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Clinical practice

Unusual venous bullet embolism – Case report

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ABSTRACT

Bullet embolism is rare complication of penetrating gunshot trauma. We are presenting a case of a single gunshot with entrance wound located on external side of a left thigh. The upward directed trajectory extends to the left lateral side of the neck, but the bullet has been recovered from right external iliac vein. The bullet migration was explained due to one rare variation of the mouth of vena cava superior and inferior.

1. Introduction

Bullet embolism is an uncommon consequence of penetrating vascular trauma[1,2] that is often related to serious complication in survivors.[3] Three types of bullet embolism are known: arterial, venous and paradoxical.[4] Embolization occur twice as often in the arterial than in the venous system,[5] while according to Colquhoun et al.[6] it is even less frequent in veins. While in veins, bullets more often follow the direction of blood flow, but in some 15% bullets may cause embolization in a retrograde manner moving against blood flow due to effect of gravity or the Valsalva's maneuver.[7,8]

We present a case of accidental gunshot wound to lateral aspect of left thigh, penetrating upwards through abdominal cavity, diaphragm, and thorax to the left side of neck where internal jugular vein was priced. Subsequent to arrival into vein's lumen, haven't left it but it went against blood flow causing embolization of right external iliac vein. Medico-legal aspects of missile embolism are discussed in regard to the given case, and a review of literature was performed. The possible explanation for retrograde venous embolization has been discussed and related to rare anatomic variation of heart.

2. Case report

A 45-year-old man was injured in own apartment; allegedly victim's gun (caliber 6.35 mm) accidentally had fired. The event was witnessed by victim's girlfriend, and his friends. According to the police investigation, victim kept the gun in his trousers, fixed by belt. He was alone in bedroom, and while getting down trousers, the gun accidentally felt on the floor and fired. Following the infliction of gunshot injury to left thigh, the victim finished dressing, went back to dining room where other people were present, took a seat, and collapsed. An ambulance was called immediately. Medical team was only able to pronounce death upon arrival.

3. Autopsy findings

Post-mortem examination of was performed on the first day following death. X-ray was not used prior to the autopsy. External examination of the body revealed single gunshot wound on lateral aspect on left thigh, about 84 cm above the heel level. The wound was oval, longitudinally orientated, and its size was 5 × 7 mm. Abrasion semi-ring was observed below the lower edge of the wound; its width was to 3 mm. Powder residua were detected on the skin surrounding the wound. No other injuries were discovered during external examination.

Body cavities were opened, and left thigh dissected. Subsequent internal examination, with organs *in situ,* revealed that the bullet, after having penetrate through the soft tissues of the left tight, upwardly had entered into abdominal cavity, passed through colon, spleen and stomach; wound track further advanced through the left hemidiaphragm into the chest cavity, continuing throughout the left lung, and left superior thoracic aperture up to the subcutaneous tissue on the left lateral aspect of neck. Approximately 700 ml of blood was found in the left pleural cavity, as well as

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300 ml in the abdominal cavity. Bones has been injured along the wound track.

Neck dissection revealed intensive subcutaneous bruising of the lower part of left lateral region, where laceration, approximately 20 mm long, was noticed on the wall of internal jugular vein. The opposite side of venous wall remained imperforated, although intima was bruised. The overall length of bullet track from entry wound on left thigh to the point of internal jugular vein piercing was 78 cm. Attempts to locate and recover the bullet in the neck, adjacent to the verified damage of left internal jugular vein, or to trace its further penetration, had failed. At that point dissection was stopped, and X-ray was requested.

Radiological investigation did not reveal presence of metal foreign objects in neck and head but indicated presence of metal bullet in right – lower quadrant of pelvis (Fig. 1).

As there was a single gunshot entrance wound, no history of firearm related trauma, and that the wound path was successfully tracked up to the damaged wall of the left internal jugular vein, the only plausible explanation was that bullet embolism had occurred.

