Case Report

Non-cemented Total Hip Arthroplasty in a Rare Case with Black Hip, A Case Report

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Abstract

Alkaptonuria is a metabolic disorder characterized by homogentisic acid accumulation in connective tissue. Ochronotic arthropathy, a rare condition reported in alkaptonuria, mostly affects the knee joint. In this study we reported a 57-year-old male patient presented with bilateral hip pain. During the operation, black bone tissue and tendons were observed. We examined the patient for alkaptonuria after the operation and the diagnosis was confirmed. In fact, alkaptonuria was not detected until the operation. Therefore, our study suggests that orthopedic surgeons be suspicious of atypical arthropathy in order to avoid being overwhelmed by the appearance of black cartilage during surgery.

Keyword: Alkaptonuria, ochronosis, total hip arthroplasty

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Introduction

Alkaptonuria, also known as black bone disease, is an uncommon amino acid metabolism disorder that affects one in every million people.[1] It is an autosomal recessive metabolic disorder characterized by homogentisic acid (HGA) accumulation in connective tissue as a result of an HGA oxidase deficit, an enzyme implicated in the catabolism of phenylalanine and tyrosine.[2] Ochronotic pigment is accumulated in all connective tissues, particularly cartilage, in alkaptonuria. Ochronosis is the name given to these pigmentary alterations.[3]

The morphologic structure of connective tissue degenerates due to the homopolymeric oxidation products of HGA binding irreversibly to collagen, leading to fragile complexes. Alkaptonuria pathogenesis includes chronic inflammation, degeneration, and, finally, osteoarthritis.[4,5] Common clinical manifestations of alkaptonuria include ear cartilage, skin, and sclera pigmentation. However, individuals are frequently asymptomatic as adolescents or young adults, with the only sign being a brownish staining of the urine when exposed to air for a while.[2,3,6]

Ochronotic arthropathy is a rare disorder reported in alkaptonuria patients. The knee is the most commonly affected joint. Shoulders, sacroiliac joints, hips, and lumbar intervertebral discs are also involved.[7] There is currently no known cure for ochronosis; instead, the condition is often controlled by treating the symptoms as they develop or get more severe. However, joint replacement surgery can be done in cases of severe degenerative arthropathy.[4,8]

Case Report

A 57-year-old male patient presented with bilateral hip pain to our clinic. The patient has experienced mild pain in the left hip for the past three years, which has been followed by pain in the right hip for the past two years. Over time, the pain increased gradually; it was initially relieved by rest and medication and

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exacerbated by physical activity. At the time of presentation, the patient's pain was interfering with his daily activities and he required a cane to walk. He also had pain at night that interfered with sleep.

The patient only had a past medical history of spinal stenosis surgery in 2006. The patient did not mention any specific drug history, even analgesics to reduce her pain. Also, due to the prevalence of COVID-19 at the time of patient's evaluation, a history of fever, chills, cough, dyspnea, gastrointestinal symptoms, and contact with a person infected with the coronavirus was taken from the patient for two weeks, but the patient did not mention any of them.

In appearance, the skin is normal and without any pigmentation. There is evidence of heat or erythema. But he had inguinal tenderness. On physical examination, he had an abnormal gait and had to use a cane to walk. The patient was unable to perform a straight leg raise due to pain. The patient's Thomas test was slightly limited in flexion and extension for both hips. Trendelenburg sign was positive for both hips. FABER Test and Ober test were negative. Also, hip rotational motion was quite painful. The range of left knee flexion was 80°. The range of left knee internal and external rotation was 0°and 30°, respectively. Leg length discrepancy was 0.5 cm and abduction force was 3 out of 5. We also assessed the Harris hip score (HSS) of the patient. The HSS for the patient was 48 before the operation.

According to these findings, OA was diagnosed and the patient was planned for direct anterior total hip arthroplasty (THA) under epidural anesthesia. First, a right non-cemented THA was planned. The patient was placed supine on a specialized operating table that allows optimal access to the hip joint. The incision is marked out based on the Smith-Petersen approach. A 3- to 4-inch incision was made in front of the hip joint, along the natural crease of the groin. This incision provides direct access to the anterior aspect of the hip joint. The surgeon carefully dissected through the layers of muscle to expose the hip joint. The muscles are gently moved aside rather than being cut or detached. During the surgery, after a wide capsular resection, the femoral head was dislocated and markedly black discoloration of the joint capsule, femoral head, and acetabular cartilage was observed [Figure 1]. Also, we observed the acetabular protrusion [Figure 1]. A cementless total hip arthroplasty was performed without any intraoperative challenges. The histopathological exam evidenced hypergranulosis, irregular acanthosis, and hyperkeratosis [Figure 2]. In radiography, evidence of OA was observed [Figure 3].

