KASTAMONU MEDICAL JOURNAL

Original Article

DOI: 10.51271/KMJ-0113

Kastamonu Med J. 2023;3(3):132-138

Assessing characteristics, treatment approaches, and outcomes of spontaneous intracerebral hemorrhage patients in intensive care: a retrospective study

Serpil Ekin, Asiye Demirel, İlkay Ceylan, Şermin Eminoğlu, Şeyda Efsun Özgünay

Department of Anesthesiology and Reanimation, Bursa Yüksek İhtisas Training and Research Hospital, Bursa, Turkey

Received: 11/07/2023 ◆ **Accepted**: 09/08/2023 ◆ **Published**: 22/09/2023

ABSTRACT

Aims: Spontaneous intracerebral hemorrhage (SIH) is a common cerebrovascular disease associated with high mortality and poor clinical outcomes. This study aimed to investigate the fundamental characteristics of patients with SIH, their treatment practices, and early results to provide a comprehensive overview.

Methods: Patient records from 2017 to 2021 were reviewed following approval from the ethics committee of our hospital. Demographic data, surgical and medical treatments applied in the intensive care unit (ICU), and immediate clinical outcome data of patients meeting the study criteria were recorded and analyzed.

Results: A total of 153 patients were included in this study. The mortality rate in SIH patients was identified as 53.59%. The mean age value of those who died was found to be higher. In these patients, "fainting" as the initial symptom was found to be more common, while "Focal Neurological Deficits" were less common. A lower median Glasgow Coma Scale (GCS) and higher Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were also observed. It was noted that the fresh frozen plasma (FFP) usage rate was higher, whereas the usage rate of oral antihypertensives was lower in those who died. It was determined that 33.33 of patients, 33.33% were transferred to a service (neurology or neurosurgery), 11.76% received palliative care, and 1.31% received home care.

Conclusion: The mortality rate of patients with SIH is extremely high, and treatment in intensive care should be conducted according to current guidelines. More comprehensive studies are needed to standardize the appropriate treatment approaches. Alongside suitable treatment strategies to reduce mortality, identifying and supporting surviving patients' long-term treatment and rehabilitation needs are of great significance.

Keywords: Spontaneous intracerebral hemorrhage, mortality, predictors, anticoagulation, antihypertensive, intensive care unit

INTRODUCTION

Stroke is the second leading cause of death and disability worldwide. Intracranial hemorrhage (ICH) is the second most common cause of ischemic stroke. Among intensive care patients, it is associated with the highest rates of mortality and morbidity among all stroke subtypes. The early phase mortality rate is approximately 30–40%. Its annual incidence is 15–25 per 100,000 individuals.[1,2] ICH can be categorized as spontaneous or traumatic. Spontaneous intracranial hemorrhage (SIH), non-traumatic bleeding into the brain parenchyma that can extend into the ventricles and subarachnoid space. The identified risk factors include arterial hypertension, amyloid angiopathy, anticoagulation use, and underlying vascular malformations. Clinical signs and symptoms depend on the hematoma volume, localization, spread, and development of edema.[2]

Previously documented contributing factors to increased SIH mortality include advanced age, lower Glasgow Coma Scale (GCS) score, infratentorial SIH, larger hematoma volume, and intraventricular hemorrhage. The cornerstone of critical care is blood pressure control to prevent hematoma expansion, intracranial pressure, secondary brain injury, medical complications, coagulopathy reversal, and early rehabilitation programs.[3,4]

Approximately 25% to 50% of patients with SIH die within the first month, and only 20% regain functional independence at six months. Rehabilitation and recovery are significant determinants of outcome and quality of life. Despite efforts to improve public health through blood pressure control, the incidence of SIH continues to increase with age.

Corresponding Author: Asiye Demirel, dr.asiyedemirel@hotmail.com

Cite this article as: Ekin S, Demirel A, Ceylan İ, Eminoğlu Ş, Efsun Özgünay Ş. Assessing characteristics, treatment approaches, and outcomes of spontaneous intracerebral hemorrhage patients in intensive care: a retrospective study. *Kastamonu Med J.* 2023;3(3):132-138.

This is set to continue because of the increasing average age of the population and the increased use of anticoagulants, thereby adversely affecting individuals, their families, and communities and remains a leading health concern.[5,6] Despite the high mortality and morbidity, optimal management remains a topic of debate. Reliable clinical and radiological indicators are required for early diagnosis and treatment.

This study aimed to provide an overview of the primary characteristics, treatment approaches, and early outcomes of patients with SIH who were treated in our intensive care unit (ICU).

METHODS

Study Design and Participants

This retrospective cohort study was conducted at Bursa Yüksek İhtisas Education and Research Hospital. Ethical approval was obtained from our Ethics Committee (Date: 21.10.2021-Decision No:2011-KAEK-25). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Retrospective analysis was performed on patients who were hospitalized in third-level anesthesiology and reanimation care units between January 2017 and December 2021. A total of 153 patients were retrospectively screened from the patient records and analyzed.

Inclusion criteria:

1. Patients aged 18 years were considered eligible.
2. The patients were diagnosed with SIH. Neurologists confirmed the diagnosis of SIH based on clinical findings, imaging studies [brain computer tomography (CT), CT angiography, or Magnetic Resonans Imaging (MRI)], and other relevant laboratory results.
3. The patients were hospitalized in our ICU for at least 48 hours. The duration of the hospital stay was obtained from the hospital records.

