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Paget's disease of the hip: surgical management

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Paget's bone disease is a rare pathology in which nonorganized resorption and deposition of new bone takes place, leading to structural changes that, in conjunction with increased local vascularity, become symptomatic. The disease affects mostly the pelvic area, including the proximal femur, but the flat bones and skull are also frequently involved. Treatment includes pain management, bisphosphonates and surgery for the correction of deformities. When the hip is compromised these changes eventually develop into arthrosis and total hip arthroplasty becomes an alternative therapy, shown to be successful in restoring patients' function.

First described by Sir James Paget in 1876, the exact etiology of the disease that now bears his name remains unknown. Genetic predisposition [1], gene alterations in chromosome 6 human leukocyte antigen loci DQW1 and DR2 [2,3] and slow virus or bacterial infection have been postulated as possible causes [4]. Although its incidence may be declining [5], Paget's disease may affect up to 3.5% of persons over the age of 45 years [6]. Paget's disease is mostly localized, although some patients may express a diffuse form with many more complications. The pelvis and the femur are the areas of the skeleton most commonly involved and may be affected in up to 80% of patients with Paget's disease [7,8]. Paget's disease is a localized disorder of the bone marked by increased bone resorption, formation and remodeling, which may in turn lead to major deformity and altered joint mechanics. These deformities, alterations in bone quality and the older age of the pagetoid patients may all contribute to the development of severe degenerative joint disease of the hip.

Pathophysiology

Metabolic hyperactivity is the main feature of Paget's disease. Excessive activity of osteoclasts results in the resorption of bone, leading to the creation of voids and cavities within the bone. The physiological compensatory mechanism for repair results in the laying down of fibrotic tissue and even new bone in these cavities by osteoblasts. There is a high degree of vascularity in the pagetoid bone due to the increased metabolic activity. The disruption of the architecture of the bone that occurs as a result of excessive osteoclast activity leads to mechanical weakening of the cortex and the creation of microfractures. The increased bone resorption and excessive

metabolic activity, as well as the microfractures, are all thought to be the cause of pain in patients with underlying Paget's disease of the bone [9]. The newly formed bone matrix remains non-organized and lacks the mechanical strength of normal bone. The continued process of excessive activity and creation of microfractures results in deformities, with a resultant change in the bio-mechanical milieu of the adjacent joints. The latter, combined with older age, predispose these patients to arthritis.

The femur is one of the most commonly affected bones [7,8]. The deformities observed around the hip in patients with Paget's disease include coxa vara, femoral bowing with enlargement of the intramedullary canal and protrusio acetabulare [8].

Diagnosis

The radiographs of affected pagetoid bone have a classical appearance (Figure 1). There is a combination of sclerosis and radiolucencies of the affected cortex. The disruption of the normal architecture is apparent, with a loss of tension bands in the proximal femur and the periacetabular region. The pagetoid bone appears capacious and disorganized on cross-sectional studies, such as computerized tomography and magnetic resonance imaging scans. Bone scans show areas of dense uptake in pagetoid bone due to the underlying high metabolic activity.

Serological markers can also be helpful in diagnosis of Paget's disease. Bone-specific alkaline phosphatase is elevated and the level of bone breakdown products, such as pyridolines and hydroxyproline, is also high.

Patients with Paget's disease usually present with severe pain and may exhibit gross deformities of the long bones. The flat bones, in

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particular the skull, may also be affected, resulting in frontal bossing. The vertebrae, when affected, become disrupted, with a narrowing of the spinal canal. Symptoms of spinal stenosis are not uncommon in these patients. In addition, loss of hearing, affected inner ear bones and high output cardiac failure may be seen.

