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Similarities and differences between two coincidently gravitational bullet cases. A case report from Iraq

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traumatic brain injury, craniocerebral falling bullet, aerial firing, advanced trauma life support

Abstract

Many cases of gravitational bullets are reported in developed and non-developed countries. However, few papers highlighted these cases in the literature. In our study, we present two cases of gravitational bullets that have an unusual coincidence in the injury characteristics through their ages, and gender, the site of the inlet.

Introduction

Traumatic brain injury (TBI) is young people's most common cause of death and disability. Represented by disruption of the brain function when physical force is applied to the brain, in case an object hits the head violently and suddenly or when an item pierces the skull and enters the brain (1). The annual incidence of TBI is estimated at 50 million cases worldwide; this means that half of the international population has occasion of TBI in their life (2). Higher mortality and morbidity rates in TBI were found in low- and middle-income countries, making this a global health problem (2). A concussion is among the most common form of TBI; the other types might be in the form of a bullet. In aerial firing or celebratory firing, when the bullets are shot into the sky for celebration or anger expression in some countries, the bullet will firstly move under the effect of explosive acceleration, this velocity will decrease according to the gravity force, and finally, its velocity will reach zero, at this moment the bullet will move downward. Its velocity will be increased by the gravity force until reaching the final steady velocity when the air resistance drag equalizes the effect of gravity. The bullets injury caused by this mechanism is called gravitational bullets or

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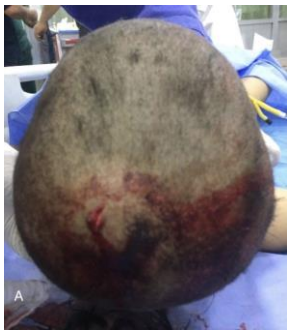
falling bullets (3). As the minor victims do not go for medical care and death at the scene is not recorded in the hospital, the incidence and outcome of the gravitational bullet are complex and challenging. However, high numbers of falling bullets are announced in the news media, and this number is increasing as firearms are more accessible and available (4). In this paper, we present two cases of randomly gravitational bullets with the characteristic of coincidence in their names, age, site of the inlet, and most site of the bullet inside the brain; no previous study highlighted such discussion about this issue.

THE CASES SCENARIOS

The two incidental cases were urgently admitted to the Neurosurgical emergency department on the same day, complaining that an unknown object had struck their child's head, resulting in minor bleeding (figure 1A) (figure 2A); both families and children were not sure of what had hit the dome. Both patients had the same name and gender, and both were in six years old; the site of inlet injury was in the midline parietal area (figure 1C) (figure 2C).



A.

B.

C.

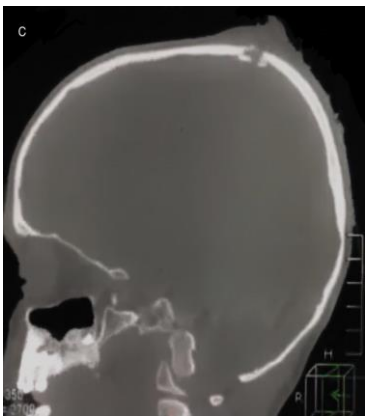
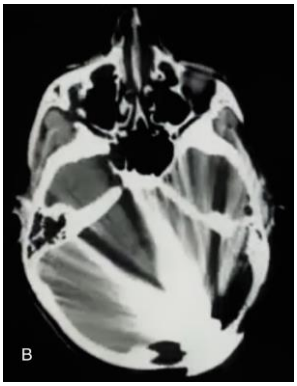


Figure 1. (**A**) superior view of scalp showing site of wound, (**B**) Computed tomography (CT) scan of the brain showing an axial view in which a metallic artefact is seen near left petrous bone, (**C**) CT scan bone window sagittal view showing site of bullet entrance of the first patient.