Exclusion criteria:

1. Patients aged < 18 years were excluded.
2. Patients with non-SIH causes of ICH (such as trauma-induced, tumor-associated, or hemorrhagic transformation of ischemic stroke). The cause of ICH was determined based on clinical findings, imaging studies, and consensus of the treating physicians.
3. Patients with incomplete medical records or missing key data points required for the study were excluded.

Data Collection

Data were systematically collected to analyze variables pertinent to the study comprehensively. The data were categorized into demographic, clinical, and therapeutic aspects.

1. **Demographic and Clinical Data:** This included patients' age, sex, and presence of chronic illnesses such as hypertension, diabetes mellitus (DM), coronary artery diseases (CAD), dysrhythmias, and habits such as alcohol consumption. The initial symptoms were meticulously recorded as fainting, consciousness alteration, headache, focal neurological deficits, nausea or vomiting, seizures, and speech disorders. Clinical parameters such as the GCS score, Acute Physiology and Chronic Health Evaluation II (APACHE II) scores, systolic and diastolic blood pressure, heart rate, and peripheric oxygen saturation (SpO2) were noted at admission. Laboratory investigations were systematically documented, such as fasting blood glucose, serum creatinine, serum glutamic pyruvic transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), hemoglobin, platelet count, International Normalized Ratio (INR).
2. **Imaging Data:** Radiological findings, including the method of imaging used for diagnosis (Brain CT, CT angiography, or MRI) and specifics of ICH, were collated.
3. **Therapeutic Data:** This included medical and surgical treatment strategies. Data on the medications administered, including antiepileptics, oral antihypertensives, Vitamin K, nitroglycerin, fresh frozen plasma (FFP), nicardipine, tranexamic acid, dexamethasone, and mannitol were collected. In surgical intervention cases, the specifics of the procedure include decompressive craniectomy, extraventricular drain (EVD), or interventional radiology. Sedation and vasoactive drug use were recorded on the day of anticoagulant initiation.
4. **ICU Course and Outcomes:** Detailed data on the critical care course, including tracheostomy, percutaneous endoscopic gastrostomy (PEG) placement and timing, day of extubation, and duration of ICU and hospital stay, were documented. Any complications, such as seizures, acute renal failure, cardiac arrest, and the patient's discharge status were also included in the collected data.

Statistical Analysis

The Shapiro-Wilk test was used to determine whether the variables adhered to a normal distribution. Continuous variables were presented as mean ± standard deviation and median (minimum: maximum) values. Categorical variables are reported as n (%). Depending on the normality test results, the independent samples t-test or Mann-Whitney U test was used to compare the two groups. Pearson Chi-square, Fisher's Exact, or Fisher Freeman-Halton tests were used to compare categorical variables. Multiple logistic regression analysis was performed to identify risk factors affecting mortality. Variables were included in the multiple logistic regression model using the inter-method. Variables found to be significant in the model were considered independent variables. Multiple logistic regression models were significant ($p < 0.001$). Statistical analyses were performed using SPSS software (IBM Corp. Release 2012. IBM SPSS Statistics for Windows, Version 21.0, Armonk, NY: IBM Corp.), and a p-value <0.05 was considered statistically significant.

RESULTS

Demographic characteristics of the participants are presented in **Table 1**. The mean age was 61.94±15.20 years, with 38.56% female and 61.44% male. Examination of the initial symptoms revealed that 43.14% of the participants had fainting, 20.92% had altered consciousness, 29.41% had headaches, 18.30% had focal neurological deficits, 17.65% had nausea and vomiting, 3.92% had seizures and 0.65% had speech disorders. The median GCS score was 5, average systolic measurement was 144.27±37.62 mmHg, average diastolic measurement was 78.31±21.78 mmHg, median pulse rate was 88 per minute, median blood sugar value was 165 g/dL, median creatinine value was 0.90 mg/dL, median SGPT value was 18.50 IU/L, median SGOT value was 26 IU/L, median hemoglobin value was 10.50 g/dl, median platelet value was 213000 103/µL,

median INR value was 1.04, and the median APACHE II score was 24. Upon examining the distribution of neurological findings, 19.61% had paralysis, 13.07% had paresis, and 7.19% had aphasia/dysphasia. Upon examining participants' chronic diseases, it was found that 56.86% had hypertension, 22.88% had DM, 17.65% had CAD, 2.61% had dysrhythmia, and 39.87% had other diseases. Upon examining the imaging methods, 98.04% underwent a brain CT scan, 39.22% underwent CT angiography, and 10.46% underwent MRI (Table 1).

