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Editorial

Database studies and hemogram derivatives in perioperative medicine research: Does it mean taking shortcuts in the scientific journey?

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As you are aware, our journal's scope is centered on perioperative medicine, encompassing a wide range of studies, from preoperative patient preparation to the long-term outcomes of surgical and anesthesia interventions. As editorial chiefs, we will continue to write editorials in each issue, addressing the topics our journal focuses on and the perspectives we ignore. In this issue, we will delve into relatively effortless, commonly used practices in the academic journey that many academics often resort to and discuss the rationale and outcomes of such endeavors.

In our country and globally, the transition from the 'small and functional clinic' model to 'colossal hospitals' has nearly concluded in the past two decades. Consequently, this has led to the natural formation of extensive databases containing a wealth of patient data. Regrettably, academics working in these institutions often opt for the easier and more accessible route of analyzing this data instead of formulating new hypotheses and conducting proof-of-concept studies. These studies, mockingly referred to as 'database mining,' are widely accepted and published in many journals. On the other hand, beyond conducting clinical studies using their institutional data, another research method involves writing reviews using national databases or data systems similar to COCHRANE. The academic credibility of articles written through database mining was recently brought into question. Some high-impact journals have declared their decisions to reduce the space dedicated to such articles and reviews or even refrain from publishing them [1].

In our publishing philosophy, the priority for publications will always lean towards clinical research. Certainly, in retrospective studies, patients to be included will be selected from a data system. However, a more appropriate approach would be a comprehensive analysis of the data by also examining physical records. Retrospective studies with a well-formulated hypothesis and an effective research model will be considered more valuable, compared to a 'database mining' study that merely presents descriptive data. *Demonstrating one's prowess as an original article author necessitates a profound understanding and wealth of experience that transcend the mere access to database systems and proficiency in basic Excel skills.*

Another salient aspect of our discourse relates to research endeavors utilizing hematological-derived ratios, such as the neutrophil-lymphocyte ratio (NLR) and platelet-lymphocyte ratio (PLR), extracted from hemogram data. These ratios and derivatives are applied across a spectrum of research domains, encompassing diagnostic processes, differential diagnosis, mortality prognosis, and the anticipation of complications [2–4]. Given the routine nature of complete blood counts conducted in the majority of hospitalized patients, we can contemplate the widespread applicability of these ratios in various clinical contexts. Therefore, using the expression 'a parameter that can be used for the diagnosis and predictability of nearly everything' does not actually mean defining a parameter that will contribute to the differentiation of anything specifically, does it? *Can conducting statistical analysis on over 40 hemogram parameters and their ratios across any patient group to investigate significance be more superior than simply tossing a coin?*

Undoubtedly, we shall not dismiss articles rooted in NLR and akin ratios entirely. Those studies underpinned by well-articulated hypotheses and executed with scientific rigor will persist within the sphere of our scholarly scrutiny. Parameters like NLR can exhibit interindividual variability, influenced by factors like age, gender, and weight status, often resulting in limited

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specificity. In optimizing study design, it is advisable to contemplate the examination of more homogenized cohorts characterized by narrower parameters, acknowledging the importance of this consideration [5,6].

As editors, our intention is not to constrain prospective authors, as it would be contrary to the spirit of science. However, we must be mindful of not squandering the valuable time of our editorial board and reviewers. Given the existence of journals that prioritize articles focused on database mining and hemogram parameters, please understand our decision to relatively limit the inclusion of such topics. Conclusively, although we acknowledge the significance of database (mining) and hemogram parameter studies, our journal's objective is to elevate the intellectual dialogue and promote pioneering, hypothesis-driven research endeavors that align with the zenith of scientific investigation.

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Research Article

The effects of pentoxyphiline on neurocognitive functions and neurobiochemical markers in coronary artery bypass graft surgery

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ABSTRACT

Aim: Neurocognitive dysfunction is a complication of cardiopulmonary bypass (CPB). Neuron-specific enolase (NSE) and S100ß protein are markers of cerebral injury. With its beneficial rheological and anti-inflammatory properties, pentoxyphiline (PTX) is an interesting agent in cardiac surgery patients. The study was designed to evaluate the influence of prophylactic use of PTX on cognitive function and S100ß and NSE in on-pump coronary artery bypass grafting (CABG) patients.

Method: In this prospective study, 40 patients undergoing on-pump CABG and received either PTX (bolus of 5 mg kg-1) after induction of anesthesia or saline are included. Neurological examination and neuropsychologic tests, including the mini-mental state examination test (MMSET) and Benton visual retention test (BVRT), were obtained preoperatively and on the seventh postoperative day. Blood samples for analysis of S100ß and NSE were collected before anesthesia, at the end of CPB, at the 3rd hour and 24th hour postoperatively.

Results: Demographic and perioperative data were similar for the two groups. Mean cross-clamping times were 67.86±22.22 and 66.32±27.84 min, respectively. In both groups, S100ß and NSE increased significantly ($p<0.01$) at the end of the CPB and remained slightly increased at T2 (at the CPB exit), and T3 (at the 3rd hour after surgery) than preoperative levels ($p>0.05$). MMSET and BVRT performances of the two groups were similar and did not change compared to preoperative scores.

Conclusions: Coronary artery bypass surgery caused a significant increase in NSE and S100ß serum levels but with no deterioration in neuropsychological outcome assessed in the first postoperative week. Although it was reported that PTX could be a promising agent to prevent post-CPB organ dysfunction in elderly cardiac surgery patients, prophylactic use of PTX appeared to offer no advantage for cerebral protection in the age group involved in this study.

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1. Introduction

Despite advances in surgical and anesthetic methods, temporary or permanent neurological and neuropsychological dysfunction continues as a problem after cardiac surgery with cardiopulmonary bypass (CPB) [1,2]. While the rate of neurocognitive dysfunction reaches 80% at discharge from the hospital after cardiac surgery, it is stated that this rate decreases to 10-35% in tests performed after six weeks and 10-15% after one year [3].

It has been reported that cognitive dysfunction after CPB may be due to many causes, such as cerebral microembolism, diffuse cerebral hypoperfusion, cerebral and systemic inflammation, cerebral hyperemia, cerebral edema, deterioration in the blood-brain barrier, pharmacological effects, and genetic characteristics [3,4].

Depending on CPB, the coagulation system, fibrinolytic system, complement system, leukocytes, endothelial cells and platelets are activated. Activation of the hemostatic system, developing systemic inflammatory response (SIRS), and ischemia-reperfusion injury are the most important factors in the pathogenesis of "post-perfusion organ damage" [3,5]. The organs most affected are the lungs, heart, brain, kidneys, and liver [6]. In addition to pharmacological agents such as corticosteroids, proteinase inhibitors such as aprotinin, and inflammatory cascade inhibitors to reduce CPB-related organ damage, methods such as "off-pump" surgery, leukocyte filter and ultrafiltration are tried [3,5].

Pentoxyphiline (PTX; 3,7-dimethyl -1-5-oxohexylxanthine) is a xanthine derivative that inhibits the 5' nucleotidase enzyme, reduces the loss of ATP in the tissue, and prevents cell damage by minimizing tissue energy consumption during the ischemia period [6]. It has been shown that PTX is protective in CPB-related peripheral organ damage due to its inhibition of the production of proinflammatory cytokines and its anti-inflammatory properties [6–8]. Its brain-protecting effect has been demonstrated in dogs [9]. No human studies have shown that PTX use is protective in preventing neurological damage in surgeries performed with CPB.

S100ß protein and Neuron-Specific Enolase (NSE) are specific proteins that indicate brain damage [2,10–13]. In cardiac surgery, especially in the early postoperative period, a significant correlation was found between the increase in NSE level and the impairment in cognitive functions [2,14].

2. Materials and Methods

The study was conducted on patients who will undergo isolated coronary artery bypass graft (CABG) surgery with CPB in the Cardiovascular Surgery Operating Room at Istanbul University Cerrahpaşa Medical Faculty. Ethics committee approval, dated 16.09.2008 and numbered 27578, was obtained from Istanbul University Cerrahpaşa Medical Faculty for the study. This prospective, randomized, controlled and double-blind study included 40 patients. The patients were aged between 50-79 years old. The patients were at least primary school graduates. Written informed consent was obtained from the patients. Our exclusion criteria was: patients with psychiatric and cerebrovascular disease, carotid stenosis, EF <40% or emergency surgery, kidney failure, concomitant valve disease, or recent steroid or nonsteroidal anti-inflammatory drug use. The patients were given no steroid or nonsteroidal anti-inflammatory drug during the study.

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2.1. Randomization and blinding

The patients were randomly divided into Group P (n=20) and Group C (n=20). Group P patients were given pentoxyphiline, and Group C patients formed the control group. The psychologist and biochemist were blind to the study.

2.2. General anesthesia

Standard cardiac anesthesia monitoring (ECG, SpO_2, invasive arterial pressure, central venous pressure, $ETCO_2$, temperature, urine output, ACT) was applied to all patients taken to the operating room.

The anesthetic management was provided with premedication midazolam, anesthesia induction with 0.15 mg/kg midazolam, 5 mcg/kg fentanyl, 0.1 mg/kg morphine, and neuromuscular blockade with 0.1 mg/kg vecuronium, as in our standard clinical practices. Sevoflurane in an O_2-air mixture, midazolam, fentanyl and morphine were used when necessary for the maintenance of anesthesia. The operations were performed with the same surgical group and the same methods. After induction of anesthesia, 5 mg/kg pentoxyphiline in 500 mL 0.9% NaCl was administrated to the patients assigned to the pentoxyphiline group, while only 500 mL 0.9% NaCl was infused to the control group.

2.3. Measurements

A total of 40 patients, 30 male and 10 female, aged between 50 and 79, from Istanbul University Cerrahpaşa

Medical Faculty Cardiovascular Surgery operating room, were included in the study. Mean arterial pressure (MAP) and heart rate (HR) were recorded before and after pentoxyphiline infusion. The use of vasopressors and inotropic agents during and after CPB, central venous pressure (CVP) at the beginning and exit of the operation, operation time, CPB duration, aortic cross-clamp time, extubation time, and exit time from the intensive care unit were recorded.

Venous blood samples for S100ß protein and NSE blood level measurements were taken;
1. Before induction of anesthesia, (T1)
2. at the CPB exit, (T2)
3. at the 3rd hour after surgery, (T3)
4. at the 24th hour after surgery. (T4)

After the samples were taken, they were centrifuged, and the serums were separated into two. The samples were stored at -80 °C until the day of the study.

S100ß protein concentrations were measured by Enzyme-Linked Immunoassay (ELISA) technique using microplate wells coated with polyclonal S100ß antibodies (Human S100ß Elisa Biovendor Research and Diagnostic Products Cat. No.:RD192090100R). The detection limit of the method is 5 pg/ml. Samples with S100ß levels above 2000 pg/ml were diluted and studied again. It was recalculated considering the dilution coefficients. Intraassay and interassay coefficient of variation (CV) was 4.45% and 4.3%, respectively.

NSE levels were determined by the ELISA method using microplate wells coated with monoclonal antibodies working with the “sandwich” principle (DRG diagnostic EIA-4610 Germany). Its sensitivity is 4 ng/ml. Intraassay and interassay CV were 4.5% and 4.8%, respectively.

For cognitive function measurement, one day before and seven days after the operation, SMMT and Benton tests, which are standardized for Turkish people, were applied [15,16].

2.4. Sample size estimation

In order to test the statistical significance of a difference of at least 20% between the groups in terms of the mean SMMT results at 95% power and 5% error level, it was observed that at least 15 subjects should be included in each group.

The sample size of the study was calculated with IBM SPSS Sample Power, since the universe was not known. A literature review was performed in accordance with the research hypotheses. With the reference to the study of Herrmann et al. [14], it was observed that at least 15 individuals should be included in each group to test the statistical significance of a difference of at least 20% between the groups in terms of mean MMST results at 95% power and 5% error level. In the study, it was decided to include 20 patients in each group to eliminate the possible dropouts.

