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Prognosis of acute subdural hematoma greater than 10 mm in thickness in head injury patients with an extension or no motor response to pain after resuscitation

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Abstract

Background: Most of the studies that examined the prognosis of acute subdural hematoma (ASDH) in severe head injury patients stated their overall prognosis as one group. The aim of the present study was to assess the prognosis of ASDH of > 10 mm in thickness in head injury patients with an extension or no motor response to pain after resuscitation.

Material and methods: This retrospective study reviewed the severe head injury patients admitted to our university hospitals from January 2014 to August 2017. The inclusion criteria were the patients with an extension or no motor response to pain after resuscitation with an ASDH > 10 mm in thickness and a midline shift > 5 mm in the initial head computed tomography (CT) scan. Two hundred six patients met the inclusion criteria of this study. Their mean age was 42.3 years. One hundred forty-two patients (68.9%) were males.

Results: The mean duration between trauma and admission was 41 min. Sixty-two patients (30%), including 38 anonymous patients, were surgically managed and the remainder were managed conservatively. All patients (100%) died in the intensive care unit within 1 month after trauma.

Conclusion: This study emphasized that both surgical and conservative management of ASDH had similar dismal results and that there was no additional benefit from surgical intervention in the studied group of head injury patients. Randomized controlled trials are needed to set a standard of care for the management of ASDH in this subgroup of the severe head injury patients.

Keywords: Acute subdural hematoma, Glasgow Coma Scale, Prognosis, Severe head injury

Introduction

Generally, traumatic acute subdural hematoma (ASDH) results in high mortality despite intensive treatment [1, 2]. It is commonly associated with brain edema, subarachnoid hemorrhage, brain contusions, and diffuse axonal injury, and all affect the neurological outcome [3, 4].

According to the current guidelines, an ASDH with a thickness greater than 10 mm or a midline shift greater than 5 mm on computed tomographic (CT) scan should be surgically evacuated, regardless of the patient's Glasgow Coma Scale (GCS) score. Also, a comatose patient

(GCS score less than 9) with an ASDH less than 10 mm in thickness and a midline shift less than 5 mm should undergo surgical evacuation of the hematoma if the GCS score decreased between the time of injury and emergency room (ER) admission by 2 or more points and/or the patient presents with asymmetric or fixed and dilated pupils and/or the intracranial pressure (ICP) exceeds 20 mmHg [5].

Most of the studies that examined the prognosis of ASDH in severe head injury patients ($GCS \leq 8$) did not perform subgrouping analysis and stated their overall prognosis as one group. This generalization resulted in a misunderstanding of their prognosis among many neurosurgeons.

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The aim of the present study was to assess the prognosis of ASDH of >10 mm in thickness in severe head injury patients with no motor response or an extension to pain motor response after resuscitation. This subgroup of the severe head injury patients with an ASDH was barely assessed per se in spite of being a common ER situation.

Materials and methods

This study retrospectively reviewed the clinical records of the severe head injury patients who were admitted to our university hospitals from January 2014 to August 2017. Nine hundred thirty-one severe head patients were admitted in this time period.

The inclusion criteria were the severe head injury patients who had no motor response or an extension to pain motor response after resuscitation and a radiologically surgical ASDH in the initial head CT scan. Criteria for defining a radiologically surgical ASDH were a hematoma thickness of >10 mm and a midline shift of >5 mm.

Two hundred six consecutive head injury patients met the inclusion criteria of this study. Their mean age was 42.3 years, ranging from 17 to 73 years. One hundred forty-two patients (68.9%) were males.

The clinical data were collected from the medical charts and included patients' demographics, mode of trauma, the motor response and the pupillary reaction after resuscitation, laboratory findings, radiological findings, the time between trauma and admission, preoperative, operative, and postoperative details of the surgically managed patients, hospital stay, and in-hospital mortality.

All patients were admitted to the intensive care unit (ICU) and initially managed according to the Advanced Trauma Life Support guidelines. They were intubated and ventilated to avoid hypoxia and to achieve normocapnia. Central venous line and Foley catheter were inserted for fluid balance.

After vital stabilization, all patients underwent head and cervical spine CT scan. CT thoracic spine and lumbar spine were ordered for polytrauma patients.

All the patients received a prophylactic antiepileptic (phenytoin) and a proton pump inhibitor upon admission. Intramuscular tetanus toxoid 0.5 ml and intravenous antibiotics were administered to patients with open wounds.

General care to minimize intracranial hypertension was applied and included elevation of the head of the bed 30°, keeping the head in a neutral position, controlling fever with antipyretics and cooling blankets, avoiding hypoxia and hypercapnia, controlling blood glucose to a range between 80 and 180 mg/dL, optimizing the blood pressure, and correcting serum electrolytes. Packed RBCs were administered to maintain hemoglobin concentration at a minimum of 10 g/dL.

The neurological status was classified according to the GCS score. Intracranial pressure monitoring was not

performed in any patient due to unavailability. ASDH was managed either conservatively or surgically, based on the decision of the treating consultant of neurosurgery and after a written informed consent from the patients' relatives or the manager of our hospital for the anonymous patients. Consultants who chose the conservative treatment were expecting unfavorable outcomes.

