

# Septic Hip Arthritis in Patients with Osteonecrosis of Femoral Head: Two Cases Report and Review of the Literature

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## Research article

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# Abstract

**Background:** In patients with osteonecrosis of femoral head (ONFH), septic arthritis of the hip is rare, especially in the absence of factors likely to cause infection, which are often ignored by surgeons.

**Methods:** Two patients seen at our hospital who had ONFH and concomitant septic arthritis of the hip joint were selected for inclusion in the study.

**Results:** The clinical course suggests that ONFH developed prior to the hip infection. The two patients were not immune-compromised, and no remote septic focus was identified. The 2 patients, clinical manifestations of infection included fever and elevated white blood cell count. Elevated levels of erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were observed in all 2 patients. In all patients, the results of hip magnetic resonance imaging (MRI) indicated hip infection. For 1 patients, culturing joint fluid revealed the presence of bacteria. In the second case, joint fluid was not cultured. In each case, the hip was debrided, and a spacer made of bone cement and containing vancomycin was implanted in the hip. Intravenous antibiotics were administered for 6 weeks postoperatively. There was no recurrence of infection, and total hip arthroplasty (THA) was performed 6 months after the operation.

**Conclusions:** Septic hip is rare but exist in patients with ONFH. Elevated ESR and CRP contributed to the initial diagnosis; the results of hip MRI help to confirm the diagnosis. Overall, THA was an effective treatment.

## Background

Osteonecrosis of the femoral head (ONFH) is a common and catastrophic disease that may result in impaired hip joint function [1, 2]. The presence of ONFH renders total hip arthroplasty (THA) necessary. Periprosthetic joint infection (PJI) is a major complication of THA and associated with significant morbidity and mortality, as well as substantial financial burden [3, 4]. If a patient with ONFH and septic arthritis of the hip undergoes THA, PJI is inevitable. Such a situation is disastrous for patients. To date, 17 cases of concomitant septic arthritis and ONFH have been documented in the literature [5–11]. The combination of septic arthritis and ONFH is extremely rare but should not be overlooked by surgeons.

We encountered two patients who were diagnosed as having ONFH and concomitant septic arthritis of the hip. Individual patients were provided with written informed consent. The human studies were approved by the Ethical Committee of the Affiliated Hospital of Qingdao University, China. In the study below, we evaluate the two patients encountered at our institution in the context of 17 cases described in the literature.

## Cases Presentation

### Case 1

A 75-year-old man who had been diagnosed with ONFH more than 10 years previously presented with right hip pain that had worsened over the past week. The patient was admitted for THA to treat ONFH in the left hip. At the time of admission, the patient was limping severely and reported pain in his right hip. Physical examination revealed characteristics typical of ONFH. The patient also had fever over 38 °C. The patient had no history of drinking, no immune system disease, and no other risk factors. Radiographs revealed stage IV osteonecrosis

(according to the Ficat staging system) in both hips [12, 13] (Fig. 1A). Preoperative laboratory testing revealed leukocytosis ( $17.29 \times 10^9/L$ ). ESR and CRP levels had increased to 48.60 mm/h and 214.97 mg/L, respectively. MRI was performed in this patient under a suspicion of septic arthritis. The results showed osteonecrosis in both femoral heads, increased joint effusion, and a diffuse increase in signal intensity in the proximal femur, acetabulum, and soft tissue surrounding the right hip (Fig. 1B), suggesting septic arthritis. Harris and AVS scores for the left hip were 20.5 and 9, respectively. The right hip was debrided, and a spacer containing vancomycin (made of bone cement) was implanted in the right hip (Fig. 1C). During the arthrotomy, pus-like fluid poured out from the right hip (Fig. 1D); a sample of joint fluid was sent to the laboratory department. *Citrobacter braakii* was found in the fluid, and a diagnosis of septic arthritis was made. Intravenous antibiotics (levofloxacin, 500 mg, qd) were administered for 6 weeks postoperatively. There was no recurrence of infection, and THA was performed 6 months after the operation. Three months after THA (Fig. 1E), right hip function was good. The Harris and AVS scores were 86.55 and 0, respectively. No complication was observed during follow-up.

