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Original Article

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Comparison of recovery and side effects after optimal isoflurane/sevoflurane/desflurane anaesthesia with BIS monitoring in patients undergoing laparoscopic abdominal surgery

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ABSTRACT

Aims: Rapid recovery of the patient after the surgery is important for the patient to gain consciousness quickly and full wakefulness is important for both anesthesiologist and for the patient. This becomes more important especially in daily surgeries such as laparoscopic surgery procedures. Rapid recovery of consciousness after extubating, spontaneous respiratory sufficiency, adequacy of protective airway reflexes minimizes respiratory side effects during recovery period. In patients under general anaesthesia, EEG activity reverts from low-voltage fast waveform to high-voltage slow waveform. Bispectral index (BIS) anaesthesia, as an EEG variant, is a simple and easy-to-use monitor that measures the depth of anaesthesia. With this monitor, it is easier to measure the depth of anaesthesia and evaluate the recovery. In our study, we aimed to evaluate the difference between recovery times and side effect rates after isoflurane/sevoflurane/desflurane anaesthesia.

Methods: 105 patients in ASA I-II risk group between 18-60 years of age whose elective laparoscopic cholecystectomy was planned in our hospital were included in our research. All patients were induced with 2 µg/kg of fentanyl, 2.5 mg/kg of propofol, 0.6 mg/kg of rocuronium for general anaesthesia. After intubation, 0.5-1.5% Isoflurane was given to group I, 1-4% sevoflurane to group II, and 2-6% desflurane to group III patients as inhaler agents.

Results: In patient groups for which demographic data do not have any statistically significant difference, monitoring with BIS reduces the amount of anaesthetic used in three groups and prevents intraoperative awareness. When compared between groups desflurane was the fastest recovered group with fastest rising BIS score due to the low blood/gas partition levels. However, contrary to our expectations, sevoflurane was not very different from Isoflurane. In addition, contrary to expected, the incidence of nausea after extubating was higher in this group. But at the end of the 1st hour, emetic symptoms were significantly higher in the sevoflurane group.

Conclusion: This study demonstrates that BIS monitoring allows for optimized anaesthetic depth control, resulting in faster recovery and fewer postoperative side effects. Among the agents compared, desflurane led to the fastest recovery, likely due to its low blood/gas partition coefficient. The findings support the use of BIS in laparoscopic procedures for improved recovery quality. Future research should explore cost-effectiveness and patient satisfaction metrics associated with BIS-guided anaesthesia.

Keywords: General anaesthesia, BIS monitoring, recovery

INTRODUCTION

Laparoscopic surgery was first performed by Philipe Mouret Farnat in 1988. Intraoperative and postoperative complication rate is less than open surgery. It also reduces the length of hospital stay and cost. Due to the benefits it provides, it has been used at increasingly widespread rates in the world in approximately fifteen years. In laparoscopic surgical

procedures, it is expected that the anaesthesia method to be chosen should provide the optimal depth of anaesthesia, few postoperative side effects and be cost effective. Anaesthetic agents with rapid onset of action, rapid recovery and short duration of action are preferred by anaesthetists in this type of surgery.

It is known that the depth of anaesthesia can be measured with EEG waves as a result of developing technologies.[1-3] In recent publications, it has been shown that the depth of anaesthesia can be measured by bispectral index (BIS) to titrate anaesthetic agents and reduce the amount of drugs used. By decreasing the amount of anaesthetic agents used, patients wake up faster and postoperative hospital stay is shortened. Side effects that may be caused by anaesthetic drugs can be observed less frequently since there is no need to use unnecessarily high doses of anaesthetic agents. The use of BIS is also one of the most important preoperative concerns of patients today.

Intraoperative wakefulness, which is one of the sources of anxiety, can be prevented. For this reason, BIS increases its preferability as it is an easy-to-use monitor that offers numerical evaluation.

Our aim in planning this study was to monitor laparoscopic cholecystectomy patients with BIS and to compare isoflurane, a medium-acting inhalation agent, with sevoflurane and desflurane, known to have a short duration of action, in terms of haemodynamic data, extubation, recovery, nausea-vomiting and side effects in the perioperative period and to compare which inhalation agent or agents provide more comfortable anaesthesia and anaesthetic costs.

METHODS

Ethics

The study was taken from the 2003 Faculty of Medicine Ankara University Specialization Thesis. Institutional approval was obtained. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patient Selection

105 patients in the ASA I-II risk group aged 18-60 years who were to undergo laparoscopic cholecystectomy in our hospital were included in our study. Exclusion criteria were as follows: -operation shorter than 20 min and longer than 150 min, -liver, kidney, endocrine dysfunction, -uncontrolled hypertension, -psychiatric disorder, -opioid hypersensitivity, -history of chronic opioid, benzodiazepine, clonidine use, and use up to 12 hours before surgery, -chronic alcohol and drug dependence, -pregnancy or breastfeeding at the time of operation. All patients were informed about the anaesthesia method to be applied before surgery and consent was obtained.

Method of Anaesthesia

Pethidine 25 mg+atropine 0.5 mg was administered intramuscularly to all patients half an hour before surgery for premedication. When the patients were taken to the operating room, a venous line was routinely opened with a 20G intravenous bag from the back of the hand 0.9% NaCl infusion was started. Standard monitoring included 3-channel ECG, noninvasive blood pressure measurement with systolic/diastolic/average pressures, peripheral blood oxygen saturation and BIS monitoring (Aspect A-2000 monitor and disposable BIS sensor). Patients were then randomly divided into 3 groups.

After the baseline monitor values of the patients were recorded, all patients were preoxygenated with 100% oxygen for 3 min. For induction of anaesthesia, fentanyl 2µg/kg and propofol 2.5 mg/kg were administered to all patients as standard, and neuromuscular block was achieved with rocuronium 0.6 mg/kg after verbal stimulus response and loss of eyelash reflex. After adequate depth of anaesthesia and neuromuscular block were achieved, tracheal intubation was performed and anaesthesia maintenance was started. Nitrogenprotoxide+oxygen mixture was routinely administered with a fresh gas flow of 4 L/min. Afterwards, maintenance anaesthesia was performed with isoflurane 0.5-1.5% in group I (group F), sevoflurane 1-4% in group II (group S), and desflurane 2-6% in group III (group D).

The precense of eyelash and corneal reflexes, the precense of pupillary light reflex, eyeball movement, at least a 25% increase in blood pressure and heart rate compared to the initial value in response to the initialing surgery, sweating, tear formation physical findings such as movement, swallowing, eye opening , grimacing in the patient and/or a BIS score of 60 or higher were considered as alertness in the patient.

In the presence of anaesthesia (value of 60 and above), anaesthetic gas concentration was increased, If these findings persisted despite the adjustment, a controlled bolus of remifentanil (1 µg/kg) was administered as a controlled bolus if there was no improvement in the findings despite the increase.

Inhaled anaesthetic agents were discontinued at the end of the operation and the patient was ventilated with 100% oxygen. Neostigmine 40 µg/kg and atropine 10 µg/kg were administered intravenously for neuromuscular block antagonisation. After spontaneous respiration was achieved (10/min and above), extubation was performed. Extubation time and spontaneous eye opening time were recorded. Diclofenac 75 mg intramuscularly for postoperative pain and metoclopramide 10 mg intravenously for nausea were administered before extubation. Postoperative nausea/vomiting times were recorded and ondansetron 4 mg intravenously was administered in the presence of persistent vomiting.

Data collection times were recorded at 5 min intervals preoperatively, at the end of induction, after intubation, after surgical incision, intraoperatively, after extubation, and at 5 min intervals in the first hour of the postoperative recovery period.

Recovery was evaluated with modified aldrete recovery score, steward recovery score, Abramowitz emesis score and BIS value.

Postoperative side effects; hypo/hypertension, bradycardia, nausea/vomiting, tremor, pruritus, urinary retention, muscle rigidity were recorded during recovery.

Statistical Analysis

The data were analysed using SPSS (SPSS for Windows 10.0 IL) for statistical analysis. One-way analysis of variance was used in the evaluation between groups and $p<0.05$ was considered statistically significant. The results obtained in this study are given as mean±standard deviation.

RESULTS

No difference was found between demographic data, anaesthesia and surgical times in the three groups of patients included in the study (Table 1).

When the blood pressures of the patients were compared, we observed that group D patients had higher blood pressures both intraoperatively and postoperatively compared to the other groups. Systolic blood pressures were statistically significantly higher than the other groups, especially at intraoperative 5th minute, 15th minute and extubation (Table 2, Figure 1). however, blood pressure elevation was at a level that did not require medical intervention.

When the heart rates of the patients were compared, was found that the heart rates were significantly higher in group F patients at 25 min intraoperatively (group F; 93.9±15.9, group S; 84.4±12.9, group D; 83.7±13.8) and lower in group D patients at 10 min postoperatively (group F; 99.9±19.9, group S; 101±10.7, group D; 81.4±10.9).

When we compared peripheral oxygen saturation in group F patients after extubation, postoperative 5. min, At 10 min, we observed that it was lower than the other two groups (Table 3, Figure 2).

When the BIS scores were compared between the groups, we observed that the BIS score was least affected by the surgical incision in group F (group F; 46.2±9.8, group S; 51.4±6.4, group D; 49.5±7.9), and the BIS value increased the most in group S patients at 0 min after incision (group F; 47.9±6.5, group S; 53.8±5.6, group D; 47.4±9.6). At 0. min, we found that the BIS value increased the most in group S patients (group F; 47.9±6.5, group S; 53.8±5.6, group D; 47.4±9.3). We found that the BIS score measured after extubation and at 5 and 10 minutes postoperatively was significantly higher in group D (Table 4).

When the three groups were compared in terms of spontaneous respiration onset time, we found that group D had a significantly shorter time than the other groups in terms of spontaneous respiration onset (group F; 7.3±3.9, group S; 4.4±1.6, group D; 2.05±1.6). When extubation times were compared, extubation time of group D was shorter than the other groups (group F; 13.1±3.2, group S; 6.2±2.5, group D; 4.3±2.7). When the response time to postoperative verbal stimuli was compared, we found that the duration was

Table 2. Systolic blood pressure changes

	Intraop 5th min	Extubation	Extubation 5th min	Extubation 15th min
Isoflurane	122	125	134	127
Sevoflurane	125	126	127	129
Desflurane	134	142	142	131

Min: Minute, Inraop: Intraoperative

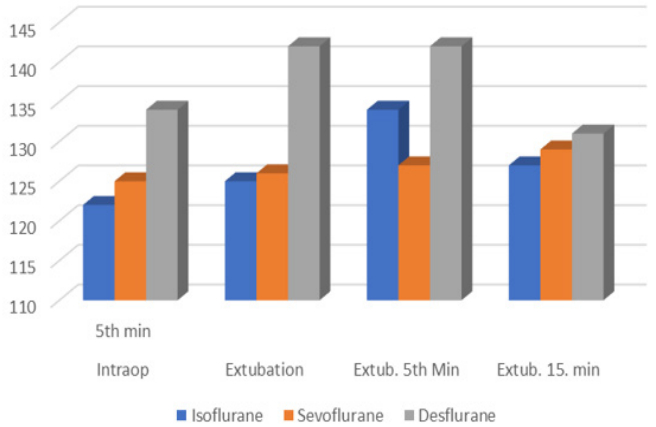

Figure 1. Systolic blood pressure changes between the three groups
(Pressure : mmHg/, time), Min: Minute, Inraop: Intraoperative, Extub: Extubation

Table 3. Evaluation of peripheral oxygen saturations in the first 15 min after extubation

	After extubation	Postop 5th min	Postop 15th min
Isoflurane	99.3	98.7	98.9
Sevoflurane	99.5	99.4	99.4
Desflurane	99.9	99.7	99.5

Min: Minute, Postop: Postoperative

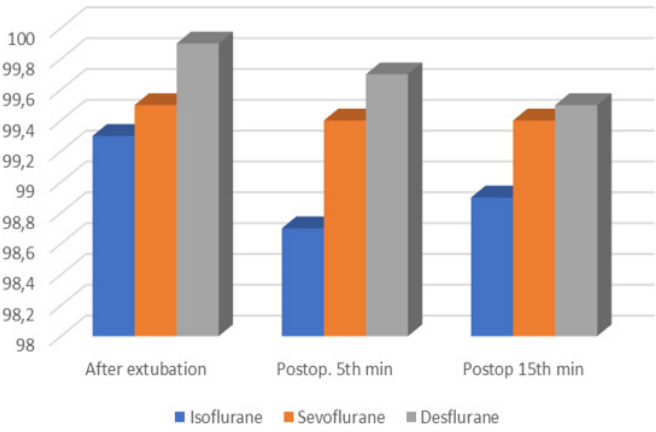

Figure 2. graComparison of peripheral oxygen saturations in the first 15 min after extubation
(Saturation %/, time), Min: Minute, Postop: Postoperative

Table 1. Demographic data

Inhaler agent used	Age (years)	Height (cm)	Weight (kg)	Surgical time	Duration of anaesthesia
Isoflurane	40.9±10.6	162.2±10.07	66.5±7.4	88±32.6	93.9±31.5
Sevoflurane	42.9±11.3	164.5±6.9	69.2±12.3	69.5±30.1	77.2±30.9
Desflurane	44.5±8.5	163.05±7.7	66.7±8.7	72.5±21.9	80.2±23.4

Table 4. Evaluation of significant differences in BIS value between groups

	Surgical incision	0 min incision	After extubation	Postop 5th min	Postop 15th min
Isoflurane	46.2±9.8	47.9±6.5	54.4±11.4	70±13.7	79.2±12.8
Sevoflurane	51.4±6.4	53.8±5.6	56.4±8.2	67.3±13.7	81±7.4
Desflurane	49.5±7.9	47.4±9.3	67.9±13.04	89.4±8.9	94.8±11.2

BIS: Bispectral index, Min: Minute, Postop: Postoperative

significantly shorter in group D (group F; 25.2±8.5, group S; 13.7±4.6, group D; 9.8±6.2) (Table 5).

Table 5. Comparison of waking times of the three groups

	Spontaneos breathing	Extub time	Verbal stimulus response	Continuous compilation
Isoflurane	7.3±3.9	13.1±3.2	21.1±7.6	25.2±8.5
Sevoflurane	4.4±1.6	6.2±2.5	10.4±3.62	13.7±4.6
Desflurane	2.05±1.6	4.3±2.7	7.05±5.1	9.8±6.2

When the recovery scores between the groups were evaluated, Steward and Modified Aldrete scores were significantly faster in group D, whereas no significant difference was observed between groups F and S. In the comparison of Abramowitz emesis scores, we found that this rate was higher in group D, and it was higher in the same group at the 12th hour (group F; 0±0, group S; 0.3±0.4, group D; 0.5±0.3). Postop 24 hours, we found that 6 patients in group F, 14 patients in group S and 9 patients in group D needed antiemetic.

Sympathetic response to intubation occurred only in two patients in group F and remifentanil requirement occurred in two patients in the same group. In the comparison of the side effects, the rate was significantly higher in group D after extubation and higher in group S at 60 min postoperatively (Table 6).

