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Radiology

Assessment of Functional Impotence in a Young Person Revealing Kienböck's Disease: Radio-Clinical Case and Review of the Literature

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Abstract | **Case Report**

Kienbock's disease is a rare form of avascular necrosis affecting the lunate bone. The underlying mechanism is poorly understood. Clinical examination is not specific, and diagnosis is typically made through imaging. Plain radiography, CT, and MRI can all aid in diagnosis, staging, and guiding treatment decisions.

Keywords: Lunate bone, avascular necrosis, CT, MRI, Lichtman classification.

INTRODUCTION

Kienbock's disease is a type of avascular necrosis that affects the lunate bone. The condition arises from a decrease in blood supply to the bone, leading to bone softening and eventual collapse. The underlying mechanism of this decrease in blood supply is not well understood, though both trauma and compromised vascularization have been implicated [1, 2].

In this paper, we present a case of Kienbock's disease that was diagnosed and treated at our hospital, along with a review of relevant literature.

OBSERVATIONS

Our patient was a 20-year-old male with no significant medical history who presented with progressively worsening pain and weakness in his right hand and wrist over the course of two months. Physical examination revealed limited joint mobility, decreased muscle strength, and pain with both passive and active wrist movements.

We performed an MRI of the wrist without gadolinium contrast, utilizing axial and coronal T1 and DP Fat-Sat sequences in all three planes. The imaging showed a collapsed lunate with hypointense T1 signal and hyperintense DP Fat-Sat signal, along with narrowing of the radiocarpal joint space, subchondral geodes of the capitate and hamate bones, and a negative ulnar variance of 4.4mm (Fig. 1).

Based on these findings, we diagnosed the patient with Kienbock's disease stage IIIA and referred him to our trauma team for further management.

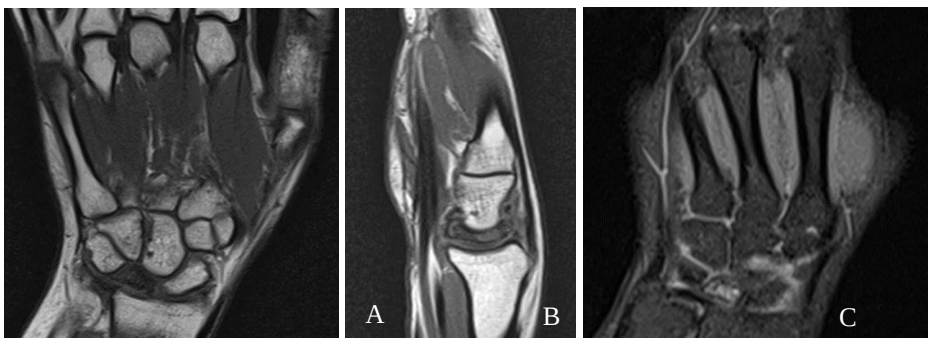

Figure 1: MRI of the wrist (A: coronal T1 weighted image, B: sagittal T1 weighted image, C: coronal DP FS image) showing a collapsed lunate with hypointense T1 signal and hyperintense DP Fat-Sat signal

DISCUSSION

Kienböck's disease is a rare form of osteonecrosis, with an estimated prevalence of 0.5% of the general population, which increases to 1.1% - 2% in workers using jackhammers [4]. This disease, which was first described by radiologist Robert Kienböck in 1910, typically affects young adults between 20 and 40 years of age and is usually unilateral [4].

The exact cause of Kienböck's disease is not fully understood, although multiple pathophysiological mechanisms have been suggested. It may be related to trauma causing bone impingement, anatomical variants of the lunate, and lesions of the intra- or extraosseous feeding vessels resulting in a lack of vascular supply [2]. The vascularization of the lunate is dependent on an extraosseous system provided by a ventral and a dorsal pedicle, and an anastomotic intraosseous system [2, 5]. The presence of a single extraosseous vascular supply predisposes to osteonecrosis [2]. Additionally, a negative ulnar variance (measured on imaging) leads to a transmission of radio-ulnar mechanical stresses to the distal radiocarpal ligament and, by contiguity, to the lunate, increasing the risk of developing this disease [5].

