Outpatient Clinic or Operating Room? Protect Your heart!

Poliklinik mi, Ameliyathane mi? Kalbinizi koruyun!

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ABSTRACT

Objective: Considering the harsh working conditions and risks taken during the procedures together, medicine is a sacred profession. Therefore, we planned a study to evaluate the stress-related cardiac effects of surgeons in the outpatient clinic and operating room.
Methods: A total of 18 physicians from surgical units working in intensive conditions were included in the study. Rhythm holter monitoring was performed to physicians in the outpatient clinic and operating room during the examination and surgical procedure. State-Trait Anxiety Inventory was used as an anxiety scale. Data in the outpatient clinic and operating room environment were compared.
Results: While the mean heart rate in the outpatient clinic was 82.94 ± 6.80, it was 94.33 ± 4.29 in the operating room, and the difference was statistically significant (p <0.001). The parameters of heart rate variability NN (p=0.004), SDNN (p=0.015), rMSDD (p=0.012) were significantly lower in the operating room. In the outpatient clinic, the anxiety score was higher than the operating room and the difference was statistically significant (p=0.037).
Conclusion: Although surgeons feel tired and unhappy in the outpatient clinic, they feel more comfortable in surgical processes. However, surgeons have an increased cardiac risk in the operating room due to increased heart rate during surgery and low heart rate variability associated with chronic stress caused by the surgical procedure.

Keywords: Surgeon, operating room, outpatient clinic, anxiety score, heart rate variability.

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ÖZET

Amaç: Zor çalışma koşulları ve işlemler sırasında alınan riskler birlikte düşünüldüğünde tıp kutsal bir meslektir. Bu nedenle, cerrahların poliklinikte ve ameliyathanede stres ilişkili kardiyak etkilenimlerini değerlendirmek üzere çalışma planladık.
Yöntemler: Çalışmaya cerrahi ünitelerden yoğun koşullarda çalışan toplam 18 hekim dahil edildi. Poliklinik ve ameliyathanede hekimlere muayene ve cerrahi işlem sırasında ritim holter monitorizasyonu yapıldı. Anksiyete ölçeği olarak Durumluk-Sürekli Kaygı Envanteri uygulandı. Poliklinik ve ameliyathane ortamındaki veriler karşılaştırıldı.
Bulgular: Poliklinikte ortalama kalp hızı 82.94 ± 6.80 iken ameliyathanede 94.33 ± 4.29 idi ve aradaki fark istatistiksel olarak anlamlıydı (p <0.001). Kalp hızı değişkenliği NN (p = 0.004), SDNN (p = 0.015), rMSDD (p = 0.012) parametreleri ameliyathanede anlamlı olarak daha düşüktü. Poliklinikte anksiyete puanı ameliyathaneden yüksekti ve aradaki fark istatistiksel olarak anlamlıydı (p = 0,037).
Sonuç: Cerrahlar poliklinikte kendilerini yorgun ve mutsuz hissetmelerine rağmen cerrahi işlemlerde kendilerini daha rahat hissetmektedirler. Bununla birlikte, cerrahlar, ameliyat sırasında artan kalp hızı ve cerrahi işlemin neden olduğu kronik stresle ilişkili düşük kalp hızı değişkenliği nedeniyle ameliyathanede artmış kardiyak riske sahiptir.

Anahtar Sözcükler: Cerrah, ameliyathane, poliklinik, anksiyete skoru, kalp hızı değişkenliği.

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INTRODUCTION

Work stress on physicians has been growing as patients' intensity is increasing day by day in developing countries, developments in health issues and the increase of patients' expectations due to easier access to medical information. Surgeons spend a significant portion of their working time in the operating room. Long working hours without breaks, high work load and technically difficult procedures are factors posing risk for physicians (1). Outpatient clinic services are also a stress and anxiety factor for physicians due to patient's intensity and difficult work conditions. Chronic stress may lead to exhaustion and depression (2). This stress can reduce the quality of the health service as it may affect negatively the surgeons' performance in the operating room or the outpatient clinic (3).

Heart rate variability (HRV) is defined as the cyclic changes in sinus rate over time. Basically, these periodic fluctuations in heart rate (HR) are respiration, thermoregulation and some baroreflex mechanisms (4). Recent studies have clearly demonstrated the relationship between cardiovascular mortality, including sudden cardiac death, and the autonomic nervous system (5). HRV provides information about sympathovagal balance during surgical procedures. There are data that mental stress reflects increased sympathetic and decreased parasympathetic activity (6). Mental stress may also be a risk factor for hypertension and coronary artery disease (7).

