



Delayed Treatment of Acute Subdural Hematomas: Retrospective Outcome Analysis of 215 Patients

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Abstract

Edited by: Ksenija Bogoeva-Kostovskai

Citation: Akhmetov K, Akshulakov S, Adilbekov Y, Jaxybayeva A, Dmitriyeva M, Toleubayev M. Delayed Treatment of Acute Subdural Hematomas: Retrospective Outcome Analysis of 215 Patients. Open Access Maced J Med Sci. 2021 Jul 26; 9(B):779-785. <https://doi.org/10.3889/oamjms.2021.6566>

Keywords: Acute subdural hematoma; Conventional delayed treatment; Nonsurgical treatment

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Received: 03-Jun-2021

Revised: 21-Jun-2021

Accepted: 16-Jul-2021

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Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

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BACKGROUND: The preferred treatment method for acute subdural hematoma (aSDH) is surgical intervention.

AIM: We aimed to show that, regardless of the good results of surgical treatment, conventional delayed treatment might be very useful in some situations and might lead to chronicity of hematoma as well as reduction of surgical intervention scope and reduce risk of anesthesia. It might also give rise to spontaneous resorption of hematoma.

METHODS: In the period March 1, 2013–March 1, 2020, we retrospectively examined 215 aSDH patients. The basic result of the outcome analysis was evaluated on the basis of the Glasgow Outcome Scale (GOS) at discharge after 3-month and 6-month follow-up.

RESULTS: A total of 215 patients with aSDH and minor or moderate brain injury were examined, while applying conventional delayed treatment, the following results were obtained: large craniotomy was carried out in 123 patients (57.2%) on the 2nd–3rd day of observation, small craniotomy with drainage was applied in 29 patients (13.5%) and spontaneous resorption of subdural hematoma occurred in 63 patients (29.3%). The median score as per the Glasgow Coma Scale at admission to the hospital was 11.4.

CONCLUSION: This study showed that conventional delayed treatment applied in patients with aSDH and minor or moderate craniocerebral injury might lead to chronicity and resorption of aSDH. The outcomes as per the GOS scale also showed good data three and 6 months after hospitalization.

Introduction

Acute traumatic subdural hematoma (aSDH) is observed in 12–29% of patients with craniocerebral injury (CCI) or craniocerebral trauma [1]. aSDH patients are often in a bad neurological state assessed with a score of 8 according to the Glasgow Coma Scale (GCS). Although the aSDH course largely varies, based on GCS, the death rate ranges from 30% to 60% in all aSDH patients and from 55% to 70% in patients with 8 or lesser score [2], [3], [4]. aSDH usually develops right after a severe injury, for example, after a traffic accident or after falling from a height; as a rule, aSDH presence and growth might elevate intracranial pressure to a dangerous level, leading to lethal outcomes [5], [6].

Current guiding principles prescribe urgent surgical treatment to patients who have 10 mm or wider hematoma or 5 mm or more midline shift shown on computerized tomography (CT) or to those who have intracranial pressure exceeding 20 mm Hg; these principles prescribe craniotomy with the removal of hematoma [7], [8], [9]. Based on research, it is apparent that the conventional treatment for aSDH might be

used in some cases. Conventional delayed treatment is applied to asymptomatic hematomas, to patients refusing surgery, or to patients with high surgical risk. Any changeable factor that might help in ensuring a better post-surgical treatment result should be studied. A delayed surgical invasion will allow an acute clot to become a chronic one, delayed intervention would allow for acute clot to become chronic subsequently allowing for a smaller incision, smaller craniotomy (bure hole), less blood loss, and duration of anesthesia. A small craniotomy will ensure lesser blood loss and shorter anesthesia duration, thereby improving the outcome and reducing mortality [10]. Moreover, the delay might lead to spontaneous resorption of aSDH.