Three months later, a left non-cemented THA was performed, with features similar to that of the right hip, with extensive blackening of the femoral head and soft tissues. Analysis of the collected samples was similar to the findings on the right hip. He received a standard rehabilitation program.

One of the differential diagnoses was alkaptonuria, which we observed after the operation when we exposed the patient's urine to air, which changed color and turned black, which confirmed the diagnosis [Figure 2]. However, the patient did not have any information about suffering from alkaptonuria. Then we evaluated other joints, and it was observed that all the joints had severe OA [Figure 4]. After the THA, radiographs showed stable prostheses with no evidence of subsidence [Figure 3]. At 3, 6, and 12 months of follow-up of the patient, there was no complaint of hip pain and the

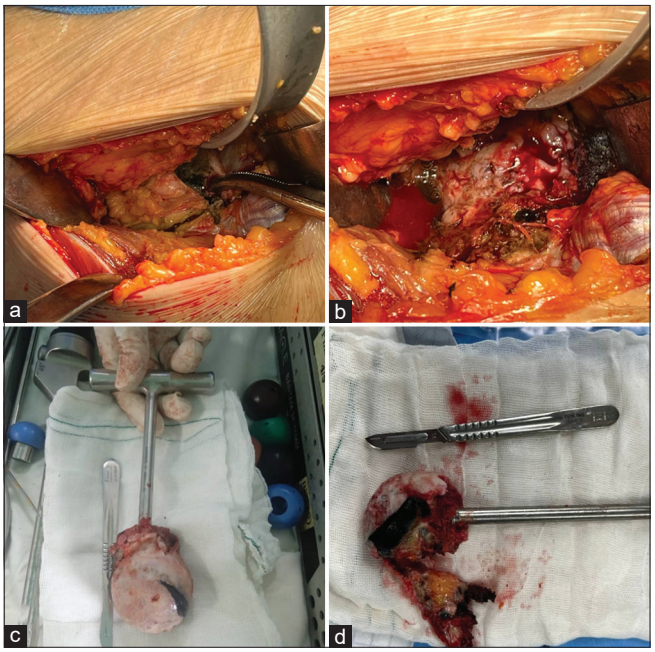

Figure 1: (a and b) Intraoperatively the joint surfaces of the ochronotic hip (c and d) Intraoperatively resected head of the femur

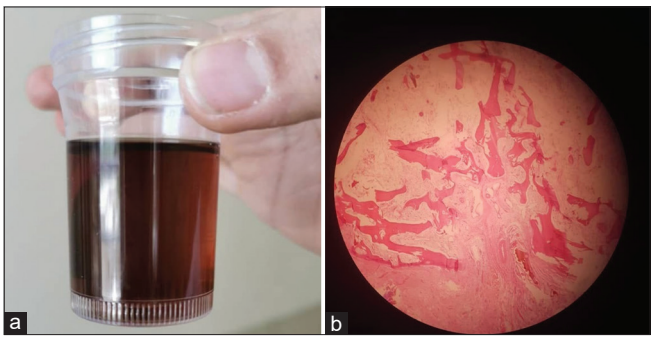

Figure 2: (a) Urine after oxidation (b) Biopsy specimen showing pigmented macrophage and inflammatory cells

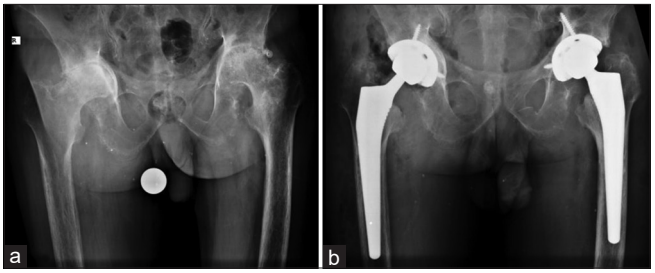

Figure 3: (a) Preoperative anteroposterior radiograph of the hips (b) Postoperative anteroposterior radiograph of the hips

Figure 4: (a and b) Preoperative anteroposterior radiograph of the shoulders (c and d) Preoperative anteroposterior radiograph of the knees

prosthesis was stable. Also, the HSS improved from poor (45, preoperatively) to excellent (84, last follow-up).