Many studies in literature have examined psychological and physiologic (cardiac) stress factors of surgeons in operating rooms (8, 11). Different methods to mitigate and remove these stress factors have been tried. Though, other working environments that might pose stress for surgeons have not been much evaluated. Nonetheless, it is known that there are other environments like outpatient clinic conditions, emergency services and intensive-care units where surgeons face stress. The study was planned to evaluate whether the surgeons were under more cardiac stress in the outpatient clinic or the operating room?, and to discuss what measures could be taken to reduce this stress.

MATERIALS and METHODS

The study was designed as a prospective cohort study. The Clinical Research Ethics Committee approval was obtained from the Yıldırım Beyazıt University Yenimahalle Research and Training Hospital Clinical Research Ethical Board dated 25/09/2018 with the protocol number 2018/18. Physicians included in the study joined voluntarily. Explained consent was obtained from the participants. Informed consent form was obtained from volunteers, privacy statement was made and archived.

The surgeons were followed up both in operating rooms and while providing service in the outpatient clinic. Physiologic and psychologic parameters of surgeons in these two conditions were compared. A 'rhythm holter' device was used to evaluate the cardiac parameter differences of surgeons relevant to their work conditions. Physicians were evaluated with respect to working environment (outpatient clinic-operating room), age, gender, field of surgery, anxiety score (State Trait Anxiety Inventory-STAI), basal electrocardiogram (ECG), short term holter monitoring as well as cardiac parameters. The physicians were also asked whether they felt more comfortable in the operating room or in the outpatient clinic.

The physicians were both followed up in the operating room and the outpatient clinic. Data obtained were compared. G Power Version 3.1.9.2 software was used to calculate the sample size. Based on the work of recent study (12), the sample size of the study was calculated to be at least 14 subjects at a power level of 80% and the significance level (α) of 0.05. In the study, 23 physicians aged between 32-50 were evaluated.

In order to ensure a standard, the physicians were advised not to consume alcohol 24 hours and cigarettes as well as beverages with caffeine 6 hours piror to the installation of the holter device. Surgeons with psychiatric disorders as well as physicians under antiarrythmic, antihypertensive and anxiolytic treatment were not included in the study.

All of the physicians were evaluated according to their medical records-clinical records in terms of heart problems before they were included in the study. Physicians with doubtful cardiologic symptomps were evaluated and not included in the study. In addition, 5 physicians with a history of drug use and insufficient holter records were excluded from the study. In total, 18 phyisicans were included.

Voluntary physicians joining the study were selected from departments which have intense outpatient clinic examinations like orthopedics, general surgery and ear-nose-throat. In order to identify the experienced stress in the operating room, major surgery interventions of the physicians were preferred.

All physicians knew that they were included in the study. The same physician was followed both in the operating room as well as the outpatient clinic. Therefore, it was thought that installing a holter device would not create a placebo effect affecting the result of the study sigificantly.

Anxiety Scoring System

STAI form was used to evaluate the stress level of patients (13). The form is comprised of 20 questions. Scoring has been performed based on these questions. In this scoring system, highest score is 80 and lowest 20. High score has been accepted as high anxiety level.

Rhythm Holter Evaluation

In order to better analyze the anxiety of physicians based on their working conditions with objective data, rhythm holter device has been used in the study. Rhythm holter device (Schiller MT-101 Holter-ECG) was put on the physicians in the operating room just before the operation started and removed as soon as the operations were concluded. In the outpatient clinic, the rhythm holter device was put on just before the examination started in the outpatient clinic room and removed as soon as it ended. P wave dispersion (Pd) was calculated for atrial arrhythmia and QT dispersion (QTd) was calculated for ventricular arrhythmia which is correlated with anxiety (14). P dispersion was accepted as the difference between the the longest and shortest P wave. QT dispersion was aceepted as the difference between the longest and shortest QT distance. The corrected value of this measurement was calculated according to the HR in order to evaluate the ventricular repolarization with ECG.

Bazett formula was used to calculate corrected QT dispersion (QTcd) (15). QTcd was accepted as the difference between the longest and shortest corrected QT dispersion. Heart Rate Variability was calculated as the mathematical formula of the fluctuation of the HR around the average HR (5, 19). QTcd was accepted as the difference between the longest and shortest QT dispersion.