Other factors that may contribute to the development of Kienböck's disease include venous congestion, glucocorticoid use, and systemic diseases such as high-dose corticosteroids, sickle cell disease, Raynaud's phenomenon, lupus, and other vasculitis [2, 5]. Studies also suggest that a genetic component may be a risk factor [3].

The clinical symptoms of Kienböck's disease are often nonspecific and include insidious mechanical wrist pain with reduced grip strength. Joint amplitudes may be limited, especially in flexion-extension [1]. The disease progresses towards necrosis and compression of the lunate, leading to functional impotence of the wrist [6].

The Lichtman classification is used to diagnose Kienböck's disease through imaging (plain radiography, CT or MRI) and to determine the stage of the disease's progression, which guides treatment decisions [7]. Plain radiography and CT scans are usually normal in stage I. In stage II, the lunate undergoes densification and sclerosis compared to the other carpal bones, and in stage III, there is a progressive loss of its height (from distal to proximal) which may lead to degenerative lesions affecting the carpal bones in stage IV [6, 7].

MRI is more effective in the initial phase of the disease. In stage I, diffuse bone edema is seen on T1 hyposignal and T2 hypersignal. In stage II, T1-hyposignal and T2-hyposignal areas indicate areas of sclerosis of the lunate; T2-hyposignal may be absent at this stage and must be compared with radiographic or CT data. Morphological changes begin in stage III; the lunate loses its height and includes areas of T1 hyposignal, T2 hypo or hypersignal. The presence or absence of carpal bone instability divides stage III into different subgroups (Fig. 2). In stage IV, the lunate is fragmented, in T1 hyposignal, in T2 heterogeneous signal, with joint effusion, and advanced degenerative lesions [6, 7, 8].

The study of gadolinium-enhanced MRI of the lunate is essential in therapeutic decision-making. A homogeneous enhancement of the bone allows revascularization, while the absence of enhancement reflects bone.

Stage	Radiographic and CT Findings	MRI Findings
I	Normal morphologic findings	Morphologic preservation
		Edema pattern in bone marrow
II	Normal morphologic findings	Morphologic preservation
	Sclerosis in bone marrow	Signal intensity low on T1-weighted images, variable on T2-weighted images
IIIA	Collapse of lunate bone	Morphologic collapse of lunate bone
	Radioscaphoid angle < 60°	Signal intensity low on T1-weighted images, variable on T2-weighted images
IIIB	Collapse of lunate bone	Morphologic collapse of lunate bone
	Radioscaphoid angle > 60°	Signal intensity low on T1-weighted images, variable on T2-weighted images
IIIC	Collapse of lunate bone	Morphologic collapse of lunate bone
	Coronal lunate fracture (chronic)	Signal intensity low on T1-weighted images, variable on T2-weighted images
		Coronal lunate fracture (chronic)
IV	Radiocarpal or midcarpal degenerative arthritis	Radiocarpal or midcarpal degenerative arthritis
		Signal intensity low on T1-weighted images, variable on T2-weighted images

Figure 2: The different evolutionary stages of Kienböck disease on imaging according to the Lichtman classification [7]

Treatment of Lichtman stage I is based on immobilization and administration of non-steroidal anti-inflammatory drugs. Stages II and III require revascularization (performed by bone grafting) isolated or associated with surgery to adjust the length of the radius or ulna. In stage IV, treatment is surgical and consists of either carpal arthrodesis, first row carpal osteotomy, or total wrist arthroplasty [6, 7].

Kienböck disease progresses gradually from stage I to stage IV. In the absence of management, osteoarthritis and destruction of the wrist occurs within 3 to 5 years [7].

CONCLUSION

Kienböck's disease remains a disorder of poorly understood pathophysiology involving multiple risk factors. Imaging, and especially MRI, is an indispensable tool in the diagnostic and therapeutic management of the disease.

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