

Etiology of Femoral Head Avascular Necrosis in Patients: A Cross-Sectional Study

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Abstract

Background: Avascular necrosis (AVN), known as osteonecrosis, aseptic necrosis, or ischemic bone necrosis, results in the destruction of bone cells. In the present study, we aimed to report the most common causes of AVN in patients referred to Isfahan educational and medical centers.

Materials and Methods: This study is a cross-sectional study that was performed on all patients with AVN in medical educational centers in Isfahan during 2019 and 2020. We included all patients diagnosed with AVN. Patients' information including age, sex, cause of femoral head necrosis, medical history, and drug usage were collected. Finally, reliable data from 99 patients were recorded.

Results: We collected data of 99 patients in this study. The most prevalent cause of AVN was corticosteroids use (32.3%), and it was more prevalent among women (51.4%); the second prevalent cause of AVN in our study sample was trauma (28.28%), and it was more prevalent among men (32.8%).

Conclusion: The most common cause of AVN was corticosteroids, which was consistent with previous studies. Other main causes of AVN were traumatic or idiopathic issues.

Keywords: Avascular necrosis, corticosteroids, prevalence, trauma

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INTRODUCTION

Avascular necrosis (AVN), known as osteonecrosis, aseptic necrosis, or ischemic bone necrosis, results in the destruction of bone cells due to poor blood flow (restriction of collateral circulation), which leads to destruction, collapse, and joint dysfunction.^[1,2]

AVN can involve different bones. The most common sites of involvement are femoral head, knee, talus, and humeral head.^[3]

The epidemiological studies worldwide about AVN show different prevalence rates among different countries. The incidence of AVN in the normal population of Korea has been reported as 28.9 people per 100,000 people, while it

has been reported 0.72% in China.^[4,5] An average of 15,000 new cases of vascular necrosis are reported in the United States each year, accounting for 10% of all hip arthroplasty surgeries. In Japan, 2500–3300 new cases are diagnosed each year, 34.7% are related to steroid use, and 21.8% are related to alcohol use.

There is a disagreement on the pathogenesis of this disease; however, factors such as genetic, metabolic, vascular damage, increased intraosseous pressure, and mechanical stress that affect the blood supply to the area can be mentioned.^[6]

One of the early symptoms of AVN is the onset of pain around the pelvis or groin; this pain manifests itself by getting up from

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a sitting position, climbing stairs, and slopes and can gradually restrict movement in patients.^[7]

The most common cause of total femoral joint replacement in Asia is vascular necrosis.^[8]

The prevalence of this disease is higher in men, especially in the fourth and fifth decades of life and has a high morbidity.^[9] Osteonecrosis of the femoral head occurs for traumatic and nontraumatic causes.^[10] The risk of osteochondronecrosis after trauma (fracture) of the femoral neck is 11%–84%.

Known causes of osteonecrosis of the femoral head include trauma, alcohol use, substance abuse, drug use, glucocorticoid use, hematologic diseases (sickle cell anemia, leukemia, and lymphoma), infectious diseases (CMV, HIV, hepatitis, rubella, and varicella), pancreatitis, coagulation disease, lupus (that is more common in females), gaucher, renal osteodystrophy, antiphospholipid syndrome, hyperlipidemia, transplant patients, hypercholesterolemia, hemodialysis, pregnancy, gout, renal failure, congenital hip dislocation, Ehlers–Danlos syndrome, caisson disease, hypercortisolism, sarcoidosis, rheumatoid arthritis, sepsis, smoking, rheumatoid arthritis, giant cell arthritis, and idiopathic causes.^[5,11]

To prevent this complication, methods such as reduction and fixation at the first opportunity, possibly hyaluronic acid injection and capsulotomy, are used.^[12]

There are different treatment options for AVN depending on the severity and stage of the disease, and helpful measures for these patients include delaying arthroplasty and advanced treatment. Nonsurgical treatment includes extracorporeal shock from pulsed electromagnetic fields, hypertensive oxygen therapy, medications, exercise therapy, and restorative drugs. It is noteworthy that unfortunately these methods do not have significant results.^[13,14]

To prevent early arthroplasty, core decompression, proximal femoral osteotomy, bone graft with and without arteries, and bone replacements are recommended. In the end stages, due to degenerative changes in the joint, hip arthroplasty is performed for treatment.^[10]

Due to the relatively high prevalence of AVN worldwide as well as in Iran, also considering the reduction of morbidity in case of early diagnosis of this disease and also the availability of interventions to delay the course of the disease in people at risk for AVN, our study was conducted to report the most common causes of AVN in patients referred to Isfahan educational and medical centers during 2019 and 2020.

MATERIALS AND METHODS

Study design and participants

This study is a cross-sectional study that was performed on all patients with AVN in medical educational centers in Isfahan during 2019 and 2020. We included all patients diagnosed with AVN by expert orthopedic surgeons and those with written informed consent to participate in this study. The exclusion

criterion was incomplete file information and patients with severe and multifactorial comorbidity whose main etiology of femoral AVN was unknown were excluded from the study, including patients with hematologic problems, rheumatoid arthritis, and transplant patients.

Diagnosis of AVN was made using the following criteria: (1) collapse of the femoral head without joint-space narrowing or acetabular abnormality on radiography (including crescent sign); (2) demarcating sclerosis in the femoral head without joint space narrowing or acetabular abnormality; (3) “cold in hot” on bone scintigraphy; (4) low-intensity band on T1-weighted images (band-like pattern); and (5) trabecular and marrow necrosis on histology.

