

Injuries caused by pellets, medical and medico-legal issues. A case presentation

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Abstract: Fire weapons cause various types of injuries, depending on their type and projectile. The observance of the methodological guidelines of medico-legal expertise, combined with investigation data, provides elements that may support accidental injury or not. This study presents a case that is problematic from a both surgical and medico-legal point of view. On a surgical level, difficulties were encountered in extracting the foreign body, while on a medico-legal level, issues referred to the accurate classification of the criminal act depending on the location and seriousness of the injury, the traumatic agent and the actual, immediate or late damage caused to the injured party. The complexity of the case reveals the drawbacks of the system for the assessment of injury gravity in medico-legal practice, as the indicative guidelines used in Romanian legal medicine for the award of medical care days is not enough to estimate the gravity of the injury caused to the victim, due to the particularities of the case. Corroborating medical data and medico-legal criteria, trauma-related expertise was drawn up so that the criminal act might be classified as accurately as possible.

Key Words: fire weapon, shooting, pellet, pellet migration, medico-legal issues.

INTRODUCTION

In medico-legal practice, the assessment of the gravity of a trauma according to the duration of medical care and life hazard is a fundamental element supporting criminal classification [1, 2]. The duration, the number of medical care days required for curing, is an estimate of the time frame that the injured person needs in order to follow medical treatment (actually covered or required), so that injuries may cure, independently from the duration of the medical care, hospital admission or other medical criteria, except for medico-legal issues. The duration of hospital admission does not correspond to the medico-legal assessment of the days of medical care required for curing, as this varies. A medical examiner must assess the need for and duration of medical care depending on the location and depth of injuries, ignoring the examined individual's attitude.

From a medico-legal point of view, the duration of medical care is strictly the time frame when the injured

individual has actually followed or needed medical treatment for the injury and possible complications, independently from the development of sequelae that do not have an indication for therapeutical intervention [3, 4] in the immediate, medium or long run. When the motor or functional damage resulting from the initial injury require specialised re-intervention, the time frame for this therapy approach is added to the duration of initially provided medical care. Though the injured individual proves that she/he has undergone a treatment, with medical documents, such data must be critically analysed by the medical examiner, who only writes down the actual elements, supported by the type and seriousness of initial traumatic injuries [5]. An objective assessment of the duration of medical care is conditioned by the gravity of the injury, the concerned region of the body, the possibility of complications, the general functional impact or individual responsiveness.

The duration of medical care required for curing is assessed based on an informative set of criteria, but

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it should be noted that every case may present certain particularities related not only to the relevant injury, but also to organic responsiveness, age, pre-existing disorders, etc. This set of criteria was drawn up based on the average duration of medical care in a usual physiological evolution. In the other cases, the medical examiner shall decide depending on the mentioned factors and the medical data resulting from objective clinical remarks.

Irrespective of the number of days of medical care, an injury may be classified as serious when it endangers the victim's life. An obvious alteration of the general state of the injured individual implies changes in consciousness, respiration or circulation, that make possible a serious evolution with imminent or presumed death.

Life hazard is assessed based on the initial gravity of the injury, the alteration of vital functions and the appearance or imminence of potentially lethal complications [7, 8].

For injuries caused by shooting, pellets are lead spheres of various sizes, integrated in hunting cartridges. The morphological features of wounds caused by pellets depend on their degree of dispersion and the distance the pellet was shot from. The shape and dimensions of the entry hole vary according to the properties of pellets [9, 10, 11].

Three types of action are distinguished depending on the dispersion of pellets [12]:

1. Shooting within the limits of compact action (with the pipe close or at less than 50-100 cm). The entry hole is unique, with a well outlined tissular defect, whose diameter varies according to the calibre of the weapon and the shooting distance (1.5 cm - 4.0 cm). The edges of the defect are quite regular, a bit excoriated.

As for its shape, the tissular hole may be round; stellar, with radial rupture of the tegument; with tissular defects larger than the pipe mouth; or combined (with tissular failures and radial rupture).

A round hole may have a diameter of 1-2 cm and regular edges, with the teguments close to the wound being usually disconnected from the subjacent tissues on a radius of about 4 cm. Such holes may be found in thoraco-abdominal regions and in the thighs.