To date, there is no consensus about the best treatment, as the treatment technique should be customized for each patient. Patients with symptoms and confirmed X-ray identification of hematomas are usually treated surgically, whereas patients with asymptomatic hematomas and small hematomas not taking a large space may be treated conventionally by means of medication or thorough observation. In this series, we report the case of 215 patients with aSDH surgical diagnosis and minor or moderate CCI who

garnered 11–12 score as per GCS at admission and who underwent the primary course of conventional therapy, namely, monitoring of vital signs, CT monitoring, anesthesia, and anti-convulsion medication. Additional diagnostics and treatment were applied at the discretion of the neurosurgeons. It is worth reiterating that delayed intervention will allow an acute clot to become a chronic one, which will permit the creation of a small craniotomy (burr hole). A smaller craniotomy will ensure lesser blood loss and shorter anesthesia duration, as well as increase the chances of spontaneous resorption of aSDH.

Data and Methods

A number of cases were studied retrospectively, with this research aiming to identify all aSDH patients in the period March 1, 2013–March 1, 2020, at the National Scientific Center of Neurological Surgery of Nur-Sultan City, Kazakhstan. Using the international disease classification, 10th review, and codes of current procedural terminology, all patients with aSDH diagnosis were identified. Inclusion criteria: Age of patients 18–90 years old, confirmed diagnosis of traumatic aSDH, mild or moderate grades of CCI, GCS scores more than 9, CT thickness <10 mm, midline shift on CT <7 mm. The exclusion criteria: Age of patients <18 or older than 90 years, presence of cSDH on admission, the presence of non-traumatic SDH on admission, patients with associated intracranial hematomas (extradural hematoma, intracerebral, and intraventricular hemorrhage), severe CCI, GCS scores <9, clot thickness on CT scan of more than 10 mm, midline displacement on CT scan of more than 7 mm. A total of 280 aSDH diagnosed patients were admitted to the center over the period of the study. Decompressive craniotomy with removal of aSDH was performed in 65 patients within 24 h after admission. Up to 215 (n = 215) patients were subjected to delayed treatment (conventional treatment, round-the-clock dynamic observation) and included in the final analysis.

For the 215 patients covered by the study, their clinical records were used to document sex, age, original injury date, surgery date, duration of delay time between injury and surgery, duration of hospitalization, primary symptoms at first scanning and before surgery including GCS at admission, post-surgical GCS, Glasgow Outcome Scale (GOS) at discharge (14 days after hospitalization) and 3- and 6-month GOS after discharge. All patients were subjected to a comprehensive examination, neurological examination, and brain CT scan. In performing the brain CT, the midline deviation, blood clot thickness was measured. When identifying subdural hematomas with volumes <30 ml in case of compensated patient state (11–12

score as per GCS), we applied delayed techniques of treatment. During the acute period, dynamic observation with conventional treatment was applied, including neuroprotective, pain-relieving, dehydrating therapy, anti-epileptic drugs, and antibacterial therapy. The criteria for surgical intervention, time prior to surgery and type of procedure were left to the discretion of the neurosurgical personnel on duty. If there are no contraindications, the standard practice at our institution is surgical removal in case of neurological examination data worsening or aggravation of symptoms such as headache and psychic state change, among others. Any movement deficit is, as a rule, the basis for immediate surgical invasion.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards (protocol №3 of Ethic committee of Nacional center for neurosurgery, Nur-Sultan city).

Descriptive statistics were used for the description of demographic and clinical characteristics of patient selection. We used Fisher's test for the quantitative assessment of relation between two category variables, particularly surgery type, surgery outcome, and treatment outcome. Regression logical analysis was carried out with the purpose of examining GOS at discharge and GOS after 3-month and 6-month follow-up and the relation thereof with demographic and clinical factors.

