

Mini Review

# Management of Gunshot Wound to the Head in Pediatric Population: Mini-Review

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Keywords

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- Pediatric population

Abstract

Gunshot wound to the head (GSWH) has 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 remains a topic of high interest. Here, we present the current data on and management of GSWH in the pediatric population. The St. Louis scale for pediatric GSWH can be utilized to stratify risks and guide clinical decisions. However, it is important to recognize that pediatric brains may still have the potential for neurological plasticity and can still benefit from aggressive measures despite severe GSWH, especially in patients with bifrontal GSWH injuries.

ABBREVIATIONS

TBI: Traumatic Brain Injury; GSWH: Gunshot Wound to the Head; GCS; Glasgow Coma Scale

INTRODUCTION

Gunshot wound to the head (GSWH) is a common clinical presentation in emergency rooms throughout America accounting for approximately half of the 50,000 annual traumatic brain injury-related deaths [1-3]. GSWH has a mortality rate of 20-90% in adults and 20-65% in the pediatric population [4-8]. It is associated with a 71% probability of causing death at the scene [4]. In fact, in the 1986 article written by Kauffman et al. it was shown that 14% of patients with GSWH died at the scene within 5 hours, 13% died between 5-48 hours, and less than 2% died more than 48 hours after the GSWH [4]. Aarabi et al., confirmed these findings in their 2014 study, which showed that 76% of GSWH led to death at the scene and 15% during the hospitalization stay [1]. As a result of high rates of mortality and morbidity, the management of these patients remains a topic of high interest. Here, we present the current data on and management of GSWH in the pediatric population.

MANAGEMENT OF PEDIATRIC GSWH

Discussion

GSWH injuries are considered some of the most challenging cases encountered in a neurosurgery practice. Treatments vary from the pure medical management to decompressive craniectomies [1,9]. Recent studies demonstrated the benefit of

rapid decompressive craniectomies to relieve the intracranial hypertension resulting from the blast injury of the GSWH [1]. Others reported that only patients suffered a single lobe injury and presented with a GCS score >8 and a normal pupillary reflex may benefit from an early aggressive management [10]. As data emerging, certain features of GSWH are found to be associated with poor outcomes despite aggressive treatments (Table 1) [1,9-12]. For example, The bullet crossing the anteroposterior plane carries the mortality rate of 25% as opposed to the 83% mortality rate for the bullet that crossing the midsagittal plane, mainly due to the involvement of bilateral hemispheres [9]. Studies in pediatric population demonstrated that penetration of 3 or more lobes, a transventricular trajectory, ICP >30 cm H<sub>2</sub>O, third ventricular and/or deep nuclei injury, and bihemispheric injuries are prognostic criteria for fatal injuries [5]. Using these criteria, The St. Louis Scale for Pediatric Gunshot Wounds to the Head, with scores ranging from 0-20, was developed to help guiding the

**Table 1:** The table summaries clinical and radiological findings associated with poor outcomes according to multiple studies [5,9,11,13,14].

Clinical and Radiological Factors Predicting Poor Outcomes
Bullet crossing the anteroposterior plane
Bullet crossing the midsagittal plane
Injuries to 3 or more lobes
Injuries to ventricles, brain stem, or eloquent cortex
ICP >30 cm H <sub>2</sub> O
GCS < 8
St. Louis Scale score <6

clinical decision [5]. This system, due to the high rate of mortality, suggests that a patient with a score of 5 or higher should first undergo only medical therapies and further treatment plan depending on the patient's ongoing clinical status [5]. In addition, injuries involving the brain stem, eloquent cortex, or ventricles also have a high probability of death or poor outcomes [5,9,11]. Given these findings, there are several necessary key features to be assessed to help with developing a treatment plan when treating these injuries. These features include the trajectory of the bullet, the location of the injury especially the side of the injury, and the clinical presentation of the patient such as the GCS score. In fact, Hofbauer et al., determined GCS to be the most important predictor of overall outcome [10]. Consistent with other studies, Rosenfeld and Kennedy et al concluded that GCS scores of 3 to 5 are correlated with an 8.1-8.6% survival rate, GCS scores of 6 to 8 are correlated with a survival rate of 25.5-38.8%, and GCS scores of 9 to 15 are associated with a survival rate of 90.5% [11,13, 14]. However, the pediatric population appears to fare better even when presented with GSWH injuries with features predicting poor outcomes [5,15]. We, in fact, reported a young patient harbored a calculated St. Louis Scale score of 6-suggesting a mortality rate of 97%-survived the severe GSWH and made a remarkable recovery [16]. We suggested bifrontal GSWH injuries may have much better outcomes than more posterior injuries [16]. The pediatric brain may still maintain a high potential for neurological plasticity. This may partially explain why pediatric patients with GSWH having a better than expected recovery course. These patients may still benefit from aggressive measures despite having severe GSWH injuries.

## CONCLUSION

The St. Louis scale for pediatric GSWH can be utilized to stratify risks and guide clinical decisions. However, it is important to recognize that pediatric brains may still have the potential for neurological plasticity and can still benefit from aggressive measures despite severe GSWH, especially in patients with bifrontal GSWH injuries.

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