



Original Research Article

Prognostic factors and management of civilian craniocerebral gunshot injuries; an institutional experience

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ABSTRACT

Introduction : Surgeons face unique challenge in the management & prognosis related issues with intracranial gunshot injuries. These injuries are more commonly seen in military conflict zone. With easy availability of weapon and increase in the conflict between civilian and paramilitary forces, clinician are facing more numbers of civilian gunshot injuries. In India the presentation and prognosis of gunshot injuries is different as many of these gunshot injuries are by country made weapons. Country made weapons have low velocity and caliber; henceforth the outcome and the management issues are different. We present our experience with 23 patients who sustained intracranial gunshot injuries, and identify the factors determining the outcome and management

Material and methods: From March 2016 to September 2019 data was collected from 23 cases who were treated for intracranial gunshot injuries in Department of Neurosurgery at J. N. Medical College, Aligarh. History, type of weapon used, clinical condition and radiological findings were noted. Outcome was assessed by Glasgow's Outcome scale.

Results: Overall mortality was 26.08% (6/23). Of the 4 patients in GCS (3-7) group there was 100% mortality. Of the 5 patients in GCS group (8-12) mortality was 2 and one patient in persistent vegetative stage. All patients survived in GCS group (13-15). 5 patients underwent surgery; there was one mortality in the surgical group. Better outcome was noted in single lobe involvement and trajectory involving supratentorial noneloquent areas.

Conclusion : Early aggressive resuscitative measures may help in better management. GCS at presentation is the most important factor affecting outcome. CT scan offers to be an important predictor of prognosis and also help in planning the management. Suicidal wound, hypotension and midline shift has poor prognosis. We don't recommend aggressive exploration of the bullet tract & pellet removal for every patient.

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1. Introduction

Indian Laws are very stringent as far as gun control are considered. Indian Arm Act 1959 is very strict for granting the license for guns. But it has led to paradoxical effect, leading to increase in large number of illegal firearm second only to United States of America.¹ With the change in the society behavior and easy availability of country made weapons we are seeing frequent incidence of intracranial

gunshot wound. Firearm accident rate in India is 0.26 and bound to increase because of rapid proliferation of illegal weapons.² According to the National Crime Record Bureau's annual report of the year 2011, victims murdered by unlicensed firearms is 7 times more than those killed by the licensed ones.

Pipe guns, Katta or country made guns are frequently assembled from locally available cheap steel pipes and other materials. As compared to other weapons the country made weapon "katta" has got a lower muzzle velocity. Hence the clinical profile and ballistic of patient is different. About

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90% the victims die before prior to reaching at the hospital care, and for those who survive and make it to the hospital, further about 50% die in the emergency room^{2,3} Glasgows coma scale at presentation and the extent of brain injury on ct scan are the most important factors defining the outcome in such patients.² Recent literature shows low surgical intervention in cases of low GCS and bihemispheric injuries.⁴

We have analyzed our cases to establish the management protocol in intracranial civilian gunshot injuries. The aim of the study is to determine the prognostic factors and the treatment options.

2. Materials and Methods

In present study intracranial gunshot injury were retrospectively analysed. Between March 2016 to September 2019 Patients with extra cranial injury without dural breach and patients with other systemic injuries due to gunshot were excluded. Twenty three patients were included in the study. In all the cases the wound was closed after proper debridement. All patients underwent aggressive resuscitation according to the latest ATLS (Advanced trauma life support) guidelines. Seven patients underwent surgical management and rest were managed medically. The decision for surgery was taken by the attending neurosurgeon depending on the clinical status and the radiological findings. Surgery includes debridement of devitalised tissue, removal of bony fragments, evacuation of the hematoma, retrieval of the pellets or the gunshot and duraplasty.