## Case 2

A 71-year-old man who with bilateral ONFH for the previous seven years and right hip pain that had worsened over recent months was admitted for THA to treat ONFH in the right hip. At the time of admission, the patient was limping severely and reported pain in his right hip. Physical examination showed characteristics typical of ONFH, but the patient presented with fever over 38 °C. The patient had no history of drinking, no immune system disease, and no other risk factors. Radiographs revealed stage IV osteonecrosis in both hips [12, 13] (Fig. 2A). Preoperative laboratory analysis revealed leukocytosis ( $16.5 \times 10^9/L$ ). ESR and CRP levels were elevated to 42.30 mm/h and 46.46 mg/L, respectively. MRI was performed under a suspicion of septic arthritis. The results showed osteonecrosis in both femoral heads, increased joint effusion, and a diffuse increase in signal intensity in the proximal femur, acetabulum, and soft tissue surrounding the right hip (Fig. 2B), suggesting septic arthritis. Harris and AVS scores for the right hip were 20.7 and 9, respectively. The right hip was debrided, and a spacer containing vancomycin (made of bone cement) was implanted in the right hip (Fig. 2C). During the arthrotomy, pus-like fluid poured out from the right hip. A sample of joint fluid was sent for laboratory analysis. Microscopic examination revealed a pyogenic infection in the joint fluid, and a diagnosis of septic arthritis was made. Intravenous antibiotics (cefazolin sodium pentahydrate, 1 g, q 8 h) were administered for 6 weeks postoperatively. There was no recurrence of infection, and THA was performed 6 months after the operation. Three months after THA (Fig. 2D), right hip function was satisfactory. The Harris and AVS scores were 89.65 and 1, respectively. No complications were reported during the follow-up period.

## Discussion

Septic hip arthritis usually develops in children, but not adults. Septic hip arthritis typically results from direct inoculation of bacteria into the joint or its surroundings or seeding from a distant site. Therefore, adult ONFH combined with hip infection is rarely encountered in clinical practice. A search of the English literature revealed 7 relevant studies from 1978 to 2011 [5–11], which reported on a total of 18 patients with concomitant ONFH and septic arthritis. In a study by Lee et.al [11], one patient who underwent internal fixation for femoral neck fracture was excluded because the infection was attributed to the process of internal fixation. The study ultimately included 17 patients (Table 1 and Table 2). In 11 cases, a bodily focus of infection was identified. 7 patients were immunocompetent (Table 1), and 10 were immunocompromised (Table 2). Therefore, ONFH combined hip

infection is rare, especially in immunocompetent patients with no risk of infection. We encountered two patients who were diagnosed as having ONFH and concomitant septic arthritis of the hip without any risk of infection or immune-related compromise (Table 3).

The clinical symptoms of septic arthritis and of ONFH may be similar, and early diagnosis of septic arthritis is difficult [14]. Septic hip arthritis in patients with ONFH is rarely encountered in clinic. 12 of the 17 patients were reported to have symptoms of fever when admitted to hospital, nine of whom were immunocompromised (Table 1, 2). None of the remaining patients had local or systemic symptoms of hip infection [5–11]. The only symptom reported by the three patients at the time of admission to the hospital was fever. Diagnosis of ONFH combined with septic arthritis is often difficult, especially in early-stage and immunocompetent patients.

WBC count may be of minimal help in diagnosis of hip infection, but the ESR and CRP are extremely sensitive for diagnosis of hip infection [15]. WBC count was confirmed in 11 of 17 cases in the literature, but leukocytosis was confirmed in only 6 cases. ESR and CRP were significantly increased in all cases included in the study. This finding supports previous reports that measurements of ESR and CRP are good indices for detection of hip infection [16]. ESR and CRP were significantly elevated in all cases for which measurements were obtained. The two cases seen at our institution involved leukocytosis. If no inflammatory etiology associated with elevated CRP and ESR is identified through diagnostic work, in patients without leukocytosis, the surgeon should rule out sepsis of the hip joint prior to THA.