Table 1. Demographic Findings of the Patients (n=153)

Age (years)	61.94±15.20
Sex	
Female	59(38.56%)
Male	94(61.44%)
Initial Symptom	
Fainting	66(43.14%)
Consciousness change	32(20.92%)
Headache	45(29.41%)
Focal Neurological Deficits	28(18.30%)
Nausea-vomiting	27(17.65%)
Convulsion	6(3.92%)
Speech disorder	1(0.65%)
Presence of light reflex	97(63.40%)
Presence of anisocoria	34(22.37%)
GCS *	5(3:15)
Systolic blood pressure (mm/Hg) Diastolic blood pressure (mm/Hg)	144.27±37.62 78.31±21.78
Heart rate (bpm)	88(51:149)
SpO2 (%) **	99(88:102)
Fasting blood glucose (gr/dl)	165(84:472)
Creatinine (mg/dl)	0.90 (0.27:6.98)
SGPT (IU/L)	18.50(3:498)
SGOT (IU/L)	26(8:268)
Hemoglobin (g/dl)	10.50(6.4 :17.30)
Platelet count (10^3/ µL)	213(310:636)
INR ***	1.04(0.80:7.29)
APACHE II ****	24(7:39)
Neurological Findings	
Plegia	30(19.61%)
Paresis	20(13.07%)
Aphasia/ Dysphasia	11(7.19%)
Surgical Procedures	
Decompressive craniectomy	12(7.89%)
EVD ***** Interventional radiology	44(28.76%) 7(4.58%)
Chronic Diseases	
Hypertension Diabetes Mellitus Coronary Artery Diseases Dysrhythmia Alcohol consumption Other	87(56.86%) 35(22.88%) 27(17.65%) 4(2.61%) 2(1.31%) 61(39.87%)
Imaging Method for Diagnosis	
Computerized Brain Tomography CT angiography Magnetic resonance imaging	150(98.04%) 60(39.22%) 16(10.46%)

Data were expressed as n (%), median (minimum: maximum), or mean±standard deviation.
GCS, Glascow Coma Scale; **SpO2, Oxygen Saturation; ***INR, Internal normalized ratio; ****APACHE, Acute Physiology and Chronic Health Evaluation; *** EVD, Extraventricular Drain.*

Findings related to the patients' medical and surgical treatment approaches are shown in Table 2. Upon examining the drugs used in the treatment, it was determined that 75.76% of the participants were given antiepileptic drugs, 44.44% oral antihypertensive drugs, 32.68% nimodipine, 29.41% esmolol, 27.45% Vitamin K, 16.99% nitroglycerin, 11.11% FFP, 6.54% nicardipine, and 3.27% were administered tranexamic acid. In their treatment, 59 (38.56%) participants were administered phenytoin sodium as an antiepileptic drug, 46 (30.07%) were administered levetiracetam, and 5 (3.27%) were administered phenytoin sodium and levetiracetam together. In the other drug group used in the treatment, 55.56% of the participants were administered dexamethasone and 32.68% were administered mannitol. Sedation was applied to 58.82% of the participants, and vasoactive drug treatment was applied to 32.68%. Upon the surgical-interventional treatment applications, it was found that 7.89% had decompressive craniectomy, 28.76% had an EVD, and 4.58% had an interventional radiological procedure. The median day on which anticoagulant therapy was started in patients was the 6th day (Table 2).

Table 2. Medical and surgical treatment approaches (n=153)

Medical Treatment	
Antiepileptics	115(75.76%)
Phenytoin sodium	59(38,56%)
Levetiracetam	46(30.07%)
Phenytoin sodium + levetiracetam	5(3.27%)
Oral antihypertensive agents	68(44.44%)
Nimodipine	50(32.68%)
Esmolol	45(29.41%)
Vitamin K	42(27.45%)
Nitroglycerine	26(16.99%)
FFP *	17(11.1%)
Nicardipine	10(6.54%)
Tranexamic Acid	5(3.27%)
Other	
Dexamethasone	85(55.56%)
Mannitol	50(32.68%)
Administering sedation	90(58.82%)
Vasopressor agents	50(32.68%)
Surgical treatment	
Decompressive craniectomy	12(7.89%)
EVD **	44(28.76%)
Interventional radiology	7(4.58%)
Anticoagulant initiation day	6(1:40)

Data are expressed as n (%). median (minimum: maximum) and mean±standarddeviation.
**FFP,Fresh frozen plasma; ** EVD, Extraventricular drainage.*

The clinical course results of our study are presented in Table 3. It was found that 25.49% of the participants underwent tracheostomy and 9.80% underwent PEG. The median day was 11 in 39 patients who underwent tracheostomy, the median extubation day was 2, and the mean day on which PEG was performed was 33.38±15.10. The median length of stay in the ICU was 10 days, and the median length of hospital stay was 16 (Table 3).

Table 3. The clinical course of the patients

	n (%)
Patients with tracheostomy	39(25.49%)
Tracheostomy (n=39)	11(3:37)
PEG*	15(9.80%)
PEG opening day (n=15)	33.38±15.10
Extubation day (n=16)	2(1:13)
Length of stay in intensive care	10(2:289)
Length of stay in hospital	16.50(2:293)
Complication	
Convulsion	10(6.54%)
Acute renal failure	5(3.26%)
Cardiac Arrest	1(0.65%)
Type of Discharge	
Exitus	54(35.29%)
Brain death	28(18.30%)
Transfer to service	51(33.33%)
Transfer to palliative care	18(11.76%)
Home Care	2(1.31%)

Data are expressed as n (%), median (minimum: maximum), or mean±standard deviation.
**PEG, Percutaneous Endoscopic Gastrostomy.*

The evaluation of bleeding sites according to CT is given in Table 4. The most common bleeding site was lobar hemorrhage (n=110) and cerebellar hemorrhage was the least common in our study group. The most common symptom in lobar hemorrhages was fainting 49(44.55%). There was no statistically significant difference between the bleeding sites (p>0.05) (Table 4).

