The ICRC Metallic Foreign Bodies After War Injuries: Should We Remove Them? Experience

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The presence of metallic foreign bodies is a relatively common finding on the x-rays of war-wounded patients. They usually represent entire bullets or part of them, or fragments from bombs or mines. They often catch the attention of the patient and his/her relatives who impute to them the cause of pain and disabilities and insist with the doctor for their removal, even when the soft tissues wound has completely healed. The experience of the ICRC (International Committee of the Red Cross), based on a surgical database of more than 36,000 war wounded patients registered and 200,000 operated in ICRC supported hospitals around the world, shows that these operations are often risky, useless, consume time and material. They result in new surgical trauma with its possible complications, often without identifying and removing the foreign body. The relatively few indications for removal of these foreign bodies are listed together with a simple stereo tactic method to locate them. A special mention of the effective risk of lead poisoning is made as this is sometimes pleaded as a reason for removal of retained bullets.

Introduction

According to WHO, war injuries are a big burden for Africa: they represent the first surgical cause of death and the first cause of surgical disease[1]. Metallic fragments are a relatively common finding on the x-rays of war-wounded patients. They are usually bullets, fragments or shrapnel. Quite often they attract the attention of the patient and/or bystanders who attribute to them the cause of their pain and discomfort and, quite often, un-experienced doctors concentrate on their removal instead of on proper wound debridement and damage control.

The International Committee of the Red Cross is an impartial, neutral and independent organization whose humanitarian mission includes the assistance to war wounded. During the last 30 years ICRC surgeons have gained a wide experience in the management of war wounded patients under difficult conditions: more than 200,000 operations have been performed in ICRC supported hospitals and more than 36,000 cases have been registered in the ICRC surgical database.

The experience of ICRC surgeons shows that operations expressly performed for the removal of a metallic fragment can very often cause more damage to the tissues than the original injury!

The aim of this paper is to provide an answer to the usual questions arising when facing a patient with retained metallic foreign bodies, indications for their removal and a simple method for their localization.

The Natural History Of Retained Metallic Fragments

As a result of the human body's reaction, metallic foreign bodies are usually incorporated in strong, fibrous, avascular scar tissue that prevents further mechanical trauma and lead leak. This is true for metallic fragments retained in soft tissues, muscle or bone. Here the risk of subsequent infection is very low (2-3%)[2].

Encapsulation by a scar does not usually happen in case of fragments retained inside joints where destructive arthritis with pain and limitation of movements or, very rarely, systemic lead toxicity may develop.

The question of "migrating bullets" is more a topic for the reporting of strange clinical cases in specialized

journals than it is a real clinical problem if we consider the millions of patients throughout the wars of the twentieth century presenting retained foreign bodies. Nonetheless, in an experimental study on monkey's brain, it has been demonstrated that copper-coated pellets do cause a local necrotic reaction that can be so severe as to allow significant migration of the pellets through the brain[3]. A bullet can also, occasionally, migrate along the spinal canal[4,5], or along a major blood vessel after eroding through the vessel wall. These are incidental reports compared to the number of cases with retained metallic fragments, without consequences, around the World.

The Problem Of Lead Poisoning And Other Metals Toxicity:

Bullets are usually composed of a lead core and a copper or brass jacket. Pellets from shotguns are composed exclusively of lead. A systemic toxicity may be caused by lead leaking out of the bullet as reported in case of bullets bathed in synovial joint fluid[6,7] or intervertebral disc space[8]. Again this is an extremely rare possibility if we compare the very few positive reports with the thousands of persons with retained bullets or pellets around the World.
Lead toxicity may affect virtually any organ: from the central and peripheral nervous system (convulsions, delirium, ataxia, slurred speech, neuritis) to the kidneys (renal failure), the gastrointestinal system (nausea, vomiting, colic pain) or the haematological one (microcytic anaemia). Death may occur as result of generalized brain oedema or kidney failure.

A suspicion of lead toxicity can be proved directly by a serum lead measurement (levels above 10 micrograms/dl in children and 40 micrograms/dl in adults are considered toxic) or the EDTA challenge test, or, indirectly, by a bone marrow aspiration to assess the effect on the haematopoietic system. Once recognized, lead poisoning should be treated with chelating agents (EDTA, dimercaprol, d-penicillamine, succimer). The surgical removal of the source of lead poisoning shouldn't be performed before blood lead levels have been reduced, to avoid acute lead poisoning.
In experimental studies on monkey brain, copper causes a severe local necrotic reaction [9].

