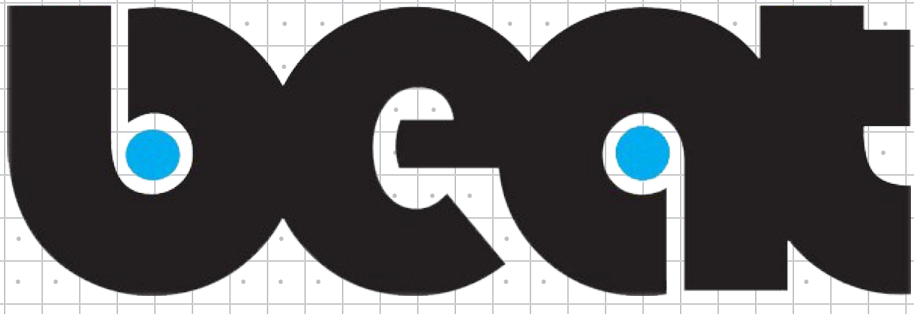
IN THE NAME OF GOD
THE COMPASSIONATE, THE MERCIFUL

BULLETIN OF EMERGENCY AND TRAUMA



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Aim and Scope

BEAT: Bulletin of Emergency And Trauma is an international, peer-reviewed, quarterly journal coping with original research contributing to the field of emergency medicine and trauma. BEAT is the official journal of the Trauma Research Center (TRC) of Shiraz University of Medical Sciences (SUMS) with cooperation of Hungarian Trauma Society, Lusitanian Association for Trauma and Emergency Surgery (ALTEC/LATES) and Serbian Trauma Association aiming to be a publication of international repute that serves as a medium for dissemination and exchange of scientific knowledge in the emergency medicine and trauma. The aim of BEAT is to publish original research focusing on practicing and training of emergency medicine and trauma to publish peer-reviewed articles of current international interest in the form of original articles, brief communications, reviews, case reports, clinical images, and letters.

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Original Article

Bull Emerg Trauma 2024;12(1):1-7.

Bulletin of Emergency And Trauma

Effect of Intranasal Remifentanil versus Lidocaine on Facilitation of Laryngeal Mask Airway Insertion and Cardiovascular Response: A Double-blind Clinical Trial Study

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ABSTRACT

Objective: This study aimed to assess and compare the effects of intranasal administration of lidocaine and remifentanil on the condition of LMA insertion and cardiovascular response.
Methods: From March 2019 to March 2020, this double-blind randomized clinical trial study was conducted on 60 patients, who underwent general anesthesia with LMA insertion at Faiz Hospital, Isfahan, Iran. After induction of anesthesia and before placing the laryngeal mask, the first group received remifentanil 1 µg/Kg, the second group received lidocaine 2% 1 mg/Kg, and the third group received normal saline with the same volume intranasally. The conditions of LMA insertion and hemodynamic changes that occurred during its insertion were investigated.
Results: In terms of demographics characteristics (p>0.05), success in placing the LMA on the first try (p=0.73), number of attempts to insert LMA (p=0.61), performance of LMA (p=0.73), need for additional propofol (p=0.53), frequency of gagging (p=0.53), cough (p=0.15) p), and laryngospasm (p=0.99) did not differ significantly. In the remifentanil group, the cardiovascular response to LMA injection was less than that of the lidocaine group. Moreover, both groups were lower than the saline group, but no significant difference was observed
Conclusion: In facilitating LMA insertion, the effect of intranasal remifentanil was comparable to intranasal lidocaine. Intranasal remifentanil was somewhat more effective than intranasal lidocaine in weakening the cardiovascular response to LMA insertion, but it did not outperform lidocaine.

Keywords: Hemodynamics; Intranasal; Laryngeal mask airway; Lidocaine; Remifentanil.

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Introduction

Insertion of laryngeal mask airway (LMA) is a non-invasive method in short-term procedures and difficult tracheal intubation [1, 2]. LMA placement requires a sufficient depth of anesthesia, relaxation of the jaw muscles, and suppression of airway reflexes to tolerate it inside the hypopharynx [3]. Such conditions are provided by administering high doses of intravenous (IV) anesthetic. A standard method of induction of anesthesia for LMA placement is the use of intravenous propofol, which has the advantage of rapid induction of anesthesia with better suppression of upper airway reflexes and jaw relaxation. However, propofol is more expensive and has more side effects, such as painful injection, deeper respiratory depression, longer apnea, and cardiovascular depression, than thiopental during induction of anesthesia [4]. Propofol does not have analgesic activity on its own, and when administered alone, the high doses required for induction might cause cardiovascular side effects [5].

Adding a short-acting drug, such as remifentanil, during propofol induction is one option for reducing the amount of required propofol, depressing airway protective reflexes, and facilitating LMA insertion without hemodynamic instability [3-5]. In particular, remifentanil is an ideal suppressor of short-term but potent noxious stimuli, such as tracheal intubation or placement of an LMA in the airway, as it provides rapid onset of intense analgesia with a relatively short duration of action [6-8]. Intubating conditions during sevoflurane anesthesia in children improved with a single bolus dose of remifentanil [9,10].

Additionally, the use of lidocaine, opioids, or ketamine can minimize the dose of propofol while increasing the success of LMA insertion [11]. On the other hand, studies reported that using topical lidocaine spray before inducing anesthesia with thiopental provides better conditions for placing an LMA than administering intravenous lidocaine and thiopental [12].

Since there was a dearth of research on the effects of intranasal remifentanil and lidocaine on the conditions of laryngeal mask placement and cardiovascular response in the induction of thiopental anesthesia, as well as the growing use of LMA in difficult intubations and short-term surgeries, the present study was designed and conducted on eye surgery candidate patients who underwent induced general anesthesia using sodium thiopental and LMA insertion.

Materials and Methods

This double-blind randomized clinical trial study was conducted at Faiz Ophthalmology Center (Isfahan, Iran) from January 2019 to January 2020. The study was approved by the Ethics Committee of Isfahan University of Medical Sciences (IR.MUI.MED.REC.1398.509) and registered in the Iranian Registry of Clinical Trials (IRCT20180416039326N10) (date:19/02/2020). The study was carried out in accordance with the Medical Declaration of Helsinki and following the CONSORT guidelines [13]. The participants were informed about the goals of the research, and written informed consent was obtained from the patients before participation.

The inclusion criteria were age 18 to 85 years, being candidates for short-term surgery under general anesthesia using a laryngeal mask airway. The exclusion criteria were risk of aspiration (full stomach, gastric reflux, pregnancy), weight less than 40 Kg or more than 110 Kg, presence of oral, pharynx, and airway pathology, insufficient pulmonary compliance, high airway resistance, presence of cervical vertebrae disease, history of musculoskeletal disorders and sensitivity to anesthetic agents.

A detailed pre-anesthesia evaluation was performed on all patients upon entering the operating room, and the patients were monitored using an electrocardiogram, non-invasive intermittent sphygmomanometer, and pulse oximetry. All patients were anesthetized with fentanyl 2 µg/Kg, thiopental 5 mg/Kg, and atracurium 0.3 mg/Kg, before LMA insertion.

The first group received remifentanil 1 µg/Kg (INR group), the second group received lidocaine 2% 1 mg/Kg (INL group), and the third group received normal saline, which was prescribed as 1 mL in each nasal passage. The content volume of the syringes in three groups increased to 2 mL by adding normal saline. Using the brain technique, a single-use LMA with the appropriate size, based on the right weight size, was then inserted by an anesthesiologist who was not a member of the research team [8]. The LMA insertion condition was evaluated by an anesthesiologist who was blinded to the study groups. The proper position of the LMA was confirmed by assessing bilateral chest movements, measuring end-tidal carbon dioxide ($ETCO_2$) and peripheral arterial oxygen saturation (Spo_2), and auscultation of breath sounds by stethoscope. Then, the patients were subjected to positive pressure ventilation and anesthesia maintenance with a mixture of oxygen, nitrous oxide 50/50, and isoflurane 0.8% to 1.2%.

The primary and secondary outcomes of the study were patients' demographic information such as age, height, weight, BMI, and ASA classification; LMA insertion condition, including function of the LMA, number of attempts to insert of LMA, complication during LMA insertion; and hemodynamic changes.

Before induction of anesthesia, mean arterial pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), and Peripheral arterial oxygen percentage (SPO2) were measured and recorded. These cases were repeated and recorded after the induction of anesthesia immediately before the insertion of the laryngeal mask, and 1, 3, and 5

minutes after the insertion of the laryngeal mask. Possible complications, including hypotension, hypertension, tachycardia, bradycardia, decrease in arterial oxygen saturation below 90, were evaluated and recorded.

The conditions of inserting the LMA, the number of attempts, the need for an extra dose of propofol (to increase the depth of anesthesia), and possible complications during LMA insertion (coughing, gagging, laryngospasm) were determined and documented.

The sampling procedure was simple and accessible method. The required sample size of the study was calculated using the sample size estimation formula to compare the averages and considering the confidence level of 95%, the test power of 80%, the standard deviation of the LMA embedding time, which is estimated at 9 seconds [12], and the effect size 0.8. The required sample size of the study was estimated as 20 people in each group.

The patient allocation in the study groups was determined by a nurse utilizing a computer-generated random number table. The results of this allocation were securely stored in sealed, opaque envelopes. Before the patient was admitted to the operating room, a separate nurse, who was not a member of the research team, assigned the patient to one of the three groups, based on the assigned number. These groups received either intranasally administered remifentanil (INR), lidocaine (INL), or saline (INS).

In this study, the patients, the anesthesiologist, and the data collector were all blinded to the drug assigned to each patient.

The data were analyzed using the SPSS software (SPSS Inc., Chicago, version 23), and a p value<0.05 was considered statistically significant. Data were analyzed using Chi-square statistical tests, one-way analysis of variance, and analysis of variance with repeated measurements.

In the present analysis, the normality of the data was assessed using the Shapiro-Wilk test. The alpha error of 5% (95% confidence interval [CI]) was employed as the threshold for accepting or rejecting the null hypothesis. All mean comparison tests were two-tailed tests. The continuous and categorical variables were presented as mean±SD and numbers (percentages), respectively. Additionally, the variance was evaluated using Mauchly's sphericity test. The applied statistical analyses were the Chi-square test, Mann-Whitney U test, and the One-Way Repeated Measures ANOVA test, followed by the Bonferroni test for multiple comparisons. p<0.05 was considered statistically significant.

Results

60 patients undergoing laryngeal mask insertion were divided into 3 groups of 20 people, who received intranasal remifentanil, intranasal lidocaine, and intranasal saline. During the study, no patients were excluded from the study due to unwanted complications (Figure 1).

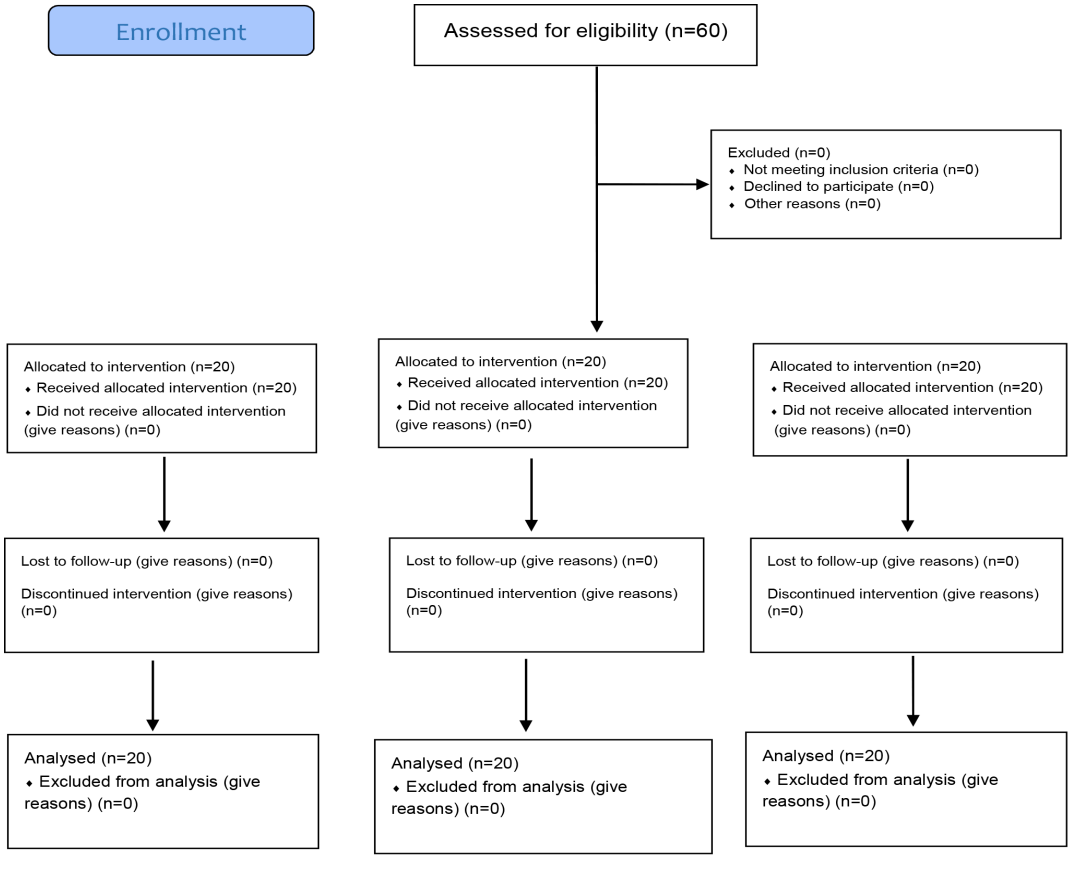

Fig. 1. The Consort flow diagram of the study

There were no significant differences between the three study groups in terms of basic and demographic variables, including age and sex distribution, weight and height, BMI, and ASA criteria (Table 1).

Table 2 shows the condition of LMA insertion in three studied groups. The success rate of inserting a laryngeal mask in the first attempt was 85% in the remifentanil group, 90% in the lidocaine group, and 75% in the saline group (p=0.73). There was no significant difference between the three groups in terms of the number of attempts to insert the LMA (p=0.61). The excellent and favorable performance of the laryngeal mask was 95% in the remifentanil group, 90% in the lidocaine group, and 80% in the saline group (p=0.73). Other variables including the need for additional propofol (p=0.53), gagging (p=0.53), cough (p=0.15), and laryngospasm (p=0.99) showed no significant difference between the three groups.

Table 3 shows that the cardiovascular response to LMA injection was weaker in the remifentanil group than in the lidocaine group, and it was lower

Table 1. Distribution of demographic variables in study groups

Variables		INR[a]	INL[b]	INS[c]	*p* value
Age (years) (mean±SD)		67.6±10.1	13.0±62.8	67±11.3	0.37
Weight (kg) (mean±SD)		72.2±11.4	13.9±70	71.2±17.4	0.89
Height (m) (mean±SD)		169.6±7.7	164.6±8.1	170.1±9.9	0.09
BMI (kg/m^2) (mean±SD)		25±2.8	25.42±3.58	24.4±4.58	0.69
Sex n(%)	Female	14 (70)	12 (60)	11 (55)	0.61
	Male	6 (30)	8 (40)	9 (45)	
ASA, N (%)	1	6 (30)	3 (15)	7 (35)	0.33
	2	14 (70)	17 (85)	13 (65)	

[a]INR: Intranasal remifentanil; [b]INL: Intranasal lidocaine; [c]INS: Intranasal Saline

Table 2. LMA insertion condition

Variables	INR[a]	INL[b]	INS[c]	*p* value
The function of the LMA after insertion (N %)				
Excellent	14 (70)	16 (80)	13 (65)	0.73
Optimal	5 (25)	2 (10)	4 (20)	
Weak	1 (5)	2 (10)	3 (15)	
The number of attempts to insert the LMA (N %)				
Once	17 (85)	18 (90)	15 (75)	0.61
more than once	3 (15)	2 (10)	5 (25)	
The need for extra propofol	0 (0)	2 (10)	2 (10)	0.53
Complications during LMA insertion				
Gagging	2 (10)	2 (10)	3 (15)	0.99
Cough	4 (20)	1 (5)	6 (30)	0.15
Laryngospasm	1 (5)	0 (0)	1 (5)	0.99

[a]INR: Intranasal remifentanil; [b]INL: Intranasal lidocaine; [c]INS: Intranasal Saline

Table 3. Comparison of cardiovascular response to laryngeal mask insertion during the study period in three groups

Variables	Time	INR	INL	INS	*p* value[a]
SBP (mmHg)	Before LMA insertion	150±19.3	142.7±21.7	149.3±21.6	0.49
	After LMA insertion	137.6±16.7	139.6±18.7	142±21.1	0.76
	Recovery room	133±22.7	134.2±27.8	138.8±19	0.71
	*p*b	0.024	0.029	0.001	0.91
DBP (mmHg)	Before LMA insertion	86.9±11.4	88.9±10.2	94±24.3	0.38
	After LMA insertion	83.4±12.8	87.6±16.1	87.9±8.5	0.47
	Recovery room	82.4±11.9	84.6±15.7	80.9±13.2	0.69
	p[b]	0.18	0.08	0.014	0.48
Heart rate (per minute)	Before LMA insertion	74.8±13.9	69.9±13.5	76.8±11.2	0.46
	After LMA insertion	76.6±11.8	76.8±11.2	82±7.81	0.3
	Recovery room	79.3±11.6	65.9±13.4	7±1.5 8	0.26
	p[b]	0.69	0.12	0.07	0.23
SPO_2	Before LMA insertion	94.6±3.2	94.6±3.2	95.4±1.1	0.08
	After LMA insertion	97.7±1.6	97.7±1.6	97.2±2.1	0.18
	Recovery room	1.4±98.5	98.5±1.4	98.1±3.1	0.8
	p[b]	0.3	<0.001	0.002	0.3

[a]Significant level of difference between three groups at each point of time according to one-way analysis of variance test. [b]Significance level of intra-group changes according to variance analysis test with repeated variance analysis.

in both groups than in the saline group. However, no significant difference was observed (p>0.05). There was no significant difference between the study groups in terms of mean arterial blood pressure (MAP), mean systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, and Spo_2. (p>0.05).

