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Pediatric gunshot penetrating on transverse sinus without graft

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ABSTRACT

A gunshot is a rare subset of penetrating head injury, and generally, the victim dies before arriving at the hospital. This paper reported an intracranial gunshot injury in an eight-year-old boy shooting by a hunter who has hunted a bird using an airgun. A missile projectile penetrated from the right zygoma and entering the transverse sinus. Vital signs were stable with GCS 14 from a physical examination. After the patient had an immediate craniotomy debridement, evacuated the foreign body (bullet) in C-arm guiding, the patient was administered to the pediatric intensive care unit (PICU) for three days. Than, patient was discharged from our hospital with a stable condition, GCS 15, without any significant neurological deficits.

1. Introduction

A gunshot is a rare subset of penetrating head injury, and the victim dies before arriving at the hospital generally. This paper reported an intracranial gunshot injury in an eight-year-old boy shooting a hunter who has hunted a bird using an airgun. A missile projectile penetrated from the right zygoma and entering the transverse sinus. Vital signs were stable with GCS 14 from a physical examination.

Airguns (AG) as low-velocity missiles (muzzle velocity < 300 m/s), but even 60–100 m/s is enough to fracture a bone. Recent studies state that the muzzle velocity in some Ball Bearing (BB) guns can be 364 m/sec. Given these numbers, BBs possess enough kinetic energy to penetrate the skin and fractured bone depending on the body region. About 80–90% of air gun injuries occur in a population age under 19 years, especially boys, and most of them causing by the gun's careless use [1–2].

Management of penetrating brain injury focusing solely on head injury should be avoided. Instead, a thorough review by a primary and secondary survey of advanced trauma life support (ATLS) is highly recommended. Radiology should be performed after the patient is stable. Computer tomography scans (CT-scan), Skull X-ray anteroposterior (AP), and lateral are the most common and practical tools to evaluate gunshot head injury. The addition of CT 3D, CT angiography, and digital subtraction angiography (DSA) provides a reasonable initial assessment when available [3,4].

The gunshot wounds can be treated using medication and by surgery. The purpose of medication is to decrease intracranial pressure (ICP) by preventing brain edema (head elevation 30–45°, hyperventilation PaCO2 = 30–35 mmHg, mannitol), antiepileptic drugs, antibiotics administration, stress ulcer prevention, and administration of tetanus toxoid. Moreover, surgery attempts to prevent a secondary injury caused by increasing ICP and infection and ischemic. Usual surgery procedures include brain stem decompression, hemostasis, and evacuation of a mass lesion like hematoma, bone fragment, missile residual, and the repair of wounds [3,4].

2. Case

After getting permission from the parent, we reported a case of 8-a year-old boy who came to ER at Ulin General Hospital with a decrease of consciousness just after getting shot at the head by a hunter, who initially wanted to play around with his friends at land and was shot by Air gun rifle that a hunter used for bird's hunting. He was shot at right zygoma and directly lost her consciousness, followed by four projectile vomiting, but there is no history of seizures. We performed ER management according to ATLS, and we cleared the airway, breathing, and circulation. The patient's vital signs were stable. According to the mini neurological state examination of the patient, the patient's Glasgow Coma Scale (GCS) is E3V5M6, pupils are bilaterally equal and reactive, and no lateralization sign was documented. At the right zygoma, the local physical head inspection was found a 3 mm × 3 mm penetrating wound showing a bullet enters the intracranial cavity (Fig. 1). No blood clot is found. After we explored the head, we did not find any indications of a bullet exit wound. Thus, we suspected that the bullet was still in the

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cranial cavity.

After all, conditions were stable, and we performed Head CT-Scan trauma with bone 3D reconstruction (Fig. 2). Found a bone fracture caused by the bullet penetrating the head at the right zygoma region based and avulsion fractures at right temporal. The bullet entering the intracranial cavity in the surface of the frontal lobe, the bullet trajectory passed through the right temporal pole, right occipital lobe, right occipital cortex, and ended at right sinus transversus. The directional slope of the bullet was medially longitudinally, with its tracking left Intracerebral Hemorrhage (ICH) at right temporal with perifocal edema but without midline shift (Fig. 3). Laboratory investigations showed Hemoglobin was 13.7 mg/dl, lucocytosis (22.600/mm3), and the average value for another blood component. There is no abnormality on the coagulation function test. Before the procedure, we have to perform a CT Angiography or MRI Angiography, but due to limited facilities in the remote area (Borneo island). We performed an immediate craniotomy debridement, evacuated the foreign body (bullet) in C-arm guiding, found the bullet suitable CT Scan exactly, and found a 3 mm × 3 mm open wound. On the lower side, we found a 3 mm × 5 mm fenestrated bone with dural tearing. Debridement was performed in this step. Using a C-Arm Guide and microscope from the frontoparietal site, we performed a 3 cm × 3 cm craniotomy, durotomy, and corticotomy. We open the special durometer from the right transverse sinus; within 7 cm depth from a surface of the brain, we found the bullet on the right transverse sinus at the lateral side about 1.5 cm. A temporary clamping was done at the transverse sinus at proximal and distal the lacerated sinus and did 1 cm transverse sinus longitudinally incision. After bullet extraction, we wrapped with surgicell at the fascia. Temporary clamping opened and observed. There was no bleeding (Fig. 3) and the wound sutured layer by layer.

