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Case Report

Lead synovitis: The important role of radiology on diagnosis and follow-up: Case report☆,☆☆

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ABSTRACT

We present the case report of a 67-year-old man with a history of a firearm injury on the left upper extremity 35 years ago. Lead synovitis and imaging features are reviewed, emphasizing radiology's crucial role in diagnosing and following this condition.

Introduction

The synovium is a thin specialized membrane lining the joint surfaces, bursae, and tendon sheaths. Synovial diseases are classified as inflammatory, infectious, degenerative, traumatic, hemorrhagic, and neoplastic [1]. Damage in other intra-articular structures, particularly cartilages, generally occurs due to pathologic processes involving the synovium, leading to irreversible joint destruction [2].

Victims of gunshot injuries can have the projectile indefinitely retained, and a lead-containing bullet embedded in soft tissues or bone is usually harmless. However, when lodged in a joint, synovial fluid can dissolve the shell, causing local lead arthropathy or systemic plumbism [3,4]. Very high lead levels in the synovial fluid are believed to be responsible for toxicity changes in the synovium and bone [5]. Nevertheless, the available literature regarding lead synovitis is limited.

Imaging plays a critical role in the early detection of synovial diseases before irreversible joint damage. Plain radiogra-

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Fig. 1 – Left elbow X-ray: Multifragmented fracture with loss of bone substance in the distal diaphysis of the left humerus with a widening of the distal metaphyseal region due to bony callus formation with separation of the more distal fracture fragments (4 mm) associated with sclerosis at the edges, suggestive of non-union. Irregularity of the proximal anterior portion of the ulna with anterior osteophyte formation of the right ulna and humerus. Deformed firearm projectile and smaller metallic pieces in the distal third of the humerus, proximal ulna, and radius. There is decreased elbow joint space-soft tissue edema.

phy, ultrasonography (US), and magnetic resonance imaging (MRI) are utilized to diagnose and follow-up on synovial conditions. Gadolinium-enhanced MRI is the best tool to diagnose synovial disorders [1].

We present a clinical case of 1 patient with lead synovitis and imaging features, emphasizing radiology's crucial role in diagnosing and following this condition.

Case report

A 67-year-old man presented to our institution with a 4-month history of bilateral upper limb pain, weakness, and paresthesias in the territory of the median and ulnar nerves. On physical examination, inflammatory changes were noted on the medial aspect of the left elbow, and he had positive Froment, ulnar Tinel test, and Phalen on the left upper extremity. Electromyography of both forearms showed an increased latency and decreased amplitude of the median nerve. He reported a relevant previous history of firearm injury on the left upper extremity, which occurred 35 years ago. Unfortunately, there is no available medical record from that time. However, the patient reports that the bullet is still lodged in the soft tissues (Fig. 1). He denies any recent history of systemic, psychiatric, or gastroenterology symptoms and cannot recall any other manifestation in the past years. Bilateral carpal tunnel syndrome was diagnosed, and the orders were delivered for surgical release.

One year after surgery, the patient presented again complaining of a week of pain and inflammatory changes in the left elbow. Laboratory results were within normal limits. On the physical exam, increased heat was palpable on the left lateral epicondyle. An ultrasound-guided joint puncture was performed, which reported cloudy yellowish liquid with little cellularity and no bacteria in the gram staining nor positive cultures. After X-ray and CT assessments of the joint, elbow synovitis were diagnosed secondary to a foreign body reaction concerning his previous medical history of firearm injury to this common (Figs. 2 and 3).

He was then referred for 5 sessions of shock-wave therapy on the left lateral epicondyle, with an intensity of 1.5-5.0 bars and a frequency of 18-3 Hz, but the patient showed no improvement.

He still complained of severe pain and limitation in his daily activities and paresthesias in the left hand's fourth and fifth fingers. Physical examination revealed edema and deformity on the left elbow. Passive motion range assessment was limited by pain and showed flexion-extension of 50-110°, supination 70°, and pronation 45°.

An MRI (Fig. 4) of the left elbow was requested, seeking to know the ulnar nerve condition and the relationship between this and the bullet fragments causing limited joint mobility and inflammatory changes.

Finally, advanced traumatic osteoarthritis of the left elbow was diagnosed with progressive lead synovitis due to a history of a bullet lodged within the joint for 35 years. Left elbow synovectomy and foreign body removal were performed (Figs. 5 and 6). Since then, the patient has presented to our hospital, referring to better pain control and improved inflammatory manifestations, but no change in functional outcome.