A complete neurological examination revealed that both patients were unconscious, Glasgow coma scale (GCS) was 11, 12, with right-sided weakness grade 4 in both. A skull x-ray was ordered, surprisingly revealing a bullet inside the skull. A non-contrast brain computed tomography (CT) scan revealed no significant hemorrhage or soft tissue edema and the location of the bullet was confirmed to be near the left petrous bone in the first patient (figure 1B) and left cerebellar hemisphere in the second patient (figure 2B). In the emergency room, the wound was cleaned and redressed; after that, both of them were given amoxicillin and carbamazepine for protection against infection and convulsions. Conservative treatment was chosen, and the parietals were neurologically intact on a 6-month follow-up.

A.



B.

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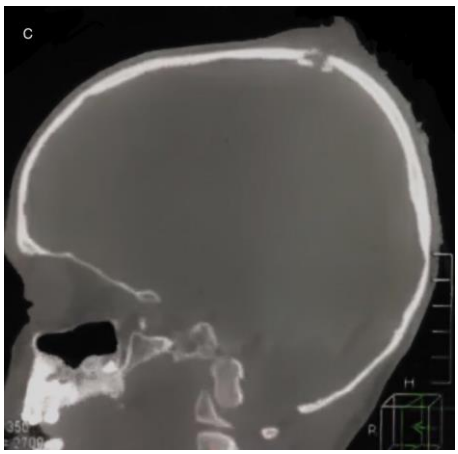

Figure 2. (**A**) superior view of scalp showing site of wound, (**B**) Computed tomography (CT) scan of the brain showing an axial view in which a metallic artefact is seen in left cerebellar hemisphere, (**C**) CT scan bone window sagittal view showing site of bullet location of the second patient.

Discussion

TBI is an important cause of morbidity and mortality in developed and industrialized countries. The estimated incidence of hospitalized patients with one or more TBIs is 57 million cases worldwide (5). In the United States, the annual average of patients with TBI is 1.4 million, 1.1 million recorded from emergency department visits, 235,000 were hospitalized, and 50,000 were dead. Regarding gender and age variability, the occurrence of TBI in males is twice as females. For emergency visits, hospitalizations, and deaths combined, children aged 0-4 years and 15-19 years are more likely to suffer from TBI than other ages; for hospitalizations the adults aged 75 years and older have the highest incidence (6). The important causes of TBI are falls, vehicle crashes, blasts, and bullets; sports and recreation activities are also important causes of TBI, including concussions (6). Of patients who die from TBI, 90% of them die within 48 hours of injury, frequently because of uncontrolled raised intracranial pressure that leads to brain stem herniation and death (7).

Craniocerebral gunshot wounds by areal firing are one of the TBI categories that involve bullets injury falling vertically onto the head after being shot into the sky; the primary cause of this situation is the gravity force that pulls the bullet downward when its muzzle force decreases until reaching the zero. This situation mostly occurs in celebrating events, military and civilian conflicts, or in cases of anger expression in some regions like North Africa, South America, the Middle East, and the middle of Asia. Iraq has been involved in many conventional and unconventional wars in the last three decades, becoming one of the most heavily armed nations. These injuries are frequently non-intentional, and the bullet escapes the sociodemographic space or perimeter customarily organized by the circumstances surrounding the firing. So, the source of firing is apart from the scene of injury (9).

Although the terminal velocity of the bullet is lower than its muzzle, the bullet shot upward may not come back downward. However, it may still cause severe brain injury with a high mortality rate (10). Only bullets that travel at 150 feet/second (46 m/s) to 170 feet/sec (52 m/s) can pierce the skin, while at less than 200 feet/sec (60 m/sec) can pierce the human skull and get entrance to the brain (11,12). In general, the mortality rate of falling bullets, about 32%, is more significant than non-falling bullets, with a 2-6% mortality rate.

The death cases of falling bullets may sometimes mimic the sudden death without apparent cause, specifically in those with prior medical history (3). Managing patients with acute life-threatening traumatic injuries are sometimes challenging and anxious, even for experienced clinicians. To provide an effective and easy approach to management, the American College of Surgeons developed the advanced trauma life support (ATLS) program for initial assessment, stabilization, and management of such injuries starting from brief history. Then assessment of (airway, breathing, circulation, disability, and exposure) focused history with a physical exam to the injured area (such as GCS, scalp laceration, avulsions, and open skull fractures) after that recognize the specific problem, for such injury should refer to radiology including CT scan and finally start with the specific treatment (12).

