High Level of Noise Affects the Consumption of Anesthetic Agents during Total Intravenous Anesthesia (TIVA) and the Satisfaction of Patient and Surgeon

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Research Article

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High Level of Noise Affects the Consumption of Anesthetic Agents during Total Intravenous Anesthesia (TIVA) and the Satisfaction of Patient and Surgeon

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ABSTRACT

Objective: The purpose of this study is to investigate the effects of high noise level on propofol and remifentanyl consumption in patients who undergo cholecystectomy surgery under total intravenous anaesthesia (TIVA) during operation and on the satisfaction of patients and physicians.

Subjects and Methods: 90 patients who would undergo cholecystectomy surgery were randomized in 3 groups in this study planned as a double blind, prospective, randomized clinical trial. Propofol and remifentanyl infusion was started to obtain BIS values between 40-60 for all patients. The patients in Group N (n=30) were subjected to noise of normal operating room. The patients in Group S (n=30) were subjected to noise between 80-85 Db with headphone and for patients in Group Q subjection to noise of the operating room was prevented by covering the ears with headphones (n=30). Intraoperative total remifentanyl and propofol consumption of the patients, postoperative patient and physician satisfaction, postoperative side effects were recorded.

Results: Total remifentanyl and propofol used during surgery was significantly lower in Group Q than in Group N and Group S (p=0,0001, p=0,04). Postoperative patient satisfaction in Group Q was statistically higher than in Group N and Group S (p=0.001). Surgeon satisfaction in Group Q was also higher than in Group N and Group S (p=0.01).

Conclusion: High noise level for patients who undergo cholecystectomy surgery under TIVA increases total remifentanyl and propofol consumption during operation. In addition, it decreases patient and surgeon satisfaction.

Introduction

Noise is defined as a sound that appears out of nowhere or disturbs anybody [1]. Noise may cause physiological and psychological addverse effects such as hearing loss, perceptual disorder, anxiety, increase in cortisol level induced by stress [1]. Previous studies reported that the normal noise level in operating room was between 51- 75 dB and maximum noise level was between 80- 119 dB [2]. Protective reflex mechanism of the ear is activated over 85 dB and transmits loud noises to internal ear by weakening them. When a person is subjected to noise over 90 dB for a long time, hearing cells in internal ear may be damaged. But, neuromuscular agents destroy this protective reflex by paralyzing the stapedius muscle [3].

The role of music in the treatment of preoperative anxiety in adult patients was investigated. Researchers concluded that listening music before surgery had anxiolytic effects [4]. And in parallel with this it was reported that music decreased sedative and analgesic requirements and reduced BIS score. Koelsch and Siebel [5] reported that the music can influence the perceptual, emotional, and cognitive processes by preventing the perception of the noise of the operating theater, evoke feelings which interact with pain and unpleasant effects related to the surgical procedure. Koelsch et al. [6] stated in the study they performed that negative sensations like anxiety prevented the people to feel good and may increase the requirement for sedative and analgesic consumption. Kim et al. [7] showed that noise in the operating room could prevent a stable sedation level to be obtained in patients undergoing surgical operation.

But, in another study they reported that blocking of noise in the patients under propofol sedation is more effective than making them listen to music for decreasing BIS value. They stated that sedative and analgesic requirement decreased consequently. However, it is not clear whether it is related to the prevention of noise of operating room or to music [8]. Therefore, we planned our study to make the answers of these questions clearer. In our study, we investigated the effect of noise on propofol and remifentanyl consumption and, anxiety in patients applied TIVA and sedation level in the patient and the surgeon during perioperative period.

Subjects and Methods

This study was conducted in Gaziantep University, Faculty of Medicine, Anesthesiology and Reanimation Department after approval was obtained from Gaziantep University, Faculty of Medicine, Ethics Committee. Ninety patients with ASA (American Society of Anesthesiologists) I-II whose ages were between 18-65 who would undergo cholecystectomy surgery under TIVA (Total Intravenous Anaesthesia) were included in the study. The study was planned as a randomized, double blind, prospective clinical study. Written consents of the patients were received after a detailed explanation was made on the previous day before the study, about anesthesia method to be performed. The work presented has been performed in accordance with the most recent version of the Helsinki Declaration.