Treatment

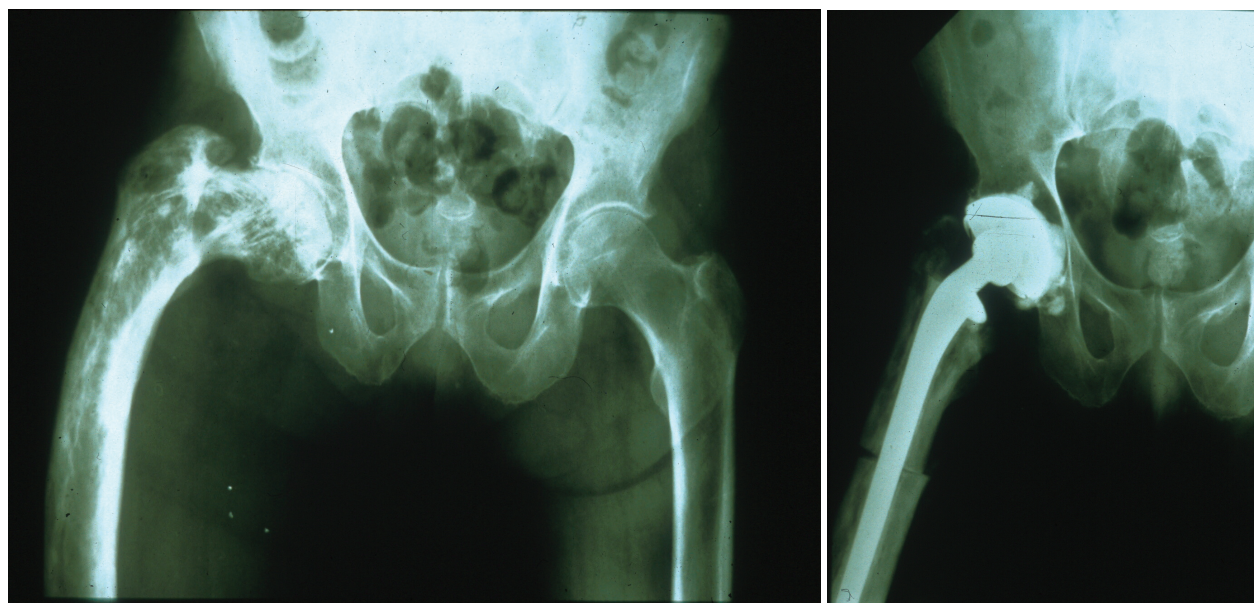
The management of patients with Paget's disease can be challenging. The mainstay of treatment is to relieve pain and improve function. This often requires the administration of nonsteroidal anti-inflammatory medications and other analgesics. In order to retard excessive osteoclastic activity, bisphosphonate drugs and calcitonin may be administered [10]. Joint arthroplasty for Paget's patients with end-stage symptomatic arthritis may also be indicated. Owing to gross deformities, osteotomy of the affected bone, either as an isolated procedure or at the time of arthroplasty, may be indicated [11]. When a subcapital or intracapsular hip fracture occurs in a pre-existing pagetoid bone, total hip arthroplasty (THA) may be indicated if acetabular bone is also affected [12].

Outcome

Although few patients with Paget's disease require surgical therapy, successful surgical management of severe orthopedic complications has improved the quality of life for these patients.

THA has been consistently reported to improve function for these patients [13,14]. The optimal method for the fixation of hip components against pagetoid bone has been debated in the past. Cemented THA is reported to be a viable and accepted treatment modality for symptomatic coxarthrosis of the hip in patients with Paget's disease [8,15–19]. However, it has been documented that there is a higher incidence of symptomatic and asymptomatic radiolucencies around the bone–cement interface of components placed against pagetoid bone, with the possibility of increased rates of implant failure over an intermediate time frame postoperatively [15,17,18]. In one series, radiolucencies occurred in 20 out of 32 acetabular components implanted against pagetoid bone [15]. Merkow and colleagues reported on 21 cemented hips that showed the need for two revisions (9.5%) at 5.2 years of follow-up [18]. Previously, McDonald and colleagues reported the results of 91 cemented THAs in 80 patients, with a significantly higher incidence of revision (15%) observed in patients with Paget's disease compared with the unselected population receiving THA during the same time period ($p < 0.001$) [16]. Radiographic loosening of 29%, cup loosening of 13.5% and a fall off of good and excellent results to 74% of the total in that same series all pointed to increasing problems over longer follow-up periods [16].

Figure 1. Anteroposterior radiograph of a patient with Paget's disease.



The use of uncemented acetabular components during hip arthroplasty has become the preferred method for most hip arthroplasty, with reports of increased survival and a lower loosening rate for uncemented acetabular components when compared with cemented alternatives [20–22]. However, concerns exist regarding the implantation of uncemented components against pagetoid bone, as it is not known whether the altered quality and morphology of the bone adversely influences ingrowth into uncemented implants. Some surgeons, owing to the underlying abnormal bone metabolism, refrain from placing an uncemented component in the hip. However, recently there have been reports showing excellent osseointegration of press-fit components placed against pagetoid bone [13,23]. The midterm results of uncemented femoral and acetabular components in patients with Paget's disease have been encouraging [13,23]. Paradoxically, uncemented hip arthroplasty may be a better treatment option for patients with Paget's disease, as sclerotic abnormal bone in these patients precludes optimal cement interdigitation. In one study, the intended cementing of hip components had to be abandoned in some patients owing to a perceived inability to obtain good cement interdigitation and bonding.