Further dissection revealed a bullet that had embolized the right external iliac vein, some 1.5 cm proximal to its origin. At the point where the embolize bullet was retained the vein diameter was approximately 8 mm, and its wall was not bruised. Recovered bulled was of 6.35 mm (0.25″) caliber, copper jacketed, round nose, without signs of deformation; its weight was 3.25 g.

These findings leads us to conclusion that the bullet, once penetrated into internal jugular vein, went through left brachiocephalic vein and superior vena cava into right atria of heart, while, from that point, it went retrograde by gravity down inferior vena cava to embolize right external iliac vein. Therefore, while progressing with further organ removal and their dissection, we were looking for signs of trauma produced by migrating bullet on veins and/or in the heart. However, no such signs (e.g. bussing of intima and/or endocard in right atrium) were detected. Still, while examining the heart, we noticed that intervenous tubercle (of Lower) is rather small (its thickness was 3 mm whereas width was 2 mm). Otherwise, no macroscopic pathology has been exposed by examination of the heart.

Fig. 1. X-ray – The bullet in the lower region of a right hip.

Other autopsy findings were insignificant. Blood alcohol concentration was 0.85‰ (18.45 mmol/l), whereas toxicological screening of blood and urine samples was negative.

4. Discussion

For the first time ever reported in 1834, embolization of blood vessels in association with penetrating firearm injuries is considered to be a rare event.[1,5] Majority of available references on bullet vascular embolization are case studies. There are very few papers reporting on the incidence of bullet embolization, mainly based on several consecutive cases observed.[7,9–14] Larger cohort studies are even fewer and most of them were monitoring embolization in period of military activities. Rich et al.,[9] in their report on 7500 casualties from Vietnam war, who sustained vascular trauma, reported missile embolization incidence of about 0.3% (observed in 22 wounded). The incidence of missile embolization after penetrating injury was about 1.1% in the Afghanistan and Iraq Wars (of 346 casualties surveyed).[9,15] In civilian setting the incidence of embolization is still unknown and there is an assumption that it is higher.[16]

Earlier research showed that smaller bullets with lesser energy are more frequently associated with bullet embolization. Di Maio reported caliber 0.22 to be most commonly associated with bullet embolization, whereas it rarely occurs with larger or faster bullets.[10,17,18] Likewise, in the case that we are presenting, the bullet was of rather small caliber 6.35 mm (0.25″).

The majority of cases describe anterograde migration through the arterial system. Embolization in the venous system is less common, caused by bullets mostly migrating to the right side of the heart or pulmonary artery. Only 4% of missiles were ultimately located in a peripheral vein.[19] Combined, antero-retrograde venous embolization is one of the most uncommon forms, met only in individual cases.[20] Likewise, there are only a few reports of retrograde migration in this group, with patient position, respiration, and missile caliber identified as contributing factors.[21–23]

The case that we are presenting is in conformity with the previous experiences, since the short 6.35 mm (0.25″) missile had penetrated the wall of internal jugular vein, without significant damage on the opposite side of venous wall. After penetrating the vein, the bullet was taken by bloodstream down to the right atrium of the heart. Many factors could cause the missile to lose its kinetic energy and remain trapped in the blood vessel, letting the blood flow to carry it. Missiles of lesser mass and lower initial velocity would have less kinetic energy. In our case, it was a caliber 6.35 mm, with mass of 3.2 g and relatively low initial velocity of 240 m/s, that gives it kinetic energy of 92 J.[24] Besides, there are factors related to the target such as density, strength and elasticity of the tissue penetrated by the missile that could significantly decrease its kinetic energy.[24]

Trajectory through the soft tissue of left leg, as well as abdominal and thoracic organs further had decreased initially low kinetic energy of the missile in the reported case, so that it was stopped once it had penetrated the wall of jugular vein. Brought by the bloodstream, the missile had reached the right atrium (anterograde part of the path).

Intervenous tubercle (Lower), located at the point where the cava veins are meeting causes the blood descending from the superior vena cava to be turned aside into the auricle, which