Decrease in the HRV, being an indicator for autonomic functions, is an independent risk factor showing the increase in mortality for cardiovascular diseases. In time domain parameters of the HRV; SDNN (standard deviation of all NN ranges) standard deviation of average NN ranges in 5-minute records), RMSSD (square root of the mean squared differences of successive NN intervals) ve PNN50 (percentage of successive NN intervals that differ by more than 50ms) were evaluated. QTcd, Pd, HRV, SDNN, SDANN, RMSSD ve PNN50 parameters were calculated.

Statistical Analysis

Statistical analysis of the study was performed with the Statistical Package for Social Sciences Version 20 (IBM Corp., Armonk, NY, USA) Programme according to statistical and data reporting guidelines for the European Journal of Cardio-Thoracic Surgery and the Interactive CardioVascular and Thoracic Surgery (16). If the numeric calculations in the study group ensured the normal dispersion was tested with the Shapiro Wilk test. Identifying statistics of parametric numeric data were calculated as mean and standard deviation, non parametric ones were calculated as median (minimum-maximum); categorical data were given as percentage (%). Comparison of categorical measurements between the groups were done with the Chi Square Test. For the comparison of numeric measurements between the groups, T test was used in Independent Groups if the assumptions were ensured and the Mann Whitney U test if the assumptions were not ensured. The line of significant result was accepted as $p<0.05$.

Statement of Ethics

This prospective study was completed with the permission of the Chair of Yıldırım Beyazıt University Yenimahalle Training and Research Hospital Clinical Research Ethics Committee (2018/18).

RESULTS

Of the 18 surgeons included in the study, 13 were men (72.2%) and 5 were women (27.8%). The mean age of the surgeons was 41.05 ± 6.07. 11 (61.1%) were orthopedists, 2 (11.1%) general surgeons, and 5 (27.8%) obstetricians and gynecologists (Table 1).

Table 1: Demographic findings of the patients according to their departments

	General (n=18) (100%)	Orthopedy (n=11) (61.1%)	Gynecology (n=5) (27.8%)	General Surgery (n=2) (11.1%)
Gender				
Woman	5 (27.8%)	0 (0%)	4 (22.25%)	1(5.55%)
Man	13 (72.2%)	11 (61.1%)	1 (5.55%)	1 (5.55%)
Age	41.05 ± 6.07	39.27 ± 5.62	42.20 ± 6.23	48.00

In total, 36 holter records were obtained from outpatient clinic and operating rooms. In 3 records, ventricular extrasystoles was observed (Table 2). Outpatient clinic and operating room holter data (minimum-maximum-mean HR, PR, PR dispersion, QT dispersion, p wave duration, QTc, average NN, SDNN, SDANN, pNN50, rMSSD) are presented in Table 2.

Table 2: Comparing findings according to the outpatient clinic and operating room conditions.

	General	Outpatient Clinic	Operating Room	p value
	M ± SD	M ± SD	M ± SD	
HR (bpm)	88.63 ± 8.05	82.94 ± 6.80	94.33 ± 4.29	**<0.001***
Min HR (bpm)	71.08 ± 7.37	65.88±4.30	76.27 ± 6.01	**<0.001***
Max HR (bpm)	110.66 ± 10.85	103.66±7.12	117.66 ± 9.38	**<0.001***
PR interval (ms)	135.38 ± 18.78	142.16±17.6	128.61 ± 17.86	**0.028***
P dispersion	24.40 ± 8.23	22.17±7.73	26.63 ± 8.32	0.105
QT dispersion	28.94 ± 7.00	31.11±7.95	26.78 ± 5.26	0.62
P wave	95.09 ± 14.43	91.4±17.57	98.77 ± 9.57	0.127
QTc (ms)	373.94 ± 28.00	377.69±26.37	370.19 ± 29.82	0.429
NN	664.51 ± 71.79	696.84 ±70.22	630.27 ± 57.39	**0.004***
SDNN (ms)	66.3 ± 18.87	73.75± 17.68	58.54 ± 17.41	**0.015***
SDANN (ms)	41.04 ± 18.59	44.80±17.61	37.27±19.27	0.23
pNN50 (%)	7.27 ± 5.42	8.46±5.61	6.07±5.09	0.189
rMSSD (ms)	35.7 ± 14.15	41.45±15.52	29.94±10.05	**0.012***
Anxiety Score	39.22 ± 4.84	40.88 ± 4.92	37.55 ± 4.25	**0.037***
PVCs	16.66%	0%	16.66%	0.229

***** p<0.05. HR (heart rate), bpm (beats per minute), Min (minimum), Max (maximum), QTc (corrected QT interval), Pd (P wave dispersion), ms (millisecond), M (mean), SD (standard deviation)
NN (normal to normal intervals), SDNN (standard deviation of the NN interval), SDANN (Standart deviation of the average NN intervals for each 5 min segment of a 24 h HRV recording), rMSSD (square root of the mean squared differences of successive NN intervals), pNN50 (percentage of successive NN intervals that differ by more than 50ms), Premature ventricular contractions (PVCs).