In intra-group studies, systolic blood pressure changes were significantly different in all three nodes, but diastolic blood pressure changes were only significant in the control group. In inter-group studies, there was no significant difference in any of the mentioned parameters indicated between the three groups. During the study period, 14 patients (23.3%) experienced hypotension, bradycardia, and tachycardia. There were five patients in the INR group, five in the INL group, and four in the control group (25%, 30%, and 20%, respectively). However, there was no significant difference between the three groups (p=0.91).

Discussion

This study was conducted to compare the effect of intranasal administration of remifentanil and lidocaine on laryngeal mask insertion and cardiovascular response during the induction of anesthesia with sodium thiopental.

According to the results of the present study, there was no significant difference between the three studied groups in terms of age and sex distribution, BMI, and ASA criteria. Moreover, no confounding effect of the above factors on the main findings of the study was observed. Therefore, the differences observed between the study groups were most likely due to the type of drug used.

Our findings revealed that the first successful attempt to place LMA was 85% in the remifentanil group, 90% in the lidocaine group, and 75% in the control group. The performance of the inserted LMA was outstanding and optimal in 95% of the remifentanil group, 90% of the lidocaine group, and 85% of the control group.

In a study by Yazicioglu *et al.,* remifentanil 0.25 or 0.5 µg/Kg (R1, R2) and normal saline were used, and the results showed that excellent conditions for LMA placement (82.5% and 85% in R1 and R2 groups, respectively, compared to 32.5% in the control group) [14].

Verghese *et al.* conducted a study and investigated the effect of intranasal remifentanil 4 µg/Kg vs normal saline on airway response and intubation conditions in children under 7 years of age. As a result, intranasal remifentanil was associated with good to excellent intubation outcomes [15].

In another study which was conducted in patients aged 65 to 80 years, after induction of anesthesia with propofol 1 mg/Kg and prescription of a blind dose of remifentanil, LMA was inserted. The findings indicated that remifentanil 0.20±0.05 µg/Kg was associated with better LMA insertion conditions in 50% of elderly patients without significant hemodynamic changes during emergency airway management. [16].

Yao *et al.* investigated the optimal dose of intranasal remifentanil in children undergoing LMA insertion. In the studied groups, before induction of anesthesia, intranasal doses of 0.25, 0.5, 0.75, and 1 µg/Kg remifentanil were administered. The success rate in placing the laryngeal mask in the 4 mentioned groups was 33.3, 60, 86.7, and 100%, respectively. In terms of the occurrence of hemodynamic disorders, no significant difference was reported between the groups [17].

Lee *et al.* reported that remifentanil provided favorable conditions for LMA placement [5].

The results of the present study were consistent with previous studies [5, 12, 15, 16] in terms of the effect of remifentanil on the success of laryngeal mask placement and its performance. Remifentanil is a potent narcotic with a rapid onset and short duration of action, which can serve as an ideal suppressor of short-term but potent noxious stimuli such as LMA insertion. [5, 16].

Gharaei *et al.,* conducted a study on children aged 1-6 years old, with mild upper airway infection candidates for an immediate complete eye examination, using intravenous lidocaine (1.5 mg/Kg) or topical lidocaine before inserting a laryngeal mask. They observed that the incidence of postoperative cough was lower in the intravenous lidocaine group than in the topical lidocaine group [18].

In another study, Ahmed *et al.* found that when a local aerosol of 10% lignocaine was sprayed on the posterior wall of the pharynx three minutes prior to propofol induction, without the use of neuromuscular blockade, it provided better LMA insertion conditions than intravenous lignocaine and also reduced the number of attempts needed for LMA insertion and minimally altered cardiovascular responses [19].

Previous studies indicated that lidocaine improves LMA insertion [20] and reduces the incidence of airway complications after surgery in children with upper respiratory infections [21]. This issue could be explained by the fact that local anesthetic might lessen the irritation of the pharyngolarynx brought on by LMA; hence, minimizing the adverse effects such as cough and laryngeal spasm [20, 21].

Previous studies reported that lidocaine improved LMA insertion and reduced the incidence of airway complications in children with upper respiratory infections [22, 23]. This finding could imply that local anesthetic can reduce the stimulation of LMA in the pharyngeal-larynx, which would lessen the side effects, such as cough and laryngeal spasms [23, 24].

In the present study, the laryngeal mask insertion was performed in the first attempt in 90% of the cases in the INL group, and the performance of the inserted laryngeal mask was outstanding or optimal in 90% of cases. Additionally, after LMA removal,

this group experienced less coughing than the control group, which was in line with other research findings [4, 17-20, 22-24].

In a study, Lee *et al.* investigated the effect of topical lidocaine and intravenous remifentanil on laryngeal mask insertion in awake patients. Their findings indicated that there was no significant difference in the number of attempts to place the LMA and the occurrence of complications during and after the insertion of LMA between the two studied groups [25]. Therefore, the findings of this study were in line with those of the present study.

It is important to remember that the drug was absorbed through the mucosal membrane after intranasal administration, and the risk of developing serious hemodynamic disorders was lower than in the intravenous injection method [20].

It should be noted that our study had several limitations. This study had a relatively small sample size. The remifentanil requirement for LMA insertion could differ according to sex [26]. This study was conducted only in a hospital. The findings of the study might be different in different races. Therefore, it is recommended that further research be conducted while considering the limitations of this study.

In terms of success in LMA insertion in the first attempt, LMA performance, occurrence of side effects (cough, laryngospasm, etc.), intranasal remifentanil had a similar effect to intranasal lidocaine.

Intranasal remifentanil was somewhat more effective than intranasal lidocaine in attenuating the cardiovascular response to LMA insertion.

Therefore, in the present study, intranasal remifentanil was not found to be superior to intranasal lidocaine.

Declaration

Ethics clearance and consent to participate: The research protocol received approval from the ethics committee at Isfahan University of Medical Sciences (IR.MUI.MED.REC.1398.509). All patients signed an informed consent to enter the study.

Consent for publication: All authors have expressed their consent to the publication of this study.

Conflict of Interest: The authors declared that there was no conflict of interest.

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Authors' Contribution: The conception and design of the work by H.S; Data acquisition by M.B, H.M; Analysis and interpretation of data by HM; MB; Drafting the work by HS; Revising it critically for important intellectual content by HS, HM; All the authors approved the final version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work.

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Original Article

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Ten-year Causes of Cerebral Venous Sinus Thrombosis in Patients Referred to Ghaem Hospital from 2009 to 2019

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ABSTRACT

Objective: Cerebral Venous Sinus Thrombosis (CVST), a complex and infrequent cerebrovascular disorder characterized by the formation of clots within the cerebral venous sinuses, occurs as a result of multiple risk factors and casualties, and its epidemiological picture should be investigated.
Methods: This descriptive study was conducted retrospectively on patients with a final diagnosis of cerebral vein thrombosis, who were referred to the emergency room of Ghaem Hospital (Mashhad, Iran) between 2009 and 2019. The study included all patients with cerebral vein thrombosis who were older than 18 years. Clinical symptoms and causes were documented and contrasted according to demographics.
Results: During the 10 years of this study, 749 cases of cerebral vein thrombosis were observed, with women accounting for the majority (72.8%). The most prevalent symptom was headache (554 cases; 74.0%), followed by seizures (23.1%), blurred vision (16.0%), nausea (7.5%), vomiting (6.9%), double nose (4.9%), and dizziness (3.3%). There was no significant difference in the frequency of symptoms between the two genders ($p<0.05$). The most commonly identified risk factors were OCP (110 cases; 14.7%), followed by infection (103 cases; 13.8%), malignancies (78 cases; 10.4%), and fasting (15 cases; 2.0%). There was no significant difference in risk factors between the two genders, with the exception that all cases of fasting were in women, and the differences were significant ($p=0.015$). The most common site of involvement according to Magnetic Resonance Venography (MRV) was the upper sagittal sinus (427 cases; 57.0%). There was no significant difference in terms of the site of the conflict between the two genders ($p<0.05$).
Conclusion: The findings of the present study showed that deep vein thrombosis occurred mainly in women and manifested itself mostly as a headache. Moreover, the upper sagittal sinus was the most common site of involvement.

Keywords: Cerebral vein thrombosis; OCP; Headache; Magnetic Resonance Venography.

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Introduction

Cerebral venous sinus thrombosis (CVST or CVT) is a type of stroke caused by blood clot formation in the brain's venous sinuses, which drain the blood from the brain [1, 2]. Severe cases might cause brain parenchymal damage, such as brain swelling, edema, venous infarction, or venous hemorrhagic infarction [2]. CVT is considered an infrequent condition. CVT incidence estimates ranged from 2.83 to 5.27 per 100,000 in individuals aged 18-64 years, highlighting age-related variability [3]. It is three times more prevalent in women [4] and affects clinical presentation and risk factors [5]. Gender-specific risk factors could explain why CVST is more common in women [6]. In adults, CVT tends to occur at a younger age than arterial thrombosis. An international study in 2004 found that the average age of CVT patients is 37 years, with only 8% being over the age of 65 [7].

The incidence of CVST is estimated to be between two and five occurrences per million annually [8]. According to a more recent analysis, there may have been an influence of the pandemic on CVST hospitalizations, as seen by the crude rate of hospitalizations for CVST rising from 14.33 in the pre-COVID-19 era to 22.92 during the COVID-19 period per 1,000,000 individuals [9]. CVST is less common than most strokes; however, it presents diagnostic challenges [10]. Previous studies identified significant gender-based variations in the presentation, course, and risk factors of CVST [11]. Although the age and sex distribution of CVST patients varies, women often make up a sizable majority of those with this ailment [12]. CVST is regarded as a condition primarily affecting childbearing women, while a significant proportion of cases also occur in men [13, 14]. The incidence of CVST varies with identifiable risk factors found in approximately 73% of patients [15]. CVST exhibits a notable sex-based distribution, with a higher incidence in women. Studies indicate that approximately 75% of CVST patients are female, as observed in the International Study on Cerebral Venous and Dural Sinus Thrombosis (ISCVST) [16]. Fasting during the Islamic holy month of Ramadan was associated with an increased incidence of CVST. Studies suggested that fasting may contribute to dehydration, particularly in women using oral contraceptive pills [2]. Previous research indicated a higher frequency of CVST during fasting, which could be attributed to dehydration and impaired hemostasis [17].

Women with CVT were significantly younger than men, with an average age of 34 years versus 42 years for men [18]. The manifestations of cerebral venous sinus thrombosis are varied and can present in a variety of ways, including acute, subacute, or chronic. Common symptoms include new headaches, isolated intracranial hemorrhage (ICH) syndrome, focal neurological deficits, encephalopathy, or seizures [19, 20]. The signs and symptoms of CVT can be classified into three main groups: 1. Isolated ICH syndrome (headache, with/without vomiting, papilledema, and visual problems) [21]; 2. Focal syndrome (focal lesions, seizures, or both); 3. Encephalopathy (changes in mental function or decreased level of consciousness, and coma) [19]. Neuroimaging findings in CVT patients might include focal edematous areas, venous infarction, venous hemorrhagic infarction, diffuse cerebral edema, or in rare cases, isolated subarachnoid hemorrhage [22]. In these individuals, 30-40% suffer from cerebral hemorrhage (ICH) [23, 24]. The cause of cerebral hemorrhage in 25% of cases was related to upper sagittal sinus obstruction [24]. To date, several studies investigated risk factors related to CVT, as well as clinical and paraclinical symptoms. However, considering that no similar study has been conducted in Iran, the findings of this study, which determine the underlying causes and common symptoms of cerebral venous sinus thrombosis in a subset of the Iranian population, can lead to early diagnosis and timely treatment of patients, thereby reducing mortality and controlling disease costs in more advanced stages. This study aims to address the following question: What are the underlying causes of cerebral venous sinus thrombosis in patients referred to Ghaem Education, Research, and Treatment Center in Mashhad? Investigating the causes of CVST might help identify potential risk factors. This knowledge is essential for establishing preventive measures and identifying individuals at higher risk, allowing for timely interventions to mitigate the risk of developing CVST. There are gaps in the current understanding of the causes of CVST. This study aims to fill these gaps by presenting additional information on specific cases in Iran.

Materials and Methods

This retrospective descriptive study was conducted on patients diagnosed with cerebral vein thrombosis (CVT), who were referred to the emergency department of Ghaem Hospital (Mashhad, Iran) between 2009 and 2019.

Due to the limited number of CVT cases, a census sampling method was employed, and all CVT patients who were over the age of 18 were included in this study. Patients with incomplete information or unrecorded clinical symptoms in their files and unconfirmed diagnoses were excluded from the study. The participant's clinical symptoms, causes of venous sinus thrombosis, and demographic information were extracted from the patient's files. The diagnosis of CVT was confirmed through MR venography, which is considered the gold standard method.

Patient files served as the primary source of data.

A standardized data extraction form was developed to systematically collect relevant information. This form included sections for demographic information such as age and gender, as well as clinical symptoms, risk factors, and diagnostic confirmation details. All the required information including demographic data and clinical symptoms, causes of venous sinus thrombosis, and risk factors, as well as symptoms such as headache, nausea, dizziness, vomiting, blurred vision, double vision, seizures, and information on risk factors like oral contraceptive pill (OCP) consumption, fasting, malignancies, and infection, were meticulously recorded [25].

The diagnosis of cerebral venous thrombosis in this study adhered to the criteria outlined by the American Heart Association/American Stroke Association, as defined by Saposnik *et al.,* [21]. As a result, the diagnosis and confirmation of CVT were based on these two previously mentioned diagnostic subgroups:

1. History and clinical examination were consistent with thrombosis diagnosis.
2. Presence of partial or complete venous occlusion in MR venography.

The data were analyzed using SPSS software version 22 (SPSS Inc., Chicago, Illinois, United States). Descriptive statistics, including mean and standard deviation for quantitative data, and frequency and percentage for qualitative data, were calculated. The Chi-square and Fisher's exact tests were used to compare the qualitative data. $P<0.05$ was considered statistically significant.

Results

In the present study, 749 confirmed cases of cerebral venous sinus thrombosis were identified during the decade from 2009 to 2019. Among these cases, 545 (72.8%) patients were women, and 204 (27.2%) were men. The mean age of these patients was 38.11±14.66 years, ranging from 20 to 88 years. Table 1 presents detailed demographic information, clinical symptoms, and risk factors associated with thrombosis in the studied patients. The most prevalent symptom was headache, which affected 554 patients (74.0%). Additional data are available in Table 1.

Figure 1 focuses on the locations of venous sinuses within the brain. The upper sagittal sinus was the most frequently affected site, accounting for 427 cases (57.0%).

The findings of the comparison between the clinical symptoms and thrombosis risk factors in men and women are shown in Table 2. There were no significant differences in terms of clinical symptoms between genders ($p<0.05$). However, all causalities of fasting were among women, and there was a statistically significant gender difference ($p=0.015$).

