BRAIN SWELLING FACTOR : A FAVORABLE PROGNOSTIC FACTOR OF COMPUTED TOMOGRAPHIC APPEARANCE OF POST-TRAUMATIC ACUTE SUBDURAL HEMATOMA

Khomdao BOONCHIT [1], Chatchawuan THANAPURA[2]

ABSTRACT

Computed tomography (CT scan) used in diagnosis and management of 102 cases of post-traumatic acute subdural hematoma during January 1996 to December 1997 were analyzed. By measurement and calculating, the Brain Swelling Factor or difference between the midline shift and the hematoma thickness seems to be important prognostic factor. The midline structures are displaced not only by the space occupying subdural hematoma but also by the edematous processes on the injured side. When the midline shift exceeded the hematoma thickness, the survival rate was 31% (16/51) and when the hematoma thickness was greater than the midline shift, the survival rate was 65% (24/37).

INTRODUCTION

The prognosis of post-traumatic acute subdural hematoma is poor. Mortality rate is very high, ranging from 50% to 90% in published series.[1-5] A number of factors are thought to be prognostically favorable in surgical treatment of acute subdural hematoma, such as early surgery,[6,7] young age patient, [1] a Glasgow Coma Scale score of more than 5,[7,8] and the presence of lucid interval.[9-11]

Computed tomography (CT scan) was used for diagnosis and management of head injury and acute subdural hematoma. [12-14]

OBJECTIVE

The patients suffering from acute subdural hematoma who cannot be examined neurologically because they have undergone intubation and sedation, the Brain Swelling Factor calculated from CT scans will be a favorable prognostic factor.

Computed tomographic data from 102 cases of post-traumatic acute subdural hematoma in Udornthani Hospital were reviewed retrospectively by the fact that the patients admitted usually had be treated with intubation, sedation, artificial ventilation with neurological examination not performable

PATIENTS AND METHOD

In a retrospective study 102 patients with isolated head injury and unilateral acute subdural hematoma were investigated during January 1996 to December 1997. Before CT scanning, patients with insufficient respiration underwent intubation and ventilation. CT scans were performed at the time of admission and immediate surgical treatment were given if the patient still survived.

From the CT data, cases with acute subdural hematoma less than 2 mm. or with cerebral contusion on the contralateral side were excluded

[1] Department of Radiology, Udornthani Hospital, Meung, Udornthani, 41000 THAILAND.
[2] Department of Neurosurgery, Udornthani Hospital, Meung, Udornthani, 41000 THAILAND

from this study. Two parameters, the thickness of hematoma and the midline shift were determined. The hematoma thickness was measured as the largest perpendicular distance between the cortex and the inner table of cranial vault (Fig.1). The midline shift is the largest perpendicular distance between an imaginary reference line joining the frontal crest and internal occipital protuberance, and the most shifted point of the septum pellucidum (Fig.2). The data was given in millimeters. Brain Swelling Factor was calculated as the difference between the midline shift and the hematoma thickness.

On admission, the patients were categorized according to age, sex, Glasgow Coma Scale, pupillary light response, and outcome on 7 days, 6 weeks, 6 months as good recovery, moderate, severe disabilities, vegetative state and death.

The Brain Swelling Factor or relationship of the midline shift and the hematoma thickness seems to be important measurement for predicting the prognosis than the hematoma alone. If the difference is positive, not only the hematoma but also brain swelling is contributing to an additional midline shift of the brain into the side originally not affected.

RESULTS

The patients consisted of 85 (83%) male and 17 (12%) female. Their ages ranged from 11 to 75 years (mean = 33 years). Glasgow Coma Scale on admission ranged from 2 to 14. GCS less than or equal to 5 was 62% and more than 5 was 38%. (Fig.3)