The mean HR was 82.94 ± 6.80 in the outpatient clinic, while it was 94.33 ± 4.29 in the operating room, the maximum HR was 103.66 ± 7.12 in the outpatient clinic, while it was 117.66 ± 9.38 in the operating room, the minimum HR was 65.88 ± 4.30 in the outpatient clinic, and 76.27 ± 6.01 in the operating room, and the statistical difference was it was significant (p <0.001). Heart rate variability time domain parameters NN (696.84 ± 70.22 vs 630.27 ± 57.39, p = 0.004), SDNN (73.75 ± 17.68 vs 58.54 ± 17.41, p = 0.015), rMSDD (41.45 ± 15.52 vs 29.94 ± 10.05, p = 0.012) values were significantly lower in the operating room than in the outpatient clinic.

When the surgeons were evaluated in terms of p dispersion (p= 0.105) and QT dispersion (p= 0.62), which are predictors of ventricular and atrial arrhythmia, there was no significant difference between the operating room and the outpatient clinic. The difference between mean corrected QT distances was also not significant (p= 0.429). P-R distance was low due to the high average HR in the operating room (p= 0.028).

All of the physicians joining the study answered with “surgery room” to the questions of whether they felt more comfortable in the outpatient clinic or the surgery room.

When compared according to gender, no statistically significant difference was found between woman and man physicians. No significant difference was found when compared according to departments, either.

When the findings were compared according to outpatient clinic and operating room environment; statistically significant difference has been found in relation to minimum-maximum-mean HR, PR, average NN, SDNN, rMSSD (Table 2). Analysis of time domain parameters of HRV, NN, SDNN, rMSSD were significantly lower in the operating room data compared to outpatient clinic data.

Average anxiety scoring was 40.88 ± 4.92 in the outpatient clinic and 37.55 ± 4.25 in the operating room. The difference was statistically significant (p=0.037).

DISCUSSION

In our study, it was found that average minimum and maximum HR of surgeons were much higher in the operating room than the outpatient clinic room. In addition, HRV time parameters were significantly lower in the operating room. As a result, physicians verbally say that they feel better in the operating room and although this is supported by anxiety score index results, when the rhythm holter results are evaluated, the doctors in the operating room are at higher risk for their own health. The reason for this finding has been thought to be their risks taken in the operating room as well as their responsibilities.

Due to intensive working conditions, surgeons are working under high stress in developing countries like Turkey with high population density. Surgery is a stressful work area (1). There are studies showing the relationship between increase in cardiovascular disease risk and prolonged work load and working stress (9, 12, 17). We planned a study to investigate whether surgeons who work devotedly under difficult conditions are at higher risk in terms of cardiac in the outpatient clinic or operating room.

In our country, surgeons working in outpatient clinics deal with more patients than the world standard. As the number of patients is high and the time allocated for the patient is shortened, stress increases even more. Generally, surgeons state that they like the operating rooms and work more peacefully there compared to the outpatient clinics, where they face communication problems with patients and their relatives. Also, high workload causes them to be more anxious.

Identifying and measuring mental stress in the surgery room is difficult. It is seen that measuring HRV to evaluate mental stress is the best method. It is also more sensitive than measuring only the HR (18).

Parasympathetic innervation increases HRV, whereas sympathetic innervation decreases HRV (19). High variability in heart rate is an important indicator that the automatic control mechanism is working well in healthy people. On the contrary, decrease in HRV is the pre-indicator of mortality in some diseases (23). While the SDNN, being one of the time domain parameters, shows the general condition of the autonomic nervous system, pNN50 and rMSSD reflect mainly the parasympathetic activity (20). Time domain parameters are completely independent of diurnal and other effects in HR and reflect changes in autonomic tone regulated vagally. Frequency domain measurements correspond to HR oscillations across a range of specific frequencies, and increases in low frequency / high frequency reflect the transition to sympathetic dominance and are a tool to assess cardiovascular autonomic regulation (21).

Studies on HRV cardiac effects have evaluated routine time domain parameters (17), and there are studies evaluating frequency-dependent parameters together (20,22). Both parameters are indicative of sympathetic and parasympathetic balance in different ways. The frequency domain parameters could not be evaluated since the Holter device used in our study did not have a feature to evaluate frequency domain parameters.

