pose 2 direct questions to the contributors whether they feel stressed at the workplace because the stress was not the main focus of the study. So we did not want to increase the number of questions, since the monotonous construction of questions in a scale, which was used as a secondary aim, would cause the contributors to put straight lines on the questionary forms. The data that were collected can be considered sufficient to establish a relationship between health and workplace exposures.

Coincidentally, at the time we started the data collection, the first COVID cases were seen in our country. The situation had not been declared as a pandemic then, and we did not think that those rare cases have played an increasing role in the stress perception of the contributors. So, we did not add extra questions inquiring about COVID that how it affected the subjects of the study.

While providing anesthesia services not only in operating rooms but also in intensive care units as well as various remote locations, pre-intervention consultations, pain clinics, magnetic resonance imaging, computed tomography, and radiotherapy centers; cerebral or cardiac angiographic interventions, they are exposed to risks different than they are in the operating room. Thus, the participants were divided into 2 groups as those who work in the operating room (OR) and those who perform anesthesia outside the operating room (NOR).

Anesthesiologists are exposed to 6 times more radiation than other staff during neuro-invasive angiographic procedures. Increasing use of the scope, especially in orthopedic procedures, causes anesthesiologists to be exposed to radiation at a dose above the radiation dose limit determined as 15 mSv/year. Thus, the cumulative effects of radiation can be observed more frequently.[5,6] Newly developed, minimally invasive surgical techniques, endoscopic procedures, interventional cardiology, and radiological imaging require anesthesia. Accompanying each intervention increases the exposure of anesthesiologists to ionizing radiation. Ionizing radiation increases the likelihood of free radical formation, cell destruction, chromosome changes, and development of malignant tumors in irradiated tissues and ionized molecules.[6-9] In this study, both the OR (93%) and the NOR (87%) groups stated that they were exposed to similar levels of radiation. However, the exposure level could not exactly be determined since there was no dosimeter used by anesthesia staff. Working in the operating room does not have an extra radiation burden on anesthesiologists.

Studies on the teratogenic effects of anesthetic gases and congenital abnormalities in the newborn as well as higher spontaneous abortion rates among female anesthesiologists have been conducted, but no definite conclusion has been reached.[10] Exposure to desflurane, sevoflurane, and isoflurane, among the inhalation anesthetics frequently used in various studies, did not affect fertility in humans and animals. In addition, no teratogenicity was observed in humans after desflurane and sevoflurane exposure.[2,3] In the contrary, Kanazawa et al[11] reported a decreased weight and increased incidence of cleft palate and lip at birth after high sevoflurane exposure in rats. While the rate of spontaneous abortion is generally between 10% and 20% in the society,[12] this rate was found to be 27.8% for the OR group in this study, yet, no significant difference was observed between the OR group and the NOR group. The higher rates of spontaneous abortions in both groups compared to the general population indicate the role of exposures that may affect both groups, such as radiation, rather than causes affecting only the OR group, such as anesthetic gases.

Anesthetic gases also contribute to the contamination of operating room air. Although their effects are not yet verified, it is thought that gases may be related to occupational diseases. Various studies have shown that chronic exposure can result in symptoms such as hepatitis, headache, nausea, drowsiness, fatigue, and irritability.[1,13] On the other hand, recent studies have shown that the magnetic field induces an electric current in the endothelium of the vestibular apparatus of the inner ear that eventually leads to vertigo.[14,15] However, the rate of vertigo was higher in the OR group compared to NOR workers who were thought to be more exposed to magnetic fields. This result may be due to prolonged exposure to loud noises in the operating room. More detailed studies are needed on this subject.

Anesthesiologists are exposed to many pathogens such as bacteria and viruses in daily practice. The prevalence of such dangers varies from hospital to hospital and from country to country. This situation is clinically observed in a wide range from asymptomatic carriage to fatal infection. The anesthesia team is a group of healthcare professionals who closely follow the patient and have long-term patient contact not only in the endemic airborne and blood-borne diseases but also in conditions called epidemic (tuberculosis, etc.) and even in pandemic (COVID-19).[16,17] In this study, no significant difference between the 2 groups in terms of infectious diseases was found. The OR and NOR groups supervise processes that are not different from each other in terms of contamination.

