Medical Journal of the
Islamic Republic of Iran

Volume 12
Number 4
Winter 1377
February 1999

TRAUMATIC ACUTE SUBDURAL HEMATOMA: ANALYSIS OF FACTORS AFFECTING OUTCOME IN COMATOSE PATIENTS

SHIRZAD AZHARI, M.D., HOSEIN SAFDARI, M.D., MASSOUD SHABEHPOOR, M.D., HOSEIN NAYEBAGHAIE, M.D., AND ZOHREH AMIRI, B.S.

From the Department of Neurosurgery, Imam Hosein Medical Center, Shaheed Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran.

ABSTRACT

To determine the factors affecting the outcome of patients with traumatic acute subdural hematoma, we reviewed the records of 74 consecutive comatose patients with a Glascow coma scale score (GCS) of less than 8 who had been admitted to Imam Hosein Medical Center from 1990 to 1996 and had undergone a uniform treatment protocol.

The overall mortality rate was 73% and 23% had functional recovery, but 4% were severely disabled or vegetative. The following variables had a statistically significant correlation with poor outcome: age over 65 years ($p<0.05$), preoperative GCS of 3 or 4 ($p<0.05$), bilateral absent pupillary light reflexes ($p<0.05$), and immediate and sustained coma from the moment of injury to operation without any lucid interval ($p<0.001$). The time interval between injury and operation, sex, mechanism of injury, and associated craniocerebral injuries were not significantly correlated with outcome. In patients with immediate post-traumatic unconsciousness, the extent of primary brain injury is the crucial factor to predict the outcome. However, in patients with a lucid interval, the mass effect of hematoma seems to be more important, therefore prompt surgical decompression in addition to management of secondary brain insults improves the outcome remarkably.

MJIRI, Vol. 12, No. 4, 313-318, 1999

Keywords: Acute subdural hematoma, GCS, lucid interval, outcome.

INTRODUCTION

Despite improved ability in early recognition, aggressive management and close monitoring of patients with acute subdural hematoma, the outcome generally has remained unsatisfactory. Presently, with few exceptions, the mortality rate in comatose patients is reported to be between 30% and 90%.[1-14,24,28] Over one-half of patients with traumatic acute subdural hematoma are unconscious from the time of injury and as much as 75% of them lose consciousness at some time during the initial evaluation.[8-10] The clinical course of patients with acute subdural hematoma is determined by the severity of brain insult at the time of impact, the rapidity of subdural clot formation and the extent of secondary brain injuries.[16-19]

The timing of surgery as the most critical determinant of outcome in acute subdural hematoma has recently been challenged.[9,28] The purpose of the present study is to analyse the influence of different variables on the outcome of 74 consecutive patients with severe head injury and traumatic acute subdural hematoma.

MATERIALS AND METHODS

This retrospective study was based on data from 96 consecutive patients with traumatic acute subdural hematoma who were admitted to the neurosurgery department of Imam Hosein Medical Center from September 1990 to September 1996. This study included only patients with severe head injury who had a preoperative Glascow coma score of less than 8, who were not responsive to verbal commands and were unable to speak intelligible words.[13,26] Patients under 12 years old, patients with subdural hematomas associated with depressed skull fractures, patients with a thin rim of subdural hematoma of 3mm or less and large midline shifts due to hemispheric swelling, patients with unknown trauma-surgery time intervals and brain-dead patients were excluded from this study. Based on the above criteria, 22 patients were excluded and the analysis was carried out on 74 patients.

Treatment protocol

After admission to the emergency room and resuscitation, all patients were evaluated and their Glascow coma scales (GCS) recorded. Patients with inadequate respiration underwent endotracheal intubation. After initial resuscitation, brain CT-scans were performed, and patients with subdural hematomas of more than 5mm thickness with equivalent midline shift underwent craniotomy with removal of clot and necrotic brain tissue (Fig. 1).

All patients received mannitol (1g/kg), loading doses of phenytoin (15mg/kg), dexamethasone, and prophylactic antibiotics.

Surviving patients were followed for at least six months and the Glascow outcome scale[7] was used for outcome evaluation.

Statistical analysis

Comparison of various proportions were performed by the chi-square test (Tables I-IV). A statistically significant difference was indicated by a p-value of less than 0.05. Student's t-test was used to compare time intervals.

RESULTS

Of 96 patients with closed head injury and acute subdural hematoma, 74 patients were in coma preoperatively (GCS<8) and fit the criteria of our study. Of these patients, 47 were unconscious from the time of injury and the remaining 27 cases had a lucid interval with subsequent deterioration to a Glascow come scale score of less than 8 during transport, evaluation, or preparation for surgical intervention.