Table 4. Comparisons between bleeding sites and bleeding sites according to CT*

	Location of bleeding relative to CT				
	Ventricular (n=9)	Lober (n=110)	Deep Structures (n=23)	Cerebellar (n=3)	p-value
Initial Symptom					
Consciousness change	1(11.1%)	23(20.91%)	3(13.04%)	1(33.33%)	0.609 [e]
Nausea Vomiting	3(33.33%)	17(15.45%)	3(13.04%)	2(66.67%)	0.065 [e]
Headache	3(33.33%)	33(30%)	4(17.39%)	3(100%)	0.069 [e]
Convulsion	1(11.1%)	4(3.64%)	1(4.35%)	0	0.448 [e]
Focal Neurological Deficits	3(33.33%)	17(15.45%)	7(30.43%)	0	0.166 [e]
Speech disorder	0	1(0.91%)	0	0	>0.99 [e]
Fainting	1(11.1%)	49(44.55%)	12(52.17%)	0	0.069 [e]
Medications					
Antiaggregant drug	3(33.33%)	20(20%)	4(17.39%)	0	0.664 [e]
Anticoagulant drug	2(22.22%)	8(7.27%)	2(8.69%)	0	0.430 [e]

*Data are expressed as n (%); e: Fisher Freeman-Halton test *CT; Computer Tomography.*

Table 5: Comparisons between mortality groups according to demographic data

	Ex (n=82)	Survivors (n=71)	p-value
Age	64.72±13.91	58.73±16.09	0.015 [a]
Gender			
Female	35(42.68%)	24(33.80%)	0.260b -
Male	47(57.32%)	47(66.20%)	
Initial Symptom			
Consciousness change	16(19.51%)	16(22.54%)	0.647[b]
Nausea Vomiting	15(18.29%)	12(16.90%)	0.822[b]
Headache	23(28.05%)	22(30.99%)	0.691[b]
Convulsion	1(1.22%)	5(7.04%)	0.097[d]
Focal Neurological Deficits	8(9.76%)	20(28.17%)	0.003[b]
Speech disorder	0	1(1.41%)	0.464[d]
Fainting	43(52.44%)	23(32.39%)	0.013[b]
Medications			
Antiaggregant			
Yes	18(21.95%)	14(19.72%)	0.735[b]
No	64(78.05%)	57(80.28%)	
Anticoagulant			
Yes	10(12.20%)	3(4.23%)	0.078[b]
No	72(87.80%)	68(95.77%)	
GCS* (n=153)	3(3:15)	7(3:15)	< 0.001[c]
APACHE II** (n=153)	28(11:39)	23(7:35)	< 0.001[c]
Epileptic Seizure			
Dialysis for AKI*** Cardiac Arrest	4(4.88%) 1(1.22%)	1(1.41%) 0	0.704[e]
Decompressive Craniectomy	8(9.88%)	4(5,63%9)	0.333[b]
EVD****	28(34.15%)	16(22.54%)	0.114[b]
Hypertension	50(60.98%)	37(52.11%)	0.270[b]
DM*****	18(21.95%)	17(23.94%)	0.770[b]
Coronary Artery Disease	17(20.73%)	10(14.08%)	0.282[b]
Alcohol Consumption	1(1.22%)	1(1.41%)	>0.99[d]
Dysrhythmia	2(2.44%)	2(2.82%)	>0.99[d]

Data are expressed as n (%), median (minimum: maximum), or mean±standard deviation.
** GCS, Glascow Coma Scale; ** APACHE, Acute Physiology and Chronic Health Evaluation; *** AKI, Acute Kidney Injury; **** EVD, Externalventricular Drain; ***** DM: Diabetes Mellitus.*
a: Independent sample t test, b: Pearson Chi-Square test, c: Mann-Whitney U test, d: Fisher's Exact test, e: Fisher Freeman-Halton test.

Statistical comparisons based on the demographic data of patients are shown in Table 5. There was a significant difference in age between the mortality groups (p=0.015). In those who died, the average age was 64.72±13.91, while it was 58.73±16.09 in survivors. There was a significant difference rate of "Focal Neurological Deficits" occurrence in those who died was 9.76%, whereas it was 28.17% in survivors(p=0.003). A significant difference was found between mortality groups when the onset symptom was "Fainting" (p=0.013). The rate of "Fainting" occurrence in those who expired was 52.44%, while it was 32.39% in survivors. The median GCS score in those who died was 3 (range:3-15), whereas it was 7 (range:3-15) in the survivors (p<0.001). The median APACHE II score in those who died was 28 (range:11-39), whereas it was 23 (range:7-35) in survivors, suggesting a higher median APACHE II score in those who died (p<0.001). No significant differences were found in the other comparisons included in the Table 5 (p >0.05). No significant difference was found between the mortality groups based on the complications seen in the patients seizure, acute renal injury (ARI), cardiac arrest and the presence of decompressive craniectomy and EVD (p>0.05). No significant difference was found between the mortality groups based on the chronic diseases of the patients including hypertension, DM, CAD, alcohol consumption, and dysrhythmia (p>0.05) (Table 5).

