Femoral vessel injury by a nonlethal weapon projectile

Rodrigo Bruno Biagioni, MD,[a] Gustavo Cunha Miranda, MD,[a] Leonardo Mota de Moraes, MD,[a] Felipe Nasser, MD, PhD,[b] Marcelo Calil Burihan, MD,[a] *and* José Carlos Ingrund, MD,[a] *São Paulo, Brazil*

ABSTRACT

Rubber projectiles are used as an alternative to metal bullets owing to their lower morbidity and mortality rate. There are few reports of vascular lesions of extremities caused by rubber projectiles in the literature. The authors report the case of a 37-year-old man who was the victim of a penetrating injury to the left thigh with a rubber projectile. He reported only pain at the site of the injury; pulses were decreased in the affected limb. After arteriography confirmed an injury to the superficial femoral artery, he underwent an arterial and venous femorofemoral bypass using a reversed contralateral saphenous vein. (J Vasc Surg Cases and Innovative Techniques 2018;4:175-7.)

Keywords: Vascular trauma; Nonlethal projectile; Penetrating trauma

The use of nonlethal projectiles has replaced traditional firearms in popular demonstrations and situations where there is a need for control of disorderly individuals.[1,2] Rubber projectiles were first used in Northern Ireland in 1970 to reduce the high morbidity and mortality caused by traditional firearms.[1] These nonlethal projectiles are made of rubber or plastic and are made in different forms. Most of these projectiles should be discharged at a minimum distance of 20 meters and should be directed at the lower limbs.[1-5] When these guidelines are followed, there is a lesser likelihood of serious tissue lesions.[2,3] Most of the articles on nonlethal projectile injuries focus on trauma to the brain, eyes, abdomen, and chest.[4,5] However, in the last decade, there have been reports of severe vascular injuries in the lower and upper limbs caused by these projectiles, resulting in high morbidity for the victims.[1-3]

The patient consented to the publication of this case and the accompanying images. The patient was provided a consent form from the Santa Marcelina Hospital.

CASE REPORT

A 37-year-old male patient presented with a lesion in the medial aspect of the left thigh caused by a nonlethal projectile (model AM-403/P, Condor Inc., Nova Iguaçu-RJ, Brazil) that was fired from approximately 10 meters away in a public protest. He was referred by the rescue ambulance to the nearest hospital. He was then transferred to a trauma I reference hospital and was evaluated by the vascular team 12 hours after the traumatic event.

At the initial evaluation, he reported only moderate pain at the site of the trauma. According to Advanced Trauma Life Support standards, he was stable (heart rate of 80 bpm, arterial pressure of 120/80 mm Hg) and was without cardiovascular, respiratory, or neurologic changes. On examination, an approximately 2 cm perforation was found on the medial aspect of the left thigh (Fig 1), with no exit wound identified. The perforation was irregular, and there was no sign of burned skin. All the pulses were adequate in the right lower limb. On the affected side, all the pulses were palpable; there was decreased amplitude in the popliteal artery, the anterior tibial artery, and the posterior tibial artery compared to the contralateral side. The brachial-ankle index was 0.8 in the affected limb and 1 in the contralateral limb. The affected limb had adequate tissue perfusion and was warm to the touch; there were no signs of motor or neurologic deficits, expanding hematoma, active bleeding, bruit, or local thrill. A radiograph revealed no fractures. Laboratory tests performed at admission revealed the following: hemoglobin, 12.3 mg/dL; International Normalized Ratio, 1.01; platelets, 182,000 U/mm^3; and leukocytes, 5260 U/mm^3.

When arteriography was performed on the limb, an approximately 4-cm area was identified in the proximal third of the left superficial femoral artery that had an irregular and eccentric appearance and was causing stenosis and flow reduction. This area was located parallel to an object consistent in appearance with a rubber projectile (Fig 2). Neither a thrombus nor an embolus was identified in the distal arteries.