The Glasgow Coma Sale score (GCS) at the scene was evaluated for all patients. Several studies have correlated poor neurological status (GCS 3-4) with poor outcome. We have divided our patients into three groups for analysing our results as done in several other studies.^{2,5} 15 patients had Initial GCS 14-15, five had initial GCS 9-13 and three patients presented with GCS 3-8. Each patient's outcome was assessed at discharge using the Glasgow Outcome Score (GOS): 1 = death; 2 = persistent vegetative state; 3 = severe disability (dependent on daily support); 4 = moderate disability (disabled but independent); 5 = good recovery. For statistical analysis, we classified patient outcomes into 2 groups: poor outcome (GOS, 1–2); and satisfactory outcome (GOS, 3–5).

Patients were considered hemodynamically unstable if systolic blood pressure was less than 90mm Hg. Ventilator requirement, pupillary reaction and extra ocular movements were noted. Wound examination was done at the site of entry and exit wound, brain herniation along with CSF, bony fragmentation. Type of weapon used and the local examination (entry wound and exit wound) were noted. Each patient was evaluated with CT scan, serial CT scan were done for patients who were operated or were neurologically unstable. Number of lobes involved, entry

and exit wound, presence of hematoma, transventricular trajectory, presence of midline shift and deep nuclear injury was also noted Chi Square test and Fischer test used to analyze the relation of different variable with outcome.

3. Results

The mean age was 30.04 years (SD= 15.92 years). The youngest patient was 8 year old child and the oldest was 75 years old. Most of the injuries were from Shotgun weapon (17/23) and six cases had rifled weapon injury. The mode of injury was mainly homicidal (15/23), there were five accidental gunshot and out of three patients had Suicidal gunshot injuries.

Four patients had pupillary asymmetry and two patients had bilateral dilated pupils at presentation. In 61% (14/23) of victims entry wound was in frontal region followed by temporal in 26% (6/23) of patients, 9% (2) in parietal and 4% (1) in fronto-occipital region. Only two patients had exit wound.

We have excluded patients with Non dural penetrating injuries. CT scan findings were note as in (Figure 1). Patients with Multilobar injuries had poorer outcome as compare to the unilobar injuries. Tran ventricular injuries and patients with evidence of midline shift had worse outcome with corresponding mortality of 2/6(33.3%) and 3/4(75%) (Table 1).

Out of the total 23 patients 15(65.2%) had good outcome, there were five (21.7%) mortality and three (13.04%) patients had GOS. 1-3. We have analyzed our outcome with respect to different variable Table-2. In our study homicidal and suicidal wound is associated with poorer outcome as compared to the accidental gunshot victims. If the patient is hemodynamically stable he has better chance of having a good outcome ($P=0.005$). A poorer Glasgows coma scale at presentation is associated with invariable poor outcome, none of our patient survived with GCS, 3-8, there was good outcome in group with GCS, 14-15 (13/15), despite having a poor GCS two out of five of our patients had good outcome in GCS 9-12.

4. Discussion

Management of intracranial gunshot injuries is guided primarily by the wartime experience and literature.^{6,7} The difference between the between intracranial gunshot wounds in civilian and those seen in wartime can be explained by the weapon involved and the ballistic wound physiology involved.⁸

Mortality after intracranial gunshot injuries is quite high, many studies have reported a mortality of more than 80%.^{9,10} The overall mortality in our study is relatively less (21.7%). The Civilian gunshot injuries in our region is different as many of the gunshot are from a country made weapon (pipegun/"kuttha").¹ These weapon usually