The Chi-square test was used to compare the two groups based on the CVT location. Furthermore, there were no significant differences in the location of the lesion between male and female patients ($p=0.649$). Table 3 provides detailed information about these cases.

Table 1. Demographic information, clinical symptoms, and risk factors for thrombosis in the studied patients

Characteristic		Frequency	Percentage
Gender	Female	545	72.80%
	Male	204	27.20%
Headache	Present	554	74.00%
	Absent	195	26.00%
Nausea	Present	56	7.50%
	Absent	693	92.50%
Dizziness	Present	25	3.30%
	Absent	724	96.70%
Vomiting	Present	52	6.90%
	Absent	697	93.10%
Blurred Vision	Present	120	16.00%
	Absent	629	84.00%
Double Vision	Present	37	4.90%
	Absent	712	95.10%
Seizures	Present	173	23.10%
	Absent	576	76.90%
OCP Consumption	Yes	110	14.70%
	No	639	85.30%
Fasting	Yes	15	2.00%
	No	734	98.00%
Malignancies	Yes	78	10.40%
	No	671	89.60%
Infection	Yes	103	13.80%
	No	646	86.20%

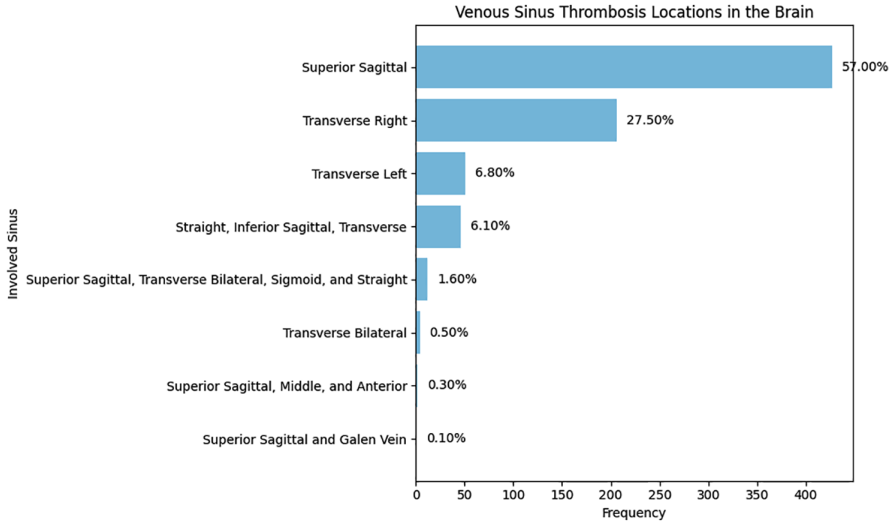

Fig. 1. Locations of involved venous sinuses in the brain

Table 2. Gender disparities in the prevalence of symptoms and risk factors of CVT

Variables		Female Prevalence (%)	Male Prevalence (%)	*p* value
Headache	Present	405 (74.3)	149 (73.0)	0.779
	Absent	140 (25.7)	55 (27.0)	
Nausea	Present	40 (7.3)	16 (7.8)	0.876
	Absent	505 (92.7)	188 (92.2)	
Dizziness	Present	20 (3.7)	5 (2.5)	0.499
	Absent	525 (96.3)	199 (97.5)	
Vomiting	Present	37 (6.8)	15 (7.4)	0.75
	Absent	508 (93.2)	189 (92.6)	
Blurred Vision	Present	94 (17.2)	26 (12.7)	0.147
	Absent	451 (82.8)	178 (87.3)	
Double Vision	Present	28 (5.1)	9 (4.4)	0.85
	Absent	517 (94.9)	195 (95.6)	
Seizures	Present	127 (23.3)	46 (22.5)	0.922
	Absent	418 (76.7)	158(77.5)	
Fasting	Yes	15 (2.8)	0 (0.0)	0.015
	No	530 (97.2)	204 (100.0)	
Malignancy	Yes	58 (10.6)	20 (9.8)	0.831
	No	487 (89.4)	184 (90.2)	
Infection	Yes	71 (13.0)	32 (15.7)	0.754
	No	474 (87.0)	172 (84.3)	

Table 3. Comparison of the location of the lesion in male and female patients

Location of Lesion	Female Prevalence (%)	Male Prevalence (%)	*p* value
Suprasellar Saggital	313 (73.3)	114 (26.7)	0.649
Right Transorse	151 (73.3)	55 (26.7)	
Left Transverse	39 (76.5)	12 (23.5)	
Streit, Subsagittal, and Transorse	28 (60.9)	18 (39.1)	
Suprasellar, Bilateral Transorse, Sigmoid, and Streit	8 (66.7)	4 (33.3)	
Bilateral Transorse	3 (75.0)	1 (25.0)	
Suprasellar, Midline, and Anterior	2 (100.0)	0 (0.0)	
Suprasellar and Galen Vein	1 (100.0)	0 (0.0)	

A chi-square test was used to compare the two groups.

Discussion

In total, 749 confirmed cases of venous thrombosis were identified in the present study, with women accounting for almost 70% of the total cases. Overall, the most prevalent symptom was headache, which affected nearly 3 out of 4 individuals. Seizures (23.1%) were the most common symptom, followed by blurred vision (16.0%), nausea (7.5%), vomiting (6.9%), double vision (4.9%), and dizziness (3.3%).

There were no significant differences in clinical symptoms between the two genders. Additionally, approximately 15% of the study participants had a history of OCP use, which was a risk factor. However, fasting was only identified as a risk factor in 2.0% of the study participants, and all cases of fasting were among women, with significant differences observed. Malignancy and infection were also identified as risk factors for thrombosis in 10.4% and 13.8% of individuals, respectively, with no significant gender differences.

Based on MRV, the upper sagittal sinus was the most frequently affected site, accounting for 57% of cases. The right transverse sinus, left transverse sinus, striate sinus, inferior sagittal and transverse sinus, superior sagittal sinus, bilateral transverse sinus, sigmoid sinus, and striate sinus, bilateral transverse sinus, superior sagittal sinus, middle and anterior sagittal sinus, and the vein of Galen were among the other involved sites, arranged in order of prevalence. The site of involvement did not differ significantly between the two genders.

The characteristics of CVST were evaluated in several studies [26-30]. The average age of these patients in the present study was 38.11±14.66 years. While CVST can happen at any age, the average age is frequently between 37 and 39 years old [31]. A previous study indicated a mean age of 33 years for young adults with CVST, with a two-thirds female preponderance [32]. Older patients (≥55 years) with CVT have a median age of 43 years [33]. Another study mentioned a mean age of 37 years for patients with CVST, with a range of 18 to 80 years [34]. In terms of age, the findings of all the research were comparable to ours.

Shakibajahromi *et al.,* conducted a similar study between 2012 and 2016, examining cases of cerebral thrombosis at Namazi Hospital in Tehran [26]. During their study, a total of 174 patients were admitted, with 128 (73.6%) being women, and the remaining patients being men. The average age of the subjects in their study was 37.8 years, ranging from 18 to 78 years. The most common symptom in their study, as in ours, was headache. Other symptoms included double vision, focal neurological deficits, decreased level of consciousness, and papillary edema. While there were no significant differences in terms of various symptoms between the two genders in the present study, their study found a significant difference mainly in cases of focal neurological deficits. The present study found no significant differences between the two genders in terms of symptoms. According to their findings, the most common risk factor was OCP use, followed by thrombophilia, fasting, and infections. In the present retrospective study, we could only examine OCP use and fasting. The findings of the present study, similar to theirs, 72.8% of the population were women, and the mean age was 38.11 years. Singh *et al.,* [27] also conducted a similar study between 2018 and 2020 at a tertiary hospital center in India. They included a total of 40 patients aged between 18 and 55, with an average age of 32.45 years. In contrast to the participants of this study, in their study, approximately 60% of the participants were men. However, the present study had a larger sample size (n=749), which provided more precise findings. Similar to this study, the most prevalent symptom in their study was headache. Additionally, in both studies, the upper sagittal sinus was the most common site of involvement, with a prevalence of 67.5%. Krishnan *et al.,* conducted a study on 50 cases of cerebral vein thrombosis between 2017 and 2019 [28]. Similar to the findings of the present study, the majority of the participants in their study were female, accounting for 78.0%. The age range in their study was 14 to 72 years. In this study, headache was the most prevalent symptom, affecting 96% of the participants. Following headache, the most common symptoms were paresis, convulsions, papillary edema, impaired level of consciousness, and aphasia. Pregnancy was the leading risk factor, followed by OCP usage, malignancy, and infection. In terms of the site of involvement, their findings confirmed ours, with the upper sagittal sinus being the most commonly affected site, followed by the transverse and sigmoid sinuses. The present study indicated that all causalities of fasting were among women. A previous study showed that men and women experience similar rates of cardiovascular events during Ramadan [35]. The impact of intermittent fasting on CVST in Ramadan may differ between men and women [36]. A retrospective study in Iran found a higher prevalence of CVST during Ramadan than in other months [37]. Coutinho *et al.,* also conducted a study between 2008 and 2010, focusing on 53 cases of cerebral vein thrombosis [29]. Similar to the findings of the present study, 72% of their participants were women. The average age of their patients was 41 years. Among the risk factors, 52% were using oral contraceptive pills (OCPs), 18% were pregnant, and 44% had parenchymal problems. In contrast to our study, the upper sagittal sinus was not the most common site of involvement, with 43% of cases affecting this region. The sigmoid sinus (53%) and the transverse sinus (70%) were the most frequently involved sites in their study. A smaller percentage of individuals had sinus tract involvement. Khealani *et al.,* conducted a study spanning from 1991 to 2007 [30]. During their study period, a total of 109 cerebral thrombosis patients were admitted, with 53% being women. The average age of the subjects in their study was 37.63 years. Headache was the most common symptom in their patients, followed by focal neurological deficits, seizures, changes in the level of consciousness, papilledema, fever, and dysarthria. Regarding the involvement of different sinuses in their study, as in ours, the upper sagittal sinus had the highest involvement at 71%, followed by the transverse sinus, sigmoid sinus, and

straight sinus.

Perhaps one of the important limitations of this study was its retrospective nature, which caused challenges in data collection procedures and sometimes file defects. However, the period of the study was 10 years, and it had a large sample size, which was not comparable with other studies and could be considered an important strength of the present study. Furthermore, since the present research was conducted on the Iranian population, it would be preferable to conduct studies on other racial groups to investigate racial and genetic factors.

In conclusion, our extensive ten-year investigation of cerebral venous sinus thrombosis (CVT) revealed important patterns. An apparent gender disparity was observed, with females having a higher proportion of cases than males. The mean age of the patients was 38.11 years. The predominant observed symptom was headache, which affected a significant majority of cases. Although there were no significant gender-based differences in clinical symptoms and the general site of blood clot formation, a clear gender-specific pattern was detected in the relationship between fasting and cerebral venous thrombosis (CVT), which was only observed in women. This finding emphasized the significance of taking into account gender-specific variables when determining the risk of CVT. The prevalence of CVT in different sinuses was similar between men and women, with the upper sagittal sinus being the most commonly affected location. These findings enhanced our understanding of CVT epidemiology by underscoring the importance of taking gender-specific factors into account in both research and therapeutic settings. The results of the present study can be applied in two ways. First of all, this information can be provided to clinicians at the bedside; so that they can have a better view of the management of these patients. Second, this study has the potential to shed light on future research on this subject. Additional research is required to clarify the fundamental mechanisms and practical implications of these gender-specific interactions.

Declaration

Ethics approval and consent to participate: All patient information was anonymized to maintain confidentiality. The study adhered to the ethical principles of the Helsinki Declaration. Additionally, it received approval from the Ethics Committee of Mashhad University of Medical Sciences. This research was conducted on 10/24/2019 and was approved by the Ethics Committee of Mashhad University of Medical Sciences under the title "Investigation of the causes of cerebral venous sinus thrombosis in patients referred to Ghaem Hospital between 2009 and 2019," with license number 980446 and code IR.MUMS.MEDICAL.REC.1399.009.

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Authors' Contribution: The contributions of the authors to this paper are as follows: EP and EVM were primarily responsible for the conception and design of the study, as well as the acquisition and analysis of data. MZ and MF played key roles in drafting and critically revising the manuscript for intellectual content. MF contributed significantly to the interpretation of data and provided valuable insights throughout the research process. RJ participated in the statistical analysis and data interpretation. All authors have read and approved the final version of the manuscript, demonstrating a collaborative effort in the development of this research work.

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Original Article

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Surgical Treatment versus Conservative Management of Splenic Rupture: Outcomes and Risk Factors

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ABSTRACT

Objective: This study aimed to evaluate the outcome and risk factors in operative and non-operative management of splenic injury.
Methods: This cross-sectional study was conducted on patients with traumatic splenic injuries who were hospitalized in Kashani Hospital (Isfahan, Iran) from 2017 to 2019. The studied variables were extracted from the medical records of the enrolled participants. The outcomes such as mortality complications and risk factors were compared based on treatment methods.
Results: A total of 240 patients were investigated. The mean age of the patients was 29.8±12.2, with 180 (77.5%) patients being men. 154 (64.2%) patients underwent operative treatment. The mortality rate was 18.9% and 4.6% among operative and non-operative groups (p<0.001). Complications were observed in 11.5% and 46.1% of non-operative and operative groups, respectively (p<0.001). Operative treatment inversely correlated with mortality (p<0.001) and complications (p<0.05). Splenic injury severity was correlated positively with mortality (p<0.001) and negatively with complications (p<0.001). Unstable hemodynamic status was positively correlated with complications (p<0.001). Age had a positive correlation with mortality (p<0.001) and complications (p<0.001). Male sex had a negative correlation with complications (p<0.001). GCS score and admission were positively correlated with mortality (p<0.001). There was no statistically significant correlation between correlated injuries and outcomes (p≥0.05).
Conclusion: Patients who received surgery had higher rates of mortality and complications. However, after controlling for confounders, operative treatment was found to be inversely correlated with mortality and complications.

Keywords: Splenic rupture; Conservative treatment; Splenectomy; Injuries.

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Introduction

Trauma kills over 4.5 million people annually, which accounts for 9.8% of Disability-Adjusted Life Years (DALYs) worldwide. Because trauma is partially preventable, it has a considerable impact on the disease burden. The gradual decrease in the proportion of trauma in the global burden of disease from 1990 to 2019 can be attributed to improvements in trauma patient care [1]. Blunt abdominal trauma is a prevalent type of trauma, accounting for roughly 80 % of abdominal injuries in the emergency department. Therefore, blunt abdominal trauma accounts for 13% of intra-abdominal injuries in patients referred to the emergency department [2]. The liver and spleen are the most often affected organs in blunt abdominal trauma [3]. The spleen is a highly vascular organ; therefore, damage to it can result in considerable bleeding from the parenchyma or the arteries and veins that supply it. The spleen plays a crucial role in lymphopoiesis [4]. The symptoms of a splenic injury could vary widely depending on the severity of internal bleeding. Patients might present with signs of tachycardia and hypotension due to hypovolemic shock. Other symptoms might be left upper quadrant soreness, widespread peritonitis, or left shoulder referred pain [5]. These injuries can lead to numerous complications and deaths [6].

Focused Assessment with Sonography for Trauma (FAST) can rapidly assist the early diagnosis by identifying intraperitoneal hemorrhage, particularly in hemodynamically unstable patients. However, intraperitoneal hemorrhage is not always evident in splenic injury. The primary diagnostic imaging for splenic injury is computed tomography, which not only identifies the intra-abdominal free fluid but also depicts the splenic parenchyma and its surrounding area [3, 7]. Computed tomography imaging plays a significant role in determining the best treatment method for splenic injury [8, 9].

Splenic injury can be managed surgically and non-surgically. Patients might require operational treatment due to hemodynamic instability, peritonitis signs, or more severe splenic injuries. Although selecting a proper treatment requires considering all the influential factors, hemodynamic stability and the absence of peritonitis signs are usually considered the primary conditions of conservative treatment. The American Association for the Surgery of Trauma (AAST) classified splenic injuries into five grades based on computed tomography findings. Patients with grade IV and V of splenic injuries usually undergo surgical treatment [10-12]. Although surgery is unavoidable in some cases, recommendations have been altered in recent years to preserve the spleen and favor conservative treatment over surgery [13, 14]. In recent decades, studies that have assessed the outcome of these two treatment methods and the factors influencing them in patients with different conditions indicated conflicting results [9, 15].

