Original Article

Patients who Talk and Deteriorate: A New Look at an Old Problem

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Abstract

Background and Methods: We sought to review established prognostic indicators applied to Asian population, and to identify new risk factors for deterioration in patients who talked and deteriorated after traumatic brain injury (TBI). This retrospective study used our prospectively maintained TBI database. From August 1999 to July 2001, 324 patients were admitted to the neurosurgical intensive care unit (ICU). Thirty-eight patients (11.8%) talked between injury and subsequent deterioration into coma. Independent outcome predictors were studied. Results and Conclusion: Fourteen patients had subdural haematomas, 9 extradural haematomas, 19 contusions/haematomas and 3 subarachnoid haemorrhages. 81.5% of the patients had mass lesions potentially requiring surgery. Twenty patients had good functional recovery at 6 months (Glasgow Outcome Score 4 and 5); 18 were dead or vegetative. Age, gender, type of intracranial lesion and presence of coagulopathy were significantly correlated with outcome. Intracranial haematomas continue to be most significant in patients who talk and deteriorate. Coagulopathy was the strongest prognostic predictor of poor outcome with fibrinolytic parameters being reliable prognostic markers of head injury. Early identification, continued monitoring and treatment of coagulopathy should be our new look at improving outcome of these patients.

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Introduction

Patients who talk after traumatic brain injury (TBI) and then subsequently deteriorate into a coma are defined as those with an initial Glasgow Coma Score (GCS) verbal score of 3 or greater, and then deteriorate to a GCS of 8 or less. Less than 10% of patients with minor head injury have positive head computed tomography (CT) scan findings and less than 1% require neurosurgical intervention.[1-3] Twelve per cent to 32% of patients, who went into coma after TBI, spoke before deterioration [4-7]. These patients are potentially all salvageable, having suffered seemingly mild head trauma. Preventing significant morbidity in these patients continues to be of utmost concern amongst primary healthcare physicians, emergency physicians, neuro-intensivists and neurosurgeons. The morbidity associated with head trauma is great and the medico-legal and socioeconomic consequences severe.

In this study, we sought to review patients admitted to our institute who "talk and deteriorate" after TBI, to review established prognostic indicators in relation to our primarily Asian population, as well as to seek to identify new indicators to better improve outcome in this group of patients.

Materials and Methods

A retrospective study was conducted using a prospectively maintained TBI database from 1999 to July 2001. Three hundred and twenty-four patients with moderate to severe TBI were admitted to our Neurological Intensive Care Unit (NICU) from August 1999 to July 2001. Thirty-eight (11.7%) of these patients spoke comprehensible words (minimum verbal GCS of 3) between injury and subsequent deterioration into coma. Patients were intubated if GCS was <8 or if there were any other clinical indications. A CT of the brain was then immediately obtained using a portable CT scanner at our NICU. Emergent craniotomies were then

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performed in patients with significant mass lesions on CT scan, after excluding any contraindications to surgery. Intracranial pressure (ICP) monitors were inserted in all operated patients. Postoperatively, patients were managed on a severe TBI protocol instituted in our unit since 1996,[8] which is in accordance with the guidelines in the management of severe TBI (Brain Trauma Foundation 1995).

The following independent outcome predictors were studied: age, sex, GCS at presentation, GCS upon deterioration, location of patient at time of deterioration, duration between injury and deterioration, CT scan findings (type of intracranial lesion and degree of midline shift), ICP and presence of coagulopathy preoperatively (as indicated by prolonged prothrombin time (PT), activated partial thromboplastin time (APTT) and/or thrombocytopenia.

In our study, we chose to focus on the mean ICP over the first 12 hours postoperatively, as we felt that this was more representative of ICP in the postoperative period compared to highest ICP postoperatively, which could be easily subjected to transient large swings (e.g., due to stimulation from tracheal suctioning).

A single surgeon scored a dichotomised Glasgow Outcome Score (GOS)[9] at 6 months. Good outcome was defined as patients with functional recovery (GOS 4 and 5), with poor outcome defined as death, persistent vegetative state or severe disability (GOS 1, 2 and 3).