Results

General demographic and clinical data

Overall, 215 aSDH patients were included in the final analysis, 124 of whom were males (57.7%) and 91 females (42.3%). The average age was 41.4 years, with a range of 19 to 86 years (Figure 1). The injury in 117 patients (54.4%) originated from traffic accidents; in 71 patients (33%), the injury resulted from household accidents; in three patients (1.4%), the injury was caused by occupational accidents; and in 24 patients (11.2%), the cause of injury was not identified. The average time from the moment of injury until admission to the inpatient treatment facility was 1.76 days (within the range of 20 min to 6 days). The average duration of hospitalisation was 14 days within the range of 12–15 days (Table 1).

Treatment methods

All patients (215) were identified with 5–7-mm-thick aSDH or with midline shift exceeding.

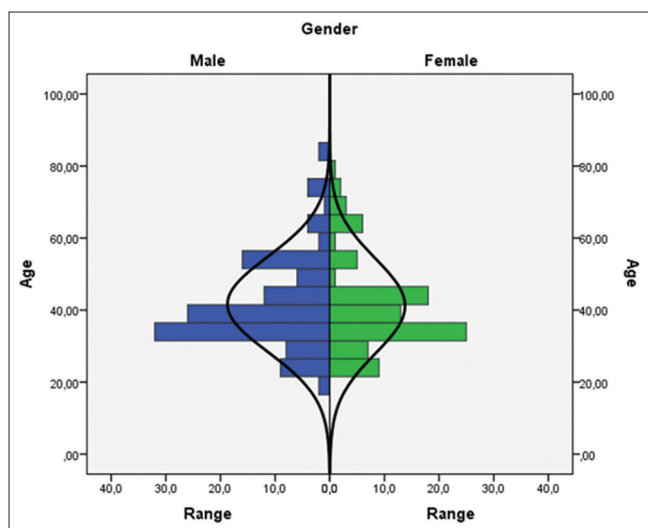


Figure 1: Gender and age distribution

5 mm as per CT. The GCS score was 11–12. Delayed treatment, dynamic follow-up, neuroprotective drugs, pain-relieving medication, dehydration therapy, antibacterial therapy and therapy aimed at the prevention of convulsions were applied. Surgery on 152 out of 215 patients (70.7%) was performed according to delayed techniques of treatment.

Table 1: General demographic and clinical data

	n	%
Gender		
Male	124	57.7
Female	91	42.3
Age	median	range
	41.4	19–86
Mechanism of injury	n	%
Traffic accident	117	54.4
Household accident	71	33
Occupational accident	3	1.4
Not identified	24	11.2
Period since the moment of injury to hospital admission (days)	median	range
	1.76	20 min to 6 days
Average period of inpatient care	median	range
	14	

Of these patients, 123 (57.2%) were subjected to decompressive craniotomy on the 2nd–3rd day due to their level of consciousness depression, which was scored 10 as per GCS or convulsive disorder. In 29 patients (13.5%), in the course of delayed surgical treatment, the hematoma transformed into a chronic form. Due to this, minimally invasive surgery (closed external drainage of subdural hematoma) was performed on the 10th–11th day. Meanwhile, in 63 patients (29.4%), unassisted resorption of subdural hematoma occurred on the 9th–11th day of follow-up (Table 2)

Table 2: aSDH patient treatment methods

Surgery	n	%
Osteoplastic craniotomy (on the 2 nd –3 rd day)	123	57.2
Closed external drainage (on the 10 th –11 th day)	29	13.5
Hematoma resorption (on the 9 th –11 th day)	63	29.3

aSDH: Acute subdural hematoma.

Assessment as per Glasgow scale at admission and prior to surgery

The aSDH diagnosed patients to whom delayed treatment was applied were subjected to assessment of

consciousness level. As per the Glasgow scale (GCS), 215 patients had an average score of 11.4 at admission. Prior to large craniotomy, the average score was 10.98. The patients with small craniotomy with external drainage showed an average score of 11.93, while the average score in the patients with spontaneous resorption of aSDH was 11.96 (Table 3).