Stellar holes with radial tegument ruptures may be found in anatomical regions with a underrepresented soft tissue skull and ankle.

Holes with tissular defects larger than the pipe mouth and combined holes can be found in any region of the body, more frequently in tangential shooting or at a sharp angle. Yellow-brown excoriations may be sometimes noticed around the entry angle, produced secondarily to the action of gases. Deposits of smoke and dust may occur adjacently to the wound.

2. Shooting within the limits of relatively compact action (from further than 50-100 cm). The entry hole is located centrally, with an irregular shape and dented undulated edges, a diameter of up to 10 cm, adjacent

teguments displaced on a radius of 2-4 cm, small holes, deposits of smoke and brown pergamented surfaces, adjacent to the entry hole.

3. Shooting outside the limits of the compact action of pellets. The entry hole associates a pronounced excoriation ring, with a tissular defect. The shape and dimensions of the entry hole vary according to the properties of pellets.

For pellet shooting, the exit hole is most frequently absent. When it exists, it has a varied shape, large dimensions within the limits of compact action (1.0-15 cm), irregular edges and, sometimes, a tissular defect. The wound canal has the appearance of a figure including two cones, with a common base; the point of one cone is the entry hole, and the point of the second one are the pellets that have entered more deeply.

Pellets enter the body secondary to the mechanical pressure exercised by shooting, but atypical situations have been referred in literature where the inhalation of such a foreign body has raised medico-legal suspicions.

Through their small size and round shape, pellets may cause both direct injuries in the area where they penetrate the body, and distant injuries, through potential migration from the initial location. In shot wounds, medical examiners make considerable efforts to certainly establish the causes of death [13]. In the case of pellets, confusions may arise in certainly establishing the cause of death [19-21] given their mobility in the body. Thus, situations were reported when a pellet migrated on an intravascular level, from the fascial area of the femoral vein to the confluence of iliac veins [22-24] or from other entry points (knees, lungs, etc.) to the heart [25, 28] or inside the lungs [29]. Most frequently, shot wounds are located at the cranium level [30-33], probably due to the aggressor's intention to cause imminent death.

CASE PRESENTATION

The patient A.C., female, 12 years old, was admitted for three days in a municipal hospital due to shooting with a pellet, by ricocheting, with the diagnosis "recent shot wound with retention of a foreign body (radiopaque pellet) in the left inguinal area (observation covered rupture of the femoral artery), with a deeply presacral oblique route, varicose disease in the left lower limb".

When admitted, the patient had a good general state, with pale teguments and mucosa, BP 90/60 mm Hg, pulse 92 beats/min. The presence of a shot wound in the left inguinal area was seen in the local examination, with a size of 2 x 1 cm.

The X-ray of the pelvis performed on admission revealed a foreign body in the lower pelvis, 2 cm left paravertebral, laterally from the sacral bone column. The inguinal wound was cleaned and explored in the surgery service, followed by a compressive gauze.

The abdominal echography taken on the second

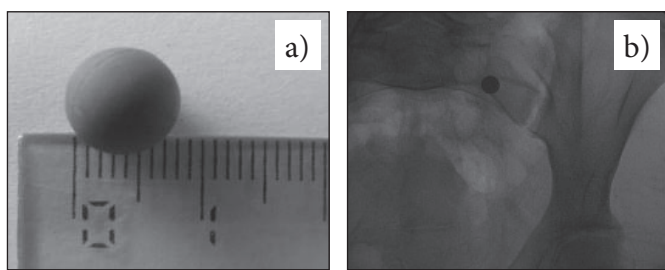


Figure 1. a) Foreign body (pellet) located in the left paramedian presacral space b).

day from admission did not show the presence of free intraperitoneal liquid or foreign bodies, and the thoraco-abdominal radiography performed 48 hours after admission showed accentuated bronchovascular markings, radiologically normal heart and a radiopaque foreign body (pellet), located in the left presacral space (Fig. 1).

Three days after admission, the patient is transferred to a tertiary level medical unit, specialised in the treatment of cardiovascular diseases, where she stayed for 26 days, with the diagnosis “shot wound in the left inguinal area, migrating radiopaque foreign body, with final location in the lower lobar artery of the left lung, hydrostatic varices in both lower limbs, 2nd degree venous insufficiency, gallbladder cholelithiasis”.