Table 1. Demographic Data

Characteristics	No. (%)
Age (y)	
Mean ± SD	50.26 ± 22.67
Range	16.00 to 96.00)
Gender	
Male	27 (71.1)
Female	11 (28.9)
Race	
Chinese	31 (81.6)
Malay	1 (2.6)
Indian	6 (15.8)
Mechanism of injury	
Fall	26 (68.4)
Vehicle accident	8 (21.1)
Assault	1 (2.6)
Sports injury	1 (2.6)
Unknown	2 (5.3)
Place of deterioration	
General ward/Neurology High Dependency Unit	33 (86.8)
Home	5 (13.2)
Emergent craniotomy	
Yes	26 (68.4)
Glasgow Outcome Score	
1	17 (44.7)
2 & 3	1 (2.6)
4 & 5	20 (52.7)

SD: standard deviation

All statistical analyses were carried out using SPSS (version 11.0). Associations between categorical variables and outcome were assessed using Chi-square or Fisher's exact tests. Logistic regression analysis for poor outcome and adjustments for the risk factors was performed. $P < 0.05$ was considered statistically significant.

Results

Table 1 shows the demographics of the patients studied. Thirty-eight patients (27 males and 11 females) with a mean ± standard deviation (SD) age of 50.26 ± 22.66 years (range, 16 to 96 years) were studied. Twenty-six patients suffered their head injuries from falls, with road traffic accidents accounting for head injuries in 8 patients. One patient was assaulted, 1 patient suffered a sports injury, while the mechanism of injury in 2 cases was unknown. Thirty-three patients deteriorated while under observation as in-patients either in the general ward or in the neuroscience high dependency ward. Five patients deteriorated at home post discharge. The median GCS on deterioration was 8, with a mean time from injury to deterioration of 24.53 ± 45.49 hours. All patients had CT scans of the head done at deterioration and scan characteristics of the patient population are as shown in Table 2. The mean midline shift was 7.88 ± 6.82 mm (range, 0 to 24 mm).

Twenty-six (64.8%) patients underwent emergent craniotomies, with ICP monitors inserted. Mean closing ICP at end of craniotomy was 18.64 ± 16.3 mm Hg. Over the first 12 hours postoperatively, the average of the mean ICP recorded (ICP12) was 20.43 ± 45.49 mm Hg.

All the patients had coagulation profiles (PT, APTT, platelet count) done at deterioration. Eleven patients had preoperative coagulopathy and this was corrected judiciously with plasma transfusions prior to and during the operative procedure. Twelve patients (35.2%) did not undergo craniotomy. Seven (18.5%) of these deteriorated due to non-mass lesions in the brain (3 had seizures, 2 developed sepsis, 1 developed cardiac failure and 1 due to a gastrointestinal bleed). Two patients were treated conservatively under close observation in the NICU and had good outcomes (age 19, bifrontal contusion, lowest GCS 10; age 26, diffuse axonal injury with left temporal contusion, lowest GCS 8). Three remaining patients had mass lesions and deteriorated to GCS of 3 and 4, but surgery was declined due to advanced age and co-morbidities.

Outcome and Analysis

Clinical and CT findings correlated with outcome as shown in Tables 2 and 3. Good outcome was seen in 20 out of 38 (52.6%) patients, with poor outcome in 18 (47.4%) patients. Mortality was 17 out of 38 patients (44.7%). These outcomes are comparable to that in previous studies and reviews on "talk and deteriorate" patients.[4-6]

Table 2. Clinical and CT Findings Correlated with the Outcome in 38 Patients

Characteristics	Good outcome (n)	Poor outcome (n)	*P*
No. of cases	20	18	
Age group (y)			
≤40	12	3	
41-60	4	4	
>60	4	11	0.012
Gender			
Male	18	9	
Female	2	9	0.007
GCS score (at presentation)			
13	2	1	
14	8	8	
15	10	9	1.000
GCS score (upon deterioration)			
3-4	3	3	
5-6	1	2	
7-8	5	6	
>8	11	7	0.717
Interval to detection of deterioration (h)			
<6	10	6	
6-24	8	7	
>24	2	5	0.333
Type of intracranial lesion*			
Contusion	9	10	0.516
EDH	9	0	0.001
SDH	5	9	0.111
TSAH	2	1	1.000
Midline shift (mm)			
≤5	6	7	
6-15	9	7	
>15	2	3	0.811
Mean ICP at 12 hours (mm Hg)			
<15	8	2	
15-35	5	4	
>35	0	3	0.058
Emergent craniotomy			
Yes	17	9	0.020
Preoperative coagulopathy			
Yes	1	10	0.001