Platelet count, prothrombin time, activated partial thromboplastin time, fibrinogen, fibrin degradation products, and D-dimer were obtained daily to detect any coagulopathy.

Patients were kept euvolemic with isotonic fluid resuscitation as required. Intravenous (IV) mannitol 20% was administered in an initial bolus of 1 g/kg then 0.5 g/kg q 4 h, provided that there was no hypotension. IV furosemide 1 mg/kg/day was administered 15 min after each dose of mannitol. Serum electrolytes and renal function were ordered every 12 h. Serial serum osmolality levels were checked every 12 h to maintain an osmolality of no more than 320 mOsm/L.

For the surgically managed patients, a wide trauma scalp flap and a wide fronto-temporo-parietal craniotomy were employed. The dura was linearly incised to decrease the intracranial pressure then a dural flap was produced to evacuate the subdural blood clot. Meticulous hemostasis was achieved followed by wide duroplasty using a large pericranial patch. The bone flap was reinserted except in cases with severe intraoperative brain swelling which did not respond to mannitol and hyperventilation; in these cases, the bone flap was placed in a subcutaneous pocket in the scalp or in the abdomen. A follow-up head CT scan was done on the first postoperative day. Drains were removed on the second or third postoperative day when the draining fluid decreased to less than 50 ml in 12 h. Sutures were removed 2 weeks after surgery.

The outcome was assessed and recorded using the Extended Glasgow Outcome Scale (GOSE) 1 month after trauma. The functional outcome was classified as "good" if the GOSE scores were ≥ 5 and as "poor" if GOSE scores were ≤ 4 [6].

Statistical analysis

The collected data were expressed as mean and range using SOFA statistics version 1.3.3 software.

Results

The mean duration between trauma and admission to the ER was 41 min, ranging from 33 to 122 min.

Traffic accidents were the mode of trauma in 192 patients (93.2%), and the remainder 14 patients (6.7%) were due to fall from height.

The GCS motor score (motor response) and the pupillary status after resuscitation are listed in Table 1.

Table 1 The Glasgow Coma Scale (GCS) motor score and the pupillary status after resuscitation

	Number of patients (%)
GCS motor score	
1 (flaccid or no motor response)	43 (20.8%)
2 (extension to pain)	163 (79.1%)
Pupillary status	
Bilateral dilated fixed pupils	31 (15%)
Unilateral dilated fixed pupil	175 (84.95%)

Twenty-seven patients suffered from hypertension, thirteen from diabetes mellitus, and three patients experienced old myocardial infarction.

The findings in the initial head CT scan are illustrated in Table 2.

The mean thickness of the subdural clot in the initial head CT scan was 16.4 mm (ranging from 12 to 25 mm). The midline shift ranged between 6 and 14 mm with a mean shift of 9.8 mm. The radiologically surgical ASDH was unilateral in all cases.

The associated body injuries are listed in Table 3.

The type of management according to the GCS motor score and the pupillary response is shown in Table 4.

Thirty-eight anonymous patients were transferred to our ER without relatives or any identity and remained anonymous for more than 8 h after admission. The treating neurosurgeons of these patients prepared them for emergency surgery to evacuate the ASDH as a potentially life-saving procedure to avoid any medicolegal responsibility and received a legal written permission from the manager of our hospital.

Sixty-two patients (30%), including the 38 anonymous patients, underwent surgical evacuation of the ASDH, and the remainder were managed conservatively. The mean age of the surgically managed patients was 32.6 years, ranging from 17 to 59 years, and the mean age of the conservatively managed patients was 47.5 years, ranging between 25 and 73 years.

The mean duration between trauma and surgery was about 5 h, ranging from 3.5 to 7 h. The bone flap was reinserted except in the thirteen cases who sustained a severe intraoperative brain swelling; hence, the bone flap was

Table 2 The findings in the initial head CT scan

Head CT scan findings	Number of patients (%)
ASDH	206 (100%)
Brain contusions	98 (47.5%)
Subarachnoid hemorrhage	187 (90.7%)
Compressed ipsilateral ventricle	206 (100%)
Midline shift > 5 mm	206 (100%)
Intraventricular blood	54 (26.2%)

Table 3 Associated body injuries

Associated injuries	Number of patients (%)
Facial fractures	133 (64.5%)
Spine injury	11 (5.3%)
Long bone fractures	49 (23.7%)
Rib fractures	78 (37.8%)
Hemothorax/pneumothorax	62 (30%)
Internal organ injury (spleen or liver)	13 (6.3%)

placed in a subcutaneous pocket in the scalp (9 cases) or in the abdomen (4 cases).

The head CT scan performed on the first postoperative day revealed adequate evacuation of the subdural hematoma in all the 62 surgically managed patients.

All the included patients did not improve in GCS motor score and suffered from a gradual decline in their hemodynamic state till death.