Upon local examination during admission, a circular tegument defect was seen, with a diameter of about 8 mm, located at the base of the left thigh, on the back side, 1 cm under the crural arcade and 1 cm medially from the cutaneous projection of the femoral artery, with normal neighbourhood teguments, no local-regional inflammatory signs, superficial injury close to cicatrization, covered by a fine fibrinohematic crust. No sensibility was found upon palpation in the iliac fossa or left lumba, and neither pain upon palpation of the root of the left thigh. Arterial pulse was within normal limits, no blows, and no palpable pathological formations were seen in the left thigh, in the left inguinal or lumbar area, dysurea, hematuria, genital bleeding, neurological deficits or irritation elements on the trajectory or in the innervation territories of lombo-sacral nerves. Intestinal transit was present and the abdomen was supple upon examination.

On the admission day, an angiography was performed revealing the presence of a radiopaque foreign body, with a diameter of about 8 mm, located about 1 cm

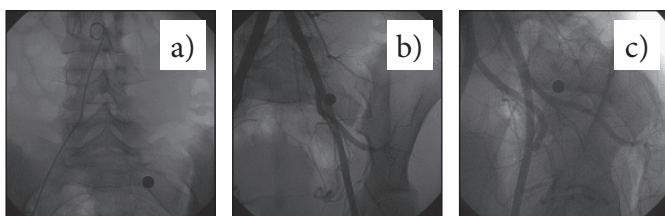


Figure 2. Arteriography: a) native; b) contrast injection in PA incidence; c) contrast injection in left anterior oblique (LAO) incidence.

from the sacrum and 3.5 cm left from the midline, as well as a permeable left ilio-femoral arterial axis (Fig. 2).

Abdominal echographies undertaken on the second and fourth day respectively from admission showed no free liquid in the peritoneal cavity, presence of collections in the left inguinal area and lower pelvis or foreign bodies.

Investigations were supported by a computerized tomography (CT) scan with contrast substance on the fourth day from admission, where an egg-shaped foreign body, with metal density, 10 mm diameter and 18 mm height was seen, located 14 mm anterior to the left sacral wing, behind the psoas muscle and left external iliac vessels, with no direct relation to such vascular elements. No pathological collections adjacent to the foreign body or other pathological elements at the level of the lower pelvis were seen upon CT examination.

The radioscopy repeated on the eighth day from admission showed the disappearance of the previously described foreign body and the presence of a foreign body with the same features and dimensions, located on the right paracardiac region, corresponding to a horizontal plane traced through the T8-T9 intervertebral disk. Thus, it was assumed that the foreign body had migrated through the inferior caval system and an angiographical examination was indicated. Angiography showed the migration of the foreign radiopaque into a segmental artery of the right lower lobe. A flebography of the left lower limb was performed in the same time revealing a patent deep venous axis and superficial varices in the calf.

Therapeutical approaches of foreign bodies with various locations vary from minimally invasive interventions (endoscopy [34-38], bronchoscopy [39], laparoscopy [40, 41], arthroscopy [42-45]) to open surgery [46-48], but no method guarantees successful extraction.

In this case, the extraction of the foreign body was attempted with a basket catheter, then surgery was made with a right thoracotomy, exploration of the right lower lobe pulmonary artery with a Fogarty catheter, as well as segmental branches, with no possibility to extract the pellet (Fig. 3).

During the surgery, the pellet moved to the left lower lobe pulmonary artery (Fig. 4). Post-surgery evolution was favourable, with no signs of pulmonary arterial thrombosis or pulmonary hypertension, with the persistence of a slight inflammatory syndrome, no leukocytosis and no feverishness, cured left inguinal wounds and right anterolateral thoracotomy.

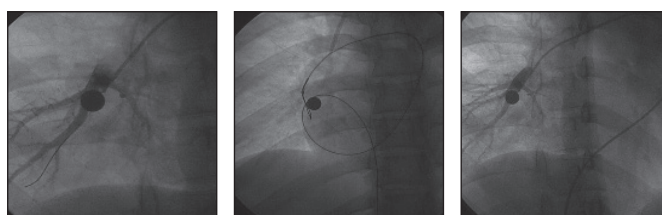


Figure 3. Unsuccessful attempts to recover the pellet.