Table 6. Comparison of side effects

	After extub	Postop 5th min	Postop 15th min	Postop 30th min	Postop 60th min	Postop hour 2nd
Isoflurane	0	2	2	4	0	2
Sevoflurane	0	4	6	4	6	2
Desflurane	4	4	6	2	2	0

Min: Minute, Postop: Postoperative

DISCUSSION

Rapid recovery of patients from anaesthesia after surgical operations, rapid recovery of consciousness and full alertness are of great importance for the patient and anaesthetist as well as for the surgeon.[4] In order to evaluate these criteria and to optimise the depth of anaesthesia, BIS is an easy-to-use and understandable monitoring method.[5] The use of inhaler agents is reduced with balanced anaesthesia given by keeping the BIS score between 40-60.[6,7] In forms of anaesthesia using TIVA (total intravenous anaesthesia), it reduces propofol consumption and decreases the cost.[7,8] In our study, we found that adjusting the depth of anaesthesia with BIS monitoring was easy and comfortable.

No complete correlation has been observed between the BIS value measured during anaesthesia and the haemodynamic data of the patient.[9] While the BIS value indicates deep anaesthesia, blood pressure increase or heart rate increase may be observed. In a study by Hug et al,[9] a barbiturate-based anaesthesia induction was applied in patients, and while the BIS value indicated deep anaesthesia, elevated blood pressure was found in patients. The sympathetic response that occurs during the surgical procedure is related with the autonomic nervous system and is not reflected in the BIS score because the stimulus cannot reach the cortex during general anaesthesia.[11] During our study, intraoperative at 25 min, we found that the BIS score of the patients in group F was 47 and the heart rate was 93±9.8. We found that the patients in group D were more hypertensive in the intraoperative period compared to the other groups, although there was no awakening.

In our study, contrary to other studies, the incidence of nausea/vomiting was higher in group D than in group S after extubation. While these rates were equalised between the two groups at the 5th postoperative minute, we found that the incidence of nausea/vomiting was higher in group S in the following period in proportion to other studies.

Since group D patients had the lowest blood/gas partition coefficient in the recovery process, we found it to be faster. In group S, unlike other studies, we found it close to group F. However, peripheral oxygen saturation was lower in group F patients than in other groups. Burrow et al.[12] randomly divided a patient group of 345 patients into two groups, one group was monitored with BIS and given general anaesthesia and the other group was given standard anaesthesia. They found that patients monitored with BIS were more active and awake in the recovery process than the non-monitored group. In a similar study, Cooper and Epstain[13] again found that extubation was faster in patients monitored with BIS, but when they looked at recovery times, they did not find any difference from non-monitored patients. In our experience, considering our previous anaesthesia experiences, we observed that monitoring with BIS provided faster recovery. In a similar study, Bannister et al.[14] performed a BIS monitoring study in 202 paediatric patients. In pediatric patients, similar to adult patients, they observed faster recovery in children monitored with BIS. They also found that sevoflurane use decreased up to 25% in these patients.

In a study by Olofsen[15] in which isoflurane and sevoflurane were compared in terms of induction and extubation, no significant difference was found between these two inhaler agents and recovery times were similar. In our groups, although we observed shorter recovery times in the sevoflurane group, no significant difference was found in statistical analysis.

Again, the time for eye opening and verbal response after sevoflurane use was found to be 5±2 min in Tang's study,

8.4 min in Elbert's study, 7.5±0.5 min in Frink's study and 8 min in Cartillon's study.[16] In Palvin's[17] study, which was also performed for this purpose, this time was found to be 8.7±4 min. Galvin and Pavlin also found that the amount of agent used decreased with the use of BIS.[18] In our study, we found that the recovery time of patients in whom sevoflurane was used was 10.4±3.6 min, which was longer than in other studies. We think that the longer recovery time in our patients was related with the use of neuromuscular blockers in our study.

Xioguag conducted a study with sevoflurane and desflurane and found no difference between postoperative nausea/vomiting levels, and in the same study, the researchers also found no difference between postoperative side effects.[20] In the same study, the response time to verbal stimuli was significantly shorter in the desflurane group (8±2.7 min) than in the sevoflurane group (12.5±7.4). In contrast to Xioguag's findings, we found a higher rate of nausea/vomiting in our patients. Again, we found a higher rate in the desflurane group after extubation and in the sevoflurane group at 30 minutes postoperatively in our patient groups.

Röbke[20] tried to provide balanced anaesthesia in patients with BIS monitoring in the use of desflurane and found that desflurane use could be reduced in this way. In the same study, they found that none of the patients were awake in the postoperative investigation. Again in this study, they could not titrate a dose that provided complete EEG suppression with surgical stimulus.[21] Johansen[21] investigated the use of desflurane for the same purpose and found the same rate of decrease in the use of desflurane in Johansen in correlation with the other study. In the same study, the mean recovery time was found to be 10 minutes. In Song's study, the recovery time was found to be 13.4±4 min.[22] In our study, although we provided a deeper anaesthesia than Song's study, we found the recovery time to be 9.8 min.

In his study on intraoperative wakefulness, O'Connor[22] found 50% wakefulness rate in their study with BIS monitoring and based on this, they argued that it is not clear whether the BIS value is sufficient to measure the depth of anaesthesia. Again in this study, they argued that monitoring of each patient with BIS increased the cost. In the same direction, Mychaskiw[23] presented a 28-year-old coronary by-pass patient who was intraoperatively awake while BIS showed adequate depth of anaesthesia, and we did not find intraoperative awakening in any patient in our study. We were able to achieve optimal depth of anaesthesia in all patients, we also ensured rapid recovery and length of stay in the hospital, and we observed that postoperative anaesthesia-related side effects were less. We think that BIS monitoring plays an important role in increasing the comfort of anaesthesia in anaesthesiologist and patient, but we also think that it may bring extra burden in terms of cost due to the price of disposable sensors of the monitor.

CONCLUSION

In our patient groups in which demographic data did not show statistically significant differences, the use of BIS decreased the amount of inhaler agents used and prevented intraoperative awareness. In our opinion, BIS is a very suitable method for measuring the depth of anaesthesia. This study demonstrates that BIS monitoring allows for optimized anaesthetic depth control, resulting in faster recovery and fewer postoperative side effects. Among the agents compared, desflurane led to the fastest recovery, likely due to its low blood/gas partition coefficient. The findings support the use of BIS in laparoscopic procedures for improved recovery quality. Future research should explore cost-effectiveness and patient satisfaction metrics associated with BIS-guided anaesthesia.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was taken from the 2003 Faculty of Medicine Ankara University Specialization Thesis. Institutional approval was obtained.

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

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Relationship between burnout levels of doctors and healthcare members working in intensive care units and sociodemographic variables*

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ABSTRACT

Aims: Intensive care units differ from other hospital departments in many ways, and due to their specific characteristics, employees are exposed to numerous challenging factors. This increases their stress levels and leads to burnout. In this study, we aimed to identify the causes of burnout syndrome among intensive care doctors and healthcare professionals and to offer possible solutions.

Methods: This research was designed as a cross-sectional study. A total of 243 anesthesiology and reanimation intensive care unit workers, the majority of whom were physicians, were included. All participants were evaluated with a two-part questionnaire method including sociodemographic, occupational, behavioral characteristics and the Maslach Burnout Inventory (MBI).

Results: The study population consisted of 141 physicians, 70 nurses, and 32 support staff. It was observed that the participants' levels of burnout were influenced by various factors. According to the average scores on the MBI subscales, participants experienced moderate burnout in emotional exhaustion (17.77±6.49) and personal accomplishment (19.67±6.09), and low burnout in depersonalization (5.83±3.63).

Conclusion: The well-being of doctors and healthcare professionals can be improved by developing permanent strategies to prevent burnout, which is a manageable and avoidable syndrome. Preventing burnout not only enhances employee satisfaction but also helps improve the quality of healthcare services by enabling the effective and efficient use of human resources.

Keywords: Burnout syndrome, intensive care unit, healthcare, physicians, anesthesiology

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INTRODUCTION

Intensive care units (ICUs) differ from other hospital departments in many aspects. They are defined as care centers established to bring patients whose lives are under threat due to their pathologies back to a healthy life, providing uninterrupted service, having many life-saving technological tools and equipment, and where a multidisciplinary and team approach is mandatory.[1]

Considering factors such as the need for employees to have emergency response skills, complex and difficult patient care, the need to meet all the needs of patients, a closed and noisy work environment, and the expectations of patients' relatives, intensive care workers are faced with more stress. ICU workers, whose stress load increases, become physically and mentally worn out and experience burnout.

The most accepted definition of the concept of burnout is the one made by Christina Maslach. According to Maslach,[2] burnout is considered a frequently seen syndrome with three sub-dimensions in working individuals: emotional exhaustion, depersonalization, and low sense of personal accomplishment. Emotional exhaustion refers to the decrease in the emotional and physical resources of the individual. It is also defined as tiredness, exhaustion, and powerlessness. Depersonalization is evaluated as negative behaviors and attitudes such as detachment, indifference, and disinterest towards the work done or service recipients. A low sense of personal accomplishment is the perception of the person as inadequate and unsuccessful in his/her job.[3,4]

This study aims to determine the causes of burnout syndrome seen among intensive care doctors and healthcare professionals and to offer current solution suggestions.

METHODS

This cross-sectional study is based on a thesis conducted in 2017 with the approval of the Faculty of Medicine Ufuk University Non-interventional Clinical Researches Ethics Committee (Date: 26.05.2017, Decision No: 26052017-4). All participants were informed about the study and a consent form was obtained. All procedures were carried out in accordance with ethical rules and the principles of the Declaration of Helsinki.

A total of 255 ICU staff were contacted during the study, of whom twelve declined to participate for various reasons. Only staff working in anesthesiology and reanimation ICUs were included.

Data were collected using a questionnaire. To ensure participant confidentiality, no names were included on the data forms, and the collected data were not reviewed by anyone outside the research team. The data form consisted of two sections. The first section is designed to assess participants' sociodemographic, occupational, and behavioral characteristics. The second section of the form included the Maslach Burnout Inventory (MBI) to evaluate levels of burnout. The MBI consists of 22 Likert-type items with five response options and measures three subscales: emotional exhaustion, personal accomplishment, and depersonalization. Emotional exhaustion is measured with a total of 9 items. The score range is between 0-36. Desensitization is measured with a total of 5 items. The score range is between 0-20. Higher scores from these negatively worded items indicate greater emotional exhaustion and desensitization. The Sense of Personal Accomplishment is measured with a total of 8 items. The score range is between 0-32. The items contain positive expressions. Therefore, higher scores indicate greater personal accomplishment. We categorized the three sub-dimensions of the syndrome as low, medium and high. In the emotional exhaustion sub-dimension, scores between 0 and 16 were considered low, scores between 17 and 26 were considered medium and scores between 27 and 36 were considered high. In the depersonalization sub-dimension, scores between 0 and 6 were considered low, scores between 7 and 12 were considered medium and scores between 13 and 20 were considered high. The personal accomplishment sub-dimension was categorized as low between 0 and 10, medium between 11 and 21, and high between 22 and 32. Low scores in the personal accomplishment sub-dimension were considered high burnout.

Statistical Analysis

The data analyses were conducted using SPSS version 15.0 (Statistical Package for the Social Sciences). To assess the internal consistency of the MBI subscales, Cronbach's alpha coefficients were calculated. According to George and Mallery,[5] alpha values between 0.60 and 0.80 indicate acceptable reliability, while values between 0.80 and 1.00 indicate high reliability. The emotional exhaustion subscale (9 items) demonstrated high reliability (α=0.852), the personal accomplishment subscale (8 items) also showed high reliability (α=0.828), and the depersonalization subscale (5 items) exhibited acceptable reliability (α=0.673).

Descriptive statistics, including mean, standard deviation, median, minimum, and maximum values, were used for variables measured on a five-point Likert scale. For categorical variables, frequencies, valid percentages, and cumulative percentages were reported. The chi-square test was used to compare categorical variables, while relationships between MBI subscales were examined using Spearman correlation analysis. All statistical analyses were conducted at a 95% confidence level with a significance threshold set at $p<0.05$.

An a priori power analysis was performed using G*power version 3.1[6] to determine the minimum sample size required for chi-square tests of independence. The analysis assumed a small-to-medium effect size (Cohen's w=0.25), an alpha level of 0.05, and target power levels of 80% and 95%. The results indicated that a minimum of 152 participants would be required to achieve 80% power, and 247 participants for 95% power. With a total of 243 participants, the present study exceeded the requirement for 80% power and closely approached the 95% threshold, corresponding to an estimated achieved power of approximately 94.6%. This suggests that the sample size was adequate to detect meaningful associations and to minimize the risk of type II errors.

RESULTS

Of the 243 people who participated in the study, 141 were doctors, 70 were nurses, and 32 were support personnel. Frequencies and percentages regarding the sociodemographic, occupational, and behavioral characteristics of the participants are presented in detail in Table 1.

When the participants of the study were considered in general, it was understood that individuals experienced a moderate level of burnout according to the mean scores of emotional exhaustion (17.77±6.49) and personal accomplishment subscale (19.67±6.09), and that individuals experienced a low level of burnout when compared to the depersonalization subscale (5.83±3.63), as shown in Table 2.

When analyzed by professional groups, the findings in Table 3 revealed that participants experienced moderate levels of burnout based on the mean scores of the emotional exhaustion and personal accomplishment subscales, consistent with the overall trend. Physicians, in particular, demonstrated higher personal accomplishment scores compared to other professional groups. In contrast, all occupational categories exhibited low levels of burnout on the depersonalization subscale.

