Avascular Necrosis of the Hamate: Three Cases and Review of the Literature

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J Wrist Surg 2014;3:269–274.

Abstract

Background Avascular necrosis of the hamate (hamate-AVN) is a seldom reported disease of which little is known on etiology, best treatment modalities, and outcome. Hamate-AVN can occur in multiple locations within the hamate.

Case Description Case one was an 8-year-old girl with painful AVN of the hamate hook. Surgical excision of the hook was performed, leading to excellent results (follow-up 8 years). Case two was a 44-year-old man with hamate-AVN of the proximal pole surgically treated with a vascularized bone graft from the radius based on the fifth extensor compartment artery, leading to excellent results (follow-up 7 years). Case three was a 36-year-old woman with hamate-AVN of the proximal pole surgically treated with débridement and cancellous bone grafting, leading to poor results (follow-up 1 year).

Literature Review Nine other cases of avascular necrosis of the hamate were found in literature, all but one treated surgically. Etiology, treatment, and results of these cases, combined with our own cases, are reviewed.

Clinical Relevance This article summarizes and synthesizes all presented cases of avascular necrosis of the hamate. We hope this will be helpful to physicians in decision making when confronted with this rare entity.

Level of Evidence 4

Keywords

- ▶ avascular
- ▶ hamate
- ▶ necrosis
- ▶ osteonecrosis
- ▶ treatment

Avascular necrosis of the hamate (hamate-AVN) is rare. There is currently no consensus on etiology, disease presentation, or best management. This lack is due to the rarity of the disease but also the diversity of location of the AVN within the hamate. The rationale for treatment of hamate-AVN is mostly derived from the knowledge on treatment for avascular necrosis in other carpal bones. Three cases of hamate-AVN were surgically treated in our center between 2005 and 2013 and presented. In the literature, nine other cases of avascular necrosis of the hamate are found. The data on the combined 12 cases are summarized to gain more insight into hamate-AVN.

Case Reports

Informed consent was obtained from each patient prior to retrospective data collection. Cases one and two were

contacted by phone for interview by the first author. Case three was examined by the first author.

Case One

An 8-year-old girl presented with pain in the left, nondominant hand; the pain had been present for the past 18 months. There was no history of significant trauma. There was normal range of motion (ROM). Resisted flexion in the fourth and fifth fingers was painful around the hamate hook, and pressure there caused a sharp pain, radiating to the fourth and fifth fingers without neurologic impairment. Radiographs, ultrasonography, and computed tomography (CT) scan showed no abnormalities. A magnetic resonance imaging (MRI) scan revealed swelling around the flexor tendons and signal loss at the hamate hook on T1-weighted imaging (→Fig. 1). Surgery through a volar ulnar approach revealed synovial

Fig. 1 Case one: transverse reconstructed slice of T1-weighted MRI scan of the midcarpal row. A hypointense signal of the hamate hook is present. This can be suggestive for AVN of the hamate hook.

swelling surrounding the flexor tendons. A débridement was performed. The hamate hook was also removed. No signs of (previous) fractures were present. A histologic examination of the hamate hook confirmed the presence of empty lacunae, consistent with bone necrosis. Two weeks after surgery the patient was no longer symptomatic. The patient was interviewed at 8-year follow-up (FU). The visual analog scale (VAS) for pain was zero in rest and on activity. The VAS for satisfaction was 10. The Quick-Disability of Arm, Shoulder, and Hand (QuickDASH) score was zero. The patient reported that she had full ROM and grip strength in comparison with the other hand.

Case Two

A 44-year-old man complained of pain in the right, dominant wrist; the pain had been present for the last 18 months. The pain was particularly present while playing tennis. Aspect and ROM were normal on examination. Pain was present on the dorsal ulnar wrist. Neurologic impairment was not present. Radiographs revealed disturbed mineralization of the proximal pole of the hamate. An MRI scan showed low signal intensity in the proximal pole on T1-weighted imaging (► **Fig. 2**).

Surgery was performed through a dorsal approach. The hamate was fenestrated and necrotic bone was removed. The cavity was filled with cancellous bone from the distal radius and sealed with a vascularized bone graft (VBG) from the radius based on the fifth extensor compartment artery. A histological examination showed focal cavities without viable osteocytes, consistent with bone necrosis. The wrist was splinted for 4 weeks. At 9 months FU, graft integration was observed with a CT scan. Patient was interviewed at 7 years FU. The VAS for pain was zero in rest and on activity. The VAS for satisfaction was 10. The QuickDASH score was zero. The patient reported that he had full ROM and grip strength in comparison with the other hand.

