

Original Article

Management dilemma in penetrating head injuries in comatose patients: Scenario in underdeveloped countries

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Abstract

Background: The optimal management of patients with minimal injury to brain has been a matter of controversy and this is especially intensified when the patient has a poor neurological status. This is important in the regions where neurosurgical services are limited and patient turnover is disproportionate to the available resources. We aimed to determine the effectiveness of aggressive management in coma patients after penetrating missile injuries of the brain.

Methods: All the patients of gunshots or blast injuries were included if they had a Glasgow Coma Scale score of less than 8 after initial resuscitation and had no other injury that could explain their poor neurological status. The indication for emergency surgery was evidence of a mass lesion causing a significant mass effect; otherwise, debridement was done in a delayed fashion. The patients who were not operated were those with irreversible shock or having small intracranial pellets with no significant scalp wounds. The patients who had a Glasgow outcome score of 1, 2, or 3 were classified as having an unfavorable outcome (UO) and those with scores 4 and 5 were classified as having a favorable outcome (FO).

Results: We operated 13 patients and the rest 13 were managed conservatively. The characteristics of the patients having a favorable outcome were young age (OR = 28, $P = 0.031$), normal hemodynamic status (OR = 18, $P = 0.08$), presence of pupillary reaction (OR = 9.7, $P = 0.1$), and injury restricted to one hemisphere only (OR = 15, $P = 0.07$). All of the patients who were in shock after resuscitation died while 25% of the patients with a normal hemodynamic status had a favorable outcome.

Conclusions: In developing countries with limited resources, the patients who are in a comatose condition after sustaining penetrating missile injuries should not be managed aggressively if associated with bihemispheric damage, irreversible shock, or bilateral dilated nonreacting pupils. This is especially important in the event of receiving numerous patients with the same kind of injuries.

Key Words: Brain injury, comatose, missile, outcome

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INTRODUCTION

Penetrating missile injuries due to bullets and bomb blasts are common in areas of conflict and are on an increasing trend.^[9,10,14,15,18] Gunshot wounds to the head are a growing problem in the United States. It has been projected that gunshot wounds will become a greater cause of death than motor vehicle accidents within this decade.^[1] Numerous studies have been published to describe the epidemiology and management issues regarding the calamity.^[11]

However, very few studies have focussed their attention on only those patients with a poor neurological status.^[11] This is especially important in underdeveloped and developing countries where neurosurgical facilities are available at limited places that have to cater to extremely large populations.

MATERIALS AND METHODS

A total of 101 patients of penetrating missile injuries to brain were admitted to the Department of Neurosurgery over a period of 3 years. Out of them only 26 patients were included in our study as they had a Glasgow coma scale (GCS) score of less than 8. Patients who had multiple organ injuries or had a GCS score of 8 and above were excluded from the study. The age ranged from 8 to 60 years with a mean age of 29.92 years. The cause of injury was either bullet, or it was a splinter injury from bomb blasts. Most of the patients reached the hospital without any field resuscitation, and primary contact care was provided by us as we are the only neurocenter in the area with a population of nearly seven million. As soon as the patients were received in the Accident and Emergency Department, they were resuscitated using the standard protocol of airway, breathing, and circulation (ABC). In all of these patients, mannitol, 1 g/kg of body weight, was administered intravenously. All the patients were started on anticonvulsants (phenytoin) and broad-spectrum antibiotics (ceftriaxone and sulbactam 1.5 g, iv, every 12 h, and Amikacin 500 mg every 12 h). The patients were shifted for a CT scan and then surgery or medical management was planned. The most common CT finding consisted of the clear visualization of the missile tract in brain parenchyma along with disproportionate edema which was more so with bullet injuries as compared to the splinter injury. Surgery consisted of wound debridement. In the surgical group, a wide scalp flap was raised and craniectomy was done in all the cases. The bone fragments were removed along with necrotic brain and hematoma. We did not attempt to debride the whole of the missile tract. All the patients were shifted to neurointensive units and managed on anti-edema drugs, antibiotics, and anticonvulsants. The patients who were in irreversible shock despite resuscitation or those who had symptoms of

brain death were not operated. Brain death was decided by the neurosurgeon and anesthesiologist together once patients were assessed in the emergency department. The outcome was assessed using the Glasgow outcome scale (GOS) with scores as follows: 1, death; 2, persistent vegetative state; 3, severely disabled; 4, moderately disabled (disabled but independent); 5, good recovery. Patients who had score 1, 2, or 3 were classified as having an unfavorable outcome (UO) and those with score 4 or 5 were classified as having a favorable outcome (FO). The follow-up ranged from 6 to 17 months (average 8.2 months). The data were analyzed by SPSS 11.5 software. The odds ratio was calculated to determine the likelihood association between various factors as the sample size was small. Than Fischer's exact test was used to determine the association between various variables and a *P*-value of <0.05 was taken as significant at a confidence interval of 95%.

