Case Report

A rare remarkable recovery in a pediatric patient with the bi-hemispheric, transventricular trajectory craniocerebral gunshot wound

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Abstract

The gunshot wound to the head (GSWH) is associated with a mortality rate of 20–90% in adults and 20–65% in the pediatric population. Due to the high rates of mortality and morbidity, the management of these patients has been a topic of high interest in the neurosurgical community. We present an 18-year-old male suffering a GSWH with the bullet following a transventricular trajectory and crossing the midsagittal plane, creating extensive intracranial injuries. Despite a calculated mortality rate of >97% from these devastating injuries, the patient survived the GSWH and made a remarkable recovery.

The young adult brain still maintains a high potential for neurological plasticity. This may partially explain why the young adult population with a severe GSWH can have a better than expected recovery course. Bifrontal GSW injuries may have much better outcomes than more posterior injuries as has been demonstrated in this patient in this case.

Introduction

The gunshot wound to the head (GSWH) is associated with a mortality rate of 20–90% in adults and 20–65% in the pediatric population [1–3]. Due to high rates of mortality and morbidity, the management of these patients has been a topic of high interest in the neurosurgical community. Treatment ranges from the pure medical management to decompressive craniectomies, in which different techniques have been reported to manage patients with GSWH with varying success [4, 5]. The GSWH with the bullets crossing the midline, injuring the ventricles and causing cerebrospinal fluid (CSF) leaks, is associated with a mortality rate of up to 83% [5]. Similarly in the pediatric population, penetration of 3 or more lobes, a transventricular trajectory, intracranial pressure (ICP) >30 cm H2O, third ventricular and/or deep nuclei injury and bi-hemispheric injuries are prognostic criteria for fatal injury [1]. Based on these criteria, the St. Louis Scale for Pediatric Gunshot Wounds to the Head, which studied patients aged from 9 days to 17 years with scores ranging from 0–20, was developed to help guide the clinical decision making [1]. This system, due to the high rate of mortality, suggests that a patient with a score of 5 or higher should first undergo medical management and further, more invasive, treatment depending on the patient’s ongoing clinical status [1].

Here, we present an 18-year-old man suffering a GSWH, the bullet followed a transventricular trajectory and crossed the midsagittal plane, creating extensive intracranial injuries. Despite a calculated mortality rate of >97% from these devastating injuries, the patient survived the GSWH and had made a remarkable recovery. Upon review of the literature, no report is
available detailing such a remarkable recovery of a patient suffering these devastating injuries with features that according to the current literature predicted the high probability of poor outcomes.

**CASE REPORT**

An 18-year-old male presented to the hospital with a GSWH. It was reported that the bullet entered the skull from the left frontal region and exited from the right frontal region (Fig. 1). The patient had a Glasgow Coma Scale (GCS) score of 6. The initial examination revealed an intubated patient with reactive pupils and intact brain stem reflexes. The patient was only withdrawing on the left side, and no movement was noted on the right side to stimulation. The computed tomography (CT) scans showed extensive cranial injuries, including the bifrontal lobe injuries, diffuse subarachnoid and intraventricular hemorrhage. The patient underwent the placement of an external ventricular drain. Given the persistent high ICP (>30 cm H₂O) despite maximal medical managements, the patient underwent the left frontal temporal decompressive craniectomy with the resection of the necrotic tissues of the anterior left frontal lobe. As expected from the location of the injury, the patient developed diabetes insipidus and was effectively treated with desmopressin (DDAVP). Subsequently, the patient developed CSF rhinorrhea. The CSF was found to be infected and was treated with i.v. vancomycin and oral rifampin. As a treatment of CSF rhinorrhea, the patient underwent the cranialization of the left frontal sinus. Clinically, the patient continued to improve, becoming more alert and was able to follow simple commands in all extremities without a focal weakness. At 11-month post-injury, the patient underwent an elective left frontotemporal cranioplasty (Fig. 2). Despite being dysarthric, the patient was able to carry out a conversation, exhibited a non-focal neurological examination, and was able to ambulate independently.

**DISCUSSION**

A bullet that transverses the anteroposterior plane carries the mortality rate of 25% as opposed to the 83% mortality rate for the bullet that crossed the midsagittal plane, mainly due to the involvement of both hemispheres [5]. There is a high probability of death or poor outcome if the areas of injury include the brain stem, eloquent cortex or ventricles [1, 5, 6]. Patients presenting with a GCS < 5 have a mortality rate nearing 100% [5]. In fact, Hofbauer et al. [7] determined GCS to be the most important predictor of overall outcome. In particular, studies by Rosenfeld and Kennedy et al. have concluded that GCS scores of 3–5 are correlated with an 8.1–8.6% survival rate, GCS scores of 6–8 are correlated with a survival rate of 25.5–38.8% and GCS scores of 9–15 are associated with a survival rate of 90.5% [6, 8, 9]. Extrapolating from these findings, the patient presenting to our institution with a GCS of 6 was expected to have a poor outcome with a calculated survival rate of <40%. Even worse, the St. Louis Scale score of 6 predicted a survival rate of <3%. Given this high rate of mortality based on GCS and St. Louis Scale score, it was decided that early surgical intervention was unlikely to improve the overall outcome. Hofbauer et al. [7] reported that only patients suffering a single lobe injury and presenting with a GCS score >8 and a normal pupillary reflex may benefited from early aggressive surgical management. Brandt et al., recommended surgery only to those pediatric patients with a St. Louis Scale score of <5. It has been shown that a GSWH penetrating the ventricles is more likely to be catastrophic due to the increased risk of infection, CSF flow obstruction, irritation and hemorrhage [6]. Due to the failure of the medical management to control the high ICP, decompressive craniectomy was eventually performed on our patient. Although the current literature predicts poor outcomes in
patients with GSWH injuring bi-hemispheres and ventricles, this may not apply equally to the pediatric population. The potential reasons behind why this patient is enjoying better than expected outcome may be a result of his young age, which still maintains the potential for neurological plasticity, the fact that less than three lobes were involved and that the majority of the injury occurred in the bifrontal lobes [1]. As such, young patients with GSWH having features that predict poor outcomes, based on the current data, may still benefit from aggressive measures. Bifrontal GSW injuries may have much better outcomes than more posterior injuries as has been demonstrated in this patient in this case.

CONFLICT OF INTEREST STATEMENT
None declared.

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