Fig. 2 Case two: coronal reconstructed slice of T1-weighted MRI scan of the wrist. A hypointense signal of the proximal pole of the hamate is present. This can be suggestive for AVN of the proximal pole.

Case Three

A 36-year-old woman had a history of nonunion of the scaphoid after a proximal pole fracture in the right, nondominant wrist. She was treated with a VBG from the volar distal radius with good results. The patient fell again 2 years later and complained of ulnar pain in the same wrist radiating to all fingers. An examination revealed volar and dorsal tenderness around the hamate. Grip strength and ROM were limited. An MRI scan showed low signal intensity in the proximal pole of the hamate on T1-weighted imaging (► **Fig. 3**). Surgery was performed through a dorsoulnar approach. The hamate was opened distally and curetted toward the proximal pole. The cavity was filled with cancellous bone graft from the distal

Fig. 3 Case three: coronal reconstructed slice of T1-weighted MRI scan of the wrist. A lucency in the proximal pole of the hamate is present. This can be suggestive for AVN of the proximal pole. Furthermore, a cyst formation in the scaphoid is present. Patient was previously treated with VBG for nonunion of the scaphoid.

radius. A histological examination confirmed the presence of lacunae that were predominantly empty, consistent with (partial) bone necrosis. The wrist was splinted for 3 weeks.

The patient was seen at 1 year FU. Disabling pain persisted around the hamate, both dorsal and volar. The VAS for pain was 7 in rest and 9 on activity. The VAS for satisfaction was 1. The QuickDASH score was 70. Range of motion was measured with a goniometer. The flexion-extension arc was 40–0–40 degrees, and the ulnar deviation-radial deviation arc was 15–0–25 degrees. The grip strength, measured with a Jamar dynamometer, was 67% in comparison with the other hand. An MRI scan showed graft incorporation and resolution of the AVN.

Discussion

Avascular necrosis of the hamate is very seldom reported. A PubMed search was performed on: “hamate AND necrosis.” This search revealed eight articles and cases. Reference list check disclosed one additional case. Combined with our own cases, the total body of reported cases is 12, documented over a span of 75 years. Perhaps the true number of hamate-AVN cases is higher, but the others are unreported.

Summarized data of all 12 cases are presented in ► **Table 1**.

The most frequent finding, although not observed in our own cases, is ulnar swelling of the wrist. Pain is present dorsal, volar, or both. In cases of hamate-AVN of the hook, there is tenderness on local volar pressure.¹ Grip strength and ROM are variably affected. Clinical findings are generally nonspecific, and hamate-AVN is often dismissed as a sprain at first evaluation.

The average age at presentation is 34 (SD 17, range 5 to 66). Men are more commonly affected than women. Trauma is the most frequent cause for hamate-AVN, with seven cases out of 12.^{1–5} A possible factor might be previous (unrecognized) hamate fracture. Isolated fractures of the hamate, however, are rare, and hamate fractures are usually part of a more severe carpal high-energy trauma.⁴

Repetitive motion is thought to have been causative in two cases.^{6,7} In one case use of corticosteroids caused AVN in multiple carpal bones, including the hamate.⁸ In two cases the etiology remained unknown.⁹

The average duration of complaints before diagnosis is one year (SD 0.9, range 0.2 to 1.5). The delay in diagnosing hamate-AVN is probably due to unfamiliarity with this condition and its subtle appearance on imaging. Radiographs can show demineralization of the hamate. Cyst formation, sclerosis, densification, and fragmentation can be present. The hamate hook is hard to evaluate on standard wrist radiographs, and an additional carpal tunnel view may be helpful. A CT scan provides proper detail on fragmentation and fracturing. A technetium-99m-methylene diphosphonate (MDP) scintigraphy is sensitive and can reveal focal accumulation; however, it is nonspecific. The most reliable diagnostic tool is an MRI scan (with or without gadolinium), which gives anatomic and biologic information with a hypointense signal on T1-weighted images.¹⁰ Hamate or carpal collapse was not seen in any of the found cases of hamate-AVN.

Hamate-AVN can morphologically be divided in four subtypes: total, proximal pole, distal pole, and hamate hook. This anatomic distribution correlates well with studies on vascular supply of the hamate.

