The traveling pelvic bullet: a case of retrograde ballistic migration through the venous system

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ABSTRACT

Migration of a ballistic missile through the vasculature is rare but important to recognize. It can lead to diagnostic confusion and seemingly unexplainable bullet trajectories. We have described the case of a young man with a gunshot wound to the axillary vein and initial embolus to the inferior vena cava. The bullet subsequently migrated to the right common iliac vein, allowing for straightforward retrieval. (J Vasc Surg Cases Innov Tech 2022;8:587-91.)

Keywords: Vascular trauma; Foreign body embolus; Endovascular retrieval

A Lancet editorial, reporting on a case from World War I, noted "The occurrence of free projectiles in the blood stream, although doubtless very rare, has already become something more than a surgical curiosity, and its possibility may well be borne in mind by those who observe anomalous symptoms after gunshot wounds, especially when the projectile is not found."[1] This sentiment was quoted in a case report and literature review of bullet emboli occurring after thoracic gunshot wounds >50 years later.[2] It remains relevant, especially with the recent increase in gun violence in the United States.[3,4] We have described the case of a young man with a gunshot wound to the axilla that led to bullet migration through the axillary vein, superior vena cava, inferior vena cava (IVC), and common iliac vein. The patient provided written informed consent to the report of his case details and imaging studies.

CASE REPORT

The patient was a 31-year-old man who had presented by private vehicle to our trauma center. He had multiple gunshot wounds but was hemodynamically stable. He had seven wounds and three retained bullets on examination. Most trajectories had been accounted for by connecting two wounds or connecting a wound and a retained bullet. However, a bullet appeared to be present in the mediastinum on chest radiography (Fig 1), without hemothorax or pneumothorax and with negative findings from a pericardial focused assessment with sonography for trauma. Additionally, he had a wound to the right axilla that did not seem to correspond with either an additional wound or a retained bullet. He had no pulse, sensory, or motor deficits in the right arm. He had a history of a prior gunshot wound but that had been a through and through injury of the left arm.

Given his stability, the patient underwent computed tomography angiography, during which metal artifact reduction reconstructions showed the bullet in his IVC at the junction with the right atrium (Fig 2). Again, no evidence was found of surrounding chest trauma. Furthermore, the axilla injury appeared to have caused disruption of the right axillary vein without trauma to the artery (Fig 3). Thus, we concluded that this bullet had embolized through the axillary vein, superior vena cava, and right atrium. His other injuries consisted of fractures of the left scapular spine, olecranon, and radial head with traumatic arthrotomy; these were initially managed nonoperatively.

He was started on aspirin 81 mg daily and admitted to the intensive care unit for monitoring. We consulted with interventional radiology and vascular surgery for endovascular retrieval of the bullet. Although feasible, the risk of embolism to the pulmonary circulation during manipulation was deemed high. Furthermore, unlike small-profile retained objects such as pacer leads, this bullet had a greater chance of lodging at a catastrophic location (eg, valve leaflet). We, therefore, had the patient walk on hospital day 1, hoping that gravity would aid in further retrograde migration of the bullet to an accessible location. He underwent abdominal radiography hospital day 2, which showed the bullet in his pelvis, presumably in an iliac vein (Fig 4), and he was taken to the operating room.

We cut down on the right groin and controlled the common femoral vein. We introduced a 7F sheath directly into the vein and attempted retrieval with an ENsnare (Merit Medical, South Jordan, UT), which was unsuccessful. We then used a 10-mm × 4-cm angioplasty balloon (Boston Scientific, Natick, MA) to "drag" the bullet down, at which point we were able to

