ABSTRACT:
Avascular necrosis (AVN) also referred to as osteonecrosis (ON) refers to inadequate perfusion to bone tissue resulting in death or necrosis of the bone. Although many known risk factors and etiologies exist, 20%-40% of AVN cases are idiopathic (1). There have been reported cases of osteonecrosis secondary to Covid-19 infection. However, these cases are typically attributed to the steroids used in the treatment plan of the viral infection. Here, we describe a case of idiopathic osteonecrosis attributed to a Covid-19 infection where the patient was not treated with steroids. We discuss a possible relationship between AVN and the cardiovascular system that may reflect an underlying cause contributing to avascular necrosis and Covid-19.

INTRODUCTION:
In the United States, it is estimated that there are 20,000-30,000 cases of Osteonecrosis per year. Males are affected more than females, and this typically occurs at age 35-50 years (3). AVN occurs when there is inadequate perfusion of bone leading to cell death and necrosis of the bone tissue. This can occur in any bone or multiple bones in the body. Here we will discuss AVN, specifically, when it occurs at the femoral head.

The most common site of AVN overall is the femoral head. The cause of AVN can be classified as traumatic (related to injury) or atraumatic (not related to injury) Some of the known risk factors include fractures and dislocations, sickle cell disease, Gaucher disease, alcoholism, steroids, decompression sickness, Slipped capital femoral epiphysis, virus and idiopathic.

**CASE PRESENTATION:**

A 48-year-old female presented to the emergency department with complaints of sudden onset constant right flank pain over the past 48 hours. The patient stated that initially the pain radiated into the right groin and this morning she began experiencing pain in the right lower quadrant. She reported the pain intensity as 8 on a scale of 1-10. The patient denies urinary symptoms and has no history of kidney stones. The patient has had 5 prior pregnancies and her last menstrual period was six months ago. The patient denied tobacco, alcohol, and drug use. She denied any fever, chills, nausea, or vomiting. On the physical exam, there was abdominal tenderness in the right lower quadrant as well as right CVA tenderness. She was hemodynamically and neurovascually intact. Laboratory tests were within normal limits and non-contributory. A pelvic ultrasound was negative for any uterine pathology and non-contrast CT scan was negative for urolithiasis and hydronephrosis. She was given morphine and Toradol for pain and subsequently discharged home with plans for a close Obgyn follow-up. Two days later she returned to the emergency department complaining that her pain had not improved. A contrast CT showed nonspecific mild right lower quadrant mesenteric adenopathy. Laboratory and physical exams were again non-contributory, and she was subsequently discharged.
next few weeks, she continued to experience right flank pain despite the use of over-the-counter medications. At this point a follow-up CT was recommended which demonstrated a tiny amount of right femoral head AVN without evidence of subchondral collapse. She was then referred to an orthopedic surgeon for further management. Based on the imaging and orthopedic evaluation the patient was found to be an appropriate candidate for a right hip core decompression with bone marrow aspirate concentrate. Prior to surgery, the patient underwent an MRI of the left hip to evaluate for bilateral AVN which was not the case in this patient. MRI of the right hip demonstrated a focal signal abnormality in the posterior superior femoral head adjacent to the fovea for the ligamentum teres which corresponded to the prior CT and was suggestive of AVN involving less than 10% of the articular surface and no depression of the articular surface. The patient subsequently underwent a core decompression with bone marrow aspirate from her right iliac wing. A one-month post-op radiograph demonstrated that the right femoral head remained well-rounded without evidence of collapse.

**DISCUSSION:**

AVN occurs when there is an inadequate supply of oxygen and or nutrition to bone secondary to decreased perfusion. This results in cell death and necrosis of the bone tissue (3). There are many etiologies of osteonecrosis of the femoral head. Common etiologies include trauma, glucocorticoids, alcohol, hyperlipidemia, systemic lupus erythematosus, sickle cell disease, Gaucher's disease, decompression sickness, and acute lymphoblastic leukemia (3). There are some studies that suggest a genetic component as well (3). However, an estimated 20% to 40% of osteonecrosis are idiopathic (3).

The vascular anatomy of the femoral head itself poses a risk for AVN. This is because of the anatomical arrangement and limited vascular collateral circulation as well as its intracapsular location (7).
Recently there have been reported cases of AVN secondary to covid-19 infections (4). Although viral infections are a known etiologic cause of septic arthritis and AVN (4), Covid 19 is unique in that steroids are commonly used as treatment (4), and steroids are a well-known independent risk factor for AVN (5).

In our case, we discussed a patient who presented with AVN secondary to covid19 and was not treated with steroids. Barring steroids as the cause of AVN in this case, the viral/covid19 component may have been the sole contributing factor. The pathophysiology may be due to Covid19 ability to cause coagulopathy-induced thromboembolic events (6). To understand the pathophysiology better we will look at a few studies that highlight this idea.

Covid 19 can have detrimental effects on the respiratory system as well as many other organ systems of the body, including the cardiovascular system (4). Although the exact mechanism remains unclear, the suggested etiologies of idiopathic osteonecrosis include genetic susceptibility, hypercoagulable state, endothelial dysfunction, mechanical stress, metabolic factors, and vascular damage (2). There is a study (2) that suggests that endothelial dysfunction leading to decreased nitric oxide may play a role in AVN. Given the similarities between endothelial dysfunction in the systemic vasculature and that of AVN, a study (2) was done to see if there is an associated risk of later developing cardiovascular disease (CVD) in patients with AVN. The study found that patients with osteonecrosis of the femoral head had a higher incidence and risk of major adverse cardiovascular and cerebrovascular events than the general population. Based on this association the study suggested additional investigations to see if there is benefit to medical management in preventing cardiovascular and or cerebrovascular events for patients with osteonecrosis of the hip.

The combination of risk factors including the vascular anatomy and coagulopathy imposed by covid 19 may contribute to the underlying pathophysiology of AVN in patients with covid19 infections who were not treated with steroids.
Physicians should be cautious of this complication in patients with COVID-19 with or without the use of steroids as well as patients with other cardiovascular risk factors. Being able to make the diagnosis early may lead to a significantly improved outcome (5). Patients may be asymptomatic in the early stages of the disease. However, some common symptoms may include pain radiating to the groin. Walking and weight bearing may also aggravate the pain, especially with abduction or internal rotation of the femur (7). Staging the extent of osteonecrosis is an important part of the clinical diagnosis as it can help dictate management. One of the most critical aspects in terms of treatment is whether there is collapse of the femoral head. There are different classification systems used for staging osteonecrosis of the femoral head including the Ficat, UPenn, and ARCO (3). Depending on the stage or risk of progression, treatment options range from observation, medication, or surgical interventions including core decompression, bone grafting, and osteotomy with a total hip arthroplasty being the only definitive cure currently available. (3)

CONCLUSIONS:
This case report demonstrates a case of AVN in a patient with a prior history of COVID-19 who was not treated with steroids. Although the exact etiology is unclear there are many associations between AVN, COVID-19, and cardiovascular risk factors. Further investigation is required to elucidate the pathophysiology underlying idiopathic osteonecrosis. However, it is imperative for physicians and health care providers to be vigilant for the signs and symptoms of AVN, especially in patients with risk factors. Prompt diagnosis and treatment can significantly improve patient outcomes.

REFERENCES:


3) George, Gary BS; Lane, Joseph M. MD. Osteonecrosis of the Femoral Head. JAAOS: Global Research and Reviews: May 2022 - Volume 6 - Issue 5 - e21.00176 doi: 10.5435/JAAOSGlobal-D-21-00176