MRI is a good tool with which to diagnose hip infection in an ONFH patient with elevated CRP and ESR [11]. Specific MRI findings indicative of septic hip include alterations in signal intensity of bone marrow of both the proximal femur and acetabulum and strong enhancement in soft tissue surrounding the hip joint [17]. Alteration of signal intensity of soft tissue around the hip joint seldom occurs in ONFH. Of the 17 cases described in the literature, MRI of the hip was performed in six and three of them showed signs of hip infection. MRI results for the 2 patients in our study indicated ONFH with septic hip arthritis.

Although organism culture is the gold standard for diagnosis of septic hip arthritis [18], organism identification may not always be possible. Patients may have received treatment with antibiotics before organism culture [19]. Although culture was successful in 1 of 2 cases in our department, culture of joint fluid was negative for 4 of 17 patients described in the literature.

In recent years, the most common approaches to treatment of septic hip have been surgical debridement with arthrotomy combined with irrigation or arthroscopic debridement combined with irrigation and intravenous antibiotics [6–8, 11, 20]. Although arthroscopic debridement combined with irrigation is less invasive than open arthrotomy [20, 21], irrigation after surgery poses a challenge for patients. The cases seen at our institution were treated with spacers made of bone cement containing vancomycin. Spacers were used to replace the femoral head and were implanted in the hip. With this approach to treatment, the patient can move freely with the help of a walking stick. Postoperative irrigation was not necessary, as the spacer was designed for sustained release of vancomycin. This approach to treatment yielded excellent results in our patients.

## Conclusion

Therefore, if ESR and CRP are markedly increased in ONFH patients, the clinician should suspect ONFH combined with hip infection. Next steps include MRI or culture of joint fluid. Implantation of a spacer made of bone cement

containing vancomycin in order to replace the femoral head was effective for treatment of patients diagnosed with ONFH and hip infection.

## Abbreviations

ONFH: osteonecrosis of femoral head; ESR: erythrocyte sedimentation rate; CRP: C-reactive protein; MRI: magnetic resonance imaging; THA: total hip arthroplasty.

## Declarations

### Acknowledgements

Not applicable.

### Authors' contributions

CW made substantial contributions to provide the cases. YW made substantial contributions to design the article. YZ and XW made substantial contributions to analysis the two cases. ZZ draft the manuscript and revise it. All authors read and approved the final manuscript.

### Funding

Not applicable.

### Availability of data and materials

The datasets used in the current study are available from the corresponding author on request.

### Ethics approval and consent to participate

This study was approved by the Ethical Committee of the Affiliated Hospital of Qingdao University, China. Written informed consents were obtained from the two patients for publication of these cases report and any accompanying images.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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## Tables

Table 1  
Immunocompetent patients with ONFH and septic arthritis of the hip

Sex/age	Risk factor of FHON	Risk factor of septic arthritis	Fever	WBC	ESR	CRP	MRI	Culture of joint fluid	Therapy
M <sup>a</sup> /45 <sup>[6]</sup>	Alcohol	endocarditis	No	4000	36	NR	NR	<i>S. aureus</i>	AT
M <sup>a</sup> /53 <sup>[8]</sup>	Idiopathic	No	No	6300	95	NR	NR	<i>S. aureus</i>	AT
M/14 <sup>[8]</sup>	SCD	Pharyngitis	Yes	17700	NR	NR	NR	<i>H.influenza</i>	AT
M <sup>a</sup> /75 <sup>[11]</sup>	Alcohol	No	No	7260	53	3.15	+	Negative	AC
M <sup>a</sup> /48 <sup>[11]</sup>	Alcohol	No	No	6120	19	5.39	ND	Negative	AC
M <sup>a</sup> /51 <sup>[11]</sup>	Alcohol	Osteomyelitis	Yes	12770	18	1.13	+	Negative	AC
M <sup>a</sup> /37 <sup>[11]</sup>	Steroid	Abscess	Yes	7090	23	4.12	+	<i>MRCNS</i>	AC
Note: FHON: femoral head osteonecrosis; WBC: white blood cell (normal range, 0–9000); ESR: erythrocyte sedimentation rate (normal range, 0–9 mm/h); CRP: C-reactive protein (normal range, 0–0.5 mg/dl); MRCNS: methicillin-resistant coagulase negative <i>Staphylococcus</i> ; NR: not recorded; ND: not done; AT: arthrotomy; SCD: sickle cell disease; AC: arthroscopy; +: positive									
<sup>a</sup> Bilateral FHON									