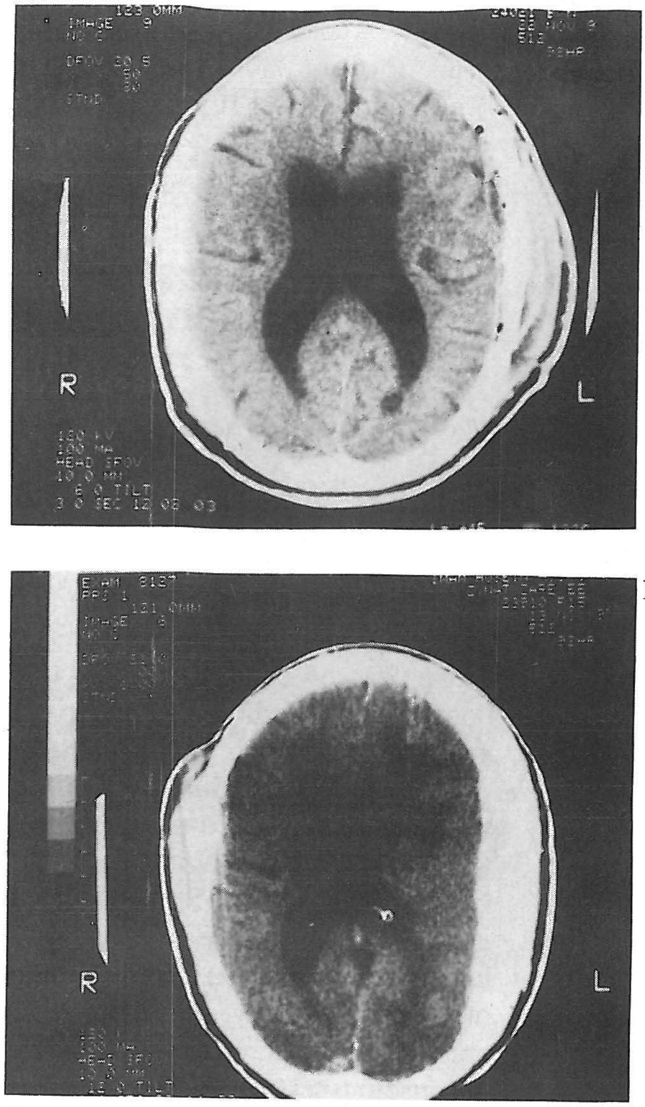

Fig. 1. A. Axial non-enhanced CT scan demonstrating left-sided acute subdural hematoma with equivalent midline shift. The patient was a victim of a car accident and had severe head injury.

B. Postoperative CT scan. The hematoma has been evacuated and there is no mass effect.

The overall mortality rate was 73% and 23% had a functional recovery which was defined as a good recovery or moderate disability on the Glascow outcome scale (GOS). 3 patients (4%) were severely disabled or vegetative.

Age

The mean age for all patients was 45±18 years. Age was not significantly different between survivors (37±15yr) and non-survivors (47±19yr) or between those with lucid

Table I. Comparison of variables affecting outcome of 74 patients with acute subdural hematoma.

Variable	No. of cases	Death	Functional recovery	Statistical significance
Total cases	74	54 (73%)	17 (23%)	
Average age	45	47	37	
Male	61 (82.4%)	44 (72%)	15 (24%)	N.S.
Female	13 (17.6%)	10 (77%)	2 (5%)	N.S.
Age:				
<40	30	19 (61%)	10 (33%)	N.S.
40 - 65	31	22 (71%)	7 (23%)	N.S.
>65	13	13 (100%)		$p<0.05$
Preoperative GCS:				
3 - 4	38	34 (89%)	3 (7%)	$p<0.05$
5 - 7	36	20 (55%)	14 (38%)	N.S.
Time to operation	340 ± 169	323 ± 165	376 ± 164	N.S.
Mechanism of injury:				
Motor vehicle accident	13	77%	23%	N.S.
Fall	16	63%	31%	N.S.
Pedestrian	20	90%	5%	N.S.
Motorcycle accident	23	74%	22%	N.S.
Others	2	0	100%	N.S.
Flaccid & posturing	42	35 (83%)	5 (11%)	N.S.
Bilateral mydriasis	33	30 (90%)	2 (6.7%)	$p<0.05$

intervals (45.8±19yr) and those unconscious from injury to operation (44.7±18yr) (Table III). With increasing age, the mortality rate showed a remarkable increase, which was statistically significant only for patients over 65 years old ($p<0.05$)(Table I).