The hamate receives blood via the dorsal intercarpal arch, the recurrent ulnar artery, and the ulnar artery.¹¹ These vessels enter the hamate in three nonarticular surfaces: dorsal, volar, and medial on the base of the hamate hook. Another vessel regularly enters the tip of the hamate.¹² Gelberman et al stated that the hamate is a Group 2 carpal bone, not at risk for AVN.¹³ Group 2 carpal bones have at least two areas of vessel entry but lack significant anastomosis. In contrast with this claim, interosseous anastomoses in the body of the hamate were seen during injection studies.^{2,14} Based on vascular supply, two locations in the hamate are likely more prone to AVN: the proximal pole and the hamate hook. Hamate-AVN in the proximal pole was described four times. The proximal pole lies intra-articular and has no direct entering vessels. The proximal pole seems to be solely dependent on the interosseous supply from the proximal dorsal artery entering more distally in the hamate body.⁴ Proximal pole fractures can thus lead to AVN of the proximal pole, especially in the presence of fracture displacement. Hamate hook AVN has been described twice.¹ Four pathways for blood to enter the hamate hook were found in specimen studies with varying levels of anastomosis.¹⁵ A vessel entering at the radial base of the hook was always present, but in 14 out of 52 specimens this was the sole provider of the hook. The hamate hooks supplied by a single vessel are naturally more prone for AVN, particularly in cases of hamate hook fracture with fracture displacement.

Eleven out of 12 cases of hamate-AVN were treated surgically. In five cases, débridement of necrotic bone and varying levels of fusion were performed.^{2,5,6,9} Results vary in this group, with three good to excellent results and two poor to fair results. In two cases a VBG was performed, leading to full pain relief and full ROM.⁷ In the two cases of AVN of the hamate hook, excision of the hamate hook gave full pain relief without compromising ROM or strength.¹ In one case, proximal row carpectomy was performed for AVN of the proximal row and the hamate, unloading the hamate and leading to good results.⁸ One case was treated conservatively. This patient was able to return to work after severe wrist trauma with acceptable pain and ROM.⁴

An explanation for the usually good outcome after surgery, regardless of the chosen procedure, could be that hamate or carpal collapse was not observed in cases of hamate-AVN. Degenerative disease due to altered wrist kinematics therefore did not occur.

There are obvious limitations to this report. The number of cases is limited to 12, and there is wide variance in patient characteristics, subtypes of hamate-AVN, treatment modalities, and outcome measures. Furthermore information, presented in cases is frequently incomplete, and duration of FU is limited. This makes it difficult to make proper recommendations on management. In addition, the natural history of this condition if no treatment is administered is not known. As carpal collapse has not been witnessed in cases of hamate-AVN, a wait-and-see policy might be justified. With this report we hope to synthesize current knowledge on hamate-AVN.

Table 1 Data on all reported cases of avascular necrosis of the hamate

Author, year	Age, sex	Complaints		Side	Etiology	Location	Treatment	Histology proven		FU	Outcome
		years	years					Y/N	Years		
Peters 2014	8, F		1.5	L	Unknown	Hook	Excision hamate hook	Y		8	No pain, full strength and motion compared with other hand, QuickDASH 0
Peters 2014	44, M		1.5	R	Sports (tennis)	Proximal pole	Débridement, VBG from distal radius based on 5th ECA	Y		7	Po pain, full strength and motion compared with other hand, QuickDASH 0
Peters 2014	36, F		0.2	R	Trauma (fall)	Proximal pole	Débridement, impaction with cancellous graft (distal radius)	Y		1	Disabling pain hamate region, F/E 40/0/40, UD/RD 15/0/25, grip strength 18 vs 27 kg other hand, QuickDASH 70
Mazis 2012 ⁸	58, M		2	R	Unknown	Total	Débridement, capitulunate-hamate fusion with cancellous graft (iliac crest)	N		0.3	Mild pain, reasonable force, F/E 30/0/30, DASH from 25 to 17
Juon 2008 ⁶	21, M		0.3	L	Repetitive motion	Total	Débridement, VBG from dorsal distal radius based on posterior interosseus artery	Y		0.5	No pain, resumed work, good incorporation graft and normal signal hamate on MRI
Tukenmez 2005 ⁵	25, M		3	R	Sports (gymnast)/repetitive motion	Proximal pole	Débridement, capitohamate fusion with spongiograft	Y		2	No pain, grip strength and ROM equal to other side
De Smet, 1999 ⁷	66, F		0.2	L	Corticosteroids	Total	Proximal row carpectomy (for AVN of scaphoid, lunare and triquetrum)	N		3	No pain, grip strength 12 versus 17 kg other hand, F/E 30/0/60, UD/RD 20/0/25
Telfer, 1994 ⁴	16, M		1.5	L	Trauma (fall)	Total	Débridement, capitulunate-triquetrohamate fusion with cancellous graft (iliac crest)	Y		1	No pain, F/E 25/0/35, nonunion in CMC 5 and hamatolunate joint
Failla 1993 ¹⁴	36, F		1.5		Sports (tennis)	Hook	Excision hamate hook	Y		0.2	return to sports, grip strength equal to other side
Van Demark 1992 ³	45, M		0.3	R	Trauma (machine)	Proximal pole	None (patient declined surgery as he was able to return to work)	N		1	Nondisabling pain, F/E 45/0/53, UD/RD 20/0/14, grip strength 50 versus 57 kg other hand
Vogel 1963 ³	23, M		1	L	Sport trauma (hockeystick on hand)	Distal pole	Unknown	N		—	—
Logròscino, 1938 ²	29, M		0.2	R	Trauma / osteomyelitis	Distal pole	Débridement, sequester and macroscopic necrotic bone	N		0.3	—