After the surgical procedure, the patient was administered to the pediatric intensive care unit (PICU) for three days, given 02 nasal cannulas, an antibiotic (Ceftriaxone 750 mg/12 h/iv) for seven days, and paracetamol 250 mg/8 h/iv for antipyretic. Day fourth patient was moved to surgery-ward and re-ct scan examination with ICH volume 13 ml without midline shift suitable temporal base (Fig. 4). After eight days of management, the patient was discharged from our hospital with a stable condition, GCS 15, without any significant neurological deficits.

3. Discussion

Penetrating brain injury has been described in numerous civilian and military series [5–15]. However, there is a deficit in the literature representing patient's surgical treatment and outcome with penetrating missile injury to the sinuses because of its rarity and eminent morbidity. Most of the case series comes from individual neurosurgeon's experiences during times of war. Most wartime injuries are from more minor, low-velocity shrapnel and not direct, high-velocity gunshot wounds. Further, many patients in the military series reached tertiary care centers days after injury; these survivors likely had less severe injuries and were not hemodynamically unstable from penetrating sinus injury. Our case describes a pediatric civilian, low-velocity, air-gunshot wound, transaction of the right transverse sinus, a retained bullet fragment within the sinus in a hemodynamically stable patient, treated operatively with a good outcome.

Some Cases of AG pellets penetrating injury were published. The head is the most commonly penetrated part of the body, and the orbit is the most common part of the skull resulting in cerebral injury [16–21]. The majority of fatal incidents were reported involving children and adults [16–18]. Pellets have entered through the eyes, temple or forehead, and then penetrated the brain.

Non-fatal injuries following AG pellet penetration include significant brain damage causing permanent impairment, and those involving the eyes may result in blindness [21,22]. The foreign body or pellet should be removed if they are accessible [22]. Miner [16] suggested that the foreign body may be left if inaccessible. An intracerebral abscess can be a long-term problem if the AG pellet or foreign body cannot evacuate [17,19,20]. There are limited clear indications to perform removal of all bullet fragments. Clear indications for bullet removal are fragment movement, abscess formation, vascular compression, and also hydrocephalus [23]. Shaw and Galbraith [24] reported the fatal case of cerebral abscess that developed around a pellet and resulted in death after 19 months. Suppose the foreign body is left in the wounded, combined antibiotics to prevent intracerebral abscess or other of infection. Early surgery and complete debridement should be applied CSF leakage or intracerebral haemorrhage [25].

Dealing with injury of the transverse sinuses can be challenging because these sinuses are critical for drainage of supratentorial and infratentorial contents. It is critically important to determine the dominance of the transverse sinuses preoperatively; the right transverse sinus is most often dominant. Right-sided transverse sinus bleeding can be catastrophic when it is the predominant drainage outlet for the superior sagittal sinus. The torcula must be preserved at all costs. The principles of transverse sinus reconstruction are the same as those discussed above in the case of the posterior superior sagittal sinus [26].

The lateral sinuses (LS) ensure symmetric drainage in only 20% of the cases; in the extreme case, one LS may drain the SSS in totality but most often is the right one and the other the straight sinus. The transverse sinus (TS) may be atretic on one side, its remaining sigmoid sinus draining the inferior cerebral veins (i.e., the Labbe' system). The sigmoid sinus (SS) drains the posterior fossa. It receives the superior and the inferior petrosal sinuses and (unconstant) veins from the lateral aspect of the pons and medulla. SS has frequent anastomoses with the cutaneous venous network through the mastoid emissary vein. When the sigmoid segment of the lateral sinus is atretic, the transverse sinus with its affluents drains toward the opposite side [27].

Sixty years ago, during the Korean Police Action, Meirowsky [14] meticulously documented the most precise and sizable case series of injury to the dural sinuses. It is essential to consider that current rapid emergency medical transport would obviate gross infection at the time of presentation and conceivably decrease preoperative sinus thrombosis.

Kapp and Gielchinsky report 24 injuries to the transverse sinus. They describe their efforts to primarily repair two separate transected transverse sinus injuries using saphenous vein grafts. One of these patients survived with a patent vein graft, and the other expired five days later due to graft thrombosis. Unfortunately, neither the mechanism of injury nor timing of surgery was described for either patient.