Table 1. Sociodemographic, occupational, and behavioral characteristics of intensive care unit professionals

Parameters	Doctor (n:141)		Support staff (n:32)		Nurse (n:70)		Total (n:243)	
	n	%	n	%	n	%	n	%
Gender								
Male	55	39.0	23	71.9	17	24.3	95	39.1
Female	86	61.0	9	28.1	53	75.7	148	60.9
Age (years)								
<35	41	29.1	20	62.5	65	92.9	126	51.9
≥35	100	70.9	12	37.5	5	7.1	117	48.1
Marital status								
With a partner	100	70.9	21	65.6	23	32.9	144	59.3
Not with a partner	41	29.1	11	34.4	47	67.1	99	40.7
Having children								
Yes	89	63.1	21	65.6	14	20.0	124	51.0
No	52	36.9	11	34.4	56	80.0	119	49.0
Home sharing								
Family/friends	116	82.3	32	100	54	77.1	202	83.1
Living alone	25	17.7	-	-	16	22.9	41	16.9
Educational status								
Undergraduate	-	-	-	-	27	38.6	27	11.1
Postgraduate	141	100		-	-	-	141	58.0
High School	-	-	32	100.0	43	61.4	75	30.9
Dependent family member								
Yes	21	14.9	4	12.5	5	7.1	30	12.3
No	120	85.1	28	87.5	65	92.9	213	87.7
Chronic disease								
Yes	44	31.2	2	6.3	6	8.6	52	21.4
No	97	68.8	30	93.8	64	91.4	191	78.6
Smoking								
Yes	39	27.7	26	81.3	52	74.3	117	48.1
No	102	72.3	6	18.8	18	25.7	126	51.9
Alcohol								
Yes	15	10.6	4	12.5	10	14.3	29	11.9
No	66	46.8	28	87.5	45	64.3	139	57.2
Social drinker	60	42.6	-	-	15	21.4	75	30.9
Career choice								
Deliberate	101	71.6	8	25.0	46	65.7	155	63.8
Random	17	12.1	14	43.8	10	14.3	41	16.9
Other reasons	23	16.3	10	31.3	14	20.0	47	19.3
Satisfaction with the current work unit								
Yes	67	47.5	23	71.9	56	80.0	146	60.1
No	16	11.3	7	21.9	9	12.9	32	13.2
Partially	58	41.1	2	6.3	5	7.1	65	26.7
Experience (total)								
≤ 5 years	34	24.1	23	71.9	49	70	106	43.6
> 5 years	107	75.9	9	28.1	21	30	137	56.4
Experience (in ICU)								
≤ 5 years	78	55.3	28	87.5	60	85.7	166	68.3
> 5 years	63	44.7	4	12.5	10	14.3	77	31.6
Number of working hours per week								
45 hours or less	28	19.9	1	3.1	5	7.1	34	14.0
More than 45 hours	113	80.1	31	96.9	65	92.9	209	86.0
Number of shifts per month								
5 or fewer	79	56.0	3	9.4%	17	24.3	99	40.7
More than 5	62	44.0	29	90.6	53	75.7	144	59.3
Post-shift rest								
Yes	52	36.9	30	93.8	50	71.4	132	54.3
No	89	63.1	2	6.3	20	28.6	111	45.7
Sleep pattern								
Regular	39	27.7	9	28.1	13	18.6	61	25.1
Irregular	102	72.3	23	71.9	57	81.4	182	74.9
Difficulty commuting to work								
Sometimes	42	29.8	5	15.6	12	17.1	59	24.3
Yes	14	9.9	13	40.6	14	20.0	41	16.9
No	85	60.3	14	43.8	44	62.9	143	58.8
Income sufficiency								
Yes	89	63.1	8	25.0	28	40.0	125	51.4
No	52	36.9	24	75.0	42	60.0	118	48.6
Secondary employment								
Yes	19	13.5	3	9.4	5	7.1	27	11.1
No	122	86.5	29	90.6	65	92.9	216	88.9
Hobby								
Yes	94	66.7	14	43.8	54	77.1	162	66.7
No	47	33.3	18	56.3	16	22.9	81	33.3
Taking annual leave all at once								
Yes	32	22.7	1	3.1	24	34.3	57	23.5
No	109	77.3	31	96.9	46	65.7	186	76.5
Regular annual vacation								
Yes	87	61.7	6	18.8	30	42.9	123	50.6
No	54	38.3	26	81.3	40	57.1	120	49.4
Perceived suitability of profession								
Yes	112	79.4	17	53.1	60	85.7	189	77.8
No	29	20.6	15	46.9	10	14.3	54	22.2
Problems with teammates								
Yes	40	28.4	5	15.6	21	30.0	66	27.2
No	101	71.6	27	84.4	49	70.0	177	72.8
Affected by patients' critical condition								
Yes	83	58.9	24	75.0	31	44.3	138	56.8
No	58	41.1	8	25.0	39	55.7	105	43.2
Problem with patients' relatives								
Yes	72	51.1	14	43.8	23	32.9	109	44.9
No	69	48.9	18	56.3	47	67.1	134	55.1
Affected by physical conditions of the work environment								
Yes	126	89.4	26	81.3	63	90.0	215	88.5
No	15	10.6	6	18.8	7	10.0	28	11.5

ICU: Intensive care unit

Table 2. Data of intensive care unit professionals regarding the scores they obtained from the MBI sub-dimensions

	Mean	SD	Median	Min	Max
Emotional exhaustion	17.77	6.49	17.00	0	36
Depersonalization	5.83	3.63	5.00	0	20
Personal accomplishment	19.67	6.09	20.00	0	32

MBI: Maslach Burnout Inventory, SD: Standard deviation, Min: Minimum, Max: Maximum

Table 3. Burnout subscale scores according to occupational groups

	Mean	SD	Median	Min	Max
Doctor					
Emotional exhaustion	18.12	7.34	18	0	36
Depersonalization	5.80	3.87	5	0	19
Personal accomplishment	21.03	5.99	21	6	32
Support staff					
Emotional exhaustion	18.00	3.57	18	8	26
Depersonalization	6.16	2.80	5	1	11
Personal accomplishment	18.00	4.57	19	8	25
Nurse					
Emotional exhaustion	16.97	5.66	17	2	33
Depersonalization	5.73	3.50	5	0	14
Personal accomplishment	17.71	6.23	17.5	5	31

SD: Standard deviation, Min: Minimum, Max: Maximum

As shown in Table 4, 20 participants (8.2%) scored high on the emotional exhaustion subscale, indicating high levels of burnout. Additionally, 10 participants (4.1%) demonstrated high burnout based on high scores in the depersonalization subscale, and 21 participants (8.6%) showed high burnout due to low scores on the personal accomplishment subscale.

Table 4. Categorization of participants based on their scores in the three subscales of the MBI

	Low		Medium		High		Total	
	n	%	n	%	n	%	n	%
Emotional exhaustion	103	49.4	120	49.4	20	8.2	243	100.0
Depersonalization	151	62.1	82	33.7	10	4.1	243	100.0
Personal accomplishment	21	8.6	124	51.0	98	40.3	243	100.0

MBI: Maslach Burnout Inventory

Table 5. Relationships between the subscales of the MBI according to occupational groups (Spearman correlation analysis)

		Emotional exhaustion	Depersonalization	Personal accomplishment
Total (n:243)				
Emotional exhaustion	p	1		
	r			
Depersonalization	p	0.603	1	
	r	<0.001		
Personal accomplishment	p	-0.376	-0.366	1
	r	<0.001	<0.001	
Doctor (n:141)				
Emotional exhaustion	p	1		
	r			
Depersonalization	p	0.634	1	
	r	<0.001		
Personal accomplishment	p	-0.417	-0.369	1
	r	<0.001	<0.001	
Support staff (n:32)				
Emotional exhaustion	p	1		
	r			
Depersonalization	p	0.400	1	
	r	0.023		
Personal accomplishment	p	-0.304	-0.061	1
	r	0.091	0.742	
Nurse (n:70)				
Emotional exhaustion	p	1		
	r			
Depersonalization	p	0.575	1	
	r	<0.001		
Personal accomplishment	p	-0.426	-0.481	1
	r	<0.001	<0.001	

MBI: Maslach Burnout Inventory

The relationship between the participants' MBI subdimensions, taking into account their occupational groups, is shown in Table 5 with the results of Spearman correlation analysis. A statistically significant positive linear correlation was found between emotional exhaustion and depersonalization subscales, while personal accomplishment was negatively correlated with both emotional exhaustion and depersonalization (p<0.001).

The data regarding the relationship between the subscales of the MBI and sociodemographic, occupational, and behavioral characteristics are presented in Table 6. Participants aged <35 years exhibited significantly higher levels of depersonalization (p=0.002) and reported lower levels of personal accomplishment (p<0.001) compared to those aged >35 years. Having children was associated with significantly greater personal accomplishment (p<0.001). Marital status and living arrangements were also influential: being in a relationship (p=0.008) and cohabitating (p=0.025) were both associated with higher levels of personal accomplishment. Educational status was significantly related to emotional exhaustion (p=0.017) and personal accomplishment (p=0.002). Participants with only a high school education were less likely to report high personal accomplishment. The presence of a chronic disease was significantly related to increased depersonalization (p=0.001), although no significant differences were observed in the other subdimensions. In terms of occupational factors, satisfaction with the current work unit was significantly associated with all three subdimensions of burnout (p<0.001). Participants who reported having made their career choice willingly exhibited lower emotional exhaustion (p=0.023) and higher personal accomplishment (p=0.048). Having fewer monthly shifts (≤5) was linked to lower emotional exhaustion (p=0.008) and greater personal accomplishment (p=0.002). Additionally, shorter total work experience (≤5 years) was significantly associated with lower personal accomplishment (p=0.001), as was shorter ICU experience (p=0.048). Those who did not perceive their profession as suitable had significantly higher levels of depersonalization (p=0.002) and lower personal accomplishment (p<0.001). Moreover, income insufficiency was associated with higher emotional exhaustion (p=0.001). Behavioral and lifestyle characteristics also demonstrated notable associations. Participants with regular sleep patterns reported significantly lower emotional exhaustion (p<0.001) and higher personal accomplishment (p<0.001). Smoking was significantly related to lower personal accomplishment (p<0.001). Similarly, having a

hobby was associated with reduced emotional exhaustion (p=0.001) and enhanced personal accomplishment (p=0.002). Furthermore, not taking regular vacations was linked to lower personal accomplishment (p=0.015). Experiencing problems with patients' relatives was associated with higher emotional exhaustion (p=0.015), increased depersonalization (p<0.001), and decreased personal accomplishment (p=0.014). Being affected by the physical working environment was significantly related to lower personal accomplishment (p=0.022), while being emotionally impacted by patients' clinical conditions was associated with higher emotional exhaustion (p=0.042).

DISCUSSION

The results of our study examining the burnout levels and influencing factors of doctors, nurses, and support staff working in the ICU reveal that the participants experienced moderate levels of burnout in the emotional exhaustion and personal accomplishment sub-dimensions and low levels of burnout in the depersonalization sub-dimension.

We examined many factors that we thought could be related to burnout syndrome. When examining the relationship between burnout syndrome and gender, there are variable

Table 6. Relationship between MBI sub-dimensions and sociodemographic, occupational and behavioral characteristics

	Emotional exhaustion						Depersonalization						Personal accomplishment					
	Low		Medium		High		Low		Medium		High		Low		Medium		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gender																		
Male	44	46.3	42	44.2	9	9.5	57	60.0	34	35.8	4	4.2	9	9.5	48	50.5	38	40.0
Female	59	39.9	78	52.7	11	7.4	94	63.5	48	32.4	6	4.1	12	8.1	76	51.4	60	40.5
X^2	1.706						0.312						0.137					
p value	0.426						0.856						0.934					
Age																		
<35	47	37.3	71	56.3	8	6.3	65	51.6	55	43.7	6	4.8	18	14.3	72	57.1	36	28.6
≥35	56	47.9	49	41.9	12	10.3	86	73.5	27	23.1	4	3.4	3	2.6	52	44.4	62	53.0
X^2	5.294						12.565						20.533					
p value	0.071						0.002						<0.001					
Partner																		
Yes	52	38.2	71	52.2	13	9.6	86	63.2	45	33.1	5	3.7	8	5.9	62	45.6	66	48.5
No	51	47.7	49	45.8	7	6.5	65	60.7	37	34.6	5	4.7	13	12.1	62	57.9	32	29.9
X^2	2.417						0.244						9.663					
p value	0.299						0.885						0.008					
Children																		
Yes	54	43.5	60	48.4	10	8.1	82	66.1	38	30.6	4	3.2	5	4.0	54	43.5	65	52.4
No	49	41.2	60	50.4	10	8.4	69	58.0	44	37.0	6	5.0	16	13.4	70	58.8	33	27.7
X^2	0.140						1.856						18.180					
p value	0.932						0.395						<0.001					
Home sharing																		
Yes	73	40.1	94	51.6	15	8.2	115	63.2	60	33.0	7	3.8	13	7.1	87	47.8	82	45.1
No	30	49.2	26	42.6	5	8.2	36	59.0	22	36.1	3	4.9	8	13.1	37	60.7	16	26.2
X^2	1.641						0.385						7.379					
p value	0.440						0.825						0.025					
Education																		
Ug	9	33.3	16	59.3	2	7.4	18	66.7	7	25.9	2	7.4	2	7.4	18	66.7	7	25.9
Pgd	60	42.6	63	44.7	18	12.8	89	63.1	44	31.2	8	5.7	7	5.0	64	45.4	70	49.6
High school	34	45.3	41	54.7	-	-	44	58.7	31	41.3	-	-	12	16.0	42	56.0	21	28.0
X^2	11.984						6.925						16.739					
p value	0.017						0.140						0.002					
Dependent family member																		
Yes	15	50.0	14	46.7	1	3.3	17	56.7	13	43.3	-	-	2	6.7	19	63.3	9	30.0
No	88	41.3	106	49.8	19	8.9	134	62.9	69	32.4	10	4.7	19	8.9	105	49.3	89	41.8
X^2	1.516						2.506						2.075					
p value	0.469						0.286						0.354					

Table continues

Table 6. Relationship between MBI sub-dimensions and sociodemographic, occupational and behavioral characteristics (Table continues)

C. disease																		
Yes	17	32.7	29	55.8	6	11.5	31	59.6	14	26.9	7	13.5	4	7.7	25	48.1	23	44.2
No	86	45.0	91	47.6	14	7.3	120	62.8	68	35.6	3	1.6	17	8.9	99	51.8	75	39.3
X^2			2.893					15.023						0.432				
p value			0.235					0.001						0.806				
Smoking																		
Yes	43	36.8	66	56.4	8	6.8	68	58.1	45	38.5	4	3.4	17	14.5	70	59.8	30	25.6
No	60	47.6	54	42.9	12	9.5	83	65.9	37	29.4	6	4.8	4	3.2	54	42.9	68	54.0
X^2			4.479					2.340						24.547				
p value			0.107					0.310						<0.001				
Alcohol																		
Yes	10	34.5	13	44.8	6	20.7	15	51.7	10	34.5	4	13.8	6	20.7	15	51.7	8	27.6
No	58	41.7	74	53.2	7	5.0	88	63.3	48	34.5	3	2.2	10	7.2	73	52.5	56	40.3
Social drinker	35	46.7	33	44.0	7	9.3	48	64.0	24	32.0	3	4.0	5	6.7	36	48.0	34	45.3
X^2			9.050					8.573						7.378				
p value			0.060					0.073						0.117				
Career choice																		
Deliberate	78	50.3	65	41.9	12	7.7	103	66.5	46	29.7	6	3.9	8	5.2	80	51.6	67	43.2
Random	12	29.3	25	61.0	4	9.8	21	51.2	18	43.9	2	4.9	4	9.8	21	51.2	16	39.0
Other reasons	13	27.7	30	63.8	4	8.5	27	57.4	18	38.3	2	4.3	9	19.1	23	48.9	15	31.9
X^2			11.381					3.802						9.452				
p value			0.023					0.433						0.048				
Unit satisfaction																		
Yes	80	54.8	61	41.8	5	3.4	108	74.0	35	24.0	3	2.1	5	3.4	71	48.6	70	47.9
No	3	9.4	20	62.5	9	28.1	10	31.3	19	59.4	3	9.4	8	25.0	20	62.5	4	12.5
Partially	20	30.8	39	60.0	6	9.2	33	50.8	28	43.1	4	6.2	8	12.3	33	50.8	24	36.9
X^2			39.471					25.908						24.940				
p value			<0.001					<0.001						<0.001				
Exp. (total)																		
≤5 years	42	39.6	59	55.7	5	4.7	60	56.6	43	40.6	3	2.8	15	14.2	61	57.5	30	28.3
>5 years	61	44.5	61	44.5	15	10.9	91	66.4	39	28.5	7	5.1	6	4.4	63	46.0	68	49.6
X^2			4.659					4.274						14.912				
p value			0.097					0.118						0.001				
Exp. (ICU)																		
≤5 years	68	41.0	87	52.4	11	6.6	102	61.4	59	35.5	5	3.0	19	11.4	85	51.2	62	37.3
>5 years	35	45.5	33	42.9	9	11.7	49	63.6	23	29.9	5	6.5	2	2.6	39	50.6	36	46.8
X^2			2.860					2.091						5.922				
p value			0.239					0.351						0.048				
Work hrs/week																		
≤45 hours	18	52.9	13	38.2	3	8.8	22	64.7	9	26.5	3	8.8	2	5.9	16	47.1	16	47.1
>45 hours	85	40.7	107	51.2	17	8.1	129	61.7	73	34.9	7	3.3	19	9.1	108	51.7	82	39.2
X^2			2.051					2.791						0.914				
p value			0.359					0.248						0.633				
Monthly shifts																		
≤5	52	52.5	37	37.4	10	10.1	66	66.7	29	29.3	4	4.0	4	4.0	43	43.4	52	52.5
>5	51	35.4	83	57.6	10	6.9	85	59.0	53	36.8	6	4.2	17	11.8	81	56.3	46	31.9
X^2			9.640					1.534						12.143				
p value			0.008					0.464						0.002				
P. shift rest																		
Yes	50	37.9	74	56.1	8	6.1	76	57.6	51	38.6	5	3.8	14	10.6	69	52.3	49	37.1
No	53	47.7	46	41.4	12	10.8	75	67.6	31	27.9	5	4.5	7	6.3	55	49.5	49	44.1
X^2			5.648					3.093						2.115				
p value			0.059					0.213						0.347				
Sleeping																		
Regular	43	70.5	17	27.9	1	1.6	45	73.8	14	23.0	2	3.3	1	1.6	22	36.1	38	62.3
Irregular	60	33.0	103	56.6	19	10.4	106	58.2	68	37.4	8	4.4	20	11.0	102	56.0	60	33.0
X^2			27.110					4.724						17.939				