Abbreviations: AVN, avascular necrosis; CMC, carpometacarpal joint; ECA, extensor compartment artery; F/E, flexion/extension; L/R, left/right; M/F, male/female; UD/RD, ulnar deviation/radial deviation; VBG, vascularized bone graft; Y/N, yes/no.

Note

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Necessary and appropriate consent was obtained from each patient. Approval of the institutional review committee was not required for this triple case report with retrospective data collection.

Conflict of Interest

None

References

- 1 Failla JM. Osteonecrosis associated with nonunion of the hook of the hamate. *Orthopedics* 1993;16(2):217–218
- 2 Logròscino D, De Marchi E. Vascularization and trophopathy of the wrist bones [in Italian]. *Chir Org Mov* 1938;23:499–523
- 3 Vogel KH. Aseptic necrosis of the hamate bone [in German]. *Fortschr Geb Rontgenstr Nuklearmed* 1963;99:112–113
- 4 Van Demark RE, Parke WW. Avascular necrosis of the hamate: a case report with reference to the hamate blood supply. *J Hand Surg Am* 1992;17(6):1086–1090
- 5 Telfer JR, Evans DM, Bingham JB. Avascular necrosis of the hamate. *J Hand Surg [Br]* 1994;19(3):389–392
- 6 Tukenmez M, Percin S, Tezeren G. Aseptic necrosis of the hamate: a case report. *Hand Surg* 2005;10(1):115–118
- 7 Juon BH, Treumann TC, von Wartburg U. Avascular necrosis of the hamate—case report [in German]. *Handchir Mikrochir Plast Chir* 2008;40(3):201–203
- 8 De Smet L. Avascular necrosis of multiple carpal bones. A case report. *Chir Main* 1999;18(3):202–204
- 9 Mazis GA, Sakellariou VI, Kokkalis ZT. Avascular necrosis of the hamate treated with capitolunate and lunatohamate intercarpal fusion. *Orthopedics* 2012;35(3):e444–e447
- 10 Reinus WR, Conway WF, Totty WG, et al. Carpal avascular necrosis: MR imaging. *Radiology* 1986;160(3):689–693
- 11 Freedman DM, Botte MJ, Gelberman RH. Vascularity of the carpus. *Clin Orthop Relat Res* 2001;(383):47–59
- 12 Panagis JS, Gelberman RH, Taleisnik J, Baumgaertner M. The arterial anatomy of the human carpus. Part II: The intraosseous vascularity. *J Hand Surg Am* 1983;8(4):375–382
- 13 Gelberman RH, Gross MS. The vascularity of the wrist. Identification of arterial patterns at risk. *Clin Orthop Relat Res* 1986;(202):40–49
- 14 Barber H. The intraosseous arterial anatomy of the adult human carpus. *Orthopedics* 1972;5:1–19
- 15 Failla JM. Hook of hamate vascularity: vulnerability to osteonecrosis and nonunion. *J Hand Surg Am* 1993;18(6):1075–1079