In our case, the right transverse sinus abnormality was caused by embolism and thrombus, so the blood and Liquor cerebrospialis circulation. We did not do a graft, and a surgycell just wrapped the right

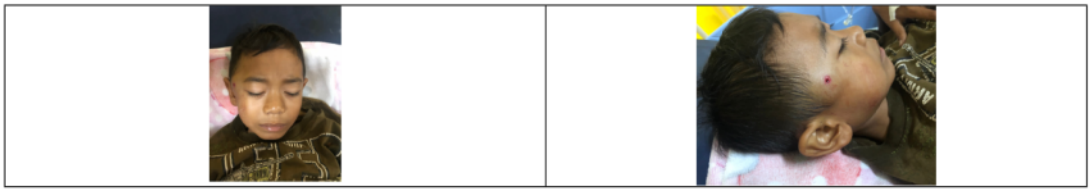

Fig. 1. bullet enter from the right zygoma lateral aspect of the head, there is no active bleeding from entering wound.

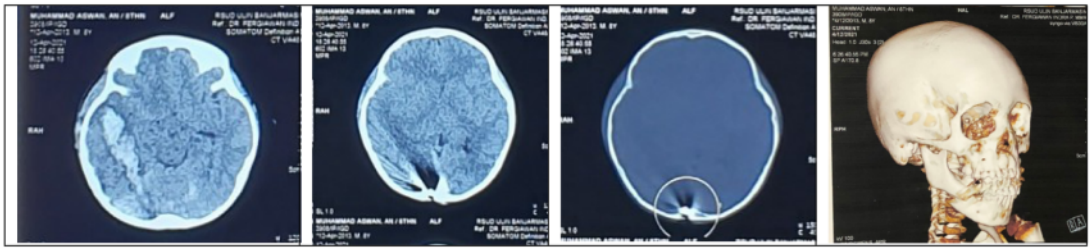

Fig. 2. Head CT-Scan Bone Window and 3D bone showing defect and fracture from entering bullet from frontal lobe, the bullet trajectory passed through the Right temporal pole, right temporal lobe, right occipital lobe, right occipital cortexs, and ended at right sinus transversus.

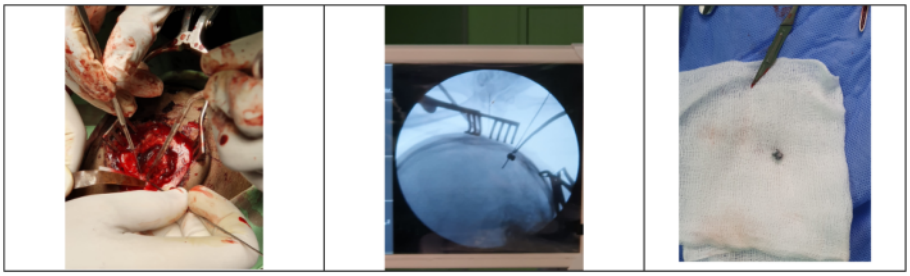

Fig. 3. Using a C-Arm Guide and microscope from frontoparietal site, we performed a 3 cm × 3 cm craniotomy, duratomy and corticotomy, then the bullet was evacuated from transverse sinus.

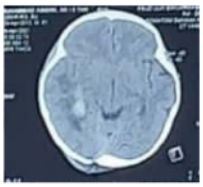

Fig. 4. Re-CT scan examination with a result is ICH volume 13 cc without midline shift ar right temporal base.

transverse sinus wound. After removing the bullet from the transverse sinus, we found a diablo bullet of 4.5 mm (0.177 in) calibers. It can develop a muzzle velocity of 330 to 340 ft/sec, which exceeds the impact velocity of 150 to 170 ft/sec required to pierce the skin, and approach the additional 200 ft/sec required for bone penetration. The bullet's trajectory does not damage the eloquent and deep area of the brain (hypothalamus, thalamus, and brain stem) with fatal and lethal manifestation. After]performing an immediate craniotomy debridement evacuation of foreign body (bullet) procedure, the patient was supported at PICU and performed Re-CT Scan with 13 cc ICH without midline shift ar right temporal base. In observation for eight days, the patient was discharged from our hospital with stable condition, GCS 15, without significant neurological deficits. BB guns should be considered more than toys. However, the endless number of fatalities raises concern about the amount that may occur in the future [28]. Limitation of this case reports CT Angiography before and after the operation was not performed on the patient because there are limitations of facilities.

4. Conclusion

In conclusion, intracerebral bullet air gunshot injury is fatal and lethal. However, early removing the bullet from the transverse sinus without graft was a safe and easy procedure.

5. Consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

6. Authorship

Agus Suhendar, Rosfi Firdha Huzaima and Agung Ary Wibowo compiled and wrote the manuscript. Agus Suhendar and Rosfi Firdha Huzaima led surgical and medical management. Agus Suhendar and Agung ary wibowo supervised the writing of the manuscript. All authors read and approved the manuscript. All authors attest that they meet the Interdisciplinary Neurosurgery Advanced Techniques And Case Management criteria for Authorship Declaration of competing interest. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval

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