Discussion

Lead arthropathy results from gunshot wounds with bullets lodged inside joint spaces. In this case, there is a clear depiction of the natural history of the inflammatory response lead-

Fig. 2 – Left elbow X-ray (1 year after initial X-ray): Sequelae of severe trauma to the elbow caused by a Deformed firearm projectile with multiple smaller metal pieces in the vicinity of the bone structures and a multifragmented fracture of the supracondylar region and a non-union fracture with decreased joint space. There is a widening of the distal metaphyseal part of the humerus. Compared to the previous study, there is increased synovial proliferation and broader distribution of the metallic fragments.

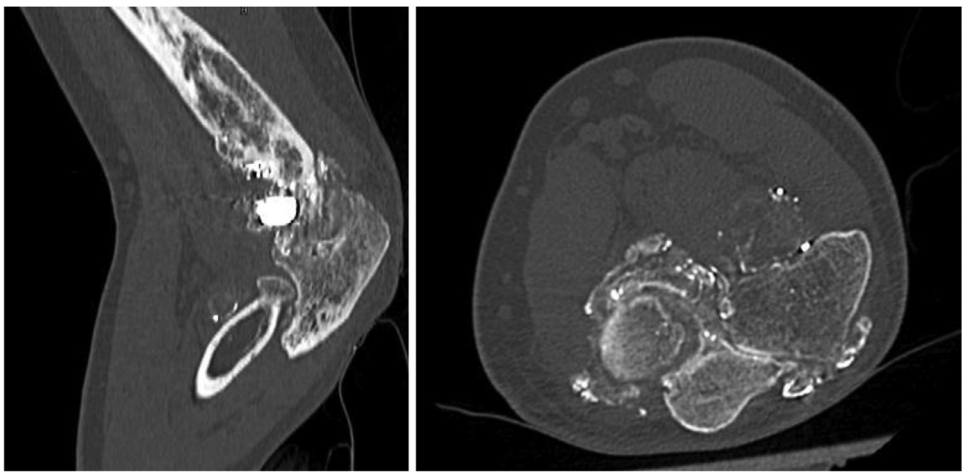

Fig. 3 – CT of the left elbow (1 year after initial X-ray): Deformed firearm projectile with multiple metallic smaller pieces distributed within the joint space; there is visible synovial proliferation. Also, note juxta-articular osteopenia with irregular and hypertrophic articular surfaces, subchondral humeral and ulnar sclerosis with intraarticular dystrophic calcifications. Oblique fracture of the distal metadiaphysis of the humerus in an advanced consolidation state on its medial side alters its morphology. It is accompanied by the heterogeneous density of the underlying medullary bone. The lateral part of this fracture has non-union sclerotic edges.

ing to a higher metabolic environment. This pathologic process was initially described by Leonard in 1969 [6]. Because of the properties of some components in the synovial fluid like mucopolysaccharides, dissolution of the lead from the bullet occurs, and systemic absorption occurs; there is also a physical and biochemical local reaction to shots causing a form of proliferative synovitis. Also, the mechanical forces inside the joint cause fragmentation of the shell, making the process of systemic lead absorption more suitable [5].

Inside the joint, the local effects of lead cause inflammation of the hyaline cartilage, making it thinner, although visible on images because of particle deposition on its surface.