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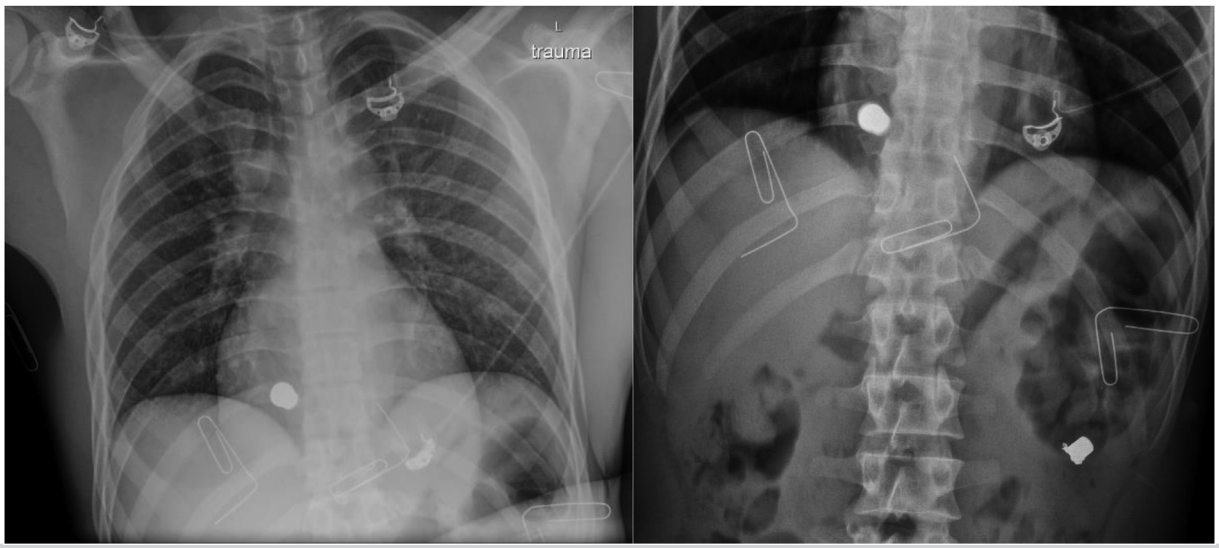

Fig 1. Chest and abdominal plain film radiographs at presentation. The left flank ballistic represents a bullet that was palpable in the patient's back and seemed to be associated with a left flank wound. The *paper clips* represent bullet wounds as is standard at our institution; *open paper clips* represent posterior wounds.

Fig 2. Representative image from the patient's chest computed tomography scan on admission showing a bullet in the inferior vena cava (IVC; image enhanced using a metal artifact reduction protocol), with no evidence of surrounding trauma.

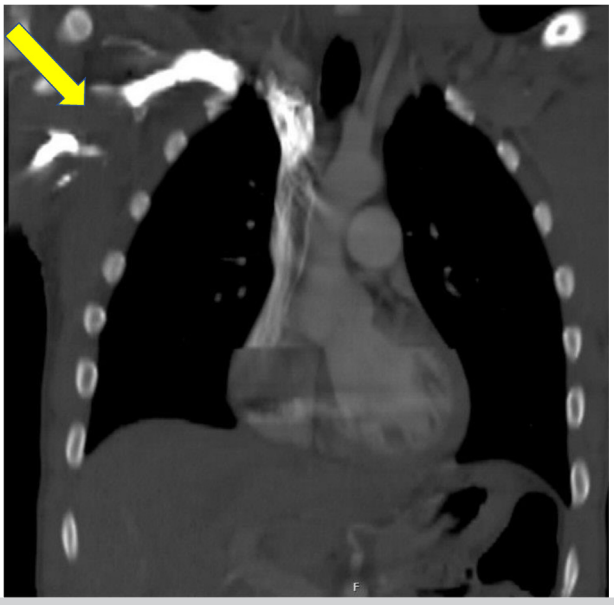

Fig 3. Representative image from the computed tomography angiogram on presentation showing disruption of the right axillary vein (contrast had been injected in the right arm) with surrounding gas. *Arrow* denotes disruption.

palpate it in the external iliac vein. We then manually moved it progressively downward until it was visible, made a venotomy, removed the bullet, and repaired the venotomy primarily (Fig 5). The patient made an uneventful recovery and was discharged to home after he had undergone elbow washout and plate reconstruction of the proximal ulna. An additional bullet was removed during that operation, leaving one projectile in the soft tissues of the left flank. Aspirin was continued after discharge.

DISCUSSION

Both arterial and venous bullet emboli have been described. Case reports have described migration to the heart and pulmonary arteries,[5,6] stroke from migration to the carotid artery,[7] and migration to the heart after entry to the facial vein.[8] Additionally, cases of paradoxical embolism have been described.[9]

