Civilian Craniocerebral Gunshot Injuries in a Developing Country: Presentation, Injury Characteristics, Prognostic Indicators, and Complications

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BACKGROUND: **Civilian craniocerebral gunshot injuries (CGIs) are rare but increasing in incidence in the developing world and there is scare literature on presentation, injury characteristics, prognostic indicators, and complications of brain trauma due to projectiles.**

METHODS: **A retrospective review of 51 civilian patients with CGI who presented to the Aga Khan University Hospital between 1998 and 2011 was carried out. Presentation, injury characteristics, and complications were analyzed with emphasis on outcomes and prognostic indicators.**

RESULTS: **There were 43 male and 8 female patients with an average age of 28.92 (±12.33) years. Twenty-three patients had a Glasgow Coma Scale (GCS) score of 13–15, 6 patients had a GCS score of 9–12, and 22 patients had a GCS score of 3–8 on admission. The overall mortality rate was 22% (n = 11). The most common postoperative neurologic deficits were motor deficits (19 patients) followed by aphasias (11 patients). On univariate analysis, admission GCS score and bi- or multilobar injuries were found to be highly predictive of neurologic outcome. There was no difference in outcomes between penetrating and perforating injuries. We also failed to find a statistically significant correlation between ventricular injury and outcomes in our patients.**

CONCLUSION: **Admission GCS and number of lobes involved are highly prognostic of outcome. Patients with a GCS score ≥9 and unilobar injury on computed tomographic scans may benefit the most from surgical management.**

INTRODUCTION

Firearm injuries have been on the rise especially in developing countries (2). Craniocerebral gunshot injuries (CGIs), initially described and managed in military settings, are now increasingly encountered by neurosurgeons in civilian and urban settings (36). However, civilian CGIs are caused by lower-velocity firearms, which cause less injury to the brain than those on the battlefield (17). Hence it is important to determine presentation, prognostic factors, management, and outcomes of CGI in civilian settings (27).

Pakistan is a developing country, with few resources. According to an estimate in 2001, there were just 35 neurosurgical centers, and one neurosurgeon for every 1.37 million population (32). Unfortunately, the increase in levels of violence and terrorism has changed the epidemiology of trauma in Pakistan (15), and doctors are increasingly encountering penetrating CGIs (25, 38). Most health facilities, especially in rural areas, are poorly staffed and equipped (10), and in the absence of emergency transport system (15), doctors have to make difficult decisions based purely on injury characteristics and clinical prognostic factors in CGIs. Because doctors in other developing countries would be faced with such scenarios, the goal of this retrospective study was to examine prognostic factors based only on injury characteristics and clinical presentation of such injuries. We also looked into how radiologic imaging at presentation affected prognosis. We were particularly interested in the Glasgow Coma Scale (GCS) and its components as these have previously been found to be important prognostic factors in other studies, but to our knowledge, no regional studies exist on civilian CGI.

PATIENTS AND METHODS

In this study, we considered 74 patients presenting with gunshot head injuries over a 13-year period (1998–2011) to our tertiary care

Key words
- Complications
- Craniocerebral gunshot injury
- Developing country
- Glasgow Coma Scale
- Injury characteristics
- Presentation
- Prognostic factors
- Trauma

Abbreviations and Acronyms
CGI: Craniocerebral gunshot injury
CSF: Cerebrospinal fluid
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Scale

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hospital in Karachi, Pakistan. Exclusion criteria included patients who were dead on arrival, had received surgical management at other facilities, had other gunshot injuries besides gunshot head injury, and had nondural piercing gunshot wounds. Application of exclusion criteria lead to final inclusion of medical records of 51 consecutive patients, which were retrospectively reviewed for the purpose of this study. The study was approved by the University Hospital Ethical Board.

Unlike First World countries, where healthcare services are highly developed, most of the patients with craniocerebral gunshot wounds in our setting were brought to our emergency department by friends or relatives and were not initially managed and stabilized by paramedics. On presentation to the emergency department, patients were managed according to the Advanced Trauma Life Support principles. Resuscitation efforts according to requirements included venous access and infusion of fluids, endotracheal intubation, and mechanical ventilation. Following hemodynamic stabilization, a complete neurologic examination was performed, patients were classified according to GCS, and computed tomographic brain scans were taken for all patients. Some patients were also ventilated as needed and received mannitol/hypertonic saline to lower intracranial pressure, along with prophylactic anticonvulsants and antibiotics. Depending on the assessment, the patients were managed conservatively or underwent limited or radical surgical management. Patients with a presenting GCS score of 3 or absent brainstem reflexes were managed conservatively. All other patients were managed surgically following informed consent from the families. The radical surgical management involved a decompressive craniectomy with judicious wound debridement and removal of almost all necrotic tissue, bone, and metallic fragments. The limited approach involved a craniotomy and removal of metallic fragments and bone where easily accessible with minimal manipulation. Which of the two approaches was eventually followed depended upon individual surgeon's preferences (**Figure 1**). Dura was closed using grafts of periosteum or fascia lata. Postoperatively, antibiotics and anticonvulsants were continued, H2 blockers and analgesics were added and patients were closely monitored in the intensive care unit. They were evaluated for any complications—seizures, infections (meningitis/brain abscess), hematoma, aphasia, hemiparesis/hemiplegia, cranial nerve deficits, hydrocephalus, and psychiatric or behavioral disorders—which were managed accordingly. Any cranial defects that occurred during injury or

