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Original Article / Özgün Araştırma

Spontaneous Intracerebral Hematoma: A Single Center 10-Year Analysis

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Abstract

Objective: In this study, we aimed to contribute to the literature by determining data such as mortality rates, demographic, clinical and radiological characteristics of patients who applied to our hospital's emergency department between January 2011 and December 2020 with the diagnosis of SISH and were operated on in our clinic.

Methods:53 patients who were operated on for SISH diagnosis between January 2011 and December 2020 were retrospectively examined. Patients with SISH on brain tomography (CT) were evaluated. Hematoma localization is lobar; those with frontal, parietal, temporal and occipital locations; Those in the thalamic, putaminal and basal ganglia were considered to be deeply located. Patients were divided into three groups according to the Glasgow coma score (GCS): GCS 5–8, GCS 9–12, and GCS 13–15.

Results: In our cohort, the patients mean age was 62.8 years (range, 19–92). The overall mortality rate was 62.87%. Age showed no significant association with mortality. Mortality was associated with increased hematoma volume and low GCS score at the first presentation ($p < 0.001$). In receiver operating characteristic curve analysis, hematoma volume was an important predictor of surgical outcome; the optimal cut-off value of 59.5 cm3 was associated with 84.4% sensitivity and 90.5% specificity ($p < 0.001$). Similarly, the optimal GCS score cut-off value of 8.5 was associated with a 96.9% sensitivity and 71.4% specificity for predicting mortality ($p < 0.001$).

Conclusions: Low GCS, increased hematoma volume, and especially the presence of concomitant hypertension (HT) are associated with poor prognosis in SISH patients.

Keywords: Spontaneous intracerebral hematoma, mortality, hematoma volume, Glasgow coma scale

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Spontan İntraserebral Hematom: Tek Merkez 10 Yıllık Analiz

Öz

Amaç: Bu çalışmada spontan intraserebral hematom (SISH) tanısı ile Ocak 2011-Aralık 2020 yılları arasında hastanemiz acil servisine başvuran ve kliniğimizde opere edilen hastaların mortalite oranları, demografik, klinik ve radyolojik özellikleri gibi verileri belirlenerek literatüre katkıda bulunmak amaçlandı.

Yöntemler: Ocak 2011-Aralık 2020 arasında SISH tanısı opere edilen 53 hasta retrospektif olarak incelendi. Beyin tomografisinde SISH olan hastalar değerlendirildi. Hematom lokalizasyonu frontal, parietal, temporal, occipital yerleşimli olanlar lobar; talamik, putaminal ve bazal gangliyon olanlar ise derin yerleşimli olarak değerlendirildi. glaskow koma skoruna (GKS) göre hastalar üç gruba ayrıldı: GKS 5–8, GKS 9–12 ve GKS 13–15.

Bulgular: Retrospektif olarak değerlendirilen 41'i erkek, 12'si kadın olmak üzere toplam 53 hasta 19-92 yaş aralığında olup yaş ortalaması 62,87 idi. Ölen ve yaşayan gruplar arasında yaş açısından istatistiksel farklılık yoktu (p =0,211). Hastaların genel mortalite oranı %60,3 olarak bulundu. Çalışmamızda mortalitenin artmış hematom hacmi ve düşük GKSile ilişkili olduğunu tespit ettik (p < 0,001). Receiver operating characteristic (ROC) analizi, hematom hacminin %84,4 duyarlılığa ve %90,5 özgüllüğe sahip, 59.5 cm3'lük kesme noktası ile cerrahi sonucun tahmininde önemli bir öngörücü değer olduğunu gösterdi (p < 0.001). Benzer şekilde, kesme noktası 8.5, duyarlılığı %96,9 ve özgüllüğü %71,4 olan GKS da mortalitenin önemli bir öngörücüsü olarak tespit edildi (p < 0.001).