The hospital stay of the surgically managed patients ranged from 3 to 25 days and ranged between 2 and 11 days for the conservatively managed patients. The mean hospital stay of all the included patients was 13 days, for the surgically managed patients was 20 days, and for the conservatively managed patients was 6 days.

The Extended Glasgow Outcome Scale for all the patient in the present study was poor, since all died within 1 month after trauma.

Discussion

This study offered insight into the prognosis of ASDH of > 10 mm in thickness specifically in a subgroup of the severe head injury patients who had no motor response or an extension to pain motor response after resuscitation. Thirty percent of the included patients underwent surgical evacuation of the ASDH and the remainder were managed conservatively. All the patients did not improve clinically and died within 1 month after trauma in the ICU.

According to the current guidelines, any ASDH with a thickness greater than 10 mm or a midline shift greater than 5 mm should be surgically evacuated, regardless of the patient's GCS score [5]. This guideline led many neurosurgeons to be radiologically minded and fear from a medicolegal responsibility if they decided not to operate on a radiologically surgical ASDH in a patient with

Table 4 The type of management according to the GCS motor score and the pupillary response

Management	GCS motor score		Total	Dilated fixed pupil		Total
	1	2		Bilateral	Unilateral	
Surgery	8	54	62	6	56	62
Conservative	35	109	144	25	119	144
Total	43	163	206	31	175	206

no motor response or an extension to pain motor response after resuscitation. This medicolegal issue was the rationale of the inclusion criteria.

The motor response was taken in this study as a simplified level of consciousness as all the included patients were intubated after resuscitation and most of them had facial fractures with severe periorbital edema.

Traffic accidents formed 93.2% of the mode of trauma in the included head injury patients in the current study; hence, accident prevention would be the chief method of preventing such tragedy.

Many studies stated that the outcome of severe head injury patients with ASDH was mostly poor but with a percentage of a good outcome [3, 4, 7–9]. These studies stated the overall outcome of all the severe head injury patients without subgrouping analysis. Leitgeb et al. reported a 6-month mortality rate of 46.7% in the severe head injury patients with ASDH [7]. Few studies had discussed the prognosis of ASDH in head injury patients with GCS score of 5 or less *on admission*, but they did not comment if these scores had improved after resuscitation or not [1, 2].

There is a worldwide consensus of the dismal prognosis of trauma patients with a post-resuscitation GCS score of 3 and bilateral dilated fixed pupils [10–12]; however, the present study found that surgical intervention was offered to six flaccid patients with bilateral dilated fixed pupils, four of which were anonymous patients and the treating neurosurgeons surgically managed them for fear of the medicolegal responsibility, and surgery was offered to the other two patients as a lifesaving procedure so the relatives agreed to surgery.

The lack of a clear prognosis of ASDH in the subgroups of severe head injury patients and the absence of a bright standard of care including not-to-operate form lead to many unnecessary surgeries for fear of the medicolegal responsibility and misinforming the families about the patients' prognosis leaving them falsely expecting a good outcome and putting a great financial burden on the poor families who are not medically insured in the developing countries.

It is a human right to let the patients and/or their families know what they are really facing and what they will suffer from, and it is important to perform surgery only on patients most likely to benefit.

The present study emphasized the poor outcome of head injury patients with a post-resuscitation no motor response (flaccid) or an extension to pain motor response after either surgical or conservative management of ASDH of > 10 mm in thickness.

The limitations of this study were the retrospective nature, the single center results, the absence of randomization, and the small number of the surgically managed patients. Also, the use of the motor response as a simplified method

of conscious level assessment may lead to some inaccuracy as some of these patients might have some degree of eye-opening thus making their GCS score higher which may encourage more surgical intervention.

Although the results of the present study are to a large extent expected, it is hoped that this study becomes a stimulus to start randomized controlled trials in different centers on the subgroups of severe head injury patients to set a standard of care including not-to-operate standards in order not to leave the decision to each surgeon's belief and experience.

Conclusion

This study emphasized that both surgical and conservative management of ASDH had similar dismal results and that there was no additional benefit from surgical intervention in the studied group of head injury patients. Randomized controlled trials are needed to set a standard of care for the management of ASDH in this subgroup of the severe head injury patients.

Abbreviations

ASDH: Acute subdural hematoma; CT: Computed tomography; ER: Emergency room; GCS: Glasgow Coma Scale; GOSE: Extended Glasgow Outcome Scale; ICP: Intracranial pressure; ICU: Intensive care unit; IV: Intravenous

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Availability of data and materials

All relevant data taken during study present in this manuscript.

Author's contribution

The only author (MA) performed the study design, data acquisition, analysis, and interpretation. The author read and approved the final manuscript.

Ethics approval and consent to participate

A retrospective approval from the Research Ethics Committee at the faculty of medicine, Ain Shams University (Federal Wide Assurance No. FWA 000017585) was obtained. Date of approval: 23/12/2018 (reference number: FMASU R 74/ 2018). All participants or their legal guardians provided informed written consent to participate in the study.

Consent for publication

Not Applicable (as this manuscript does not contain any individual person's data)

Competing interests

The author declares that he has no competing interests.

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