Assessing the Neurological Outcome of Traumatic Acute Subdural Hematoma Patients with and without Primary Decompressive Craniectomies

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Abstract

Background We have investigated the impact of primary decompressive craniectomies on neurological outcomes after adjusting for other predictive variables.

Method We have collected data from trauma patients with acute subdural hematomas in a regional trauma center in Hong Kong over a 4-year period. Patient risk factors were investigated using logistic regression.

Results Out of 464 patients with significant head injuries, 100 patients had acute subdural hematomas and were recruited for analysis. Forty-four percent of the patients achieved favorable neurological outcomes after 6 months. Favorable neurological outcomes at 1 year were related to age, pupil dilatation, and motor GCS scores at the time of admission. In the 34 patients who underwent evacuation of acute subdural hematomas, primary decompressive craniectomy was not associated with favorable neurological outcomes.

Conclusion Primary decompressive craniectomy failed to show benefit in terms of neurological outcomes and should be reserved for cases with uncontrolled intra-operative brain swelling.

Keywords Acute subdural hematoma • craniotomy • decompressive craniectomy • neurological outcome

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Introduction

Despite studies of the impact of early craniectomy on patients with traumatic acute subdural hematoma (5,7,8) the value of primary decompressive craniectomies remains uncertain. There is only one literature reference that compares mortality rates between normal craniotomies and decompressive craniectomies (10). Woertgen et al. found that there was no difference between the two groups. However, their analysis was not adjusted for age, the Glasgow coma scale or signs of herniation. We sought to judge the value of decompressive craniectomy with reference to functional outcome after taking into account other patient disabilities. We designed the current study to investigate the impact of primary decompressive craniectomy on neurological outcomes as well as other prognostic factors.

Methods and Materials

We collected data from trauma patients with traumatic acute subdural hematomas in a regional trauma center in Hong Kong over a 4-year period. Out of 464 patients who had significant head injuries, 100 patients had acute subdural hematomas and were recruited for analysis. Of the 34 patients who underwent surgical evacuation of their hematomas, 15 were subjected to normal craniotomies, while 19 had decompressive craniectomies (one patient who had a craniotomy also had a secondary craniectomy afterwards). Data regarding the age, sex, Glasglow coma scale (9) (GCS), GCS motor component, signs of herniation (unilateral or bilateral pupil dilation), extradural hematoma, cerebral contusions, traumatic subarachnoid hemorrhages, extracranial trauma and surgical procedures were recorded. We assessed the patient outcome using the Glasgow outcome scale (GOS) 6 months after injury (3). Favourable outcomes were defined as GOS 4–5 (good recovery and moderate disability including independent daily living activity), while unfavourable outcomes were defined as GOS 1–3 (severe disability, vegetative state or death).

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Statistical analysis was carried out with SPSS for Windows 14.0. Univariate analysis was performed with the Chi-Square test and the Mann–Whitney U test as appropriate. Multivariate analysis was performed using logistic regression. Statistical significance was defined as $p < 0.05$ (two-tailed).

Results

All patients were successfully evaluated after injury in our cohort. The cohort age (mean +/− SD) was 60.0 +/− 24.6 years, and the male to female ratio was 2:1. Thirty-three percent of the hematoma causes were related to road traffic accidents, 14% to falls from heights, 43% from falls at ground level (or below the height of one meter). Twenty-three percent of patients had significant extracranial injury (defined as an abbreviated injury score >2). Nine percent of patients had extradural hematoma, 44% had cerebral contusions and 36% had traumatic subarachnoid hemorrhages. A full 41% of the patients exhibited signs of herniation. The mean intensive care unit stay (mean +/− SD) was 2.8 +/− 5.7 days, and the total hospital stay was on average 12.3 +/− 18.9 days. With regard to the mode of evacuation of subdural hematoma, 15% had craniotomies performed, and 19% had craniectomies performed (18 primary and 1 secondary). Mortality rates were 38%, and 38% of patients required inpatient rehabilitation after hospital discharge. A favourable outcome was seen after 6 months in 44% of the patients.

The characteristics of patients as reported in this study and their relation to the patients' neurological outcomes are displayed in Tables 1 and 2. Univariate analysis showed that unfavourable outcomes were associated with the conditions of being male, being older, having signs of herniation, having low GCS upon admission, and having a low GCS motor component upon admission.

Using a multivariate analysis, favourable outcomes were related to age (adjusted OR 0.94, 95% CI 0.92–0.97), pupil dilation (adjusted OR 2.15, 95% CI 1.2–114.5) and GCS motor score at admission (adjusted OR 2.15, 95% CI 1.44–3.21). In 34 patients with surgical evacuation of their hemotomas, decompressive craniectomy (adjusted OR 0.42, 95% CI 0.08–2.20) was not associated with favourable outcomes after adjustments were made for the age, pupil dilatation and GCS motor scores.