2.5. Statistical analysis

Data are given as mean ± standard deviation. For statistical analysis, the chi-square test was used to compare demographic data, an unpaired t-test was used to compare data between groups, and "Repeated Measures ANOVA" tests were used for in-group comparison. P<0.05 was considered statistically significant.

3. Results

The control group (Group C) consisted of 20 patients, and the PTX group (Group P) consisted of 20 patients. Flow diagram of our study is presented in Fig. 1. The number of male patients was observed to be higher in both groups. There was no significant difference between the groups regarding age, weight, height, gender distribution and educational status (p>0.05). (Table 1) When the surgical parameters of the groups were compared, no significant difference was observed (Table 2).

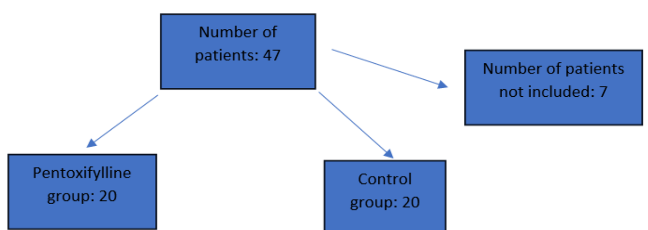

Fig. 1. The flow chart of the study.

Table 1. Patient characteristics in the groups.

		Control Group (n=20)	Pentoxyphiline Group (n=20)	*p-value*
Age (years)		61.48 ± 8.14	60.31 ± 7.69	0.619
Weight (kg)		77.08 ± 10.97	77.90 ± 14.80	0.827
Height (cm)		166.68 ± 9.33	167.18 ± 7.48	0.841
Male/Female		12/8	18/2	0.078
Educational Status	Primary School	12	7	0.563
	Middle School	5	3	
	High School	2	6	
	University	1	4	
Euroscore		4.24 ±1.76	4.5 ± 1.94	0.635

The data are presented as mean ± standard deviation or number.

Table 2. Surgical characteristics of the groups.

	Control Group (n=20)	Pentoxyphiline Group (n=20)
Surgery Time (min)	237.80±43.66	261.13±51.96
CPB Time (min)	93.92±33.01	99.18±38.73
Aortic Cross-Clamp Time (min)	66.32±27.84	67.86±22.22
Extubation Time (hour)	14.00±5.73	12.09±5.73
Discharge from ICU (hour)	62.08±37.22	46.77±9.03

The data are presented as mean ± standard deviation, CPB: Cardio-pulmonary bypass.

When the hemodynamic parameters of the cases were examined in the perioperative period, no significant difference was found between the CVP values measured at the beginning and end of the operation (p>0.05). There was no significant difference between the groups in the use of inotropic agents and vasopressors in the perioperative period according to the number of cases (p>0.05) (Table 3).

Although a decrease was observed in the HR and MAP values measured after 0.9% NaCl in Group C, they were not statistically significant compared with the initial values. A similar decrease was observed in HR and MAP values after infusion of 0.9% NaCl containing 5 mg/kg pentoxyphiline in Group P, but it was not statistically significant (p>0.05). No significant difference was found in the comparison between the groups.

Table 3. Peroperative hemodynamic properties.

		Control Group (n=20)	Pentoxyphiline Group (n=20)
Use of inotropes (n)		7	8
Vasopressor use (n)		8	13
CVP (mmHg)	Preoperative	7.56 ± 2.84	7.68 ± 2.83
	Postoperative	8.00 ± 3.12	7.90 ± 2.81
MAP (mmHg)	Before NS/PTX	83.08 ± 15.08	83.95 ± 18.02
	After NS/PTX	73.48 ± 14.20	77.00 ± 18.30
HR (beat/min)	Before NS/PTX	70.84 ± 13.64	66.40 ± 9.46
	After NS/PTX	65.20 ± 13.75	64.00 ± 13.75

The data are presented as mean ± standard deviation or number.
CVP: Central venous pressure; MAP: Mean arterial pressure; HR: Heart rate;
PTX: Pentoxyphiline; NS: %0.9 NaCl (Normal Saline).

S100ß protein measured at the CPB exit was significantly higher than the S100ß protein levels measured before induction, at the 3rd hour after surgery and at the 24th hour after surgery (p<0.001) (Table 4). NSE values measured at CPB exit were significantly higher than the pre-induction period (p<0.05). In the comparison between groups, S100ß and NSE values did not differ statistically in any period.

Table 4. S100ß (pg mL-1) and NSE (ng mL-1) values of the groups.

		Control Group (n=20)	Pentoxyphiline Group (n=20)
S100ß	Pre-induction	150.45±64.05	95.28±133.04
	CPB exit	840.90±578.05**	743.10±503.47**
	3rd hour after surgery	249.95±131.19	219.52±108.89
	24th hour after surgery	247.00±169.55	195.14±138.01
NSE	Pre-induction	22.81±11.61	23.04±11.32
	CPB exit	34.85±17.27*	31.70±13.04*
	3rd hour after surgery	26.28±14.61	30.11±11.74
	24th hour after surgery	26.23±13.49	26.53±13.00

The data are presented as mean ± standard deviation.
**p<0.001 Comparison with the intragroup CPB exit period.
*p<0.05 Comparison with the intragroup CPB exit period.

Standardized mini mental test (SMMT) and Benton test were used to evaluate the cognitive functions of the cases. There was no significant difference between the groups in the SMMT and Benton tests performed before and after the surgery (p>0.05). In the intragroup evaluation, although a decrease was observed in the Benton test scores after the operation in Group P, it was not statistically significant (p>0.05) (Table 5).

Table 5. Cognitive function test results of the groups.

		Control Group (n=20)	Pentoxyphiline Group (n=20)
Standardized Mini Mental Test	Before surgery	25.63 ± 3.40	24.76 ± 3.61
	After surgery	25.42 ± 3.45	24.41 ± 3.24
Benton Test	Before surgery	9.26 ± 3.08	9.52 ± 2.18
	After surgery	9.84 ± 3.51	8.29 ± 3.25

The data are presented as mean ± standard deviation.

4. Discussion

Our study found that S100ß and NSE levels peaked in both groups at CPB exit in patients who had undergone CPB operation and increased significantly compared to preoperative values. We found an approximate 5-6 fold increase in preoperative S100ß in the control group, while in the pentoxyphiline group, a 6-7 fold increase. NSE increased significantly from 22.81±11.61 ng/mL preoperatively to 34.85±17.27 ng/mL at CPB exit in the control group and from 23.04±11.32 ng/mL to 31.70 ± 13.04 ng/mL in the pentoxyphiline group. We could not find a significant difference between the postoperative 3rd and 24th hour values of NSE and S100ß and the preoperative values in both groups.

In a study on the prophylactic use of pentoxyphiline to preserve postoperative organ functions in elderly patients undergoing cardiac surgery, liver, kidney, and endothelial damage was found to be less in patients [6].

In another study investigating the effect of PTX on leukocytes and inflammation markers (TNFα, IL6, leukocyte count) in cardiac surgery and extracorporeal circulation, it was reported that PTX partially suppressed inflammation [17].

For the first time, Aberg et al. reported that increased levels of protein S100β were associated with cerebral damage [18]. Westaby et al. emphasized that protein S100β level increases as the duration of cardiopulmonary bypass increases, and Taggart et al. emphasized the relationship between neurocognitive tests and protein S100β [19,20]. Jönsson et al. reported that neurocognitive tests were negatively affected as protein S100β increased [21].

Neuron-specific enolase (NSE) is another marker to determine neurological survival in cardiac surgery. It has increased in central nervous system damage and head traumas [10].

In a study examining the variation of protein S100β and NSE over time during CPB and their relationship with each other, it was observed that both of them increased rapidly and proportionally, especially during the warm-up period (10-fold in protein S100β, 3-fold in NSE), while a 50% decrease was observed in NSE and a 79% decrease in protein S100β on the first postoperative day, and decreased to pre-bypass levels on the second postoperative day [11].

In the studies of Farsak et al., neurological survival in cardiac surgery was evaluated by a mini-mental test, and its relationship with protein S100β was examined. It was found that protein S100β peaked when the skin was closed after CPB and increased in direct proportion to the duration of CPB; a weak correlation was found in age, and there is a significant relationship between protein S100β elevation and neurocognitive tests. Protein S100β decreased to its normal level after 24 hours in half of the patients and 48 hours in the others [22].

In our study, these markers decreased significantly (60-70%) from the 3rd hour to the 24th hour after surgery, and we could not find a significant difference between them when compared with the preoperative values.

Wimmer-Greinecker stated they could not find a relationship between postoperative neuropsychological evaluation and S100ß and NSE in CPB operations [23].

In the study of Heinze et al., it was stated that a single dose of 5 mg/kg PTX given before the operation to patients scheduled for CPB could alleviate the inflammatory response. It was also reported that there was a shortening in ventilation and intensive care unit length of stay depending on this dose [24].

In the study of Das et al., in which 400 mg of pentoxyphiline was administered twice a day orally to patients scheduled for CPB operation from the day of hospitalization, a neurocognitive assessment was evaluated one day after hospitalization and on the seventh postoperative day. Although the perioperative use of PTX did not make a neurocognitive difference, it was stated that it reduced the early postoperative neurocognitive decline after CPB due to the decrease seen in the control group [25].

In our study, we could not find a significant difference between the results of the SMMT and Benton test performed on the seventh day after the operation and the preoperative period. Also, no difference was found between the groups. The absence of major comorbidities in our patients, the inclusion of only CPB patients in the groups except for valve surgeries reported in some studies, and the younger age of our patients compared to the average age reported in the literature affect our results. No significant neurological damage developed in any of our patients. There are also publications reporting a weak relationship between neurocognitive dysfunction

and these biochemical markers, apart from apparent neurological damage. There are also studies using various complicated neuropsychological and neuropsychiatric tests. In our study, we applied the SMMT and Benton tests because they can be done quickly in daily practice and are easy to apply. The specificity and sensitivity of the tests we used should also be considered since there was no difference between our groups regarding neurocognitive functions.

The limitations of our study are the insufficient number of patients in evaluating the effect of PTX, the younger average age compared to other studies, and the necessity of studies involving more elderly patients to evaluate the long-term effects of pentoxifylline use on cognitive functions.

In conclusion, our study found that NSE and S100ß protein significantly increased in CPB exit, consistent with the literature. Since there was no difference between the groups in neurocognitive functions, it can be said that this is not an indicator of neuron damage in the early period. We found that pentoxyphiline, which is effective in organ preservation, but we could not find any information on cerebral protection except for an experimental study in the literature, did not make a significant difference between the groups regarding early cerebral damage and neurocognitive dysfunction.

Author Contributions

All of the authors made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; they have been involved in drafting the manuscript or revising it critically for important intellectual content; have given final approval of the version to be published.

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Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of İstanbul University-Cerrahpaşa Faculty of Medicine. Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

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Research Article

Comparison of ultrasound-guided genicular block vs. intrathecal morphine for postoperative analgesia in patients undergoing knee arthroplasty: A randomised prospective study

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ABSTRACT

Aim: Total knee arthroplasty (TKA) is a major orthopedic surgical procedure often necessitating effective postoperative analgesia. This study aimed to compare the analgesic efficacy of ultrasound-guided genicular block (GB) and intrathecal morphine (ITM) in patients undergoing THA under spinal anesthesia.

Method: A prospective, randomized, single-blind study was conducted at Ordu University Training and Research Hospital from October 1, 2022, to April 1, 2023. Eligible patients aged 18 to 90 undergoing knee surgery with spinal anesthesia were randomized into two groups: Group ITM received intrathecal morphine, while Group GB underwent ultrasound-guided triple genicular block. Pain scores, rescue opioid consumption, time to initial mobilization, and Modified Bromage Scale (MBS) scores were assessed at five time points (0, 2, 6, 12, and 24 hours) within the first 24 hours post-surgery.