The patients with midazolam or remifentanyl sensitivity, who had history of psychiatric drug usage recently, who had active respiratory tract infection and ear infection, who were addict of alcohol, narcotics or drugs, who had renal, cardiac or liver dysfunction, who were pregnant and did not want to be included to the study, were not included in the study. Audible level of the patients before surgery were tested audiometrically and the patients with auditory deficit were excluded from the study.

Preoperative sedation was not applied to any of the patients. Peripheral venous catheter was inserted, non-invasive blood pressure, peripheric oxygen saturation (SPO_2), ECG (electrocardiogram) and BIS (Bispektral Index) were monitored after all the patients were entered in the operating room. Than demografhic values were evaluated with modified Observer's Assessment of Alertness/Sedation Score (OAA/S) 5 minutes before operation and at the 0th. minute. OAA/S: 0 = no response to painful stimulant; 1 = no response to delicate shaking and nudging; 2 = response only to delicate shaking and nudging; 3 = response only when called with noisy and repeatitive voice; 4 = lethargic response when called with normal voice; 5 = ready response when his/her name is called with normal voice [9]. Emergence agitation score (behaviour score) (1= sleeping, 2= awake, calm, 3= irritable, 4= inconsolable crying, 5= severe restlessness, disorientation) [10] and basal anxiety score were evaluated and also heart rate (HR) and mean arterial pressure (MAP) was recorded. The application of anesthesia was performed by a single assistant and the evaluation was performed by another individual blinded to the group of the patient. The patients were randomized according to the computer ranks.

The patients were intubated 2-4 minutes after anethesia induction was applied with standard doses of rocuronium bromide (Esmeron® vial 10 $mg.ml^{-1}$, Organon, Oss, Holland) 0.5 mg/kg and propofol (Propofol 1% Fresenius®, 10 $mg.ml^{-1}$, Fresenius Kabi AB, Uppsala, Sweden) 2-2.5 mg/kg and they were connected to anesthesia machine. Maintenance of anesthesia was continued as TIVA by applying remifentanyl (Ultiva® 2 $mg.ml^{-1}$, Glaxo Smith Kline, S.p.A, Italy) and propofol infusion with different perfusors (Braun Infusomat, Melsungen, Germany). Therefore, 0.01-0.1 µ/kg/min remifentanyl infusion and 6-10 mg/kg/hour propofol infusion were performed for BIS value to be in the range 40-60. Mechanical ventilation was performed with 50% O_2 and 50% air. BIS measuring device (Aspect Medical Systems, Natick, MA) was used for monitorization. The patients were randomized into 3 groups according to the order in the computer. The patients in high noise group (Group S (n=30)) were subjected to noise in the environment together with induction (Noise of the alarm was increased, everbody spoke loudly, music was listened on the radio) and they were made to listen traffic noise at the level of 80-85 dB with headphone. The sources of noise are different types of equipments; the conversations between the workers and the alarms of different equipments [11-13].

The ears were covered with headphones tightly in Group Q (silence group). Silence of the environment was maintained as far as possible. In the patient group where normal room noise was maintained (Group N (n=30)), the ears of the patients were left open so that they could be sensitive to the ambient noise. TIVA was terminated after surgical intervention was completed.

HR, MAP, BIS values were recored during intraoperative period at minute 0, 5, 10, 15, 30, 45, 60 and HR, MAP, sedation score and anxiety scores were recorded at minutes 0 and 5 after they were awaken. Postoperative total remifentanyl and propofol consumption of the patients; operation duration, recovery duration from anesthesia (time passed from extubation until verbal communication is established in postoperative observation room), patient and surgeon satisfaction scores (0= not satisfied, 1= slightly satisfied, 2= satisfied, 3= very satisfied); side effects like postoperative nausea, vomiting, tachycardia, bradycardia (HR<50/dk), hypertension, hypotension (MAP<60 mmHg), coughing were also evaluated and recorded. Aneshesia and data collection were performed in each group by a person who had no information about the other group.