Immediately after the diagnosis was made, the patient was placed under general anesthesia, and open vascular exploration was initiated. Access to the superficial femoral vessels was gained through a 15-cm, longitudinal incision in the middle third of the thigh medial to the sartorius muscle. The proximal superficial femoral artery was first exposed through this incision, and then it was explored distally. The rubber projectile was visualized anterior to the femoral vein and was in contact with the artery laterally. A 5-cm segmental occlusion of the femoral vein was identified with an anterior wall laceration of 2 cm; a

From the Department of Vascular and Endovascular Surgery, Santa Marcelina Hospital[a]; and the Department of Interventionist Radiology, Hospital Israelita Albert Einstein.[b]

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Correspondence: Rodrigo Bruno Biagioni, MD, Department of Vascular and Endovacsular Surgery, Santa Marcelina Hospital, Rua Canario, 917 apto 122 Moema, São Paulo-SP 04521-004, Brazil (e-mail: rbbiagioni@gmail.com).

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Fig 1. Left thigh. The *white arrow* denotes the entry point of the rubber bullet.

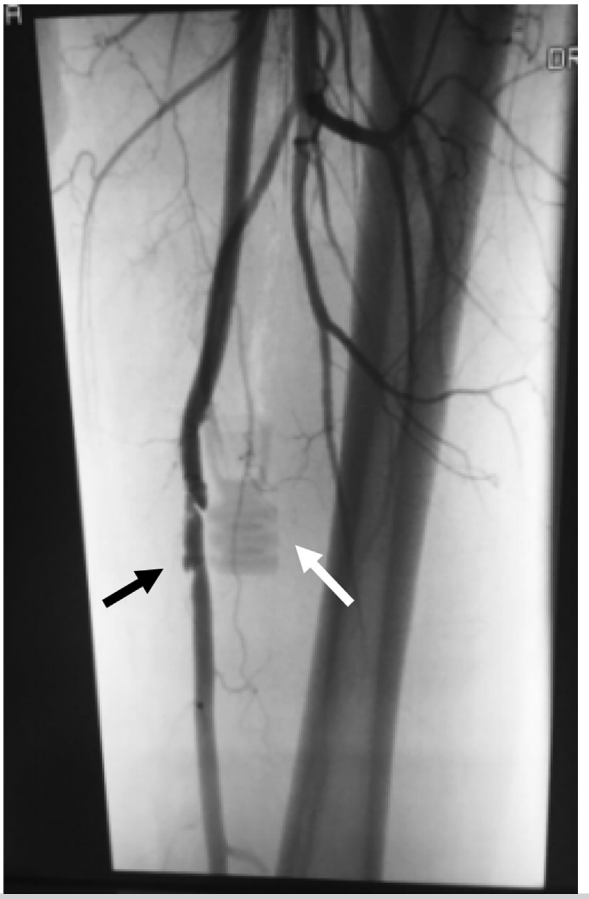

Fig 2. Arteriography of the superficial femoral artery (SFA). The *black arrow* denotes the lesion of the SFA. The *white arrow* denotes the radiographic image of the rubber bullet.

3-cm thrombus in the superficial femoral artery was identified without evidence of any external vascular damage (Fig 3). The contralateral great saphenous vein was excised by segmental incisions in the right thigh. Then, 5000 IU of intravenous heparin was administered, and the damaged segments of vein and artery were sectioned on each side (proximally and distally). The femoral vein was repaired using an end-to-end anastomosis with a nonreversed segment of the saphenous vein using 6-0 Prolene in a continuous suture pattern. The artery was then repaired using an end-to-end anastomosis with a reversed segment of the saphenous vein using 6-0 Prolene (Fig 4). This surgical technique was elected owing to the length of the damaged artery. No drains were placed, and a fasciotomy was not performed because arterial perfusion was still present; the artery only sustained partial damage. The procedure lasted 150 minutes. The patient remained stable after the surgical procedure, with the distal pulses returning to normal amplitude, and the ankle-brachial index of the treated limb improved to 1.1 at 24 hours after the procedure. Two red blood cell concentrates were administered 2 days after the procedure because of anemia (hemoglobin, 8 mg/dL) and tachycardia. After the procedure and until discharge, the patient was treated with extended antibiotic therapy, analgesic medication, nonsteroidal antiinflammatory medication, acetylsalicylic acid, and prophylactic heparin (enoxaparin 40 mg). The patient was discharged 4 days after surgery with analgesic medication and acetylsalicylic acid.

Follow-up was performed at an outpatient clinic. A duplex scan was performed at 1, 6, and 12 months postoperatively. After 5 months, the patient still had patent bypasses (venous and arterial). A duplex scan at 30 days postoperatively was normal. The wound did not show any signs of infection, and complete healing was achieved. Secondary lymphedema of the affected limb was present until the third month of follow-up.