Selecting the proper treatment method for patients with splenic injury has been discussed in recent decades, with trends favoring preserving the spleen. Thus, it is necessary to investigate the outcomes of surgical and conservative treatments for splenic injury. Previous studies on the outcome of these treatment methods reported conflicting results. Therefore, the present study aimed to investigate the outcome and influential factors in patients with splenic injury treated with operative and non-operative methods.

Materials and Methods

This retrospective and prognostic cross-sectional study was conducted on patients who were hospitalized in Kashani Hospital (Isfahan, Iran) from 2017 to 2019 and were diagnosed with traumatic splenic Rupture.

The database of Kashani Hospital was used to identify eligible patients, and the required information was extracted from the patient's medical records. This information included demographics, the mechanism of trauma, the AAST splenic injury scores, which were evaluated and determined by a radiologist from the CT scan, taken on admission, the level of consciousness (based on the Glasgow Coma Scale [GCS]), signs of peritonitis in abdominal examination (generalized tenderness and/or guarding), and the vital signs during hospitalization in the emergency department (systolic blood pressure of lower than 90 mmHg, diastolic blood pressure of lower than 60 mmHg, or heart rate over 100 beats per minute were considered as unstable hemodynamics), initial laboratory findings, treatment method, hospitalization duration, number of blood transfusions received, outcome and complications (hemorrhagic shock, intestinal obstruction, infectious complications including pneumonia, sepsis, wound infection, urinary tract infection, deep vein thrombosis, pulmonary thromboembolism, hepatic or renal dysfunction, and intra-abdominal abscesses). The patients with a history of anticoagulant use, acute or chronic liver or kidney disease, cardiovascular or respiratory disease, as well as patients with conservative treatment failure (requiring additional and delayed procedures, such as splenectomy, splenorrhaphy, or angioembolization), and patients who initially underwent conservative treatment were excluded from the study.

The collected data were analyzed using SPSS software (version 28). Qualitative data were expressed as numbers and percentages. Quantitative data were presented as mean±SD. The Kolmogorov-Smirnov test was used to test the normality of the distribution. Inferential analysis was conducted using the independent t-tests, Chi-square test, and partial correlation analysis. A p-value of less than 0.05 was considered statistically significant.

Results

The study involved 270 patients. Among them, 19 patients (7.0%) were excluded due to the failure of conservative treatment, and 11 were excluded for other reasons. The failure rate of conservative treatment was 7.0%. A total of 240 patients were investigated. The mean age of the patients was 29.8±12.2 years, and 180 (77.5%) patients were men. 154 (64.2%) patients received operative, and 86 (35.8%) received non-operative treatment. The patients' demographic characteristics, outcomes, and clinical and laboratory findings based on the treatment strategies are shown in Table 1.

According to Table 1, the sex distribution was different between the two groups. The relative frequency of men in the surgical treatment group was higher than those in the conservative treatment group (p<0.001). The results showed that the injury scores of surgical cases were higher than conservative patients (p<0.001). Patients receiving surgical treatment had significantly higher rates of associated injuries (p<0.001), unstable hemodynamic status (p<0.001), and complications (p<0.001). Furthermore, a higher proportion of patients treated surgically had a moderate and severe loss of consciousness than the conservative group (p=0.001). Mortality was significantly higher among surgical group patients (p=0.002). Patients in the conservative group were more likely to have peritonitis signs (p<0.001). The proportion of trauma mechanisms differed significantly between the two groups (p<0.001). The most common trauma mechanisms among the operative and non-operative groups were motorcycle (50.6%) and pedestrian (38.3%) accidents. By comparing the means of age, duration of hospitalization, and the number of blood transfusions required between the two groups, it was observed that patients who underwent surgical treatment required significantly more amounts of

Table 1. A Comparison of patients managed operatively and non-operatively

Variables		Total (n=240)	Non-operative treatment (n=86)	Operative treatment (n=154)	*p*-value
Sex	Male	186 (77.5%)	44 (51.1%)	142 (92.2%)	<0.001
	Female	54 (22.5%)	42 (48.8%)	12 (7.8%)	
AAST[a] Injury Score (according to admission CT scan)	1	19 (7.9%)	19 (22.1%)	0 (0)	<0.001
	2	25 (10.4%)	8 (9.3%)	17 (11.0%)	
	3	63 (26.2%)	33 (38.3%)	30 (19.48%)	
	4	89 (37.0%)	26 (30.2%)	63 (40.9%)	
	5	44 (18.3%)	0 (0)	44 (28.5%)	
Mechanism of trauma	Falling	26 (10.8%)	22 (25.5%)	4 (2.6%)	<0.001
	Sports	12 (5.0%)	8 (9.3%)	4 (2.6%)	
	Car Accident	62 (25.8%)	21 (24.4%)	41 (26.6%)	
	Motorcycle accident	78 (32.5%)	0 (0)	78 (50.6%)	
	Penetrating	21 (8.7%)	2 (2.3%)	19 (12.3%)	
	Pedestrian accident	41 (17.1%)	33 (38.3%)	8 (5.2%)	
Correlated injury	No	53 (22.0%)	40 (46.5%)	13 (8.4%)	<0.001
	Yes	187 (78.0%)	46 (53.5%)	141 (91.5%)	
Unstable hemodynamics	No	97 (40.4%)	81 (94.1%)	16 (10.3%)	<0.001
	Yes	143 (59.6%)	5 (5.9%)	138 (89.6%)	
Peritonitis signs	Yes	110 (45.8%)	2 (2.3%)	108 (70.1%)	<0.001
	No	130 (54.1%)	84 (97.6%)	46 (29.8%)	
GCS[b]	Mild (13-15)	160 (66.6%)	70 (81.4%)	90 (58.4%)	0.001
	Moderate (9-12)	53 (22.1%)	12 (14%)	41 (26.6%)	
	Severe (1-8)	27 (11.2%)	4 (4.6%)	23 (14.9%)	
Complications	No	160 (66.7%)	77 (89.5%)	83 (53.9%)	<0.001
	Yes	80 (33.3%)	9 (11.5%)	71 (46.1%)	
Outcome	Recovery	207 (86.2%)	82 (95.3%)	125 (81.1%)	0.002
	Death	33 (13.7%)	4 (4.6%)	29 (18.9%)	
INR[b]	High	192 (80%)	81 (94.2%)	111 (72.0%)	<0.001
	Normal	48 (20%)	5 (5.8%)	43 (27.9%)	
MCHC[d]	Low	240 (100%)	86 (100%)	154 (100%)	-
WBC[e]	Normal	240 (100%)	86 (100%)	154 (100%)	-
Age, Mean±SD		29.8±12.2	32.0±14.5	28.6±10.6	0.056
Hospitalization duration, Days, Mean±SD		4.4±2.2	4.2±2.3	4.6±2.2	0.308
Number of blood transfusions, Mean±SD		2.1±1	1.4±0.9	2.5±0.9	<0.001

[a]AAST: American Association for the Surgery of Trauma; [b]GCS: Glasgow Coma Scale; [c]INR: international normalized ratio; [d]MCHC: mean corpuscular hemoglobin concentration; [e]WBC: White blood cell.

Table 2. Correlation of predictive factors and outcomes

Variables	Mortality		Complications	
	Correlation coefficient	*p*-value	Correlation coefficient	*p*-value
Operative treatment[a]	-0.244	<0.001	-0.137	0.039
AAST Injury Score (according to admission CT scan)	0.573	<0.001	-0.403	<0.001
Unstable hemodynamics	-0.027	0.690	0.522	<0.001
Age	0.268	<0.001	0.330	<0.001
Sex (Male against female)	0.054	0.420	-0.298	<0.001
GCS	0.459	<0.001	0.033	0.619
Correlated injuries	-0.045	0.500	-0.012	0.863

[a]Partial correlation analysis was used.

blood transfusions (p<0.001), and no significant difference was found between the two groups in terms of age and duration of hospitalization (p≥0.05). Baseline laboratory findings showed that patients who underwent conservative treatment had higher INR levels (p<0.001).

Logistic regression analysis was initially considered to investigate the association between predictive factors and outcomes. However, due to the non-fulfillment of the conditions of this test, partial correlation analysis was used as an alternative. In analyzing the correlation between each variable and outcome, adjustments were made for the rest of the predictive factors (Table 2).

In comparison with non-operative treatment, operative treatment inversely correlated with mortality (p<0.001) and complications (p=0.039). Injury scores had a positive correlation with mortality (p<0.001) and a negative correlation with complications (p<0.001). Unstable hemodynamic status was positively correlated with complications (p<0.001). It was also observed that age had a positive correlation with mortality (p<0.001) and complications (p<0.001). Moreover, the male sex was inversely correlated with complications (p<0.001). GCS scores on admission were positively correlated with mortality (p<0.001). There was no statistically significant correlation between other predicting factors and outcomes (p≥0.05).

Discussion

Splenic injuries are among the most prevalent ones caused by abdominal trauma. Considering the immunological function of the spleen, the complications, and the risk of infections and thrombocytosis following splenectomy, current efforts are increasingly focused on preserving the spleen rather than splenectomy in traumatic cases [16, 17]. Despite the rising trend of selecting conservative over surgical management, determining the best treatment for each patient is yet undecided because conservative treatment necessitates intensive monitoring and can be associated with delayed bleeding, missed correlated injuries in the abdominal area in multiple traumas, and in some cases increased mortality [18].

The primary goal of this study was to investigate the treatment outcomes of patients with traumatic splenic injuries undergoing surgical and conservative management. Studies showed that motorcycle accidents cause the majority of splenic injuries [19]. In our study, motorcycle accidents were the most common mechanism of trauma, and all of these patients underwent surgical treatment. The treatment method for a splenic injury is determined by the patient's hemodynamic stability, intra and extra-abdominal injuries, peritonitis signs, active bleeding, and injury severity [20]. In the present study, the most prevalent splenic injury score was grade 4 on the AAST spleen injury scale, and 70.7% of these patients, as well as all of those with grade five injuries, underwent surgical treatment

Previous studies indicated higher grades of splenic injury as an independent risk factor for treatment failure. In assessing the correlation coefficients, the findings of the present study indicated that more severe injuries were associated with higher mortality rates, and this association was investigated regardless of the treatment method. Although patients who underwent surgical treatment had a higher risk of mortality and complications, after considering confounding variables, such as age, sex, level of consciousness, trauma grade, hemodynamic stability, and associated injuries, that could affect the outcomes, surgical treatment was found to be associated with lower risk of mortality and complications. In other words, the higher rates of mortality and complications in patients who underwent surgery were probably caused by the effects of age, sex, the severity of splenic injuries, unstable hemodynamics, more associated injuries, and lower consciousness levels on the outcome of these patients, rather than surgical management. This finding differed from most previous studies; the explanation for this discrepancy can be investigated in methodologies, statistical analysis, and the inclusion of numerous confounders [9, 21, 22]. Some studies that have shown poor outcomes in patients treated non-surgically attributed these poor outcomes to the improper management of these patients and delayed treatment of intra-abdominal

injuries [23-25].

Our findings revealed that patients with more severe splenic injuries were less likely to develop complications. In other words, considering the role of confounders, including age, sex, level of consciousness, grade of trauma, hemodynamic stability, and associated injuries, more severe splenic injury was correlated with fewer complications. Several studies demonstrated poor outcomes in patients with more severe splenic injuries [26, 27]. Regarding the inverse correlation of injury severity and complications, our findings were inconsistent with previous studies [28-30]. This difference could be attributed to the correlation between mortality and the severity of the injury. In other words, this disparity could be attributed to the death of some patients with more severe injuries before the incidence of any complication.

In the present study, all patients with unstable hemodynamics underwent operative treatment, and unstable hemodynamics were correlated with complications, which was consistent with previous studies [31, 32].

Our findings suggested that higher admission conciseness levels were positively correlated with mortality risk. According to emergency department treatment protocols, patients with altered levels of consciousness were considered critical, required immediate actions, and were prioritized over other patients [33, 34]. Therefore, it can be hypothesized that patients with loss of consciousness receive critical care in the emergency department, which leads to better outcomes.

The patient's age was positively and independently correlated with mortality and complications. Age has always been considered a significant factor in managing splenic injury. Non-surgical treatment in patients over 55 could be correlated with treatment failure and mortality. Elderly patients had decreasing biological reserves [35]. Age-related structural changes make spontaneous homeostasis unlikely and increase splenic fragility. Furthermore, previous studies marked age as an independent risk factor affecting the outcome of trauma patients [36].

This study had some limitations. This study had a single-centered design. Furthermore, this study was conducted cross-sectional and did not provide information on the long-term outcomes of patients. For this purpose, conducting cohort studies in this field is required. Similarly, the present study did not investigate the failure of conservative treatment and its related factors, which was a major concern in managing splenic injury. Future studies should take into account the emergency department triage level as a potential confounding factor.

Despite these limitations, this study had some advantages. One of its strengths was adjusting multiple confounding variables in examining the correlation between treatment methods and outcomes, which was only marginally assessed in previous studies. This study assessed patients of one of the major trauma centers in Iran, which can help in the selection of suitable treatment methods for splenic injuries.

Declaration

Ethical approval: The present study was approved by the Isfahan University of Medical Sciences Research Ethics Committee (IR.MUI.MED.REC.1400.526) and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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Original Article

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Bulletin of Emergency And Trauma

Pattern of Traumatic Injuries in Patients with Tramadol Poisoning: A Cross-Sectional Study in a Tertiary Care Hospital

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ABSTRACT

Objective: This study aimed to investigate the incidence and pattern of tramadol-induced seizures and injuries in patients admitted to the hospital.
Methods: The cross-sectional study included 300 patients with alleged tramadol intoxication. Demographic information, tramadol dosage and duration of abuse, co-existing illicit drug abuse, hospital stay length, and occurrence of seizures and trauma (type and site of injuries) were collected. Different statistical tests, including the Mann-Whitney U-test, Pearson's Chi-square test, and Student's t-test, were conducted to compare the patients with and without seizures, trauma, and co-ingestion of illicit drugs. The analysis was performed using SPSS software (version 21.0). A p value of less than 0.05 was considered statistically significant.
Results: The average patient's age was 24.66±5.64 years, with males comprising 84.3% of the sample. The mean tramadol dose and duration of abuse were 1339.3±1310.2 mg and 2.43±1.35 years, respectively. Seizures were observed in 66% of patients, with men having a higher incidence (69.6% vs. 46.8%; p=0.004). Trauma was reported in 23% of patients, accounting for 35.4% of seizure cases. All trauma patients had experienced seizures, with the head and neck being the most prevalent injury sites (55.1%), typically presenting as abrasions (55.9%). Patients with seizures and trauma had an average hospital stay of 1.73±0.94 days, which was significantly longer.
Conclusion: Trauma occurs in more than one-third of tramadol-induced seizures, highlighting the need to perform physical examinations to detect and localize injuries. Tramadol-associated traumas prolonged hospitalization times and thus required prompt attention to prevent further injuries during pre-hospital handling and transferring to hospitals.

Keywords: Poisoning, Seizure, Tramadol, Wounds and injuries.

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Introduction

Tramadol is a synthetic narcotic analgesic with both opioid and non-opioid properties. It is often used to treat moderate to severe pain due to its lower risk of causing respiratory depression [1, 2]. The dual analgesic effect of tramadol is achieved through its action as a μ-opioid receptor agonist and its ability to inhibit the uptake of norepinephrine and serotonin [3]. Tramadol has the potential for abuse, particularly in areas where it is easily available, prompting many individuals to seek medical assistance to address opioid addiction [4, 5]. Tramadol poisoning has emerged as a significant concern in Iranian emergency departments, resulting in serious complications, particularly among young men with mental disorders and substance abuse issues [6]. Although tramadol poisoning may not pose an immediate life-threatening risk, it can lead to serious adverse outcomes in affected patients, particularly when seizures occur [7, 8]. Seizures can cause a sudden loss of consciousness, which can lead to traumas due to falls or injuries sustained during patient restraints [7]. The impact of tramadol-induced trauma becomes particularly significant when patients with tramadol intoxication present to the emergency department with initially undiagnosed injuries [8]. More research is required into the various forms of trauma that might occur following seizures in patients admitted with tramadol ingestion. This study aimed to investigate the incidence and patterns of injuries caused by tramadol poisoning among patients who were referred to a tertiary care hospital.

Materials and Methods

A total of 300 patients with tramadol intoxication were included in this cross-sectional study, which was conducted at Bu Ali Hospital (Qazvin, Iran), from 2014 to 2017. Tramadol poisoning was defined as any clinical manifestation caused by tramadol ingestion that prompted the patients or their relatives to seek immediate medical assistance. Patients with incomplete medical records were excluded from the study.

