



A case of avascular necrosis of capitate bone in an air compressor jack hammer worker

Ali Tabrizi*¹ , Ali Aidenlou¹

¹ Clinical Research Development Center AND Department of Orthopedics, School of Medicine, Imam Khomeini Hospital, Urmia University of Medical Sciences, Urmia, Iran

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Abstract

Introduction: Avascular necrosis (AVN) is very rare in capitate bone. It mostly occurs due to direct trauma to wrist. However, it could also occur as the result of disturbed blood supply due to repetitive micro-trauma in rare cases.

Case Report: In this report, a 30-year-old man who was an air compressor jack hammer worker with chronic wrist pain was presented. Imaging revealed a low-signal intensity lesion on T1-weighted which supported AVN of capitate. Blood supply damage was due to continuous stress to palmar hand as the consequence of working with air compressor jack hammer which led to AVN of capitate.

Conclusion: AVN of capitate could occur as the result of repetitive micro-trauma. It has a high correlation with the job of patients. Radiography does not help in the first stages. Magnetic resonance imaging (MRI) has high diagnostic sensitivity. In the primary stages in patients with occupation-induced AVN, it could be improved by changing the job and temporary immobilization.

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Introduction

Avascular necrosis (AVN) of capitate bone is very rare and was first reported by Jonsson in 1942.¹ In most of cases, it has correlation with serious trauma to wrist.² However, in some cases, severe trauma does not have significant role in its ethology. In some reports, AVN occurred without any history of serious trauma.^{2,3} In such cases, the main etiology is unknown. Some theories have proposed reasons such as increased bone venous pressure, a consequence of venous thrombosis, reduced arterial flow, and hypoxia as the factors in advancement of ischemic necrosis of capitate bone.⁴ Repetitive motion micro-trauma is one of the other factors which could lead to blood supply disorder in this bone and hence extend AVN.^{2,3}

In this report, a young worker referring to

our orthopedic clinic with chronic wrist pain who was diagnosed with AVN of capitate bone is presented.

Case Report

A male 30-year-old worker complaining from pain in left hand wrist for one year referred to orthopedic clinic. He mentioned no history of direct trauma or inflammatory disease. Examinations showed slight tenderness and inflammation by touching wrist dorsal. No deformity was observable. Wrist range of motion was normal in passive motions of wrist. However, the wrist was painful in palmar dorsiflexion and flexion. No sign of dorsal or volar instability was observed. In comparing the active motion of right and left wrist, dorsiflexion was 90° in right hand and 70° in left; palmar flexion was 90° in right and 80° in left hand. He expressed that he had

* Corresponding Author: Ali Tabrizi, Email: ali.tab.ms@gmail.com



changed his job two years ago and was working as a worker in urban service unit and worked with air compressor jack hammer. He was also left-handed. Conventional radiography of wrist showed a subtle decrease in density of entire capitate bone without any evidence of collapse or sclerosis (Figure 1).



Figure 1. Conventional radiography of wrist showing decreased density in entire of the capitate bone without any evidence of collapse or sclerosis

T1-weighted magnetic resonance (MR) images revealed homogenous low-signal intensity in entire capitate bone (Figure 2).



Figure 2. Coronal magnetic resonance imaging (MRI) of the left wrist
The capitate has an entire area of low-signal intensity on T1-weighted without contrast.

T2-weighted MR image also indicated symptoms of signal increase in capitate bone. Signal increase was also evident in fat suppression view of wrist (Figure 3). Laboratory findings showed no evidence of infection. Laboratory tests showed that blood cell count was normal: blood cell count = $8.8 \times 10000/\text{mm}^3$, rheumatoid factor (RF) = 0,

uric acid = 3.9 mg/dl, erythrocyte sedimentation rate (ESR) = 10 mm/h, C-reactive protein (CRP) = 4.5 mg/dl.