Table 3: Assessment as per Glasgow scale at admission and during the course of treatment

GCS score	median	range
Initial	(11.4 ± 0.55)	10–13
Prior to surgery	Median	range
Large craniotomy	(10.98 ± 0.25)	10–12
Small craniotomy with drainage	(11.93 ± 0.25)	11–12
On the 5 th day of observation in patients not subjected to surgery	median	range
	(11.96 ± 0.3)	11–13

GCS: Glasgow coma scale.

CT characteristics

All patients had aSDH after primary CT examination. All patients (100%) had an average of 5.96-mm midline shift according to CT and an average of 7.06 mm blood clot thickness. Based on the images right before surgery, the average midline shift was 6.06 mm and the average clot thickness was 7.17 mm in patients with large craniotomy; the average midline shift was 5.93 mm and the average clot thickness was 6.48 mm prior to small craniotomy with external drainage. At discharge (14 day), the CT of the patients with unassisted resorption of hematoma showed an average 5.04-mm midline shift and an average of 5.85-mm clot thickness (Table 4). Figure 2 shows the CT images of the patients during follow-up.

Table 4: CT characteristics of aSDH patients

Right aSDH	n	%
	159	73.9
Left aSDH	n	%
	56	26.1
At admission	median	range
Midline shift (mm)	(5.96 ± 0.67)	5–7
Thickness (mm)	(7.06 ± 0.62)	6–9
Prior to osteoplastic craniotomy	median	range
Midline shift (mm)	(6.06 ± 0.66)	5–7
Thickness (mm)	(7.17 ± 0.75)	6–8
Prior to external drainage of hematoma	median	range
Midline shift (mm)	(5.93 ± 0.84)	5–7
Thickness (mm)	(6.48 ± 0.56)	6–9
At discharge, the CT of patients with unassisted resorption of hematoma	median	range
Midline shift (mm)	(5.04 ± 0.21)	5–6
Thickness (mm)	(5.85 ± 0.53)	5–7

aSDH: Acute subdural hematoma, CT: Computed tomography.

Glasgow outcome score analysis

The GOS was examined in all patients at discharge and at 3- and 6-month follow-up.

The discharge GOS scores were as follows: GOS 5 for 99 (46%), GOS 4 for 84 (39%) patients, GOS 3 for 32 (15%) patients, GOS 2 for 0 patient (0%) and GOS 1 for 0 patient (0%). The 3-month follow-up GOS scores were as follows: GOS 5 for 103 patients (48%), GOS 4 for 99 patients (46%), GOS 3 for 13 patients