Table continues

Table 6. Relationship between MBI sub-dimensions and sociodemographic, occupational and behavioral characteristics (Table continues)

p value			<0.001						0.094						<0.001			
Commute difficulty																		
Sometimes	18	30.5	35	59.3	6	10.2	44	74.6	11	18.6	4	6.8	4	6.8	27	45.8	28	47.5
Yes	16	39.0	22	53.7	3	7.3	24	58.5	16	39.0	1	2.4	4	9.8	25	61.0	12	29.3
No	69	48.3	63	44.1	11	7.7	83	58.0	55	38.5	5	3.5	13	9.1	72	50.3	58	40.6
X^2			5.749						8.640						3.447			
p value			0.219						0.071						0.486			
In. sufficiency																		
Yes	67	53.6	49	39.2	9	7.2	82	65.6	39	31.2	4	3.2	8	6.4	62	49.6	55	44.0
No	36	30.5	71	60.2	11	9.3	69	58.5	43	36.4	6	5.1	13	11.0	62	52.5	43	36.4
X^2			13.373						1.514						2.460			
p value			0.001						0.469						0.292			
Second job																		
Yes	13	48.1	12	44.4	2	7.4	15	55.6	9	33.3	3	11.1	2	7.4	12	44.4	13	48.1
No	90	41.7	108	50.0	18	8.3	136	63.0	73	33.8	7	3.2	19	8.8	112	51.9	85	39.4
X^2			0.413						3.826						0.772			
p value			0.813						0.148						0.680			
Hobby																		
Yes	81	50.0	72	44.4	9	5.6	105	64.8	51	31.5	6	3.7	13	8.0	71	43.8	78	48.1
No	22	27.2	48	59.3	11	13.6	46	56.8	31	38.3	4	4.9	8	9.9	53	65.4	20	24.7
X^2			13.271						1.497						12.521			
p value			0.001						0.473						0.002			
All-at-once leave																		
Yes	32	56.1	21	36.8	4	7.0	40	70.2	17	29.8	-	-	7	12.3	28	49.1	22	38.6
No	71	38.2	99	53.2	16	8.6	111	59.7	65	34.9	10	5.4	14	7.5	96	51.6	76	40.9
X^2			5.828						4.177						1.249			
p value			0.054						0.124						0.535			
Reg. vacation																		
Yes	60	48.8	55	44.7	8	6.5	79	64.2	39	31.7	5	4.1	7	5.7	56	45.5	60	48.8
No	43	35.8	65	54.2	12	10.0	72	60.0	43	35.8	5	4.2	14	11.7	68	56.7	38	31.7
X^2			4.403						0.483						8.398			
p value			0.111						0.786						0.015			
Prof. suitability																		
Yes	96	50.8	82	43.4	11	5.8	124	65.6	59	31.2	6	3.2	12	6.3	91	48.1	86	45.5
No	7	13.0	38	70.4	9	16.7	27	50.0	23	42.6	4	7.4	9	16.7	33	61.1	12	22.2
X^2			5.086						12.201						24.320			
p value			0.079						0.002						<0.001			
Teammate problems																		
Yes	23	34.3	36	53.7	8	11.9	31	46.3	31	46.3	5	7.5	8	11.9	38	56.7	21	31.3
No	80	45.5	84	47.7	12	6.8	120	68.2	51	29.0	5	2.8	13	7.4	86	48.9	77	43.8
X^2			3.318						10.568						3.603			
p value			0.190						0.055						0.165			
Aff. of pt. cond.																		
Yes	50	36.2	73	52.9	15	10.9	82	59.4	50	36.2	6	4.3	8	5.8	73	52.9	57	41.3
No	53	50.5	47	44.8	5	4.8	69	65.7	32	30.5	4	3.8	13	12.4	51	48.6	41	39.0
X^2			6.356						1.008						3.285			
p value			0.042						0.604						0.193			
Prob. w/ pt. relatives																		
Yes	41	37.6	53	48.6	15	13.8	56	51.4	43	39.4	10	9.2	12	11.0	64	58.7	33	30.3
No	62	46.3	67	50.0	5	3.7	95	70.9	39	29.1	-	-	9	6.7	60	44.8	65	48.5
X^2			8.432						17.885						8.525			
p value			0.015						<0.001						0.014			
Aff. by phy. cond. work																		
Yes	86	40.0	109	50.7	20	9.3	132	61.4	73	34.0	10	4.7	20	9.3	115	53.5	80	37.2
No	17	60.7	11	39.3	-	-	19	67.9	9	32.1	-	-	1	3.6	9	32.1	18	64.3
X^2			5.766						1.493						7.657			
p value			0.056						0.474						0.022			

Ug: Undergraduate, Pgd: Postgraduate. C.disease: Chronic disease, Exp: Experience, ICU: Intensive care unit, Hrs: Hours, P.shift: Post shift, In.sufficiency: Income sufficiency, All-at-once leave: Taking annual leave all at once, Reg. vacation: Regular vacation, Prof. suitability: Perceived suitability of profession, Aff. of pt. cond: Affected by patients' critical condition, Prob. w/ Pt. relatives: Problem with patients relatives, Aff. by phy. cond. Work: Affected by physical conditions of the work environment

statements in the literature. While Soler et al.[7] found that burnout is more common among men in their study, there are studies [8,9] reporting that women experience more burnout than men.

In our study, no significant relationship was found between burnout subdimensions and gender. There are many articles from which we can conclude that, in general, younger people are more prone to burnout.[10-12] In our study, it is seen that there is more burnout in the depersonalization and personal accomplishment subscales under the age of 35. The reasons for this situation can be listed as young people's inability to cope with work stress, being under more workload, and the extra pressure on them due to lack of experience.

Living alone has many negative effects, both psychologically and physically. While the risk of depression increases in those living alone, cardiovascular disease and gastrointestinal problems can also be seen.[13] Although being married or having a partner brings extra responsibilities, it protects a person from loneliness and social isolation, and they can cope with work stress with the support they receive from their spouse during difficult times. Similarly, although having a child is stressful, it can be said that the important role of the parent in the family protects against burnout.[14] Like our study, Yao et al.[15] found in a study among doctors that married people are less prone to burnout, while Woodside et al.[16] revealed that those who have children experience lower levels of burnout in the burnout sub-dimensions.

There is no clear relationship between education level and burnout levels. Contrary to studies indicating that higher levels of burnout occur as the level of education increases, there are also studies reporting higher levels of burnout at lower levels of education.[17] Our study also found that higher levels of emotional exhaustion occur at higher levels of education, while burnout occurs in the personal accomplishment sub-dimension at lower levels of education.

The presence of physical or mental illnesses and poor health in general can be considered among the causes of burnout. While a study including 2075 Canadian workers found a relationship between the presence of chronic illness and emotional exhaustion, our study found that intensive care workers with chronic illnesses experienced more burnout in the depersonalization sub-dimension.[18] A comprehensive systematic review analyzing various factors associated with parental burnout found that having dependents—particularly children with special needs—significantly increases the risk of burnout.[19] The persistent experience of such adverse conditions in an individual's life may generate significant psychological stress and, over time, jeopardize their emotional resilience. Chronic stress of this nature can also contribute to the development of long-term affective disorders. In our study, although the presence of dependents—an element potentially contributing to burnout—was examined as a possible variable, we did not observe a statistically significant association with burnout levels. This finding may reflect the complexity and multifactorial nature of burnout, suggesting that additional mediating variables, such as the intensity of caregiving responsibilities, perceived social support, or coping mechanisms, may play a more critical role in shaping burnout outcomes.

When we examine the literature, there is growing evidence that both smoking and alcohol consumption are associated with an increased risk of burnout. A study conducted among healthcare professionals in Ethiopia[20] reported that individuals with alcohol dependence had more than six times higher odds of experiencing burnout compared to those without dependence. Similarly, a cross-sectional study among medical students in Serbia demonstrated that those who consumed alcohol one to two times per week had a significantly higher risk of burnout. The same study also found a significant association between smoking and increased levels of burnout, suggesting that substance use may be a maladaptive coping mechanism in response to academic or occupational stress.[21] In our study, we observed a statistically significant relationship between smoking and burnout, particularly in the personal accomplishment sub-dimension. This finding supports the view that individuals may resort to smoking as a way to manage stress in demanding work environments; however, this behavior may paradoxically be linked to a diminished sense of professional achievement. On the other hand, despite the associations reported in the literature, we did not identify a statistically significant relationship between alcohol consumption and burnout levels in our study. This discrepancy may be attributed to factors such as underreporting due to social desirability bias, cultural stigmatization of alcohol use, or the relatively low frequency and quantity of alcohol consumption among participants.

Career choice can be identified as a critical determinant of long-term professional satisfaction and psychological well-being. Existing evidence suggests that individuals who do not choose their profession autonomously or who later experience regret regarding their career decisions are more vulnerable to burnout. Tian et al.[22] found a significant association between career choice regret and increased levels of burnout among Chinese neurology postgraduates, indicating that a lack of alignment between personal values and professional demands may exacerbate emotional exhaustion and reduce perceived accomplishment. Similarly, Lu et al.[23] in a study of emergency medicine residents in the United States, reported that career choice regret was strongly linked to higher rates of burnout, particularly in environments where workplace mistreatment and systemic stressors were prevalent. These findings suggest that the psychological impact of pursuing a career misaligned with one's intrinsic interests or expectations can accumulate over time, leading to disengagement and emotional fatigue. Consistent with these observations, our study demonstrated that participants who reported not having voluntarily chosen their profession experienced significantly greater burnout, specifically in the sub-dimensions of emotional exhaustion and reduced personal accomplishment. This supports the idea that not having a say in one's career choice can reduce job satisfaction and increase the risk of burnout.

Satisfaction with the current work environment may be shown to be a protective factor against burnout. Studies have shown that perceived organizational support, effective teamwork, and high-quality leadership within one's work unit significantly affect levels of emotional exhaustion, depersonalization, and personal accomplishment.[24] Our finding that satisfaction with the current work unit was significantly associated with all three subscales of burnout

is consistent with this evidence. It suggests that a supportive and functional unit structure may buffer the psychological demands of high-stress clinical environments and promote greater professional engagement and well-being.

It is challenging to draw a definitive conclusion regarding the relationship between the length of professional experience and burnout. On the one hand, individuals with shorter durations of service may be more susceptible to burnout due to limited experience in managing complex clinical situations, lack of professional autonomy, and insufficient acquisition of status-related rewards that contribute to job satisfaction. On the other hand, while longer professional tenure may be associated with greater clinical maturity and coping capacity, it has also been suggested that prolonged exposure to high-intensity work environments may lead to increased emotional detachment and burnout over time.[3,25] In our study, we found that intensive care workers with five years or less of professional experience reported significantly higher levels of burnout in the personal accomplishment sub-dimension, which may reflect the challenges faced by less experienced staff in developing a sense of efficacy and fulfillment in high-demand settings.

Lower monthly shift frequency (≤5) was significantly associated with decreased emotional exhaustion and increased personal accomplishment in our study. This finding aligns with previous research highlighting the detrimental impact of excessive workload and prolonged work hours on burnout, particularly in high-intensity clinical settings such as ICUs.[1,2] It has been well-documented that frequent night or weekend shifts may disrupt circadian rhythms and reduce opportunities for recovery, thereby increasing vulnerability to emotional fatigue and professional inefficacy.[26,27] Similarly, cross-sectional studies[3,25] conducted among ICU professionals have consistently identified high shift burden as a major risk factor for burnout. Our findings support the notion that reducing shift load may serve as an effective institutional strategy to mitigate burnout risk and promote a healthier, more sustainable work environment for critical care staff.

Sleep disturbances have been identified in the literature as both a potential antecedent and consequence of burnout syndrome. A recent study demonstrated a significant association between poor sleep quality and increased levels of burnout, highlighting the bidirectional nature of this relationship.[28] In line with this finding, our study revealed that intensive care workers who reported insufficient and poor-quality sleep exhibited significantly higher levels of burnout in the personal accomplishment subdimension. This observation supports the hypothesis that inadequate restorative sleep may impair emotional regulation and diminish an individual's sense of professional efficacy, thereby exacerbating vulnerability to burnout, particularly in high-demand healthcare environments.

In our study, income insufficiency was associated with increased emotional exhaustion, while the absence of regular vacations and lack of engagement in hobbies were linked to lower levels of personal accomplishment. These findings align with previous research emphasizing that financial insecurity, inadequate recovery time, and the absence of fulfilling non-work activities contribute significantly to burnout.[2,29] Among intensive care professionals, the opportunity to take regular vacations has been shown to support both physical and emotional restoration, thereby reducing burnout risk.[25] Furthermore, participants who perceived a poor fit between themselves and their profession reported greater depersonalization and diminished personal accomplishment, echoing earlier studies that identified perceived professional suitability as a key protective factor against burnout.[8,17] These results underscore the importance of addressing both organizational and individual-level determinants when developing strategies to mitigate burnout in high-intensity clinical environments.