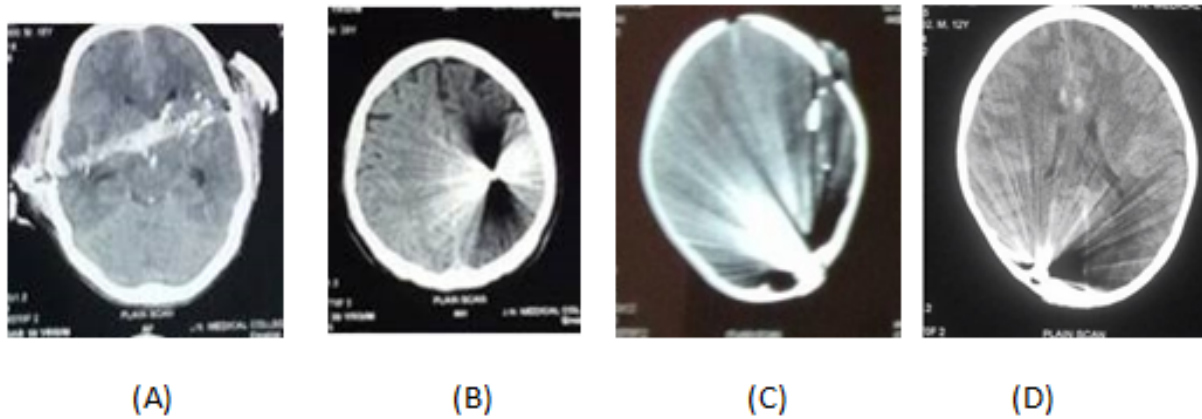


Fig. 1: Noncontrast CT Scan in a case of Intracranial Civilian Gun Shot Wound; (A): Showing transventricular trajectory of the gunshot with both entry and exit wound with pneumocephalus; (B): Unilobar pellet injury in posterior frontal area; (C): Bilobar involvement with the trajectory of the gunshot; (D): Showing Intraventricular blood with diffuse cerebral edema