The sample size was determined based on a prevalence of 15%, an α error of 5%, and an accuracy of 5%, resulting in a calculated sample size of 220 participants. Anticipating a 20% loss to follow-up, 300 patients were ultimately enrolled. A convenient sampling method was used to include patients who met the criteria. Following explaining the objectives of the study to eligible patients, written informed consent was obtained from them.

A checklist was utilized to collect the patient's information, which included demographic information, such as age and sex), history and duration of tramadol abuse, alleged dose of ingested tramadol, co-ingestion of other illicit drugs, such as heroin, opium, and methamphetamine, length of hospital stay (LOS), occurrence of seizure and trauma, as well as the site and type of injury.

The collected data was analyzed using SPSS software, version 21.0 (IBM Statistics, Chicago, USA). A comparative analysis was conducted between patients with and without seizures, trauma, and co-ingestion of illicit drugs in relation to their demographic characteristics (sex and age), tramadol ingested dosage, duration of tramadol abuse, and LOS using the Mann-Whitney U-test, Pearson's Chi-square, and Student's t-test. A p value of <0.05 was considered statistically significant.

Results

A total of 300 patients were admitted to hospital with tramadol poisoning. The demographic and clinical characteristics of the patients are summarized in Table 1. The average age of the patients was 24.66±5.64 years, ranging from 14 to 52 years, and 84.3% were men (n=253). The mean LOS was 1.73±0.94 days, with no in-hospital mortality. Out of the total, 44 patients(14.7%) had concurrently abused another illicit drug. The mean tramadol ingested dose was 1339.3±1310.2 mg, and the mean duration of tramadol abuse was 2.43±1.35 years. Patients who used other illicit drugs had a higher mean tramadol ingested dose (p=0.006) and were hospitalized for a longer period (p=0.004).

Table 2 presents the frequency of seizures based on demographic variables (age and sex), tramadol ingested dose, duration of tramadol abuse, and LOS. It shows that 66% of the patients experienced seizures, with men having a higher incidence than women (69.6% vs. 46.8%; p=0.004). Patients with seizures had a higher mean tramadol dose (1524.7±1395.9 vs. 1028.5±1006.6 mg; p=0.002) and a longer LOS (1.81±0.97 vs. 1.57±0.66 days; p=0.02) than those without seizures.

Table 1. Demographic and clinical attributes of the patients with tramadol poisoning

Variables		Patients n (%) N=300
Sex	Male	253 (84.3)
	Female	47 (15.7)
Age		24.66±5.64
Tramadol dose (mg)		1339.3±1310.2
Duration of tramadol abuse (year)		2.43±1.35
Length of hospital stay (day)		1.73±0.94

Table 2. The frequency of seizure based on the demographic variables (age and sex), tramadol ingested dose, duration of tramadol abuse, and length of hospital stay

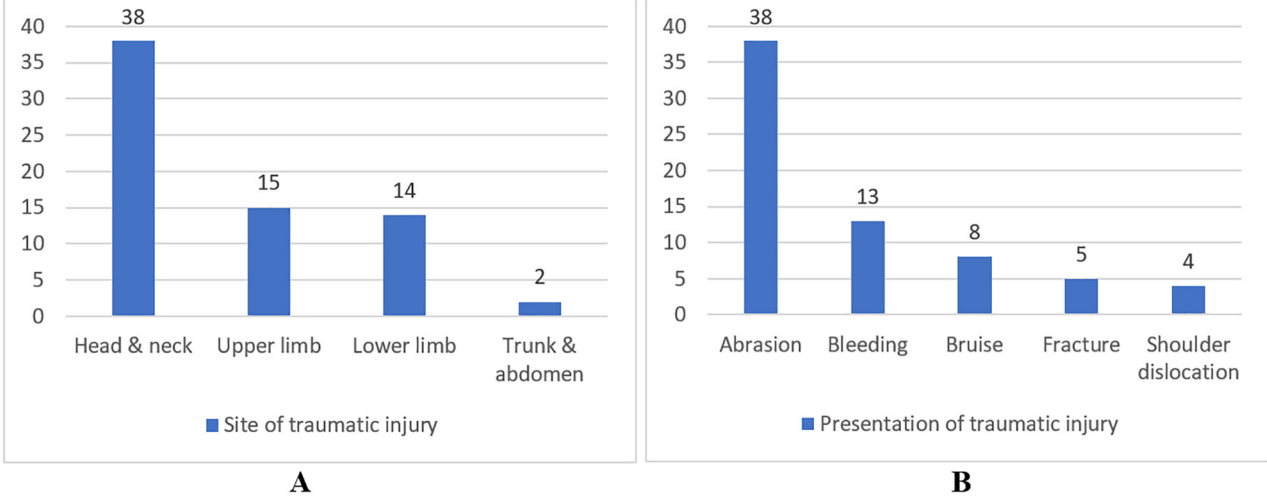
Variables		Seizure		*p* value
		Yes (n=198)	No (n=102)	
Sex	Male	176 (88.9)	77 (75.5)	0.004[a]
	Female	22 (11.1)	25 (24.5)	
Age		24.81±5.44	24.38±6.03	0.532[b]
Tramadol dose (mg)		1482.1±1763.2	1192.7±1413.1	0.002[c]
Duration of tramadol abuse (year)		2.44±1.35	2.41±1.4	0.88[b]
Length of hospital stay (day)		1.81±0.97	1.57±0.66	0.02[b]

[a]Pearson's Chi-square, [b]Independent samples t-test, [c]Mann-Whitney U test

Table 3. The frequency of traumatic Injuries based on the demographic variables (age and sex), tramadol ingested dose, duration of tramadol abuse, and length of hospital stay

Variables		Trauma		*p* value
		Yes (n=70)	No (n=230)	
Sex	Male	59 (84.3)	194 (84.3)	0.861[a]
	Female	11 (15.7)	36 (15.7)	
Age		24.86±5.79	24.61±5.62	0.74[b]
Tramadol dose (mg)		1680.1±1782.5	1302.1±1347.1	0.067[c]
Duration of tramadol abuse (years)		2.69±1.31	2.33±1.37	0.13[b]
Length of hospital stay (day)		2.14±1.26	1.61±0.7	0.001[b]

[a]Pearson's Chi-square, [b]Independent samples t-test, [c]Mann-Whitney U test



A **B**

Fig. 1. Site (A) and presentation (B) of traumatic injury among patients with tramadol poisoning and incidence of trauma

Table 3 outlines the prevalence of traumatic injury based on demographic variables, tramadol ingested dose, duration of tramadol abuse, and LOS. It indicates that 23% of the patients experienced trauma, which accounted for 34.8% of the patients with seizures, all of whom had seizures. As shown in Figure 1, the most common sites of trauma in patients with tramadol poisoning were the head and neck (55.1%), followed by the upper extremities (21.7%), and trunk (20.4%). The most prevalent types of injury were abrasions (55.9%), bleeding (19.1%), and fractures (15.5%). Patients with trauma had a longer LOS than those without (2.14±1.26 vs. 1.61±0.7 days; p=0.001). However, the mean tramadol ingested dose and ingestion duration did not differ between patients with or without trauma (p=0.067 and p=0.13, respectively).

Discussion

The findings of the present study revealed that seizure and trauma were frequent and serious complications of tramadol poisoning, associated with higher tramadol doses and longer duration of abuse, leading to extended LOS. Among the admitted patients with tramadol intoxication, 66% experienced seizures, which outnumbered other opioid toxicities [9]. A review of 51 articles with a total sample size of 101,770 patients reported that seizures occurred in 30% to 52.5% of tramadol abusers [10], which was similar to the findings of the present study. The pooled incidence (17%) reported in this meta-analysis was lower than that of the present study, most likely due to the inclusion of therapeutic doses, while our study focused only

on drug poisoning.

The present study also found trauma in 23% of admitted tramadol cases, with all traumatic cases associated with seizure occurrences. More than one-third (35.4%) of seizure cases in the present study resulted in traumatic injury. Tramadol-intoxicated patients experienced generalized tonic-clonic seizures without any warning, which resulted in falls and subsequent injuries [11].

A cohort study on seizure-related traumas in adult and pediatric patients with epilepsy (age ≥ 7 years) indicated that out of 200 patients, 86 individuals (43% of the group) suffered injuries while experiencing their typical seizures [12]. The inclusion of children with epilepsy in this study may contribute to a higher incidence of trauma in seizure events. Willems *et al.* investigated 292 adult patients with epilepsy (range 18-86 years) and found that 14.0% suffered from epilepsy-related injuries [13].

Regarding the effect of dose on seizures, the findings of the present study indicated that the mean tramadol dose was higher in patients who experienced seizures. The effect of tramadol dose on the incidence of seizures was controversial. Some studies suggested that seizures were dose-dependent and more frequent in higher doses, especially those with recurrent seizures who had consumed double doses than those with single seizures [14, 15], while others suggested that seizures might occur at any dose, even at therapeutic doses or minor overdose [16, 17].

The present study showed a higher incidence of tramadol poisoning in men. A meta-analysis of 18 studies also showed a pooled odds ratio of 2.24 for seizure incidence in men [10], which was in line with the results of the present study. This is while other Iranian studies have rejected the association of seizure with the age or sex of the patients [16-18]. The study on the U.S.A. registry also showed no association between age and seizure after tramadol poisoning [19]. These results were inconsistent with the results of the present study. This difference might be related to the difference in other factors, which could influence the incidence of seizures in patients with tramadol poisoning, such as having a history of epilepsy or having more than one episode of seizure [20]. In the current study, the mean duration of tramadol abuse was 2.43 years, higher in those who had seizures. Furthermore, patients, who used concurrently other illicit drugs, consumed higher doses of tramadol and abused it for a longer period of time. Others have also reported that patients with tramadol poisoning also ingested benzodiazepines, naloxone, and illicit agents (opium, heroin, and cannabis) in patients with tramadol poisoning [9, 16]. Medical comorbidities and concomitant use of proconvulsant serotonergic cytochrome P-450 inhibitors were identified as risk factors for serotonin toxicity and seizures [21].

According to the findings of the present study, trauma was another important injury that was observed after tramadol poisoning. As provided in the results, about one-fourth (23%) of the admitted patients had trauma after tramadol poisoning, mainly in the head and neck, and upper and lower extremities. In a study by Farajidana *et al.,* 24.6% of patients had trauma to the face, shoulder, head, trunk, and upper extremities. Trauma is considered an important consequence, especially in the head and neck, which might worsen patients with loss of consciousness and unrecognized injuries [7].

The present study recommended a physical examination to determine the type and site of injuries, as many injuries would be mild and may remain undetected. Tramadol-associated trauma complicates patients with prolonged hospitalization and requires prompt detection to prevent further injuries during patients' pre-hospital handling and transfer to the hospital. It is essential to weigh the risk-benefit ratio of using tramadol for pain management and consider alternative therapies in vulnerable individuals. Caution must be exercised when prescribing opioid medications to patients, as these drugs have the potential to induce side effects such as seizures or prolonged QTc intervals [22].

The present study had several strengths. First, the findings of this study provided valuable insights into the types and severity of injuries associated with tramadol-related admissions, allowing healthcare professionals to better identify and manage these cases. Second, the key strength of this study was its large sample size. Several limitations required to be noted regarding the present study. The responses relating to co-existing illicit drug abuse were subjective and thus prone to recall bias. This study provided no report of mortality because it lacked pre-hospital and post-discharge follow-up mortality statistics.

Declaration

Ethics approval and consent to participate: The protocol of the study was approved by the Ethics Committee of Qazvin University of Medical Sciences (code: IR.QUMS.REC.1397.286).

Consent for publication: The authors expressed their consent to the publication of this article.

Conflict of Interest: The authors declared no conflict of interest.

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Original Article

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Demographic Assessment of Burn Injuries in Iranian Patients

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ABSTRACT

Objective: This study investigated the demographic characteristics and factors influencing burn injuries, primarily in low socioeconomic societies where such incidents are prevalent due to factors such as illiteracy and poverty.
Methods: This cross-sectional study included all burn patients admitted to Shahid Motahari Hospital in Tehran, Iran. Demographic data such as age, sex, occupation, education level, and residence as well as detailed information about the burn incidents such as date, time, location, number of people present at the scene, and referral place was collected. Additionally, comprehensive burn details such as cause, extent, severity, previous history, and need for hospitalization directly at the emergency department were documented.
Results: The study included 2213 patients (mean age 34.98±19.41 years; range 1-96), with a men predominance (60.6%). The majority of burns (64.4%) occurred at home, primarily due to accidents (99.6%), with boiling water being the most common cause (39.2%). The most frequent burns were second-degree burns (91.8%), with an average injured body area of 6.31±6.67%. There were significant correlations between burn severity and demographic factors such as age, sex, occupation, cause of burn, hospital admission, outcome, and length of stay. Remarkably, the extent of burns was negatively correlated with the distance to the hospital, while positively correlated with the length of hospital stay.
Conclusion: Burn injuries were significantly influenced by demographic factors. Enhancing treatment facilities and reducing the time and distance to medical care could be crucial in high-risk cases.

Keywords: Demographic variables; Burn; Emergency.

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Introduction

Injuries are an urgent public health concern worldwide, affecting entire communities significantly [1-4]. Burn injuries are notably debilitating and sometimes disregarded. They are associated with severe morbidity, death, economic costs, and profound psychological effects, with long-term systemic consequences [5, 6]. Burn injuries, which rank fourth among unintentional injuries following car accidents and interpersonal violence, cause dramatic changes in homeostatic mechanisms, including circulation, metabolism, immune response, and inflammation, potentially resulting in multiple organ failure [1, 2, 7-9]. Burn injuries present a major global health issue, exacerbated by variables such as ignorance, poverty, and complications from other conditions [10, 11]. Accurate epidemiological statistics are essential for effective intervention. These injuries occur at varying rates across different demographics, with socioeconomic variables playing a significant role [12-15]. Unfortunately, the majority of data was extracted from high-income countries, with low-income nations frequently underrepresented due to healthcare disparities [16-18].

Annually, nearly 486,000 people in the United States seek treatment for burns, resulting in 40,000 hospitalizations and 3,400 deaths [19, 20]. In Iran, burn injuries were reported at an annual rate of 100,000 to 150,000 incidents, with a 6% hospitalization rate and a 10% fatality rate [21]. The World Health Organization (WHO) estimated about 11 million cases each year, resulting in 180,000 fatalities, representing a significant recovery challenge [22]. WHO classifies burns based on their etiology, which includes exposure to fire, smoke, flames, hot objects, electricity, and lightning [23, 24]. Various factors, such as direct contact with high temperatures, electricity, friction, radiation, or chemicals, contribute to burns, emphasizing the importance of prevention and improved patient outcomes [25, 26].

Burns are especially prevalent in developing and low- to middle-income countries, such as Iran [27-29]. They are ranked as the seventh leading cause of injuries in Iran, accounting for approximately 100,000 cases per year [30, 31].

Effective management of burn patients requires diverse medical care approaches, including expertise and interdisciplinary monitoring, with a major part being managed on an outpatient basis [22]. Remarkably, more than 90% of burn injuries are treated as outpatients [32]. In Iran, hot liquids are the predominant cause of burns, occurring mainly at home as a result of an accident [33-37]. Variables such as lifestyle, socioeconomic status, and energy sources significantly affect fatality rates and risk factors associated with burns in various countries [38]. Psychopathological consequences, such as depression and anxiety, are typical after a burn, and they are frequently associated with a lack of social support. Reduced social support is a critical predictor of post-traumatic stress disorder (PTSD) in burn patients and is associated with an increased risk of mortality, particularly during the intensive resuscitative phase [39]. Despite advancements and public health initiatives targeting burn prevention, there is still a gap in comprehensive research, particularly for patients in emergency room settings [3, 40-42]. This study focused on emergency room presentations and aimed at filling this gap in burn injury research in Iran. Burn injuries, which are recognized as a major public health issue, lead to extensive morbidity, mortality, and socio-economic burdens, particularly in countries such as Iran. The present research enhanced the understanding of burn injury epidemiology, aiding in resource allocation and prevention strategies. It also helped to identify high-risk groups by providing insights into the epidemiology and risk factors of burns in various demographics and regions.

Materials and Methods

This cross-sectional study was conducted in 2020 at Shahid Motahari Hospital (Tehran, Iran). All the patients with burn injuries, who were admitted to the emergency room, were included in this study. Patients whose profiles were incomplete were excluded.

