Acute Subdural Hematoma: A Comparative Study of 2 Types of Operative Techniques

Shahrokh Yousefzadeh Chabok, MD, Mohammad Safaie, MD, Anosh Dehnadi Moghadam, FCCM, Hamid Behzadnia, MD, Maryam Khalili_Rad, MSc, and Seyyede Roghye Larimi, MD

Abstract: Several surgical procedures have been reported for the treatment of acute subdural hematoma. We compared the results of treatments for acute subdural hematoma achieved by decompressive craniectomy with wide opening of the dura versus multidural fenestrations. Forty-five patients with acute subdural hematoma underwent surgery at our hospital from August 2002 to July 2007. Our patients were classified into 2 groups according to the operative procedure: group A, decompressive craniectomy with wide opening of the dura (n = 21) and group B, multidura fenestrations (n = 24). Glasgow Outcome Scale at time of discharge from hospital, duration of surgery, and length of hospital stay (LOS) were compared between the 2 groups of patients who were operated upon with the different surgical techniques. Glasgow Outcome Scale was not statically different between the 2 groups of patients, but when comparing craniectomy group and multidural fenestration group (groups A and B), duration of surgery and LOS were statistically lower in group B than in group A. Duration of surgery in group B was one-third of group A. Mean of LOS was 24 ± 8.83 in group A and 18 ± 6.72 in group B. Such results indicate that multifenestration of dura can be considered as an alternative treatment option in patients with acute subdural hematoma.

Key Words: acute subdural hematoma, decompressive craniectomy, multidural fenestrations, time of surgery, length of hospital stay

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One of the most serious traumatic neurosurgical emergencies, which often require surgical intervention, is acute subdural hematoma. If proper treatment is not prompt, hematoma can lead to other problems such as intraparanchymal hemorrhages and contusion.[1] Despite improvement in the management of severe traumatic brain injury, the mortality rate of acute subdural hematoma remains in the range of 60% to 90%.[2,3] This high mortality rate has been attributed to characteristics of the hematoma itself, to the presence of additional cerebral paranchymal injury, and to secondary insult.[4] The value of surgical treatment of patients with acute subdural hematoma is still controversial, because this group always includes moribund patients who have little chance of survival.[5,6] Decompressive craniectomy with wide opening of the dura matter is the most often used techniques for clot evacuation in these patients. However, in many cases, marked herniation of swollen brain through the craniectomy was observed, which is followed by rapid decompression of acute subdural hematoma due to kinking of cerebral veins and laceration of the cerebral cortex on the bone edge and the dural opening.[7,8] Dural repair is time consuming in many patients who have undergone decompressive craniectomy. Therefore, it is necessary to develop techniques to avoid these problems, to reduce immediate or late complications, to take shorter time than the conventional approaches, and to reduce length of hospital stay (LOS). One modification of technique is to use a membrane of polytetrafluoroethylene or other materials as a dural graft to avoid injury to the brain and to decrease operating time.[9,10] Another recommended technique is multidural fenestrations. In this procedure, the dura has been fenestrated rather than opening it completely. The clot can then be removed through the small dural openings.[11]

In a series of 31 patients with a mean age of 32.5 years who were operated by the fenestration method, Guilburd and Sviri[11] found that more than 80% of the clot was removed in 29 patients as shown by computed tomography. In another study by Bhat et al,[12] 2 methods of surgery for clot evacuation were compared and he found that the method named as dural stabs was much more effective for clot evacuation than the open dura flap method.

Most investigators do not evaluate the effect of operative techniques used for evacuation of the acute subdural hematoma on patient's outcome, and if they do, they usually do not address the effectiveness of the procedure with respect to time and LOS. The objective of this study was to compare the outcome, duration of surgery, and LOS in the 2 abovementioned techniques for clot evacuation in 2 groups of patients with subdural hematoma.

From the Guilan University of Medical Sciences, Guilan Trauma Research Center, Guilan, Iran.

Reprints: Mohammad Safaie, MD, Guilan Trauma Research Center, Poursina Hospital, Namjoo Avenue, 4193713191, Rasht, Guilan, Iran (e-mail: Info@gtrc.ir).

MATERIALS AND METHODS

Patient Description

This study was a descriptive-analytical study, which included 45 patients with acute subdural hematoma who underwent craniotomy between August 2002 and July 2007 in the neurosurgery ward of Poursina Hospital, Rasht, Iran. Clinical characteristics of patients were recorded, which included age, sex, mechanism of injury, glasgow coma scale on admission, injury severity score, anatomic site of subdural hematoma, total operating time, and any associated systematic injury. Several observations were also recorded in the postoperative period, such as presence or absence of complications and the LOS. Of the 45 patients, 21 patients (46.7%) were operated by craniotomy with wide opening of the dura and 24 patients (53.3%) with the multidural fenestration technique. The selection of the operative techniques was randomized by an attending neurosurgeon.

Glasgow Outcome Scale (GOS) score was used to describe outcome. The GOS score differentiated the outcome into 5 groups: good recovery (GOS 5), moderate disability (GOS 4), severe disability (GOS 3), vegetative state (GOS 2), and death (GOS 1).

