Treatment strategy in a child with a retained bullet in the cerebellomedullary cistern

Case report

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A 6-year-old girl was admitted to our emergency room because of a gunshot wound in the posterior craniocervical junction. On admission, she was alert, but left hemiplegia and right hemiparesis were noted. Cranial CT scanning showed a retained bullet in the cerebellomedullary cistern without bone destruction. Moreover, fourth ventricle hemorrhage was observed. There were no signs of acute hydrocephalus. The patient underwent suboccipital craniectomy and C-1 laminectomy for bullet removal. Postoperatively, the patient experienced significant neurological improvement. To the best of the authors’ knowledge, this is the first documented case of a patient with a retained bullet in the cerebellomedullary cistern. The management strategies in such a unique case are discussed.

Case Report

History and Examination. A 6-year-old girl was admitted to our emergency room with a GSW in the posterior craniocervical junction. On admission, she was alert (Glasgow Coma Scale Score 15) with reactive pupils. Incomplete tetraparesia (left flaccid hemiplegia and right hemiparesis, MRC Grade 2/5 in the arm and Grade 4/5 in the leg) were noted together with hyperalgesia on the left arm and hemithorax as well as indifferent plantar responses. Cranial nerve examination revealed no abnormalities. Cranial CT scanning showed a retained bullet in the cerebellomedullary cistern without bone destruction (Fig. 1). Moreover, fourth ventricle hemorrhage was observed. There were no signs of acute hydrocephalus.

Operation. The patient was taken to surgery the next day (< 12 hours after admission) and was carefully placed in the ventral position as a result of transitory bradycardia during intubation. The location of the projectile was confirmed by fluoroscopy after final positioning. A suboccipital craniotomy and C-1 laminectomy were performed for bullet removal (Fig. 2). During surgery, the bullet was seen to compress the rhomboid fossa, but it was not adherent to neural structures. Dural repair was achieved with pericranial graft and fibrin glue.

Postoperative Course. Postoperatively, the patient experienced significant neurological improvement represented by 1 grade for the arms and 2 grades for the left leg (MRC scale). On the 11th postoperative day, CSF was leaking through the surgical scar, and external lumbar drainage was performed. After 3 days of conservative treatment, acute tetraventricular hydrocephalus was diag-

Abbreviations used in this paper: GSW = gunshot wound; MRC = Medical Research Council; PBI = penetrating brain injury.
Retained bullet in the cerebellomedullary cistern

nosed on sequential imaging based on the obstruction of fourth ventricle outflow, leading to ventriculoperitoneal shunt insertion. Complete resolution of the CSF fistula was observed thereafter. Motor recovery was gradually recognized over time. At the 26-month follow-up, the patient was doing well and completely independent, even though a slight left hemiparesis was still noted (Glasgow Outcome Scale Score 5).

Discussion

In 2001 the Journal of Trauma published evidence-based guidelines for the treatment of PBI. These guidelines were proposed by the consortium of the International Brain Injury Association, Brain Injury Association of America, the AANS, and the CNS. After performing MEDLINE searches up to January 2000, the authors concluded that the available data were not sufficient to support any surgical treatment as standard for PBI. As an option, the surgical treatment of small and extensive wounds was recommended.

Since that study, there has been a trend in the literature for more conservative approaches to prevent additional injury by reducing the degree of debridement. Patients suffering from PBIs can be treated without surgical intervention, with minor or superficial debridement, small craniotomy or craniectomy and debridement, and classic craniotomy and aggressive debridement of all necrotic tissue, depending on the size and type of wound.

Note that the guidelines did not address the scientific basis of special situations within PBI, namely bullet migration and lead poisoning. The movement of intracerebral bullets has been attributed to cerebral softening (caused by edema or local tissue damage), gravitational factors, and the “sink” function of the cerebral ventricles. When bullets are free within the CSF cavities, they can migrate to distant parts of the CNS. Bullets or fragments that do not move within the brain are presumably walled off by gliosis and fibrotic scarring. This phenomenon occurs after migration.

Bullet removal is not a routine procedure, even though it is recommended when the bullet is easily accessible within the operative site, when an abscess has formed, or when focal epilepsy is associated with the metallic fragment or lead poisoning. If migration has been recognized, bullet removal is justified given the increased risk of obstructive hydrocephalus and additional injury to the CNS, especially for intraventricularly retained bullets. It is worth noting that before proceeding with surgical removal, plain skull roentgenograms are indicated after final positioning of the head to ensure the location of the fragment.

Lead poisoning is a well-recognized complication of retained bullets, with fairly frequent description even though only about 80 cases have been reported. Despite several descriptions, the clinical significance of artificially implanted inorganic lead as a source of lead poisoning was not addressed until the recent study by McQuirter et al. These authors demonstrated in blood assays and lead measurements of trabecular and cortical bone that lead increases over time after an injury in cases of a retained bullet. This increase is mostly related to bone fracture caused by the gunshot. An additional risk factor is contact with the joint fluid or CSF. It is believed that the acidic pH of these fluids induces lead solubilization and subsequent mobilization into plasma.

As yet, a proposed guideline for the surgical management of GSWs to the spine has not been considered. Surgical treatment is justified in patients affected by lead poisoning, intracanal copper bullets, and progressive neu-
The role of decompression and bullet removal for cervical and thoracic injuries remains undefined even for incomplete neurological deficits. Conversely, surgical treatment has improved motor recovery in patients suffering from T-12 to L-5 level gunshots. In rare instances, surgery is indicated for treating CSF fistula and spinal instability.

Our case is unique in the way that the retained bullet was lodged in the cerebellomedullary cistern without subjacent bone fracture. Different strategies could be adopted depending on stratification as a GSW to the head or spine. If one considers the patient to be affected by a GSW to the head, minimal debridement and wound closure might be recommended. On the other hand, if the patient is considered to have a spinal GSW, surgery should be directed to bullet removal if it is known that the metallic fragments are copper jacketed.

Given that the metallic alloy was unknown in our case, we decided to perform surgery because of the potential benefit on incomplete neurological dysfunction and to avoid hydrocephalus, late complications of lead and copper poisoning, and bullet migration. We were very successful in improving motor function and preventing future complications in light of the patient’s youth since poisoning becomes symptomatic from 3 months after injury. A reasonable question might be whether neurological improvement would have occurred anyway, without bullet removal. Nonetheless, were this the case, the patient would still be at risk for poisoning and migration. Note that hydrocephalus developed thereafter but was easily managed with shunt insertion.

Conclusions

In summary, as GSWs have reached epidemic numbers in the civilian setting, it is possible to identify situations not previously reported, such as that experienced by the patient we described. Head and spinal GSWs have a somewhat defined management strategy that includes special situations such as spontaneous bullet migration and poisoning in the setting of a retained bullet.

We described the unique case of a girl who survived a gunshot injury to the craniocervical junction with a retained bullet in the cerebellomedullary cistern without bone destruction. To the best of our knowledge, this is the first report of such a case. In deciding to perform surgery, we considered the incomplete neurological deficit, the risk of bullet migration, lead poisoning, and hydrocephalus development. In light of the surgical results, we recommend bullet removal in special situations of penetrating CNS injuries.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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