Sex

82% of the patients were male and 18% were female. There was no significant difference in outcome between males and females. The neurologic presentation, mechanism of injury, timing of operation and associated cerebral injuries did not differ significantly between the two sexes (Tables I-III).

Mechanism of injury

75% of the patients had vehicle-related accidents (motor vehicle, motorcycle and pedestrian). Although a large number of victims were pedestrians (27%) and the worst outcome was seen in this group, we could not find any significant difference in outcome between the various mechanisms of injury. The average age of pedestrians injured in traffic accidents was 51.4 years, victims of falls

Table II. Influence of preoperative GCS on outcome of 74 patients with acute subdural hematoma.

GCS*	No. of cases	Mortality	Functional recovery	Severe disability & vegetative state
3-4	38	34 (89%)	3 (8%)	1 (3%)
5	14	9 (64%)	3 (21%)	2 (15%)
6	13	7 (53%)	6 (46%)	
7	9	4 (44%)	5 (56%)	

$p<0.005$ $\chi^2 = 13.56$
* GCS = Glascow coma scale score

27.6 years, victims of motor vehicle accidents 43.6 years and those injured in motorcycle accidents 37 years. The frequency of various types of injury was not significantly different between patients unconscious from injury and those with a lucid interval.

Preoperative neurologic examination

All 74 patients had preoperative GCS scores of less than 8. The average GCS score was 5.5 among survivors and 4.3 among those who died. The average score for all patients was 4.7.

As shown in Table III, the preoperative GCS significantly influenced the outcome of patients ($p<0.005$).

Bilaterally absent pupillary light reflexes were demonstrated in 44% of patients and was associated with a 90% mortality rate and 6.7% functional recovery ($p<0.05$). Decerebrate posturing or flaccidity was present in 56% of our patients, with a mortality rate of 83% and functional recovery of 11%. This motor response was not statistically significant. Presence of a lucid interval significantly influenced outcome ($p<0.001$). Patients who were unconscious since injury had a mortality rate of 87.2%, while those with lucid intervals had a mortality rate of 48% (Table III).

There was also a significant difference in preoperative neurologic dysfunction between these two groups.

Associated intracranial mass lesions

40 patients (54%) had an associated brain contusion, intracerebral hematoma or extradural hematoma which was also appropriately managed at the time of initial operation. 34 patients (46%) had only acute subdural hematomas. The mortality rate was 77% in patients having associated brain contusion or intracerebral hematoma and 71% in those with simple subdural hematoma. Skull fractures were found in 48% of patients by plain X-ray films, CT scans or at operation.

The presence or absence of an intracerebral hematoma, brain contusion or skull fracture did not significantly alter the outcome. Bilateral hematomas were found in 3 patients, all of whom died.

Table III. Influence of the preoperative clinical course on outcome of 74 patients with acute subdural hematoma.

Variable	Unconscious from injury	With lucid interval
No. of patients	47	27
Mortality	41 (87.2%)	13 (48%)
Functional recovery	4 (8.5%)	13 (48%)
Severe disability & vegetative state	2 (4.3%)	1 (3.7%)

$p<0.001$

Acute subdural hematoma of the posterior fossa was seen in 3 patients, two of whom died and the surviving one was not included in this study because of age (6 years old).

Time interval from injury to operation

The time interval from injury to surgical decompression was determined in all patients. The mean delay between injury and surgical intervention was 340±169 minutes. The mean time from injury to operation was 323±165 minutes for patients who died and 376±164 minutes for survivors with functional recovery. Outcome was not significantly improved by rapid surgical decompression. In addition, further division of the whole group into 4 hourly subsets failed to show any statistically significant difference in outcome (Table IV).

DISCUSSION

Acute subdural hematoma following head injury still remains a difficult challenge for neurosurgeons because of high mortality and limited functional recovery. Mortality from acute subdural hematoma is higher than other post-traumatic intracranial lesions, ranging from 30% to 90% in most large series.[1-14,16,28]

Severe head injury refers to patients who typically fulfill the criteria for coma and have post-resuscitation

Table IV. Relationship between time from injury to operation (in hours) and outcome of 74 patients with acute subdural hematoma.

Time interval	Mortality	Functional recovery	Severe disability or vegetative state	Total
<4 h	25	5	-	30
4 - 8h	22	8	1	31
>8h	7	4	2	13
Total	54	17	3	74

$\chi^2 = 5.92$
df = 4
Not significant.

