Comparison of the Effect of Noise Levels on Stress Response in Two Different Operation Groups in an Orthopedic Surgery Room

Ortopedi Ameliyathanesinde Farklı iki Ameliyat Grubundaki Gürültü Düzeylerinin Stres Yanıt Üzerine Etkisinin Karşılaştırılması

Noise in the Operating Room

H. Gül Baytan Yıldız[1], Enver Özgencil[2], Sanem Çakar[2], Feyhan Ökten[2], Filiz Tüzüner[3]
[1]Department of Anaesthesia, TOBB ETU Faculty of Medicine,
[2]Department of Anaesthesia, Ankara University Faculty of Medicine,
[3]Department of Anaesthesia, Ufuk University Faculty of Medicine, Ankara, Turkey

TARK 2006 (Türk Anestezi ve Reanimasyon Kongresi)'nde sözlü sunu olarak kabul edilip sunulmuştur.

Özet

Amaç: Bu randomize, tek kör çalışmanın amacı, nöroaksiyel anestezi uygulaması ile gerçekleştirilen diz protezi operasyonlarında ortam gürültü düzeyinin ölçümü sağlanarak, hastalarda gürültünün hemodinamik yanıt, stres düzeyi ve nöroendokrin yanıt üzerine etkilerini değerlendirmektir. Gereç ve Yöntem: Nöraksiyal blok uygulanması yapılan 2 grup hastadan, Grup1'de kullanılan enstrumantasyonlara bağlı olarak gürültü düzeyinin yüksek olduğu diz protezi operasyonu geçiren hastalar için ve Grup 2'de menüsküs operasyonu geçirecek hastalar için gürültü düzeyi desibel olarak ölçüldü. Hastalara preoperatif ve postoperatif The State-Trait Anxiety Inventory (STAI-1) Durumluluk kaygı ölçeği(Süreksiz); Anxiety test (STAI-2 (Sürekli Kaygı Ölçeği)) yapıldı. Hastalardan bazal, intraoperatif 30.dakika ve derlenme odasında ilk 1.saatte 20 ml kan alındı. Bulgular: Hastaların hemodinamik yanıtlarında; sistolik, diyastolik ve ortalama arter basınçları gürültünün yüksek olduğu grupta, daha yüksek olduğu bulundu. Grup 1'de ACTH'da intraperatif erken dönemde arttığı, geç dönemde ise normale döndüğü, Grup 2'de ise ACTH değerlerinin anlamlı olarak düştüğü bulunmuştur. Kortizol değerlerinde bazal kortizol değerlerinin anlamlı olarak Grup 2'ye göre yüksek olduğu bulunmuştur. İnflamatuar yanıtın göstergesi olan hCRP düzeylerinde tüm hastalarda her iki grupta da düşüş gözlenmiştir. Grup 1'de erken ve geç dönemdeki glukoz değerleri yüksek seyretmiştir. Glukoz değerlerinde erken ve geç dönemde Grup 1'de daha fazla artış gözlenmiştir. Postoperatif dönemde daha fazla gürültülü ortamın olduğu hastalarda sürekli kaygı ölçeği (STAI-2) düzeylerinin daha yüksek olması, her ne kadar bu ölçeğin kişilerin içinde bulunduğu durum ve koşullardan bağımsız olarak kendini nasıl hissettiğini belirlese de, bu sonuç bize hastalarda intraoperatif dönemde maruz kalınan gürültünün stres yanıta neden olabileceğini düşündürdü. Tartışma: Sonuc olarak, operasyon odasındaki yüksek gürültü düzeyine neden olan faktörlerin düşürülerek standart gurultu düzeylerine ulaşılması gerektiğine inanmaktayız. Bu daha iyi sedasyon , daha az ilaç tüketimi ve daha iyi metabolik kontrol sağlayacaktır.