A checklist was used to collect the patient's demographic and medical history, including age, sex, occupation, education, and place of residence. This task was carried out by emergency staff by interviewing and monitoring the patients on a regular basis. The required information regarding the injury, including the date, time, number of people at the accident scene, accident location, referral source, means of transportation to the hospital, and time of emergency department visit, were all recorded. Furthermore, information on the burn, such as its source, extent, severity, necessity for hospitalization, historical background, and length of emergency department stay, was documented.

The data was gathered and analyzed using SPSS statistical software (version 24). Qualitative variables were presented as frequency and percentages. Quantitative variables were expressed as mean±SD. Relationships between variables were examined using Spearman's non-parametric test. The Chi-square test was used to compare categorical qualitative data. The independent sample T-test and Mann-Whitney U test were utilized to compare non-parametric variables. A p-value of ≤ 0.05 was considered statistically significant.

Results

A total of 2213 burn patients, with 1342 (60.6%) men

and 871 (39.4%) women, were examined at Shahid Motahari Hospital (Tehran, Iran). The mean age of the patients was 19.41±34.98 years, with men averaging 34.77±18.59 years, and women 35.31±20.62 years. The age category of 20 to 39 was the most represented, accounting for 41.8% of the sample. Although a significant association between age groups and sex was noted (p=0.028), there was no significant

Table 1. Demographic characteristics of burn patients

Demographic features		Number (%)	Demographic features	Number (%)
Age groups			Occupation	
1-19		441 (19.9)	Unemployed	44 (2.00)
20-39		924 (41.8)	Self-employment	902 (40.8)
40-59		592 (26.8)	Governmental	418 (18.9)
79-60		231 (10.4)	Housewife	419 (18.9)
80-99		25 (1.10)		
Sex			Urban areas of burn accidents	
1-19	Male	247 (56.0)	1	63 (2.80)
	Female	194 (44.0)	2	106 (4.80)
20-39	Male	594 (64.2)	3	45 (2.00)
	Female	330 (35.7)	4	88 (4.00)
40-59	Male	356 (60.1)	5	105 (4.70)
	Female	236 (39.8)	6	52 (2.30)
79-60	Male	131 (56.7)	7	58 (2.60)
	Female	100 (46.2)	8	53 (2.40)
80-99	Male	14 (56.0)	9	18 (0.80)
	Female	11 (44.0)	10	34 (1.50)
Education			11	32 (1.40)
Elementary		159 (7.20)	12	26 (1.20)
Middle School		94 (4.20)	13	29 (1.30)
High school		224 (10.1)	14	46 (2.10)
Diploma		603 (27.2)	15	40 (1.80)
Associate Degree		92 (4.20)	16	24 (1.10)
Bachelor's Degree		375 (16.9)	17	23 (1.00)
Master's Degree		101 (4.60)	18	30 (1.40)
Doctorate		22 (1.00)	19	18 (0.80)
Location			20	23 (1.00)
Tehran		1712 (77.4)	21	12 (0.50)
Other Cities		501 (22.6)	22	25 (1.10)
Vehicle type			Place of burn incident	
Personal		1719 (77.7)	Home	1426 (64.4)
Ambulance		91 (4.10)	Workplace	471 (21.3)
Rental Car		409 (18.2)	Other	316 (14.3)
Cause of the burn (etiology)			Cause of the burn	
Accident		1886 (85.2)	Flame	2 (0.10)
Forgiveness		320 (14.4)	Boiling Water	868 (39.2)
Suicide		1 (<0.1)	Acid	59 (2.70)
Other		6 (0.3)	Explosion	20 (0.90)
Previous history of burns			Steam	43 (1.90)
Yes		87 (3.9)	Electricity	55 (2.50)
No		2126 (96.1)	Hot Body	468 (21.1)
Type of hospital admission			Wound	5 (0.20)
Hospitalization		98 (4.4)	The Cold	8 (0.40)
Outpatient		2115 (95.6)	Flame	465 (21.0)
Degree of burn			Laser Therapy	5 (0.20)
I		80 (3.6)	Hot liquid (hot oil, thermal glue, paraffin, bitumen)	165 (7.5)
II		2031(91.8)	Molten material	50 (2.30)
III		102 (4.6)		
			Patients' admission	
			Discharge	2125 (96.0)
			Hospitalization	84 (3.80)
			Transfer to another center	2 (0.10)
			Died in the emergency room	2 (0.10)

age difference between sexes (p>0.05). Total Body Surface Area (TBSA) was critical in determining burn severity, particularly in understanding third-degree burns in terms of length of hospitalization. The majority of patients were from Tehran (77.4%), specifically the second and fifth districts. The home was identified as the primary accident site (64.4%), with boiling water (39.2%), hot materials (21.1%), and flames (21%) being the most common burn causes. Accidents accounted for 99.6% of burns. 3.9% of patients reported a previous burn history, and 4.4% had past hospital admissions.

The majority of patients (91.8%) suffered from superficial second-degree burns. Such burns are often accompanied by skin redness, pain, and swelling. A significant majority(96%) were discharged after treatment. The demographic information of the studied patients is shown in Table 1.

The analysis of third-degree burns in relation to TBSA revealed that larger burn areas typically require longer hospital stays. This emphasizes the strong correlation between the severity of the burn and the length of hospitalization. In addition, the burn incident lasted an average of 14.5±5.27 hours, and the average distance from the accident site to the hospital was 36.73±75.86 Km. Incidents reported from 1 to 7 burn victims, with an average emergency room stay of 24.82±16.92 min. The mean burn percentage was 3.67±6.31, ranging from 1 to 100%. Comprehensive details are presented in Table 2.

There were significant correlations between burn severity and several patient demographics and clinical features. A significant association was found between the degree of burns and patient age, with a majority of first to third-degree burns occurring in the 20-39 age range, accounting for 924 cases (p=0.012). The length of hospitalization for third-degree burns was significantly influenced by the affected Total Body Surface Area (TBSA).

In terms of sex differences, males predominantly suffered from first to third-degree burns (1342 cases). The average burn percentage was significantly higher in men (7.44±4.22). Moreover, there was a significant correlation between burn degree and sex (p<0.05).

Occupationally, 902 of the burn victims were unemployed, while 1632 employed individuals had a significant number of second-degree burns, indicating a significant association between burn degree and occupation (p<0.05).

Concerning educational level, individuals with a diploma level of education were significantly affected (603 cases reported). Although there was no significant association between burn degree and education level, a correlation with burn percentage was found.

Following analyzing the causes of burns, accidents were the predominant cause of burns, accounting for 2205 cases. The majority of these incidents occurred at home (1426 cases), with second-degree burns being the most common (2031 cases). The degree of burns had a significant relationship with the cause (p<0.05), but not with the location of the incident.

Distance to the hospital was also a factor, with second-degree burn patients having the longest average distance from the accident site to the hospital (146.88±195.68 km). There was a negative significant relationship between burn degree and distance to the hospital (Pearson correlation=-0.068, p=0.005).

In terms of hospitalization, the majority of patients, especially those with first to second-degree burns, were treated as outpatients, with a total of 2115 cases. There was a direct significant relationship between burn degree and the length of hospital stay (Pearson Correlation=0.238, p=0.001). Remarkably, a large proportion of patients (2125 cases) were discharged, highlighting the effectiveness of the treatment.

Our findings provided detailed insights into the relationships between burn degrees and patients' demographic characteristics, as well as sex-based variations in burn percentage. These associations, along with their implications, are comprehensively presented in Tables 3-5.

Discussion

Burn injuries with an annual estimated 180,000 deaths have been considered a serious public health concern worldwide [1]. The purpose of the present study was to provide a better understanding of the etiological, demographic, and clinicopathological patterns of burn injuries in Iran to help healthcare providers and researchers in the future. We were mainly focused on the burn patients' characteristics, including age, sex distribution, employment, marital and educational status, cause of burn, place of burn accident, length of hospital stay, and outcomes. The main findings revealed a significant association between the degree and percentage of burns and demographic variables such as age, sex, occupation, and level of education. Moreover, a significant relationship was found between the variables related to burns, such as the cause and location of the burn

Table 2. The average time and distance from the accident site to the hospital and patients' visit to the emergency room

Patients' demographics in the emergency room	Minimum	Maximum	Mean±SD
Time of occurrence	1	24	14.5±5.27
Time of patient's visit	1	24	12.4±4.41
Distance from the accident site to the hospital (Km)	1	161.4	75.8±36.7
Number of burn patients	1	7	1.05±0.33
Burn percentage	1	100	3.67±6.31
Length of hospitalization (min.)	2	201	24.8±16.9

Table 3. The degree of burns according to the status of the patient's demographic characteristics

Demographic features		Degree of burn			Total
		1st	2nd	3rd	
Age groups	1-19	17	412	12	441
	20-39	42	837	45	924
	40-59	14	552	26	592
	60-79	6	208	17	231
	80-99	1	22	2	25
	Total	80	2031	102	2213
Sex	Male	39	1233	70	1342
	Female	41	798	32	871
	Total	80	2031	102	2213
Occupation	Unemployed	3	35	6	44
	Self-employment	23	836	43	902
	Governmental	15	382	21	418
	Housewife	22	379	18	419
	Total	63	1632	88	1783
Education	Elementary	1	151	7	159
	Middle School	3	91	0	94
	High school	7	200	17	224
	Diploma	26	548	29	603
	Associate Degree	3	84	5	92
	Bachelor's Degree	17	349	9	375
	Master's Degree	5	93	3	101
	Doctorate	0	21	1	22
	Total	62	1537	71	1670
Etiology	Accident	79	2026	100	2205
	Forgiveness	0	1	0	1
	Suicide	0	1	0	1
	Other	1	3	2	6
	Total	80	2031	102	2213
Place of burn	Home	54	1314	58	1426
	Workplace	15	432	24	471
	Other	11	285	20	316
	Total	80	2031	102	2213
Type of hospital admission	Hospitalization	1	69	28	98
	Outpatient	79	1962	74	2115
	Total	80	2031	102	2213
Patients' admission	Discharge	77	1972	76	2125
	Hospitalization	2	58	24	84
	Transfer to another center	0	0	2	2
	Death in the emergency room	1	1	0	2
	Total	80	2031	102	2213

Table 4. The percentage of burns in each sex

Burn patients' status	Sex	N	Mean	SD	SEM
Percentage of burn	Male	1016	4.22	7.44900	0.234
	Female	676	2.84	3.92700	0.151

incident, the status of the patient's admission to the hospital, and the patient's outcomes. Besides, the distance from the place of the burn accident to the hospital was also an important factor in increasing the degree of burn. The severity of the burn significantly increased the length of the patient's stay in the hospital. It was reported that there was a correlation between the place of living and working and burn traumas. According to a comprehensive systematic review, the majority of burn traumas occurred at home (75.05%), in the workplace (14.67%), and in other places (9.88%), respectively [1]. Similar to the findings of a previous systematic review, the findings of the present study indicated that the most common place of burn occurrence was at home in 64.4% of cases, at the workplace in 21.3% of cases, and 14.3% at other places [1]. According to the findings of the present study, the most common cause of burns was accidents (85.5%), in comparison to other causes of burns such as forgiveness and suicide.

Table 5. The association between the degree of burn with patient's etiological, clinicopathological, and demographic characteristics

Demographic features	Degree of burn	1st	2nd	3rd
Place of burn incident	N	80	2031	102
	Minimum	1	1	1
	Maximum	3588	16142	979
	Mean	94.69	71.56	146.88
	SD	404.213	372.183	195.682
Duration of Hospitalization	N	80	2031	102
	Minimum	5	2	10
	Maximum	180	180	201
	Mean	21.94	24.05	42.47
	SD	19.511	14.211	39.826

It is essential to comprehend the main causes of burns to develop preventative strategies. While boiling water was a prevalent cause, a broader spectrum of etiological factors, such as electricity, friction, radiation, and chemicals was also mentioned in the literature. It's crucial to recognize that while some causes, such as boiling water in domestic environments, are more common in particular locations, other causes, such as chemical and electrical burns, might be more prevalent in industrial or occupational settings. The variety of these factors emphasizes the necessity for focused preventative interventions across various environments [25].

Mobayen *et al.,* reported that burn injuries were frequently caused by flames, indoors, and in adolescents with a low educational state [1]. However, the findings of the present study indicated that the most prevalent cause of burns was boiling water (39.2%), followed by a hot material (21.1%), and the flame was observed only in 21% of cases. However, in a retrospective cohort study conducted specifically on women in Baghdad, fire (64.8%) was reported as the leading cause of burns among females [41]. In a survey of socio-demographic and quality of life status post-burn, 94% of the injuries claimed by the respondents were accidental, most of which occurred as a result of catastrophes of flame, electrical, or scald burns, mainly in patients with synthetic material cloths (39%), mixed (35%), and cotton/other material (26%) at the time of the occurrence [43].

Since burn cases have the highest hospital bed occupancy rate, it imposes a high financial burden on both the family and the hospital [43]. Given that burn traumatic injury is a very overwhelming occurrence that has short- and long-term consequences such as prolonged recovery and extended rehabilitation periods, it requires immediate management by a specialized healthcare team [43]. As a result, the World Health Organization (WHO) has identified burn injuries as one of the leading causes of disability-related life years (DALYs), especially in the South East Asia Region (SEAR) [43]. In the present research, 4.4% of patients who were admitted to the hospital had the highest superficial second-degree burn (91.8%). These burns, primarily affecting the outer layer of the skin, are frequently accompanied by redness, pain, and swelling. Despite the severity of these burns, as indicated by an average burn percentage of 6.31±3.67, the mortality rate was significantly low, with only 0.1% of deaths recorded in the emergency department. This emphasizes the necessity of prompt medical intervention in improving burn patient outcomes. A 10-year epidemiological survey of 92,333 hospitalized burn patients in Romania found a significant correlation between the increase in mortality rate and the year of study, which was accompanied by a drastic reduction in the annual number of burns from 10,547 (47 cases per 100,000) in 2006 to 7313 (36.93 per 100,000) in 2015 [44]. In addition, about 3,194 deaths (1/100,000 cases) in the United States were caused by fire and burn injuries, accounting for only 1.3% [42]. Out of 450,000 annual cases of burn patients in the United States, only 40,000 required hospitalization, and 3,400 died as a result of burn complications [45]. In the present study, the ratio of mortality to hospitalization was lower than in the previous studies, which could be attributed to the larger sample size and other risk factors in the American population. In a cohort study of the burn registry program, risk factors for mortality and lethal area fifty percent (LA50) of the Iranian population were evaluated over two years. Burn causes had little effect on the mortality of patients, and age (median age of 25), female sex, and burn size were the most important predictors of mortality [46]. They found that the mean length of hospital stay for burn patients was 14.41 days, which was twice as long in suicide cases. In the present study, the main demographic features of patients that could affect burn intention, degree, and size were evaluated. The findings indicated that age was related to the degree of burn, and most cases were between 20 and 39 years old. In a study conducted in Turkey, the average age of burned cases was 27.9 years, with a 15.8% hospitalization rate [47]. In other Iranian and Chinese studies, the mean age of burn patients was reported to be 30 [48], 16-25 [49], and 25-27 (80% under 40) years old [50], respectively. According to these figures, people in this age range are more likely to have burns as a result of occupational risk factors. Therefore, it is essential to maintain safety for patients in this age group. The findings of a previous

study indicated that females of reproductive age are frequently at risk of intentional burning because of their low socioeconomic status and unsafe cooking appliances [51]. As a result, it showed that sex might be an important risk factor in the degree of burn. Gatea *et al.,* found that the mean age of burn females was 27.1 with 64.8% fire exposure, and that there was a significant relationship between clinical outcomes and length of stay, causes of burn, and educational level [41]. According to the findings of the present research, men were significantly involved with the higher degrees and average percentage of burns than women. Findings of other studies showed that men had twice the risk of women (68% vs. 31.9%, or a ratio of 2.2-2.4 to 1) [48, 50, 52, 53]. As well, the findings of these studies showed that the higher rate of burns in men could be related to their hazardous occupational status compared to women. Therefore, in addition to the proper culture of society, sufficient safety equipment should be provided for both sexes, especially men, in more dangerous circumstances. The decline in burn admissions, incidence, and severity in several countries could be attributed to a variety of factors, including governmental policies, preventive curricula, and improved workplace safety [54-56]. However, burn mortality rates must be considered more cautiously, as most studies have only reported inpatient mortality, while a certain proportion of patients died at the scene of injury [56-59]. Similar to the findings of other studies, the present research found a significant correlation between the degree of burn and the accident location, with the majority of burns occurring at home [48, 49]. Furthermore, the hospitalization rate of burn patients in this study was 4.4%, with mean lengths of 21.9, 24.0, and 42.4 in the 1st, 2nd, and 3rd degrees of burn, respectively. It showed that this amount could be increased with the degree of burn of the patients, as we observed that patients with higher burn degrees were hospitalized with a longer hospital stay, had poor outcomes, and a poor prognosis leading to transplantation or death. Previous research confirmed our findings, indicating that a lower percentage of burns led to more outpatient management and faster discharge. Therefore, after the occurrence of a burn, patients should be transferred to medical centers as soon as possible to prevent infection and even organ failure due to a lack of follow-up and early referral. Enhanced treatment facilities play a crucial role in not only providing immediate and effective care for burn injuries but also in preventing future occurrences. These facilities frequently serve as centers for education and awareness, disseminating crucial information about burn prevention and safety measures to patients, their families, and the community. By educating the public on the common causes and risk factors associated with burns, particularly in high-risk groups and settings, treatment centers can foster a more informed and cautious approach to activities that pose burn risks.