There is a significant decrease in HRV in patients with myocardial infarction (MI) compared to patients with stable angina pectoris (22). Decrease in SDNN in the early stage of acute MI is associated with left ventricular dysfunction, peak creatine kinase MB and Killip classification. It shows that HRV time domain parameters can be used as an advanced risk assessment method in low-to-moderate risk individuals without known CAD (23). A meta-analysis also found that reduced HRV was associated with an increased risk of first cardiovascular events by 32% to 45% in patients without known coronary artery disease (24).

It is generally accepted that work stress of surgeons is high taking into account the risk they take during an intervention. Excessive stress level during operation mainly derives from technical problems, difficulty of the procedure, complications as well as high work stress. Excessive stress level also does affect non-technical abilities like communication, teamwork, judgement as well as decision-making. Loss of these abilities may risk the patient’s security (25).

In another study, HRV was used in 6 of 10 articles evaluated in the meta-analysis of the latest scientific studies to evaluate the stress in surgeons with HR and HRV, which are the parameters of physiological stress, while 4 studies only evaluated with HR. As a result, it has been shown that surgeons working under high stress present higher intraoperative HR and low HRV expression as well as being under higher cardiac risk (18).

While evaluating stress parameters during hepatobiliary surgery, Yamanouchi et al., found that the sympathetic nerve activity increased compared to the preoperative level. Various procedures during operations have lead to different changes in the autonom nervous activtiy. It has been shown that HRV analysis can evaluate cardiac activation related to mental stress via autonom nervous system (8).

Average HR of physicians is high and HRV is low in night shifts was shown in a recent study. This is correlated with increased sympathetic discharge (9). In another study it is shown that HR and HRV values are indicators of different workload of emergency room physicians (12). As physician group was not homogenous in our study, such a comparison has not been done. According to their anxiety scores doctors divided into two groups in the operating room in another study. At the end of the study they found the HR significantly higher in the group with high anxiety score (10).

In a study investigating the effects of the optimized ergonomic and technical environment on the psychological and physiological stress of the surgeon, it was found that work stress in a modern room decreased compared to a standard room while performing a procedure (11). In another study, it was reported that the work stress of surgeons was high and 2.4% of them used antidepressant drugs (26).

Engelmann et al., shown that intraoperative breaks decreased the cortisol level of surgeons by %22 while not prolonging the surgery (27). Also, there are data showing that the surgeon's sleep time positively affects the surgical performance (28). All of these data are important for increased work performance and decreased work stress with respect to periodical planned breaks, regular and enough sleep.

Surgeons' intraoperative HRV time domain analysis showed less variability during laparoscopic operation than open procedures. A significant reduction in frequency domain parameters has been observed during conventional sigmoid resection versus laparoscopy (29). These results were interpreted as a result of increased sympathetic activity due to increased mental strain. In a study conducted in Sweden, surgeons had a higher risk of dying from ischemic heart disease than general practitioners. This result was thought to be due to the physicians' not using their knowledge and experience in a way to protect their health (30).

In previous studies, the reasons underlying the surgeons' increased cardiac risk were evaluated mostly with questionnaire scales, and our study is important in terms of showing that this risk is due to decreased HRV and supported by quantitative data. Our study data should be supported by studies with more physicians and in improved work environments.

Although there are many studies evaluating HR and HRV which are physiological stress parameters of surgeons in operating room, there has not been found a study evaluating the stress physicians face in outpatient clinic and operating rooms and the cardiac reflections of it. Our study has shown that although physicians working in intense outpatient clinics think that they are more tired and unhappy, surgical procedures, operating room conditions and risks taken during the operation create severe mental stress. Chronic stress creates significant cardiac risk by affecting cardiac parameters.

CONCLUSION

The quality of life can be negatively affected in surgeons primarily working in operating rooms due to a decreased HRV and an increased HR. Working conditions should be improved and the awareness of physicians should be raised on this issue. Although it is the primary duty of physicians to protect people from diseases and treat diseases, in order to protect our own health and decrease mental stress, improvement of working conditions, creating sufficient and proper resting facilities will create more healthy and productive working procedures.

The operating room environment, where surgeons see it as a place of worship and find serenity, may actually be an important factor affecting their lifetime. Therefore, when determining the number of daily operations and the time between operations, we ask our precious surgeons to think about themselves as well as their patients. The findings of our study are supported by further studies involving a larger number of patients.

Conflict of interest

No conflict of interest was declared by the authors.

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