Anahtar Kelimeler

ACTH; Anksiyete; Kortizol; Nöroendokrin Stres Yanıt

Abstract

Aim: The aim of this randomized, single-blinded study was to evaluate the effects of noise on hemodynamic and neuroendocrine stress response by measuring the level of noise in the surgery rooms of patients undergoing knee operations under neuroaxial anesthesia. Gereç ve Yöntem: We compared patient responses from two groups of patients: those undergoing knee operations in a surgery room where the noise level (measured in decibels) is high, and those undergoing meniscus operations in a surgery room with lower noise levels. The STAI, the State-Trait Anxiety Inventory (STAI-1), and the anxiety test (STAI-2)wereperformed at preoperative and postoperative periods. 20 ml of blood sample was taken for basal, intraoperative 30th minute, and postoperative 1st hour measurements. Systolic, diastolic, and mean arterial blood pressures were found to be higher in the high noise level group. ACTH levels were increased during the early postoperative period and became normal during the late postoperative period in the high noise level group whereas ACTH levels were significantly decreased in the low-noise level group. Basal cortisol levels were significantly higher in the high noise level group. HCRP, an inflammatory response mediator was found to be decreased in both groups. Early and late blood glucose levels were significantly higher in the high noise group. There was a greater increase in early and late blood glucose levels in the high noise group. In the postoperative period, although the state-trait anxiety inventory (STAI-2) levels being higher in patients subject to noisier environment determines how people feel independent of the conditions and state they are in, this result made us consider that the noise the patients were subjected to in the intraoperative period may cause a stress response. Discussion: As a result we believe that standard noise levels should be achieved by reducing the factors causing high noise levels in the operating room. This will provide better sedation, less drug consumption, and better metabolic control.

Keywords

ACTH; Anxiety; Cortisol; Neuroendocrine Stress Response

DOI: 10.4328/JCAM.4752 Received: 19.07.2016 Accepted: 16.08.2016 Printed: 01.03.2017 J Clin Anal Med 2017;8(2): 116-21
Corresponding Author: H. Gül Baytan Yıldız, Department of Anesthesiology, TOBB ETU Hospital, Ankara, Türkiye.
T.: +90 3122929821 GSM: +905326977196 E-Mail: gulbaytan@gmail.com

Introduction

The operating room is an environment where great care is taken to be silent and avoid noise. However, a noise level which medical staff thinks is not disturbing can be disturbing and even damaging for patients given that it is an unfamiliar environment, along with the stress of the operation and anesthesia. The average noise level for hospitals' acute care areas has been determined as 45 dBA by the International Noise Council [1,2]. Orthopedics surgery rooms are environments in which there is an especially high level of noise. Due to the instruments used in orthopedic surgery, the noise levels can range between 95 and 105 dBA [3]. It is known that anesthesia applications have direct effects on the physiological functions in the body. In particular, there are numerous studies on the repression of hypothalamic and pituitary hormones by opioids [4]. It is also known that etomidate and benzodiazepines reduce cortisol secretion. With the use of epidural anesthesia and local anesthetic agents, the endocrine and metabolic stress responses in pelvis and lower extremity surgeries can be inhibited, positively changing the result of the surgical intervention [5]. Various studies have been conducted on how surgical success can be influenced by changing the stress response and in particular its relationship to the anesthesia method. It has been determined that noise levels over 80 decibels are harmful [6]. However, noise pollution in surgery rooms appears as a factor before us in the formation of stress response. Although noise does not always mean loud sound, it is harmful to be subjected to very high noise levels, such as orthopedics surgery rooms, for too long [7]. Anxiety and the resulting increase in the need for sedation causes a change in the metabolic, hormonal, cardiovascular, lipid profile, and carbohydrate metabolism and can deteriorate the balance of glucose homeostasis and perioperative fluids, especially with the increasing cortisol and catecholamines [8-12].

The purpose of this randomized and single-blind study was to measure the ambient noise levels in knee prosthesis operations carried out with neuroaxial anesthesia and evaluate the effects of noise on the patients' hemodynamic response, stress level, and neuroendocrine response .

Material and Method

Included in this study were a total of 53 patients between the ages of 18-75 who underwent total knee prosthesis or meniscus operations with the spino-epidural anesthesia method under elective conditions with their consent, with ASA physical status I-III (American Anesthesiologists Foundation) between February 2006 and May 2006. This study received approval number 01022006/271 from the ethical board at Ankara University's Anesthesia and Reanimation Department in 2006 [12]. The patients included in this study were informed about the anesthesia method of epidural application a day before the operation during the preoperative evaluation and the volunteers who wished to participate in the study were included following the receipt of their patient information form.