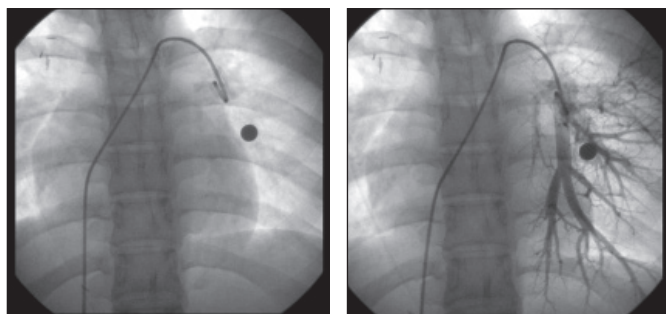


Figure 4. Migration of the pellet at the level of the left lower lobe pulmonary artery.

The extraction attempt was repeated a month later, percutaneously, without managing to recover the foreign body (Fig. 5).

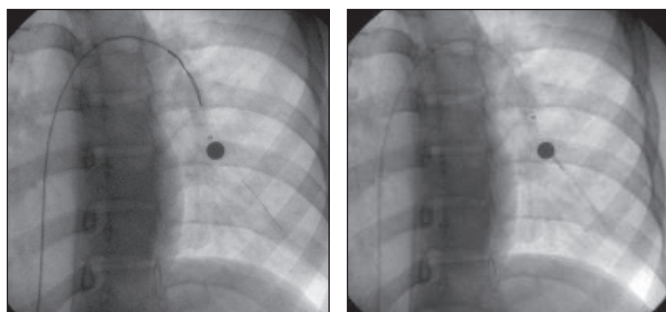


Figure 5. Unsuccessful percutaneous extraction attempt, a month after the first intervention.

Three months after the incident, it was concluded that the foreign body had a stable position, and a new attempt of extraction was thought to be unwelcome, for the major risk of potential complications (pulmonary artery rupture, massive bleeding). Thus, a conservative approach was taken, with periodic medical supervision. The therapeutical decision was justified by the failure of extraction attempts and by the patient's inclusion in an ethnic group with a minimal medical culture, as her parents had difficulties in understanding the implications of inaction and the need to ensure optimal life quality [49, 50].

Subsequently, the patient was repeatedly admitted to the pediatrics department, for repeated pulmonary

infections due to the injury.

Medico-legal examination was undertaken about a month after the event, and a round, violet-coloured scar was found in the left inguinal area, with the diameter of about 1 cm, as well as a sewn post-surgery scar, 12 cm long, secondarily to the right anterolateral thoracotomy, to the side of which two other sewn surgical incisions were made, 1.3 cm long each.

Medico-legal examination was repeated two years after the initial injury, and showed a white, slightly cheloid scar, 12/0.5 cm, located at the level of the right hemithorax, between the median axillar line and the submammary edge. Below, on the lateral side of the thorax, two other scars associated to surgical wounds were found, 1.5 cm long each. The left inguinal scar was supple, pinkish, 1/0.5 cm.

From a medico-legal point of view, it was found that the patient had a shot left inguinal wound, with the retention of a migratory foreign body (pellet), finally located in the left lower lobe pulmonary artery, injuries which could have been caused by shooting, needing 30-35 days of medical days to cure, stipulating that the injuries endangered her life and the patient had to be reexamined for assessment of other medico-legal consequences, after all therapeutical means have been exhausted.

CONCLUSIONS

Pellet shooting traumas may have an atypical evolution, as the projectiles migrate from the entry hole, rendering impossible their extraction and exposing the victim to long-term complications due to retention of the foreign body (repeated pulmonary infections in this case).

The diagnostic, therapeutical and evolutionary complexity of such cases requires complex medico-legal expertise, for a most accurate classification of the criminal act, considering the many admissions, interventions and complications that may occur during one's lifetime or until the foreign body is removed.

Conflict of interest. The authors declare that there is no conflict of interest.

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