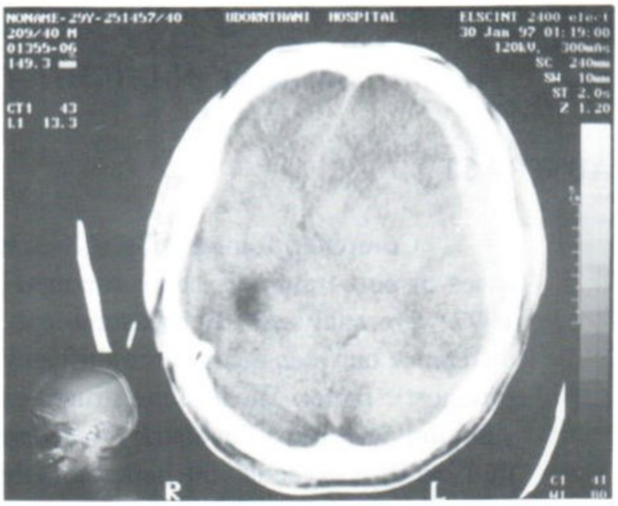

Fig. 1 The hematoma thickness measurement

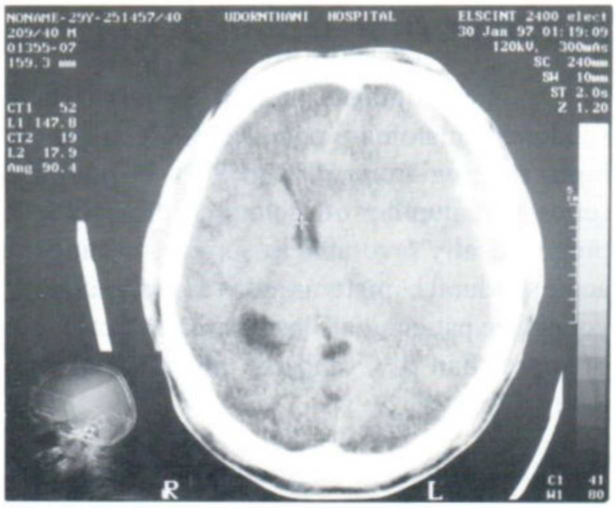

Fig. 2 The midline shift thickness measurement.

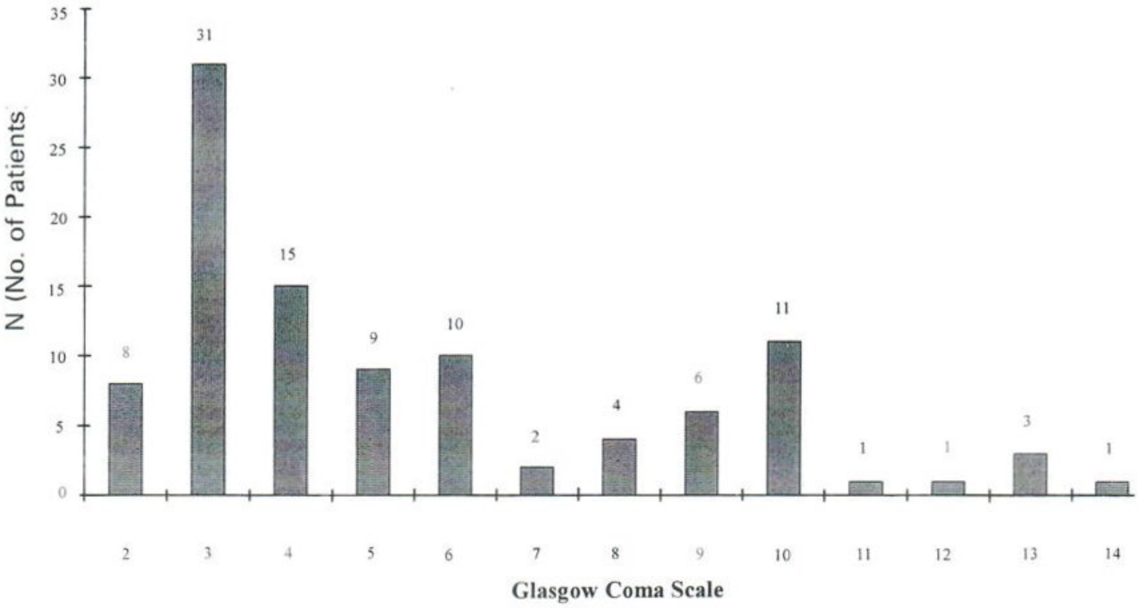

Fig. 3 Distribution of coma scores (Glasgow Coma Scale) at admission (n = 102)

CT FINDINGS

In 102 patients, the hematoma thickness ranged from 2 to 38 mm. and the midline shift were 0 to 28 mm. The midline shift exceeded the hematoma thickness in 51 patients (50%), the hematoma thickness equaled to the midline shift in 14 patients (14%) and the hematoma thickness was greater than the midline shift in 37 patients (36%). 52 patients (51%) were dead on first day to tenth day after admission. 50 patients (49%) had good recovery, moderate or severe disabilities. In summary, when the midline shift exceeded the hematoma thickness 1-5 mm. the survival rate is 36.6%(15/41) and drops to 10% (1/10) when the midline shift exceeded the hematoma thickness more than 5 mm. (table 1, Fig.4). The midline shift exceeded the hematoma thickness, the survival rate was 31%(16/51) and when the hematoma thickness was greater than the midline shift, the survival rate was 65% (24/37) (table 2).