Results: At the 24-hour mark, cumulative tramadol consumption was significantly lower in Group ITM compared to Group GB (35.45±54.84 vs. 63.37±37.7 mg, respectively, $p = 0.028$). Group ITM also exhibited statistically lower Numeric Rating Scale (NRS) scores at 12 hours ($p = 0.005$) but had similar scores at other time points. Additionally, time to first ambulation and MBS scores were consistent across all intervals ($p < 0.05$).

Conclusions: In patients undergoing knee arthroplasty with spinal anesthesia, those receiving ultrasound-guided genicular blocks demonstrated higher opioid consumption over a 24-hour period compared to those receiving intrathecal morphine. However, regarding postoperative pain scores, both groups exhibited similar outcomes. These findings provide valuable insights into the selection of postoperative analgesic modalities for TKA patients.

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1. Introduction

Total knee arthroplasty is a widely embraced surgical intervention for patients suffering from persistent knee pain and functional limitations, consistently yielding favorable outcomes [1,2]. Wang et al. initially introduced the use of intrathecal morphine for pain management [3]. Originally employed to mitigate acute postoperative discomfort, particularly in cancer-related surgeries, intrathecal morphine has demonstrated efficacy even in extensive orthopedic procedures [4–12]. In the realm of peripheral nerve blocks, the genicular block has emerged as a promising approach to alleviate pain in total knee arthroplasty [13]. This modern peripheral nerve

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block has captured the attention of anesthesia practitioners, who utilize it either independently or in combination with other methods to address postoperative pain following knee arthroplasty [13]. Empirical studies underscore the dual advantages of genicular blocks: reducing opioid consumption in major orthopedic surgeries while also facilitating unrestricted mobilization, thanks to their minimal impact on motor function [14].

The objective of this study was to perform a comparative analysis of postoperative analgesic strategies in patients undergoing knee arthroplasty with spinal anesthesia, specifically comparing ultrasound (US)-guided genicular block (GB) and intrathecal morphine (ITM). Our principal research hypothesis posited that the use of genicular block would result in decreased postoperative opioid consumption while maintaining comparable pain scores to those achieved with intrathecal morphine administration.

2. Materials and Methods

This study was designed as a prospective, randomized, comparative investigation with blinded assessors. It was conducted at Ordu University Training and Research Hospital from October 1, 2022, to April 1, 2023. Ethical approval for the research was obtained from the Ordu University Clinical Research Ethics Committee (Decision no: 2022/247, Date: 16.10.2022) to ensure strict compliance with the principles delineated in the Declaration of Helsinki. Inclusion criteria encompassed patients aged 18 to 85 scheduled for unilateral knee arthroplasty under spinal anesthesia, all of whom provided written informed consent. Exclusion criteria included individuals contraindicated for neuraxial or peripheral blocks, those with ongoing infections or malignancies, individuals with active psychopathological or neurological conditions potentially impacting pain perception, individuals with malnutrition, and those who declined regional anesthesia.

2.1. Randomization and blinding

We employed the sealed envelope method to achieve randomization, guaranteeing an unbiased allocation of participants to the study groups. To uphold the study's integrity, a single-blind protocol was implemented. The anesthesiologist (EC) responsible for administering the blocks remained separate from the subsequent postoperative data collection. A different anaesthesiologist (IC), unaware of the specific block performed, conducted the data collection, ensuring the blinded nature of the assessment.

2.2. Spinal anesthesia procedure

During the preoperative phase, no premedication was administered. Upon entering the operating room, patients underwent routine monitoring, which included pulse oximetry, electrocardiography, and noninvasive blood pressure measurement. Vascular access was established by inserting a 20 G intravenous cannula into the dorsum of both hands. Hydration was maintained by intravenously infusing a 0.9% NaCl solution at a rate of 4 ml/kg/h.

Subsequent to preparatory measures and sterile draping, a 25-Gauge spinal needle was utilized to administer 15 mg of hyperbaric bupivacaine for spinal anesthesia. Typically, this injection was performed at either the L2-L3 or L3-L4 vertebral level to achieve the targeted sensory blockade. Upon attaining the desired level of sensory block, patient comfort was enhanced through the intravenous administration of midazolam at a dose of 0.07 mg/kg .Patients assigned to the intrathecal morphine group (Group ITM) received an additional 400 mcg of intrathecal morphine, concurrently with 15 mg of hyperbaric bupivacaine. This administration was meticulously conducted using the same sterile syringe to uphold optimal aseptic conditions. For patients in the genicular block group (Group GB), only 15 mg of hyperbaric bupivacaine was injected into the intrathecal space.

2.3. Ultrasound guided genicular nerve block

In this study, genicular block interventions were performed after inducing spinal anesthesia with 15 mg hyperbaric bupivacaine. In the genicular block group (Group GB), a 5 ml solution of 0.25% bupivacaine was carefully administered to each of the three genicular nerves under ultrasound guidance. The procedure involved blocking the superior medial genicular nerve (SMGN), inferior medial genicular nerve (IMGN), and superior lateral genicular nerve (SLGN).

For SMGN blockade, anatomical landmarks were identified, including the medial femoral epicondyle and adductor tubercle, and the block needle was guided towards the superior medial genicular artery. For IMGN blockade, landmarks such as the medial tibial epicondyle and distal medial collateral ligament were used, guiding the needle towards the inferior medial genicular artery. The SLGN blockade involved visualizing the lateral femoral epicondyle and the deep edge of the vastus lateralis muscle, with the needle directed near the superior lateral genicular artery. This meticulous and standardized approach ensured precise nerve blockade for effective pain management.

2.4. Postoperative analgesia management and the evaluation of outcomes

All patients received scheduled analgesia comprising intravenous paracetamol (3x1 g) and tenoxicam (2x20 mg). Following surgery, all patients from both study groups were connected to a patient-controlled analgesia device enabling the administration of tramadol (20 mg) via bolus injection, without continuous infusion. The cumulative tramadol consumption within the first 24 hours post-surgery was meticulously recorded, providing valuable insights into postoperative pain management dynamics.

Critical parameters were systematically documented for each patient during the initial 24-hour postoperative period, including pain scores, tramadol consumption, time to initial mobilization, and Modified Bromage Scale

(MBS) scores. Numeric Rating Scale (NRS) scores were used for pain intensity assessment and diligently recorded at various time intervals, commencing with the baseline (0 h) in the postoperative recovery room. Subsequent assessments occurred at 2 hours, 6 hours, 12 hours, and 24 hours after the patient's transfer from the recovery room to the ward.

Concurrently, MBS scores were consistently evaluated at corresponding time points (0, 2, 6, 12, and 24 hours), categorized as follows: 0 = no motor block, 1 = inability to fully extend the leg while retaining knee flexion, 2 = inability to flex the knee but with unrestricted foot movement, 3 = complete block, indicating no movement of the leg or foot. Furthermore, meticulous documentation encompassed the quantification of opioid consumption during the initial 24 hours following surgery, along with the time taken for the initial mobilization of patients."

2.5. Sample size estimation

Sample size determination for this study relied on opioid consumption data obtained from a previous study [12]. Calculations were performed using the G*Power V. 3.1.9.6 software. A total of 40 cases, distributed evenly with 20 cases in each group, were determined as necessary for this study, considering a 95% confidence level (1-α), an 80% test power (1-β), and an effect size of d = 0.812. To account for potential data losses and dropouts, it was prudent to initially screen a total of 50 patients, representing a 25% increase over the calculated sample size.

2.6. Statistical analysis

The analysis of the study data was performed using IBM SPSS version 23. Normality of the data was assessed using the Shapiro-Wilk Test. For parameters displaying a normal distribution, comparisons between groups were conducted using the Independent Samples t-Test. Conversely, for parameters deviating from a normal distribution, the Mann-Whitney U Test was employed to ensure robust analysis across all data types. Regarding categorical data, group comparisons were made utilizing Yates's correction and Fisher's Exact Test, as deemed appropriate. Categorical variables were depicted through median and min-max, while quantitative variables were presented as both mean ± standard deviation. The predefined threshold for statistical significance was established at $p < 0.050$. Additionally, given that NRS and MBS scores were measured at five separate time frames, Bonferroni correction was applied, and NRS and MBS assessments were considered statistically significant at $p<0.001$.

3. Results

In this study, 50 patients were initially enrolled, but 5 of them were subsequently excluded for various reasons. Consequently, a total of 45 patients were included in the analysis, with 22 in Group ITM and 23 in Group GB. Fig. 1, displayed as the CONSORT diagram, delineates the enrollment process for this study.

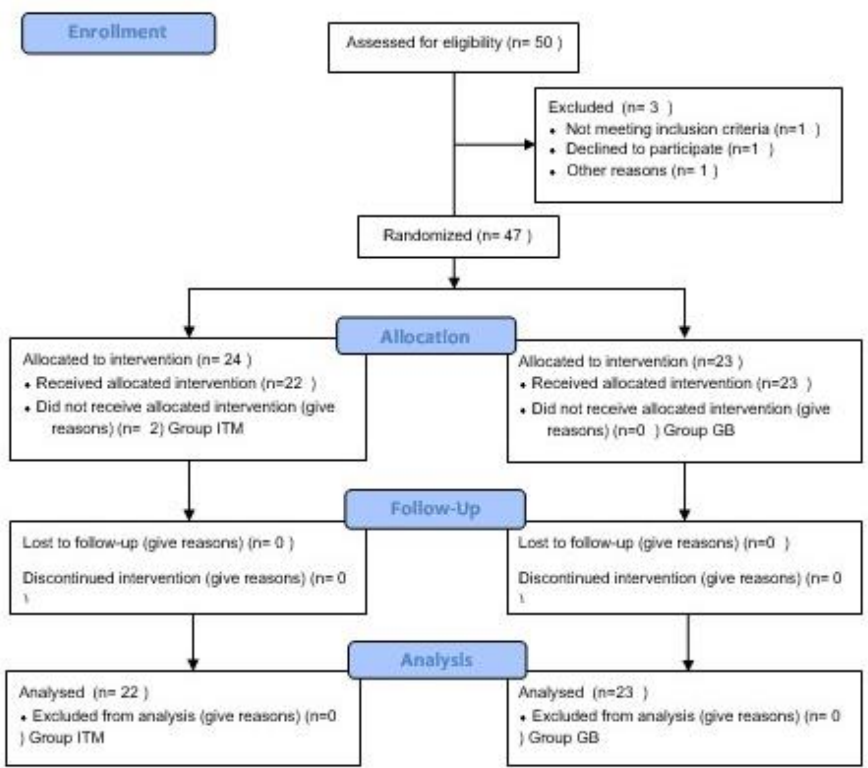

Fig. 1. CONSORT flow diagram of the study.

When groups compared for descriptive, no significant differences were observed between the groups in ASA class and gender (p>0.05). However, a significant disparity was evident between the groups concerning the age variable, with Group ITM exhibiting a younger patient population. Furthermore, the ITM group displayed shorter operation times, tourniquet times, and block application times (p values: p=0.019, p=0.016, p<0.001, respectively) as summarized in Table 1.

When comparing the groups based on Numeric Rating Scale (NRS) scores at various time intervals, a divergence in NRS scores was observed solely at the 12-hour mark, with Group ITM exhibiting lower scores than Group GB (p=0.002). However, the groups displayed similarity in terms of pain scores at all other time intervals (Table 2). The median values of the MBS scores, assessed at various time intervals, did not exhibit statistically significant variations between the groups (p>0.050) (Table 2).

A statistically significant difference was observed in opioid consumption between the groups (p=0.028). However, the median values for the time to the first mobilization did not exhibit statistically significant differences between the groups (p=0.102). (Table 3). Furthermore, no complications, such as nausea, vomiting, or itching, were reported in any of the cases within the initial 24 hours postoperatively.