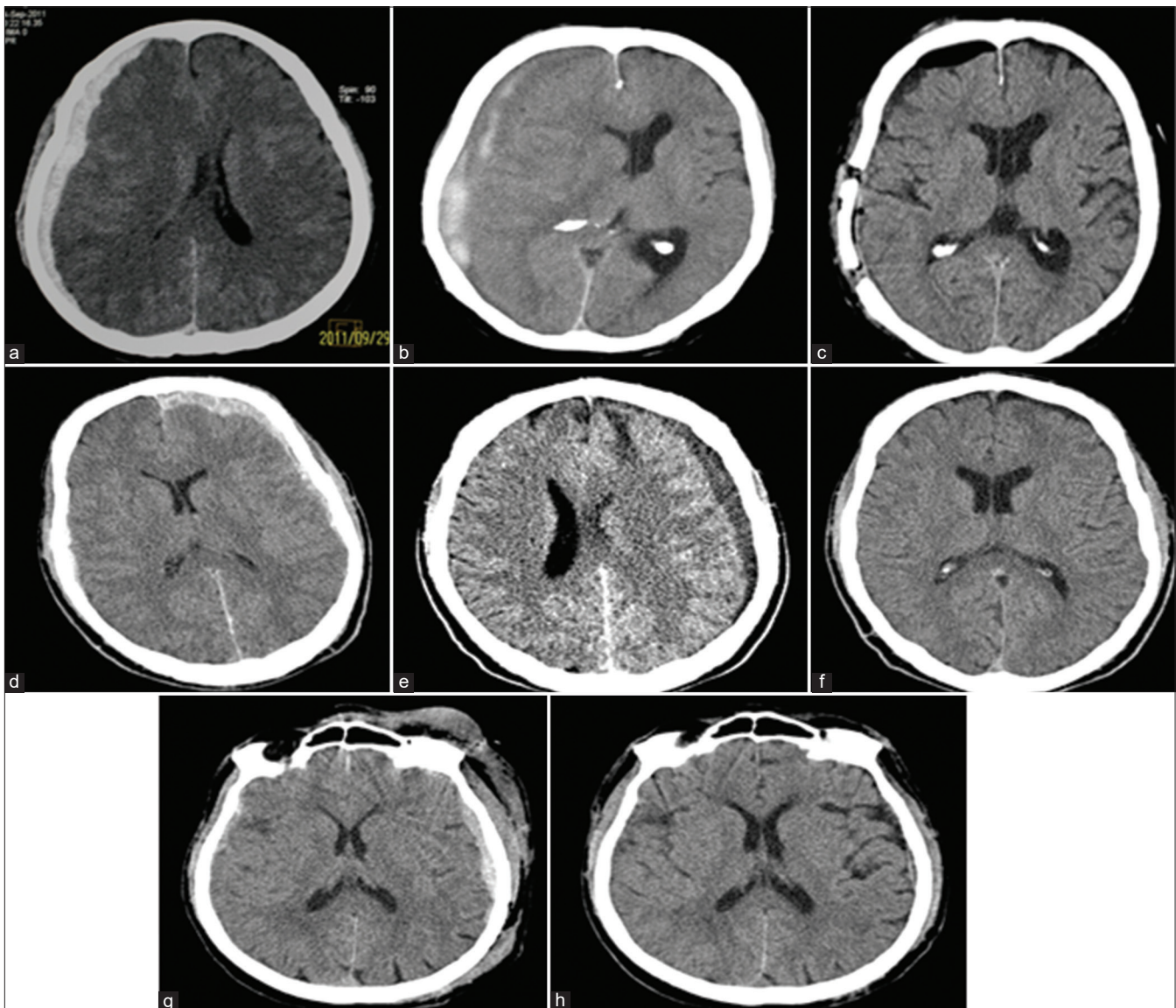


Figure 2: Computed tomography images of patients during follow-up. (a) Computed tomography (CT) prior to surgery; (b) CT on the 3rd day; (c) CT after osteoplastic craniotomy; (d) CT prior to surgery; (e) CT on the 10th day of observation; (f) CT on the 7th day after closed external drainage of aSDH; (g) CT at admission; and (h) CT after unassisted resorption of hematoma on the 10th day

(6%), GOS 2 for 0 patients (0%) and GOS 1 for 0 patients (0%).

The 6-month follow-up GOS scores were as follows: GOS 4–5 for 120 patients (98.2%), GOS 3 for 4 patients (1.8%), GOS 2 for 0 patient (0%) and GOS 1 for 0 patient (0%) (Figure 3, Tables 5-7).

Table 5: Discharge outcome

Score	GOS 3		GOS 4–5		p-value
	n	%	n	%	
Gender					
Male	19	8.8	111	51.6	0.035
Female	13	6	72	33.5	
Age	median	range	median	range	
	(40.9 ± 12.9)	23–72	(41.4 ± 12.9)	19–86	0.132
Surgery	n	%	n	%	
Large craniotomy (on the 2 nd –3 rd day)	18	8.4	105	48.9	<0.001
Small craniotomy with drainage (on the 10 th –11 th day)	9	4.2	20	9.3	
Spontaneous resorption of hematoma (on the 9 th –11 th day)	5	2.3	58	27	
Duration of hospitalisation	median	range	median	range	
	(14.15 ± 0.72)	12–15	(14.03 ± 0.8)	12–15	0.001

GOS: Glasgow Outcome Scale.