Table 1 Difference of the MLS and the HT related to survival rate.

Difference of the MLS and the HT(mm.)	survived No.	survived %	died No.	died %
<-5	8	66.7	4	33.3
(-5) - (-1)	16	64.0	9	36.0
0	10	71.4	4	28.6
1 - 5	15	36.6	26	63.4
>5	1	10.0	9	90

Difference significant: $p < 0.001$

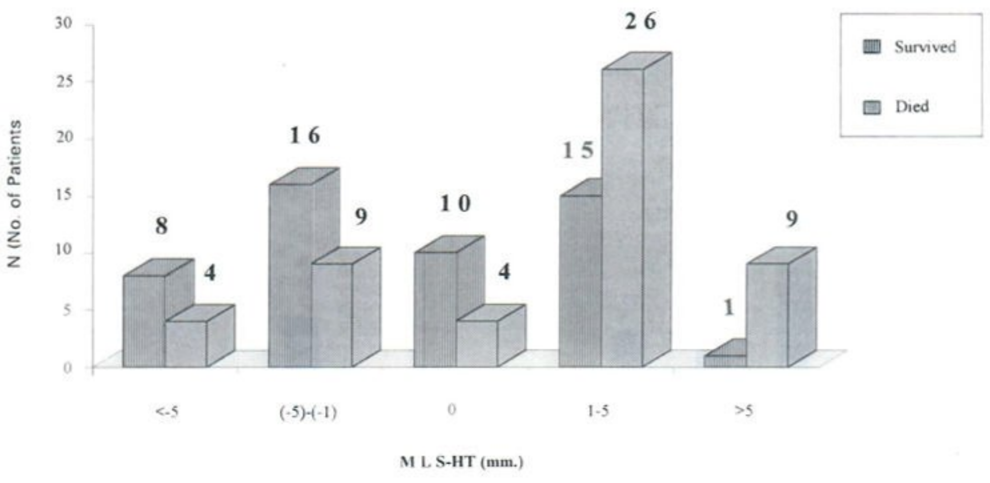

Fig. 4 Relationship of difference between midline shift (MLS) & hematoma thickness (HT) and outcome in 7 days.

Table 2 Survival rate related to relationship of the MLS and the HT.

	MLS<HT		MLS=HT		MLS>HT	
	No.	%	No.	%	No.	%
Survived	24	64.9	10	71.4	16	31.4
Died	13	35.1	4	28.6	35	68.6
Total	37	100	14	100	51	100

Difference significant: $p < 0.001$

DISCUSSION

The midline shift signifies compression of the neuronal structures, so the midline shift and prognosis behave reciprocally.[4,15-17] Review of three reports considering the midline shift and survival rate was compared to our data (table 3). When the midline shift equals to the hematoma thickness (difference is 0 mm.), the volume reserved provided by the subarachnoid space is completely exhausted by the development of the hematoma. Difference become positive (the midline shift more than the hematoma thickness) when the volume reserved capacity is exhausted and brain swelling develops on the injured side. This state characterized by a concomittent decrease in survival rate.

Table 3 Results of Surgical Treatment Considering Midline Shift and Survival Rate.

Series (Ref. No.)	Midline Shift (mm)	Survival Rate (%)
Marshall et al. (17)	<5	64
	5-15	53
	>15	13
Kotwica and Jakubowski(18)	<15	60
	5-30	48
	>30	24
Lobàto et al.(16)	<6	86
	6-15	77
	>15	69
Present study	<10	82
	10-15	33
	>15	14

By calculating, the "Brain Swelling Factor" as the difference between the midline shift and the hematoma thickness, we quantify brain swelling and thus the grade and extent of the induced brain damage. The midline structures are displaced not only by the space occupying subdural hematoma but also by the edematous processes on the same side of subdural hematoma. The edema is an additional space occupying lesion and should be taken into consideration when estimating prognosis.