The comparisons between the mortality groups based on the treatments applied are shown in Table 6. The rate of FFP use in those who died was 15.85%, whereas it was 5.63% in the survivors (p=0.045). A significant difference was observed between the mortality groups based on the oral antihypertensive treatment (p=0.036). The rate of additional oral antihypertensive use in ICU in those who died was 36.59%, whereas it was 53.52% in survivors. No significant difference was found between the mortality groups based on Vitamin K, tranexamic acid, nimodipine, nicardipine, esmolol, nitroglycerin, or antiepileptic treatment (p>0.05) (Table 6).

Table 6. Comparisons between mortality groups according to treatment

	Ex (n=82)	Survivors (n=71)	p-value
Vitamin K	22(26.83%)	20(28.17%)	0.853 [b]
FFP*	13(15.85%)	4(5.63%)	0.045 [b]
Tranexamic Acid	4(4.88%)	1(1.41%)	0.373 [d]
Nimodipine	25(30.49%)	25(35.21%)	0.534 [b]
Nicardipine	6(7.32%)	4(5.63%)	0.752 [d]
Esmolol	25(30.49%)	20(28.17%)	0.754 [b]
Nitroglycerine	16(19.51%)	10(14.08%)	0.373 [b]
Oral antihypertensive	30(36.59%)	38(53.52%)	0.036 [b]
Antiepileptic			
Phenytoin	35(58.33%)	24(43.64%)	
Levetiracetam	22(36.67%)	28 (50.91 %).	0.274 [d]
Phenytoin+levetiracetam	3(5%)	3(5.45%)	

Data are expressed as n (%).
b: Pearson Chi-Square test, d: Fisher's Exact test
**FFP, Fresh frozen Plasma.*

Multiple logistic regression analysis was performed to determine the risk factors for mortality (Table 7). According to the analysis results, a unit increase in the GCS score reduced the mortality risk by 21%, and a unit increase in the APACHE II score increased the mortality risk by 1.14 times (Table 7).

Table 7. Risk factors affecting mortality.

Factors	Wald	p-value	OR	95%CI	
				Lower	upper
Age	1.31	0.252	1.02	0.99	1.05
Gender					
Female (ref. cat.)	-	-	one	-	-
Male	0.837	0.360	0.69	0.31	1.54
GCS*	13.46	<0.001	0.79	0.69	0.90
APACHE II**	11.27	0.001	1.14	1.06	1.24
Antiaggregant Usage					
No (ref. cat.)	-	-	one	-	-
Yes	0	0.989	1.01	0.39	2.61
Anticoagulant Use					
No (ref. cat.)	-	-	one	-	-
Yes	3.01	0.083	0.22		
Model χ^2 =53.03; p<0.001					
Hosmer and Lemeshow Test p=0.514					
n=153					

OR: Odds ratio, Ref.cat.: Reference category, CI: Confidence Interval
* GCS, Glascow Coma Scale; ** APACHE, Acute Physiology and Chronic Health Evaluation.

DISCUSSION

In the following discourse, our objective was to elucidate the prevailing epidemiological trends of SIH within our critical care environment, dissect the currently employed treatment modalities, and critically scrutinize their ramifications for patient outcomes. We posit that our investigation will augment the extant body of knowledge and provoke further erudite dialogues geared towards refining SIH treatment protocols and patient care trajectories.

Key findings:

1. The mortality rate of patients with SIH in the ICU was 53.59%.
2. There was a notable correlation between age and mortality, with the mean age of deceased patients being higher than that of survivors.
3. The most common initial symptom among the patients was ''fainting'', while ''Focal Neurological Deficits'' were less frequently observed.
4. FFP was more common in patients who died, whereas oral antihypertensive drugs were less common.
5. The median GCS score was lower and the APACHE II score was higher among patients who died.
6. Of patients, 33.33% were transferred to a service (neurology or neurosurgery), 11.76% received palliative care, and 1.31% received home care.
7. Despite providing the necessary medical supplies, the rate of sending patients home for care was low, possibly due to the unsuitability of the relatives' working conditions, their concerns about the inability to care, and the insufficiency of home care services.

We found that the average age was higher in those who died, and the incidence of "fainting" as the initial symptom was higher in these patients. By contrast, the incidence of "Focal Neurological Deficits" was lower. A lower GCS score reduced the risk of mortality by 21%, and each unit increase in the APACHE II score increased the risk of mortality 1.14 times. In patients who died, the use of Total Parenteral Nutrition (TPN) in intensive care was higher, whereas the use of oral antihypertensives was lower. In our study, hypertension did not affect mortality.

The incidence of SIH increases proportionally with age.[6,7] Our study's average age was 61.94±15.20, similar to other studies. Studies have shown a positive relationship between SIH and male gender.[8] Teles J. et al. reported that 66.3% of the 285 patients included in their study examining the effect of gender on long-term outcomes in SIH patients were male.[9] Similarly, in our study, the male sex ratio was 61.44%, similar to that reported in other studies. Ridder et al. investigated the effect of sex on long-term functional outcomes and reported that 54% of patients with SIH were male. However, they found no sex differences in long-term functional outcomes.[10] Although our study does not cover long-term outcomes, when examining the effect of sex and age on mortality in the short-term outcomes, there was a statistically significant difference between the mortality groups regarding age values.