Patients with a history of psychiatric illnesses, uncontrolled hypertension or diabetes mellitus; those who used psychiatric medicine and steroids; those with hormonal dysfunctions (adrenal, thyroid, hypophysis); those with medicine addictions; those with hearing problems; those who refused the method; those with coagulopathy and those who used anticoagulants; those with neurological deficits, serious aortic stenosis, serious mitral stenosis, increased intracranial pressure, infection in the intervention area, and regional anesthesia contradictions such as serious hypovolemia; those who did not cooperate; those whose operation duration exceeded 100 minutes; and those who needed additional analgesic and other medicine (local anesthetics, opioids, ephedrine, insulin) during the intraoperative period have not been included in the study.

Anesthesia Method

When the patients were taken to the surgery room, 18-22 gauge intravenous catheters were routinely placed in the dor-

Table 1.1 Demographic Data (age, weight, Height, gender, anesthesia and duration of operations), 1.2 ASA Score (American Society of Anesthesiologists), 1.3 Blood Transfusion.

Group		Age	Weight	Height	Anessure	Cersure
Noisy environment	N Valid	27	27	27	27	27
	Missing	0	0	0	0	0
	Mean	65,96	76,74	160,26	101,67	86,11
	Median	66,00	75,00	160,00	100,00	80,00
	Std. Deviation	6,892	17,444	12,227	25,533	19,282
	Minimum	47	42	105	20	50
	Maximum	80	135	175	160	130
Less noisy environment	N Valid	26	26	26	26	26
	Missing	0	0	0	0	0
	Mean	43,58	77,42	168,27	87,69	68,27
	Median	45,00	80,00	167,00	80,00	60,00
	Std. Deviation	12,064	9,061	8,225	28,504	27,127
	Minimum	19	50	150	50	30
	Maximum	64	95	180	165	140

Group * Gender Cross Tabulation

			Gender		Total
			Female	male	
Group	Noisy environment	Count	22	5	27
		% within Group	81,5%	18,5%	100,0%
	Less noisy environment	Count	12	14	26
		% within Group	46,2%	53,8%	100,0%
Total		Count	34	19	53
		% within Group	64,2%	35,8%	100,0%

Table 1.2 Group * ASA Cross Tabulation

			ASA		Total
			1	2	
Group	Noisy environment	Count	15	12	27
		% within Group	55,6%	44,4%	100,0%
	Less noisy environment	Count	25	1	26
		% within Group	96,2%	3,8%	100,0%
Total		Count	40	13	53
		% within Group	75,5%	24,5%	100,0%

sum or antecubital fossa and venous blood samples were sent for measurement of preoperative cortisol, adrenocorticotrophic hormone (ACTH), high-sensitive C-reactive protein (hCRP), and glucose level evaluations.

All of the patients were given 0.5 mg atropine as premedication. The gender, age, weight, height, ASA physical status, chronic illnesses, and the medications of all the patients were recorded preoperatively. The State-Trait Anxiety Inventory (STAI-1); Anxiety test (STAI-2); and stress anxiety test, which evaluates various measures together with subjective emotions such as tension, anxiety, sadness, and irritability related to the stimulation of the autonomic nervous system [13]. In our study, patients self-evaluated their anxiety levels 5 minutes prior to the operation and after the operation. The total score value obtained from the two scales ranges between 20 and 80. The higher the score, the higher the anxiety level [14]. We performed pilot measurements of noise levels, with the assumption that the ambient noise levels in the knee prosthesis operations (Group I) are higher than in meniscus operations (Group II). To ensure comparability, we have chosen these two surgical procedures because they are similar in terms of surgery duration, use of regional anesthesia, and level of the area to be operated on. The ambiance decibel level was measured in all of the procedures. In the period starting after the basal values were taken, heart rate, systolic, and diastolic blood pressures and ambiance noise level were recorded at 10 minute intervals until the end of the operation. As for standard anesthesia monitoring, heart rate (HR), systolic (SAP), diastolic (DAP) and average (MAP) artery pressures, and peripheral arterial oxygen saturation (SpO2) (Viridia CMS M1166A, Hewlett Packard, Germany) were measured for all patients.