* Some patients had mixed lesions.
EDH: extradural haematoma; GCS: Glasgow Coma Score; ICP: intracranial pressure; SDH: subdural haematoma; TSAH: traumatic subarachnoid haemorrhage

Table 3. Perioperative Findings Correlated with the Outcome in 38 Patients

Characteristics	No. Good outcome	No. Poor outcome	*P*
No. of cases	20	18	
Closing ICP			
Mean ± SD	12.15 ± 7.55	28.00 ± 20.55	
Median	11.00	22.00	
Range	3.00-30.00	5.00-56.00	0.110
Closing CPP			
Mean ± SD	78.92 ± 15.22	64.78 ± 17.88	
Median	78.00	64.00	
Range	59.00-108.00	35.00-94.00	0.102
Mean ICP (at 12 hours)			
Mean ± SD	15.91 ± 7.03	26.97 ± 14.76	
Median	14.10	26.67	
Range	7.20-29.40	6.20-48.00	1.000
Mean CPP (at 12 hours)			
Mean ± SD	73.97 ± 16.87	67.91 ± 11.24	
Median	70.80	73.25	
Range	61.00-126.00	46.00-80.00	1.000

CCP: cerebral perfusion pressure; ICP: intracranial pressure; SD: standard deviation

The results revealed that only age group, gender, type of intracranial lesion [extradural haematoma (EDH)] and presence of emergent craniotomy and preoperative coagulopathy were significantly correlated with the outcome after TBI. Females and patients with age >41 years are 9 times [*P* = 0.007; odds ratio (OR) = 9.01; 95% confidence interval (CI), 1.60 to 50.00] and 7.5 times (*P* = 0.006; OR = 7.50; 95% CI, 1.63 to 34.59) more likely to have poor outcome, respectively. In addition, the patient with preoperative coagulopathy is 23.8 times more likely to have poor outcome (*P* = 0.001; OR = 23.75; 95% CI, 2.59 to 217.67). On the other hand, the patient with EDH intracranial lesion and who had emergent craniotomy is 2.6 times [*P* = 0.001; relative risk (RR) = 2.64; 95% CI, 1.66 to 4.20] and 5.7 times (*P* = 0.020; OR = 5.68; 95% CI, 1.22 to 26.32) more likely to have functional survival respectively.

Logistic regression analysis was performed on the poor outcome and adjusting for age, gender, GCS score at presentation, interval to detection of deterioration, presence of emergent craniotomy and preoperative coagulopathy. The analysis revealed that only the preoperative coagulopathy (*P* = 0.005; OR >100; lower bound of 95% CI = 4.42) still proved to be a significant predictor.

Of the 5 patients who deteriorated at home, all were found to have mass lesions, resulting in mortality in 3 of the 5 patients. Two of these patients presented to a hospital emergency department (ED) after their initial injury but were sent home after review. No CT scan of the head was performed on these 2 patients as they were both of GCS 15 at initial discharge. These 2 patients subsequently deteriorated to GCS of 7 and 8 at second presentation to the ED and although emergent craniotomies were performed, they both fared poorly. The other 3 patients were observed for >24 hours in the general ward before being discharged seemingly well. The 2 patients of this group who fared well were both under 20 years of age.

Discussion

Reily's seminal paper[10] in 1975 first highlighted the significance of intracranial mass lesions and raised ICP in the prognosis and outcome of patients who talked and died

after head injury. Today, intracranial haematomas and mass lesions continue to be the main cause of deterioration in this group of TBI patients.[4-6,11] The outcome in this group of patients has not improved dramatically as reflected in results from previous reviews compared with our results. It is clear that improving outcome depends on early recognition of deterioration, identifying patients at risk of deterioration, rapid removal of mass lesions, and the prevention of secondary or additional brain injury.[11-13]