Sonuç: SISH hastalarında düşük GKS, hematom hacminin artması ve özellikle eşlik eden hipertansiyon (HT) varlığı kötü prognoz ile ilişkilidir.

Anahtar kelimeler: Spontan intraserebral hematom, mortalite, hematom hacmi, Glaskow koma skoru.

INTRODUCTION

Spontaneous intracerebral hematoma (SICH) is a non-traumatic hemorrhage accounting for about 10%–15% of all strokes[1]. The annual incidence of SICH is approximately 25 per 100,000 population and the 12-month mortality rate is approximately 40%–60%, with most deaths occurring within the first month[2,3]. SICH can be supratentorial or infratentorial. Brain computed tomography (CT) has up to 100% sensitivity and specificity in diagnosing SICH and is also a rapid and useful technique for the measurement of hematoma volume[4]. SICH, which is most frequently seen in the basal ganglia, is associated with uncontrolled arterial hypertension (HT), and its incidence increases with increasing age[5,6]. Glasgow coma scale (GCS) score, concomitant diseases, and the volume and localization of hemorrhage are the main prognostic factors in these patients[7]. This study aimed to analyze the clinical and radiological profile of patients with SICH treated at a single center for a duration of 10-year. In order to be able to reduce disability and mortality that may occur as a result of SICH, it is of great significance to explore its etiology, whether its causes are preventable, and the factors affecting the mortality, based on accurate data. Thus, the primary objective of our study was to reveal the factors associated with poor surgical outcomes of SICH by comparing with the literature data in line with our clinical experience.

METHODS

This was a retrospective cohort study based on a database of SICH patients admitted to a single academic institution (Faculty of Medicine, Tokat Gaziosmanpasa University) between January 2011 and December 2020. The inclusion criterion was patients aged over 18 years with spontaneous supratentorial hemorrhage. Patients aged <18 years, those with infratentorial hemorrhage, and those with hematomas due to aneurysm or other pathology, traumatic hemorrhage, patients using antiplatelet and anticoagulant drugs and hematoma volume <30 cm3 were excluded from the study. Besides, patients with concomitant hemorrhage (such as epidural and subdural hematoma) and those who could not be evaluated because of missing data were excluded from the study.

Before starting the study, approval was obtained from the local institutional ethics committee (23-KAEK-124). Owing to the retrospective nature of the study, the ethics committee exempted the need for informed consent. An electronic patient record system (Enlil Hospital Information Management System, Version V2.19.46 2019118) and the PACS software (Sectra Workstation Ids7, Version 21.2.11.6289; ©2019 Sectra Ab) were employed to retrieve data from the patient medical records.

In this study, 53 adult patients (41 men, 12 women) were evaluated. Demographic information and systemic diseases of the patients were assessed. GCS score and neurological findings of the patients at the first presentation were clinically evaluated. Patients were divided into three groups according to GCS: GCS 5–8, GCS 9–12, and GCS 13–15[8]. All patients underwent preoperative brain CT. The location of hemorrhage was supratentorial in all patients. Based on their location of occurrence, hematomas were grouped into two categories: those on the right hemisphere and those on the left hemisphere. The location of hematoma was evaluated as lobar (frontal, parietal, temporal, occipital) and deep (thalamic, putaminal, basal ganglia)[9]. The maximum width (W, transverse diameter), length (L, anteroposterior diameter), and height (H, craniocaudal diameter) of hemorrhage were measured, and the following equation was used to estimate hemorrhage volume: Hemorrhage volume = W × L × H × 0.58. Hematomas were classified into three groups with respect to hemorrhage volume: medium (31–60 cm3), large (61–90 cm3), and extensive (>90 cm3)[8]. There was a midline shift in the brain tomography of the operated patients taken at the time of admission. Additionally, there was impaired consciousness and lateralizing deficit on examination. All patients underwent decompressive craniotomy and duraplasty. It was examined whether hematoma opened to the ventricle. Those who developed hydrocephalus were treated with external ventricular drainage (EVD). Postoperatively, the patients were followed in the intensive care unit (ICU).

