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Case Report

# A Low-Velocity Semi-Wadcutter Bullet Resulting in a Fatal Traumatic Brain Injury: A Case Report

**Salih O. Al-Ani[1], Saja A. Albanaa[2*], Ezzeddin K. Alhajjaj[1], Aktham O. Al-Khafaji[2], Bahaa Muhsen[3], Samer S. Hoz[4]**

[1]Department of Surgery, College of Medicine, The Hashemite University, Zarqa, Jordan

[2]Department of Surgery, University of Baghdad, College of Medicine., Baghdad, Iraq

[3]Division of Neurosurgery, Department of Surgery, King Huessin Cancer Center, Amman, Jordan

[4]Department of Neurosurgery, University of Cincinnati, Cincinnati, Ohio, United States

[*]**Corresponding author:** Saja A. Albanaa, Department of Surgery, University of Baghdad, College of Medicine., Baghdad, Iraq

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## Abstract

**Introduction:** Traumatic Brain Injuries are becoming increasingly common worldwide, particularly in countries with political instability and those allowing unrestricted access to firearms. The authors report a rare case of low-velocity Semi-Wadcutter bullet, a presumably "safe" weapon used for target shooting, causing a fatal penetrating traumatic brain injury in a young male victim. The paper aims to demonstrate the lethal potential of these bullets. To the best of our knowledge, this is the first documented head injury case in the literature for this type of bullet.

**Case:** A 32-year-old male was brought to the emergency department having sustained a bullet injury to the head. His Glasgow Coma Scale at admission was 5/15 (E1M3V1). A cranial computerized tomography showed an unknown penetrating missile object settling in the midline at the foramen of Monro. The patient was admitted to the neurocritical care unit and subsequently deteriorated and died at 20 hours post admission. The autopsy report identified the missile object as a Semi-Wadcutter bullet.

**Conclusion:** Severe traumatic brain injuries caused by low-speed bullets are thought to be extremely rare, but in our case the Semi-Wadcutter bullet, passed through the left front lobe to settle in the foramen of Monro. There is a case for challenging the safety of such missiles and for imposing new restrictions on accessibility and use.

**Keywords**: Bullet Head Injury; Penetrating; Traumatic Brain Injury

**Abbreviations**: CT: Computed Tomography; m/s: meters per second; GCS: Glasgow Coma Scale; ICP: Intracranial Pressure; IVH: Intraventricular Hemorrhage; SWC: Semi-Wadcutter; TBI: Traumatic Brain Injury.

## Introduction

Traumatic Brain Injuries (TBIs) are becoming increasingly common worldwide, particularly in countries with political instability and those allowing unrestricted access to firearms [1]. TBIs are classified as closed and penetrating injuries. Penetrating TBIs are less common, tend to be more severe, and carry worse prognosis than closed TBIs, with survival rates of 13% and 96%, respectively [2,3]. Penetrating TBIs are categorized into low and high velocity injuries, with a cutoff speed of 457 m/s [1,3]. Besides velocity, bullets can be divided into two groups based on their configuration: solid nonexpanding bullets and expanding bullets. The former group has greater penetration, while the latter can cause more extensive tissue damage [4]. The Semi-Wadcutter (SWC) is a low-velocity bullet, designed for hunting, target shooting, and self-defense [5]. Here, we report a rare case of low-velocity SWC bullet causing a fatal penetrating TBI in a young male victim to demonstrate the lethal potential of these bullets. To the best of our knowledge, this is the first documented case in the literature

## Case Description

A 32-year-old male was brought to the emergency department by ambulance with a penetrating TBI. Emergency medical workers reported that the patient was injured by a bullet to the head during crowd protests in Baghdad. No eyewitness was available, and the patient had no medical records. The patient had a Glasgow Coma Scale (GCS) of 5/15 (E1M3V1), a left frontal penetrating wound, and bilaterally midsized pupils with sluggish light reaction. His vital signs were normal. A cranial computerized tomography (CT) showed an unknown penetrating missile object settling in the midline at the foramen of Monro, intraventricular hemorrhage (IVH), pneumocephalus, and a small left frontal depressed skull fracture with no evidence of hydrocephalus (Figures 1-3). The patient's GCS did not change after initial resuscitation trials. He was admitted to the neurocritical care unit to lower his intracranial pressure. The patient was pronounced dead 20 hours after admission. The autopsy report identified the missile object as a Semi-Wadcutter (SWC) bullet of .44 magnum caliber (Figure 4). The report also confirmed the imaging findings.