The Problem Of Bullets Or Fragments Located In Dangerous Or Delicate Areas:

In case of metallic foreign bodies close to a major vessel or in the mediastinum, close to the heart, we have to consider the risks and benefits of a major surgical procedure to remove the foreign body. The morbidity of such a procedure can be significant, whereas the overall incidence of complications is extremely low. Our experience suggests that it is probably better to leave them alone unless they are causing specific, proven complications. Should the surgeon suspect a pseudoneurysm or an artero-venous fistula then an operation to treat the complication would probably involve the removal of the foreign body.

Another delicate area is the central nervous system. It is not yet clear if metallic foreign bodies in the brain increase the risk of brain abscess and epilepsy: there are reports for[9,10] and against[11,12]. Again, as a matter of common sense, our experience tells us that the surgical damage related to the foreign body's removal is much bigger than its benefit. Retained bone fragments in the brain, however, are well known to be more significant a cause of abscess formation than metallic fragments[13].

Brain metallic foreign bodies are removed only if detected in the surgical field during the "debridement". If the patient develops an abscess we treat the abscess; if it was related to such a foreign body, the fragment should come out with evacuation and drainage of the abscess.

If the metallic foreign body is located in the spinal cord, we consider laminectomy and removal only if the surgeon is experienced in this field and there is a clear progressive neurological deficit and radiological evidence of spinal cord compression by the foreign body[14].

For metallic foreign bodies penetrating the eye, we consider the removal in case it is located in the anterior chamber, the surgeon is experienced, and magnification, instruments and proper suture material are available[15].

So what are the indications for removal of metallic foreign bodies?

The problem of retained metallic fragments subsequent to war injury is usually more psychological than organic in origin. Should the surgeon come upon it during primary wound excision, then it should be removed. The surgeon should not, anyway, explore unnecessarily and open fresh planes in healthy tissue to look for metallic fragments: they may be left in situ[16]! Very few metallic bodies cause sufficient problems, however, to warrant their surgical excision.

Here are the usual situations where we suggest removing the foreign body:

- A metallic foreign body causing a localized infection: the abscess or fistula draining pus will not heal until the foreign body is removed or expelled.
- A metallic foreign body that disturbs function: a fragment retained inside a joint is a physical impediment to proper joint movement and damages the articular cartilage, further reducing joint function. (In this case it should be removed as part of the initial surgical excision and wound toilet). Pain can also compromise function: again as in the case of a fragment retained in a joint, or in body areas particularly subject to constant or repeated pressure (sole of the foot; palm of the hand; subcutaneous over elbow, back or sacrum).
- A metallic foreign body causing pain exclusively and convincingly, and within easy access. Pain receptors are located in known parts of the body, particularly in the subcutaneous tissues. There are no pain receptors deep in the muscle, for example: ischaemia will cause muscular pain, not a foreign body that does not cause infection.

And here are some much rarer indications for retained metallic fragment removal:

- A confirmed case of lead poisoning, only after lowering blood lead levels.
- A metallic foreign body in the spinal cord, but only in the presence of an experienced surgeon, a clear progressive neurological deficit and radiological evidence of cord compression by the foreign body.
- A metallic foreign body in the anterior eye chamber in the presence of experienced surgeon, magnification, proper instruments and suture material.

How to localize and remove the metallic foreign body:

For those patients with pain due to a superficial fragment just under the skin, excision under local anaesthesia is, usually, a straightforward procedure. For those patients requiring removal of a deeply seated metallic fragment, proper localization prior to surgery is of the utmost importance. Most district hospitals do not have fluoroscopy or an image intensifier in the operating theatre so that the surgeon can operate under direct vision.

A simple stereo tactic technique to assist localization involves taping a series of radio-opaque objects (paper clips, injection needles, steel wires) to the body part, usually a limb (both anterior surface and lateral surface), and then taking ordinary X-rays with postero-anterior and lateral views. The position of the radio-opaque object is marked on the skin with a felt pen when the object is removed.

By looking at the two X-ray views, the surgeon can estimate the relative distance of the bullet from the radio-opaque objects in the axis across the limb (ex. half-way between the second and third paper clips) and in depth (ex. one-third of the way between the first and second paper clips). The idea is to use a two-dimensional X-ray to extrapolate into three dimensions.

During operation, the surgeon should always remember that, with time, the body will form a fibrous tissue pseudo-capsule around the metallic fragment. This includes other foreign matter and dirt, and should be excised together with the foreign body.

Conclusions

- The metallic missile is dangerous when it is moving, not when it has come to a stop in the body. The damage has already been done.
- Retained metallic foreign bodies in soft tissue or bone usually do not cause any harm.
- Lead poisoning is an extremely rare event, as it is fragment migration.
- Standard indications for removal of retained metallic foreign bodies are: infection; location inside major joints; superficial localization in the subcutaneous tissues, in areas subject to pressure; in the sole of the foot or palm of the hand.

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