It is notable that in our study population, GCS at presentation, highest ICP, degree of midline shift on CT head did not statistically predict outcome, as had been shown in previous studies.[4,6] These factors are also widely accepted as known prognostic indicators in all head-injured patients. It is possible that our sample size failed to detect any statistical significance, although trends indicate that rising ICP results in poorer outcome. As the national centre for neurotrauma, the presence of on-site 24-hour coverage by neurosurgeons and anaesthetists, together with resources for emergent surgical interventions or intensive care interventions being available at anytime, there is minimal delay in response to rising ICP, CT scan findings and changes in patients GCS scores. While data detailing the duration between detection of deterioration in clinical condition and intervention (surgical or non-surgical) in this group of patients were not specifically studied, the short duration between deterioration and clinical intervention may negate the effect these changes have on patient outcome. The majority of our patients studied (86.8%) deteriorated in hospital, and it is expected that in our centre, it would take less than an hour to go from point of deterioration to CT scan to the operating room or the NICU.

In our review, advancing age was associated with a poorer outcome. This correlates with findings in previous "talk and deteriorate" reviews.[4,6] The decline in normal physiologic function and neuroprotective mechanisms with age indicates that more focused and aggressive correction of any altered physiology in the older patient must be done to minimise morbidity and the socioeconomic burden of an increasingly aged and disabled population.

It is interesting that females in our study fared poorer. It has been previously shown that females are more likely to develop post-concussive symptoms, persistence of symptoms after mild head injury and poorer outcome after TBI.[14-18] However, several studies have also shown that females may fare better.[19-21] Unpublished data from our centre suggest that gender differences have no significant effect on outcome following TBI. The independent effect of gender on outcome following TBI is yet to be fully elucidated and shown conclusively one way or the other, and we await further reviews to demonstrate this.

Our results show a strong association between coagulopathy and poor outcome in patients who talk and deteriorate following seemingly mild head injury. The prompt identification of coagulopathy in patients with mild TBI would appear to be the "new look" in the quest to identify at risk patients for deterioration. It has been well accepted that patients with severe head injury develop abnormalities in the coagulation and fibrinolytic systems, and that disseminated intravascular coagulation (DIC) has been associated with poor outcome following severe head injury.[22-29]

The damaged brain, in proportion to the severity of injury,[22,23,25,26] releases large amounts of tissue factor. This activates the extrinsic coagulation pathway, resulting in an initial hypercoagulable state, which is followed by an activation of the fibrinolytic system. If allowed to escalate, DIC ensues. Coagulopathy in patients with mild head injury may reflect the presence of severe brain damage, which may not be apparent in an early post-injury CT head. Stein et al[24] developed a coagulopathy index based on degree of abnormality in the PT, APTT and platelet count. They showed a correlation between the coagulopathy index and the probability of developing delayed injury following head trauma. Fibrinolytic activity in patients with head injury is well correlated to the extent of brain damage regardless of GCS on admission.[22,24] With the activation of fibrinolysis, a rise in plasma fibrinolytic parameters, such as alpha2-plasmin inhibitor–plasmin complex (PIC), and d-Dimer fraction of fibrin degradation products follows. Takahashi et al[22] have found that following TBI, plasma PIC levels >15 ug/mL and d-Dimer >5 ug/mL are associated with poor outcome, whilst good outcome is associated with plasma PIC <2 ug/mL and d-Dimer <1 ug/mL. Patients who "talked and deteriorated" following TBI had significantly higher plasma PIC and d-Dimer levels when compared to conscious TBI patients who did not deteriorate.

The hypercoagulable state following tissue factor release by the damaged brain may reflect a state where a patient's PT, APTT, and platelet count may be normal, while the fibrinolytic parameters have already risen. Therefore, a model using abnormalities of the coagulation process to predict patients at risk of deterioration and poor outcome should then include assays of PT, APTT, platelet count and plasma fibrinolytic parameters.

Conclusion

The majority of patients who suffer mild TBI and talk after injury do not have significant findings on head CT scans. Early identification of patients at risk of deterioration and prevention of secondary brain injury is the key to improving outcome in head-injured patients. While we bear in mind established prognostic indicators, monitoring coagulation and fibrinolytic parameter assays early in these

patients' clinical course and then serially, may be useful in identifying patients at risk and improving early detection of significant injury, thereby improving outcome in this group of patients.

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