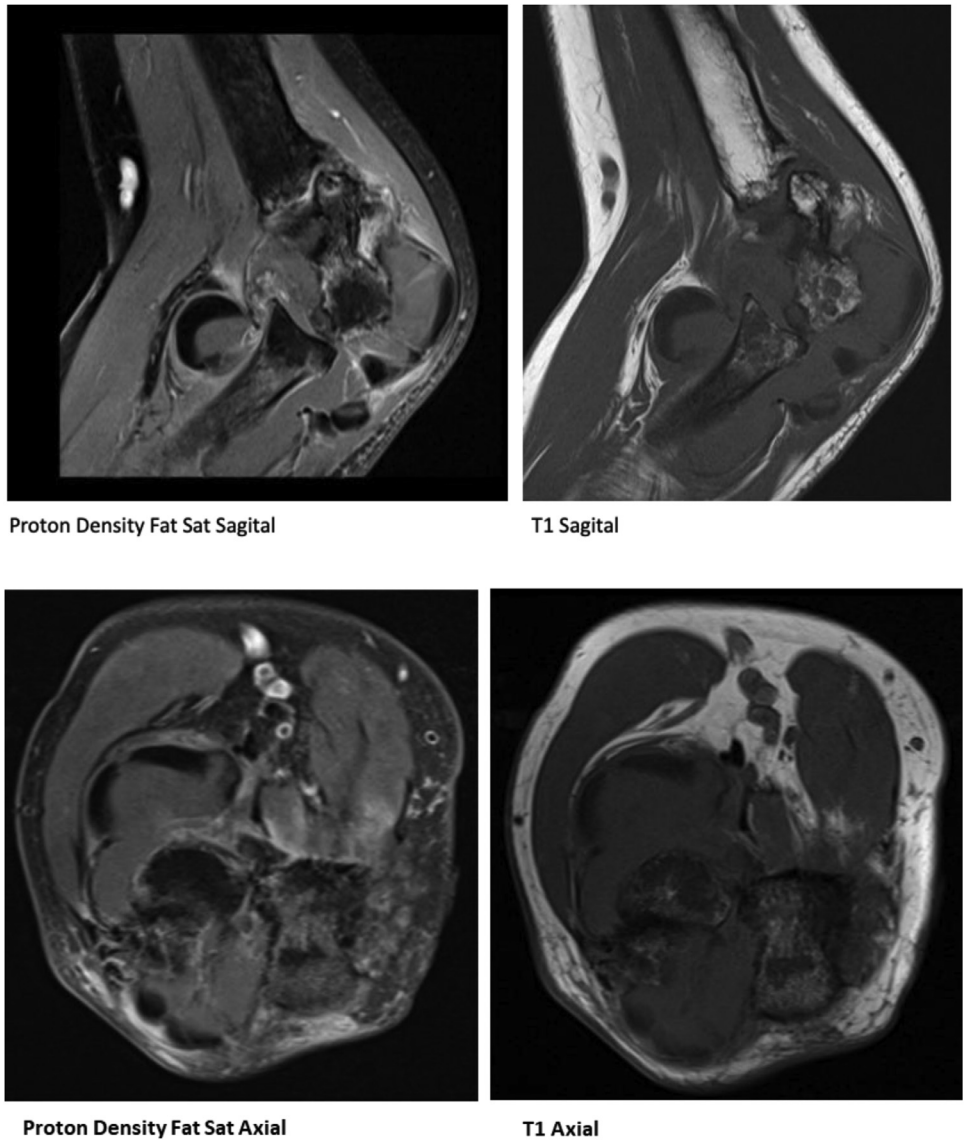

Fig. 4 – MRI of the left elbow (3 years after initial X-ray): PD FS and T1W sagittal and axial images showing a multi fragmented distal humerus fracture with osteolysis and partial reparative changes, especially noting instability of the lateral epicondyle. Extensive osteoarthritic changes are associated with chondral injury, marginal osteophytes-joint effusion, and signs of synovitis, with some areas of paramagnetism indicative of synovial lead deposition. There are also signs of radius subluxation and ligamentous injury.

The inner surface of the synovium and joint capsule may also be coated with lead particles causing inflammation, proliferation, and a cloud-like appearance similar to an arthrogram called *"lead arthrogram"* or *"plumbogram"* [7].

The nearby bone is also affected in cases of lead arthropathy, as is the growing bone of children in cases of exogenous systemic intoxication [8]. Most of the lead burden in cases of systemic intoxication is located in bones, with a slightly more significant fraction in adults compared to children; there are periods of greater lead release from bones in times of increased bone resorption like pregnancy and old age [9]. It has been described in previous reports that sequestration of the lead fragments occurs within the bone, followed by the fibrous encasement. The *"lead line"* that appears in the metaphysis of bones in children is thought to result from chondroclastic and osteoclastic activity failure. In the same way, there is depression of osteoclastic activity of the adjacent bone in cases of lead arthropathy, which contributes to increasing amounts of non-degraded bone [5].