In our study, several psychosocial and environmental stressors were found to be significantly associated with burnout among intensive care professionals. Experiencing difficulties with patients' relatives was associated with increased emotional exhaustion, higher depersonalization, and reduced personal accomplishment, while being emotionally affected by patients' poor clinical conditions was also linked to higher emotional exhaustion. Additionally, perceived adverse physical working conditions were related to lower personal accomplishment. These findings are in line with previous studies indicating that frequent exposure to suffering and end-of-life care in ICUs can intensify emotional fatigue and moral distress.[26,27] Moreover, consistent with the literature, our results demonstrated that interpersonal conflicts, particularly those involving coworkers, were associated with greater burnout in the domains of depersonalization and diminished personal accomplishment, underscoring the importance of cohesive team dynamics and supportive work culture.[2,3] These results highlight the multifactorial nature of burnout in critical care settings and emphasize the need for both structural improvements in work environments and the promotion of interpersonal support systems among healthcare teams.

Limitations

This study has some limitations. Being cross-sectional in nature, it only reflects associations at a specific point in time and does not allow for causal interpretations. The use of self-reported questionnaires may have introduced recall or social desirability bias. The sample was limited to third-level anesthesiology and reanimation ICUs, which may restrict the generalizability of the findings to other departments or healthcare settings. In addition, the burnout assessment was based on a validated scale but not on clinical diagnosis. Future research with longitudinal designs, broader ICU populations, and objective clinical evaluations would help to better understand the causes and consequences of burnout.

CONCLUSION

Burnout is a syndrome that is frequently seen in occupational groups that interact with people one on one, but can actually be prevented. Due to the specific characteristics of ICU, employees may encounter this syndrome.

The level of well-being of doctors and healthcare professionals can be increased by determining and analyzing the factors related to the level of burnout, which is affected by many

factors, and by developing permanent solution strategies for the problems. While employee satisfaction can be ensured by preventing burnout, it is also possible to increase the quality of the service provided by using human resources efficiently and effectively.

ETHICAL DECLARATIONS

Ethics Committee Approval

This cross-sectional study is based on a thesis conducted in 2017 with the approval of the Faculty of Medicine Ufuk University Non-interventional Clinical Researches Ethics Committee (Date: 26.05.2017, Decision No: 26052017-4).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

Retrospective evaluation of patient-controlled analgesia (PCA) practices in a tertiary hospital

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ABSTRACT

Aims: This study aimed to evaluate the patient-controlled analgesia (PCA) methods applied in a tertiary health care institution, the profiles of the practitioners and the patients involved, and the factors affecting the application process.

Methods: The data of the patients who were administered PCA in 2023 and 2024 were analyzed retrospectively. The demographic information of the patients, the types of PCA applications, in which clinics they started and for what purpose, who started the treatment, complications, reasons for termination, and duration of use were evaluated.

Results: 52.5% of the 1.040 patients included in the analysis were female, with a mean age of 55.7±17.75 years. The most common PCA method was epidural (53.7%), and the clinic where it was applied the most frequently was the orthopedics clinic. The complication rate was low, and the most common complication was found to be nausea-vomiting. The duration of PCA use showed a significant difference according to the type of application, and the longest duration was observed in peripheral nerve (PN) catheter PCA ($p<0.001$). Epidural PCAs were mostly initiated by resident physicians, while PCAs applied with PN catheters were initiated by academic staff.

Conclusion: PCA is an effective and safe method in postoperative pain management. These retrospective findings provide important contributions to the evaluation and standardization of existing protocols.

Keywords: Patient-controlled analgesia, pain management, clinical supervision

INTRODUCTION

Pain is a health problem that is felt in any part of the body, affects the quality of life of the individual, and is affected by many factors.[1] Especially inadequate postoperative pain treatment leads to a decrease in patient satisfaction in the early period, prolongs the healing process, and increases the length of hospital stay, as well as increasing the risk of developing chronic pain in the long term.[2,3]

Patient-controlled analgesia (PCA) is used to treat acute, chronic, postoperative, and labor pain. PCA is an effective and widespread pain management method that was defined as a concept in 1965 and entered clinical practice in 1982.[4,5] PCA patients are provided with the opportunity to use the drugs prescribed by their doctor within safe limits according to the severity of the pain they feel.[6] Studies have shown that PCA is associated with high patient satisfaction as well as early mobilization, reduced side effects due to opioid use, and reduced length of hospital stay due to effective analgesia.[4,7]

It can be administered in many ways, most commonly by intravenous (IV) and epidural catheters placed around the subcutaneous, intramuscular, rectal, oral, and peripheral nerves (PN). In fact, noninvasive PCA models such as the transdermal system and the sublingual tablet system have been developed recently.[8,9]

With this research, we aimed to define the PCA application habits and patient profile in the anesthesia clinic of a tertiary hospital. In addition, we sought an answer to the question of how we can increase the effectiveness of future

PCA applications by determining the factors affecting the initiation and termination of PCAs.

METHODS

The study was conducted with the permission of the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 08.04.2025, Decision No: 2025-220). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patients who were administered PCA in the Anesthesiology and Reanimation Clinic in the Gülhane Training and Research Hospital in 2023 and 2024 were retrospectively examined after the approval of the local ethics committee. The data were obtained from the hospital registration system and PCA follow-up books kept by our clinic. The age and gender of the patients, American Society of Anesthesiologists (ASA) scores, types of surgery and clinics performed, PCA administration route, whether there is non-protocol drug use in PCA, the status of the doctor who initiated the application, the presence of complications during the application, and, if any, the duration of use and the reasons for PCA termination were recorded. Patients with incomplete data were excluded from the study.

In our clinic, three main types of PCA with predetermined protocols are used. Patients who are administered PCA are followed up by the pain team, and the patient's name, surname, clinic name, type of surgery, type of PCA administered, starting and ending times, starting doctor's ID, whether there are complications, and the reasons for termination are recorded in the pain book. Our pain team in our hospital consists of an anesthesiologist experienced in pain, a lecturer, an anesthesia resident physician, and an anesthesia technician. IV PCA is used at a contramal 5 mg/ml concentration, a 5 mg/ml infusion dose, a 20 mg bolus dose, a 30-minute lockout period, and a four-hour limit of 60 mg. In the epidural PCA protocol, bupivacaine at a concentration of 0.125% is administered at a 4 ml infusion dose, a 5 ml bolus dose, a 30-minute lockout period, and a four-hour limit of 30 ml. In the PCA protocol performed with a PN catheter, Bupivacaine at a concentration of 0.125% is administered at a 4 ml infusion dose and a four-hour limit of 20 ml, without a bolus dose and lockout period.

Statistical Analysis

Descriptive statistics for continuous variables were presented as mean, standard deviation, median, minimum, and maximum values, while numbers and percentages were used for discrete data. The Shapiro-Wilk test was used to examine the conformity of continuous data to normal distribution.

Chi-square test was used for group comparisons of nominal variables (cross-tables). The Kruskal-Wallis variance analysis was employed to compare drug use durations in PCA types. The Kruskal-Wallis multiple comparison test was used to determine which groups caused the difference.

IBM SPSS version 20 (Chicago, IL, USA) program was used in the evaluations, and $p<0.05$ was accepted as a statistical significance value.

RESULTS

A total of 1.084 patients were administered PCA between 2023 and 2024, and the data of 48 patients were not included in the evaluation because they were incomplete. 52.5% of the patients were female, 47.5% were male, and the ASA score of 54.3% was recorded as "3". The mean age was calculated as 55.70±17.75 years; the youngest patient was 10 years old, and the oldest patient was 88 years old. The decision to start PCA was mostly made by resident doctors (59.3%) (Table 1). The clinic with the highest number of PCA applications was the orthopedics clinic with 35.6% (Figure 1). When thetypes of PCA were examined, it was determined that 53.7% of the patients were administered PCA via epidural, 42.6% via IV, and 3.8% PN PCA (Figure 2).

Table 1. Characteristics of patients who were administered PCA

	Mean±SD median (min-max)	
Age (years)	55.70±17.75 58 (10-88)	
	n	**%**
Gender		
Female	546	52.5
Male	494	47.5
ASA		
1	76	7.3
2	395	38.0
3	565	54.3
4	4	0.4
Doctor starting PCA		
Resident Dr.	617	59.3
Specialist Dr.	301	29.0
Academic staff	122	11.7

PCA: Patient-controlled analgesia, SD: Standard deviation, Min: Minimum, Max: Maximum, ASA: American Society of Anesthesiologists Score, Dr: Doctor

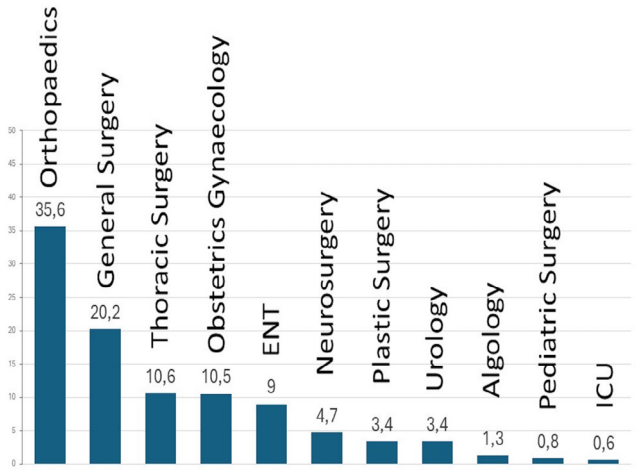

Figure 1. Distribution of PCA usage across clinical departments
Percentage of clinics' PCA usage rates are stated as. PCA: Patient-controlled analgesia

The complication rate was generally low, and it was found that 87.8% of the patients did not develop any complications. The most common complication was nausea and vomiting, with 6.3%. The complication rates of PCA types were similar.

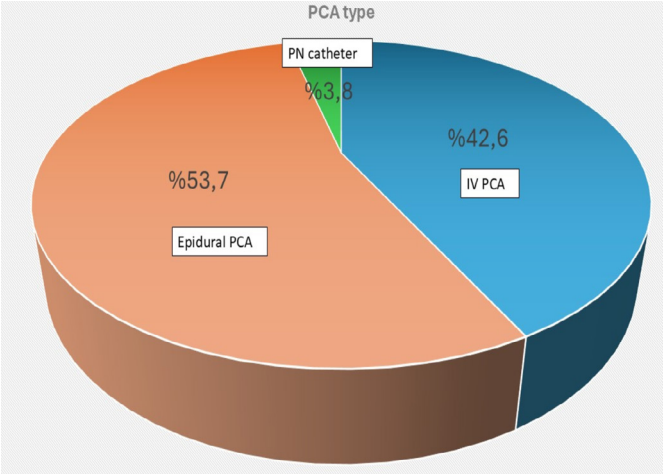

Figure 2. Distribution of PCA types
IV: Intravenous, PCA: Patient-controlled analgesia, PN: Peripheral nerve

When the types of PCAs started according to the clinics were investigated, it was seen that IV PCA was used the most in the general surgery clinic (66.2%), epidural PCA was used the most in the orthopedics clinic (71.1%), and epidural PCA was used the most in the gynecology and obstetrics clinic (82.6%). It was observed that the most commonly performed operations in 1.028 patients for whom PCA was started in the postoperative period were gastro-intestinal system operations with a rate of 18.9% (194 patients), Total Knee Prosthesis with a rate of 17% (175 patients), and Total Hip Prosthesis with a rate of 10.6% (109 patients).

The most common cause of termination in all types of PCA was pain termination (Table 2). When the three types of PCAs were compared in terms of their duration of use, a statistically significant difference was found between them ($p<0.05$). It was observed that the duration of PN PCA use was the longest ($p<0.001$) (Table 3).

Table 2. Reasons for PCA termination by type

	IV PCA		Epidural PCA		PN PCA	
	n	%	n	%	n	%
Reasons for termination						
Termination of pain	168	37.9	400	71.7	16	41.0
Block development	2	0.5	43	7.7	0	0
Nausea/vomiting	28	6.3	8	1.4	0	0
Refusal by the patient	16	3.6	3	0.5	0	0
Not preferred by the surgeon	17	3.8	5	0.9	1	2.6
Infection at the application site	0	0	4	0.7	5	12.8
Catheter dislocation	3	0.7	37	6.6	5	12.8
Hypotension	0	0	3	0.5	0	0
Discharge	42	9.5	21	3.8	1	2.6
Expiration of working time	112	25.3	12	2.2	9	23.1
Being ineffective	44	9.9	16	2.9	2	5.1
Respiratory depression	7	1.6	0	0	0	0
Numbness	0	0	3	0.5	0	0
Other	4	0.9	3	0.5	0	0

IV: Intravenous, PCA: Patient-controlled analgesia, PN: Peripheral nerve

Table 3. Comparison of drug use durations between PCA types

	IV PCA	Epidural PCA	PN PCA	
	Mean±SD median (min-max)	Mean±SD median (min-max)	Mean±SD median (min-max)	p
Duration of drug use	1.66±1.83 1 (0-29)	1.81±1.73 2 (0-7)	3.41±1.74 3 (0-7)	<0.001 [b]

PCA: Patient-controlled analgesia, SD: Standard deviation, Min: Minimum, Max: Maximum, IV: Intravenous, PN: Peripheral nerve, b: Kruskal Wallis variance analysis

A significant relationship was found between the status of the doctor initiating PCA and the types of PCA ($p<0.001$). Resident doctors initiated epidural PCA more frequently, while specialists and academic staff performed IV PCA applications more frequently. PN PCA catheter was most often initiated by the academic staff. In addition, those who used non-protocol drugs the most were the academic staff ($p<0.01$).

The rate of non-protocol drug use was found to be higher in PN PCA use than both IV and epidural PCA types ($p<0.001$). When PCA types were compared in terms of complications, it was observed that there was no significant difference between them ($p>0.05$). However, in patients who were administered epidural PCA, a difference was found between the complication rates according to the status of the physicians who started the treatment ($p<0.05$). The complication rates of resident physicians who started the treatment in patients using epidural PCA were found to be higher than those of specialist physicians ($p>0.05$).

DISCUSSION

In recent years, awareness about the importance of pain management has increased. Pain management practices based on patient participation stand out as a determining factor in terms of the success of quality management systems in surgical processes.[10] The effectiveness of PCA in the treatment of acute, chronic, postoperative, and labor pain has been demonstrated in various studies.[3,7,11] PCA can be administered in many ways, such as IV, through an epidural or PN catheter, or transdermally and by using different medications.[4] Health institutions often determine and implement specific PCA protocols with pain teams involving anesthesiologists.[6] In our hospital, which is a tertiary health institution, PCAs are followed up by a pain team including anesthesiologists, technicians, and nurses. With this study, we aimed to increase awareness of the clinical applications of PCA by examining the PCA applications applied in our hospital over a two-year period.

We observed that 1.040 patients were started to be administered PCA in our hospital over a two-year period, and it was determined that the number decreased compared to a two-year study conducted in our clinic in 2009.[12] We thought that this may be due to the more widespread use of various USG-guided nerve blocks for multimodal analgesia.