RESULTS

A total of 26 patients were recruited for the study. We had grouped the patients into two groups of ≤ 18 years and >18 years of age. The number of patients in each group was 5 and 21, respectively. The likelihood of UO in patients >18 years of age was 28 times as compared to those ≤ 18 years and this yielded a *P*-value of 0.031 (CI = 1.77–379.4; Table 1). We had only 1 patient among 26 who was female; hence no statistical correlation could be achieved with respect to the sex of the patients.

Regarding modes of injury, the patients had either bullet injury ($n = 7$) or splinter injury caused by bomb blasts ($n = 19$). None of the patients with bullet injuries survived (OR = 1.6) while we had two patients with FO in the splinter injury group ($P > 0.05$; Table 1).

All the patients who had bihemispheric involvement died and the likelihood of having UO in patients with bihemispheric involvement was 15 times as compared to the unihemispheric involvement (OR = 15, $P = 0.07$; Table 1). Entry wound was in the supratentorial compartment in 24 cases and infratentorial in only 2 patients.

Most of our patients reported to the hospital within 2 h ($n = 20$) and only six reached afterward (however, all had reported before 3.5 h). The likelihood of having FO was 3.8 times in patients reporting early; however, this did not prove to be a statistically significant factor ($P = 0.41$, CI 0.338–43.42).

A total of 18 patients were in shock (BP $<90/60$) at the time of admission (postresuscitation) and none of these patients survived. The likelihood of having UO in patients with shock was 12 times as compared to those with a normal hemodynamic status. However, due to the small sample size, the *P*-value was 0.08 [Table 1].

Table 1: Relation between various variables and the outcome

Variable	Outcome		Statistical inference		
	Unfavorable	Favorable	P value	OR	CI
Age (years)					
>18	21	0	0.03	28	1.77–379.4
≤18	3	2			
Mode of injury					
Bullet	7	0	1.00	1.4	0.011–20.54
Splinter	17	2			
Lobes involved					
Bihemispheric	15	0	0.07	15	0.993–197.2
Unihemispheric (CT not done in 5 patients)	4	2			
Time interval (h)					
≤2	19	1	0.41	3.8	0.38–43.42
>2	5	1			
Hemodynamics					
Shock	18	0	0.08	12	0.856–151.45
Normal	6	2			
Pupils					
Nonreacting	17	0	0.11	9.7	0.704–121.5
Reacting	7	2			

CI: Confidence interval; OR: Odds ratio

A total of 17 patients were having pupils not reacting to light (FDP) and only 9 patients had reacting pupils (including anisocoria). All the patients who had dilated pupils had UO while we had two patients with FO in the other group, and so the chances of having UO was 9.7 times in patients with FDP as compared to those with reacting pupils [Table 1].

There was an equal number of patients who were operated and managed conservatively. There was no difference in the outcome in the two groups ($P = 1.000$; Table 1).

DISCUSSION

The incidence of missile injuries is on an ever-increasing trend due to the widespread increase in crimes and conflicts. Our state also being a disturbed area could not escape from this calamity. The initial significant work on the management of the patients is credited to none other than Harvey Cushing^[5] who advocated early surgery in these patients. He could reduce the operative mortality from 54% to 28%. Numerous studies have been published regarding the prognostic factors and management of these patients.^[11] However, the studies focusing on these patients with a low neurological status and their management are few.^[11] The authors explained their view points regarding the management of these patients;