Statistical Analysis

Quantitative and categorical variables were expressed as mean ± standard deviation and frequency (percentage), respectively. The independent sample t-test was employed to analyze between-group differences regarding continuous variables that follow normal distribution. Chi-square test was used to evaluate categorical variables. A receiver operating characteristic (ROC) curve analysis was done to determine the predictive ability of hematoma volume and GCS score for mortality. P values < 0.05 were considered indicative of statistical significance. The SPSS 22.0 software package (Chicago, IL, USA) was used to conduct statistical analysis.

RESULTS

The patients in our cohort had a mean age 62.8 years (range, 19–92). Of our patients, there were 41 male and 12 female. Hematomas were located in the right hemisphere in 26 patients and in the left hemisphere in 27 patients. It was found that 12 patients had DM, 5 patients had asthma and 18 patients had coronary artery disease. The preoperative ASA score was evaluated to be grade 4 with 84.9%. All patients were surgically treated. The most common location of hematoma in our cohort was the deep region (37 [69.8%] patients). The mean hospitalization time was 22.5 days. Postoperatively, 26 patients developed pneumonia, 8 patients developed urinary tract infection, 3 patients developed meningitis, and 1 patient sustained myocardial infarction. A summary of the qualitative and quantitative variables is shown in tables 1 and 2, respectively.

Table I: Distribution of qualitative variables

Variables		N	%
Hemorrhage volume range (cm^3)	31–60	25	47.2
	61–90	13	24.5
	>90	15	28.3
GCS	3–8	37	69.8
	9–12	16	30.2
Sex	Female	12	22.6
	Male	41	77.4
Location	Lobar	16	30.2
	Deep	37	69.8
Hemorrhage side	Right	26	49.1
	Left	27	50.9
Opening to the ventricle	No	10	18.9
	Yes	43	81.1
Patient exit type	Discharged	21	39.6
	Exitus	32	60.4
DM	No	41	77.4
	Yes	12	22.6
Asthma	No	48	90.6
	Yes	5	9.4
CAD	No	35	66.0
	Yes	18	34.0
EVD	No	37	69.8
	Yes	16	30.2
HT	No	21	39.6
	Yes	32	60.4
ASA Score	3	7	13.2
	4	45	84.9
	5	1	1.9

DM: diabetes mellitus; CAD: Coronary artery disease, EVD: external ventricular drainage; HT: hypertension; ASA: American Society of Anesthesiologists

Table I: Distribution of quantitative variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Age (years)	62.87	14.32	19.00	92.00
Hemorrhage volume (cm^3)	74.83	37.82	32.00	208.00
Length of Intensive care unit stay (day)	22.53	27.00	1.00	174.00
GCS	6.85	2.43	3.00	12.00

GCS: Glasgow coma scale

No patients in our cohort exhibited a GCS score within the range of 13–15. A total of 32 (60.3%) patients died, of whom 31 had a GCS score at admission within the range of 3–8 (Table 3), which was statistically significant ($p < 0.001$). All discharged patients had neurological sequelae such as aphasia, paralysis or plegia. The mean GCS score of the deceased patients (5.41 ± 1.68) was found to be significantly lower compared to that of the survivors (9.05 ± 1.60) ($p < 0.001$) (Table 4). Likewise, the mortality rate showed a positive association with hematoma volume ($p < 0.001$).