Operative Technique

Decompressive craniectomy was done by removing parts of the frontal, parietal, temporal, and occipital squama, resulting in a large bone flap (diameter > 12 cm).[13] A cruciate durotomy was then opened centered on the flap and clot, and then evacuated by irrigation. In the multidural fenestration method, the dura was often fenestrated first to allow for evacuation of the subdural hematoma, whereas the underlying brain was gradually rather than abruptly decompressed (Fig. 1).

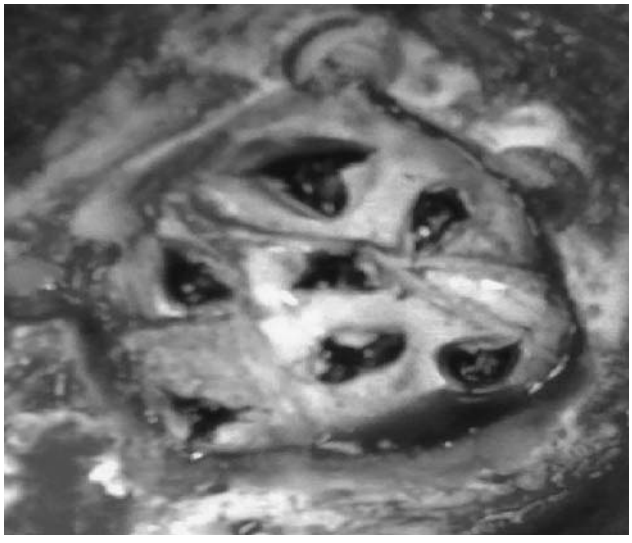

FIGURE 1. Evacuation of clot by use of the multidural fenestration technique in the operative room.

Statistical Analysis

SPSS 16.0 for windows package was used for statistical analysis. All values are expressed as mean ± SD. Fisher exact significance test were used to compare the 2 groups who were operated upon with the 2 different surgical techniques. Statistical significance was assigned to P value of < 0.05.

RESULTS

Forty-five patients who were operated between August 2002 and July 2007 in our hospital for acute subdural hematoma were included in this study. The mean age of the patients was 42.2 ± 2.2 years and their age ranged from 4 to 85 years. The age distribution showed the highest peak of incidence at the sixth and the lowest peak at the fourth decade of life. Thirty-nine patients (86.7%) were male and 6 (13.3%) were female patients. In our study, majority of patients (84.4%) had road traffic accidents. Another cause of injury was fall from height (13.3%) and violence (2.2%). We used 2 surgical techniques, craniectomy and multidural fenestration, for clot evacuation in 2 groups of patients to compare the efficiency of these techniques for treatment of patients with acute subdural hematoma. Twenty-one patients (46.7%) were operated with craniectomy with opening the dura (group A) and 24 patients (53.3%) with the multidural fenestration technique (group B). The demographic characteristics of patients according to the surgical techniques used are summarized in Table 1. GOS, operating time, and LOS of the cases that underwent craniectomy (group A; n = 21) were compared with those undergoing fenestration (group B; n = 24).

Regardless of the surgical technique used, that is, fenestration or craniectomy with wide opening of the dura matter, a favorable outcome (GOS 4 and 5) was seen in 24 patients (53.3%). Six patients (13.3%) remained severely disabled; lastly, 15 (33.3%) patients died and none of the patients ended up in a permanent vegetative state.

In group A, at time of discharge from hospital according to GOS, 6 patients (28.6%) showed good recovery, 5 patients (23.8%) experienced moderate

TABLE 1. Patient's Demographic Characteristic According to Surgical Techniques Used

	Surgical Techniques	
Variable	**DC**	**MDF**
No. patients	21 (46.7%)	24 (53.3%)
Sex		
Male	21 (100%)	18 (75%)
Female	—	6 (25%)
Age (y)		
Mean ± SD	36.76 ± 19.58	46.88 ± 22.63
GCS on admission		
Mean ± SD	6.62 ± 3.29	6.67 ± 3.17
ISS		
Mean ± SD	26.90 ± 3.03	26.96 ± 5.30

DC indicates decompressive craniectomy; GCS, glasgow coma scale; ISS, injury severity score; MDF, multidural fenestrations.

disability, 3 patients (14.3%) were found to have severe disability, and 7 patients (33.3%) were dead, whereas in group B, 8 patients (33.3%) were reported as having good recovery, 5 patients (20.8%) had moderate disability, 3 patients (12.5%) were found to have severe disability, and 8 patients (33.3%) were dead. The outcome was not significantly different between the 2 different types of operative technique (Table 2).

The mean of operating time was 73.3 ± 12.4 minute in group A and 26.7 ± 12.4 in group B (Table 2). The duration of surgery was lower in group B than in the other group and this difference was strongly significant ($P < 0.000$). In addition, the mean LOS was 24.6 ± 8.83 days in group A and 18 ± 6.7 in group B (Table 2). The LOS was lower in group B than in the other one and the difference between 2 groups was statistically different ($P < 0.05$).