Discussion

The preconditions necessary for surgical evacuation of traumatic acute subdural hematomas have previously been well defined. An acute subdural hematoma with a thickness greater than 10 mm or a midline shift greater than 5 mm as determined from a computed tomography scan should be surgically evacuated (1,4,11). However, there is no consensus regarding which surgical technique should be employed for evacuation of traumatic acute subdural hematomas. Some doctors perform craniotomies, while others perform decompressive craniectomies. In our unit, we used the question mark trauma flap with a bone flap of approximately 10 cm in all patients. Whether to perform a duroplasty and leave the bone flap out was left up to specialist neurosurgeons. Some doctors would leave the bone flap after decompressive craniectomies, while

Table 1 Univariate analysis of the categorical variables and their neurological outcomes

	Unfavourable outcome (56 patients)	Favourable outcome (44 patients)	Odds ratio, 95%CI, p-value
Sex (male)	79.5% (35)	55.4% (31)	0.32, 0.13 to 0.79, p = 0.011
Extradural hematoma	8.9% (5)	9.1% (4)	1.02, 0.26 to 4.05, p = 0.978
Cerebral contusion	41.1% (23)	47.7% (21)	1.31, 0.59 to 2.90, p = 0.506
Traumatic subarachnoid hemorrhage	39.3% (21)	31.8% (14)	0.72, 0.31 to 1.66, p = 0.440
Extracranial trauma	19.6% (11)	27.3% (12)	1.53, 0.60 to 3.91, p = 0.368
Signs of herniation	62.5% (35)	13.7% (6)	0.10, 0.03 to 0.26, p < 0.001
Craniotomy	33.9% (19)	34.1% (15)	1.01, 0.44 to 2.32, p = 0.986
Craniectomy	21.4% (12)	15.9% (7)	0.69, 0.25 to 1.94, p = 0.485

Table 2 Univariate analysis of continuous variables and their neurological outcomes

Mean +/− SD	Unfavourable outcome (56 patients)	Favourable outcome (44 patients)	p-Value
Age (mean +/− SD)	70.5 +/− 20.3	46.7+/-23.1	<0.001
GCS (median, interquartile range)	7.5, 4 to 14.75	14.5, 11 to 15	<0.001
GCS motor (median interquartile range)	4, 1.25 to 6	6, 5.25 to 6	<0.001
ICU stay (mean +/− SD)	2.4 +/− 5.9	3.3 +/− 5.5	<0.001
Hospital stay (mean +/− SD)	11.4 +/− 19.7	15.8 +/− 17.6	0.666

some would try to put the bone flap back if feasible. This provided an opportunity to carry out the current study.

In the literature, there is only one retrospective observational study that compares the mortality rates of patients undergoing craniotomies and those patients undergoing decompressive craniectomies to treat acute subdural hematomas (9). Woertgen et al. reported that decompressive craniectomies do not seem to have therapeutic advantages over craniotomies in traumatic acute subdural hematoma treatment and that they had a higher mortality rate (53% versus 32%). However, the results were not adjusted for other variables, and no data on the neurological outcome were available.

We found that patients undergoing decompressive craniectomies (after adjustment for age, GCS motor component and signs of herniation) did not have improved neurological outcomes at 6 months. However, decompressive craniectomies were not significantly associated with unfavourable outcomes. This may be explained by the fact that some bone flaps were not replaced because of severe intra-operative brain swelling. In the current study, the distribution of concomitant extradural hematomas, cerebral contusions and traumatic subarachnoid hemorrhages did not differ between the two groups.

The limitations of our current study are that it is observational in nature and has a limited sample size. Nevertheless, we were able to demonstrate that there was no benefit in terms of neurological outcome from primary decompressive craniectomies when compared to craniotomies. Given the potential complications arising from craniectomies, primary decompressive craniectomies should be reserved for patients with intractable intra-operative swelling that precludes placement of the bone flap.

It remains possible that some patients would benefit from decompressive craniectomy for treatment of subsequent severe cerebral edemas. Furthermore, there is no class I evidence to support the routine use of secondary decompressive craniectomies to reduce unfavourable neurological outcomes in adults with refractory high intracranial pressure (6). Two randomized controlled trials of decompressive craniectomies (RescueICP and DECRAN) are ongoing and are expected to assess the value of secondary decompressive craniectomies (2,6).

In conclusion, application of primary decompressive craniectomies failed to show patient benefits on neurological outcomes and should be reserved for cases of uncontrolled intra-operative brain swelling. Whether secondary decompressive craniectomies are beneficial for cases of severe cerebral edema remains to be investigated.

Conflict of interest statement: We declare that we have no conflict of interest.

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