Table 1. Comparison of quantitative sociodemographic characteristics between groups.

	Group ITM	Group GB	P value
Age (year)	64.09 ± 11.47	70.57 ± 7.6	0.043*
Weight (kg)	83.27 ± 17.77	83.52 ± 15.26	0.555
Height (cm)	170.18 ± 8.59	171.87 ± 10.78	0.566
Operation time (min)	65.91 ± 19.13	80.22 ± 23.33	0.019*
Duration of tourniquet application (min)	59.91 ± 18.71	73.39 ± 21.21	0.016*
Block administration time (min)	3.82 ± 2.79	12.39 ± 3.17	<0.001*
Gender (n, %)			
Male	12 (54.5)	14 (60.9)	0.899
Female	10 (45.5)	9 (39.1)	
ASA (n, %)			
2	20 (90.9)	15 (65.2)	0.071
3	2 (9.1)	8 (34.8)	

The data are presented as mean ± standard deviation or number (%).
*p<0.05

Table 2. Comparison of NRS and MBS scores between groups.

	Group ITM	Group GB	P value
Baseline NRS	0 (0 - 0)	0 (0 - 0)	1.000
2-hour NRS	0 (0 - 2)	0 (0 - 5)	0.978
6-hour NRS	0 (0 - 6)	1 (0 - 8)	0.115
12-hour NRS	1 (0 - 5)	2 (0 - 8)	0.005
24-hour NRS	0 (0 - 7)	1 (0 - 6)	0.027
Baseline MBS	3 (3 - 3)	3 (3 - 3)	1.000
2-hour MBS	1 (0 - 3)	1 (0 - 3)	0.925
6-hour MBS	0 (0 - 1)	0 (0 - 2)	0.625
12-hour MBS	0 (0 - 1)	0 (0 - 2)	0.311
24-hour MBS	0 (0 - 0)	0 (0 - 0)	1.000

The data are presented as min-max.
NRS: Numeric rating score; MBS: Modified bromage score.

Table 3. Comparison of time to first mobilization and amount of tramadol consumption between groups.

	Group ITM	Group GB	P value
Time to first mobilization (hour)	13.05 ± 5.96	16.39 ± 7.37	0.102
Tramadol consumption (mg)	35.45 ± 54.84	60 ± 37.17	0.028

The data are presented as mean ± standard deviation.

4. Conclusions

Based on the findings from our study, it was evident that tramadol consumption within the initial 24-hour period was notably lower in ITM group when compared to GM group. Moreover, the Numeric Rating Scale (NRS) scores exhibited a similar pattern in both groups, with no substantial differences observed at the 0, 2, 6 and 24 hours intervals during the measured. However, it is significant that a distinct difference in NRS scores emerged at the 12th hour mark, with the ITM group displaying significantly lower scores compared to the GM group.In a study on the prophylactic use of pentoxyphiline to preserve postoperative organ functions in elderly patients undergoing cardiac surgery, liver, kidney, and endothelial damage was found to be less in patients [6].

In a comprehensive study centered on knee arthroplasties, femoral and sciatic nerve blocks were ingeniously combined with a genicular block [15]. Within the femoral and sciatic block group, notably lower Numeric Rating Scale (NRS) scores and reduced opioid consumption were observed by the researchers. While our study did not directly compare two distinct peripheral nerve block techniques, certain similarities exist between our findings and the outcomes reported by Gümüşkanat et al. [15]. Specifically, our study demonstrated a discernible reduction in opioid consumption in the intrathecal morphine group when compared to the genicular block group.

Expanding beyond the genicular block, a spectrum of pain management options after total knee arthroplasty extends to techniques like the interspace between the popliteal artery and the capsule of the posterior knee (iPACK) block, selective tibial nerve block, adductor canal block, and even combinations of these distinct blocks [16–20].

In a notable anatomical study by Fonkoué et al. [21], the intricate distribution of knee joint nerves was meticulously explored using 21 lower limbs dissected from 21 cadavers. Their study shed light on the comprehensive innervation of various knee joint components, demonstrating that the medial portion of the knee capsule and the retinaculum find their innervation from multiple sources, including the vastus medialis nerve, saphenous nerve, anterior branch of the obturator nerve, and the inferior medial genicular nerve taking origin from the sciatic nerve. Innervation of the superolateral aspect of the knee joint is attributed to the sciatic nerve and the vastus lateralis nerve, while the inferolateral portion receives its supply from the fibular nerve. The posterior aspect of the knee capsule, in turn, receives innervation from the tibial nerve, a terminal branch of the sciatic nerve, and the posterior branches of the obturator nerve [21].

The genicular nerve block, traditionally used for managing chronic knee pain related to osteoarthritis, has recently gained significance in postoperative pain management after knee surgery within multimodal analgesic strategies [20]. Yasar et al. [22] conducted anatomical dissections on 6 cadavers, consistently visualizing nerves in 12 dissections focused on superior medial genicular nerve and inferior medial genicular nerve blocks. These ultrasound-guided blocks, guided by anatomical landmarks, were found to be viable and successful for these specific nerves. In our study, Group GB demonstrated effective pain relief during most of the measured time intervals (0, 2, 6 hours) compared to Group ITM. Only at the 12 and 24-hour marks did Group ITM report lower Numeric Rating Scale (NRS) scores. This difference in pain perception could be attributed to the extended half-life of morphine. Importantly, our results align with existing literature, affirming the efficacy of genicular blocks in postoperative pain management following knee surgery.

In a study by Kukreja et al. [13] involving 52 cases of primary knee arthroplasty, 26 patients received an adductor canal block, while an equivalent number underwent a combination of adductor canal block along with superolateral, superomedial, and inferomedial genicular nerve blocks. Interestingly, the group that received the combined genicular nerve and adductor canal block showed significantly lower Numeric Rating Scale (NRS) scores six hours after surgery. Moreover, there was a notable reduction in morphine consumption observed in the 6 to 12-hour period among patients who received the combined block [13]. In our study, our approach diverged as we independently administered blocks to the inferior medial, superior medial, and superior lateral genicular nerves, rather than combining them as done by Kukreja et al. However, akin to their results, we also observed lower NRS scores in the intrathecal morphine group at the 12 and 24-hour intervals. Essentially, our observed analgesic duration for the genicular block aligns with the findings detailed in the study by Kukreja et al.

In clinical practice, opioids have long held the esteemed status of being the 'gold standard' for postoperative pain management, with morphine playing a prominent role in this domain [23]. Among these opioids, intrathecal administration of morphine emerges as a particularly appealing regional technique, setting it apart from its epidural counterpart. Notably, this approach is characterized by its simplicity, expediency, and significantly reduced susceptibility to technical complications and infection risks when compared to epidural administration [24]. Synthesizing findings across diverse studies, a collective narrative emerges that underscores the utility of intrathecal opioids in reducing postoperative

pain, as demonstrated by a decrease in Numeric Rating Scale (NRS) scores. Simultaneously, it diminishes the necessity for supplementary analgesic interventions among patients [25–27].

In a placebo-controlled study by Kaczocha et al. [28] involving total knee arthroplasty, two groups were formed. One group received intrathecal morphine, while the other received intrathecal saline as a placebo, with all patients undergoing general anesthesia. The study revealed reduced postoperative pain scores in the intrathecal morphine group. Additionally, the results indicated that morphine influenced endogenous cannabinoid and cortisol levels, impacting immune functions by attenuating leukocyte activities.

There are several limitations to our study that should be acknowledged. One constraint arises from our focus on monitoring patients solely within the initial 24 hours postoperatively, which prevented us from assessing the potential long-term effects of the administered blocks on pain scores and complications. Extending our postoperative observations to a 48-hour period could have provided a more comprehensive perspective. Furthermore, our study was conducted with a relatively restricted patient population, and the absence of a larger sample size might be considered another limitation.

In conclusion, we observed that intrathecal morphine administration led to a more substantial reduction in cumulative rescue opioid consumption at 24 hours compared to genicular block. However, NRS scores remained similar between the two groups throughout all time periods except for the 12-hour mark. These results suggest that genicular block can be deemed a viable alternative within the realm of multimodal analgesia techniques for knee arthroplasty, offering potential benefits in postoperative pain management.

Author Contributions

All authors have made significant contributions to the design or data acquisition or analysis and interpretation of data; were involved in the drafting or critical review for important intellectual content; gave final approval of the version to be published.

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

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Research Article

Assessment of gender equality among graduates of anesthesiology residency in the last decade: A national data analysis

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ABSTRACT

Aim: Despite the global upward trend in the representation of female doctors, certain medical specialties continue to exhibit a notable gender disparity. The presence of an equitable gender distribution within the healthcare sector has been shown to enhance the overall quality of service provision and has the potential to enhance performance outcomes. The objective of our research is to examine the gender composition of anesthesiology and reanimation professionals in Turkey.

Methods: Data was collected regarding physicians who successfully completed their anesthesiology and reanimation specialization training and subsequently participated in the state service obligation lottery since the year 2013. Data provided by the General Directorate of Management Services of the Republic of Turkey Ministry of Health. The gender of the specialist physicians in the specified time period and the type of hospital they trained in were collected.

Results: There were 1249 males and 1400 females among the 2649 specialists with no difference in the gender distribution. Upon conducting separate annual evaluations, there were significant increases in the proportions of men in the years 2017 and 2021, as well as women in the years 2019 and 2023. Additionally, 852 of them had received specialization from training hospitals and 1797 from university hospitals. Over the course of a decade, there was an absence of variation in the hospital preferences of anesthesiologists with regards to gender distribution. However, in the subsequent years of 2018, 2021, and 2023, female anesthesiologists exhibited a significantly higher preference for these hospitals. In 2019, a notable trend was observed wherein female anesthesiologists from university hospitals, while in 2021, male anesthesiologists demonstrated a similar inclination.

Conclusions: In Turkey, the field of anesthesiology and reanimation demonstrates a balanced gender distribution in terms of expertise. There is no discernible disparity in the gender distribution among anesthesiologist' hospital preferences.

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1. Introduction

Although there are instances where women may be favored in certain professions, it is widely acknowledged that there are other professions where women are not preferred, irrespective of their abilities and qualifications [1]. The medical profession still lacks gender equality, particularly in senior positions. Despite the equitable distribution of genders within medical faculties, there exists a notable underrepresentation of women in academic and leadership roles. The pervasive lack of female representation in academic and professional spheres frequently serves as a source of discouragement for women [2].

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The presence of a gender-balanced healthcare team is advantageous due to the inherent complementarity of interpersonal skills. The promotion of gender equality within the realm of healthcare yields numerous advantages with respect to the advantages it confers upon the patient. A workforce characterized by diversity and inclusivity enhances the probability of delivering healthcare services to marginalized and underserved populations.

The divergence in practice styles between male and female physicians presents a distinctive and advantageous circumstance for the patient population [3–5]. It has been known for a long time that the promotion of gender equality contributes to the advancement of the physician workforce, enhances physician-patient interactions, augments patient satisfaction, and ultimately enhances overall patient outcomes [6,7]. The presence of a gender-balanced team has been found to enhance overall performance and has the potential to positively impact per operative outcomes [8].

Despite the progressive growth in the representation of female physicians, a notable gender disparity persists within specific medical specialties [9]. In numerous countries, female physicians tend to gravitate towards areas of specialization such as gynecology and obstetrics, as well as pediatrics. Conversely, their male counterparts exhibit a greater preference for departments such as orthopedics and urology [9]. The preferences for specialization among physicians exhibit a strong correlation with their respective lifestyles. Female physicians often exhibit a preference for professional settings that afford them the opportunity to allocate more time towards domestic responsibilities, such as caring for their children, and exert greater control over their work schedules [8].

The aim of this study to examine the gender distribution among anesthesiology and reanimation specialists over the past decade, utilizing data on the gender distribution of anesthesiology and reanimation residency students in Turkey.