Unlike in synovial fluid easily absorbed, blood lead is mainly bound to erythrocytes [5], which limits diffusibility, causing symptoms intermittently. The constellation of symptoms is known as "plumbism." It primarily derives from the effect of lead on the central nervous system causing symptoms like headaches, amnesia, ataxia, poor concentration, psychosis, and manifestations in other systems like abdom-

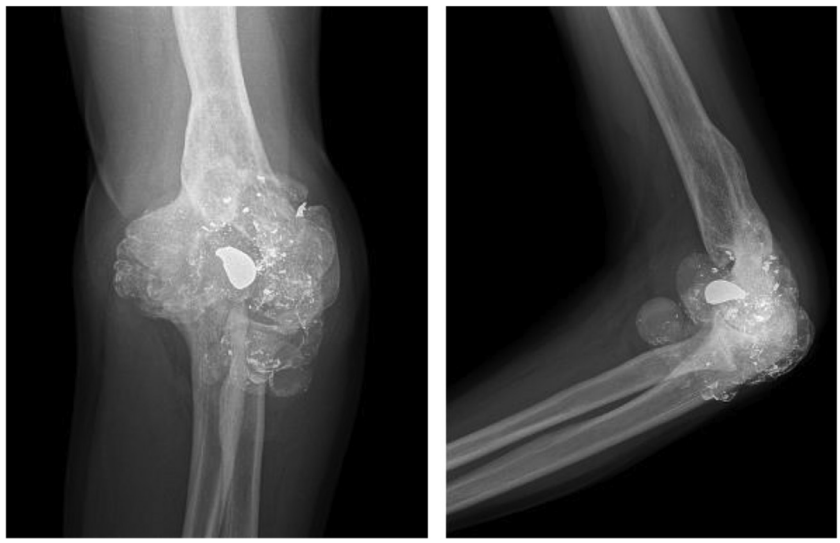

Fig. 5 – Left elbow X-ray (4 years after initial X-ray): Presurgical X-ray shows significantly increased joint deformity with exostosis, synovial proliferation, and metallic pieces projected on the joint space. The firearm projectile has deformed even further. There is also deformity of the distal humeral metaphysis due to consolidated fracture.

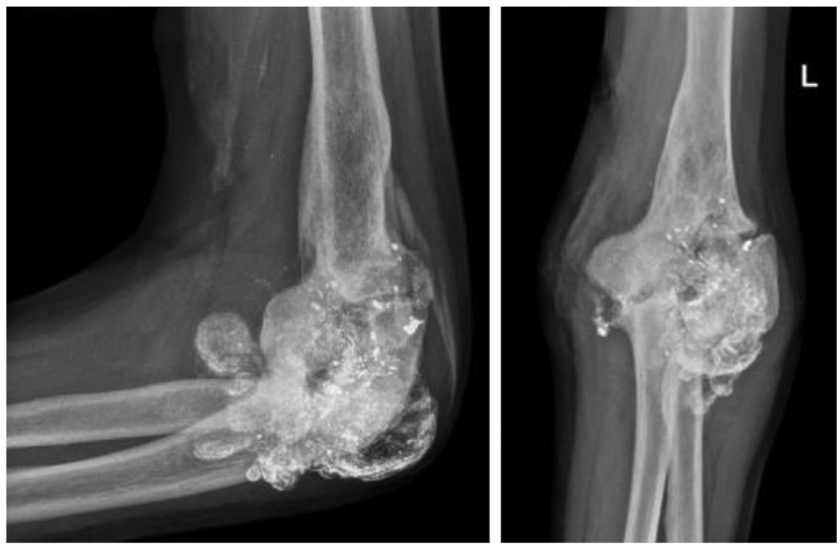

Fig. 6 – Left elbow X-ray (4 years after initial X-ray): Postsurgical radiograph shows most extensive projectile extraction and partial synovectomy with persistent plumbogram and degenerative changes.

inal pain, anemia, and harmful effects on bones, as previously mentioned.

Conclusions

This paper presents a case of evolving lead arthropathy from the imaging point of view, which is closely related to the known pathologic process. Although we lack the entirety of clinical information since the beginning of the disease, we do not rule out the possibility of previous systemic symptoms in our patient and emphasize the importance of recognizing lodged bullets in joints after gunshot wounds as a cause of significant morbidity for patients. The inflammatory changes reported by the patient appeared after a carpal tunnel release surgery, and unfortunately, there is no recorded medical history from the time of the trauma. Lead levels have stayed normal, and there have been no systemic symptoms during the time the patient has been followed up in our institution.

This remarks the importance of correctly treating firearm injuries, mainly when these occur in joints.

Data sharing statement

The relevant anonymized patient-level data are available via request from the authors.

Ethical approval and informed consent

The report case was reviewed and approved. Following our institutional guidelines, all protected health information was removed, and individual patient consent was not required for the analysis.

Patient consent

Written informed consent has been obtained for the publication of this case report.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.radcr.2022.07.015.

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