The patients were separated into two groups of 26 according to the type of surgery (high or low noise level) and analyzed separately. The patients in Group I underwent knee prosthesis operation while those in Group II underwent a meniscus operation. Neuroaxial block was performed on both groups. The single space segment technique was performed using Combined Spinal Epidural Anesthesia. All patients received an epidural catheter at the L4-L5 interval in the preoperative period. We then applied 2% of lidocaine 60 mg as a test dose (Osel, Istanbul, Turkey) and 0.5% heavy marcaine from the spinal space (Astra-Zeneca, İstanbul, Turkey). The sensory blockade level required for regional anesthesia has been kept at the T5 level. For the measurement of the ambiance noise level, a Lutron SL 4010 (Taiwan) decibel meter device was used. For the measurements of basal, intraoperative on the 30th minute and ACTH, cortisol, hCRP and glucose levels on the 30th minute at the recovery room (MediSenseOptium, 3942), blood samples were taken at these times and STAI test evaluations were performed prior to and after the operation.

Statistical analysis

The statistical analysis has been carried out with an IBM compatible computer suitable for personal use and Windows SPSS 12 statistics program (Statistical Package for Social Sciences, Chicago, IL, ABD). The obtained data has been used in the two group independent comparison for the Mann-Whitney U Test and in Wilcoxon sign test in dependent intergroup comparisons. The significance level was set as 0.05. Because the data did not have a normal distribution, the Mann-Whitney U Test and Wilcoxon sign tests, which are non-parametric tests, have been preferred.

Findings

Demographic Data

While no difference was observed between the two study groups in terms of weight, height and gender, the mean age of the patients in the noisy environment group (Group I) has been determined as 66±7.29(SD) and in the less-noisy environment group (Group II) as 43±11.9(SD), which represents a significant difference (P<0.05). The durations of the operations were observed as 83±15(SD) in Group I and 65±24(SD) in Group II, a significant difference.

Intraoperative Hemodynamic Differences

When the intraoperative heart rate values of the groups were compared, a statistically significant difference was not found. When the intraoperative systolic arterial blood pressure values of the groups were compared, with the exception of 60th-70th minutes the SAP, MAP, and DAP values in Group 1 in measurements taken at the other times were significantly higher in comparison to Group II (P<0.05). The comparative MAP values can be seen in Figure 4.1.

Table 1.3 Group * Total Blood Cross Tabulation

			Total Blood				Total
			0	1ü	2ü	3ü	
Group	Noisy environment	Count	10	14	2	1	27
		% within Group	37,0%	51,9%	7,4%	3,7%	100,0%
	Less noisy environment	Count	26	0	0	0	26
		% within Group	100,0%	,0%	,0%	,0%	100,0%
Total		Count	36	14	2	1	53
		% within Group	67,9%	26,4%	3,8%	1,9%	100,0%

Hormonal Differences

a) Blood Glucose Values: When the glucose values between the groups were compared, the glucose values in Group I measured in the basal, 30th minute and recovery time were significantly higher (P<0.05) (Figure 4.2).

b) Blood ACTH Values

When the blood ACTH values between the groups were compared, the basal ACTH values in Group II were significantly higher (P<0.05). When the difference in the 30th minute in comparison to the basal was compared, the

Table 2.1 The noise levels of the groups

	Basal	0*	During the operation*	5	10*	20*	30*	40*	50*	60*	70*	80*	After the operation*
Group 1	53	69	61,7	64	68	70	68	67	66	67	66	65	65
Group 2	53	58,8	57,7	60	59,1	60,5	58,9	57,6	60	60,2	61,15	59	60

ACTH values in Group I significantly increased, whereas the ACTH values significantly decreased in Group II (P<0.05). In Group I, the increase at the 30th minute in the ACTH values in comparison to the basal was significantly higher than in Group II (P<0.05) (Figure 4.3).

c) Blood Cortisol Values

When the blood cortisol values between the groups were compared, the basal cortisol value in Group I was significantly higher than in Group II (p<0.05). The blood cortisol values of the groups in the basal, 30th minute and recovery periods are given in Figure 4.4.

d) Blood hCRP Values

When the blood hCRP values between the groups were compared, no statistically significant difference was observed (p>0,05). The groups' blood cortisol values in the basal, 30th minute and recovery periods are presented in Figure 4.5.

Intraoperative decibel measurement findings

When the noise level between groups was compared, we found that, with the exception of the 5th minute, the decibel measurement values were significantly higher in the noisy environment group (P<0.05).