Administering opioids through IV PCA is an effective method that increases the quality of life of the patient,

especially in patients who cannot use oral drugs or experience severe pain despite oral drugs.[13,14] It has also been shown that PCA offers obstetric and analgesic advantages in painless delivery practices.[15] However, in our hospital, we found that PCAs are used more for postoperative pain, especially after orthopedic surgeries, than for chronic pain treatment and labor analgesia. When we examined the literature, we found that PCAs were most commonly used for postoperative analgesia, similar to our results.[8] When we examine retrospective studies conducted on PCA use in Turkiye, we see that it is most commonly used for postoperative pain management after orthopedic surgeries, similar to our results. Nevertheless, while epidural PCA was found to be the most commonly used type of PCA in our study, IV PCA was determined to be the most commonly used type in those studies.[12,16,17]

Although there is no clear information about the duration of use of PCAs, the person who decides on the duration is the doctor who starts the treatment and follows up on the effectiveness and complications of PCA application.[6] In our clinic, the duration of PCA use varied according to the types, with an average of one day for IV PCA, two days for epidural PCA, and an average of three days for PCAs administered through the PN catheter**.** We think that the reason for the shorter duration of IV PCA use is that it is preferred more in cases whose pain does not persist for a very long time in the postoperative period.

The most common complication seen during PCA use in this two-year period in our hospital was nausea-vomiting. When we look at the results of a study examining the use of PCA in our hospital in 2009, we see that the most common complication causing PCA termination was nausea and vomiting.[12] In a retrospective study conducted by Senayli et al.,[16] the most common complication encountered in PCAs was found to be sedation. We think that this result was caused by the use of pethidine and morphine in IV PCA protocols. When the literature is examined, it is seen that the most common complications after the use of PCA are nausea-vomiting, sedation/drowsiness, itching, and urinary retention; however, no serious complications are generally encountered as a result of the follow-ups performed by the pain teams.[12,16,17] Complications such as local anesthetic toxicity, catheter site infection, short-term or long-term nerve damage, allergy, and systemic infection may also occur, depending on the drug used with these complications, the route of use, and the dosage. Complications that may be encountered in PCAs can be minimized by patient follow-up at appropriate intervals.[4,18,19]

In our study, we investigated the status of doctors who started PCA administration, which has not been examined before, and whether this had an effect on PCA preference and complications. While most of the epidural PCAs in our hospital were started by resident doctors, we found that PCAs were mostly started by the academic staff through a PN catheter. We think that this result stems from the tendency of resident doctors to learn the epidural anesthesia technique, which is one of the cornerstones of regional anesthesia, in their educational process and the fact that PN catheter application requires more experience and knowledge. When compared in terms of complications, more complications, such as block development and numbness, were encountered in PCAs started through epidural catheters placed by resident doctors compared to those started by specialist doctors. We believe that this is caused by the difference in experience in placing the epidural catheter.

Limitations

The limitations of our study were that it was retrospective, did not include postoperative pain scores, and was single-centered. In parallel with the developments in today's technology, we think that prospective, multicenter studies including different PCA models (such as new generation non-invasive PCA systems) will contribute to the literature. Moreover, data on analgesic satisfaction and long-term outcomes were not included, which could be addressed in future studies.

CONCLUSION

PCA is one of the effective methods in pain relief with less anxiety and higher patient satisfaction, providing better pain control compared to conventional methods. It has been widely used, especially in the management of postoperative pain. However, PCA settings are often determined by institutional standards or individual clinician preferences. We think that such retrospective reviews will be useful in revising the protocols.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 08.04.2025, Decision No: 2025-220).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Evaluation of nutritional status in intensive care unit patients

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ABSTRACT

Aims: Malnutrition and systemic inflammation are known to be associated with poor prognosis in critically ill patients. This study aimed to investigate the prognostic value of the Controlling Nutritional Status (CONUT) and hemoglobin, albumin, lymphocyte, and platelet (HALP) scores on mortality in intensive care unit (ICU) patients.

Methods: This retrospective study included adult patients hospitalized in the internal medicine ICUs of two tertiary centers in 2024. Patients with chronic or systemic diseases were excluded from the control group. Laboratory data, APACHE II scores, CONUT and HALP scores were recorded on admission. We conducted statistical analyses to evaluate the association between these scores and mortality.

Results: A total of 53 ICU patients were included. The mean CONUT score was significantly higher in the patient group (6.71) compared to healthy controls (1.15) (p=0.000), indicating moderate malnutrition. The HALP score was also significantly lower in the ICU group (20.90) than in the control group (63.19) (p=0.000). However, no statistically significant association was found between either CONUT or HALP scores and mortality, length of stay, or APACHE II scores.

Conclusion: Although CONUT and HALP scores differed significantly between ICU patients and healthy individuals, they did not predict mortality in this cohort. However, the potential implications of our findings are significant. These easily applicable scores may still be useful for assessing nutritional and inflammatory status in ICU patients, and our study provides a foundation for further research in this area. Further multicenter, prospective studies with larger sample sizes are needed to clarify their prognostic utility.

Keywords: CONUT score, HALP score, mortality, intensive care, malnutrition, systemic inflammation

INTRODUCTION

Malnutrition and systemic inflammation are key pathogenic factors determining prognosis in intensive care unit (ICU) patients. Therefore, these patients are monitored for nutritional and inflammatory status during clinical follow-up.[1] The Control of Nutritional Status (CONUT) score, used to assess nutritional status, draws attention as an objective assessment tool based on serum albumin level, total lymphocyte count, and total cholesterol level. Introduced in 2005, the CONUT score is used as a prognostic marker, especially in cardiovascular and critical diseases, by demonstrating the relationship between low nutritional status and high mortality.[2,3]

The hemoglobin, albumin, lymphocyte, and platelet (HALP) score was first reported in the literature in 2015, when it was found to be a significant prognostic marker in a clinical study conducted in patients with gastric cancer. The HALP score is calculated by the formula 'Hemoglobin [g/L]×albumin [g/L]×lymphocyte count [103/μL])÷platelet count [103/μL]'.[4]

HALP scoring, a biomarker that includes haematological and inflammatory parameters and reflects the systemic physiological response, has been applied to a wide variety of conditions, such as haematological and solid cancers, cardiovascular disease, surgical patients, acute pancreatitis, acute appendicitis, Fournier's gangrene, and hyperemesis gravidarum.[5-13] Its prognostic value has been determined at various levels .

The combined evaluation of CONUT and HALP scores in ICU patients has the potential to significantly enhance clinical management by providing a comprehensive

assessment of both nutritional and inflammatory status. In this study, we aimed to investigate the prognostic roles of CONUT and HALP scores on mortality in ICU patients, thereby empowering clinicians with valuable insights.

METHODS

Ethics

The study was initiated after obtaining approval from Yozgat Bozok University's Non-interventional Clinical Researches Ethics Committee (Date: 04.06.2025, Decision No: 2025-GOKAEK-2511_2025.06.04_500). In this comprehensive retrospective study, we included individuals who were followed up in Yozgat Bozok University and Sivas Cumhuriyet University Internal Medicine Intensive Care Units in 2024 as the patient group. The control group comprised individuals without any history of chronic and systemic diseases and whose examinations did not reveal any pathology. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design

We recorded age, gender, laboratory data obtained on admission to the ICU, including hemogram, BUN, creatinine, total protein, albumin, ALT, AST, cholesterol and electrolyte levels from the hospital data system. Duration of hospitalization until mortality and APACHE scores during hospitalization were recorded from the ICU data system. CONUT (Table 1) and HALP scores were calculated and recorded to evaluate nutritional and inflammation status and to predict prognosis. HALP score was calculated with the formula "[hemoglobin (g/L)×albumin (g/L)×lymphocytes (/L)]/platelets (/L)".

Table 1. The Controlling Nutritional Status (CONUT) score

Parameters	Normal	Mild	Moderate	Severe
Serum albumin (g/ml)	≥3.50	3.00–3.49	2.50–2.99	<2.50
Score	0	2	4	6
Total lymphocyte/ml	>1600	1200-1599	800-1199	<800
Score	0	1	2	3
Cholesterol (mg/dl)	≥180	140–179	100–139	<100
Score	0	1	2	3
Total score	0-1	2-4	5-8	9-12

Inclusion Criteria

Individuals aged 18 years and older, hospitalized in the internal medicine ICU, and without a known diagnosis of malabsorption were included as the patient group. Individuals with no known history of disease and no pathology detected in physical examination and laboratory data were included as the control group.

Exclusion Criteria

The study excluded patients under 18 years of age, those hospitalised in the ICU for postoperative reasons, those with a non-intact gastrointestinal system, those with known malabsorption, and those diagnosed with chronic pancreatitis. The 183 patients obtained from the registration system were evaluated according to these criteria. A total of 120 patients were excluded according to the exclusion criteria, and 10 patients were excluded due to missing data (Figure).

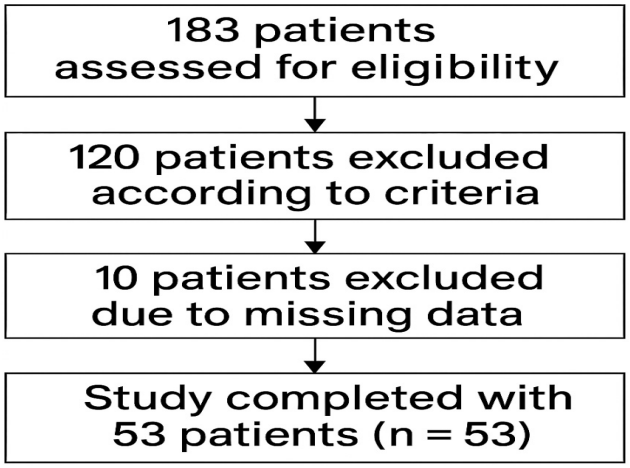

Figure. Study flow chart

Statistical Analysis

The data analyses were performed using the software SPSS 20.00 (Statistical Package for The Social Sciences, SPSS Inc, Chicago, IL). Descriptive statistics were given as mean±standard deviation for continuous variables, median, quartile distribution, and % for categorical variables for data not conforming to normal distribution. Whether the groups were normally distributed was determined by the Kolmogorov-Smirnov test. In the measurement values between the groups, independent groups were evaluated using a t-test and categorical variables were evaluated using a Chi-square test. Mann-Whitney U test was used for the groups not normally distributed. p values below 0.01 and 0.05 were considered statistically significant. The Pearson correlation method was used when the data were normally distributed and the Spearman correlation method was used when the data were not normally distributed.

RESULTS

Of the 53 ICU patients included in the study, 28 were male and 25 were female. The mean age of the patients included in the study was 71.11±13.09 years (min-max: 42-93). There was no statistical difference in age distribution between genders (p=0.684). ICU patients' mean number of hospitalisation days was 19, with a minimum of 1 and a maximum of 300 days. ICU patients' mean APACHE II score was 29.83±9.09 (min-max: 10-49). Laboratory data of the patients are given in Table 2. The relationship between mortality and nutritional status of ICU patients was evaluated, and no statistical relationship was found between APACHE score, HALP score and CONUT score (Table 3). In the comparison of ICU patients and the healthy control group, the CONUT score was in the normal range (1.15) in the healthy group and moderate nutritional deficit (6.71) in the patient group. The difference between them was statistically significant (p=0.000). The HALP score was lower in the patient group (20.90) compared to the healthy group (63.19) (p=0.618) (Table 4).

Table 2. Laboratory data of intensive care unit patients

	n	Min	Max	Mean	SD
Neutrophil (#)	53	0.01	37.60	9.3208	8.96873
Lymphocyte (#)	53	0.06	7.31	1.1462	1.25374
Monocyte (#)	53	0.01	16.85	0.9634	2.30210
Hemoglobin	53	5.90	16.00	10.8868	2.41844
Platelet	53	5.00	626.00	196.6415	150.66393
Fasting plasma glucose	53	69.00	870.00	198.8491	140.88612
Blood urea nitrogen	53	13.30	108.00	48.3094	23.69413
Creatinine	53	0.24	9.32	2.1421	1.62008
Clor	53	82.00	116.00	101.3774	6.19313
Sodium	53	115.00	151.00	136.9057	6.76320
Potassium	53	2.63	6.80	4.6321	1.02000
Albumin	53	19	38	28.20	4.086
Alanine transaminase	53	4.00	4856.00	147.1132	663.19360
Aspartate transaminase	53	6.00	8084.00	256.0566	1109.33532
C-reactive protein	53	4.95	459.00	139.6745	110.47151
Triglyceride	53	52.00	318.00	152.4717	52.01390
Cholesterol	53	48.00	269.00	148.5660	48.10426

Min: Minimum, Max: Maximum, SD: Standard deviation

Table 3. Outcomes of mortality and nutritional indicators in intensive care unit patients

	Length of stay in intensive care unit	APACHE score	CONUT score	HALP score
Length of stay in intensive care unit	1.000	-0.037	-0.145	0.153
APACHE score	-0.037	1.000	0.123	0.099
CONUT score	-0.145	0.123	1.000	-.806
HALP score	0.153	0.099	-.806	1.000

Correlation is significant at the 0.01 level (2-tailed). Abbreviations: APACHE: Acute Physiology and Chronic Health Evaluation, CONUT: Controlling Nutritional Status, HALP: Hemoglobin, albumin, lymphocyte, and platelet

Table 4. The analysis of CONUT and HALP scores of intensive care unit patients and healthy individuals

	Patient	Healthy	p
CONUT (mean)	6.71	1.15	0.000*
HALP (mean)	20.90	63.19	0.618

CONUT: Controlling Nutritional Status, HALP: Hemoglobin, albumin, lymphocyte, and platelet

DISCUSSION

Our study evaluated HALP and CONUT scores for their prognostic value in ICU patients. HALP and CONUT were not associated with mortality or prognosis. Nevertheless, our findings suggest that these scoring systems may be effective tools for the combined assessment of nutritional status and systemic inflammation in ICU patients with significantly different CONUT and HALP scores compared to healthy control subjects.

Hospitalized patients are a risky group in terms of malnutrition.[14] Malnutrition in ICU patients affects disease progression and prolongs hospital stay.[15] The prevalence of malnutrition in ICU patients is 57.6% according to a recent study of 380 patients.[16] In another study, this rate was 37.5%.[17] The variability of rates is related to many factors such as sample size, presence of comorbidities, age, and mechanical ventilation. Critically ill patients, such as ICU patients, have a severe underlying systemic inflammation. Inflammatory cytokines, an impaired immune response, protein catabolism, and inhibition of protein synthesis affect the patient's prognosis and post-discharge well-being.[18] According to a 5-year cohort study with patient data, the overall mortality rate of ICU patients was 35.9%.[19] In a larger cohort of 5834 patients, the overall mortality rate was 23.9%.[20] It is normal to expect a significant increase in mortality markers in ICU patients, a patient group with high mortality rates, compared to the healthy control group. Therefore, accurate assessment of nutritional status and systemic inflammation in this group of critically ill patients with high mortality rates is crucial for a comprehensive understanding of their prognosis and effective management of related problems.

