



ORIGINAL ARTICLE / *Musculoskeletal imaging*

Contribution of imaging in the initial management of ballistic trauma

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KEYWORDS

Gunshot wound;
Trauma;
Conventional x-ray;
Computed tomography;
Ultrasound

Abstract

Introduction: The purpose of this study is to specify the role of imaging in the initial management of ballistic traumas.

Methods: This is a retrospective study that colligated 83 victims of a gunshot wound during demonstrations, treated in our trauma centre between 12 January and 3 February 2011. All of the patients were haemodynamically stable and examined by conventional radiography and/or ultrasound and/or 16-slice CT-scan (CT).

Results: The mean age of the victims was 26 years with a sex ratio of 0.02. All wounds were unique. Injury to the limbs was most common in 75.5% of the cases ($n=64$) followed by that of the torso in 19.5% of the cases ($n=16$). Wounds in the spine ($n=2$), brain ($n=2$) and facial skeleton ($n=1$) were observed. Conventional x-rays objectified 32 cases of open fractures 95% of which were in the legs. Twenty-one of the victims of gunshot wounds had a CT-scan that objectified the path of the bullet and an assessment of the wound was made in all cases. The confrontation of the data from the CT-scan and that noted during surgery and during the monitoring demonstrated that the CT-scan is very efficient in the diagnosis of pleural effusion, vascular wounds, thoracic parenchymatous wounds and wounds of the solid organs and brain lesions and the facial skeleton. However, the sensitivity is low for the diagnosis of hollow organs.

Conclusion: The CT-scan is very useful in the initial care of stable patients with gunshot wounds as regards the haemodynamics and helps objectify the path of the bullet and obtain a precise assessment of the damage. Conventional x-rays are unavoidable for wounds to the legs and spine.

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Ballistic traumas result from a projectile entering the body: bullet, birdshot, metal fragment from the casing or the contents of an explosive device. They often cause serious wounds characterised by the multiplicity of clinical pictures and the frequency of the associated wounds. These wounds may be life threatening by loss of blood, respiratory distress and contamination of the wound [1]. The functional prognosis may also be involved in wounds to the central nervous system or the limbs. Before January 2011, ballistic traumas were a rare or even exceptional reason for consultation in emergency units, resulting from hunting accidents or soldiers who made a mistake in handling firearms. The uprisings of 14 January 2011 led to the care of a great many ballistic traumas over a short period of time in mainly young civilians.

The purpose of this study is to specify the role of imaging in the initial management of ballistic traumas based on the experience in our trauma centre.

Methods

This is a retrospective study of patients with ballistic traumas treated in our institution during a period ranging from 12 January to 3 February 2011.

The patients included in this study had at least one penetrating ballistic wound, were haemodynamically stable and were explored by conventional x-rays and/or ultrasound and/or CT-scan. The criteria for exclusion were patients that did not need to be hospitalised and were monitored on an outpatient basis.

All of the CT explorations used a 16-slice scanner (Bright Speed, GE Medical Systems) with volume acquisitions in fine slices 1.25 mm thick and soft and hard filters. The images were interpreted on native slices using coronal, sagittal and oblique views using multi-plane reconstructions in mediastinal, parenchymatous, soft tissue, wide and bone windows.

The brain acquisitions were obtained without the injection of iodine contrast agent (120 kV, 300 mAs) whereas the abdominal-pelvic sections were obtained at venous time immediately after the injection of the contrast agent (120 kV, 250 mAs) but without gastric opacification or late acquisition.

Results

Between 12 January and 3 February 2011, we treated 83 patients suffering from a penetrating trauma by firearms. There were 81 men and two women whose mean age was 26 years with extremes ranging from 17 to 46 years. 96% of these ballistic traumas involved the civilian population ($n=80$), 6% of which were escaped prisoners. 4% of the wounded were soldiers ($n=3$).

All wounds were unique resulting from standard bullets (5.56×45 mm NATO), fired by an arm such as an assault rifle. Each victim received a single bullet. Leg wounds were most common in 75.5% of the cases ($n=64$) followed by that of the torso in 19.5% ($n=16$). Wounds in the spine ($n=2$), brain ($n=2$) and facial skeleton ($n=1$) were also observed. These bullets weren't removed during the surgical interventions.

Limb wounds

The victims wounded in the limbs were men, with a mean age of 28 years. Conventional x-rays of the wounded limb, with two orthogonal front and profile views were obtained in all cases. These x-rays objectified 32 open fractures with lead debris in the soft tissue. In 95% of the cases, the fractures were located in the lower limbs, including 39,5% ($n=15$) in the leg (Fig. 1), 29% ($n=11$) in the femur, 13% ($n=5$) in the foot, 5% ($n=2$) in the knee and 5% ($n=2$) in the ankle (Fig. 2). A right greater trochanter fracture was observed in one case (Fig. 3) as well as a wrist fracture.

Isolated wounds were observed in 28 cases including 77.5% ($n=24$) in the lower limbs, predominantly in the thigh ($n=14$) (Fig. 4).

The association of wounds and fractures was observed in five cases (Fig. 5).

Table 1 sums up the distribution of the wounds and fractures in the limbs.

Upon admission, seven patients presented signs of ischaemia in the lower limbs, explored by arterial Doppler ultrasound in two cases and angio-CT in five cases. The Doppler ultrasound was normal in both cases. The angio-CT of the lower limbs was carried out according to the automatic detection of an iodine bolus. It revealed vascular lesions in both cases: one lesion of the infrapopliteal artery associated with a thrypsis of two bones in the leg (Fig. 6) and one wound of the left common femoral artery with extravasation of contrast agent observed following a bullet wound in the right buttock (Fig. 7). In the other cases ($n=3$), the angio-CT did not reveal any anomalies.

All patients received tetanus antiserum and antibiotic therapy. The treatment consisted of a wound excision and a suture in 51% of the cases, a wound excision, a suture and immobilization in 9% of the patients, external fixation in 31% of the cases, pinning in 3% and immediate amputation in 6% of the cases. The mean hospitalization was 2.6 days.



Figure 1. Front x-ray of the left leg. Midshaft thrypsis of the bone of the leg with lead debris in the soft tissue.

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