The noise level basal measurements in Group I were significantly low, whereas no significant difference was observed in the basal values and decibel values measured at other times in Group II. In Group I, decibel levels ranged between 68.4 and 85. In Group II, decibel levels ranged between 54 and 66.7.

Preoperative and Postoperative stress test findings

When the State Anxiety Inventory(STAI-1) and the Trait Anxiety Inventory(STAI-2) scores between the groups were compared, no significant difference was observed between preoperative and postoperative values.

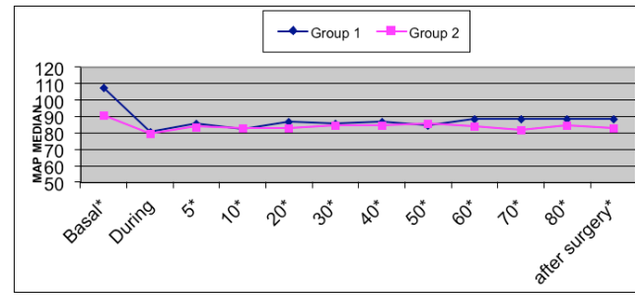
When the within-group Trait Anxiety Inventory (STAI-2) scores were compared, a significant difference was found between preoperative and postoperative periods in Group I (p=<0.05), whereas no significant difference was found in Group II.

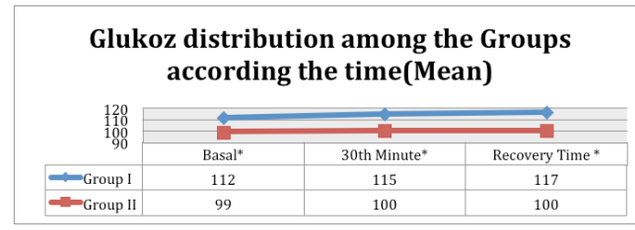
Discussion

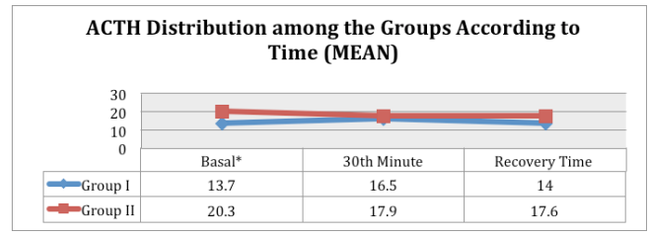
Uncontrolled noise is an activator of stress and various physiological mechanisms. However, all of its effects have not been clarified yet. Noise can increase systolic blood pressure, diastolic blood pressure, and heart rate [15]. Many studies have shown the relationship between uncontrolled noise and cardiovascular diseases. It is considered that the release of stress hormones induced by noise is an important biological mechanism [16].

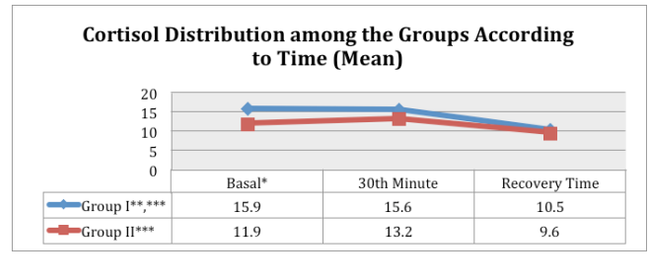
A blockage of T5 level for the metabolic and endocrine system temporarily suppresses the neuroendocrine response to operations [17-18]. With the appropriate sensorial blockage created through regional anesthesia, the increase in the levels of plasma catecholamines, cortisol, glucose, ADH, and GH which otherwise emerge from surgical stimulation can be suppressed [19-20]. Thus, the neuroendocrine response based on fear and anxiety can be correlated.