Figure 3. Coronal magnetic resonance imaging (MRI) of the left wrist
The capitate has high-signal intensity on T2-weighted without contrast

Finally, he was recommended to change his job and left comfort wrist splint was prescribed for him for 2 months. To control the pain, a nonsteroidal anti-inflammatory drug (NSAID), celecoxib 200 mg, was prescribed twice a day for two weeks. After two months, the pain was resolved and permanent job change was proposed.

Discussion

Capitate bone necrosis would occur due to blood supply blockage. Different etiologies have been mentioned for AVN including fractures or dislocation in wrist, diabetes mellitus (DM), decompression sickness, surgery, steroid injection on wrist, alcoholism, irradiation, and tumor.² It is mostly due to direct wrist trauma, especially when capitate and scaphoid fractures occur simultaneously which is called naviculocapitate syndrome.³ However there are some reports of capitate AVN with no history of trauma.² These reported observed cases in clerical workers, a paint sprayer, a carpenter, and a gymnast. AVN could also occur in capitate bone due to repetitive motion trauma as the result of blood supply disturbance.^{2,3}

Hand blood circulation happens in two pathways. The first one is extrinsic blood

supply through ulnar and radial arteries whose common branches form palmar carpal branch and is one of the nutritional pathways of capitate bone. The other one is intrinsic (intraosseous) and is related to anterior interosseous artery.^{3,5} Both blood supplies of capitate bone occur through palmar section. Therefore, if palmar aspect is exposed to any type of pressure or stress, the blood supply will be affected. Moreover, extrinsic blood supply is related to wrist capsular and ligamentous structures including flexor retinaculum and flexor pollicis longus tendon.^{2,3} Any injuries in these structures, especially in palmar side, could result in disturbing the capitate bone blood supply. The tip of capitate bone has no collateral blood supply.³ Hence, it is more prone to AVN. All the mentioned blood supply pathways are through proximal pole. Thus, the vascular supply to the proximal pole of the capitate is tenuous, and analogous to the vascular supply to the scaphoid.³

At first stages of capitate AVN, the diagnosis is very difficult. It is impossible to diagnose it by conventional radiographies.² Therefore, MR imaging (MRI) is a more sensitive method for diagnosis of AVN. MRI findings of T1-weighted are in the form of low-signal intensity which have high sensitivity for diagnosis of AVN.⁵ Murakami et al. reported that MRI findings for capitate AVN were in the form of low and high-signal intensity in T1-weighted and T2-weighted areas.⁴ Lapinsky and Mack also reported that a low-signal intensity lesion on T1-weighted MRI had more accordance with capitate bone AVN.⁶

In our presented patient, MRI findings were in the form of low-signal intensity lesion on T1-weighted; like the other studies. Radiography did not help in the first stages of the disease. Moreover, based on blood supply of capitate, it seemed that continuous repetitive motion of wrist in long term had affected the blood supply condition of the capitate bone. A huge amount of force exerted by air compressor jack hammer to the wrist could be the main reason for capitate

bone AVN. AVN of capitate is the only wrist bone AVN with high correlation with job of the patient. Based on the published reports, several occupations have shown association with AVN of capitate bone including carpenters, pallet car drivers, construction laborers, bus conductors, warehousemen, pneumatic tool users, and vibrating tool users.^{3,4,7} Our patient was exposed to continuous vibration pressure of air compressor jack hammer which resulted in AVN in capitate bone; this is the first report on the relationship of the mentioned job with this disease. In the first stages, before bone changes, changing the job and wrist immobilization by splint could be helpful in controlling the symptoms.

Conclusion

AVN of capitate bone could occur due to repetitive minor trauma. It has high correlation with the job of patients. Radiography could not help a lot in the first stages of the disease. However, MRI showed high sensitivity for diagnosis. In the first stages of the disease due to patients' work, changing the work and temporary immobilizations can be helpful.

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Authors' Contribution

All of the authors contributed equally.

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Conflict of Interest

Authors have no conflict of interest.

Ethical Approval

The case report was confirmed by Ethics Committee of Urmia University of Medical Sciences.

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