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Operative management of intracerebral hemorrhage: 3 year experience in multidisciplinary city hospital

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Abstract

Hemorrhagic stroke is a hemorrhage in the brain parenchyma or ventricles resulting from a rupture of an intracerebral vessel or increased permeability of its wall. Intracerebral hemorrhage is a serious medical and social problem associated with high mortality and disability worldwide. Our study aimed to analyze the operative treatment results of patients with hemorrhagic stroke to determine the factors influencing mortality.

Key words: hemorrhagic stroke, intracerebral hemorrhage, surgical treatment, stroke mortality.

Introduction

Hemorrhagic strokes account for about 20% of all strokes and are one of the leading causes of death and disability worldwide [1-3]. Even though various drugs are currently being developed to enhance neuroprotection and neuroplasticity, which can be used in combination with rehabilitation to accelerate recovery, surgical and conservative treatment in the acute period remains an important integral component of the treatment of hemorrhagic stroke [4, 5]. The decision to operate is a controversial issue: early surgical treatment to limit brain compression and blood toxicity may limit secondary neuronal damage, but in cases with ongoing bleeding, the risk of surgery may be higher [6].

Aim. Analysis of the surgical treatment of patients with hemorrhagic stroke based on the Multidisciplinary city hospital №1 in Nur-Sultan hospitalized from January 2019 to December 2021 and determine factors influencing the worst outcome.

Material and methods

This is a retrospective analytical study. The study included 63 patients with intracerebral hemorrhage hospitalized at the Multidisciplinary city hospital №1 in Nur-Sultan from January 2019 to December 2021 on an emergency basis. After hospitalization, there was a conjoint decision-making process that included evaluation of neurologic status (Glasgow coma scale), CT data (localization, hematoma volume), and treatment strategy. This process was also influenced by the medical history of the patient, as many of them had concurrent diseases in other systems (cardiovascular, hematologic, gastrointestinal, genitourinary). All data were collected by different authors and double-checked for accuracy. There were strict inclusion criteria: any hospitalized patient with intracerebral hemorrhage in the Multidisciplinary city hospital №1 in Nur-Sultan from January 2019 to December 2021. Exclusion criteria were: patient did not receive surgical treatment and, for some reason, the patient's hematoma volume was not described in any part

of the medical history. All types of operations were divided into three types: Arendt drainage placement, hematoma evacuation by different methods (trephination, endoscopic, aspiration assisted, or simply by syringe), and decompressive craniectomy. For better statistical distribution all localizations were anatomically divided into supratentorial and infratentorial. Supratentorial localization was further investigated by ventricular perforation. The time from admission to the operation was estimated as hours and was divided into intervals: the first three hours, the first 24 hours, and more than 24 hours. After admission, consent to participate in further studies was obtained from patients, or closest relatives if the patient was not able to understand and sign proper papers. Ethical committee approval was not required in this retrospective analysis.

Statistical analysis of patients was made by Jamovi. Student's t-test and Mann-Whitney U test were used to determine significance, and p< .001 was considered significant.

Results

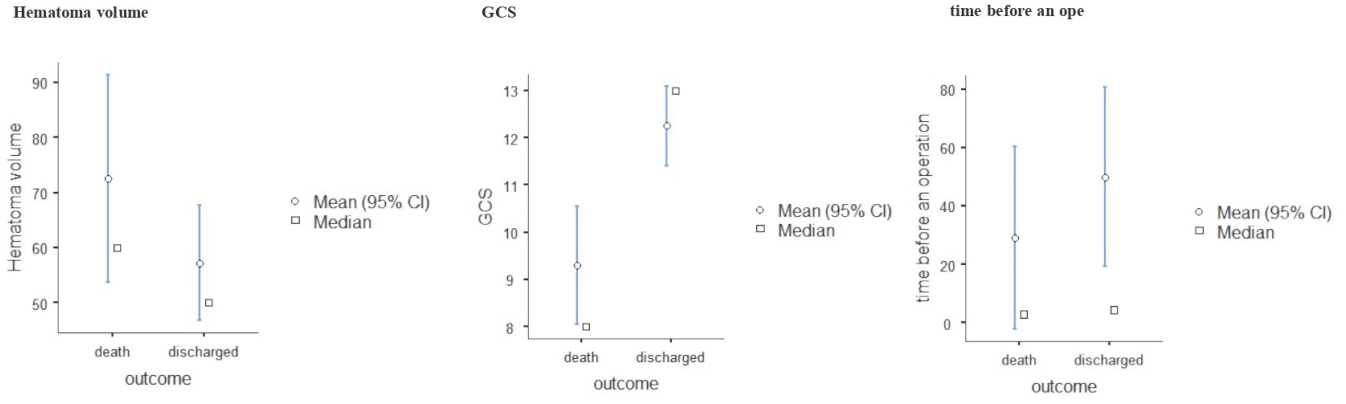
63 patients met all inclusion criteria. 30 (47,6%) male and 33 (52,4%) female patients. The age of the patients ranged from 25 to 80 years; the average age was 54.66±11.9 years. The hematoma volume ranged from 16 to 219 cm3, averaging 63.7±39.56 cm3. In most cases (85,7%), the hemorrhagic focus was located in the cerebral hemispheres, which was considered supratentorial localization, and the remaining 14,7% were in the brainstem, and cerebellum, defined as infratentorial. 38% had a ventricular perforation on the initial presentation.