Zumkeller and et al.[19] recomended that if the hematoma thickness exceeded 18 mm., the survival rate drops below 50%. 50% survival rate is reached when the midline shift is 20 mm. and drops to zero at 28 mm. If the midline is shifted by 3 mm. more than the hematoma thickness, the survival rate is 50%.

REFERENCES

1. Alberico AM, Ward JD, Choi SC, Marmarou A, Young HF: Outcome after severe head injury: Relationship to mass lesion, diffuse injury and ICP course in pediatric and adult patients. J Neurosurg 67:648-656, 1987.
2. Gennarelli TA, Spielman GM, Langfitt TW, Gildenberg PL, Harrington T, Jane JA, Marshall JD, Pitts LH: Influence of the type of intracranial lesion on outcome from severe head injury. J Neurosurg 56: 26-32, 1982.
3. Klun B, Fettich M: Factors determining prognosis in acute subdural haematoma. Acta Neurochir (Wien) 28(Suppl): 134-136, 1979.
4. Kotwica Z, Brzezinski J: Acute subdural hematoma in adults : An analysis of outcome in comatose patients. Acta Neurochir (Wien) 121:95-99, 1993.
5. McKissock W, Richardson A, Bloom WH: Subdural haematoma: A review of 389 cases. Lancet 1:1365-1369, 1960.
6. Haselsberger K, Pucher R, Auer LM: Prognosis after acute subdural or epidural haemorrhage. Acta Neurochir (Wien) 90: 111-116, 1988.
7. Seelig JM, Becker DP, Miller JD, Greenberg PR, Ward JD, Choi SC: Traumatic acute subdural hematoma: Major mortality reduction in comatose patients treated within four hours. N Engl J Med 304:1511-1518, 1981.

8. Greenberg J, Wendy JD, Cohen A,Cooper PR: The "hyperacute" extraaxial intracranial hematoma: Computed tomographic findings and clinical significance. J Neurosurg 17:48-56, 1985.
9. Gardner WJ: Traumatic subdural hematoma with particular reference to the latent interval. Arch Neurol Psychiatry 27: 847-858, 1932.
10. Stone JL, Rifai MHS, Sugar O, Lang RGR, Oldershaw JB, Moody RA: Acute subdural hematoma: Part I-Progress in definition, clinical pathology, and therapy. Surg Neurol 19:216-231, 1983.
11. Wilberger JE, Harris M, Diamond DL: Acute subdural hematoma: Morbidity, mortality, and operative timing. J Neurosurg 74:212-218, 1991.
12. Forbes GS, Sheedy PF, Piepgras DG, Houser OW: Computed tomography in the evaluation of subdural hematomas. Radiology 126:143-148, 1978.
13. Zimmerman RA, Bilaniuk LT, Gennarelli T, Bruce D, Dolinskas C, Uzzell B: Cranial computed tomography in diagnosis and management of acute head trauma. Am J Roentgenology 131:27-34, 1978.
14. Marshall LF, Marshall SB, B.S.N., Klauber MR, Clark MVB: A new classification of head injury based on computerized tomography. J Neurosurg 75:S14-S20, 1991
15. Kuchiwaki H, Inao S, Furuse M, Hirai N, Misu N: Computerized tomography in the assessment of brain shifts in acute subdural hematoma. Zentralbl Neurochir 56: 5-11, 1995.
16. Lobato RO, Rivas JJ, Gomez PA, Castaneda M, Canizal JM, Sarabia R, Cabrera A, Munoz MJ: Head-injured patients who talk and deteriorate into coma. J Neurosurg 75:256-261, 1991.
17. Marshall LF, Toole BM, Bowers SA: The National Traumatic Coma Data Bank: Part 2-Patients who talk and deteriorate: Implications for treatment. J Neurosurg 59: 285-288, 1983.
18. Kotwica Z, Jakubowski JK: Acute head injuries in the elderly: An analysis of 136 consecutive patients. Acta Neurochir (Wein) 118:98-102, 1992.
19. Zumkeller M, Behrmann R, Heissler HE, Dietz H: Computed tomographic criteria and survival rate for patients with acute subdural hematoma. J Neurosurg 39:708-713, 1996.