2. Materials and Methods

The study was carried out following the approval of the Samsun University Clinical Research Ethics Committee (SÜKAEK-2023 13/9), by analyzing the data provided by the General Directorate of Management Services of the Republic of Turkey Ministry of Health (https://yhgm.saglik.gov.tr). This system has been utilized to access the data pertaining to anesthesiologist who have successfully completed their specialization training in anesthesiology and reanimation, and subsequently participated in the state service obligation lottery, starting from the year 2013.

The study aimed to determine the distribution of anesthesiologist across different time periods, the hospitals where this anesthesiologist received their training, and the gender composition of the anesthesiologist. The study aimed to assess the influence of gender distribution on the hospital preferences of students pursuing anesthesiology and reanimation residencies. Additionally, the study examined the gender distribution of male and female anesthesiology and reanimation specialization students across different years.

The archival records of the General Directorate of Management Services within the Ministry of Health were subjected to a scanning process, where in the selection criteria encompassed anesthesiologists who successfully fulfilled their specialized training in Anesthesia and Reanimation within the time frame spanning from 2013 to 2023.

Inclusion criteria; it was stated in the article as 'Anesthesiologists appointed as a result of the state service obligation lottery between 2013 and 2023'. Exclusion criteria; People whose gender we could not determine with the data we obtained (ministry records, hospital records, social media platforms, i.e.) were excluded from the study.

2.1. Statistics

The statistical analysis was conducted utilizing SPSS 21 software. In the context of statistical analyses, a significance level of $p<0.05$ was deemed to be statistically significant. The frequencies and percentages of gender and hospital preference were computed. A cross-tabulation analysis was conducted to examine the relationship between gender and hospital preferences over different years. Subsequently, a Pearson Chi-square test was employed to assess the statistical significance of this relationship. Furthermore, the years were organized into clusters of three, and these clusters were then subjected to cross-tabulation based on gender. Subsequently, a chi-square test was conducted.

3. Results

The research revealed that 2649 specialist physicians completed the anesthesiology and reanimation specialization program between 2013 and 2023 and were placed through the state service obligation lottery. Among these anesthesiology specialist students, 1249 were male and 1400 were female. Upon examination of the aggregate figure, it is evident that there was an absence of disparity in relation to the distribution of genders. Among a total of 2649 specialist physicians, it was found that 852 individuals expressed a preference for training and research hospitals, while the remaining 1797 individuals favored university hospitals. There was no significant difference in physicians' hospital preferences in relation to gender distribution throughout the entire duration of the study ($p=0.289$) (Table 1).

Table 1. Gender and hospital preferences.

	Training and Research Hospital	University Hospital	Total	
Gender	n	n	n	%
Male	389	860	1249	47.15
Female	463	937	1400	52.85
Total	852	1797	2649	100.0

*:Pearson Chi-Square; P=0.289; n: number.

Upon analyzing the gender distribution across different years, a notable disparity was observed. Specifically, there was a substantial overrepresentation of males in the years 2017 and 2021, while females were more prevalent in 2019 and 2023 (p<0.001). The provided visual representation, denoted as Fig. 1, is presented for reference.

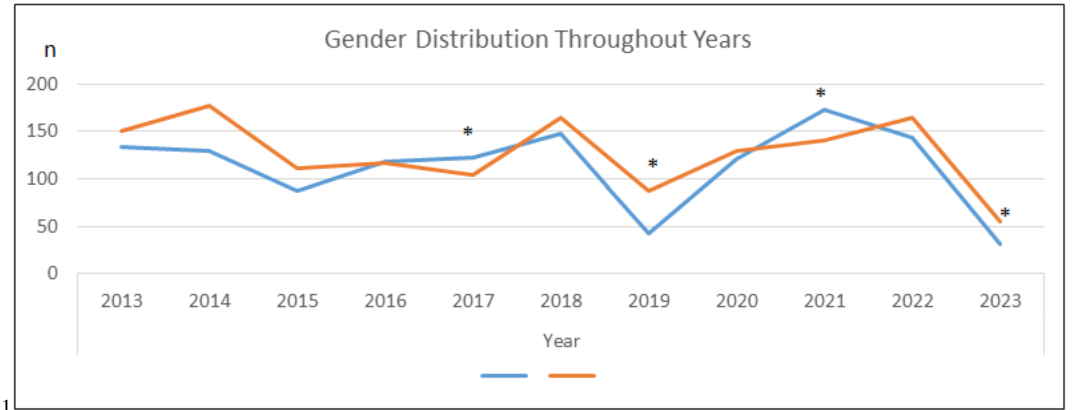

Fig. 1. Gender distribution throughout years (*:p<0.001; n: number).

Upon conducting a separate evaluation of the association between hospital preferences and gender across different years, it was observed that male physicians exhibited a greater preference for training and research hospitals in both 2016 and 2017. Conversely, female physicians demonstrated a higher preference for such hospitals in 2018, 2021, and 2023. This association was found to be statistically significant (p=0.008). The data indicates that female physicians exhibited a higher preference for university hospitals in 2019, while male physicians displayed a similar preference in 2021 (p=0.012) (Fig. 2).

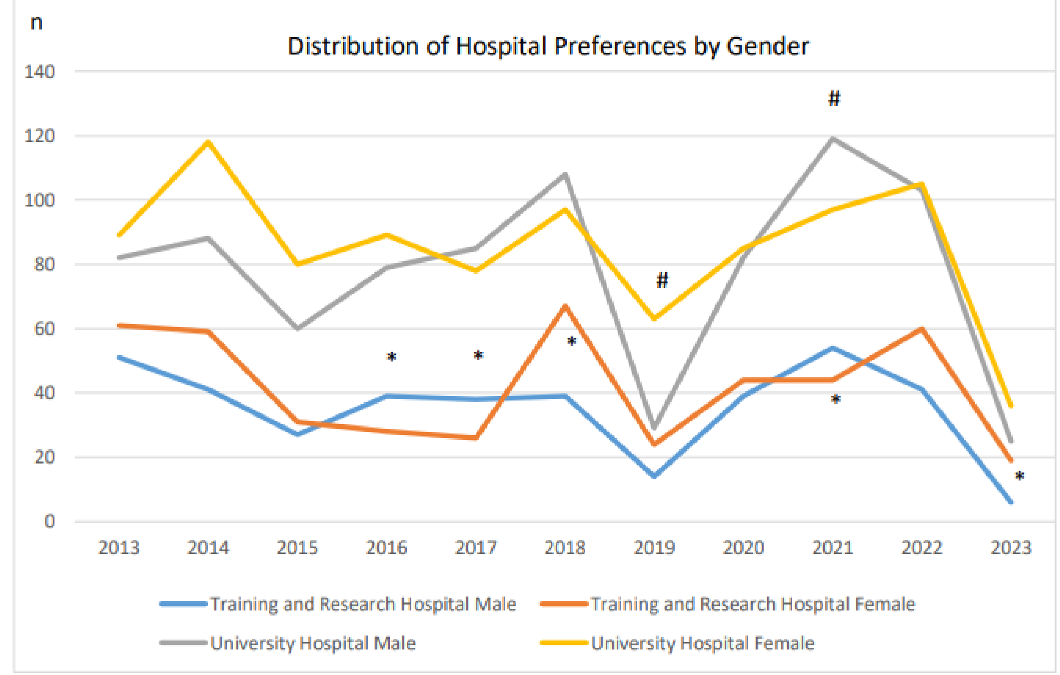

Fig. 2. Distribution of Hospital Preferences by Gender throughout the years. The gender's institute preference that causes a statistical difference in the evaluations is indicated with * and # signs (*:p<0.05 n: number).

No significant gender differences were observed when the years were categorized as Group 1 (2013-2015), Group 2 (2016-2018), and Group 3 (2019-2021). Nevertheless, it was noted that Group 1 exhibited a greater proportion of female physicians, while Groups 2 and 3 displayed a higher representation of male physicians. Upon comparing the first group with the second group, it was observed that the proportion of female physicians was notably greater than that of male physicians, as indicated in Table 2. No statistically significant difference was found between these groups when analyzing the preference tendencies of male and female physicians for training and research hospitals and university hospitals (p=0.058).

Table 2. Comparison of the preferences of male and female physicians when years are grouped.

		Male		Female		Total		
Years		n	%	n	%	n	%	p
Group 1	(2013-15)	349	44.3	438	55.7	787	100	
Group 2	(2016-18)	388	50.2	385	49.8	773	100	0.058*
Group 3	(2019-21)	337	48.6	357	51.4	694	100	

*:Pearson Chi-square; n: number.

4. Conclusions

In the present investigation, an examination was conducted on the gender composition of anesthesia residency trainees from 2013 to 2023. The findings revealed that there was a greater representation of male individuals in the years 2017 and 2021, while female individuals exhibited higher numbers in 2019 and 2023. Upon analyzing the hospital preferences of physicians, it was noted that male physicians exhibited a greater inclination towards training and research hospitals in the years 2016 and 2017. Conversely, female physicians displayed a preference for such hospitals in the years 2018, 2021, and 2023. The data indicates that female physicians exhibited a higher preference for university hospitals in 2019, while male physicians demonstrated a greater preference for university hospitals in 2021. When examining the historical development of anesthesia specialist medicine in Turkey, it is evident that among the initial cohort of six physicians who obtained specialization in 1957, one was female while the remaining five were male [10]. Upon examining the data pertaining to the influx of specialist physicians entering the field of anesthesiology since 2013, it has been observed that the distribution of female and male practitioners stands at 1400 and 1249, respectively. Consequently, the proportion of female anesthesiologists among the newly established cohort amounts to 52.8%. In 2010, the proportion of female to male permanent anesthesiologists in the United States (USA) was 75.5% and 24.3% respectively. However, in 2021, this proportion shifted to 68.84% for females and 31.16% for males [11]. In a separate publication presenting empirical evidence from the United States, the proportion of women practicing as anesthesiologists was documented as 32.8% during the period of 2007-2008, subsequently decreasing to 32.4% in the timeframe of 2017-2018 [12]. The findings of our study indicate a higher proportion of female anesthesiologists within our sample. Based on the 2023 data provided by the Turkish Society of Anesthesiology and Reanimation, it was observed that out of the total registered anesthesiologists, 2225 were identified as female, while 1790 were identified as male. Consequently, the female-to-male ratio was determined to be 55.4% to 44.6% respectively. The numerical values align with the data that was acquired during our research investigation. There is no indication of gender inequality within the field of anesthesiology in Turkey.

In the academic year of 2004-2005, an examination of medical school enrollment in Canada revealed a notable disparity between the number of male and female students. Specifically, the male student population surpassed that of their female counterparts, a trend that was particularly pronounced within the field of anesthesia [13]. According to data from the 'Medical Workforce Census Report 2020' in the United Kingdom, 31.2% of permanent anesthesiologists are female. The current rate of representation exceeds that of 2007 [14].

The field of anesthesia requires a high level of expertise, as it encompasses various challenges. These challenges include enduring extended working hours, being constantly available for duty, operating within confined spaces, maintaining continuous vigilance, being exposed to high levels of noise, radiation, and electromagnetic fields, as well as collaborating and effectively communicating with other units [15]. The field of anesthesiology may experience reduced preference due to certain disadvantages associated with female physicians, including considerations related to maternity status, increased responsibilities in household tasks, particularly in light of long working hours, and the nature of working in a confined environment. Particularly amidst the Covid-19 pandemic, mothers experienced a heightened burden of mental and physical responsibilities compared to fathers, primarily attributed to factors such as the limited availability of babysitters. Additionally, the implementation of social distancing measures resulted in a decreased need for domestic assistance, while also negatively impacting the productivity of female scholars [16].