Most patients with SIH experience loss of consciousness when brought to the emergency department. Hu et al. investigated the risk factors and clinical features of intracerebral hemorrhage and identified that the main symptoms of ventricular, parietal lobe, and brainstem hemorrhage were headache in the occipital, temporal, and frontal lobes; dizziness; nausea and vomiting in the cerebellum; extremity dysfunction in the thalamic and basal ganglia; and loss of consciousness.[11] In our study, fainting (43.14%) was the most common initial symptom, followed by headache (29.41%), changes in consciousness (20.92%), and focal neurological deficits (18.30%).

Stroke diagnosis should be considered in patients with sudden focal neurological symptoms until proven otherwise. However, it is challenging to determine whether a stroke is ischemic or hemorrhagic based on neurological examination alone. CT and MRI are the first options chosen for the emergency diagnosis and evaluation of SIH.[2] Non-contrast brain CT accurately identifies the presence of acute SIH, distinguishing it from an ischemic stroke. When we examined the imaging methods applied for diagnosis at the first presentation, it was found that CT was performed in 98.04% of patients, CT angiography in 39.22%, and MRI in 10.46%, consistent with the literature. Although the most common locations of SIH hemorrhages in the literature are the basal ganglion, thalamus, and pons, lobar hemorrhages were the most common in our study. No statistically significant difference was found between the hemorrhage locations in our study.[12]

Hypertension is the most important known risk factor for intraparenchymal hemorrhage. In a retrospective study, Øie et al. found that SIH was associated with high mortality, with a history of arterial hypertension in 52.7% and DM in 11.7% of patients, and that most survivors became dependent on care.[13] Martini et al.[14] found that hypertension and warfarin use were more common in patients with SIH, and hypertension was particularly associated with non-lobar SIH. In a prospective study by Sturgeon et al., advanced age and hypertension were positively correlated risk factors for SIH.[15] Similar to other studies, hypertension was found in 56.86%, DM in 22.88%, CAD in 17.65%, arrhythmia in 2.61%, alcohol consumption in 1.31%, and other diseases in 39.87%. However, in our study, there was no statistically significant difference between the mortality groups based on hypertension, DM, CAD, alcohol consumption, and arrhythmia.

Owing to the frequent occurrence of cardiovascular diseases in the elderly, the use of both antiplatelet and anticoagulant agents

is increasing. Consequently, the incidence of SIH, one of the most serious complications of these drugs, is also increasing. In a study by Goeldlin et al., the incidence of SIH and the likelihood of poor prognosis increased in patients receiving antithrombotic therapy, underlining the need for extreme caution in patients receiving dual antiplatelet and anticoagulant therapy in terms of SIH.[16] However, a systematic review and meta-analysis by Wu et al.[17] concluded that antiplatelet therapy did not affect hematoma expansion and functional outcomes, and moderately increased mortality, which is associated with the strong impact of antiplatelet therapy use on early mortality. Our study showed no statistically significant difference in mortality between patients taking antiplatelet anticoagulants and those who did not. However, the ICU and hospitalization durations were longer.

According to the multiple logistic regression analysis conducted to identify risk factors affecting mortality, it was found that an increase of one unit in the GCS score reduced the risk of mortality by 21%; an increase of one unit in the APACHE II score increased the risk of mortality by 1.14 times. Similar to our study, Rodríguez-Fernández et al., in their multicenter cohort study to verify the intracerebral hemorrhage score in SIH patients, determined the APACHE-II score as 21(15–26) points, GCS score of 7 (4–11) points, and a mortality rate of 54.17%, showing that deceased patients were significantly older, had lower GCS at admission, and higher APACHE-II scores.[18] The mortality rate in our study was 53.59%, and brain death occurred in 18.30% of the cases. The death rate was generally similar to that reported in previous studies.

The STICH II study conducted by Mendelow et al. showed that early surgery did not increase the 6-month rate of death or disability in patients with spontaneous superficial intracerebral hemorrhage without intraventricular hemorrhage. This could potentially provide a small but clinically significant survival advantage.[19] In a retrospective cohort study, hematoma evacuation during decompressive hemicraniectomy did not change the 6-month functional outcomes compared to hemicraniectomy alone.[20] Minimally invasive approaches for drainage of supratentorial SIHs and intraventricular hemorrhages have shown reductions in mortality compared with medical treatment alone. However, clinical trial evidence for improving functional outcomes with these procedures is insufficient.[21,22] Our study found that 7.89% of the patients underwent decompressive craniectomy, 28.76% underwent EVD, and 4.58% underwent interventional radiological procedures. No statistically significant difference was found between the mortality groups according to decompressive craniectomy and EVD.

Most patients with SIH have a high blood pressure due to hypertension. Blood pressure regulation should be provided for medical treatment of patients with SIH. Uncontrolled increases in blood pressure and variability are risk factors for hemorrhagic expansion and poor outcomes. Treatment should be initiated as soon as possible, and careful titration is required to ensure continuous blood pressure control. Various intravenous drugs, including nicardipine, labetalol, esmolol, enalaprilat, and fenoldopam, can control blood pressure. Nitroprusside and nitroglycerin are generally avoided because of the risk of increased intracranial pressure. Oral antihypertensive drug therapy was initiated in 44.44% of the patients admitted to the ICU. Nimodipine, a calcium channel blocker used to prevent vasospasm secondary to bleeding, was used in 32.68% of the cases but was not associated with mortality.