Complications

Although rare, osteolysis following THA in Paget's disease patients, thought to be related to the increased metabolic turnover, has been reported [21,24,25]. However, much more evidence has been reported reinforcing the concept that no rapid osteolysis has been found after cemented [18] and noncemented [8,13,26,27] primary or revision THA.

Patients with Paget's disease are still at a moderate risk for developing heterotopic ossification after THA compared with those at high risk, for instance those with a previous history of heterotopic ossification in either hip, bilateral hypertrophic osteoarthritis or post-traumatic arthritis. This is the basis for starting preventive measures (pre- and post-operative radiation and prophylactic drug regimens [4,28].

Excessive bleeding during surgery is one of the most common complications related to Paget's disease, which is attributed to the

hyper-vascularity of the bone, technical difficulty prolonging the procedure and the need for additional procedures such as osteotomy during the hip arthroplasty [13,27]. Therefore, a large amount of cross-matched blood may need to be available for Paget's patients undergoing surgical procedures. Some authors suggest less bleeding occurs in patients who receive bisphosphonates prior to surgery [29].

Other complications include nonunion of the trochanteric osteotomy in the formerly used approach for THA [27] and a higher incidence of periprosthetic fractures around the hip arthroplasty components [30].

The continuation of bone pain following joint arthroplasty, due to the presence of disease or coexistent deformity, pathological microfractures and, in very rare instances, malignant transformation, can also occur. Malignancy, mostly osteosarcoma [31], may develop in 1–14% of Paget's patients [32,33]. Transmission of Paget's disease during autologous bone grafting, from one location to another, has also been described [34].

Conclusion

Paget's disease often affects the femur and the acetabulum. The older age of these patients, together with the underlying disease, can result in progressive arthritis of the hip, which in turn necessitates hip arthroplasty. Treatment with bisphosphonates, calcitonin and even radiotherapy may be necessary, prior to undergoing an uncemented hip arthroplasty, which is a viable option that has good midterm results. Concurrent corrective osteotomy or the need for custom-made prostheses may need to be considered in the future.

Future perspective

Although the overall incidence of Paget's disease seems to be decreasing, physicians will continue to be challenged by this disease. New and more reliable 'single dose' bisphosphonates and other new drug regimens may decrease the symptoms and complications associated with the disease. Uncemented THA will continue to be an alternative treatment option for patients who have developed secondary arthrosis.

Executive summary

Introduction

- The exact etiology of Paget's disease is unknown. Possible causes may be genetic predisposition and slow virus or bacterial infection.
- There are localized and diffuse forms of the disease.
- In 80% of patients the pelvis and hip are compromised.

Executive summary

Pathophysiology

- Unorganized bone resorption and deposition leads to structural changes.
- Subsequent microfractures and increased vascularity lead to the onset of pain.
- Deformities (e.g., coax vara, femur bowing) change the biomechanics of joints, leading to arthrosis.

Diagnosis

- Radiological tests, including plain x-rays, computerized tomography scans and magnetic resonance imaging, highlight the combination of sclerosis and radiolucencies of the affected bone.
- Elevated bone-specific alkaline phosphatase, pyridolines and hydroxyproline are present as serological markers.
- Patients experience an onset of pain and the deformity of long bones (e.g., the femur).
- The skull may change, with a subsequent loss of hearing.
- Spinal stenosis is also common in Paget's disease patients.

Treatment

- Anti-inflammatory medication is administered to relieve pain and improve function.
- Calcitonin or bisphosphonates may be administered to slow excessive osteoclastic activity.
- Osteotomies may be required for severe deformities.
- Hip arthroplasty is a further treatment option at the onset of arthrosis.

Outcome

- Patients have improved function following hip arthroplasty
- The use of uncemented components yields a lower failure rate.
- There is enough documentation to support osseointegration in uncemented stems.

Complications

- Osteolysis can occur following total hip arthroplasty due to increased bone turnover.
- The risk of heterotopic ossification is higher if the patient had previous heterotopic ossification. In this case, the patient should be treated with pre- and post-operative radiotherapy.
- Excessive bleeding may occur due to increased vascularity.
- Nonunion of osteotomies and a higher incidence of periprosthetic fractures.
- Perpetuation of pain secondary to vascularity or microfractures.
- Osteosarcoma transformation may develop in 1–14% of cases.

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