Furthermore, advanced treatment facilities should be equipped to conduct comprehensive post-burn assessments and provide rehabilitation services. These services include counseling and guidance on avoiding circumstances that caused the initial injury, thereby reducing the likelihood of repeated incidents. The presence of well-equipped facilities also signifies a strong healthcare system, which can inhibit risky behaviors that lead to burns, as individuals become more aware of the consequences and the seriousness with which such injuries are treated [60-62].

In summary, while the primary function of treatment facilities is to provide medical care, their potential impact extends to preventive measures by raising awareness, educating the public, and preventing the recurrence of burn injuries through comprehensive post-treatment assistance.

According to the persuasive results found in the present study, it is recommended to identify significant risk factors in more population-based studies to help administrators and policymakers pay more attention and prioritize accident injuries based on sex, especially younger men, the improvement of pre-hospital and hospital services, and the safety of medical and emergency care equipment.

In conclusion, the findings of the present study highlighted the impact of demographic factors such as sex, education, occupation, and the accessibility of treatment facilities on burn injuries. Recognizing these factors could contribute to the development of effective prevention strategies and improve healthcare services. This study recommended policymakers and administrators prioritize accident injury prevention, particularly for younger men, enhance pre-hospital and hospital services, and ensure the availability of safe medical and emergency care equipment. This allows us to reduce the burden of burn injuries and improve outcomes for affected individuals.

Declaration

Ethics approval and consent to participate: This study was approved by the Ethics Committee of the Iran University of Medical Sciences, Tehran, Iran (code: IR.IUMS.FMD.REC.1399.780).

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Original Article

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An Epidemiological Investigation on Patients with Non-traumatic Subarachnoid Hemorrhage from 2010 to 2020

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ABSTRACT

Objective: Subarachnoid hemorrhage (SAH) is still considered a life-threatening medical condition with a high mortality rate, particularly in developing countries. Thus, the present study aimed to investigate the angiographic findings of non-traumatic or spontaneous SAH.
Methods: This retrospective cohort study included 642 health records of patients with non-traumatic SAH over a 10-year period, from 2010 to 2020. The required data, including demographic information, aneurysm type, size, location, disease severity classification, and secondary complications, were extracted.
Results: The study included 642 patients, with 262 (40.8%) being male. The mean age of the participants was 54.72±13.51 years. The most prevalent type of aneurysm was saccular (89.1%), while serpentine (0.2%) and dissecting saccular (0.2%) aneurysms had the least prevalence. The most frequently involved arteries were the anterior communicating artery (ACoA; 38%), internal carotid artery (ICA; 27.6%), and middle cerebral artery (MCA; 13.4%). There was a significant correlation between sex and aneurysms occurring at ACoA and ICA ($p< 0.0001$), and ACoA – A1 ($p=0.02$). Patient age and sex were also significantly correlated with one another ($p<0.0001$). There was no statistically significant correlation between sex, aneurysm size, Glasgow coma scale (GCS), and modified Rankin scale (MRS).
Conclusion: Based on our findings, the presence of aneurysms at ACoA, ACoA – A1, and ICA should be thoroughly ruled out in patients with severe headaches of sudden onset, particularly male patients of younger ages.

Keywords: Subarachnoid hemorrhage; Aneurysm; Complication.

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Introduction

Subarachnoid hemorrhage (SAH) is a medical condition characterized by bleeding in the space between the brain and the dura matter [1]. This condition is classified as a medical emergency due to its potentially life-threatening consequences [2]. It can cause severe neurological damage or even death if not promptly diagnosed and treated [3]. The bleeding in the subarachnoid space can cause an increase in intracranial pressure, which can compress vital structures within the brain, and cause brain injury [4]. Additionally, blood clots may form and obstruct normal blood flow, depriving brain tissue of oxygen and nutrients [5].

Common symptoms of subarachnoid hemorrhage include a sudden severe headache (often described as "the worst headache of my life"), nausea, vomiting, neck stiffness, sensitivity to light (photophobia), seizures, loss of consciousness, or focal neurological deficits such as weakness or numbness in specific body parts [6]. Recognizing these symptoms promptly can help individuals seek immediate medical attention and receive appropriate treatment.

Early diagnosis and treatment are essential for improving outcomes in patients with subarachnoid hemorrhage [7].

Imaging plays a crucial role in the diagnosis of SAH, and useful imaging techniques include computed tomography scans (CTs), CT angiography, magnetic resonance imaging (MRI), and digital subtraction angiography (DSA) [8-10]. Angiography findings in subarachnoid hemorrhage play a crucial role in the diagnosis, management, and prognosis of this potentially life-threatening disease [11].

The size, location, and morphology of aneurysms identified through angiography are essential factors in determining appropriate treatment options [12]. Endovascular techniques, such as coiling or stent-assisted coiling, can be employed during angiography to treat certain aneurysms non-surgically. Furthermore, angiography findings can help in determining the overall prognosis for patients with SAH [13]. The presence of multiple aneurysms or certain characteristics of the aneurysm, such as size, shape, and location, can influence the risk of re-bleeding and subsequent complications. This information is critical for making long-term management decisions and providing appropriate counseling to patients and their families [14].

The present study evaluated the DSA findings of non-traumatic or spontaneous SAH by following patients admitted to a referral hospital from 2010 to 2020.

Material and Methods

From 2010 to 2020, this retrospective cohort research was conducted on the health records of patients admitted to an institutional referral hospital in eastern Mashhad with an initial diagnosis of non-traumatic or spontaneous SAH. This study included all patients suspected of SAH, as well as individuals with a confirmed diagnosis based on the findings of brain CT, LP, or validated by a fellow neurosurgeon.

As this was a retrospective study on patient health records, neither an informed consent was required, nor did we intervene in the treatment of patients.

To evaluate the clinical condition of patients upon admission, they were categorized into several classes using four major classification systems: Fisher, modified Fisher (M Fisher), World Federation of Neurological Surgeons (WFNS) scale, and Modified Rankin Scale (MRS), as shown in Table 1. While the (M) Fisher scales are based on the hemorrhage features, the WFNS system is based on the Glasgow Coma Scale (GCS), and MRS takes into account the patients' physical competency (Table 1).

The data was analyzed using the SPSS software version 22 (SPSS Inc., Chicago, Illinois, USA). The continuous variables were presented as mean±SD. The Chi-square test was used for the association of sex and location of the aneurysm. The associations among age, aneurysm size, and aneurysm neck size, GCS, and MRS were evaluated using the independent T-test.

Table 1. MRS and WFNS classification systems, are used for categorizing the patients, based on the severity of their condition

Class	Fisher	M Fisher	MRS	WFNS
0			No symptoms	
1	No blood was detected.	Focal or diffuse thin SAH, no IVH [a]	No significant disability, despite some symptoms.	GCS: 15 without neurological deficit
2	Diffuse deposition or thin layer with all vertical layers of blood <1 mm thick	Focal or diffuse thin SAH, with IVH	Slight disability. Able to look out after own affairs without assistance.	GCS: 13–14 without neurological deficit
3	Localized clots and/or vertical layers of blood ≥1 mm thick	Thick SAH present, no IVH	Moderate disability. Requires help, but can walk unassisted.	GCS: 13–14 with neurological deficit
4	Diffuse or no subarachnoid blood, but with intracerebral or intraventricular clots	Thick SAH present, with IVH	Moderate–severe disability. Unable to walk unassisted.	GCS: 7–12
5			Severe disability. Requires constant nursing.	GCS<7
6			Dead	

[a]Intraventricular hemorrhage.

Table 2. Demographic information of patients.

Variable	All
Sex (n=642)	642 (100%)
Male	262 (40.8%)
Female	380 (59.2%)
Age (mean±SD)	54.72±13.51
Aneurysm size (mean±SD)	7.53±6.20
Aneurysm neck size (mean±SD)	3.53±2.05
GCS (mean±SD)	13.08±2.94
Aneurysm type (n=572)	
Saccular	572 (89.1%)
Large saccular	13 (2.0%)
Giant saccular	10 (1.6%)
Dissecting saccular	1 (0.2%)
Dissecting	11 (1.7%)
Desiccant	6 (0.9%)
Serpentine	1 (0.2)
Pseudoaneurysm	2 (0.3%)
Blister	6 (0.9%)
Giant	9 (1.4%)
Recanalized	11 (1.7%)
Aneurysm location (n=654)	
ICA	177 (27.6%)
MCA	86 (13.4)
ACoA	244 (38%)
ACoA–A1	9 (1.4%)
Vertebrobasilar	82 (12.8%)
Perical	42 (6.5%)
PCA	14 (2.2%)
Number of aneurysms (n=640)	
1	593 (92.7%)
2	41 (6.4%)
3	5 (0.8%)
4	0 (0%)
5	1 (0.2%)
Fisher (n=541)	
1	48 (7.5%)
2	206 (32.1%)
3	255 (39.7%)
4	32 (5%)
M Fisher (n=495)	
1	214 (33.3%)
2	17 (2.6%)
3	175 (27.3%)
4	89 (13.9%)
MRS (n=602)	
0	50 (8.3%)
1	394 (65.4%)
2	49 (8.1%)
3	34 (5.6%)
4	21 (3.5%)
5	5 (0.8%)
6	49 (8.1%)
WFNS	
1	342 (53.3%)
2	96 (15%)
3	21 (3.3%)
4	136 (21.2%)
5	38 (5.9)
Adverse events following surgical treatment	
None	570 (89.1%)
Ischemia	1 (0.2%)
Coil migration	2 (0.3%)
Perforation at coiling	1 (0.2%)
PCA occlusion	1 (0.2%)
Perforation	1 (0.2%)
Hydrocephalus	99 (16%)
Infection	19 (3.1%)
Mass Effect	2 (0.3%)
Recurrent hemorrhage	3 (0.5%)
SAH	118 (18.4%)
Death	41 (6.4%)

Quantitative data were presented as mean±SD or median (interquartile range), and compared using Mann-Whitney U and student-t tests. A p-value<0.05 was considered statistically significant.

Results

The present study involved 642 patients with non-traumatic SAH, including 380 (59.2%) females and 262 (40.8%) males. The mean age of the patients was 54.72±13.51. A total of 595 patients (92.7%) had only one aneurysm, while 6.4% and 0.2% had 2 and 5 aneurysms, respectively. The demographic information of the participants is presented in Table 2. When categorized based on the WFNS classification, the majority of participants were assigned to class 1 (53.3%) and class 4 (21.2%), respectively. However, when categorized based on the MRS classification, 65.4% of all participants fell into class 1. Table 2 shows the distribution of patients in the categories of these classification systems.

Saccular aneurysms were the most predominant type of aneurysm among the participants (89.1%). The least prevalent types of aneurysms were serpentine (0.2%) and dissecting saccular (0.2%) aneurysms. The most frequently involved arterial branches were the anterior communicating artery (ACoA; 38%), internal carotid artery (ICA; 27.6%), and middle cerebral artery (13.4%), while the least commonly involved arteries included the A1 segment of ACoA (1.4%) and posterior cerebral artery (PCA; 2.2%) (Table 3).

In terms of adverse events and complications, 89.1% of patients did not develop any sort of complications following surgical intervention. Recurrent SAH was the most frequently reported complication (18.4%), followed by hydrocephalus (16%), and death (6.4%). The prevalence of other complications is presented in Table 3.

Statistical analysis revealed a significant correlation between sex and the location of aneurysm, particularly ACoA, and ICA. About 33.4% of female patients had ICA aneurysm, while only 19.1% of males were reported to have the same condition (p<0.0001). In the case of ACoA, 46.6% of male participants had an aneurysm at this branch, which was significantly higher than the 32.1% of females who had the same condition (p<0.0001). Although not as significant as the two former arteries, the A1 segment of ACoA was also significantly associated with sex, with a higher proportion of male patients inclined to have an aneurysm in this branch (p=0.02). The relationship between sex and aneurysm location is presented in Table 4.

A significant correlation was found between age and sex. The mean age of female patients was significantly higher than males (p<0.0001). Patients with ICA aneurysms had a significantly lower mean age than those who did not have an aneurysm at this arterial branch. The information regarding the correlation between age, sex, and aneurysm location is summarized in Table 4.

Discussion

The present study investigated demographics and clinical features of 642 patients with non-traumatic SAH, with a mean age of 54.72±13.51, and sex distribution of 59.2% and 40.8% for females and males, respectively. According to the Fisher scale, 7.5%, 32.1%, 39.7%, and 5% of patients were categorized as classes 1-4, respectively. 89.1% of patients had no complications following surgical intervention. As previous research reported non-

Table 3. The statistical association between sex and the location of aneurysm

Aneurysm location	Patients		p-value[a]
	Male	Female	
ICA	50 (19.1%)	127 (33.4%)	<0.0001
MCA	34 (13%)	52 (13.7%)	0.79
ACoA	122 (46.6%)	122 (32.1%)	<0.0001
ACoA–A1	7 (2.7%)	2 (0.5%)	0.02
Vertberobasilar	31 (11.9%)	51 (13.4%)	0.56
Perical	16 (6.1%)	26 (6.8%)	0.71
PCA	7 (2.7%)	7 (1.8%)	0.47

[a]Chi-squared test was used for statistical analysis.

Table 4. Statistical associations among age, aneurysm size, aneurysm neck size, GCS, and MRS

Variables	Patients (mean±SD)		p-value[a]
	Male	Female	
Age	52.25±13.68	56.42±13.13	<0.0001
Aneurysm size (mm)	7.81±7.33	7.34±5.27	0.35
Aneurysm neck size (mm)	3.47±1.95	3.56±2.12	0.61
GCS	12.95±3.00	13.19±2.98	0.37
MRS	1.63±1.55	1.68±1.56	0.69

[a]Independent T-test was used for statistical analysis.

traumatic SAH tended to occur most frequently in individuals between the ages of 40 and 60, the present study found a comparable age group [14]. This age group was considered to be at higher risk for developing vascular abnormalities, such as aneurysms, which are a common cause of non-traumatic SAH. However, it is important to note that SAH can occur at any age, including in children and the elderly.

Moreover, previous studies found that the incidence of non-traumatic SAH increased with age, with older individuals being more prone to experience this type of hemorrhage. This could be attributed to age-related changes in blood vessels and increased prevalence of risk factors such as hypertension and smoking.

A recent study by Lissak *et al.,* on non-traumatic SAH, reported a mean age of 57 for patients, of whom 73% were female [15]. There is evidence that non-traumatic SAH is more common in women than in men [11]. The reasons for this sex difference are unclear, but hormonal factors may play a role in increasing the risk of vascular abnormalities in women.

The highest incidence rates for complications were 61% and 49% for hydrocephalus and delayed cerebral ischemia, respectively [15], which was in contrast with the findings of the present study, in which the most frequent complication was a recurrence of SAH (18.4%), followed by hydrocephalus (16%), with an incidence rate of only 0.2% for ischemia. One major reason for the significantly higher rate of ischemia in the previous study could be the long duration of patient follow-up, which provided enough time for the development of delayed cerebral ischemia. Moreover, based on MRS classification, the majority of participants (71%), in the study by Lissak *et al.,* were categorized as class 4-6. In contrast, a great proportion of our participants were categorized as class 0-3, suggesting that the overall clinical conditions of patients in the present study were fairer than those of the previous investigation. Despite these differences, both studies suggested that MRS classification was not correlated with sex ratio, nor was it associated with nosocomial complications such as Clostridium difficile and urinary tract infections, pneumonia, and sepsis.