Clear evidence regarding whether dexamethasone has beneficial or adverse effects is still lacking.[23] The routine use of glucocorticoids to reduce intracranial pressure is not recommended because of the risk of infection and hyperglycemia. Our study observed that dexamethasone and mannitol were used by 55.56% and 32.68% of the participants, respectively.

The clinical benefits of using hemostatic treatment to stop bleeding and prevent the growth of bleeding in SIH patients without coagulopathy and without anticoagulant or antiplatelet drug use are not clear. However, these treatments can lead to thromboembolic complications.[24] One of SIH's most studied hemostatic agents is tranexamic acid.[23] In our study, only 3.27% of patients used tranexamic acid, and its effect on mortality was not statistically significant. Platelet transfusion is not recommended in patients who receive antiplatelet treatment and develop SIH, and it was not used in our study. However, reversing the antiplatelet effect of acetylsalicylic acid with platelet transfusions could reduce the volume of postoperative bleeding only when urgent craniotomy for hematoma evacuation is planned.[25] Four-factor prothrombin complex concentrate is preferred for patients with SIH using warfarin. If not available, a three-factor prothrombin complex can be combined with recombinant activated factor VII or FFP. Some studies suggest administering intravenous Vitamin K to increase the duration of the effect of prothrombin complex concentrate or FFP.[24] Our study used Vitamin K in 27.45% and 11.11% of the patients, respectively.

Besides acute surgery and medical treatment, there are important issues that the entire healthcare team needs to address throughout the patient's hospital stay. These include respiratory support, nutrition, and physical therapy to prevent problems caused by immobility; tracheostomy care; swallowing disorders; ensuring hemodynamic stability; preventing infections; intensive care delirium; and problems related to changes in consciousness. Competency in this care process is associated with mortality rates, an increased length of hospital stay, and worse functional outcomes. Our study observed that tracheostomy was performed in 33 patients, with tracheostomy performed between the 3rd and maximum of the 37th day. Extubation was also performed between the minimum of the 1st and maximum of the 13th day. Hallan et al.[26], investigating the effect of early (≤7 days) and late tracheostomy (>7 days - 3 months) on multiple patient outcomes, including length of stay in the ICU, pneumonia, and mortality at 30, 90, and 365 days, found that early tracheostomy is associated with reduced pneumonia risk and decreased ICU care time. However, it did not affect survival at 90 and 365 d. Garcia et al.[27] found that 18.2% of patients had PEG, with a median time of 10 days for gastrostomy. Our study found that PEG was opened in 9.8% of the patients, with a median opening day of 33.38±15.

Our study did not include patient evaluations after ICU. However, we believe that early tracheostomy will reduce the negative effects associated with the need for mandatory mechanical ventilation, length of stay in ICU, and hospital costs. Despite the provision of necessary medical supplies, we think that our low rates of sending patients home as care patients result from the unsuitability of the working

conditions of the patients' relatives, their concerns about being unable to care, and the inadequacy of home care services. Increasing the capacity of palliative care centers for SIH patients with high care needs and increasing support for home care services, including physical therapy, will increase patients' quality of life and survival.

Study Limitations

The greatest limitation of our study was the inability to collect patient-level data on certain outcomes due to its retrospective nature. Bleeding volume could not be tracked because systematic imaging was unavailable for area calculation using CT. Our study observed that no mortality score was used, apart from GCS and APACHE II, and the recommended intracranial pressure measurement for close monitoring to prevent secondary damage was not performed. Follow-up of patients after ICU cannot be performed, and long-term outcomes (such as mortality, quality of life, and recurrence of bleeding rates) are unknown.

CONCLUSION

Our study aimed to create awareness for adjusting to reduce mortality and morbidity by examining the epidemiology of patients monitored in the ICU for SIH. This study showed that SIH is associated with high mortality, and that most survivors become dependent on care. Despite ongoing controversial practices in treatment, we believe there should be more focus on improving survivors' quality of life after ICU. More extensive randomized controlled prospective studies divided into subgroups are needed to determine the etiology, treatment, and long-term outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was conducted at Bursa Yüksek İhtisas Education and Research Hospital. Ethical approval was obtained from our Ethics Committee (Date: 21.10.2021-Decision No:2011-KAEK-25).

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

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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

