**Migratory Traumatic Cardiovascular Foreign Bodies**

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**SUMMARY**  Six cases of cardiovascular foreign bodies secondary to trauma are presented. The various modes of entry and travel within the vascular system are reviewed. Routine radiographic examination and angiography are shown to be the most useful techniques in defining the location and subsequent course of the foreign body in the vascular system.

NUMEROUS REPORTS concerning cardiovascular foreign bodies (CVFB) have appeared in the literature. The most common CVFB are catheters, mainly those used for intravenous therapy and central venous pressure monitoring. Cardiovascular foreign bodies that result from trauma are less common. This paper is concerned with solid foreign bodies that have gained access to the cardiovascular system by trauma and are located in an intracavitary cardiac or intraluminal vascular position. Six cases of CVFB secondary to trauma will be presented along with a discussion of the varied modes of entrance and migration in the vascular system. The role of angiography in locating the body will also be briefly presented.

**Case Reports**

**Case 1**

A 32-year-old male was admitted to the hospital shortly after sustaining a short-range shotgun blast to his left thigh and inguinal area. Physical examination revealed a continuous murmur over the femoral vessels in the thigh secondary to a traumatic arteriovenous fistula. Radiographs showed multiple pellets in the femoral region and one pellet in the right lung having embolized to the lung from its entrance point in the femoral vein (fig. 1). The pellet in the lung was left undisturbed and after repair of the fistula, the patient made an uneventful recovery.

**Case 2**

A 28-year-old male was admitted to the hospital with three bullet wounds in the left lower extremity, one in the thigh and two in the calf. Initial radiographic examination disclosed a bullet in the thigh; however, on subsequent examination it was no longer present in the thigh but was seen in the right ventricle (fig. 2). Under cardiopulmonary bypass, the bullet was removed from the right ventricle and the patient recovered fully.

**Case 3**

A 28-year-old female was admitted to the hospital because of a bullet wound to the left axilla. Angiography revealed the bullet near the basilic vein. Subsequent radiographic examination revealed the bullet within the right ventricle having embolized there after entering the basilic vein (fig. 3).

Exploration of the right cardiac chambers under cardiopulmonary bypass failed to reveal the bullet. A radiograph done in the operating room showed the bullet in the inferior vena cava and successful removal was accomplished.

**Case 4**

A 19-year-old male was admitted to the hospital with a bullet wound in the left upper quadrant of the abdomen. Exploratory laparotomy revealed multiple perforations of the small bowel and a laceration of the left common iliac vein. The bullet had no point of exit and could not be found in the abdomen. Radiographic examination including angiography showed the bullet in the right ventricle (fig. 4). Following removal under cardiopulmonary bypass, the patient recovered uneventfully.

**Case 5**

A 32-year-old male was admitted to the hospital with multiple bullet wounds including one in the right second intercostal space just to the right of the midline, and another in the left fourth intercostal space at the midaxillary line. Radiographic examination revealed a small bullet fragment in a branch of the right lower pulmonary artery, and a second bullet in the right ventricle. Surgery revealed the entrance point of the second bullet to be the right atrium. The bullet in the right ventricle was removed, however the fragment in the right lung was left undisturbed. The patient made an uneventful recovery.

**Case 6**

A 32-year-old male was admitted to the hospital following three gunshot wounds to the chest and left shoulder. Radiographic examination revealed one bullet overlying the left humeral head, another in the left lower chest, and the third in the right axilla. Physical examination revealed a pulseless but warm right arm. Surgical exploration of the right axilla revealed the bullet in the lumen of the axillary artery at the level of the origin of the posterior humeral circumflex branch.

Anterior thoracotomy showed a six mm sealed perforation of the anterior wall of the right ventricle. The bullet had
thus penetrated through the right ventricular myocardium and the interventricular septum into the left ventricle and had embolized to the right axillary artery (fig. 5).

Discussion

Traumatic foreign bodies may enter the cardiovascular system by various routes. In addition to direct cardiac or vascular entrance, the foreign body may reach the cardiovascular system through the gastrointestinal tract, bronchial tree, skin, uterus, vagina, and urinary bladder.¹

Entrance into the venous system is more common than into the arterial system. Reasons for this include the greater cross-sectional area of the venous system, the higher pressure in the arterial system, and the greater structural resistance of arterial walls.

Foreign bodies entering the venous system may remain stationary secondary to thrombosis and adhesions to the

Figure 1. A) Multiple pellets are seen in the soft tissues of the left thigh. B) A pellet is seen wedged in a branch of the right lower pulmonary artery. The metallic density overlying the left parahilar area represents an artifact on the film.

Figure 2. A) A large bullet fragment is seen in the soft tissue of the thigh. B) The bullet fragment migrated toward the heart and was fluoroscopically and radiographically identified within the inflow tract of the right ventricle.
FIGURE 3. A) Left upper extremity venogram reveals a bullet fragment adjacent to the basilic vein. B) Fluoroscopy and angiocardiogram show the bullet has migrated to the inflow tract of the right ventricle. At the time of surgery, the bullet migrated back to the inferior vena cava. AP and lateral views must be obtained prior to the thoracotomy to determine the final position of the foreign body.

FIGURE 4. Frontal (A) film of the chest and lateral view (B) of an angiocardiogram reveal a bullet in the right ventricle.
vessel wall or may travel about in the cardiovascular system.\textsuperscript{1,2} Cases 1–5 demonstrate embolization of the CVFB to the right ventricle and pulmonary circulation. It would appear that larger CVFB tend to remain in the right ventricle while smaller fragments seem to have a greater propensity to travel further into the pulmonary circulation. Venous foreign bodies may occasionally be carried in a seemingly contradictory fashion away from the heart. Davey and Parker have reported migration of a metallic foreign body from an entrance point in the left cephalic vein to the right common iliac vein, presumably caused by gravity.\textsuperscript{4} Case 3, in which the bullet migrated from the right ventricle to the inferior vena cava, is another example of this phenomenon.

Once in the pulmonary circulation, CVFB may also travel on unexpected routes. This is exemplified by cases reported by Barrett\textsuperscript{1} and by Harkins.\textsuperscript{6} Both reported patients with bullets localized to the left pulmonary artery on preoperative radiographs, only to find no foreign body when a left thoracotomy was performed. Postoperative radiographs in both cases revealed migration of the bullet to the right pulmonary artery presumably secondary to gravity when the patient was positioned for left thoracotomy. Thus, radiographic examination in the operating room just prior to surgery is a useful and necessary procedure.

Foreign bodies may reach the systemic circulation by many routes. These include systemic arteries, the left ventricle, left atrium, pulmonary veins, or as in case 6, through the right ventricle and the interventricular septum into the left ventricle.\textsuperscript{1,2,6,7}

Embolization of the foreign body in the systemic circulation has been reported to occur most frequently to the left lower extremity and the right upper extremity.\textsuperscript{5,6,7} Cases of embolization to the cerebral circulation have also been reported.\textsuperscript{5,7}

Mention should also be made of paradoxical embolization through a patent foramen ovale or other septal defect. In this regard we have observed paradoxical embolization of a catheter fragment in a patient with truncus arteriosus.

Angiography has been shown to be of value in accurate localization of CVFB since routine radiographs and fluoroscopy may be unrewarding.\textsuperscript{6,8} However, it is advisable to continue radiographic surveillance in patients with foreign bodies that might invade the vascular system.

References

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