The HALP score, a marker of systemic inflammation and nutritional status, is obtained by dividing the product of hemoglobin, albumin and lymphocyte count by the platelet count. Low hemoglobin value, which means low oxygen carrying capacity, is common in ICU patients and is associated with adverse clinical outcomes affecting many systems.[21] Hypoalbuminemia, malnutrition and predominant inflammatory process are associated in patients with serum albumin level <3 g/ml. Hypoalbuminemia is prognostic for mortality in ICU patients.[22,23] Lymphocytes, one of the main actors of immunity and inflammation, are used to determine prognosis. In a cohort of 226 ICU patients, lower lymphocyte levels were observed in patients with a mortal course.[24,25] Platelets that can interact with immune cells and secrete proinflammatory cytokines are also used for predicting mortality rates and prognosis.[26,27] Low hemoglobin, albumin, lymphocyte, and high platelet levels result in a low HALP score. A low HALP score has been associated with mortality.[28]

A retrospective study of 1533 patients with chronic obstructive pulmonary disease (COPD) revealed that a low HALP score was associated with an increased risk of ICU mortality, a new prognostic marker for COPD.[29] In another retrospective study evaluating the prognostic value of the HALP score in ICU patients, APACHE II scores of patients with HALP score <37.1 were significantly higher. A 47.04-fold increase in mortality risk was observed in these patients.[30] According to a 2025 clinical study analyzing 20.083 critically ill patients, a low HALP score (HALP score <3.56) showed a higher risk of ICU mortality. According to the results of this study, HALP score was associated with short-term mortality.[31] According to a clinical study conducted on 2.968 sepsis patients in 2025, a one-point increase in HALP score was associated with a 2% decrease in 28-day mortality when the HALP score was below 24.69. According to the study, albumin was found to be the most determinant component of the HALP score.[32] According to another retrospective study of 405 patients over 65 years of age followed in a respiratory ICU, patients with higher HALP scores had lower mortality rates. These results suggest that the HALP score may be useful in determining mortality and the choice of treatment approach in geriatric patients followed in the ICU.[33] In our study, neither HALP nor CONUT scores were associated with APACHE II scores. In a retrospective study conducted

in 2022 with 250 ICU patients, the HALP score was not found to be associated with mortality, similar to ours.[34]

CONUT scoring, a classification obtained by scoring albumin level, lymphocyte count and cholesterol level and which reveals the nutritional status of patients, was evaluated in an internal medicine study of 203 patients. Its relation with mortality was revealed. According to the score, normal=0-1; mild=2-4; moderate=5-8; severe=9-12 points.[35] In a retrospective clinical study of 307 ICU patients with sepsis, a low CONUT score was found to be an independent prognostic factor.[36] In another retrospective large-scale study conducted in South Korea with data from 9763 ICU patients, the median CONUT score was found to be 5. Higher 30-day mortality rates were found in individuals with moderate (CONUT score: 5-8) and severe (CONUT: 9-12) malnutrition compared to those without malnutrition (CONUT: 0-1).[37] In a retrospective study of 1678 patients evaluating the relationship between nutritional status and mortality in critically ill patients, high CONUT values were associated with increased risk of death, intubation, age, APACHE-II scores and number of comorbidities, and patients with high CONUT scores during hospitalization had a high risk of ICU death.[38] In our study, the mean CONUT score was 6.71.

Limitations

Its retrospective nature limits the ability to establish causality and introduces potential bias due to reliance on medical records. Second, the relatively small sample size and data from only two centers may reduce the generalizability of the findings. Third, only baseline laboratory parameters were used to calculate HALP and CONUT scores, and temporal changes were not evaluated. Additionally, the control group comprised individuals without any systemic disease, which may have introduced clinical disparity in comparisons.

CONCLUSION

These practical, easily applicable and reproducible scores, which allow simultaneous and objective assessment of nutritional deficiency and systemic inflammatory burden, may be useful for early identification of high-risk patients, early initiation of targeted supportive therapies and optimization of nutrition in the ICU where clinical decision-making time is limited. However, in our study, although we found higher CONUT scores and lower HALP scores in ICU patients compared to healthy controls, we could not show an association with mortality, APACHE II and length of ICU stay. Our findings contradict studies describing HALP and CONUT scores as independent prognostic markers in ICU populations. The retrospective, single-center and relatively small number of patients in this study may limit the generalizability of the results. Supporting these findings with larger multicenter and prospective studies in the future will further strengthen the place of these scores in clinical practice.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was initiated after obtaining approval from Yozgat Bozok University's Non-interventional Clinical Researches Ethics Committee (Date: 04.06.2025, Decision No: 2025-GOKAEK-2511_2025.06.04_500).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Causes of prolonged ICU stay: a retrospective study

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ABSTRACT

Aims: Patients with prolonged intensive care unit (ICU) stays constitute a significant portion of the patient population in ICUs. The aim of this study is to reveal the reasons for prolonged ICU stays and to describe the demographic and clinical characteristics of these patients.

Methods: In this single-center retrospective study, patients with an ICU stay exceeding 21 days were included. The parameters evaluated included age, sex, reason for ICU admission and length of stay, comorbidities, use of inotropic agents during ICU stay, requirement and duration of mechanical ventilation, renal replacement therapy (RRT), tracheostomy and PEG (percutaneous endoscopic gastrostomy) application, APACHE (Acute Physiology and Chronic Health Evaluation) II scores, and mortality rates. The patients were divided into two groups: those who died (group E) and those who survived (group S).

Results: In this study, respiratory failure was identified as the most frequent reason for ICU admission. Compared with survivors, non-survivors were older, had longer ICU stays, and exhibited higher APACHE II scores. Moreover, the requirements for inotropic support, invasive mechanical ventilation, and RRT during the ICU stay were significantly greater among non-survivors ($p<0.05$).

Conclusion: Identifying the causes of prolonged ICU stays may help in determining high-risk patient groups and contribute positively to their prognosis. In addition, it can support intensive care management by enabling more efficient utilization of healthcare resources.

Keywords: Intensive care unit, mortality, prolonged ICU stay

INTRODUCTION

The intensive care unit (ICU) is an essential component of the healthcare system, where patients with severe, life-threatening conditions requiring continuous life support are monitored by an experienced medical team.[1] Due to rapid population growth and recent advances in medical care, the demand for ICU beds is increasing faster than the available supply, leading to significant challenges in the optimal allocation of resources. Delays in ICU admission for patients requiring critical care have been shown to increase both mortality and morbidity. Therefore, effective triage during ICU admission has become increasingly important.[2]

It is estimated that approximately 2% to 11% of critically ill patients experience prolonged ICU stays, accounting for 25% to 45% of total ICU bed occupancy. In the literature, prolonged ICU stay has been defined as lasting 10, 21, or 30 days.[3-5] Several factors contribute to this condition, including age, comorbidities, presence of trauma, and the need for mechanical ventilation.[6,7] Moreover, prolonged ICU stays not only negatively impact patient prognosis but also increase healthcare system costs.[2,8]

Identifying the causes of prolonged ICU stays may help determine high-risk patient groups and contribute positively to their prognosis. Understanding the characteristics of patients who require extended ICU care is essential for optimizing resource utilization and improving outcomes. However, the demographic and clinical factors contributing to prolonged ICU hospitalization remain insufficiently defined.

The aim of this study was to identify the demographic and clinical characteristics of patients who remained in the ICU for more than 21 days and to elucidate the underlying reasons for their prolonged stay.

METHODS

This single-center retrospective study was conducted after obtaining approval from the Scientific Researches and Evaluation and Ethics Committee of Ankara Etlik City Hospital No. 2 (Date: 24.06.2025, Decision No: AEŞH-BADEK2-2025-284). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The study included patients who had an ICU stay exceeding 21 days in the 16-bed adult ICU of our hospital between August 1, 2024, and May 1, 2025. This was a descriptive epidemiological study, and the study population comprised all patients who had ICU stays exceeding 21 days during the specified period. The aim was to include the entire eligible patient population.

All patients over 18 years of age with complete medical records were included in the study. Patients younger than 18 years, those with missing data in their medical records, and those who stayed in the ICU for less than 21 days were excluded.

Patient data were collected retrospectively from the hospital information system and ICU follow-up forms. The parameters evaluated included age, sex, reason for ICU admission and length of stay, comorbidities, use of inotropic agents during ICU stay, requirement and duration of mechanical ventilation, renal replacement therapy (RRT), tracheostomy and PEG (percutaneous endoscopic gastrostomy) application, APACHE (Acute Physiology and Chronic Health Evaluation) II scores, and mortality rates.

Additionally, patients were categorized into two groups based on mortality outcomes: survivors (group S) and non-survivors (group E). ICU admission diagnoses and other clinical characteristics were compared between the two groups.

RESULTS

During the study period, a total of 589 patients were admitted to the ICU. Among these, 41 patients who stayed for more than 21 days were included in the study. None of the eligible patients were excluded (Figure).

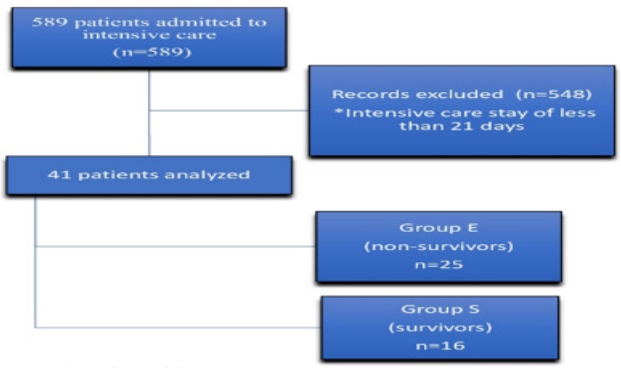

Figure. Flow chart of the patients

The demographic and clinical characteristics of the patients are presented in Table 1.

Table 1. Demographic and clinic characteristic

	All patients n=41	Group E n=25	Group S n=16	p
Age (year)	71.46±12.61	76.80±9.36	63.13±12.72	<0.001
Sex (n)				
Female	20 (48.7%)	12 (29.2%)	8 (19.5%)	0.901
Male	21 (51.2%)	13 (31.7%)	8 (19.5%)	
Length of stay in the ICU (day)	37.68±15.16	42.56±16.55	30.06±8.57	0.003
APACHE II score	20±6.76	23.52±5.97	14.50±3.44	<0.001
GCS	11.20±2.87	10.72±3.08	11.94±2.40	0.189
Mechanical ventilation				
+	34 (82.9%)	25 (60.9%)	9 (21.9%)	**<0.001**
-	7 (17.1%)	0 (0%)	7 (17.1%)	
Tracheotomy				
+	21 (51.2%)	12 (29.2%)	9 (21.9%)	0.606
-	20 (48.8%)	13 (31.7%)	7 (17.1%)	
Inotropic agent				
+	22 (53.7%)	18 (43.9%)	4 (9.7%)	**0.003**
-	19 (46.3%)	7 (17.1%)	12 (29.2%)	
RRT				
+	17 (41.5%)	15 (36.5%)	2 (4.8%)	**0.003**
-	24 (58.5%)	10 (24.3%)	14 (34.1%)	
Transfusion				
+	19 (46.3%)	9 (21.9%)	10 (24.3%)	0.097
-	22 (53.7%)	16 (39%)	6 (14.6%)	
PEG				
+	16 (39%)	7 (17.1%)	9 (21.9%)	0.07
-	25 (61%)	18 (43.9%)	7 (17.1%)	

APACHE II: Acute Physiology and Chronic Health Evaluation II, GCS: Glasgow Coma Scale, ICU: Intensive care unit, PEG: Percutaneous endoscopic gastrostomy, RRT: Renal replacement therapy. Values are presented as mean±standard deviation or number (percentage). p<0.05 was considered significant. Values in bold type were significant.

Regarding ICU admission diagnoses, the most common reason for admission was respiratory failure (n=15, 36.6%), followed by sepsis (n=6, 14.6%) and neurological pathologies (n=6, 14.6%) (Table 2).

Table 2. Indications for intensive care unit admission and patient comorbidities

	All patients n=41	Group E n=25	Group S n=16	p
Indications				
Respiratory failure	15 (36.6%)	10 (24.3%)	5 (12.2%)	
Cardiac pathologies	5 (12.2%)	4 (9.7%)	1 (2.4%)	
Sepsis	6 (14.6%)	4 (9.7%)	2 (4.8%)	
Acute renal failure	3 (7.3%)	1 (2.4%)	2 (4.8%)	
Neurological pathologies	6 (14.6%)	3 (7.3%)	3 (7.3%)	
Trauma	1 (2.4%)	0 (0%)	1 (2.4%)	
ROSC	1 (2.4%)	1 (2.4%)	0 (0%)	0.349
Intoxication	2 (4.8%)	2 (4.8%)	0 (0%)	
Gastrointestinal system bleeding	2 (4.8%)	0 (0%)	2 (4.8%)	
Comorbidity				
COPD	24 (58.5%)	13 (31.7%)	11 (26.8%)	0.288
CAD	23 (56.1%)	14 (24.1%)	9 (21.9%)	0.987
Diabetes mellitus	12 (29.3%)	6 (14.6%)	6 (14.6%)	0.354
Hypertension	14 (34.1%)	10 (24.4%)	4 (9.7%)	0.323
Renal disease	8 (19.5%)	6 (14.6%)	2 (4.8%)	0.365
Cerebrovascular disease	14 (34.1%)	7 (17%)	7 (17%)	0.300
Malignancy	13 (31.7%)	7 (17%)	6 (14.6%)	0.524

CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease, ROSC: Return of spontaneous circulation. Values are presented as number (percentage). p<0.05 was considered significant.

A total of 34 patients (82.9%) required invasive mechanical ventilation, while tracheostomy was performed in 21 patients (51.2%) (Table 1).

The mean duration of mechanical ventilation was 30.79±19.01 days. The mean time to tracheostomy following intubation was 14.2±2.1 days.

At the time of ICU admission, 22 patients (53.7%) required inotropic support. During the ICU stay, a total of 19 patients (46.3%) received blood transfusions. RRT was required in 17 patients (41.5%); intermittent RRT was applied in 10 patients, while continuous RRT was used in 7 patients (Table 1).

Of the total cohort, 25 patients (61%) died during their ICU stay (group E), while 16 patients (39%) survived (group S).

The mean age of patients in group E was 76.8±9.36 years, compared to 63.13±12.72 years in group S ($p<0.001$). The total ICU length of stay was significantly longer in group E (42.56±16.55 days) compared to group S (30.06±8.57 days) ($p=0.003$) (Table 1).

Patients in group E had significantly higher APACHE II scores during ICU admission compared to group S. Moreover, the number of patients requiring inotropic support and those who underwent RRT during the ICU stay was higher in group E ($p<0.05$) (Table 1).

DISCUSSION

In this retrospective study of patients with prolonged ICU stays, we found that the most common reason for ICU admission was respiratory failure. Compared to survivors, non-survivors were older and had longer ICU stays as well as higher APACHE II scores. Furthermore, the need for inotropic support, invasive mechanical ventilation, and RRT during the ICU stay was significantly higher among non-survivors.

In a study investigating patients with ICU stays exceeding 21 days, 9.23% of all ICU admissions were classified as prolonged ICU stays.[8] Other studies have reported varying incidences of prolonged ICU stays, such as 4.7% and 8.57%.[4,9] In our study, consistent with the literature, 6.9% of all ICU admissions during the study period were prolonged ICU stays.