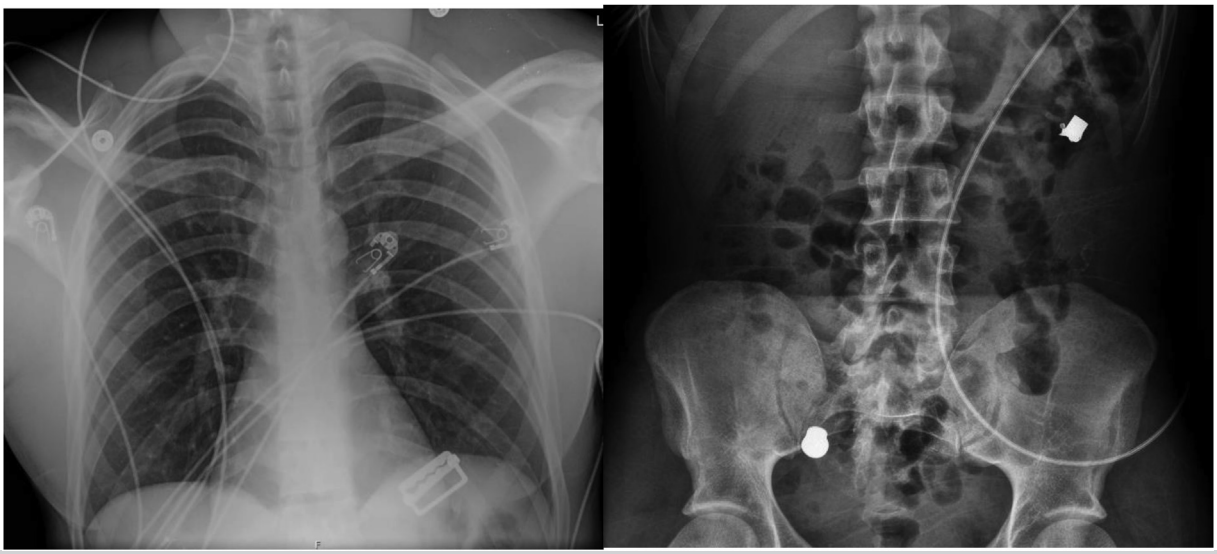

Fig 4. Chest and abdominal radiographs taken 2 days after presentation. The left flank bullet remains in an unchanged location; however, the bullet previously identified in the inferior vena cava (IVC) has migrated to the pelvis.

A 1979 case series described 28 patients with intravascular bullet emboli during a 13-year period at Ben Taub General Hospital in Houston, TX.[10] Nearly one half of these were venous injuries with embolization to the heart or pulmonary arteries. Of the 28 cases, 21 open retrievals were attempted, of which 20 were successful; the remainder were left in place because of the small size or the patient had left against medical advice. Their review of the literature noted a high mortality rate among the reported cases (20%-30% for venous injuries and higher for arterial injuries).

Traditionally, the enthusiasm for removing arterial bullets greater owing to concerns for distal ischemia. The answer to the question of venous injuries, which constitute only ~20% of bullet embolus cases,[10,11] is less clear. In 1987, Shannon et al[12] described a case of bullet removal from a hepatic vein and reviewed 102 cases of venous bullet embolism in the preceding 57 years. They reported a 25% morbidity rate without intervention for venous injuries and advocated for removal of all intravenous bullets owing to concern for proximal migration and the relative ease of removal using modern techniques.

In contrast, a 2017 series of five patients reported by Sparkman and Batson[13] suggested that watchful waiting could be an acceptable approach for asymptomatic patients with venous bullet embolism. The length of follow-up varied widely for this small number of patients, from 3 to 54 months, although they reported no complications. However, it should be noted that these were small caliber missiles, with four of these five incidents had involved birdshot.

Consideration should be given both to the potential risk associated with the presenting bullet location and the nature of the intervention that will be required to retrieve the bullet. After presenting several cases and reviewing the literature, Miller et al[11] suggested a paradigm in which all arterial emboli and most venous emboli would be retrieved using endovascular techniques—the only exceptions are those that are asymptomatic, in a pulmonary artery, and/or not endovascularly accessible. However, as Miller et al[11] noted, improvements in endovascular techniques have changed the risk/benefit ratio involved in removing bullets. A similar management approach was proposed in a recent review by Yoon et al.[14]

Several other reports have described the endovascular retrieval of bullets, including a case similar to that of our patient involving an axillary wound and retrieval from a common iliac vein.[15] That case had been performed entirely percutaneously using a snare and 24F sheath. We elected to cut down on the vein based on the size of the bullet. Other reports have described snare retrieval from the left iliac artery after migration from the right to left iliac vein,[16] endovascular and/or cutdown retrieval via both sides of the groin under protection from an IVC filter after migration into an iliac vein from a chest wound,[17] and retrieval from an external iliac vein using a Fogarty balloon under manual protection of an infracardiac IVC via a small thoracotomy.[18]

CONCLUSIONS

Bullet emboli are a rare phenomenon. Although endovascular and hybrid techniques have lowered the threshold to retrieve projectiles, the decision to attempt retrieval is multifactorial and should be made on a case-by-case basis.

