Avascular Necrosis of Femoral Head: A Short Review

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Abstract: Avascular necrosis of femoral head (AVNFH) is the commonest cause of hip joint destruction leading to hip replacement in Hong Kong. Steroid and alcohol are the two commonest causes of AVNFH. Management of this painful and progressive situation in its early stages remains a controversial subject but when the painful hip is affecting the patient's quality of life, a hip replacement is the treatment of choice for pain relief. However, there are concerns about the longevity of the hip replacement in this group of relatively young and active patients. Recent advances in the artificial hip joint such as the use of metal or ceramic may prolong the survivorship of the prosthesis even in the very young and very active patients.

Keywords: Avascular, hip replacement, management, necrosis

Introduction

Avascular necrosis of femoral head (AVNFH) is the commonest cause of hip joint destruction leading to hip replacement in Hong Kong.1 There are concerns about the longevity of the hip replacement in this group of relatively young and active patients. In this article, we discuss the etiology, staging and treatment of AVNFH with special reference to hip replacement.

The Situation in Hong Kong

The pattern of pathologies affecting the hips of local Chinese patients is very different from that in western countries. Although there is no data on the actual incidence of hip disease in Hong Kong, one local study involving 647 cases of total hip replacement showed that AVNFH was the commonest cause, contributing to 45.6% of all cases of hip destruction.1 This is in contrast to the much smaller percentages of AVNFH in Sweden2 (<5%) and in the United States3 (7%) in patients undergoing hip replacement. It is also important to realize that patients with AVNFH are usually much younger than those with osteoarthritis, the major cause for hip replacement in the Caucasian populations. One can imagine the effects of the hip pain on these young patients' life style which should otherwise be very active socially and economically. A reliable and durable pain relieving treatment is therefore essential to restore their ability to enjoy their golden age.

Etiology

Steroid and alcohol intake are the two commonest causes of AVNFH, attributing to approximately 40% of all cases. Trauma to the hip region accounts for another 10 percent of cases. In about half of the cases of AVNFH, the etiology remains uncertain and is therefore considered to be idiopathic. However, there is more evidence to suggest that patients in this so-called "idiopathic" group might have taken steroid, for instance, in the form of herbal medicine. The pathogenesis of trauma related AVNFH is different from that of steroid and alcohol. Trauma, including fracture of the femoral neck and traumatic dislocation of hip, causes direct disruption of the arterial blood supply to the femoral head subsequently leading to AVNFH; whereas steroid and alcohol give rise to intra-osseous hypertension because of hypertrophy of the
AVASCULAR NECROSIS OF HIP IN CHINESE

marrow lipocytes in the femoral head. Venous stasis secondary to intra-ossous hypertension will subsequently result in osteonecrosis.\(^4\) There is also evidence indicating that the altered lipid metabolism in patients taking steroid or alcohol can also give rise to fat embolism to the end arteries of the femoral head.\(^4\) The dose-response relationship of steroid and AVN femoral head has been established in a group of local severe acute respiratory syndrome (SARS) patients treated with steroid. The risk of AVN was 0.6% for patients receiving less than an accumulative dosage of 3 g and 13% for patients receiving more than 3 g of prednisolone equivalent dose.\(^5\)

Other causes of AVNFH such as decompression sickness, sickle cell anemia and human immunosuppressive virus infection are rare.

**Natural Progress of AVNFH**

The natural progress of AVNFH is unclear. A prospective study published recently has shown that early, asymptomatic disease with small lesion size was likely to resolve spontaneously.\(^7\) The results from this study were in line with what we have observed in our local SARS patients with AVNFH. The majority of our patients' lesions were in stage I and most of their lesions were regressing on serial MRI examinations. Other studies have also demonstrated that the area and site of the necrotic bone are important prognostic factors. While a small lesion at the non-weight-bearing part of the femoral head might have a less than 20% chance of collapse,\(^8\) a possibility of up to 70% of collapse has been documented if the lesion is a large one involving the weight-bearing portion.\(^9\)

**Staging**

Although a number of staging methods, including some very sophisticated ones have been described, the most commonly adopted one nowadays remains to be the classical Ficat and Arlen's method\(^6\) (Figure 1) based on plain radiographs. With the use of magnetic resonance imaging (MRI), very early and small AVNFH which cannot be seen on plain radiograph can now be detected with great accuracy. MRI also allows quantification of the volume of the necrotic bone and is therefore invaluable in following patient's progress. The Ficat and Arlen's method not only tells the severity of the disease but also guides us in selecting the appropriate treatment modalities. Stage I and II are early stages before collapse of the femoral head; whereas stage III pronounces the collapse of the femoral head and stage IV refers to secondary osteoarthritis involving the acetabulum.

![Figure 1. Ficat and Arlen's classification of avascular necrosis of femoral head. Note that stage I lesion can only be demonstrated on MRI but not on plain radiograph.](image)

**Surgical Options for AVNFH**

There are a number of surgical options for AVNFH including core decompression, vascularized bone grafting and total hip replacement (THR). Core decompression is usually offered to the patients at the pre-collapse stages. Once collapse of the femoral head has occurred and when the hip pain becomes so severe as to jeopardize the patient's activities for daily living, THR will offer reliable and persistent pain relief and excellent functional restoration.

**Core Decompression**

In theory, better perfusion to the femoral head could be achieved by decompressing the high intra-ossous pressure by removing a core of necrotic bone at the femoral head. The procedure is therefore considered to be a disease-modifying procedure. How effective is core decompression for preventing of collapse of the femoral head is however very controversial. Two randomized controlled studies produced conflicting results.\(^10,11\) One meta-analysis concluded that conservative treatment was having a more or less comparable success rate (29% to 84%) when compared with core decompression in early stage AVNFH (25% to 86%).\(^12\)

**Total Hip Replacement**

No other measures can provide the reliable and long lasting pain relieving effect to patients with AVNFH as THR. However, the results of THR in patients with AVNFH are usually inferior to those with osteoarthritis. The AVNFH group
is usually much younger and active than the osteoarthritis group, and once the hip pain is relieved by a successful hip replacement, their activities are comparable to normal people at their age. The high activity level will put great stress to the bearing surface of the artificial joint and give rise to a wear and tear problem, which is the number one reason leading to re-operation (revision) of the hip. The commonest bearing of the artificial hip joint is cobalt-chrome hip ball versus high molecular weight polyethylene liner. The problem of this metal-polyethylene bearing is that it generates very small (below one micron) polyethylene particles which can activate osteoclast and leads to bone destruction around the artificial joint, a process known as osteolysis. The solutions of this problem included the use of polyethylene with more resistance to wear (cross-linked polyethylene) or to avoid polyethylene at all (ceramic-ceramic or metal-metal bearing). Newer THR design is modular and allows for exchange of the worn bearing without the removal of the usually well-fixed stem and acetabular shell, thereby making the revision surgery easier and safer to be performed (Figure 2).

Conclusions

Unlike the western society, majority of those who require hip replacement in Hong Kong are patients with AVNFH and their average age at operation is much younger and their activity level much higher than that of the Caucasians. Since contemporary artificial hip joint fails mainly because of wear and tear at the bearing part and it is related to the activity level of patients, newer technologies that address this wear problem may benefit our patients.

References


Figure 2. A modular hip replacement system composed of (from top to bottom) 1. acetabular shell, 2. polyethylene liner, 3. ball head and 4. stem.