In a separate investigation concerning the perception of parental leave within the anesthesiology residency program in the United States, it was noted that female residents experienced a greater impact compared to their male counterparts when faced with the arrival of a child patient. Furthermore, it has been determined that individuals who delay their plans for childbearing until the later stages of their specialization tend to perceive an escalation in infertility issues and encounter conflicts between breastfeeding and their professional obligations [17]. The prevalence of female anesthesiologists in our nation may be attributed to the prevailing traditional family structure and societal expectations placed upon women, as well as the relative resilience of female anesthesiologists in the face of these challenging circumstances. Gender equality in the field of anesthesiology appears to have been attained within our nation, in contrast to prevailing global norms.

We acknowledge the presence of certain limitations within our study. Our research focused on the assessment of anesthesia residencies on a nationwide scale. It is important to note that within the realm of anesthesia training, numerous subspecialty programs exist, includ-

ing pain medicine, perioperative medicine, and intensive care, each of which may exhibit distinct characteristics and variations based on regional factors.

Within these specialized domains, there exists the potential for gender-related disparities and evaluations in gender equity. We must acknowledge that our study may have unintentionally omitted valuable insights by not directly engaging with subject matter experts. Furthermore, we did not account for individuals who chose not to disclose their gender orientation or the LGBTQ+ community. It is imperative to clarify that our approach in this regard should not be misconstrued as an act of discrimination or marginalization. Rather, it was necessitated by the study's design and constraints. Nevertheless, we recognize the importance of further exploration and sensitivity in addressing gender-related aspects in future research endeavors."

In conclusion, it is evident that gender inequality persists as a significant issue within the field of anesthesiology on a global scale. Based on the analysis of data pertaining to graduates specializing in the field after 2013, our findings indicate the absence of gender inequality. The field of anesthesiology remains equally favored by both male and female physicians.

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Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

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Research Article

Frequency and importance of herbal use among presurgical patients: A prospective cohort study

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ABSTRACT

Aim: Herbal medicine has been used by humankind since ancient times. However, its popularity has increased in the last 20-30 years. In addition to the production, presentation and marketing of herbal medicines, their effects on the body are also very complex. Uncertainty about the effects of these drugs on the body has increased the importance of pre-anesthetic evaluation. To determine the frequency of herbal drug use in patients presenting for preoperative evaluation and to highlight its importance in anesthetic practice.

Method: It was designed as a prospective study with observational-analytical character. Patients over 12 years of age presenting to the Anesthesia Outpatient Clinic of our hospital for pre-anesthetic assessment were interviewed about their use of herbal medicines for 2 months. Patients who used herbal medicines were asked about the medicines they used.

Results: A total of 2712 patients were evaluated. Of the patients attending the outpatient clinic, 2367 were over 12 years of age. The use of herbal drugs was found to be 1.18% (n=28). Among the patients who used herbal medicines, 53.6% were female and the mean age was 52.18±15.87 years. The most commonly used herbal medicines were black cumin, green tea, ginger, turmeric, cinnamon, and olive leaf.

Conclusions: The use of herbal medicines may be much higher than detected in patients presenting for pre-anesthetic examination. As the effects of herbal products are very uncertain, they may interact with anesthetic drugs. They can prolong bleeding time, increase blood pressure and cause heart problems. For these reasons, they should be closely questioned in the pre-anesthetic examination and discontinued before surgery.

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1. Introduction

Before the development of modern medicine, patients sought treatment from traditional healers using various herbs and chemicals that could be obtained under the conditions of the time [1]. Despite the development of modern medicine, the search for alternative medicine continues today. Applications of alternative medicine are found in almost every field, including pain, nutritional support, medical treatment, psychotherapy, rehabilitation, and even alternative medicine is involved in diseases that fall within the field of surgical sciences [2]. This intense search for alternative treatment by patients has found an answer in modern medicine, and modern medicine has begun to approach the subject from different perspectives, such as complementary medicine, alternative medicine or holistic medicine [3].

However, herbal supplements in particular are widely preferred because they create a more natural perception in patients and are both cheaper and easily accessible [4]. In our country, there is a wide market for herbal medicines, ranging from local markets where medicinal and

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aromatic plants are sold as part of our culture, to companies that produce more industrial herbal medicines.

Herbal mixtures, also called natural herbal products, can be obtained without a prescription in our country and are frequently used by many people. Many patients preparing for the operation can also use these herbal mixtures and medicines, which are available without a prescription, in addition to the prescription medicines. These herbal medicines may be directly effective or they may be effective by pharmacodynamic and pharmacokinetic means. Thus, side effects can often be observed. It may also be possible that they may increase bleeding or show drug interaction with other drugs used in anesthesia [1]. It has been shown in various studies that they may also increase mortality and morbidity. For example, there are cases including epidural hematoma associated with excessive garlic consumption [5], bilateral subdural hematoma associated with ginkgo use [6], and acute renal failure associated with Chinese weight loss pills [7]. In the preoperative anesthesia examination, the use of herbal medication should also be questioned when the drugs used by the patients are interrogated, but it is frequently overlooked.

In anesthesia practice, patients are asked about their medications at the preoperative assessment, and possible drug-drug interactions and anticoagulant use are identified. However, they have not been questioned by physicians because they are not the focus of modern medicine and the use of these drugs has not been reported by patients because they are natural and innocent [8].

The objective of this research was to establish the prevalence of herbal medicine use and the most widely used herbal medicines in patients attending the Anesthesia Outpatient Clinic for preoperative analgesia.

2. Materials and Methods

Our study was designed as a prospective observational study. After obtaining the necessary ethical approval from the Clinical Research Ethics Committee of Kocaeli University (KOU KAEK 2015/8), patients who applied to the Anesthesia Outpatient Department of a tertiary hospital for preoperative examination were planned as the study population.

Inclusion criteria: Being 12 years or older, having applied to the outpatient clinic for preoperative anesthesia examination, and agreeing to participate in the study. Patients under 12 years of age, patients with an indication for emergency surgery, and patients with pain were excluded from the study.

When the use of herbal medication was questioned in the anesthesia outpatient clinic, patients who expressed the use of medication were asked to fill out a questionnaire about their use of herbal medication after informed consent was obtained.

In addition to demographic data such as age, gender, and educational status, the herbal medicine they were using, how long they had been using this medicine, where they learnt the medicine, for what purpose they were using the medicine, chronic disease status, and abnormal laboratory results were recorded.

2.1. Statistics

The analyses were conducted using the SPSS 25.0 program. In the descriptive statistics of the data, values such as the mean, standard deviation, median, minimum, maximum, frequency, and ratios will be used. The Kolmogorov-Simirnov test will be utilized for evaluating the distribution of the variables. Quantitative data will be analyzed using the Mann-Whitney u test. The Wilcoxon test will be used to analyze the results of multiple measurements. Correlation analysis will make use of the Spearman correlation method. Statistical significance threshold was determined as $p<0.05$.

3. Results

The study comprised 2712 patients who attended the anesthesia outpatient clinic at our hospital. Of these, 345 patients were ineligible due to being under 12 years of age. The final evaluation included 96 patients aged between 12 and 18 years and 2271 patients who were over 18 years of age.

Out of the 2367 patients who were queried about their usage of herbal medicines, 32 reported using oral supplements. However, 4 patients were excluded due to non-herbal use. It was determined that 28 patients (1.18%) were found to be utilizing herbal medicines. (Fig. 1).

The age range of patients using herbal medicines was 18-85 years (52.18±13.87). The demographic details of the patients are shown in Table 1. When we looked at the data related to the drugs used by the patients, we found that the shortest duration of drug use was 7 days and the longest duration of use was 15 years. It was found that 84.6% of the patients used the medication regularly and 50% of them used more than one herbal medicine/mixture (Table 2).

Table 1. Demographic data of patients using herbal medicines.

		Number (%) or Mean ± SD
Age (years)		52.18 ± 13.87
Gender	Male	13 (46.4%)
	Female	15 (53.6%)
	Total	28 (100.0%)
State of Education	Illiterate	1 (3.6%)
	Primary School Graduate	18 (64.3%)
	High-School Graduate	2 (7.1%)
	Associate Degree	2 (7.1%)
	Bachelor’s Degree	4 (14.3%)
	Master’s Degree	1 (3.6%)
	Total	28 (100.0%)

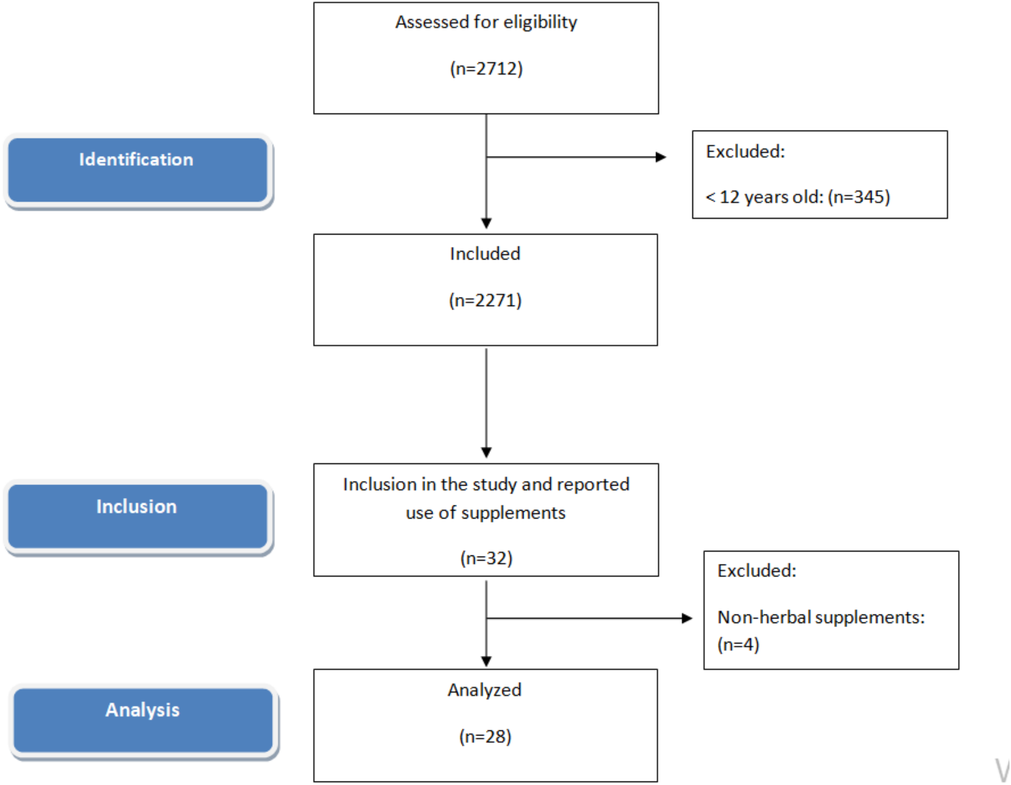

Fig. 1. Flow diagram of the study.

Table 2. Herbal medicines used and habits of use.

		N (%)
Regular use of medication	No	5 (17.9%)
	Yes	23(82.1%)
Multiple/mix use of drugs	No	14(50.0%)
	Yes	14(50.0%)
	Total	28(100.0%)

When we asked our patients whom they first heard about the herbal medicine they were using, we found that the most common source was advice from their own social circle, such as relatives and friends. The second most common source was television, followed by their own knowledge, and advice from doctors and pharmacists (Fig. 2).