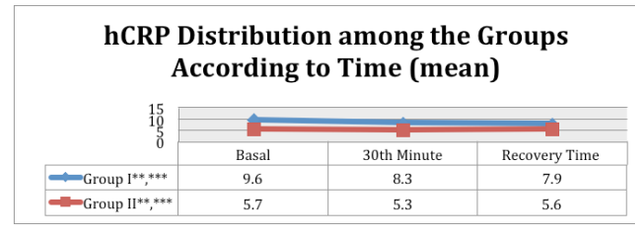
Various studies have analyzed the effect of epidural and spinal anesthesia on suppression of stress responses due to surgical intervention [18]. It has been determined that epidural analgesia blocks afferent neural impulses which have been removed from the surgical intervention area and that morphine and diamorphine, particularly when applied with the dural method, are effective in suppressing stress responses which are considered to develop pain after abdominal interventions [19-21]. In abdominal surgical interventions, when regional anesthesia is applied together with general anesthesia, endocrine stress

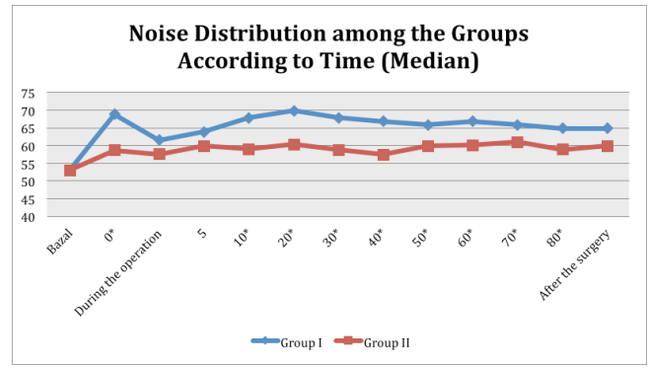












response is suppressed [22].

Our study analyzed the effects of noise on the patients' anxiety level, hemodynamic, and stress hormone response by measuring the ambient noise level in knee prosthesis operations carried out with neuroaxial anesthesia application.

Noise is an unsettling phenomenon which appears in our daily life; it causes a person to feel bad and has a negative effect on work performance. Like other work areas, surgery rooms are easily affected by noise pollution. Shapiro and Baland have likened the noise level in surgery rooms to the noise on a highway [23]. In the surgery rooms, the surgical personnel and patients are subject to noise caused by ventilators, screening devices, alarms, aspirator pipes, diathermy devices, mechanical and air devices, heaters, paging devices, intercoms, telephones, metal basins, tools, and trolleys. These kinds of noises can cause lack of concentration and loss of performance and can complicate communication for the surgical personnel. Increasing noise and the surgery itself can cause patients who are anxious during certain parts or for the whole of the surgery to be more irritable and anxious [13-23-15]. In our study, the stress test evaluation STAI levels were higher during noisy surgery than less noisy surgery in the preoperative and postoperative periods. This may indicate that anxiety is higher in noisy environments [13].

Hodge et al. in their study have suggested that devices such as earphones can be beneficial in eliminating noise [13-6]. Contrary to this suggestion, while ambient noise levels are measured in our study, there was no attempt to reduce noise. In particular in the patient with lower noise level operations such as meniscectomy in which noise producing instruments are not used were preferred. The devices used in sound isolation (earphones, earplugs, cotton balls, etc.) are not very effective in method. Note further that some studies state it is not necessary for the patient to be awake to be disturbed by noise and that stress response can emerge even under general anesthesia. However, it has been observed that by using methods which eliminate noise in noisy environments (for instance, earphones, making patients listen to music) [10-11-24] and creating a noise-free environment, it is possible to decrease the stress response of patients and their need for sedation and analgesia. In our study, we have not used sedation, earphones or similar sound elimination on our patients. Instead, for the low-noise condition (Group II) we have selected meniscus operations, in which the instruments used create an environment with less noise than in unilateral knee prosthesis operations with similar durations (Group I) in which the sound reaching the patients' ears can be as high as 90 decibels.

In order to communicate with the patients and evaluate stress levels prior to and after operations, we selected the regional anesthesia method in both of our groups. We thought that ambient noise can be perceived variably by the patients and that the source and character of the noise might be important. Although ambient noise did not exceed basal values, noise caused by hammers, saws and aspirators and heard by patients can cause neuroendocrine and sensory stress response. In our study, we observed that the level of background noise in surgery rooms contributes to the overall noise level measured during the operations. Furthermore, the baseline background noise level was too high to be a satisfactory study environment. When we evaluated the operation room while it was empty, we found an ambient noise level of 53 decibels. According to Standards Association of Australia, the background noise level should not exceed 30 dB [25].