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

REFERENCES

1. An SJ, Kim TJ, Yoon B-W. Epidemiology, risk factors, and clinical features of intracerebral hemorrhage: an update. *Journal of stroke.* 2017;19(1):3.
2. Jain A, Malhotra A, Payabvash S. Imaging of spontaneous intracerebral hemorrhage. *Neuroimaging Clinics.* 2021;31(2):193-203.
3. Krishnamurthi RV, Ikeda T, Feigin VL. Global, regional and country-specific burden of ischaemic stroke, intracerebral haemorrhage and subarachnoid haemorrhage: a systematic analysis of the global burden of disease study 2017. *Neuroepidemiology.* 2020;54(2):171-179.
4. Fallenius M, Skrifvars MB, Reinikainen M et al. Spontaneous intracerebral hemorrhage: Factors predicting long-term mortality after intensive care. *Stroke.* 2019;50(9):2336-2343.
5. Jolink WM, Klijn CJ, Brouwers PJ, Kappelle LJ, Vaartjes I. Time trends in incidence, case fatality, and mortality of intracerebral hemorrhage. *Neurology.* 2015;85(15):1318-1324.
6. Jolink WM, Wiegertjes K, Rinkel GJ, Algra A, De Leeuw F-E, Klijn CJ. Location-specific risk factors for intracerebral hemorrhage: systematic review and meta-analysis. *Neurology.* 2020;95(13):e1807-e1818.
7. Van Asch CJ, Luitse MJ, Rinkel GJ, van der Tweel I, Algra A, Klijn CJ. Incidence, case fatality, and functional outcome of intracerebral haemorrhage over time, according to age, sex, and ethnic origin: a systematic review and meta-analysis. *The Lancet Neurology.* 2010;9(2):167-176.
8. Roquer J, Rodríguez-Campello A, Jiménez-Conde J, et al. Sex-related differences in primary intracerebral hemorrhage. *Neurology.* 2016;87(3):257-262.
9. Teles J, Martinez J, Mouzinho M, Guilherme P, Marreiros A, Nzwalo H. Gender differences in long-term mortality after spontaneous intracerebral hemorrhage in southern Portugal. P*orto Biomedical Journal.* 2021;6(4). e137
10. de Ridder I, Kuramatsu J, Gerner S, et al. No sex differences in long-term functional outcome after intracerebral hemorrhage. *Intern J Stroke.* 2017;12(4):416-420.
11. Hu Y-z, Wang J-w, Luo B-y. Epidemiological and clinical characteristics of 266 cases of intracerebral hemorrhage in Hangzhou, China. *J Zhejiang Un Sci B.* 2013;14(6):496-504.
12. Jauch EC, Pineda JA, Hemphill JC. Emergency neurological life support: intracerebral hemorrhage. *Neuro Care.* 2015;23(Suppl 2):S83-S93. doi:10.1007/s12028-015-0167-0
13. Øie LR, Madsbu MA, Solheim O, et al. Functional outcome and survival following spontaneous intracerebral hemorrhage: a retrospective population-based study. *Brain Behavior.* 2018;8(10):e01113.
14. Martini SR, Flaherty ML, Brown WM, et al. Risk factors for intracerebral hemorrhage differ according to hemorrhage location. *Neuro.* 2012;79 (23):2275-2282.
15. Sturgeon JD, Folsom AR, Longstreth Jr W, Shahar E, Rosamond WD, Cushman M. Risk factors for intracerebral hemorrhage in a pooled prospective study. *Stroke.* 2007;38(10):2718-2725.
16. Goeldlin MB, Siepen BM, Mueller M, et al. Intracerebral haemorrhage volume, haematoma expansion and 3-month outcomes in patients on antiplatelets. a systematic review and meta-analysis. *Euro Stroke J.* 2021;6(4):333-342.
17. Wu Y, Zhang D, Chen H, Liu B, Zhou C. Effects of prior antiplatelet therapy on mortality, functional outcome, and hematoma expansion in intracerebral hemorrhage: an updated systematic review and meta-analysis of cohort studies. *Front Neuro.* 2021;12:691357.
18. Rodríguez-Fernández S, Castillo-Lorente E, Guerrero-Lopez F, et al. Validation of the ICH score in patients with spontaneous intracerebral haemorrhage admitted to the intensive care unit in Southern Spain. *BMJ open.* 2018;8(8):e021719.
19. Mendelow AD, Gregson BA, Rowan EN, Murray GD, Gholkar A, Mitchell PM. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial. *Lancet.* 2013;382(9890):397-408.
20. Li L, Molian VA, Seaman SC, et al. Impact of intracerebral hematoma evacuation during decompressive hemicraniectomy on functional outcomes. *Stroke.* 2021;52(3):1105-1108.
21. Greenberg SM, Ziai WC, Cordonnier C, et al. 2022 Guideline for the management of patients with spontaneous intracerebral hemorrhage: a guideline from the American Heart Association/American Stroke Association. *Stroke.* 2022;53(7):e282-e361.
22. Hersh EH, Gologorsky Y, Chartrain AG, Mocco J, Kellner CP. Minimally invasive surgery for intracerebral hemorrhage. *Cur Neuro Neurosci R.* 2018;18(6):1-7.
23. Wintzer S, Heckmann JG, Huttner HB, Schwab S. Dexamethasone in patients with spontaneous intracerebral hemorrhage: an updated meta-analysis. *Cerebrovascular Dis.* 2020;49(5):495-502.
24. Virani SS, Alonso A, Benjamin EJ, et al. Heart disease and stroke statistics-2020 update: a report from the American Heart Association. *Circulation.* 2020;141(9):e139-e596.
25. Li X, Sun Z, Zhao W, Zhang J, Chen J, Li Y, et al. Effect of acetylsalicylic acid usage and platelet transfusion on postoperative hemorrhage and activities of daily living in patients with acute intracerebral hemorrhage. *J Neurosurg.* 2013;118(1):94-103.
26. Hallan DR, Simion C, Rizk E. Early versus late tracheostomy in spontaneous intracerebral hemorrhage. *Cureus.* 2022;14(4).e24059.
27. Garcia RM, Prabhakaran S, Richards CT, Naidech AM, Maas MB. Race, socioeconomic status, and gastrostomy after spontaneous intracerebral hemorrhage. *J Strok Cerebrovas Dis.* 2020;29(2):104567.