Nontraumatic femoral head osteonecrosis was diagnosed in any patient meeting two or more of the five criteria. This study was based on the 2008 Helsinki Declaration and has a code of ethics in the committee of Isfahan University of Medical Sciences.^[15]

Data collection

A self-made checklist was prepared by researchers for recording the required data from medical documents of patients. Patients’ information including age, sex, cause of femoral head necrosis, medical history, and drug usage were collected. Finally, data from 99 patients were recorded.

Statistical analysis

The obtained data were entered into the Statistical Package for the Social Sciences (SPSS)(IBM, United states America) version 24. Continuous and categorical variables were reported as mean \pm standard deviation and frequency (percentage).

RESULTS

In our study, 64.6% of patients were men. The mean age of patients was 40 ± 8.6 years. The most prevalent cause of ANV was corticosteroids use, and it was more prevalent among women; the second prevalent cause of AVN in our study sample was trauma, and it was more prevalent among men. The other prevalent causes of AVN were idiopathic, coagulation problem, infection, and alcohol use. More details are presented in Table 1.

The idiopathic causes of the disease were also examined based on the patient’s underlying disease, which according to statistical findings is the most common cause of gender

Table 1: The etiology of avascular necrosis in study population

Cause	Males (%)	Females (%)	Total (%)
Corticosteroids	14 (21.9)	18 (51.4)	32 (32.3)
Coagulation problem	9 (14.06)	3 (8.57)	12 (12.12)
Alcoholism	2 (3.1)	0	2 (2)
Infection	5 (7.8)	2 (5.7)	7 (7.1)
Trauma	21 (32.8)	7 (20)	28 (28.28)
Idiopathic	13 (20.3)	5 (14.21)	18 (18.18)

segregation in women with diabetes and in men with crystal addiction. Other causes by gender are listed in Table 2.

DISCUSSION

Osteonecrosis of the femoral head is characterized by bone death, pain, joint destruction, and loss of ability. The causes and pathogenesis of osteonecrosis in nontraumatic cases are not fully understood. In the present study, we aimed to investigate the possible risk factors associated with AVN in our study population in Isfahan, Iran. In our study, the most common cause of the disease was corticosteroids, which is consistent with previous studies. Also, in our study, the ratio of men to women was about 1.4 times, which is due to the higher prevalence of this disease among men.

Numerous studies have been conducted in recent years to investigate the etiology of AVN, in which a review study that has examined several studies has identified steroid and alcohol use as the most important risk factors.^[16] Studies have also reported the use of corticosteroids as the main risk factor for AVN. In a study conducted at Rasoul Akram Hospital in Tehran, Iran, in 2013–2015, 42% of patients with AVN were treated with corticosteroids, 4% with bisphosphonates, and 4% with hematologic disease.^[4] In a study of 285 nontraumatic AVN patients in Japan, the female: male ratio was 1:2, with 47.4% due to corticosteroid use, 30.5% due to alcohol use, 4.9% due to concomitant alcohol use, and 17.2% due to idiopathic AVN.^[17] These data were in line with the findings of our study. We also found that corticosteroids were the most important and common factor of AVN.

In most studies, the prevalence statistics due to smoking, alcohol, and addiction were significantly different from our study, which could be due to the patient's secrecy and nonconfession due to the taboo nature of this issue. We also believe that the prevalence of these causes could be higher. Another study of 92 patients with AVN at Craiova Hospital in 2011 found that smoking is responsible for 36.96%, idiopathic causes for 29.35%, alcohol consumption for 20.65%, trauma for 11.96%, and corticosteroids for 8.7% in these patients.^[18] Various studies have been performed to investigate idiopathic causes. For example, a retrospective study of 416 patients diagnosed with sickle cell disease for 15 years in Nigeria in 2007 found that 15.9% of these patients developed AVN during their lifetime.^[19]

In general, regarding the impact of genetic diseases as a risk factor, various studies have been performed that

have identified genetic abnormalities in patients with osteonecrosis that contribute to the progression of the disease.^[20-23] Some abnormalities and risk factors directly affect clotting mechanisms in people who are prone to excessive blood clotting, which are related to other factors such as corticosteroids, alcohol consumption, and hyperlipidemia, as well as the metabolic effects of some fats, osteoblasts, and osteoclasts, can increase the risk.^[20]

In our study, It is noteworthy that diabetes was the most common case of idiopathic causes, but in other studies there are no accurate statistics on the prevalence of AVN in these patients. It is suggested that prospective studies are conducted to closely examine this association in diabetic patients.

The important point of the current study was that we evaluated the etiology of AVN in Isfahan for the first time and similar studies have not been conducted so far. On the other hand, the limitations of our study were restricted study population and not evaluating the outcomes of patients. We recommend that further studies on larger populations should be conducted.

CONCLUSIONS

The most common cause of AVN was corticosteroids, which was consistent with previous studies. Other main causes of AVN were traumatic or idiopathic issues. We believe that further studies on larger populations are required in this regard.

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Conflicts of interest

There are no conflicts of interest.

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Table 2: Classification of idiopathic causes of the disease

Cause	Males (%)	Females (%)	Total (%)
Crystal addiction	4 (25)	1 (14.3)	5 (21.7)
Addiction to other drugs	2 (12.5)	0	2 (8.7)
Diabetes	2 (12.5)	3 (42.9)	5 (21.7)
Cigarettes	2 (12.5)	0	2 (8.7)

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