Table III: Distribution of qualitative variables by survival status

Variables		Exit type			p
		Total	Discharged	Exitus	
		n (%)	n (%)	n (%)	
Hemorrhage volume (cm^3)	31–60	25 (47.2)	19 (90.5)	6 (18.8)	< 0.001
	61–90	13 (24.5)	1 (4.8)	12 (37.5)	
	>90	15 (28.3)	1 (4.8)	14 (43.8)	
GCS	3–8	37 (69.8)	6 (28.6)	31 (96.9)	< 0.001
	9–12	16 (30.2)	15 (71.4)	1 (3.1)	
Sex	Female	12 (22.6)	6 (28.6)	6 (18.8)	0.403
	Male	41 (77.4)	15 (71.4)	26 (81.3)	
Location	Lobar	16 (30.2)	5 (23.8)	11 (34.4)	0.412
	Deep	37 (69.8)	16 (76.2)	21 (65.6)	
Hemorrhage side	Right	26 (49.1)	11 (52.4)	15 (46.9)	0.695
	Left	27 (50.9)	10 (47.6)	17 (53.1)	
Opening to the ventricle	No	10 (18.9)	8 (38.1)	2 (6.3)	0.004
	Yes	43 (81.1)	13 (61.9)	30 (93.8)	
DM	No	41 (77.4)	18 (85.7)	23 (71.9)	0.239
	Yes	12 (22.6)	3 (14.3)	9 (28.1)	
Asthma	No	48 (90.6)	19 (90.5)	29 (90.6)	0.986
	Yes	5 (9.4)	2 (9.5)	3 (9.4)	
CAD	No	35 (66)	15 (71.4)	20 (62.5)	0.502
	Yes	18 (34)	6 (28.6)	12 (37.5)	
EVD	No	37 (69.8)	18 (85.7)	19 (59.4)	0.041
	Yes	16 (30.2)	3 (14.3)	13 (40.6)	
HT	No	21 (39.6)	12 (57.1)	9 (28.1)	0.035
	Yes	32 (60.4)	9 (42.9)	23 (71.9)	
ASA Score	3	7 (13.2)	6 (28.6)[a]	1 (3.1)[b]	0.022
	4	45 (84.9)	15 (71.4)[a]	30 (93.8)[b]	
	5	1 (1.9)	0 (0)	1 (3.1)	

GCS: Glasgow coma scale; DM: Diabetes mellitus; CAD: Coronary artery disease; EVD: External ventricular drainage; HT: Hypertension; ASA: American Society of Anesthesiologists

Table IV: Distribution of quantitative variables by survival status

Variables	Total	Exit type		p
		Discharged	Exitus	
	Mean ± SD	Mean ± SD	Mean ± SD	
Age (years)	62.87 ± 14.32	59.81 ± 17.52	64.87 ± 11.63	0.211
Hemorrhage volume (cm^3)	74.83 ± 37.82	49.26 ± 13.62	91.61 ± 39.32	<0.001
Length of ICU stay (days)	22.53 ± 27	29.33 ± 36.89	18.06 ± 17.11	0.139
GCS	6.85 ± 2.43	9.05 ± 1.6	5.41 ± 1.68	<0.001

ICU: İntensive care unit; GCS: Glasgow coma scale

The ROC analysis results of are illustrated in Table 5 and Figure 1. Figures 2 and 3 present indicative examples of brain CT (sagittal sections) of patients with deep and lobar hematoma, respectively.

Table V: The results of ROC analysis showing the predictive ability of hemorrhage volume and GCS for mortality

Variable	Cut-off	AUC	Sensitivity	Specificity	PPV	NPV	p
Hemorrhage volume (cm^3)	≥59.5	0.877	0.844	0.905	0.931	0.792	<0.001
GCS	≤8.5	0.937	0.969	0.714	0.838	0.937	<0.001

AUC: Area under the curve; PPV: Positive predictive value; NPV: Negative predictive value; GCS: Glasgow coma scale.