Table 2  
Immunocompromised patients with ONFH and septic hip arthritis

Sex/age	Protopathy	Risk factor of septic arthritis	Fever	WBC	ESR	CRP	MRI	Culture of joint fluid	Therapy
F <sup>a</sup> /47 <sup>[5]</sup>	SLE	No	Yes	NR	NR	NR	-	<i>MSSA</i>	AC
F <sup>a</sup> /38 <sup>[5]</sup>	SLE	No	Yes	NR	NR	NR	-	<i>MSSA</i>	AC
F <sup>a</sup> /51 <sup>[7]</sup>	TPL	Pneumonia	Yes	10400	NR	NR	-	<i>Nocardia</i>	AT
M <sup>a</sup> /32 <sup>[8]</sup>	HD	Endocarditis	Yes	12800	67	NR	NR	<i>S. viridans</i>	AT
M <sup>a</sup> /33 <sup>[8]</sup>	TPL	Pharyngitis	No	18700	NR	NR	NR	<i>Streptococcus</i>	AT
F <sup>a</sup> /36 <sup>[9]</sup>	SLE	bacteremia	Yes	12500	127	NR	NR	<i>Salmonella</i>	AT
F <sup>a</sup> /25 <sup>[10]</sup>	TPL	DSWI	Yes	NR	NR	NR	NR	<i>S. aureus</i>	RA
F <sup>a</sup> /21 <sup>[10]</sup>	SLE	Skin infection	Yes	NR	NR	NR	NR	Negative	RA
M <sup>a</sup> /30 <sup>[10]</sup>	TPL	sepsis	Yes	NR	NR	NR	NR	<i>Salmonella</i>	RA
M/20 <sup>[10]</sup>	TPL	No	Yes	NR	NR	NR	NR	<i>Peptostreptococcus</i>	RA
<p>Note: FHON: femoral head osteonecrosis; WBC: white blood cell (normal range, 0–9000); ESR: erythrocyte sedimentation rate (normal range, 0–9 mm/h); CRP: C-reactive protein (normal range, 0–0.5 mg/dl); SLE: systemic lupus erythematosus; TPL: transplantation; HD: Hodgkin disease; MSSA: methicillin-sensitive <i>Staphylococcus aureus</i>; DSWI: deep surgical wound infection; NR: not recorded; AT: arthrotomy; AC: arthroscopy; RA: repeated aspiration; -: negative</p>									
<p><sup>a</sup>Bilateral FHON</p>									

Table 3  
Patients with femoral head osteonecrosis and septic arthritis of the hip seen at our institution

Patient	Patient 1	Patient 2
Sex/age	M <sup>a</sup> /75	M <sup>a</sup> /71
Risk factor of FHON	Idiopathic	Idiopathic
Risk factor of septic arthritis	NO	NO
Fever	YES	YES
WBC count(x10 <sup>9</sup> /L)	17290	16500
ESR(mm/h)	48.60	42.30
CRP(mg/L)	214.97	46.46
MRI	Positive	Positive
Culture of joint fluid	<i>Citrobacter</i>	Not done
Harris Hip Score (Pre-operation)	20.5	20.7
VAS (Pre-operation)	9	9
Therapy	spacer	spacer
Antibiotic (weeks)	6	6
Harris Hip Score(3M after operation)	86.55	89.65
VAS (3 M after operation)	0	1
Note: FHON: femoral head osteonecrosis; WBC: white blood cell (normal range, 0–9000); ESR: erythrocyte sedimentation rate (normal range, 0–20 mm/h); CRP: C-reactive protein (normal range, 0–5 mg/l)		
<sup>a</sup> Bilateral FHON		