Discussion

According to CT data, aSDH with a hemorrhage thicker than 10 mm and/or with a midline shift of 5 mm or more is considered to be an urgent surgical condition in accordance to standard recommendations; large

Table 6: 3-month outcome

Score	GOS 3		GOS 4-5		p-value
	n	%	n	%	
Gender					
Male	7	3.3	117	54.4	0.106
Female	6	2.8	85	39.5	
Age	median	range	median	range	
	(39.4 ± 11.8)	24–67	(41.5 ± 13.1)	19–86	0.380
Surgery	n	%	n	%	
Large craniotomy (on the 2 nd –3 rd day)	8	3.7	115	53.5	<0.001
Small craniotomy with drainage (on the 10 th –11 th day)	1	0.5	28	13	
Spontaneous resorption of hematoma (on the 9 th –11 th day)	4	1.9	59	27.5	

GOS: Glasgow Outcome Scale.

craniotomy is required for the removal of subdural hematoma [11]. In any case, the CT data should correlate with clinical evidence in order to make the decision to perform an urgent surgery. In our research, we applied conventional delayed treatment to patients with aSDH and minor or moderate CCI and initial Glasgow scale score of 10–13. Delay in surgical intervention might reduce the grounds for a surgery in case of spontaneous resorption of aSDH. It may also reduce the surgical scope in case of the hematoma becoming chronic, reduce the risk of anaesthesia and reduce the possible complications of a surgery and its duration.

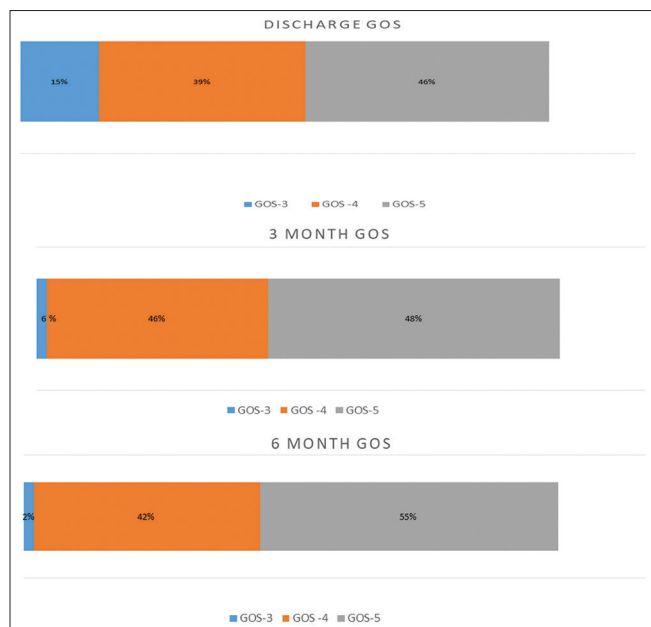


Figure 3: Distribution of GOS at discharge and at 3-month and 6-month follow-up. GOS: Glasgow outcome score

Kim *et al.*'s study showed that the surgery duration in aSDH patients is correlated with an increase in the number of complications [12]. Mathew *et al.* examined 23 aSDH patients (average GCS score of 14; range is 13–15) who were treated conventionally prior to hematoma becoming chronic, with the application of delayed closed drainage of hematoma with good results [13]. Moreover, Choi *et al.* published a series of 18 patients who were subjected to delayed removal

of aSDH, whereas 89% of their patients showed good results at discharge (GOS 4–5) [14].