The patient was informed that data concerning the disease would be submitted for publication and he agreed for publication.

Discussion

Alkaptonuria is a rare autosomal recessive metabolic condition characterized by HGA accumulation due to a deficiency in HGA oxidase. Since HGA renal clearance declines with aging, the clinical symptoms typically manifest by the third or fourth decade. Compared to females, males have more symptoms.[2,3]

HGA is metabolized in the urine to benzoquinone acetate (BQA). Freshly discharged urine is a normal color, but upon exposure to air, BQA is rapidly oxidized and the urine color changes to a brownish-black. Other clinical indications include pigmentation of the sclera, ear cartilage, and corneal limbus.[9] Even while pigment is deposited everywhere over the skin, it often only becomes visible in a few areas, such as joints, the tympanic membrane, and areas that are close to the skin's surface such as the sides of fingers and the thenar and hypothenar eminences. The palpebral fissure's surrounding brownish-black pigmentation is the most noticeable change in the eye. Hoarseness of voice can be caused by pigmentation and hardness of laryngeal cartilage. Intervertebral disc prolapse has a higher probability. Heart valve stenosis can be caused by both chronic inflammation and increased connective tissue rigidity. Due to pigment deposition, tendons and ligaments become stiffer and more prone to injury.[10]

Due to pigment deposition, microscopic ruptures, and chronic inflammation, arthopathy is frequently seen. The most common location for orthopedic abnormalities is the knee. The pubic symphysis, sacroiliac joints, hips, and shoulders are other sites of involvement.[11,12] Although nitisinone, an inhibitor of 4-hydroxyphenyl pyruvate dioxygenase, has been demonstrated to reduce HGA excretion in the urine, there is no known cure for the condition. It is not known whether or not nitisinone is effective in treating osteoarthritis caused by ochronosis.[13] In people with this condition, premature degenerative arthritis that affects large joints is very common. Conservative treatment is used for the early stages of ochronotic arthropathy; however, the only treatment that can significantly enhance the quality of life for patients whose hip and knee joints are seriously impaired is joint arthroplasties.[14] Due to the fact that the affected bone is typically of poor quality, the longevity and success of arthroplasty can be a reason for concern. However, the vast majority of published research indicates good outcomes for joint arthroplasty, comparable to osteoarthritis patients without ochronosis.[2]

To date, only a few case reports with short-term follow-up have described arthroplasty in ochronosis [Table 1]. In 2018, Couto *et al*.[15] published a report on the case of a 65-year-old woman who presented for medical examination due to chronic hip and knee pain, and then OA was diagnosed. During total hip arthroplasty, it was discovered that the articular capsule and femoral head cartilage were black. She was diagnosed with alkaptonuria in the postoperative period. After that, a total knee arthroplasty was done, and the black cartilage was found again. To avoid being overwhelmed by the appearance of black cartilage during surgery, orthopedic surgeons must be wary of unusual arthropathy.

Also, Ilyas *et al*.[16] reported a 45-year-old man with ochronosis and progressive OA of bilateral knees and hips. He received bilateral hip and knee arthroplasties as staged procedures. At a follow-up examination after more than 12 years, the patient had complete mobility and no implant loosening.

However, another differential diagnosis that can be considered is the use of minocycline. Minocycline is used to treat a variety of gram-positive and gram-negative infections, and ochronosis is most commonly seen in patients using 100–200 mg/day for as little as a year.[17] The rate of occurrence ranges between 3% and 15%.[18] Hyperpigmentation caused by minocycline can be quite disfiguring and occurs more frequently in specific patient demographics (e.g. those with pemphigoid, atopic dermatitis, pemphigus, or cystic acne). Pigmentation is a common adverse reaction related to most tetracycline medicines, affecting the nails, bones, skin, teeth, palate, thyroid, eyes, and heart valves.[19] Therefore, in the differential diagnosis of ochronosis, minocycline-induced hyperpigmentation should be evaluated. Other drugs that may induce changes in skin pigmentation include bleomycin, anti-malarias, chlorpromazine, and amiodarone.[20] Therefore, if pigmentation is observed in any cases, in addition to suspicion of alkaptonuria, the physician should examine the patient's medical history to determine if

Table 1: Brief description of case reports published regarding ochronotic arthropathy