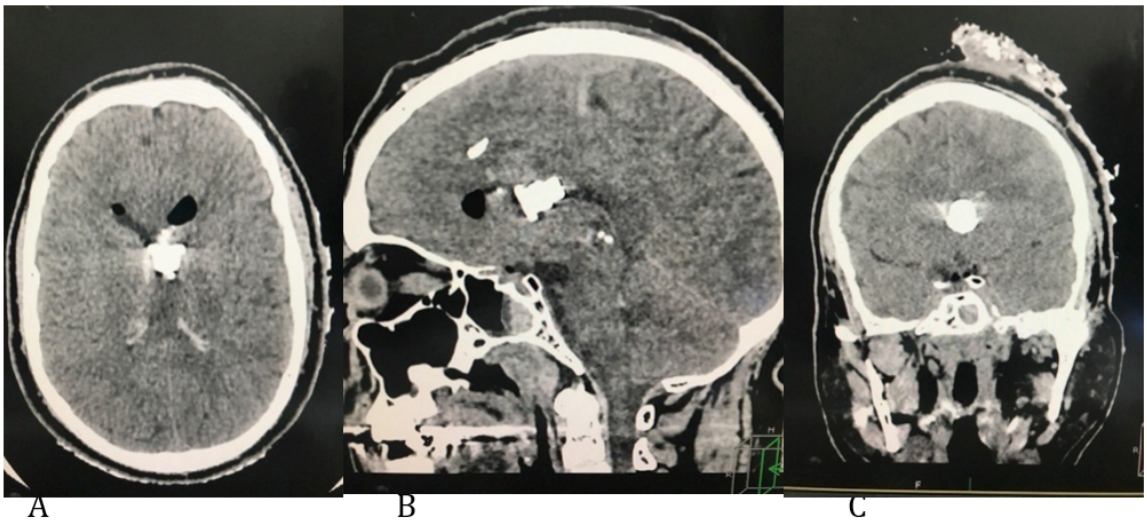


**Figure 1:** Axial (A), sagittal (B), and coronal (C) views of non-contrast head CT scan revealing a hyperdense foreign object residing near the midline at the foramen of Monro.

**Figure 2:** Sagittal view of head CT scan (bone window) revealing a hyperdense object near the third ventricle.

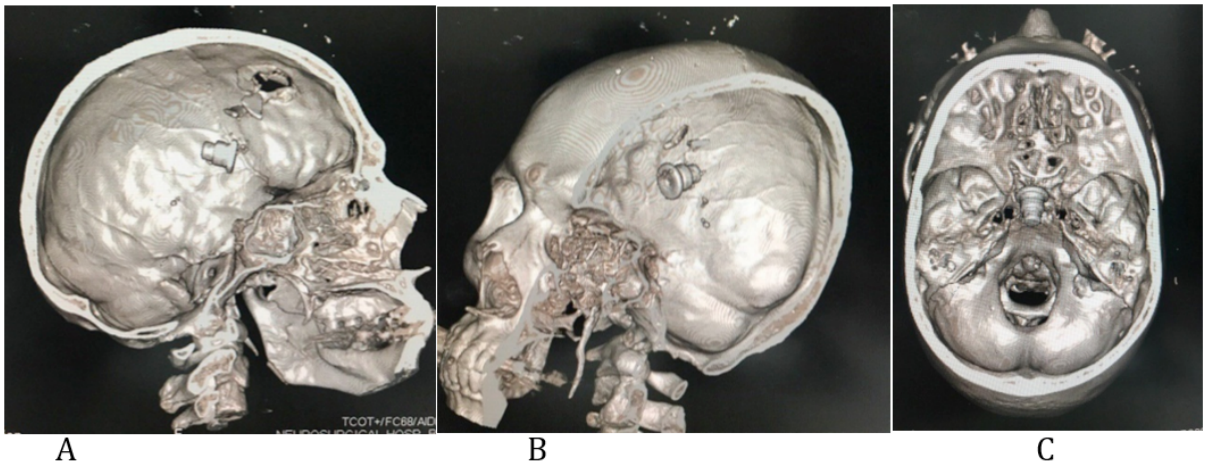


**Figure 3:** 3D reformatted head CT scan showing a penetrating missile object settling near the midline and a small left frontal depressed skull fracture.