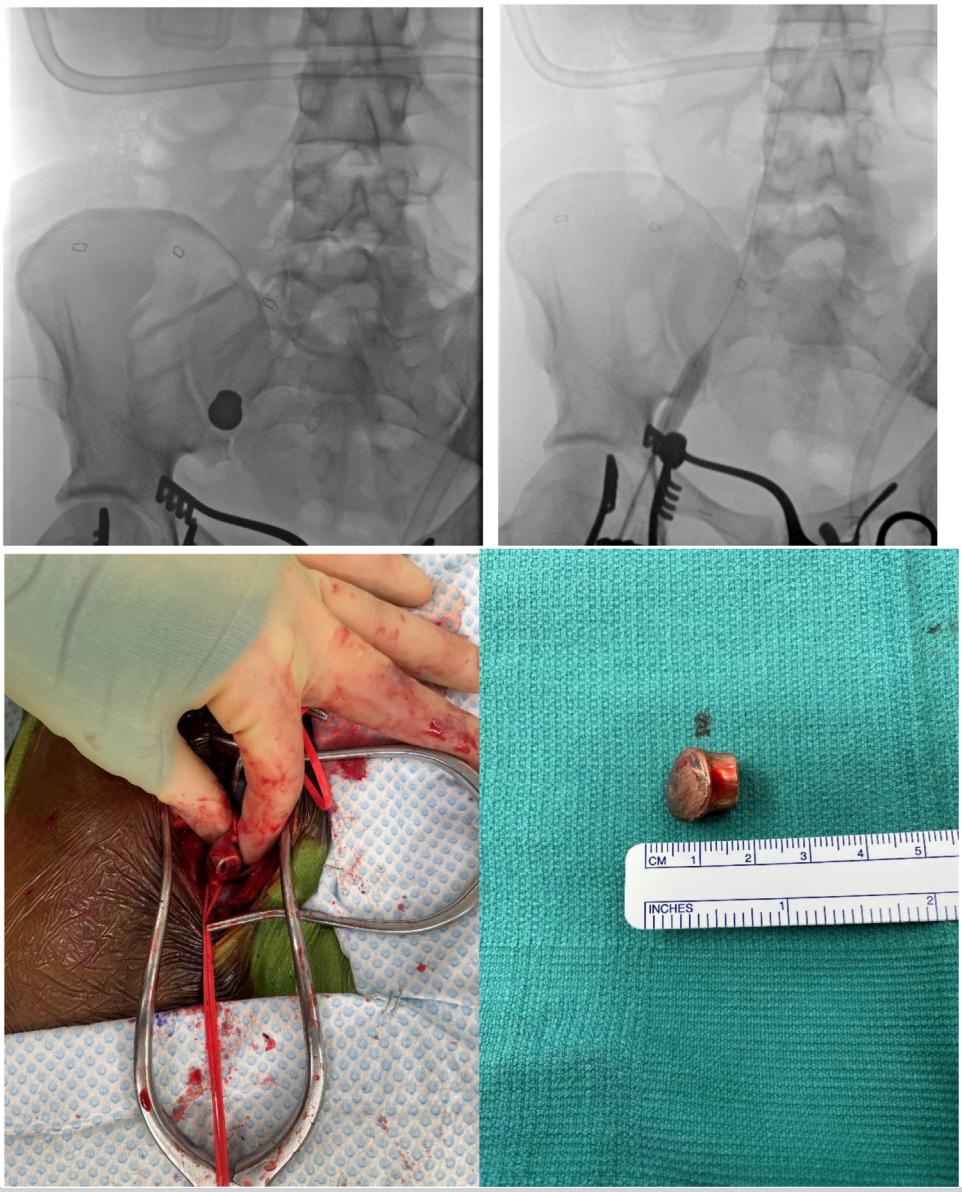

Fig 5. Intraoperative findings. **Top left,** Initial fluoroscopy image. **Top right,** Balloon extraction. **Bottom left,** Bullet in situ. **Bottom right,** Bullet after extraction.

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