Multiple risk factors, individual sensitivity, long monotonous working hours, exhausting work shifts, personal family problems and marital discord, easy availability of sedatives, and strong psychoactive drugs make anesthesiologists prone to substance use.[18] It is clear that this situation would be harmful not only for the person themself but also for the patient. Reports on recreational substance use were very low in both groups (1-2%). Despite the assurance of anonymity, it is possible that the participants did not report due to the concern of being identified. It may be informative to work with a larger sample size on this issue.

Anesthesiology is a field where practitioners work under stress. The tense atmosphere in the operating room, the necessity of teamwork, strict rules, and responsibility regarding the patient's life can easily explain the high stress and burnout rates among anesthesiologists.[19,20] In accordance with the literature, 75% of the OR group stated that their mental energy was exhausted often while this rate remained at 52% in the NOR group. The OR group experiences more intense stress. On the other hand, even if the fact that symptoms and signs which can be associated with stress such as headache, peptic ulcer, weight gain, and insomnia[21] are observed equally in the OR and NOR groups may be contradicting to this finding, it should be noted that anesthesiologists generally work under stress conditions in addition to the operating room environment which is a little more stressful.

Leading to mental, physical, or emotional fatigue and sleep disorders, stress significantly reduces one's ability to fulfill their professional duties by leading to various consequences such as decreased clinical skills and attention deficits.[22] Survey studies conducted in Europe have shown that one-third of anesthesiologists have been feeling stressed most of the time, while 5% have been feeling it almost always.[23]

According to the data of the World Health Organization, the depression rate in the society in 2015 is approximately 4.4%.[24] Depression, which was reported as the most common chronic disease in the OR group, is well above the prevalence in the general population (13.1%). Although this rate was significantly lower in the NOR group (7.1%) than in the OR group, it was still higher than the general population. There are many findings explaining why OR employees report more depression cases than NOR employees: their daily working hours were significantly longer, their mental energy was lower, they felt sluggish, they had more complaints due to standing for a long time such as varicose veins. Although the depression rates in the study should have been evaluated with caution as the participants were not asked to document their illness, the rates of antidepressant drug use still support this data. The common treatment for depression in the community is the use of antidepressant medication and psychotherapy, and success has been reported in 60% to 80% of the patients receiving depression treatment, but approximately 1 in 4 people diagnosed

with depression receive treatment.[25] Antidepressant use was reported as 31% in the OR group while reported as 22% in the NOR group. If the relationship between antidepressant use and depression in the general society is projected on the participants of this study, it may be concluded that anesthesia workers have a masked depression at the slightest. This finding was also consistent with the reports indicating the depletion of mental energy. In other words, anesthesia workers are under a heavy psychosocial burden, especially in the operating room environment. However, another perspective, as of course, is the tendency of anesthesiologists to use antidepressants, and operating room conditions trigger this somewhat. Randomized controlled studies are needed to investigate this issue in more detail.

It is known that daylight has preventive and curative effects on mood disorders such as depression.[26,27] Only 13% of the operating room employees and 10% of the NOR group stated that they could get enough sunlight. Although there is no statistically significant difference between these 2 groups in terms of getting sunlight, it is very striking that the rate of daylight exposure in both groups remains at the level of 10%. Such low rates are only associated with very demanding businesses such as mining. The relationship between daylight intake and depression may provide an insight into the high depression rates in both groups.

In conclusion, in this study, it was determined that the operating room environment causes more physical complaints such as fatigue, varicose veins, and vertigo on employees compared to the non-operating environment. In addition, it was observed that the operating room environment creates more physical and mental stress, which is related to feeling depressed. The workload and working conditions of anesthesiologists as a whole are quite harsh. Detailed studies regarding workplace environment exposures and prevention from those exposures have great importance on both employees[1] and patient safety.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of İstanbul University-Cerrahpaşa (Date: November 15, 2019, No: 38082516-900-176105).

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