Figure 1 - Correlation between hematoma volume, CGS, time before operation and an outcome.

Independent Samples T-Test

		statistic	df	p
Hematoma volume	Student's t	1.482 [a]	61.0	0.143
	Mann-Whitney U	423		0.384
GCS	Student's t		61.0	<.001
	Mann-Whitney U			<.001
time before an operation	Student's t	-0.913	61.0	0.365
	Mann-Whitney U	368		0.098

[a] Levene's test is significant (p < .05), suggesting a violation of the assumption of equal variances



Decompressive craniectomy was performed in 32 cases (50,7%), Arendt placement in 8 patients (12,6%), and the rest 23 (36,7%) patients had the hematoma evacuation. In the period of up to 3 hours, operations were performed in 33 (52,4%) patients, 17 patients (26,9%) had an operation in the first 24 hours after admission, and 13 patients (20.6%) had an operation delayed for more than one day. Among all treated patients, lethality in the hospital was 42.8% of cases. 11 patients (17.4%) required tracheostomy. In this study, the initial Glasgow coma scale was the significant predictor of the outcome (Figure 1). It is possible to see the correlation between discharged patients with higher Glasgow coma scores on the initial presentation in Figure 2. Hematoma volume and Glasgow coma scale and operation types are demonstrated in Figure 2. Hematoma volume and Glasgow coma scale and time before an operation and relation for outcomes are demonstrated in Figure 3. Time before an operation and relation to the different localization and operation types are demonstrated in Figure 2. An assessment of the relationship of mortality with the gender and Glasgow coma scale is demonstrated in Figure 3.

Discussion

Despite notable advances in surgical technique and understanding of the mechanisms of secondary brain injury, the prognosis of intracerebral hemorrhage remains unfavorable [7]. The mechanisms responsible for brain damage within a cerebral hematoma are numerous and complex: initially, there is a direct effect of acute bleeding into the brain parenchyma, causing a mass effect, which is subsequently accompanied by hemorrhage arrest in about two-thirds of patients. However, in the remaining third of patients, the hematoma continues to grow during the first 24 hours, which contributes to an additional mass effect, midline shift and leads to further neurological deficit and an increased risk of adverse outcomes [8-10].

Hematoma volume is a known predictor of an outcome [13]. Hematomas larger than 30 ml are statistically associated with poor results. With a hematoma volume of more than 60 ml with a level of consciousness of fewer than 8 points, the predicted mortality within 30 days was 90%. Volumetric hematomas (≥150 ml) usually lead to death in patients due to a sharp increase in intracranial pressure and, as a result, a decrease in cerebral

Figure 2 - Correlation between hematoma volume, CGS, time before operation and anatomical localization and an outcome