however, all of the studies have been conducted in the centers with all the logistic resources available to them. In developing countries, this needs to be studied in their perspective as the resources are limited and the number of patients to be managed is far in excess of the resources. In this context, we tried to develop a protocol for their management. GCS is the strong predictor of the outcome in all head injuries irrespective of the etiology.^[1,2,11,16] The patients who present in a comatose state invariably have a poor outcome. In a study by Kaufman *et al.*, there was a mortality rate of 97% (83 of 86 patients) in patients with a GCS score of 3–5.^[10] In their study, only four patients had an admission score of 7 or less. They recommended no surgical intervention to be done in patients with a GCS score of 3, or with fixed dilated pupils. Levy *et al.*^[11] in their study on 60 patients with a GCS score of 5 or less found that only 2 patients had a good outcome. They and others concluded that patients with a GCS score of 5 or less are not likely to get any benefit from surgical intervention.^[4,13] In a series by Benzel *et al.*,^[3] 120 patients were reviewed. Among patients presenting with coma, only four survived. Grahm *et al.*^[7] prospectively studied the effect of aggressive field resuscitation, triage to a neurosurgical center, and early surgical intervention on the outcome in 100 patients. None of the patients with a GCS score of 3–5 had a good outcome. They found that the outcome improved as the GCS score increased, and concluded that the patients with an admission GCS score of 3–5 after resuscitation (without an operable hematoma) should not be operated. Levy *et al.*^[11] evaluated the outcome of patients who had a low GCS (5 or less) score. They had 60 patients in the series, and out of them only two patients had FO. The variables most predictive of mortality in their study included admission GCS score and subarachnoid hemorrhage in one model and admission GCS score and pupillary changes in a second model, when pupillary response was definitive at admission ($P \leq 0.00005$). In another study by Splavski *et al.*,^[16] the state of consciousness on admission was the most sensitive criterion as far as the prognosis was concerned. The outcome also depended on the extent of brain damage since the wounds associated with a high mortality rate were predominantly bihemispheric. Ansari and Panezai^[2] reviewed the data in their center, which were again from the developing world, and found that only 2 of 35 patients with a GCS score of less than 5 survived with severe disabilities. In our study, out of total 26 patients, only 2 patients survived, both having a GCS score above 3, and surgery had no benefit over conservative management. No patient with the GCS score under 4 survived. We found that none of our patients with bilateral dilated and nonreacting pupil survived, consistent with the findings of Suddaby *et al.*,^[17] while one patient with anisocoria (25%) had FO. In the Kaufman series,^[10] nearly half of the patients had hypotension and that was more common in patients

who died (58% versus 33%). In our study, we had 18 patients who presented with irreversible shock and all of them died (100%). The extent of involvement is a very strong predictor of outcome. Many series have reported a very high mortality rate in injuries with the missile tract crossing the midline. Kaufman found a mortality rate of 85% in his patients. In the Nagib series,^[13] only 3 patients out of 23 who had bihemispheric involvement had FO, and the mortality rate was 85% for those admitted with a score of 7 or less. This has also been documented in previous studies.^[7,10,13] We had no survivors among the patients with bihemispheric involvement. Graham^[7] found only 3 (5.6%) patients out of 53 who had moderate disability in this group and none had a good outcome. Martins *et al.*^[12] concluded that the surgical treatment is not recommended for patients with penetrating wounds and a GCS score of 3–5 in the absence of hematoma causing a mass effect. Suddaby *et al.*^[17] retrospectively reviewed 49 civilians with .22 caliber gunshot wounds. The mortality rate was 85% for those admitted with a score of 7 or less. All those with fixed pupils at admission died. They recommend no treatment in patients with an admission coma score of 3 and/or fixed pupils. In a series by Helling *et al.*,^[8] only 2 patients (out of 60 patients) with an admission GCS score of 3, 4, or 5 had a good outcome. One had an admission GCS score of 4, and the other had an admission GCS score of 5. Patients with bihemispheric injuries clearly had the worst prognoses. Age older than 55 years has been an independent risk factor for poor outcomes in another similar study.^[6] Kaufman *et al.*^[10] in their series had the best outcome in the under 10 year age group, worsening with the advancing age, the worst being after 50 years of age. Age >18 years in our series had a significant bad prognosis in the penetrating missile injury of the brain.

CONCLUSION

While analyzing the study, we conclude that in the places with limited resources that have to cater to a disproportionately large population, patients with missile injuries to brain and a GCS score of <8, having bilateral nonreacting pupils, or bihemispheric damage or

irreversible shock should not be offered surgery. However, a larger study is required to answer the question of efficacy of surgery in this group.

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