GCS scores of 3 to 8 or a subsequent deterioration to 8 or less.[9,13] Approximately one-third to one-half of these patients have mass lesions requiring intensive medical and surgical therapy.[9,13,2]

Our mortality rate in 74 patients with acute subdural hematoma was 73%, good to moderate recoveries were seen in 23% and severe disability or a vegetative state in 4%. These data compare favorably with the results of other reports.[10-]

Preoperative neurologic status is the most important factor in determining outcome. McLaurin and Tutor[15] reported a mortality of 6% in patients with acute subdural hematoma who were conscious before operation and a mortality of 77% in those who were comatose. Genarelli et al.[3] reported the highest mortality (76%) in patients with acute subdural hematoma and a GCS of 3 to 5.

Wilberger et al.[28] found a mortality rate of 57% in those with a lucid interval, while 78% of those unconscious from injury died. Our patients who were unconscious since injury had an 87% mortality rate and 8.5% functional recovery, while those with a lucid interval who showed neurologic deterioration prior to admission, or during evaluation and preparation for surgery had 51.9% mortality and 44.4% functional recovery rates, this difference being significant ($p<0.001$) (Table III). In many reports younger patients with acute subdural hematoma were shown to have a better outcome.[1,]

In 1989, Howard et al.[6] reported that in their patients aged 18 to 40 years, mortality was 18% as comapred to 74% in those aged over 65 years. Seelig et al.[21] and Stone et al.[24] found no relationship between age and outome.

In our series, there was an association between increasing age and increased mortality rate but this was significant only for patients over 65 years old ($p<0.05$, Table I).

Older patients are predisposed to subdural hematoma regardless of injury mechanism.[4,9]
change in viscoelastic properties of the brain, alterations in the mechanical properties of bridging veins, and stress placed on venous structures secondary to cerebral atrophy may all contribute.[16,24] In
the ability of the brain to recover following pathological insult, regardless of etiology.[11,27,28] In most series men outnumber women two- to four-fold. Although Seelig et al.[21] showed a more favorable outcome in women, other reports have not found any significant influence of gender on outcome.[24,] 1-26
significant difference in outcome was found between the sexes. The most common mechanisms of injury are falls, motor vehicle accidents and assaults.[4,] Wilberger et al.[28] and Seelig et al.[21] reported vehicular accidents as the most common mechanism of injury, while motorcycle accidents had the worst outcome. 19,24.

In our series, 76% of patients had vehicle-related accidents. The number of pedestrians as victims of traffic accidents was remarkable (27%) and this group showed the worst outcome, with 80% mortality. As expected, the mechanism of injury played some role in determining outcome. Pedestrians fared particularly poorly; a product of not only their age but also a greater frequency of secondary injuries, particularly shock and hypoxia as a consequence of multiple injuries. Pupillary abnormalities have been found to correlate with a poorer outcome. In patients with bilateral pupillary abnormalities, mortality has been reported to be over 80% in most series.[8-16] The mortality rate in our patients with bilateral mydriasis was 90%, which was statistically significant ($p<0.05$). Richards and Hoff[18] reported a mortality of 75% in patients with pupillary abnormalities versus 35% in those with equal and reactive pupils. The presence of decerebrate posturing before operation has a devastating effect on outcome.[9,13-19] 6,
Stone et al.[24] reported a mortality of 77% in decerebrate patients which increased to 95% when associated with bilaterally nonreactive pupils. Wilberger et al.[28] reported a mortality of 78% in patients who were flaccid or decerebrate on admission. Decerebrate posturing or flaccidity was present in 56% of our patients, with a mortality rate of 83% and functional recovery of 11% which was not statistically significant. Seelig et al.[21] noted that the presence or absence of a co-existing contusion did not significantly effect outcome. But others have shown that these patients have prolonged elevation of intracranial pressure and increased mortality rates.[5,9,28,29] Patients with acute subdural hematoma

are more likely to develop the complications of cerebral ischemia including infarction, lactic acidosis, propagating cerebral edema, and increased intracranial pressure.[20,25]

Although we could not find any significant benefit from early surgical intervention in patients with acute subdural hematoma, we still believe and emphasize that rapid surgical decompression plays an integral role in the management of these patients. Early intubation, hyperventilation, prevention and treatment of shock, and surgical decompression and management of increased intracranial pressure are basic requisites for meaningful recovery in patients with severe head injury and acute subdural hematoma.