DISCUSSION

The main factors associated with the severity of an injury are the elasticity coefficient of the traumatized area, the kinetic energy transferred (calculated by the mass of the projectile multiplied by the square of its velocity), and the drag coefficient of the ammunition.[6,7]

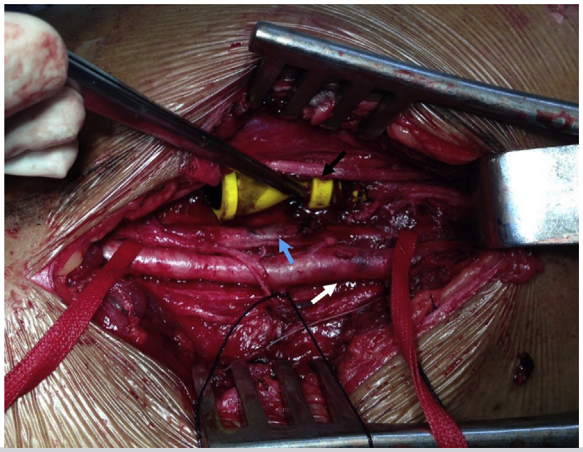

Fig 3. Identification of the femoral vessels. *Black arrow*, rubber projectile; *white arrow*, damaged superficial femoral artery; *blue arrow*: injured femoral vein.

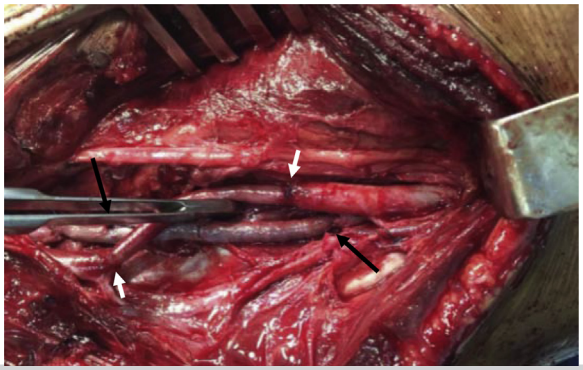

Fig 4. After segmental interposition bypass with an end-end saphenous vein graft. *Black arrows*, proximal and distal anastomosis of the femoral vein; *white arrows*, proximal and distal anastomosis of the femoral artery.

Therefore, less elastic areas of the body, such as the skull, eyes, and thorax, are prone to more serious lesions, with a greater likelihood of penetration.[1-3] Tissue damage is attributed to direct compression (such as bruising or crushing) or indirect compression through a shock wave generated by the impact that cause fractures and lacerations distant from the impact.[6] Vascular lesions caused by these weapons may result in thrombosis, dissection, laceration, transection, and occlusion.[3-5] In the present case, it was opted to repair the femoral vein. The damage was located distal to the profunda vein, and the repair was elected because the patient was hemodynamically stable and because the repair was technically easy (end-to-end anastomosis). We consider venous repair to always be possible because it may reduce venous stasis and enhance limb salvage.[8]

Considering the potential risks, there is a minimum firing distance recommended based on the model of the nonlethal weapon and the projectiles used. This distance should always be observed to prevent lethal injuries.[3,5] It is recommended that the weapon be aimed at the lower limbs because of their relatively low tension, and there are few reports in the literature of serious injuries in this area.[1,3] The arteries most affected by penetrating trauma are the femoral and popliteal arteries,[6] and young men are predominantly affected, as described in the present case.[6,7] Patients with signs of vascular injury, such as expanding hematomas, murmurs, thrills, absence of pulses, or active bleeding, should undergo surgical exploration.[6,7] In the presence of minor signs of a vascular lesion and/or brachial-ankle index of less than 0.9, it is recommended to perform diagnostic imaging, such as an angiographic study, to rule out vascular lesions.[7] In the present case, the patient was shot from a distance of 10 m, instead of the recommended distance of 20 to 50 m.[1,3] Although the shot, in this case, was in the recommended location, the distance was shorter than recommended and could be a factor in the penetration of the rubber bullet.

CONCLUSIONS

Although nonlethal weapons are associated with less energy transference compared with traditional weapons, complex vascular lesions can still occur.

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