## Figures



1A



1B



1C



1D



1E

## Figure 1

A 75-year-old man (Patient 1) with bilateral femoral head osteonecrosis combined with septic arthritis of the right hip. (A) X-ray of the positive pelvis; (B) MRI of the pelvis; (C) Pus-like fluid may be observed perioperatively (arrow); (D) Postoperative X-ray of positive pelvis. (E) X-ray of positive pelvis after THA.



1A



1B



1C



1D



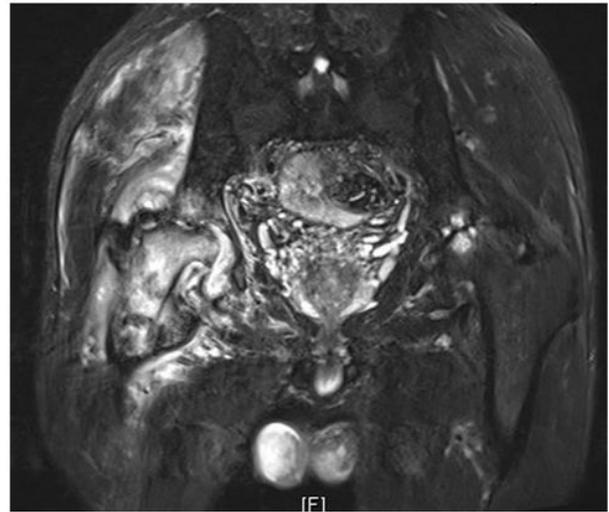
1E

## Figure 1

A 75-year-old man (Patient 1) with bilateral femoral head osteonecrosis combined with septic arthritis of the right hip. (A) X-ray of the positive pelvis; (B) MRI of the pelvis; (C) Pus-like fluid may be observed perioperatively (arrow); (D) Postoperative X-ray of positive pelvis. (E) X-ray of positive pelvis after THA.



2A



2B



2C



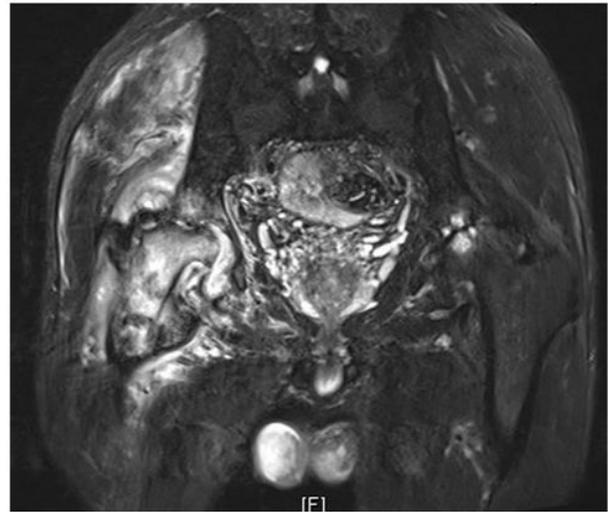
2D

## Figure 2

A 63-year-old man (Patient 2) with bilateral femoral head osteonecrosis combined with septic arthritis of the right hip. (A) X-ray of positive pelvis; (B) MRI of the pelvis; (C) Postoperative X-ray of the positive pelvis. (D) X-ray of positive pelvis after THA.



2A



2B



2C



2D

### Figure 2

A 63-year-old man (Patient 2) with bilateral femoral head osteonecrosis combined with septic arthritis of the right hip. (A) X-ray of positive pelvis; (B) MRI of the pelvis; (C) Postoperative X-ray of the positive pelvis. (D) X-ray of positive pelvis after THA.