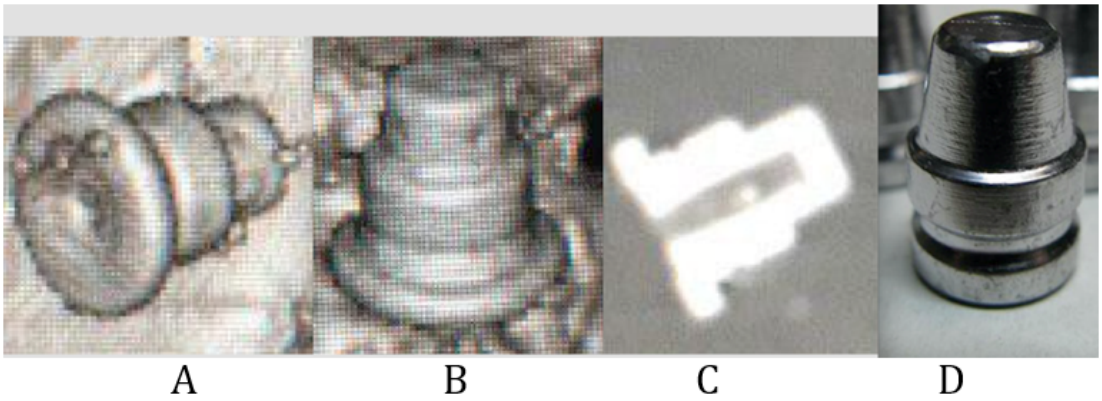


**Figure 4:** A and B: zoomed-in 3D reformatted head CT scan showing the penetrating missile object. C: zoomed-in sagittal view head CT scan showing the hyperdense missile object. D: intact semi-wadcutter bullet. Note how the bullet shape was changed after firing in contrast with what its shape was before firing.

## Discussion

Penetrating TBIs are increasingly recognized as a global concern. Bullet-induced penetrating TBIs are more common in developing countries, often resulting in debilitating injuries [1]. TBIs were first classified and studied by Harvey Cushing during World War l. Matson then modified Cushing's classification during World War ll. Both Cushing and Matson were the pioneers of the systematic guidelines upon which contemporary TBIs management and understanding depend [1]. Conventionally, if a bullet is fired with a speed not exceeding 457 m/s, it is said to be of low-velocity [6]. The current literature lacks sufficient evidence on low-velocity-bullets-induced TBIs that are generally thought to be milder and have reasonably good clinical outcomes. Our data are mainly derived from retrospective observational civilian and military studies [7-9]. Historically, numerous experimental studies have been conducted to demonstrate the clinical outcomes of TBI caused by low-velocity bullets. One neuropathological study has reported various changes, including cerebral edema were documented 24 hours after a skull penetrating gunshot wound caused by a low-velocity bullet [6]. Patient's GCS at admission is understood to be the most important prognostic factor for patients with penetrating TBIs [10]. However, the management decision is often made in lieu of other prognostic parameters, including the presence of surgical lesions, elevated intracranial pressure, multimodality evoked responses, status of brainstem reflexes, decerebrate rigidity, patient's age, and hypotension [11]. The present case is a gunshot injured young male, with an admission GCS of 5/15. The brain CT scan identified a SWC bullet settling at

the foramen of Monro after penetrating craniocerebrally through the left frontal lobe. Given the unpredicted outcome of such patients, their surgical management usually present a dilemma to the treating multi-disciplinary team [12]. The primary cause of death in TBI patients is increased intracranial pressure, which leads to secondary brain injury leading to a vicious cycle of brain damage [13]. Currently, continuous ICP monitoring is recommended in in these patients [12]. In this case, ICP monitoring was achieved and the pressure was lowered in accordance with international protocols [14]. Despite vigorous resuscitation trials, our patient showed little progress and quickly declined. The patient died twenty hours after admission**.**

### Conclusion

Serious TBIs caused by low-velocity bullets are thought to be exceedingly rare, but in our case a low-velocity SWC bullet induced lethal head injury by passing through the left front lobe to settle at the foramen of Monro. An argument is made to question the safety of such missiles and to introduce new accessibility and usage restrictions.

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