DISCUSSION

The purpose of this study was to compare the outcome measures (GOS, LOS) and duration of surgery of patients with acute subdural hematoma who were operated upon with 2 different surgical techniques. Although the GOS was not significantly different between 2 groups of patients, our analysis showed that the duration of surgery and LOS in the fenestration group was significantly lower than patients who underwent craniectomy with wide opening of the dura mater. In this study, the operating time among patients who underwent multidural fenestration was one-third of the other method. In contrast, the LOS in those patients who survived was shorter in the multidural fenestration group, between 1 half-day and nearly 2 weeks (0.95% confidence interval of the difference between −0.57and −12.66). Reducing the LOS could lead to a significant decrease in cost. It is imperative to consider such factors for development of greater clinical efficiency in hospitals with the current challenge of staffing limitations and reimbursement constraints.[14,15] The results of our study suggest that multifenestration of the dura can be used for the clot evacuation as an alternative method for the wide opening of the dura mater. This approach conserves the arachnoid layer, a natural protective layer covering the brain, and avoids wasting time in opening the dural flaps. This method avoids potential injury to the brain, resulting from dural suturing. In our study, no complications of cerebrospinal fluid fistula or wound infection were observed in the fenestration group. Reduction of intracranial pressure in the fenestration procedure can be performed slowly and the hazards of acute brain swelling and extrusion of tissue through the intervention process can be decreased. This observation is similar to the conclusion made by Guilburd and Sviri[11] in 2001, who reported that it is possible to remove most of the clot by creating openings in the dura in a mesh-like manner rather than by completely opening it, to avoid the deleterious consequences of abrupt decompression of the subdural space with disruption of brain tissue. The overall mortality rate in their series of patients was 51.6%. Aung et al[16] have reported that the abrupt change in intracranial condition resulted in complications such as convulsions, brain edema, and cerebral hemorrhage. In addition, in a study by Ogaswara et al,[17] it was shown that rapid decompression of subdural hematoma can result in the sudden increase of cerebral blood flow, with the probability of hyperemia increasing due to disruption of autoregulation in that region, because the dilated vessels cannot constrict after the sudden restoration of normal perfusion pressure of blood flow. Our study failed to show the superiority of fenestration to the craniectomy group in terms of GOS. Bhat et al[12] have evaluated the standard procedures for clot evacuation against a multifenestration of dura and found that fenestrating the dura at intervals decompressed the underlying edematous brain slowly with better results in comparison with open dural flap. In their study, the overall survival in the fenestration group was 78.3% with the good recovery in 43.3% and a mortality of 21.6%, compared with 40% survival in the open dural flap group with 11.6% good recovery and a mortality of 60%.

One limitation to this study was the different factors influencing the outcome in this series, such as patient's age, sex, and time gap between the trauma and surgery. The age of patients who underwent with fenestration technique was slightly higher than the other technique used; however, this difference was not statistically significant. The previous studies showed that older

TABLE 2. Outcome, Length of Hospital Stay, and Operating Time According to the Surgical Techniques

	Surgical Techniques				
Variable	**DC**	**CI 95%**	**MDF**	**CI 95%**	***P***
GOS					
Good recovery	6 (28.6%)	0.09-0.48	8 (33.3%)	0.14-0.52	NS
Moderate disability	5 (23.8%)	0.06-0.42	5 (20.8%)	0.05-0.37	NS
Severe disability	3 (14.3%)	−0.01-0.29	3 (12.5%)	−0.01-0.26	NS
Vegetative state	—	—	—	—	—
Death	7 (33.3%)	0.13-0.53	8 (33.3%)	0.14-0.52	NS
Length of hospital stay	24.0 ± 8.83	19.28-29.95	18 ± 6.72	14.28-21.73	0.03
Operating time	73.33 ± 12.38	67.70-78.70	26.67 ± 7.02	23.70-29.63	0.000

CI indicates confidence interval; DC, decompressive craniectomy; GOS indicates Glasgow Outcome Scale; MDF, multidural fenestrations; NS, not significant (*P* value ≥ 0.05).

patients with serious head injuries have poor outcomes compared with younger patients with similar injuries.[18,19] Another limitation of this study was the time gap between the trauma and surgery. However, the relationship between outcome and time to surgery is still controversial. Some investigations have shown that early surgery within 4 hours after trauma can be related to better outcome.[19,20] In our study, all patients did not undergo surgery within 4 hours after trauma. Moreover, there were no female patients in the decompressive craniectomy group, whereas there were 6 female patients in the fenestration group. We recommend further studies using a larger sample to investigate the efficacy of these techniques. Our experience indicates that fenestrating the dura may be especially useful in emergency cases of severe brain injury requiring decompression.

CONCLUSIONS

The GOS was not significantly different between the 2 types of operative techniques tested. Clear differences were observed in the operating times in patients who operated by multidural fenestration than the craniotomy technique. LOS was found to be lower in those operated upon by multifenestration of dura and this difference was found to be statistically significant. However, the choice of operative techniques depends on the surgeon's training and expertize. It is necessary to use techniques that can be easily performed in a shorter time and that can reduce the patient's average LOS without compromising the outcome.

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