REFERENCES

1. Aoki N. Masuzawa H: Infantile acute subdural hematoma. Clinical analysis of 26 cases. J Neurosurg 61: 273-280, 1984.
2. Becker DP, Miller JD, Ward JD, et al: Outcome from severe head injury with early diagnosis and intensive management. J Neurosurg 47: 491-502, 1977.
3. Gennarelli TA, Spielman GM, Langfitt TW, et al: Influence of the type of intracranial lesion on outcome from severe head injury. A multicenter study using a new classification system. J Neurosurg 56: 26-32, 1982.
4. Gennarelli TA, Thibault LE: Biomechanics of acute subdural hematoma. J Trauma 22: 680-686, 1982.
5. Haselsberger K, Pucher R, Auer LM: Prognosis after acute subdural or epidural hemorrhage. Acta Neurochir 90: 111-116, 1988.
6. Howard MA, Gross AS, Dacey RG, et al: Acute subdural hematomas: an age-dependent clinical entity. J Neurosurg 71: 858-863, 1989.
7. Jennett B, Bond M: Assessment of outcome after severe brain damage: a practical scale. Lancet 1: 480-484, 1975.
8. Jamieson KG, Yelland JDN: Surgically treated traumatic subdural hematomas. J Neurosurg 37: 137-149, 1972.
9. Kelly DF, Nikas DL, Becker DP: Diagnosis and treatment of moderate and severe head injuries in adults. In: Youmans JR, (ed), Neurological Surgery. Philadelphia: W.B. Saunders, pp. 1645-1650, 1996.
10. Klun B, Fettich M: Factors influencing the outcome in acute subdural hematoma. A review of 330 cases. Acta Neurochir 71: 171-178, 1984.
11. Kotwica Z, Jakubowski JK: Acute head injuries in the elderly: an analysis of 136 consecutive patients. Acta Neurochir 118: 98-102, 1992.
12. Kotwica Z, Brzezinski J: Acute subdural hematoma in adults: an analysis of outcome in comatose patients. Acta Neurochir (Wien) 121: 95-99, 1995.
13. Marshall LF, Gautille T, Klauber MR, et al: The outcome of severe closed head injury. J Neurosurg 75 (suppl): S28-S36, 1991.
14. McKissock W, Richardson A, Bloom WH: Subdural hematoma. A review of 389 cases. Lancet 1: 1365-1369, 1960.
15. McLaurin RL, Tutor FT: Acute subdural hematoma. Review of ninety cases. J Neurosurg 18: 61-67, 1961.
16. Obana WG, Pitt LH: Extracerebral lesions. Neurosurg Clin North Am 2 (2): 358-369, 1991.
17. Phuenpathom N, Choomuang M, Ratanalart S: Outcome and outcome prediction in acute subdural hematoma. Surg Neurol 40: 22, 1993.
18. Richards T, Hoff J: Factors affecting survival from acute subdural hematoma. Surgery 75: 253-258, 1974.
19. Sahuquillo-Barris J, Lamarca-Ciuro J, Vilalta-Castan J, et al: Acute subdural hematoma and diffuse axonal injury after severe head trauma. J Neurosurg 68: 894-900, 1988.
20. Salvant J, Muizalar JP: Changes in cerebral blood flow and metabolism related to the presence of subdural hematoma. Neurosurgery 33: 387, 1993.
21. Seelig JM, Becker DP, Miller JD, et al: Traumatic acute subdural hematoma. Major morbidity reduction in comatose patients treated within four hours. N Engl J Med 304: 1511-1518, 1981.
22. Stein SC, Spettell C, Young G, et al: Delayed and progressive brain injury in closed head trauma: radiological demonstration. Neurosurgery 32: 25-31, 1993.
23. Stone JL, Lowe RJ, Jonasson O, et al: Acute subdural hematoma: direct admission to a trauma center yields improved results. J Trauma 26: 445-450, 1986.
24. Stone JL, Rifai MHS, Sugar O, et al: Subdural hematomas. 1. Acute subdural hematoma: progress in definition, clinical pathology, and therapy. Surg Neurol 19: 216-231, 1983.
25. Siesjo BK: Pathophysiology and treatment of focal cerebral ischemia: II. Mechanisms of damage and treatment. J Neurosurg 77: 337, 1992.
26. Teasdale G, Jennett B: Assessment of coma and impaired consciousness. A practical scale. Lancet 2: 81-84, 1974.
27. Vollmer DG, Torner JC, Eisenberg HM, et al: Age and outcome following traumatic coma: why do older patients fare worse? J Neurosurg 75 (Suppl): S37-S48, 1991.
28. Wilberger JE, Harris M, Diamond DL: Acute subdural hematoma: morbidity, mortality, and operative timing. J Neurosurg 74: 212-218, 1991.
29. Zumkeller M, Behrmann R, Heissler HE, et al: Computed tomographic criteria and survival rate for patients with acute subdural hematoma. Neurosurgery 39: 708-713, 1996.