The conventional treatment of aSDH has become increasingly applicable, especially under the conditions of a minor CCI. A number of studies have described the conventional treatment of patients as a good initial technique with subsequent delayed surgical decompression after the hematoma becomes chronic [12], [13], [14], [15]. There are research data available about the good results of conventional non-invasive treatment of aSDH patients not older than 65 years with GCS score over 8 [16].

Thus, for aSDH patients without strong lateralization signs and with almost normal GCS showing CT data of ≥ 5 -mm midline shift and/or ≥ 10 -mm-thickness, there might be reasons for conventional non-invasive treatment in order to achieve unassisted resorption of hematoma or for a follow-up in an attempt to reduce surgical intervention and accompanying surgical risk related to a more extensive procedure. The abovementioned also depends on the availability of a facility, where a thorough neurological observation can be carried out [17].

Our study included aSDH patients with initial average GCS score of 11.4 (interval of 10–13) and average CT data of 5.96-mm midline shift and 7.06-mm-thick clot. The average age of the patients was 41.4 years. We applied delayed techniques of treatment, over the course of which 63 (29.3%) out of 215 aSDH patients achieved spontaneous resorption of hematoma as a result of delayed treatment. From the result of follow-up, the aSDH of 29 (13.5%) patients transformed into chronic form (cSDH) with delayed small craniotomy (burr hole) on the 10th day after admission, while 123 patients (57.2%) had to undergo large craniotomy due to health state aggravation on the 2nd–3rd day of follow-up.

As far as outcome is concerned, 85% of the patients had a GOS of 4–5 at discharge, 94% had a GOS of 4–5 at 3 months after discharge and 98% had a GOS of 4–5 after 6-months follow-up.

Comparing our results of delayed surgical intervention at discharge, 8.4% of the patients subjected to large craniotomy had a GOS of 3 in comparison with 9% of patients after bur hole craniotomy and 5% of patients after spontaneous resorption of hematoma. The patients who underwent delayed surgery showed a GOS of 4–5 at discharge in 48.9% of cases in comparison with 9.3% of patients after bur hole craniotomy and 27% of patients after spontaneous resorption of hematoma. The average number of days spent at the inpatient care facility was 12–15. The mortality rate at discharge was 0%.

This research has the following limitations. The study is retrospective, so there is no monitoring group involved. Our study also included patients with minor and moderate brain injury, which possibly led to a high percentage of spontaneous resorption of subdural hematoma.

Table 7: 6-month outcome

Score	GOS 3		GOS 4–5		p-value
	n	%	n	%	
Gender					
Male	1	0.5	123	57.1	0.037
Female	3	1.4	88	41	
Age	median range (49.2 ± 34–67 14.1)		median range (41.1 ± 19–86 12.9)		0.286
Surgery	n	%	n	%	
Large craniotomy (on the 2 nd –3 rd day)	2	0.9	121	56.3	<0.001
Small craniotomy with drainage (on the 10 th –11 th day)	0	0	29	13.5	
Spontaneous resorption of hematoma (on the 9 th –11 th day)	2	0.9	61	28.4	

GOS: Glasgow Outcome Scale.

Thus, the application of delayed and minimally invasive treatment leads to a more favorable outcome, especially in the category of patients with minor CCI and aSDH. This might facilitate a quicker recovery and reduction of disability risk. Modern methods of treatment, risk factors, and results of conventional treatment of aSDH might constitute a valuable body of knowledge in the application of conventional strategies of aSDH patient treatment.

Conclusion

This study has shown that conventional delayed treatment yields good results in patients with aSDH and minor or moderate CCI. These strategies might lead to chronicity of subdural hematoma and delayed small craniotomy, as well as spontaneous aSDH resorption, in the given category of patients. The outcomes at 3 and 6 months after hospitalization also showed good results.

Acknowledgment

The authors thank all of the staff members of the National Scientific Centre of Neurosurgery of Kazakhstan for their assistance while this study was being conducted.

Consent for Publication

The results of the analysis were solely based on the previously published literature, as this study did not involve patients or public.

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