The average noise level for hospital acute care areas has been determined as 45 dB by the International Noise Council [1-2]. When the noise level is taken into consideration, orthopedics surgery rooms are environments where noise is intense. The noise level when orthopedics instruments are in use ranges between 95 and 106 dB [3]. Outside noise is a particularly important problem for conscious patients who are given local and regional anesthesia. An operation is already a source of stress for most patients. It is possible to be free of stress and anxiety only by reducing noise to the minimum level. Sudden high sounds not only raise the stress level of patients, but they also can cause sudden movements in the body area being operated on. Thompson et al. have suggested that using earphones, playing background music or making patients listen to music with earphones can be used in reducing stress by minimizing noise [1].

It has been shown in human studies that noise increases hemodynamic response. It has been revealed in short-term laboratory studies that being subject to noise affects the sympathetic and endocrine systems and causes responses in acute physiological heart rate, blood pressure, and stress hormones [26]. Similar to these studies, while a change in the heart rate of patients who are subject to more noise due to the use of orthopedics instruments was not observed in our study, an increase was observed in systolic and diastolic blood pressure. When compared with the basal values in all patients, heart rates being lower during the operations can be explained by the choice of high level regional anesthesia as the anesthesia method.

Perioperative pain, which is an important stimulant for stress response, causes the activation of the autonomous system through indirect influence and various complications in the systems of the organs [8]. Although numerous methods have been developed to change mediator release and the catabolic hormonal response, it has been stated that, as in our study, the most important are somatic and autonomic afferent neural block and other pain preventing methods.

In our study, when the blood glucose values which are the stress response indicators of patients were analyzed, it has been observed that the blood glucose levels in patients subject to more noise were higher. In addition, we found that glucose increase in patients subject to more noise is correlated with the increase in noise during operations. Despite the fact that the high noise patients underwent a more traumatic operation (knee replacement), that they did not have diabetes mellitus, and that their stress response was suppressed with a regional nerve block, their blood glucose values were found to be higher. Correspondingly, we expect younger patients who were in less noisy group neuroendocrine response was more intense.

In one of his studies, Spreng analyzed the effects of cortisol release related to noise and determined that noise causes CRH and ACTH increase [27]. Similarly, when the ACTH values which are the stress response indicators were taken into consideration in our study, especially in periods in which noise increases with the operation of instruments, the level of ACTH being higher in patients subject to more noise shows the correlation

between the ambient noise level and ACTH level.

Lepage et al. in their study have compared patients who were operated on under spinal anesthesia and who were played music with patients who were not played music. The patients who were played music needed less sedation during the intraoperative period and there was no difference between the STAI levels [11-24]. This illustrates that the type of noise is important as well. While noise related to the surgical operation increases stress response, being played music decreases it [10-11]).

Conclusion

This study was conducted in a surgery room with higher baseline noise levels than those recommended by the International Noise Council. There was a noisy environment condition (knee replacement operation) and a less-noisy environment condition (meniscus operation). Noise levels were measured as the patient would experience them. In the noisy environment group, the hemodynamic responses, mean arterial pressures, metabolic, and endocrine responses to surgery were significantly higher. Consequently, we believe that standard noise levels should be achieved by reducing the factors causing high noise in the operating room, both at baseline and during operation. This will provide better sedation, less drug consumption, and better metabolic control.

In our study, surgery duration and age were different between the two groups. This fact, along with the small sample size, may be a limiting aspect of the study. However, even though the average age and surgical trauma level seems to be different in the two groups, the standardization of the ambient noise level was more important for us. Since the stress response related to surgical trauma would begin after it regressed to the T4 level with regional anesthesia, the blood sample follow-ups were carried out in an intraoperative manner. Thus, noise was isolated as the stress factor. We stopped our observation time before the nerve block was removed. Although only patients with no significant hearing loss have been included, not determining the hearing level of the patients through audiometry can be listed as another limitation.

Competing interests

The authors declare that they have no competing interests.