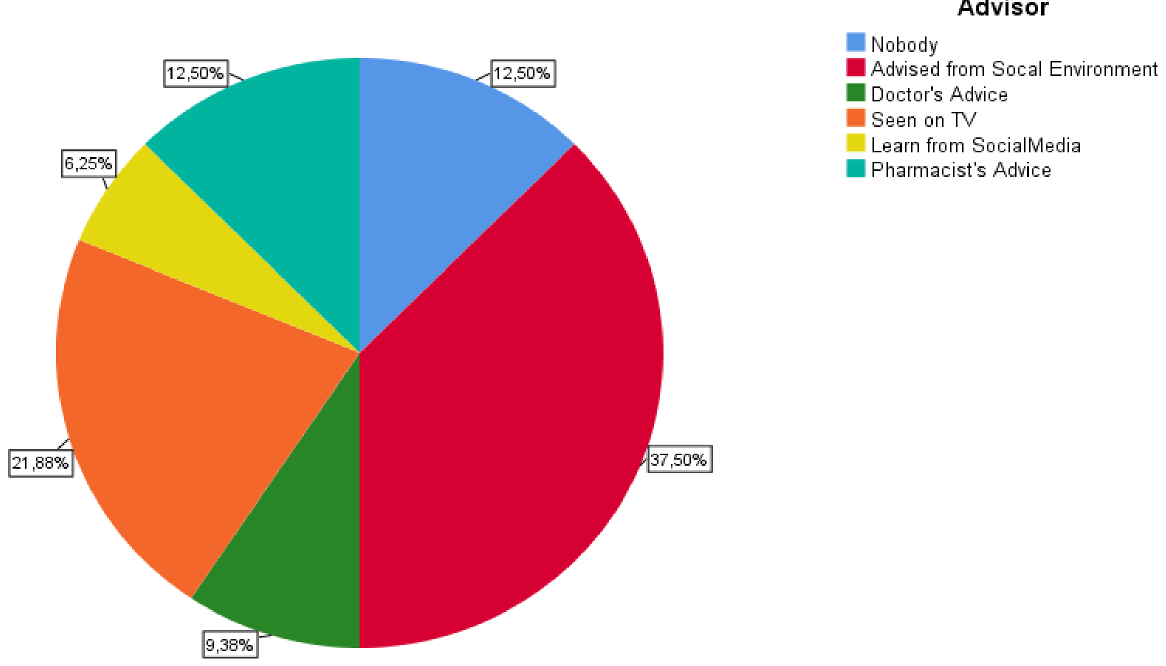

Fig. 2. Advisor of the herbal medicine.

When the co-morbidities of the patients were questioned, we found that 34% of the patients did not have any chronic disease and 28% had more than one chronic disease (Table 3). The number of patients with abnormal laboratory findings was n=9 (28%). Abnormal values in laboratory findings were compatible with the existing chronic diseases of the patients.

A detailed analysis of the herbs used by patients who declared that they use herbal medicines and the reasons for their use is given in Table 4. No side effects were observed in any of our patients neither in the intraoperative period nor in the postoperative period.

There was no statistically significant correlation among using multiple herbal remedies and having a chronic illness (p >0,005) (Table 5).

Table 3. Disease status of the patients.

Disease Status	N (%)
No disease	9 (32.1%)
One chronic disease	11 (39.3%)
More than one chronic disease	8 (28.6%)
Total	28 (100.0%)

Table 4. Case summaries of the study.

		n	Purpose of Use
Single Herbal Medicine	Black cumin	4	Anticancer, glucose regulation, anti-inflammatory
	Green tea	4	Indigestion, to lose weight, to live healthy, antioxidant
	Rhamnus catartica	1	Constipation
	Momordi cacarantia	1	Indigestion
	Ginseng	1	Vasodilator
	Gilaburu	1	Kidney stone
	Olive leaves	1	To regulate blood glucose level
	Parsley	1	Anti-edema
	Pistacia lentiscus	1	To treat low back pain
	Saw palmetto	1	To prevent prostate enlargement
Mixture of Herbs	Herbal slimming tea	3	To lose weight
	Black cumin, Cantaron, Carob molasses, St. John's wort	1	To treat of illnesses and to reduce stress
	Mixture of ginger, turmeric, cinnamon, sage	1	Asthma, goiter
	Reishi mushroom, olive leaf	1	Cleanse the bladder
	Horsetail herbal tea Moxibustion Black grape extract with seeds and skins	1	Supplement to main treatment
	Carob molasses Flax seed	1	Expectorant. To relieve lung
	Green tea, fennel, ginger, turmeric, cinnamon, rosehip, Lemon mixture	1	To live healthy
	Mesir Paste	1	To live healthy and improve the immunisation
Total		28	

Table 5. Relationship between health status and single/multiple herbal medicine preference.

	Single Herbal Drug	Mixture of Herbs	p
	n (%)	n (%)	
Healthy	5 (17.8%)	6 (21.4%)	0.699
Having chronic disease	9 (32.1%)	8 (28.5%)	

4. Discussion

In this prospective study, the frequency of herbal medicine use in patients who underwent anesthesia examination before surgery was found to be 1.18%. It was reported that 82% of the patients used herbal medicine regularly, but only 21.88% of them followed the advice of a healthcare professional (doctor or pharmacist). It was found that 67.9% of patients using herbal medicine had at least one chronic disease, and 50% of them were

using multiple herbal products. There was no statistically significant correlation between the occurrence of multiple chronic diseases and the use of multiple drugs.

If we consider the studies conducted globally and domestically, it is evident that the cultural variability impacts the prevalence of herbal medicine usage in society. Notably, in Asian countries like China and India, there is a widespread use of herbal medicines with a reported high usage rate of 80% during pre-anaesthetic examination [9]. In western societies, the rate is slightly lower and in a study conducted in California, 39.2% of patients reported using adjuvant products and 62% of these products were herbal [10]. Another study reported that 4.8% of patients attending the anaesthesia outpatient clinic used one or more herbal medicines [11]. In the study by Tsen et al, this rate was reported to be 22% [12]. If we look at the studies conducted in our country, it was 14.5% in the study by Yılmaz et al [13] and 35.8% in the study by Uysal et al [14]. In the study conducted, it was discovered that the prevalence of herbal medicine use was 1.18%. Furthermore, in our study, no herbal drug use was found in the group of patients aged 12-18 years, whereas in a study by İyilikçi et al [15], 32% of the pediatric age group reported current or past herbal drug use. In our study, the rate was quite low compared to the literature. We believe that this may be due to the fact that some herbal teas consumed in our daily lives are not expressed as herbal medicines by patients, and the fear of withholding information in the pre-anesthesia assessment. Previous studies have shown that a significant proportion of patients did not disclose their use of herbal medicines to the anesthetist and surgeon during the preanesthetic examination [2,10]

In our study, 53.2% of patients who used herbal medicines were female, and the mean age was 52.18±13.87 years. Concurrently, a literature review discovered that women and those aged 40-60 years had higher herbal medicine usage [8,10,11].

Echinacea, ephedra, garlic, ginkgo, ginseng, kava, valerian, St. John's wort are reported as the most commonly used plants in reports from the USA [8], and in reports from India [9], we see that more local products such as blueberry and cohosh species are used, as well as herbal species reported from the USA. Studies in our country have also reported the use of herbs such as green tea, cinnamon, ginger, garlic, thyme, sage, lime, mint, chamomile and senna [13–16]. In our study, black cumin seed, green tea, ginger, turmeric, cinnamon and olive leaf were the most commonly used herbal products.

It has been reported that the main indications for the use of these medicines are diseases such as diabetes mellitus, cancer and arthritis [9]. When we analysed the indications for the use of herbal medicines in our study, we found that patients used these medicines to support the treatment of their chronic diseases, to treat an acute illness, to lose weight or to stay healthy.

Patients use herbal medicines because they think they are harmless or because they underestimate the potential for side effects. However, there are not enough studies on allergic effects, liver and kidney side effects. When the side effects of the most preferred herbal products are studied, they are found to have serious side effects such as bleeding coagulation disorders, toxic hepatitis, spontaneous intracranial haemorrhage, arrhythmia, nausea, vomiting, immunosuppressive effect, hypo/hypertension, tachycardia, myocardial infarction, stroke, seizure [17–21].

Based on their side effects, publications report that herbal medicines have sedative, diuretic, antiaggregant, vasoconstrictor/vasodilator effects. They are also known to affect the pharmacodynamics and pharmacokinetics of drugs by inducing or inhibiting liver enzyme systems. [16,22–24]

In the study, it was found that black cumin seed and green tea were the herbal products most frequently used by the patients. When we looked at the side effects of these two products, we found that green tea may cause insomnia, arrhythmias, and antagonise the effect of warfarin because it contains high amounts of vitamin K [16]. It has been reported that black cumin increases liver enzymes, shortens aPTT, decreases hemoglobin, hematocrit and platelet count in case of advanced exposure, therefore its use is not recommended in patients using blood thinners, pregnant women and patients who will undergo surgery [25]. Ginger, which is widely used in Turkey, causes hyperglycemia, prolongs bleeding time, thyme; has tachycardic and diuretic effects, garlic; prolongs bleeding time, may cause hypotension, St. John's wort may decrease the activity of other drugs, ginseng; disrupts platelet aggregation, is a vitamin K antagonist[9,16].

For all of these reasons, the pre-anesthetic assessment should ask whether the patient is using herbal medicines in addition to the prescription medicines they routinely take. In the American Society of Anesthesiology (ASA) article on the use of herbal medicines, the potential effects of using herbal medicines before surgery are listed as follows: Prolonging the effect of anaesthesia Increased risk of bleeding. Increase blood pressure, interact with other medications, cause heart problems. For this reason, he recommends stopping herbal medicines 2-3 weeks before surgery [26].

In emergency scenarios, if the patient can provide information about the medication they are taking, it would be helpful to consider potential side effects. If the patient is not aware of the medication they are taking, it is necessary to assess preoperative liver and kidney functions, protrombin time (PT), activated partial thromboplastin time (aPTT), international normalized ratio (INR), and bleeding time. Additionally, a detailed blood count should be conducted, and hemodynamic instability and drug interactions during the per operative period should be examined. Vigilance is crucial in this regard.

5. Conclusions

As a result, herbal medicines are not as innocent as they are thought to be, and are used far more than is reported in the literature because of their easy accessibility, their use without a prescription and the fact that they are part of the culture of many countries. The number of herbal products used as herbal medicines is in the thou-

sands. The lack of standardization in the dosage, preparation and storage of these products, the paucity of randomised controlled trials on the effects of herbs, and the high number of reports of adverse effects have complicated the issue. For all these reasons, we believe that questioning the use of herbal supplements in the pre-anesthetic assessment, educating patients on the subject, and discontinuing the use of these drugs 2-3 weeks before surgery is one of the issues that should be included in daily anaesthesia practice.

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Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

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Research Article

Anesthesia in patients with electrical burn: A retrospective study

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ABSTRACT

Aim: We aimed to share our anesthesia experiences with patients hospitalized for electrical burns and underwent surgical intervention under anesthesia in the burn clinic of our hospital.

Method: Data gained from our hospital's patient files and medical information system were retrospectively evaluated. The study included patients diagnosed with electrical burns hospitalized in our burn clinic in 2018-2022.

Results: The study involved files of a total of 694 patients. Fifty (7.2%) patients were treated for electrical burns. The required data from 3 of the patients could not be accessed, therefore the study was completed including 47 patients. We found that 22 patients did not need surgical treatment. Twenty-five were given anesthesia for different surgical procedures: 20 of those received general anesthesia, while five underwent neuraxiel anesthesia/regional anesthesia. There were no anesthesia-related complications in any patients in the perioperative period.

Conclusions: Anesthesia applications should be carefully planned against possible complications in patients with electrical burns.

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1. Introduction

Burns are among the most common traumas worldwide, especially in developing countries, and are a significant cause of morbidity and mortality. According to the World Health Organization (WHO) data, approximately 11 million burn injuries occur annually, 180,000 of which result in death [1]. Burn injuries may occur after contact with flame, hot liquids, chemicals, and electricity. Electrical injuries constitute 5% of the total burn admissions to the hospital and are reported to cause approximately 1000 deaths per year in the United States of America (USA) [2] For electrical burns, these rates are much higher in low-income countries and can account for 30% of hospitalizations [3].