Statistical Analysis

SPSS (Statistical Package for Social Sciences) for Windows 16.0 statistics program was used in the assessment of the parameters studied. The demographic features of each group were compared by means of variance analysis. In order to analyze and compare the between-groups parametric data (comparison of MAP, HR, recovery time, duration of surgery, total remifentanil consumption and total propofol consumption) one-way ANOVA was used. The anxiety, sedation and the satisfaction scores of the groups were compared by means of Kruskal-Wallis test. The nausea-vomiting, bradycardia, tachycardia, hypertension, hypotension and caughing were compared with $\chi 2$ test. All the data were expressed as mean ± standard deviation or percentage % or median (minimum-maximum). The statistical significance level was determined to be meaningful at $p<0.05$. We did not calculate the sample size. However, for purposes of the power calculation, a 25% increase in consumption in propofol and remifentanyl was considered to be significant.

Results

There was not any significant difference between the groups with regards to demographic data, recovery time from anesthesia and surgery ($p>0.05$) (Table 1).

Total remifentanyl consumption determined during operation in Group Q was statistically significantly lower than Group N and Group S ($p=0.0001$) (Table 1). Total propofol consumption determined during operation in Group Q was statistically significantly lower than Group N and Group S ($p=0.04$) (Table 1).

There was no statistical difference between groups with regards to preoperative and postoperative anxiety scores and sedation scores ($p>0.05$) (Table 2).

Postoperative patient satisfaction score in Group Q was statistically significantly higher than Group N and Group S ($p=0.001$) (Table 2). Postoperative surgeon satisfaction score in Group Q was statistically significantly higher than Group N and Group S ($p=0.01$) (Table 2).

A statistically significant difference was not observed with regards to postoperative complications like nausea, vomiting, hypertension, hypotension tachycardia, bradycardia and coughing ($p>0.05$) (Table 3).

Discussion

We investigated the effects of high noise level in patients who underwent cholecystectomy surgery under TIVA on propofol and remifentanyl consumed during operation and postoperative anxiety and sedation levels. We observed that high noise level increased total propofol and remifentanyl consumed during operation. Beside, we determined that patient and surgeon satisfaction was significantly higher in silence group.

Bispectral index (BIS) is a useful monitor for the evaluation of sedation, hypnosis and loss of consciousness and for the decrese of drug consumption, for the prevention of awareness and for providing short recovery periods [14, 15]. TIVA ensures fast induction, balanced maintenance of anaesthesia and also decreases side effects like nausea, vomiting, shivering. The best combination in TIVA is generally obtained with remifentanyl and Propofol that is hypnotic and analgesic [16].

Many studies performed before, showed that the noise level in the hospitals is far above the recomended noise level [6]. WHO (World Health Organisation) recomends a noise level up to 30 dB in operating rooms but in reality the noise level in operating room is approximately two times this value [2]. The studies performed before, stated that average noise level in operating room was between 51-75 dB and the maximum level was between 80-119 dB [2]. In our operating room the average noise is 65 dB. In our study we used traffic noise between 80-85 dB together with ambient noise in noise group both to generate adequate and not to cause damage in the patients .