Author	Year	Joint	Summary of results
Di Marco *et al*.[21]	2020	Bilateral knee and bilateral hip	They presented a 30-year-old woman affected by ochronosis. The patient showed severe degeneration of the hip and knee joints bilaterally, associated with an important and painful functional limitation. They performed bilateral cementless TKA and bilateral cementless THA. They report satisfactory outcomes in terms of range of motion and pain control in a six-year follow-up. They suggest that prosthetic replacement represents a definitive way to treat ochronotic arthropathy.
Ilyas *et al*.[16]	2020	Bilateral knee and bilateral hip	They presented a 45-year-old man with ochronosis and progressive hip and knee osteoarthritis. He received bilateral hip and knee replacements as phased procedures. After 12 years, the man had full mobility and no implant loosening. This study showed that alkaptonuric patients with ochronotic arthritis can benefit from arthroplasty and prosthesis survival.
Couto *et al*.[15]	2018	Left hip and left knee	They presented a 65-year-old woman with chronic hip and knee pain that was compatible with end-stage hip osteoarthritis and knee osteoarthritis. The articular capsule and femoral head cartilage were black during THA. Postoperatively, she was diagnosed with alkaptonuria. Thus, orthopaedic surgeons must suspect an unusual arthropathy to avoid being overwhelmed with black cartilage during surgery.
Fernando *et al*.[22]	2018	Bilateral hip	They presented an unusual case of a 69-year-old female who suffered advanced degenerative arthropathy secondary to ochronosis. A staged bilateral total hip arthroplasty was performed on her successfully using a Corail metal-on-poly total hip prosthesis nine months apart. The authors believed the aforementioned surgical technique was safe and useful to control the recurrence of disease in the involved joint.
Mazoochi *et al*.[23]	2018	Right knee and right hip	They described a 57-year-old woman with ochronosis who underwent successful cementless hip replacement surgery as well as a cemented cruciate knee replacement. Pre-operative orthopedic and anesthetic preparation, soft tissue treatment, especially patella tendon management, and cautious bleeding control are essential. After 24 months and 18 months of follow-up, respectively, the results of the patient's joint replacement surgeries for the knee and hip are satisfactory.
Harun *et al*.[24]	2014	Left knee and right hip	They presented a 60-year-old female for evaluation after a 10-year history of low back pain, right hip pain, and bilateral knee pain. A cementless right THA and a cemented left TKA were performed. Intraoperatively, the joint surfaces, neighboring ligaments, and tendons were black with pieces of black cartilage tissue. Histological sections of bone and soft tissue demonstrated classic findings of ochronosis. Joint replacement has excellent outcomes in patients with significant degenerative arthropathy due to ochronosis.
Cebesoy *et al*.[25]	2014	Right hip	They presented a 46-year-old-male patient with ochronosis who underwent the right THA due to osteoarthritis. In ochronotic cases, they recommend complete removal of the joint capsule during hip joint replacement surgery if the diagnosis has been made before the surgery or if it can be made due to the gross appearance of tissue during the surgery. They believed that arthroplasty surgery performed with particular attention to these points would be highly effective in pain control and in preserving joint mobility in patients with ochronosis.
Gowda *et al*.[26]	2013	Left hip	They presented a 60-year-old female patient with a history of progressive pain in her left hip joint for the last eight months. She was diagnosed as suffering from ochronic arthritis of the left hip. After tissue confirmation, she was operated on with a total hip replacement. At the end of two years, the patient was symptom-free without any implant loosening. They conclude that in cases of severe degenerative arthritis of the hip, THA may be considered as a surgical option.
Acar *et al*.[27]	2013	Right hip and left knee	They presented a 62-year-old female who underwent staged left non-cemented THA and right-cemented TKA for osteoarthritis secondary to ochronosis. Although there is no cure for ochronotic arthropathy, replacement surgery is available. Hip and knee total joint arthroplasties significantly enhance the patient's physical activity.

they have used minocycline or other pigmentation-causing medicines. However, our case did not express a medical history of any pigmentation-causing medicines.

Conclusion

Ochronotic arthropathy due to alkaptonuria is a rare condition and only few cases have been reported so far. In this study, we reported a 57-year-old male patient presented with bilateral hip pain. During the operation, black bone tissue and tendons were discovered. We examined the patient for alkaptonuria after the operation and the diagnosis was confirmed. In fact, alkaptonuria was not detected until the operation. Therefore, our study suggests that orthopedic surgeons be suspicious of atypical arthropathy in order to avoid being overwhelmed by the appearance of black cartilage during surgery.

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Conflicts of interest

There are no conflicts of interest.

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