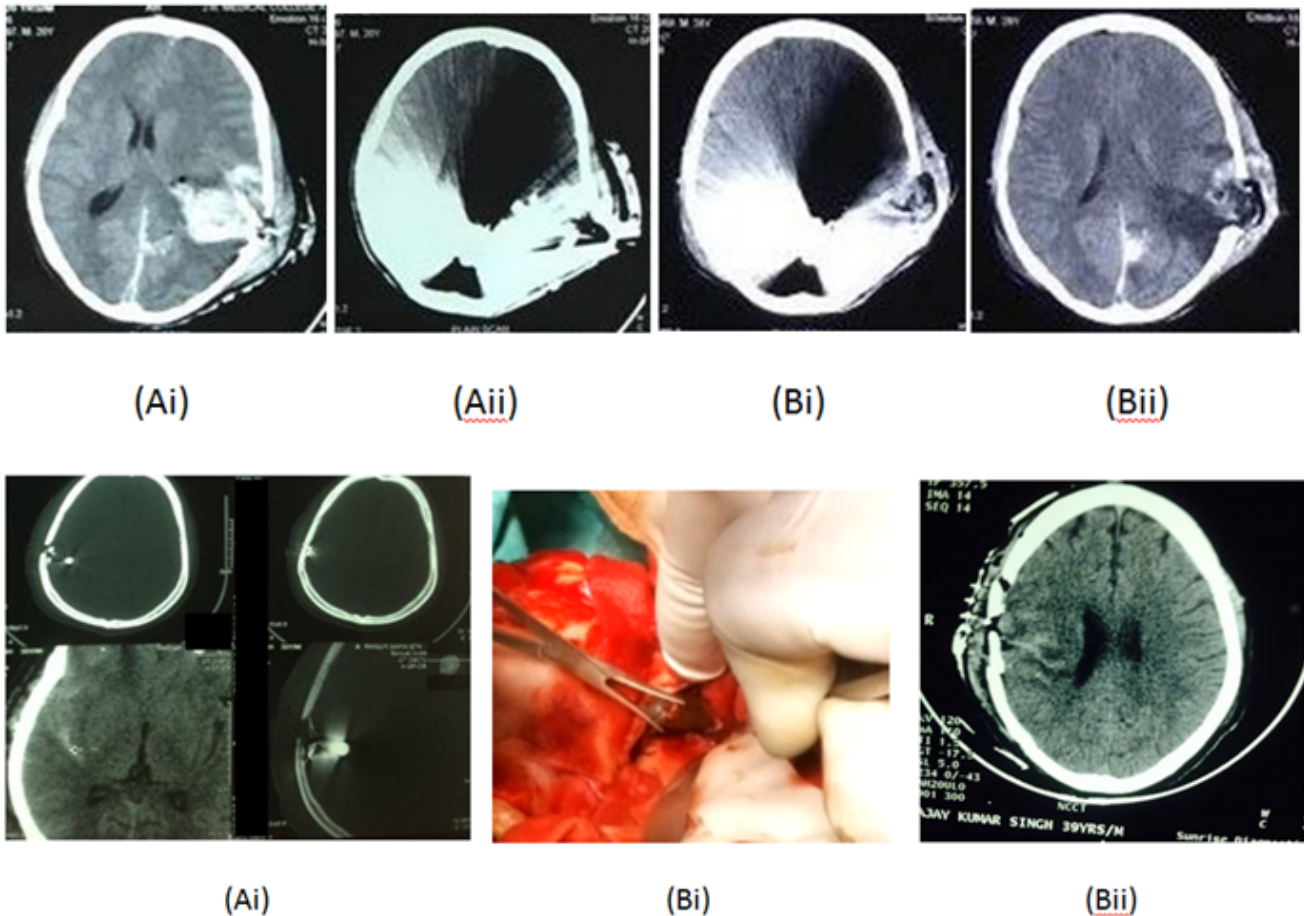


Fig. 2: Two illustrative cases: Case 1; (Ai, Aii) Shows a Intracerebral gunshot with the pellet insitu and large intracerebral hematoma with fracture fragment impinging on the brain tissue (Bi, Bii) Shows postoperative scan showed good evacuation of hematoma, decreased midline shift. Gunshot was left behind as it was deep seated. Case 2; (Ai) Shows a gunshot with depressed fracture and subarachnoid hemorrhage (Bi, Bii) Shows intraoperative images, postoperative scan.

Table 1: Outcome analysis of patient with respect to the Radiological finding

CT Scan Finding	No. of Patients	GOS 4-5	GOS 1-3	Death
Uni-lobar injury	13	9	2	2 (15.3%)
Multi-lobar injury	10	6	1	3 (30%)
Trans-ventricular injury	6	2	2	2 (33.3%)
Deep nuclei involvement	3	1	0	2 (66.7%)
Midline shift	4	1	0	3 (75%)

Table 2: Outcome analysis in relation to other variables

Variables		Good	Bad	P Value
Type of Injury	Suicidal/Homiscidal	10	5	0.02
	Accidental	5	0	0.32
Type of Weapon used	Shotgun	13	4	-
	Rifled	2	4	-
GCS	3-7	0	3	0.004
	8-15	15	5	-
Vitals	Stable	15	5	0.005
	Unstable	0	3	-
CT Scan Findings	Transventricular	2	4	0.226
	Significant Midline Shift	1	3	0.033
	Multilobar Injuries	2	4	0.224
	Deep Nuclear Involvement	1	2	0.134

have lesser velocity and different balastic profile.¹¹It can also be emphasized that in our study we have lesser number of patients with low GCS and unstable vital (n = 3). GCS was found to be most important factor in deciding the outcome, none of our patient in GCS 3 -7 survived. Despite this we recommend aggressive management for all patients as we have good outcome in GCS 8-12 with 3 out of five patients having good outcome. Suicidal wound and hypotension has poor prognosis. There is a statistically significant correlation between midline shift and poor outcome (p value 0.003). As compared to other studies though transventricular missile track is associated with poorer outcome in our study with a mortality of 66% but it was not stastically significant.⁴Vrankovic et al¹²proposed “aggressive” debridement along the missile and bone track¹³for every patient but we don’t recommend such aggressive approach as a rule for every patient.

Intracranial gunshot injury is identified as a highly lethal or devastating condition, producing marked consequences to the affected individual, the family and the health system itself. Unfortunately for the past few decades its incidence has been increased due to increased conflict between civilians and paramilitary forces and easy availability country made weapons. It is important to recognize the role of vigorous and intense resuscitation but should always be evaluated together with predictors of mortality, to provide an individualized treatment approach. The spectrum of gunshot injury and the clinical outcome in our group is different may be because of the weapon of injury is different. We also recommend further research in neurocritical care of such patients. Surgery is required for selected patients and

good resuscitative care is utmost important in management of these patient.

5. Conflict of interest

None

6. Source of funding

None

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