It is known that audio warnings organizes stress response [17, 18]. In some studies it was stated that music had reduction effect on stress during surgery and before surgery and on anxiety before surgery. Furthermore cortisol level was determined lower in the music group in intraoperative period [6]. But, different from this, cortisol secondary to activation of hypophysis-adrenal cortex axis increases due to noise and noise may cause harmful hormonal changes associated with stress response and secondary effects such as tachycardia and hypertension on circulatory physiology [1]. Koelsch et al. [6] in the study they performed found out that cortisol and ACTH levels increased in both music and control group in postoperative period although music decreased corisol and ACTH levels during surgery. Noise is also a stress source for employees and may disturb the concentration and the mental activity of the employees. It may cause mental fatigue, headache and hypertension in the employees [17]. Disturbance of mental activity is one of the most important reasons of medical error and side effects and this subject should be taken seriously [2]. In other words, noise may be a detrimental factor not only for the patients but also for the employees of the hospital. Noise also affect staff by impairing the concentration and mental efficiency [19]. Bayo et al. [20] reported that the noise affect the hospital workers badly causing headaches, mental fatigue and hypertension. As noise is an important discomfortting factor, health-care workers should be protected from excessive noise.

At the end of our study we determined that noise increased intraoperative propofol and remifentanyl consumption. In most studies performed with patients who underwent surgery under regional anesthesia, it was stated that music had effects in the direction that decreased the consumption of sedatives and analgesics [6, 21-23]. But we did not encounter to many studies that investicated the effects of noise on consumption of sedatives and analgesics in patients who underwent surgery under general anesthesia with TIVA. Bondoc et al. [23] made a group of patients to listen hemispheric synchronized noise and second group of patients to listen music and the third group of patients to listen blank tape who underwent surgery under general anesthesia. In conclusion, intraoperative analgesic reguirement in the group who were made to listen hemispheric synchronized noise was less and the patients were discharged earlier. Kim et al. [7] reported that increase in noise level triggered the recovery response of the patient and could cause an increase in BIS value. This condition shall increase the anesthetic amount consumed. However, music, different from noise may decrease the need for sedative and analgesic [4]. According to those previous studies, it is unclear whether the cause of this decrease results from the music or from elimination of operating room noises. Koch et al. [17] reported that, the decrease in sedative and analgesic requirements can be related with the elimination of operating room noise and not by the effects of music. Kang et al. [8] compared 3 groups consisting of noise, silence amd music groups in patients who would undergo total knee arthroplasty under combined spinal epidural anasthesia and obtained propofol sedation. Ultimately, blocking of noise is more effective than music in decreasing BIS score. Minckley et al. [24] reported that, the number of patients need much more analgesics when the noise levels were high (60-70 dB).

These studies suggest that auditory stimulation might affect neurohormonal response even under general anasthesia. While music is theoretically expected to decrease stress hormones in patients under general anaesthesia, noise might increase the consumption of sedative and analgesics by increasing stress hormones. Increase in stress hormones related to noise may induce tachycardia and hypertension and this shall increase the requirement for propofol and remifentanyl. This increase in stress hormones might be a reason of anxiety in both the patients who recover from anaesthesia and the staffs' working in the same environment. Surgeon satisfacion and postoperative patient satisfaction was the highest in silence group. Unlike from our study, Bondoc et al. [23] could not find any difference between groups. But they did not use noise in their study; they separated groups with use of music, hemispheric synchronized noise and blank tape. The reason of this might be that the effect of noise on consumption of sedative and analgesics is more.

A significant difference was not determined between groups with regards to postoperative sedation and anxiety scores, side effects like postoperative tachycardia, bradycardia, hypertension, hypotension. Furthermore, Nilsson et al. [18] did not observe a difference between groups with regards to postoperative nausea, vomiting.

In our study, we could obtain the stabilization of noise level might be ensured by a different source, the patients under general anesthesia would be subjected to. Perioperative, intraoperative and postoperative stress hormone (ACTH, cortisol, epinephrine, norepinephrine) levels could not be measured due to limited resources. Instead of this, clinical results were taken as a basis.

Conclusion, we observed that noise increased consumption of propofol and remifentanyl in patients who underwent cholecystectomy surgery under TIVA. The consumption was determined as minimum in silence group. Furthemore, patient and surgeon satisfaction was also higher in silence group.

Conflict of interest: We have no conflicts of interest.

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