References

1. B.Hodge, J.F.Thompson. Noise pollution in the operating theatre. Lancet 1990;335:891-4.
2. Eugene, H.C.Liu,FRCA, Consultant and Su-Meng Tan. RegistarPatients' perception of sound levels in the surgical suite. Journal of Clinical Anesthesia 2000;12:298-302.
3. Kam PC, Kam AC, Thompson JF. Noise pollution in the anaesthetic and intensive care environment. Anaesthesia1994;49: 982– 6.
4. Holmes GB Jr, Goodman KL, Hang DW, McCorvey VM. Noise levels of 2. Orthopedic instruments and their potential health risks. Orthopedics 1996;19:35-7.
5. J.P.Desborough. The stress response to trauma and surgery. Br J Anaesth 2000;85:109-17.
6. Kehlet H. Surgical stress: the role of pain and analgesia. Br J Anaesth 1989;63:189-95.
7. B.C. Kennedy, G. M. Hall. Neuroendocrine and inflammatory aspects of surgery:do they affect outcome?ActaAnaesth. Belg 1999;50:205-9.
8. M.R.Nott, P.D.B.West. Orthopaedic theatre noise: a potential hazard to patients. Anaesthesia 2003;58:775-803.
9. Murthy MD, S.K., Malhotra MD.,BalaBD,Raghunathan Detrimental effects of noise on anaesthetists. Can J Anaesth1995;42:608-11.
10. Ganidagli S, Cengiz M, Yanık M, Becerik C, Ünal B. The effect of music on preoperative sedation and the bispectral index.AnesthAnalg 2005;101:103-6.
11. Migneault B, Girard F, Albert C et al. The effect of music on the neurohormonal stress response to surgery under general anesthesia. AnesthAnalg 2004;98:527-32.
12. Sitzman BT, Watson D, Schug AS. Combined general and epidural anesthesia for abdominal aortic aneurysm surgery. Techniques in Regional Anesthesia & Pain Management 2000.
13. STAI Eysenck MW, Derakshan N, Santos R, Calvo MG. Anxiety and cognitive performance: attentional control theory. Emotion (Washington, DC) 2007;7(2):336–353. doi: 10.1037/1528-3542.7.2.336. pmid:17516812
14. Downing R, Davis I, Black J, Windsor Wo. Effect of intrathecal morphine on the adrenocortical andhyperglysemic responses to upper abdominal surgery. Br J Anesth 1986;58:858-61.
15. Mori H, Murata H. A study of noise in operating room. Jap J Anaesthesiol 1979;10:1102-6.
16. Bigert C1, Bluhm G, Theorell T. Salivacortisol--a newapproach in noiseresearchtostudy stresseffects. Int J Hyg Environ Health 2005;208(3):227-30.
17. Ayoub CM, Rizk LB, Yaacoub CI et al. Music and ambient operating room noise in patiens undergoing spinal anesthesia. AnesthAnalg 2005;100:1316-9.
18. Sally ve ark. Chronic effects of workplace noise on blood pressure and heart rate. Archives of Enviromental Health, July-August 2002.
19. Davies JM, Ewen A, Cuppage A, Gilbert D, Winkelear R. Noise levels in the operating rooms-a comparison of Canada and England.Anaesthesia Intensive Care 1989;17: 98-9.
20. The pituitary hormones and their control by the hypothalamus. In: Guyton A.C., ed. Textbook of medical physiology. Philadelphia: W.B Saunders 1991:819-30.
21. The adrenocortical hormones. In: Guyton A.C., ed. Textbook of medical physiology. Philadelphia: W.B Saunders 1991:842-54.
22. Kehlet H. Epidural analgesia and the endocrine-metabolic response to surgery. Acta AnaesthesiolScand 1984;28:125-7.
23. Shapiro RA, Baland T. Noise in the operating room. N Engl j Med 1972;287:1236-7.
24. Morgan G. E., Mikhail M. S., Murray M. J., Larson C. P. The Practice of Anesthesiology, 3th edition, New York: McGraw-Hill 2002:1-14.
25. Ambient sound levels for areas of occupancy within buildings Australian Standard .2107-1977 Standards Association of Australia 1977.
26. W.Babisch.Stress hormones in the research on cardiovascular effects of noise. Division of
Environment and Health, Federal Environmental Agency 2003;5:1-11.
27. Spreng M. Possible health effects of noise induced cortisol increase. Noise and Health 2000; 12:59-64.

How to cite this article:
Baytan Yildiz HG, Özgencil E, Çakar S, Ökten F, Tüzüner F. Comparison of the Effect of Noise Levels on Stress Response in Two Different Operation Groups in an Orthopedic Surgery Room. J Clin Anal Med 2017;8(2): 116-21.