Retrograde migration and endovascular retrieval of a venous bullet embolus

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Venous bullet embolism is a rare and complicated occurrence reported in approximately 0.3% of penetrating trauma. The management of bullet emboli is decided on a case-by-case basis, balancing the risk of the embolus itself against those associated with extraction. We report a case of a 19-year-old man who sustained a gunshot wound to the anterior chest, which migrated to the left internal iliac vein in a retrograde fashion. We were able to successfully retrieve the missile using an endovascular approach, thereby minimizing the morbidity associated with an open procedure. (J Vasc Surg 2011;53:1113-5.)

Penetrating wounds rarely result in a venous missile embolism. Most gunshot wounds result in an entrance and exit wound or, in the absence of an exit wound, a projectile located in the area of the injury. A venous bullet embolus should be suspected in the absence of an exit wound and a projectile in the region of the injury. Frequently, these missiles are seen in other areas with screening radiographs and travel via the vascular system in an anterograde fashion toward the heart. We report a case of retrograde migration of a venous bullet embolus and its successful endovascular retrieval.

CASE REPORT

A 19-year-old man presented to the emergency department with a gunshot wound to the anterior right chest. There was no evidence of an exit wound and the patient was hemodynamically stable with equal breath sounds bilaterally. The entrance wound was inferior to the right sternoclavicular junction. The remainder of the physical examination was unremarkable. A chest x-ray revealed no evidence of a foreign body or pneumothorax. The patient was sent immediately for a computed tomography (CT) scan of the chest, abdomen, and pelvis that revealed a fractured manubrium with bullet fragments in the anterior mediastinum and a small left superomedial pulmonary contusion (Fig 1). A mediastinal hematoma was evident surrounding the brachiocephalic and subclavian veins and the carotid and subclavian arteries. There was no extravasation of intravenous contrast on CT angiogram. An approximately 8-mm bullet fragment was visualized in the right lower pelvis without evidence of free air or free fluid in the abdomen (Fig 2). There was no evidence of retroperitoneal air or hematoma. The patient was transferred to the interventional radiology suite for further vascular evaluation.

Initial fluoroscopic evaluation revealed that the bullet had further migrated from the right to the left hemipelvis (Fig 3, A). Percutaneous access was established via the right common femoral vein and venography of the brachiocephalic and subclavian veins confirmed no extravasation, and no other injuries were identified. Due to the recent migration, the decision was made to remove the bullet fragment. A retrievable Bard G2X inferior vena cava (IVC) filter (Bard Peripheral Vascular Inc, Tempe, Ariz) was placed in the infrarenal IVC to prevent anterograde migration of the projectile to the heart. After IVC filter placement, a 5F Cobra C2 catheter (Bioteq, Taipei, Taiwan) was placed over the iliac bifurcation and used to select the left internal iliac vein. Anterior-posterior and lateral oblique venography was performed confirming the position of the foreign body within the left internal iliac vein.

The existing right common femoral vein access was upsized to a 24F × 30-cm-long Gore Delivery Sheath (Gore Medical Inc, Flagstaff, Ariz) custom cut to 10-cm length. The left internal iliac vein was selected using an Ansel II 5F sheath (Cook Inc, Bloomington, Ind) and coaxial Cobra catheter. Through the Ansel sheath, a Bean-Smith biliary stone removal set (Cook Medical Inc, Bloomington, Ind) was advanced. The basket was opened adjacent to the foreign body in the left internal iliac vein and the foreign body was captured within the wire basket (Fig 3, B). The basket was withdrawn over the iliac bifurcation to the contralateral groin (Fig 3, C-E). Due to the size of the projectile, it could not be pulled into the sheath and a right femoral vein cutdown was performed. The bullet was retrieved. The venotomy was repaired primarily.

After completion of the procedure, the patient was maintained on venous thromboembolism (VTE) chemoprophylaxis with 40 mg Lovenox (Sanofi-Aventis, Bridgewater, NJ) daily. A lower extremity ultrasound scan revealed no evidence of deep venous thrombosis. The retrievable IVC filter was removed before discharge, and VTE chemoprophylaxis was continued. Repeat lower extremity ultrasound scan 3 weeks postoperatively confirmed no evidence of a deep venous thrombosis, and VTE chemoprophylaxis was discontinued. The patient had resumed his previous level of activity with no evidence of long-term sequelae.
Bullet embolism is a rare complication of gunshot injuries, occurring in 0.3% of cases.\(^1\) The majority of cases involve the arterial system with anterograde migration. There are fewer reports of venous involvement, accounting for 20% of cases.\(^2\) Of the 120 cases of venous missile emboli reported between 1900 and 1990, 83% migrated to the right side of the heart or pulmonary artery, and only 4% were ultimately located in a peripheral vein.\(^3\) There are a few reports of retrograde migration in this group with patient position, respiration, and missile caliber identified as contributing factors.\(^4-6\)

In our case, the path of retrograde migration led from the superior vena cava, through the right atrium and IVC to the iliac vessels. The bullet’s momentum was reduced as it traveled through the sternum, allowing passage through the anterior wall of the brachiocephalic vein but not the posterior wall. Gravity, patient position, and negative intrathoracic pressure likely contributed to retrograde migration down the vena cava and into the right iliac vein. Remarkably, the projectile remained freely mobile as it migrated from the right to the left hemipelvis during evaluation. Although the mechanism remains unclear and the patient remained supine throughout the evaluation, this weighed heavily on the decision to retrieve the bullet.

Controversy exists regarding indications for removal of bullet emboli. The risks of vascular perforation, embolization, ischemia, and infection must be weighed against those associated with surgery. Conservative management can be complicated by occlusion of a major vessel resulting in edema, evidence of migration toward the heart, the development of endocarditis, septic pulmonary or cerebral emboli, and lead poisoning.\(^5,7\) In our case, the continued migration of the bullet fragment was felt to pose a significant risk of morbidity.

Historically, bullet emboli treated operatively with open procedures have been associated with significant morbidity, especially when located in difficult anatomic regions such as the internal iliac vessels. An endovascular approach allows for a less morbid approach and obviates the need for a difficult dissection, therefore eliminating the risk of damage to surrounding structures. While there have been reports of endovascular retrieval, none have outlined the specifics and rationale of their technique.\(^8,9\)

Placement of a retrievable IVC filter served to protect from anterograde migration during manipulation and provided perioperative protection in the event of a venous thromboembolism. The filter was retrieved 48 hours postprocedure after no evidence of venous thrombosis was confirmed.

A venopuncture was initially used to gain access as the most expeditious approach to placement of the IVC filter and isolating the migrating bullet. Knowing that the size of the bullet would render percutaneous removal unsafe, as the resultant venotomy would be difficult to control, a venous cutdown was planned for controlled extraction. The 24F sheath (the largest currently available) was chosen,
as it allowed the bullet to be trapped between the tip of the sheath and the basket and allowed delivery to the venotomy. The biliary stone removal kit was chosen in lieu of a snare due to the shape of the bullet. Snaring the bullet embolus would be extremely difficult. While a Fogarty balloon was considered, the basket seemed to provide more control of the bullet especially during delivery across the bifurcation.

Retrograde migration of an intravascular bullet embolus is a rare occurrence. An endovascular approach utilizing a biliary stone removal kit provides a less invasive alternative to manage a rare and complicated injury.

REFERENCES