Respiratory failure is known to be one of the most common causes of prolonged ICU hospitalization.[10] In the literature, patients requiring prolonged invasive mechanical ventilation have been reported to have higher mortality rates and longer hospital stays.[11,12] Prolonged mechanical ventilation increases the risk of various pulmonary complications, such as ventilator-associated pneumonia and barotrauma. These complications, in turn, further extend the duration of mechanical ventilation and ICU stay.[13,14] Similarly, in this study, respiratory failure was the leading cause of prolonged ICU stay. A total of 34 patients (82.9%) required invasive mechanical ventilation, with a mean ventilation duration of 30.79 days. Among these, 21 patients (51.2%) underwent tracheostomy for continued airway management. Our findings are in line with the literature and suggest that prolonged mechanical ventilation contributes significantly to extended ICU stays.

Damuth et al.[15] reported a mortality rate of 62% among patients requiring invasive mechanical ventilation. In the literature, studies have reported varying mortality rates in patients with prolonged ICU stays, ranging from 4.7% to 51.2%.[9,16] In our study, the mortality rate was found to be 61%. We believe that these differences may be attributed to variations in ICU patient populations and sample sizes. Additionally, discrepancies among studies may arise from the absence of a standardized definition for prolonged ICU stay, which varies widely from 7 to 90 days.

Elderly patients, due to their existing comorbidities, constitute a substantial proportion of ICU admissions. Compared to younger populations, older patients have been reported to require ICU care more frequently and to have higher mortality rates.[17,18] However, some studies have suggested that age itself may not be an independent predictor of ICU mortality.[19,20] In the ICU, mortality is influenced by multiple factors associated with advanced age, such as the acute disease burden, comorbidities, frailty, and response to treatment. In our study, the mean age of patients with prolonged ICU stays was 70 years, and non-survivors were observed to be older than survivors.

APACHE II scoring system is one of the most commonly used tools for predicting mortality in the ICU. It has been utilized in the literature for mortality prediction across various disease groups.[21-23] Godinjak et al.[24] reported APACHE II scores above 27.5 as predictive values for mortality, while Oliveira et al.[6] identified APACHE II scores greater than 11 as a risk factor for prolonged ICU stay. In this study, consistent with the literature, non-survivors had higher APACHE II scores compared to survivors. Furthermore, APACHE II scores ranged from 10 to 33 in our patient cohort, with a mean score of 20. Based on our findings, we believe that higher APACHE II scores are valuable in predicting both prolonged ICU stays and mortality.

Different inotropic agents are used when hemodynamic stability cannot be achieved. In severe clinical conditions such as cardiogenic shock, sepsis, and multiple organ failure, vasopressor support is frequently required.[25] Similarly, severe acute kidney injury (AKI) is commonly associated with poor prognostic conditions, including multiple organ failure, sepsis, or significant hemodynamic instability, which often necessitates RRT.[26] In our study, the use of inotropic agents at ICU admission was more common among patients who did not survive. It is well known that patients with hemodynamic instability have worse prognoses. Additionally, the development of organ failure is expected to be more frequent in non-survivors compared to survivors. Therefore, the higher need for inotropic agents and the increased use of RRT observed in non-survivors is an anticipated outcome.

Limitations

This study has several limitations. First, due to its retrospective design, only a limited number of patients with prolonged ICU stays could be included. Moreover, as the study was conducted in a single center, the findings may reflect only a specific patient population. Therefore, multicenter studies

with larger sample sizes are needed to better identify the predictive factors associated with prolonged ICU stays.

CONCLUSION

In this study, respiratory failure was identified as the most common cause of prolonged ICU stay. Compared to survivors, non-survivors were older and had higher APACHE II scores. Furthermore, patients who required inotropic support and RRT during their ICU stay had higher mortality rates. Identifying the clinical characteristics and reasons for prolonged ICU stays may contribute to improving the prognosis of this patient group through closer monitoring and the implementation of appropriate treatment strategies. Additionally, early identification of high-risk patient groups and their timely referral to palliative care units could facilitate more efficient utilization of ICU beds.

ETHICAL DECLARATIONS

Ethics Committee Approval

This single-center retrospective study was conducted after obtaining approval from the Scientific Researches and Evaluation and Ethics Committee of Ankara Etlik City Hospital No. 2 (Date: 24.06.2025, Decision No: AEŞH-BADEK2-2025-284).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Our anesthesia experience in a case with Giant Goiter

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ABSTRACT

Although large goitre disease is rare in developed countries, they are more frequently encountered in underdeveloped regions. Large thyroid masses requiring surgery pose challenges for anesthesia and surgery due to their proximity to vital anatomical structures. A 53-year-old female patient presented to the anaesthesia clinic for a total thyroidectomy. A prominent mass was observed in the anterior and lateral neck, extending from the mandibula to the sternal notch and ears. CT scans revealed narrowing of the tracheal lumen to 4 mm, indicating stenosis. Upon arrival in the operating room, the head of the surgical table was elevated to 45 degrees. Following standard monitoring, induction was performed. Laryngoscopy revealed a Cormack/Lehane grade 3 view. Due to difficulty with intubation, the endotracheal tube (ETT) was guided with a bougie. After a 3- hour surgery, the patient was extubated with 2 mg/kg sugammadex. The patient's vital signs remained stable. Thyroid nodules are common, and total thyroidectomy is one of the most frequently performed surgeries globally. The main challenges for anesthesiologists during thyroid surgery include the gland's endocrine function, anatomical structures, and bleeding risks. A thorough preoperative assessment and preparation helped prevent complications in this case.

Keywords: Giant Goiter, anesthesia, thyroidectomy

INTRODUCTION

Thyroid nodules are one of the most common pathologies in the population. When there is more than one nodule in the thyroid gland, multinodular goiter (MNG) is mentioned. MNG, which does not release hormones, occurs because of enlargement of the thyroid gland without iodine deficiency and can reach very large sizes.[1] In developed countries, cases of large goiters are rarely seen; however, this problem continues as endemic goiter in some countries.

In late diagnosed cases with MNG, cosmetic problems, dyspnea and compression problems that may cause dysphagia may be observed. Large thyroid masses requiring surgery are special for surgery and anesthesia because of the vital structures in the anatomical neighborhood. The preferred method of thyroidectomy is general anesthesia.

Lesions over 4 cm in the thyroid gland increase the risk of malignancy, and anesthetic management is complicated by difficult mask ventilation, difficult intubation, longer operative time, difficulty in surgical exploration and increased likelihood of bleeding. Therefore, careful preoperative examination and preparation are necessary. Preoperative preparation should include preparation for difficult intubation and blood products that may be required.

Our patient scheduled for thyroidectomy had a giant goiter compressing the trachea. We aimed to present the anesthetic management of our patient in whom we anticipated mask ventilation and difficulty in intubation.

CASE

A 53-year-old woman who presented to the anesthesia outpatient clinic with a gradually growing swelling in the neck that had been present for about 20 years described respiratory distress when lying supine for the last 6 months. Her height was 163 cm and weight were 65 kg. Examination revealed a firm, palpable, non-tender large mass extending from the submental area superiorly to the sternal notch inferiorly and to the ear level on the lateral borders (Figure 1). The patient with a Mallampati score of 3 was informed about the operation and the procedures to be performed and

her consent was obtained. Laboratory tests showed normal T3 and T4 levels and TSH level was suppressed. Fine needle aspiration biopsy result was benign. Computed tomography of the neck and thorax showed that both lobes of the thyroid gland were severely hyperplasic and multinodular, extending from the hypopharyngeal space to the thoracic inlet. It was observed that the hyperplasia especially in the isthmic region narrowed the lumen up to 4 mm in the proximal part of the trachea and caused tracheal stenosis.

Figure 1. Firm neck mass extending from the submental area to the sternum

Figure 2. Mask ventilation after anesthetic induction

Our patient who had no known disease other than hypertension was evaluated as ASA II. After preoperative preparations were completed, the patient was brought to the operating theatre for bilateral total thyroidectomy with the diagnosis of MNG. Preparations were made considering that ventilation and intubation might be difficult. Awake fiberoptic intubation is considered the gold standard technique in anticipated difficult airway cases. However, due to our patient's severe anxiety, communication difficulties, and inability to cooperate with awake intubation, this approach was deemed inappropriate. Instead, intubation was performed after induction, with an experienced team present and alternative airway management plan readily available. A heating blanket was laid on the operating table. Since the patient described respiratory distress when lying in the supine position, the head of the table was raised at a 45-degree angle. After standard monitoring, 3 mg/kg propofol 1 mcg/kg fentanyl 0.6 mg/kg rocuronium was given and mask ventilation was performed (Figure 2). Although a difficult airway was anticipated in our case, adequate mask ventilation was achieved just before the administration of the muscle relaxant. For this reason, rocuronium was administered at a standard dose. Approximately 3 minutes later, the laryngoscopy image was found to be Cormack/Lehane grade 3 with video laryngoscope. Since the endotracheal tube (ETT) (Neurostyle EMG ETT, Inside Diameter 7.00 mm, GERMANY) suitable for neuromonitoring could not be guided with a guide, the ETT was advanced through a bougie (i- Bougie VBM Medizintechnik GmbH 14 Fr) and intubated. Anesthesia was maintained with 2.5% sevoflurane 50% medical air/oxygen mixture and 0.5 mcg/kg/min remifentanil infusion. Invasive arterial monitoring was performed. The patient was positioned, and the operation was started. At the end of the operation which lasted approximately 3 hours, 500 ml of blood loss occurred. Thyroid tissue of 1900 grams (g) was removed, and a drain was placed. The patient received postoperative analgesics 1 mg/kg tramadol, 50 mg Dex ketoprofen and 4 mg ondansetron as antiemetic. She was given 2 mg/kg sugammadex and extubated according to extubating criteria,[2] then sent to the recovery unit (Figure 3). The patient who did not develop any complication and whose vital signs were stable was transferred to the surgery department after 1 hour. The patient who had no problems in follow-up was discharged on the 3rd postoperative day with recommendations.

Figure 3. Before extubation

DISCUSSION

Thyroid nodules are a common pathology in the population and total thyroidectomy is one of the most common surgeries performed worldwide. Abnormal enlargement of the thyroid gland is called goiter. In patients with asymmetric enlargement of the thyroid gland, surrounding structures including the trachea, esophagus or blood vessels are compressed. In these patients, symptoms including cosmetic problems, hoarseness, tracheomalacia, laryngeal oedema and respiratory problems are frequently observed, and they may present with hyperthyroidism and lead to an increased risk of thyroid cancer.[3] In our patient, cosmetic problems due to a large goiter, dyspnea in the supine position and left deviation of the trachea, which was also seen on chest X-ray, were present.

Lesions over 4 centimeters (cm) in the thyroid gland increase the risk of malignancy, while lesions over 6 cm are considered giant goiter. Although the incidence of giant goiter has decreased in our country, this disease is still prevalent in some countries. The removed thyroid tissue weighed 1900 g and was larger than 15 cm.

In patients with giant goiter, the extension of the thyroid gland to the mediastinum makes it open to complications with problems such as difficulty in surgical dissection during the operation and bleeding due to proximity to vascular structures.[4] Blood preparation should be performed in the preoperative period. The duration of the surgical procedure performed in our patient was longer than normal. With the experience and success of the surgical team, the main vascular structures were not damaged and there was no need for blood transfusion. Blood gas and electrolyte abnormalities did not develop at the end of the surgical period which lasted approximately 3 hours.

Thyroidectomy is generally a safe procedure with a relatively low mortality rate. However, some postoperative complications such as bleeding, compressive hematoma, damage to the laryngeal nerves and trachea, and hypocalcemia may occur.[5,6] In the perioperative monitoring of our case, complications such as bleeding, respiratory distress, hoarseness, and hypocalcemia were not observed. The volume of the thyroid tissue and surgical skill play a significant role in reducing the risk of complications.[7]

The rate of difficult laryngoscopy during thyroid surgery is reported to be between 6.8% and 9.6%.[9,10] Airway management is a fundamental skill for anesthesiologists. Unexpected difficult airway management contributes to perioperative morbidity and mortality. Difficult airway represents a complex interaction between patient factors, the clinical setting, and the practitioner's skills.[8] A thorough preoperative assessment allows the anesthesiologist to make necessary preparations while protecting the patient from morbidity and mortality. Many different methods can be used to achieve intubation in cases of difficult airway. However, there is no evidence in the literature to show that one method is superior to another. What is crucial, however, is intervening with a pre-planned strategy for a predicted or known difficult airway situation.

The physical examination of our patient revealed a large mass extending from the mandible to the sternal notch, laterally towards the ears. This included many of the anatomical features used in predicting a difficult airway.[11] Due to the large thyroid tissue, the mandible could not be fully drawn forward and upward, making mask ventilation difficult. During intubation, the epiglottis was positioned on the left and superiorly, which allowed us to guide the tube and perform intubation by advancing the tube through a bougie. An anesthesiologist must be prepared for a difficult airway in patients scheduled for thyroidectomy due to a large thyroid and should be ready to implement a series of strategies in case of an unforeseen difficulty. By conducting a thorough preoperative evaluation, the anesthesiologist should apply the most suitable airway management alternatives based on experience and the situation, preventing irreversible hypoxic lesions.

Succinylcholine or high dose rocuronium is recommended as a muscle relaxant in cases of predicted difficult intubation, as it provides rapid intubation conditions and has a short duration of effect. On the other hand, if rocuronium is used, its muscle relaxant effect can be rapidly reversed with sugammadex. Therefore, due to the advantage of rapid muscle relaxation or the ability to reverse it, we preferred to use rocuronium in our case. Although a difficult airway was anticipated in our case, adequate mask ventilation was achieved just before the administration of the muscle relaxant. Rocuronium at a standard intubation dose of 0.6 mg/kg was chosen to induce muscle relaxation while keeping the duration of neuromuscular blockade under control. Considering the patient's age, comorbidities, and the risk of difficult ventilation, a higher dose was avoided to reduce the risk of prolonged blockade. In difficult intubations, extubating should be performed carefully due to the possibility of reintubation. At the end of the procedure, after preparing for reintubation conditions and fiberoptic bronchoscopy, we successfully extubated the patient once sugammadex was administered and the patient was awake and cooperative.

The primary issues anesthesiologists face during thyroid surgery are related to the thyroid being an endocrine organ, its anatomical structures, and potential bleeding complications. Before elective thyroid surgeries, patients are rendered euthyroid. In hypothyroid patients, drug biotransformation is slower, which may delay recovery from general anesthesia. Hemodynamic changes, anemia, hypoglycemia, coagulopathy, and a reduction in hepatic and renal drug clearance may also occur.[12] During our patient's follow-up, we did not observe any disturbances in drug metabolism or hemodynamic. However, as with all endocrine organ pathologies, caution should be exercised with drug metabolism in thyroid diseases as well.

CONCLUSION

In this case, we wanted to emphasize that the anesthetic management for total thyroidectomy in cases of giant goiter, which are rare in our country, started with a thorough preoperative evaluation and preparation. We believe that this process should continue with careful airway management, intraoperative monitoring, and proper postoperative care.

With good anesthetic management, the perioperative course of complex cases can be made safer, the risk of complications can be reduced, and patient outcomes can be improved. Especially in cases of large goiter, careful planning of airway management, appropriate preoperative preparations, and collaboration with an experienced surgical team contribute to achieving a successful outcome for both the anesthesiologist and the surgeon.

ETHICAL DECLARATIONS

Informed Consent

The patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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