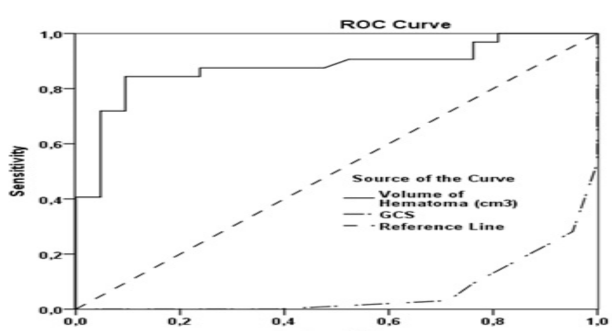

Figure 1. Receiver operating characteristic (ROC) curve for hematoma volüme and GCS

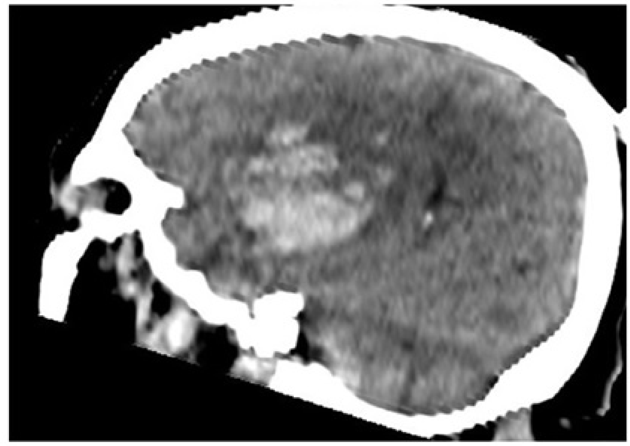

Figure 2. Representative brain computed tomography (sagittal section) image of a patient with deep hematoma

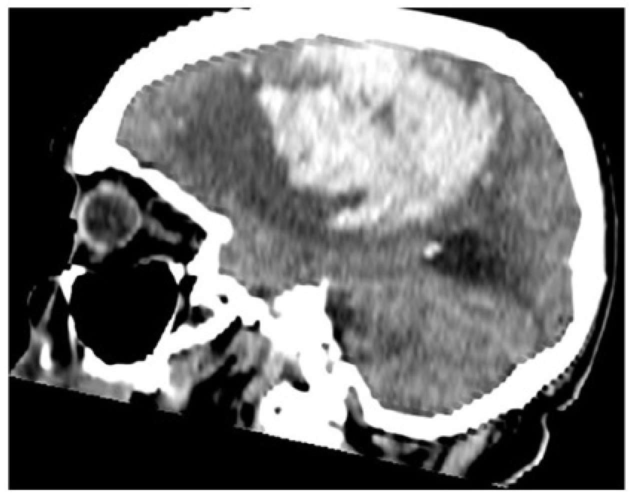

Figure 3. Representative brain computed tomography (sagittal section) image of a patient with lobar hematoma

DISCUSSION

This study revealed that hemorrhagic cerebrovascular diseases, the leading cause of disability and death, are associated with HT, a preventable and treatable risk factor. Mortality was associated with increased hematoma volume and low GCS score at admission ($p < 0.001$). On ROC curve analysis, the hematoma volume cut-off value of 59.5 cm3 was associated with 84.4% sensitivity and 90% specificity ($p < 0.001$) for predicting surgical outcomes. Similarly, the GCS score cut-off value of 8.5 was associated with 96.9% sensitivity and 71.4% specificity for predicting mortality ($p < 0.001$).

SICH is frequently observed in neurosurgery practice, especially in elderly patients, and it is among the conditions requiring prompt surgical intervention for patients with surgical indications. Parameters such as age, level of consciousness at the time of admission, and hematoma volume are important in making surgical decisions for the patient. The main objective of surgical procedure is to reduce intracranial pressure by performing decompression and to hinder the onset of neurological deficit and, if possible, mortality in the advanced stage.

The clinical presentation of SICH may range from headache to deep coma. However, all patients in our cohort were unconscious when admitted to the hospital and were treated surgically. The level of consciousness (GCS)is a widely used prognostic marker in SICH patients[10]. The prognosis seems to be better in patients with high GCS scores. The rate of mortality among patients with GCS scores of[9–12] was 6.25%, whereas it was 83.7% in those with GCS scores of[3–8]. The overall mortality rate in our study was 60.3%. Our results were similar to previous studies[11].