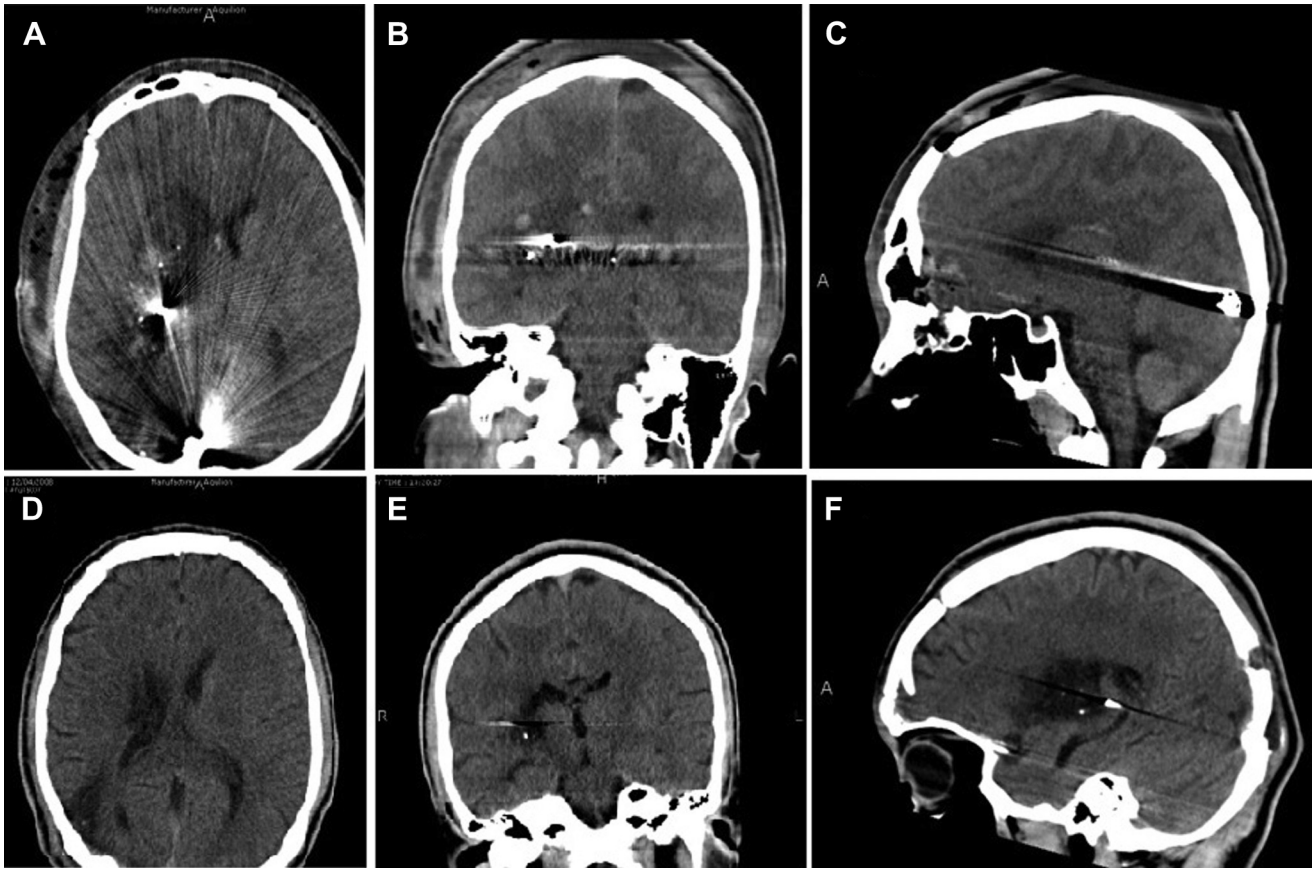

Figure 1. (**A**, **B**, **C**) Preoperative computed tomography (CT) scan images in which metallic shrapnel are identified in brain parenchyma along with hemorrhagic contusions in the right cerebral hemisphere with midline shift and ipsilateral brain edema. Right-sided subgaleal collection along with air is seen on the right side. (**D**, **E**, **F**) Postoperative CT scan images in which surgical changes are evident. Encephalomalacia, gliosis, and previously seen hemorrhagic contusions show resolution. Minimal residual shrapnel are seen. Surgical defect identified in posterior parietal region.