As the electric current passes through the tissues, it impairs the permeability of the cell membrane with a direct effect and causes cell necrosis. As an indirect effect, it damages the tissues it passes through due to the conversion of electrical energy into heat energy [4,5]. The severity of this damage depends on the voltage and duration of the electric current, the path the current travels through the body, and the resistance of the body tissues that the current encounters [6]. Necrosis may later develop in tissues that initially appear normal due to the nature of electrical burns, unlike other burns [7]. Necrosis can result in reduced or complete loss of function in the affected limb. Life-threatening complications such as kidney failure and sepsis may occur [8]. In effort to avoid such complications, close follow up of the patients must be performed and surgical interventions under anesthesia must be scheduled appropriately [9].

Both intensive care follow-up and intraoperative management of burn patients require special attention from the anesthesiologist. Depending on the severity of the burn, a systemic reaction develops in the body in ad-

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dition to the injury in the local burn area. Inflammatory and vasoactive mediators such as histamines, prostaglandins, and cytokines are released—capillary permeability increases. Intravascular fluid loss, decrease in cardiac output, hypovolemia, and hypo-perfusion develop [10,11]. Therefore, the following are critical in the management of burn patients: providing vascular access for appropriate fluid replacement at the appropriate time, providing hemodynamic support, maintaining organ perfusions, treating arrhythmias, controlling temperature regulation, determining difficult airway management and mechanical ventilation strategies when necessary, choosing the appropriate anesthesia method (if general anesthesia is to be applied), paying attention to the drugs to be used in the induction and maintenance of anesthesia, and providing pain control [12].

Our goal is to share the experience we have gained regarding anesthetic management of the patients hospitalized for electrical burns in the burn clinic of our hospital, who underwent surgical interventions under anesthesia.

2. Materials and Methods

This study was carried out retrospectively by evaluating our hospital's patient files and medical information system data. It involved patients hospitalized in our burn clinic with the diagnosis of electrical burns in the years 2018-2022 after receiving the approval of the Samsun University Ethics Committee (SUKAEK 2023/9/6). Patients who died within the first 24 hours and who were admitted to a department or hospital other than the burn clinic due to electrical burns were excluded from the study.

The study form included the following: the patients' age, gender, systemic diseases, American Society of Anesthesiologists physical status classification (ASA), burn percentage, previous surgeries, number of surgeries, anesthesia methods applied, development of Acute respiratory distress syndrome (ARDS), development of secondary infection, whether kidney failure developed, length of hospital stay, type of discharge. Complications and results of anesthesia methods applied in patients were evaluated.

2.1. Statistics

We used the Statistical Package for the Social Science (SPSS) program, version 26 (IBM, Corp. Armonk, NY, USA) for statistical evaluation. Distribution analysis of the data was evaluated using the Kolmogorov-Smirnov test or, for subgroup analyses with a sample size of 30 or less, the Shapiro-Wilk test according to normality tests. Patient data were presented according to normality test results using mean (± standard deviation) or median (interquartile range) for quantitative data and frequency (and percentage) for categorical data. Student T and Mann-Whitney U tests were used for comparisons between quantitative variables. Chi-square ($\chi 2$) and Fisher's exact test were used to compare categorical data. For all tests, a p-value of <0.05 was considered statistically significant.

3. Results

The files of 694 patients were reviewed during the study period. Treatment causes were as follows: electricity in 50 (7.2%) patients, hot water in 340 (49%), milk in 34 (4.9%), flame in 257 (37%), inhalation in two (0.3%), and chemical burns in 11 (1.6%). Data of three patients followed up for electrical burns could not be reached. The study was completed with 47 patients followed up for electrical burns (Fig. 1). Table 1 shows their demographic and clinical characteristics.

Flow Diagram

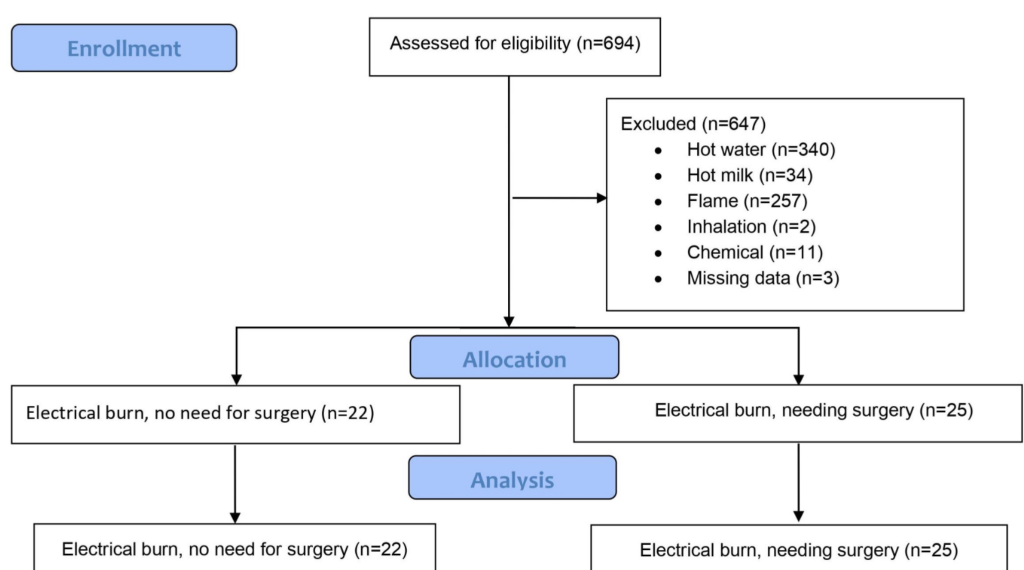

Fig. 1. Flow diagram showing patient selection.

Table 1. Demographic and clinical characteristics of the patients.

Age (years) mean ± SD	40 ± 15
Gender (female/male) n (%)	2 (4.3) / 45 (95.7)
ASA n (%)	
I	8 (17)
II	38 (80.9)
III	-
IV	1 (2.1)
TBSA (degree) median (IQR)	10 (22)
Technique n (%)	
Regional Anesthesia	5(10.6)
General Anesthesia	20(42.5)

ASA: American Society of Anesthesiologists physical status classification.
TBSA: Total body surface area.

Of the patients included in the study, 22 (46.8%) did not need surgical treatment and anesthesia. Six patients (12.8%) required surgical treatment and anesthesia for debridement, 11 patients (23.4%) for grafting, one patient (2.1%) for fasciotomy, and seven patients (14.9%) for amputation. We observed that 20 (80%) of the anesthetized patients underwent general anesthesia, and 5 (20%) underwent regional anesthesia. We found that propofol, fentanyl, and rocuronium were used most frequently (75%) for general anesthesia induction, and often (56%) anesthesia was maintained with sevoflurane inhaler anesthesia. Two (8%) patients needed inotropic support during the intraoperative period. Of the 25 patients who underwent surgical treatment, 24 required more than one surgical intervention. No patients had anesthesia-related complications in the perioperative period. The duration of the patient's stay in the hospital was [days; median (IQR)]: 27 (38). Complications that developed during the hospitalization period and the variables affecting the hospital duration are in Tables 2 and 3, respectively.

4. Conclusions

Electrical burns occur less frequently than scalding or flame burns. The mechanism of tissue damage is usually directly related to cell damage and denaturation caused by electrical forces. These patients deserve special attention because of their high morbidity and mortality rates. They constitute approximately 0.04% to 5% of all applications to burn centers in developed countries and 30% in developing countries [13]. The incidence of electrical burns was reported as 16% in a study conducted in our country, 17% in Kosovo, 18% in China, and 10.8% in Iran [1]. Although the frequency of electrical burns in our study was lower compared to some studies conducted in developing countries, it was generally similar to the literature.

Table 2. Complications during hospitalization.

ARDS n (%)	2 (4.3)
AKI n (%)	3 (6.4)
Secondary infection n (%)	18 (38.3)
Discharge n (%)	
Healing	30 (63.8)
Disabled	13 (27.7)
Mortality	3 (6.4)
Transfer to another hospital	1 (2.1)

Table 3. Variables of hospital duration.

	P
Need of anesthesia	< 0.01
ASA	0.371
Age	0.592
TBSA	< 0.01
Times of surgery	< 0.01

Electrical injuries are more common in men, as men are more exposed to power tools and work in high-risk jobs. Al et al.14 reported that 76.4% of electrical burns occurred in adult men and 23.6% in women. Haberal et al. similarly reported that 82% of electrical burns occurred in adult men and 18% in women. Another study carried out in our center indicated that 89% of the patients were male, and 11% were female [14]. In our study, 95.7% of our patients were men. Various studies have reported the mean age of electrically injured patients differently. The mean age is reported as 2.5 to 71.5 years, depending on the study population [1]. Our study's mean age (mean ± SD) was 40 ± 15 years.

Electrochemical and thermal damage caused by electricity passing through tissues may cause coagulation necrosis, hemolysis, thrombosis, muscle or tendon rupture, and massive tissue edema [15]. Compartment syndrome may develop in the extremities. Compartment syndrome is a condition that requires early diagnosis and emergency fasciotomy. Otherwise, amputation is inevitable. In addition, necrosis tissues should be cleaned with serial debridements, and wounds should be closed in the early period [16]. For this purpose, performing surgical interventions in burn injuries under anesthesia at the appropriate time is critical. Güzel et al. [17] performed 197 surgical procedures on 104 cases and reported that they performed one surgical procedure in 50% of the cases, two in 24%, and three or more in 26% of cases. They performed 94.2% of these procedures under general anesthesia. Michael et al. [18] performed 19 anesthesia-guided surgical procedures on 16 patients, 64.8% of which were general anesthesia and 26.3% were subarachnoid blocks. In our study, 96 surgical interventions were performed on 25 patients under anesthesia. Twenty-four patients had more than one surgical intervention, and 80% of these were performed with

general anesthesia and 20% with central regional anesthesia. We thought the patients underwent such surgical procedures because our clinic was a burn center. General anesthesia was preferred because surgical procedures were mostly planned in multiple regions.

Inflammatory reactions and pathophysiological changes in burn patients may complicate intraoperative anesthesia management. Ensuring airway safety, providing adequate fluid replacement, maintaining hemodynamic stability and organ perfusion, ensuring adequate tissue oxygenation, intervening in arrhythmias, maintaining body temperature, and selecting drugs used in the induction and maintenance of anesthesia require special attention. In our study, intraoperative inotropic support was needed in two patients due to bleeding and hypovolemia during the surgical procedure. None of the patients had anesthesia-related complications in the perioperative period.

Control of burn pain is very important in the recovery of patients with burn injuries. Inadequate pain control causes stress hormones to rise and recovery time to be delayed. It causes long-term physical and psychological problems and prolongs hospital stays [19,20]. It has been determined that nociceptive, neuropathic and inflammatory mechanisms play a role in burn pain, and multimodal analgesia methods are recommended to control this pain. For this purpose, nonsteroidal anti-inflammatory drugs, opioid analgesics, non-opioid analgesics, benzodiazepines, narcoleptics, antidepressants, and anticonvulsants can be used. Neuraxial analgesia and peripheral nerve block methods can be applied [20,21]. Additionally, it has been shown in the literature that virtual reality and hypnosis techniques are effective in reducing the patient's anxiety and the severity of pain [19,22,23]. We provided pain control for our patients with intravenous analgesia. For this we used tramadol, morphine, acetaminophen and nonsteroidal anti-inflammatory drugs. Midazolam, haloperidol, and olanzapine were added to the treatment according to the patient's needs. Patient-controlled analgesia, neuraxial/regional anesthesia methods, and lack of use of non-pharmacological methods are the limitations of our pain protocol in our burn clinic.

In conclusion, electrical burns are injuries that cause significant mortality and morbidity. They can cause clinical pictures ranging from minor skin burns to life-threatening organ damage. Considering the pathophysiological changes that develop due to the damage caused by the electric current while passing through the tissues, the patients should be evaluated meticulously in the perioperative period. General or regional anesthesia methods should be chosen according to the selected surgical procedure. Precautions should be taken against possible complications, and these patients should be followed up closely with a multidisciplinary approach.

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Data Availability
The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

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