In SICH patients, there is an association between advanced age and poor prognosis[12]. The mean age of tour cohort was 62.8 years (range, 19–92). Age showed no significant relationship with mortality ($p = 0.211$). Similar to reports in the literature indicating that SICH is more frequently seen in males[13], males (72.4%) outnumbered females (22.6%) in our study population. In the current study, there was no significant relationship between gender and mortality ($p=0.403$).

Among SICH patients, HT is the most common etiology[14]. There were 32 patients with HT in our study group, 23 of whom died. HT is a disease that can be prevented and controlled with regular treatment. We believe that the incidence of SICH may be reduced by meticulous management and stringent follow-up of hypertensive patients and by raising their awareness on issues such as complying with dietary measures and adapting to drug treatment if they use drugs. Particular attention should be paid to the use of antihypertensives, such as nimodipine, which are also known to have effects on the central nervous system[15].

It has been reported that SICH is most commonly located in the basal ganglia (50%–60%)16. Consistent with this study, hematomas were most commonly localized in the deep region in our study (37 patients [69.8%]). Hematomas in the lobar location were observed in[16] patients (30.2%). Deep-seated hematomas have been found associated with higher mortality[17]. However, in our study, although 21 of the 32 deceased patients had a hematoma in the deep region, the location of the hematoma showed no significant association with mortality ($p = 0.412$). This may be related to the small number of patients and/or the exclusion of patients with missing data from the study.

The cranium is a closed box with a fixed volume. The formation of hematoma in this fixed volume region is liable to exert a mass effect on normal tissues over time. As a result, intracranial pressure increases, disrupting cerebral perfusion and causing loss of physiological functions. These events increase the mortality rate. Therefore, the primary aim in SICH is to reduce the pressure on normal brain tissue[18]. Examination of hemorrhage volume of the deceased patients indicated that out of 32 deceased patients, 6 (18.8%) were in the 31–60 cm3 group, 12 (37.5%) in the 61–90 cm3 group, and 14 (43.8%) in the >90 cm3 group. Most of the deceased patients (43.8%) were in the group with a hemorrhage volume of >90 cm3. The results we obtained align with previous reports indicating a positive association of mortality with increasing hematoma volume[19].

In SICH, hematoma can sometimes open to the ventricle, leading to the blockage of the pathway for the circulation of the cerebrospinal fluid. The consequent development of hydrocephalus leads to poor prognosis. According to the literature, hematomas open to the ventricle in approximately 40% of SICH patients19. In our study, hematoma opened to the ventricle in 43 patients (81.1%), and 30 of these patients died (p = 0.004). Hydrocephalus developed in 16 patients (30%) which was treated by EVD. Thirteen of these were in the deceased patient group (p = 0.041). Our results line up with previous reports in the literature.

Even though SICH patients may have a wide range of presenting symptoms, they are most commonly brought to the emergency room with impaired consciousness by bystanders. SICH needs to be considered in the etiology of patients presenting with impaired consciousness. For this reason, patients presenting with confusion and loss of consciousness should urgently undergo brain CT, and it should be remembered that early intervention may help improve the prognosis.

The limitations of our study are that it was conducted in a single center, retrospectively, and the sample size was relatively small (n = 53). Since postoperative brain CT scans were not available for all patients, relevant comparisons could not be performed. Larger multicenter prospective studies are required to obtain more robust data.

CONCLUSION

In SICH patients, low GCS score at admission, high hematoma volume, and the presence of concomitant HT are associated with poor prognosis.

Ethics Committee Approval: Before starting the study, approval was obtained from the local institutional ethics committee (23-KAEK-124). Owing to the retrospective nature of the study, the ethics committee exempted the need for informed consent.

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

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