Bogossian *et al.* conducted a study on SAH and reported a 57% mortality rate for a total of 353 patients in the WFNS classes 4 and 5. The majority of these deaths (nearly 80%) were observed with patients in WFNS class 5 (corresponding to Fisher classes 3-4), who generally required more rigorous treatment. This investigation concluded that the occurrence of hydrocephalus was correlated with a lower mortality rate [16]. The WFNS grading system is routinely used to determine the severity of SAH and predict the patient's outcome. It is important to note that these mortality rates are estimated and may vary depending on various factors, such as age, comorbidities, and treatment received. Early detection and appropriate management of SAH are critical in improving patient outcomes and reducing mortality rates.

Fragata *et al.* investigated the SAH and reported a mean age of 60 and a prevalence of 63% for female patients. 54% of all patients were categorized as WFNS class 1, indicating an overall fair clinical condition upon admission. Similar to our findings, they found no significant associations between sex and MRS classification [17].

Konczalla *et al.* conducted a study on 125 patients with traumatic SAH and reported a mean age of 56. Based on this investigation, 85% of patients were deemed to be in fair clinical condition (WFNS classes 1-3) when they were admitted to the hospital. Therapeutic interventions resulted in desirable outcomes in 83% of patients (MRS classes 0-2), with hydrocephalus as a secondary complication reported in 29% of participants, and death in 10% of patients. While there was no meaningful correlation between age and MRS classification, Konczalla *et al.* concluded that the clinical condition of patients at the time of admission, based on WFNS classification, was the only independent variable associated with the clinical outcome [18].

Lin *et al.,* published the findings of their investigation on 627 non-traumatic SAH patients in Taiwan, highlighting a mean age of 55 and a prevalence rate of 8.82 in every one million individuals, while refuting a significant association between age and SAH. Nevertheless, the study concluded that the age of onset in women was significantly higher than in men, which was in line with the findings of the present study. They also reported a mortality rate of 13% [19], which was roughly two times higher than what we observed with our patients.

Morita *et al.* investigated the epidemiology of SAH in a cohort of 283 Japanese patients, reporting a mean age of 62, and an average diameter of 5.7 mm for aneurysms located in different parts of the cranium. According to their findings, the prevalence of aneurysm was 36.2% for the middle cerebral artery (MCA), 18.6% for the internal carotid artery (ICA), and 15.5% for the anterior communicating artery (ACoA) [20]. On the contrary, the findings of the present study indicated that the prevalence of aneurysm was 38% for the ACoA, 27.6% for ICA, and 13.4% for MCA. It seems that there are several reasons for variances in aneurysm site studies; heterogeneity in patient population characteristics such as age, sex, comorbidities, and risk factors might also influence the distribution of aneurysm locations in SAH. Studies with diverse patient populations may reveal different patterns of aneurysm locations.

One of the strengths of our study was the examination of a large number of patients, who were admitted to a referral hospital in the East of Iran over a 10-year period. The lack of follow-up of patients for 30 days or longer was beyond the limitations of

this study.

Similar to any other research, the present study had several limitations. The first one was that the patient's health records contained missing information. Nonetheless, we made an effort to make up for this problem by enrolling as many qualified patients as we could. We anticipate that the findings of the present will be complemented in the future by further clinical research.

In conclusion, the present study indicated a significant correlation between sex and the aneurysms occurring at ICA and ACoA. Additionally, as the mean age of female patients was significantly higher than that of male patients, this research revealed a statistically significant correlation between the patient's sex and age. This finding warrants a more conservative approach toward male patients who present with headaches at younger ages.

Declaration

Ethics approval and consent to participate. This study was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (code: IR.MUMS.MEDICAL.REC.1398.085). All of the data from this study is available and will be provided upon request for scientific purposes.

Conflict of Interest: None.

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Author's Contribution: EVM and SRAK Conceptualization, Methodology, MZ, and MSK Data curation, Software, and Writing- Original draft preparation. HBV and MTD Visualization, Investigation, ZA, MSK and EVM, Supervision, SRAK, BRK Validation, and HBV resources**,** all authors finalized the manuscript**.**

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Case Report

Bull Emerg Trauma 2024;12(1):42-45.

Bulletin of Emergency And Trauma

A Novel Skin Incision for Posterior Fossa Midline and Paramedian Lesions: A Technical Note and Case Series

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ABSTRACT

Approaching posterior fossa pathologies is fairly challenging. Poor exposure, cerebrospinal fluid (CSF) leak following surgery, post-operative suboccipital and neck pain, as well as wound healing are all common complications following traditional suboccipital midline incision. Herein, we present a novel incision for approaching posterior fossa pathologies. The incision is shaped like a question mark and makes a musculofascial flap supplied by the occipital artery on top as well as a wide area for craniotomy. In our technique, the dura is also incised in a question mark-shaped manner. The new incision was used to operate on three patients who had masses in the posterior fossa. Following surgeries, none of the patients experienced any adverse events such as CSF leak, wound complications, severe suboccipital pain, and neck instability. This new incision not only facilitates approaching pathologies in the posterior fossa by providing wider exposure but also enables us to perform watertight dural closure, which reduces CSF leak. Furthermore, as the muscular incision provides a sufficient area for craniotomy, muscular retraction can be minimized to reduce post-operative pain. Moreover, unlike the midline avascular incision, the flap is well supplied by the occipital artery, which facilitates the healing procedure.

Keywords: Suboccipital craniotomy; Posterior fossa; Skin incision; Muscular incision; Musculofascial flap.

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Introduction

In the pediatric central nervous system, the posterior fossa is the most prevalent site of tumor involvement [1]. Surgical access to the pathologies of this area is one of the most challenging issues in neurological surgery [2]. The current convention for midline suboccipital approach to posterior fossa pathologies, including lesions in the craniovertebral junction (CVJ) and lesions in or around the fourth ventricle, begins with a midline suboccipital skin incision [3, 4].

Despite the extensive adoption of midline suboccipital skin incisions, there have been concerns regarding postoperative wound healing and aesthetics. The midline linear incision is located in an avascular plane, which is associated with poor wound healing due to insufficient blood supply [3, 5].

Moreover, a substantial number of patients who require surgery for pathologies in the posterior fossa will further need radiotherapy and chemotherapy, all of which are known to disrupt the wound-healing process [6].

Another limitation of the midline incision is insufficient surgical exposure, which makes it difficult to reach paramedial pathologies, such as those around medulla oblongata or in foramen magnum, and CVJ [2]. As a result, the midline incision is extended to at least the C2 spinous process to improve craniotomy and exposure of underlying tissues [3, 7]. Besides, suboccipital muscle retraction and dissection are used to enhance the exposure; however, this might damage the muscles, destabilize CVJ, and cause neck pain [8, 9].

Finally, a Y-shaped dural incision is frequently performed, after the skin incision. Suturing and closing the Y-shaped dura might be difficult, resulting in a post-operative cerebrospinal fluid (CSF) leak that can induce complications such as an incisional leak, meningitis, pseudo meningocele, and infections [10-12].

The decreased rate of CSF leak in anterior skull base surgery utilizing vascularized flaps, particularly the nasoseptal flaps and pericranial flaps, prompted us to investigate whether scalp flaps are effective in diminishing CSF leak following posterior fossa procedures [13, 14].

Herein, we present our experience with a novel surgical technique for approaching the posterior fossa midline and paramedian lesions, which seems to have overcome the mentioned challenges.

Illustrative Cases and Surgical Technique

Case 1

The patient was a six-year-old boy with no significant medical history, who was presented to the emergency department with severe headache, nausea, and vomiting. His pre-operative magnetic resonance imaging (MRI) revealed an enhancing mass with central necrosis in the midline of the posterior fossa, in favor of medulloblastoma. After discussions concerning his management in our unit, he underwent surgical resection of the tumor.

Case 2

The patient was a nine-year-old girl with no past significant medical history, who was admitted to our unit with complaints of diplopia, headache, nausea, and vomiting. Her pre-operative MRI indicated a medulloblastoma-like mass at the level of the fourth ventricle, posterior to pons and medulla oblongata. After discussions about her management in our unit, surgical resection of the tumor was recommended for her.

Case 3

Due to hydrocephalus, an eight-year-old girl presented to our unit with a previously inserted right anterior ventriculoperitoneal shunt. She was suffering from vertigo and ataxia. Her pre-operative MRI demonstrated a heterogeneous mass in the posterior fossa, which was distended in the fourth ventricle. The mass was most likely compatible with medulloblastoma. After discussions about her management in our unit, surgical resection of the tumor was recommended for her.

Surgical Technique

After safely placing the patient in a prone position, padding, and securing the patient to the bed, we shaved the occipital area from above the superior nuchal line to the level of the foramen magnum and extended the shaving to the lateral sides to prepare the skin for planning the incision. The border of the foramen magnum, C1 and C2 vertebras, superior nuchal line, and external occipital protuberance and the limits of underlying pathology were determined, and its center was marked on the skin. Following that, the pathway of a question mark-shaped incision was planned (Figure 1).

The base of the incision began at the same level as

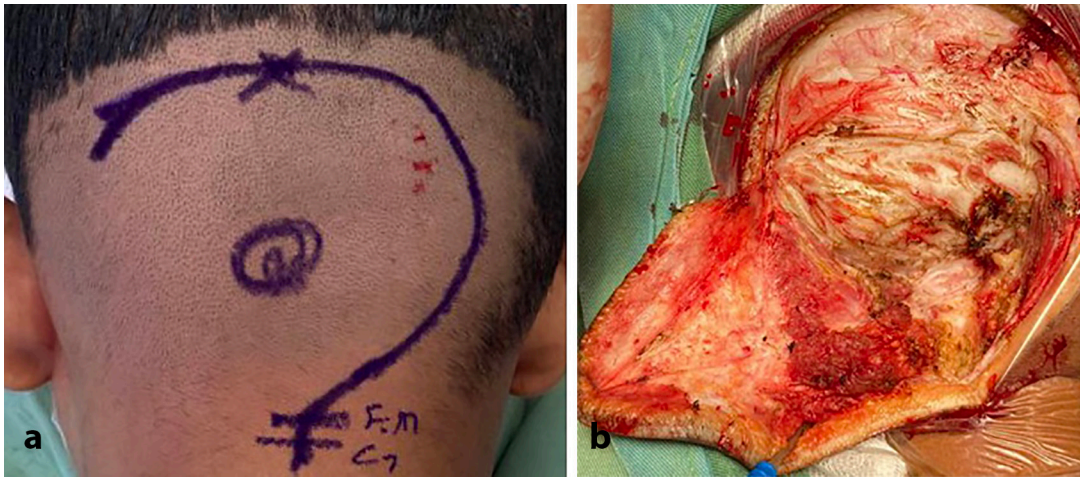

Fig. 1. Intra-operative photographs taken from a patient with medulloblastoma. **a.** The question mark-shaped pathway of the incision is started from the same level of the C1 vertebra. The superior nuchal line is considered the upper limit of the incision. **b.** The rotated musculofascial flap is made by performing skin and muscular incisions.

the C1 vertebra, and the upper border of the incision touched the superior nuchal line. The incision was horizontally extended 1cm lateral to the sides of the midline lesion. It should be considered that in the paramedian approach, the incision should also be extended 1cm lateral to the margins of the lesion. However, the symmetrical advancement to the contralateral side is not required. Indeed, by making this incision, we made a musculocutaneous flap based on the occipital artery that was entirely rotated (Figure 1). Craniotomy was planned and performed while keeping the location of pathology and its borders. Craniotomy was performed using two burr holes. The dura was incised in a curvilinear manner resembling a question mark. Then, the mass was resected. After hemostasis, duraplasty was performed at the end of surgery. The pericranial fascia was applied as a secondary dural graft to improve dural healing. After sealing the dura, cranioplasty was performed. The muscles and the fascia were then restored, and the skin was sutured.

Progress

No post-operative CSF leak was recorded in any of the patients. During the one-month outpatient clinic follow-up, all three patients' neurological symptoms improved, their neck posture and stability were preserved, and their parents reported no annoying occipital and neck pain or neck instability. Additionally, the patient's surgical wounds healed well without any complications (Figure 2). During the 12-month outpatient clinic follow-up, no complications regarding interruption of the nuchal musculature were observed in any of the patients.

Discussion

Suboccipital craniotomy through a midline skin incision has been the most extensively accepted surgical approach for achieving pathologies in the posterior fossa and CVJ [3, 4, 7]. Using this approach, the surgeon and the patient might experience difficulties, which we attempted to solve with our novel technique. In this technique, a question mark-shaped incision is performed rather than a midline incision in an avascular plan, which primarily makes a well-vascularized musculocutaneous flap supplied by the occipital artery. Therefore, it improves the wound-healing process by enhancing the blood supply. Moreover, the incision begins at the level of the C1 vertebra and is not extended to the C2 vertebra, where the origins of suboccipital muscles such as rectus capitis posterior major and obliquus capitis inferior are located [15]. As a result, these muscles remain virtually intact, reducing the risk of damage and maintaining neck stability. In this new incision, the pathway of the muscular incision provides a wide area for craniotomy with adequate access to structures in the posterior fossa, even poor accessible structures located in lateral borders, without requiring additional muscular retraction. Postoperative neck and occipital pain can also be alleviated by reducing muscle retraction and surgical stress [8, 9]. Furthermore, the wide access to the dura allows us to incise the dura in a curvilinear shape. Therefore, the dura can be repaired easily at the end of the surgery. A further advantage of this technique is that the flap is capable of reducing the CSF leak, as it is proven to do in other neurosurgical procedures. Thus, there is a lower risk of complications caused by CSF leak [14].

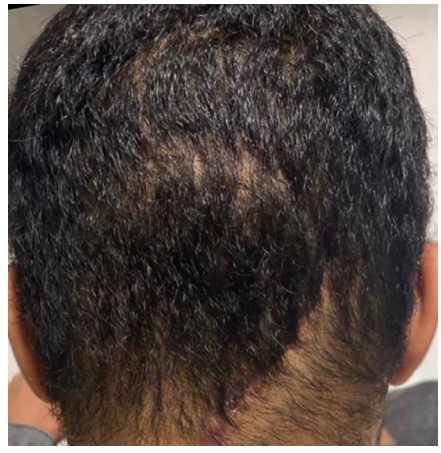

Fig. 2. Post-operative photograph taken from well healed wound of a patient. No sign of wound complication is visible.

Despite the traditional approach, in which the linear incision crosses the midline at the level of the C1 vertebra, in this technique, the curvilinear incision is initiated from C1 in a superolateral pathway. Thus, it is critical to explore the underlying area with a finger to preserve the vertebral artery in each step of performing this incision.

Declaration

Ethics approval and consent to participate: Written informed consent was obtained from the patient's parents.

Consent for publication: The authors provide consent for publication.

Conflict of Interest: The authors declare no conflict of interest.

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Authors' Contribution: The study was designed by M.M. and R.T. The main manuscript was written by A.A., S.Z. and A.H. A.A and S.Z. collected the data and prepared the figures. The final manuscript was read and approved by all authors.

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Instruction to Authors

I. Aims and Scope

BEAT: Bulletin of Emergency And Trauma is an international, peer-reviewed, quarterly journal coping with original research contributing to the field of emergency medicine and trauma. BEAT is the official journal of the Trauma Research Center (TRC) of Shiraz University of Medical Sciences (SUMS) with cooperation of Hungarian Trauma Society, Lusitanian Association for Trauma and Emergency Surgery (ALTEC/LATES) and Serbian Trauma Association aiming to be a publication of international repute that serves as a medium for dissemination and exchange of scientific knowledge in the emergency medicine and trauma. The aim of BEAT is to publish original research focusing on practicing and training of emergency medicine and trauma to publish peer-reviewed articles of current international interest in the form of original articles, brief communications, reviews, case reports, clinical images, and letters.

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The corresponding author must affirm that all co-investigators have been duly credited in the manuscript either as co-authors or in the acknowledgement section. To meet the criteria of authorship, it is necessary to have taken a significant part in the overall conception and design of the research or to have participated in the acquisition, analysis and interpretation of data as well as having written initial drafts of the manuscript, revised and contributed to the final manuscript. Simply having been a part of the research group or having contributed to data collection or provided patients or analysis of tests is not sufficient in and of itself to satisfy the criteria for authorship.

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Letters to the Editor about previous articles in the ***BEAT*** are welcomed. The letter will be sent the author of the article for a reply and published together. Those contributing new ideas in the field emergency medicine and trauma can also write their comments to the editor. For Letters to the Editor limit the number of words to 500 and no more than 10 references.

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Acknowledgements. No personal acknowledgements are allowed. Only funding organizations may be acknowledged.

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