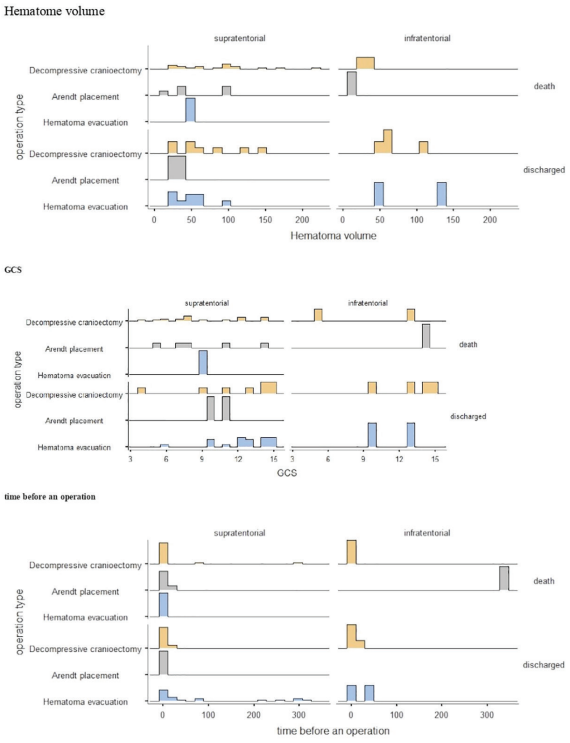
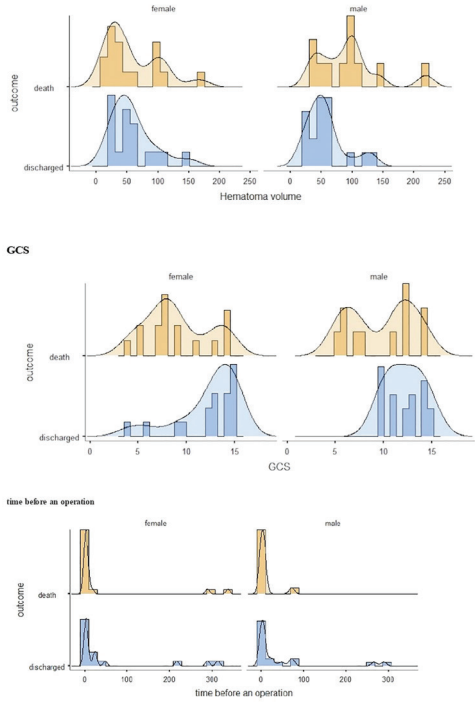


Figure 3 - Correlation between hematoma volume, CGS, time before operation and gender and an outcome



perfusion pressure [8, 15]. Surgical drainage of hematoma has several theoretical advantages, such as prevention of mass effect and dislocation syndrome, reduction of intracranial pressure, reduction of excitotoxicity, and neurotoxicity of blood products. Surgical treatment of intracerebral hematomas includes decompression craniectomy with or without hematoma evacuation, craniotomy with hematoma evacuation, hematoma drainage through a trephine hole, installation of a ventricular drain, and other minimally invasive techniques [8, 17]. Surgical evacuation of the hematoma is considered in patients with large volumes of hemorrhage with breakthrough into the ventricles to prevent compression of the brainstem and subsequent complications. In cases of obstructive hydrocephalus caused by displacement and occlusion of the III-IV ventricles or the Sylvian aqueduct, as well as their tamponade, ventricular drainage is indicated [1, 16]. The Surgical Trial in Intracerebral Hemorrhage (STICH) I and II, a large randomized clinical trial evaluating early surgery versus conservative treatment or delayed surgery, showed a modest benefit in early mortality but no clear benefit in long-term outcome after removal of hematoma in supratentorial intracerebral hemorrhage [18, 19]. Current guidelines [20] state that decompression craniotomy, with or without hematoma evacuation, can reduce mortality in patients with supratentorial hematomas who are comatose and have large hematomas with significant midline displacement or have increased intracranial pressure that is resistant to medical treatment. A case series showed that patients with a Glasgow Coma Score greater than 6 and a hematoma volume of fewer than 50 ml who underwent minimally invasive surgery had better functional outcomes and a shorter length of stay in the intensive care unit compared to traditional craniotomy [16]. Minimally invasive surgery, on the other hand, requires proper time and patient selection to be performed [14]. However, larger randomized controlled double-blinded investigations should be performed to indicate better outcomes.

It is unclear whether ICH is related directly to COVID-19 or reflects expected comorbidity and/or complications observed in severely ill patients [11,12]. Our series of patients included those hospitalized during the strict quarantine, and mortality was not higher than reported in the literature [11]. But it is clear that survival chances significantly decrease in case of acute COVID-19 infection [12].

Although it is suggested that early intervention in acute hemorrhagic stroke is not considered to increase survival rates [14], the sign of acute cerebral edema on initial CT scans prompted sooner operation in our series of patients. Delay in operation in our series of patients was mainly caused by the existence of other medical conditions, and required stabilization first. According to some studies, risk of the lethal outcomes is higher in case of lower Glasgow coma scales on initial presentation in hemorrhagic stroke [21, 22]. Given this fact, our team, if possible, carried out surgical treatment even with a slight decrease in the level of consciousness. A wait-and-see tactic was adopted in cases of unstable hemodynamics, while CT monitoring of the size of the hematoma in dynamics was carried out. Currently, an ongoing prospective study with conservative treatment as a control group is in our consideration.

Conclusion

Despite the multimodal approach, the development of surgical techniques and equipment, and the selection of optimal conservative therapy - the question of determining the tactics for managing and treating hemorrhagic strokes is still controversial. Hematoma volume certainly plays a significant role in the higher mortality rates. Nevertheless, our experience shows patients with a worse initial Glasgow coma scale will have worse outcomes. Multicenter randomized double-blinded studies should be performed to see clearer correlation.

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