For craniocerebral wounds, the management may be just conservative. At the same time, if there is any serious indication, the surgery should be done urgently through bullet ablation, debridement of injured tissue, and evacuation of the hematoma. The outcome of patients with falling bullets is based mainly on the age, GCS of admission, pupil reactivity, the course of bullet through the brain, presence of injured structures, and patency of basal cisterns (13). It is important to highlight the relation between psychological reaction toward the gravitational bullet and its prognosis; the magnitude of psychological trauma is frequently disproportionate to the prognosis, which means that whenever the traumatic reaction is strong, the prognostic management outcome will be more than better.

The gravitational bullet is completely different from the cases of homicidal or suicide because the occurrence of the first one is always unexpected, and its prognosis or outcome is better than the other two cases. Regarding traumatic psychological reaction of the family and patients, there is also a difference between them; in the event of a gravitational bullet, they react fearfully more than in other situations because the occurrence is unexpected and unknown. Many cases of gravitational bullets are reported in developed and non-developed countries. However, few papers highlighted these cases in the literature. In our study, we present two cases of gravitational bullets that have an unusual

coincidence in the injury characteristics through their ages, and gender, the site of the inlet was in the midline parietal area. Patients were unconscious on their examination, the Glasgow coma scale (GCS) was 11, 12, with right sided weakness grade of 4.

The location of the bullet inside the brain was confirmed by non-contrast CT scan, which was revealed to be near the left petrous bone and left cerebellar hemisphere for the first and second case, respectively; there was no significant hemorrhage or soft tissue edema. The initial management for both cases in the emergency room was cleaning, redressing, and drug coverage by amoxicillin to prevent wound complication by infection and carbamazepine to prevent epileptic attacks. Conservative treatment was chosen and the parietal were neurologically intact on 6-month follow-up. the similarities and differences of both patients were recorded and documented in Table 1.

Table 1. Similarities and differences between two gravitational bullet cases

Similarities	Differences
Name	Site of inlet: midline parietal area
Age: both were 6 years old.	The GCS: was 11 in the first case and 12 in the second one.
Gender: both were male.	Location of bullet inside the brain: was near left petrous bone in the first case while left cerebellar hemisphere in the second one.
Time of admission: same day	
Knowledge about the injury: patients and families of both cases were unknown about their child's cause of injury.	
Neurological deficit: both had right side grade 4 weakness.	
Pathology in brain CT scan: both patients had not significant hemorrhage or soft tissue edema.	
Initial management in the emergency room by giving amoxicillin and carbamazepine to prevent wound complication and epileptic attacks.	

The occurrence of same injury at different location in different patients with same age, gender, site of inlet and time of admission was incredible that may base on scientific cause or not. Such situation was challenging to be resuscitated and managed at the same time and this circumstance had occurred once till now in our center. In Iraq, there is unstable security situation and huge numbers of traumatic cases can be seen, at the same time the Neurosurgical Teaching Hospital is considered to be one from three centers in Baghdad that receive and manage such urgent cases which represent a further challenge to the health care professionals. So, well-trained team with the appropriate skills for the particular cases are needed to prevent the occurrence of complication in such urgent admission. The problem caused by this coincidence should be addressed from training perspective and there is no previous study highlighted such discussion about this issue before.

Conclusions

The prevalence of aerial firing that result in gravitational bullet injuries is alarming on rise especially in countries of unstable security, the occurrence of this injury may happen in more than one patient at the same time coincidently. So, this issue should be addressed for any department treating such urgent injuries to be trained and prepared in order to prevent or decrease the occurrence of complication and death.

Abbreviations

TBI - Traumatic brain injury,
GCS - Glasgow coma scale,
CT - Computed tomography,
ATLS - Advanced trauma life support.

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