

Crystal Arthropathy of the Prosthetic Joint

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Abstract

Complications following knee and hip arthroplasty surgery are not uncommon, with features of pain, erythema, warmth and an effusion strongly suggestive of an underlying infective process. Managing septic arthritis in the setting of a prosthetic joint usually requires complex and invasive surgery. A diagnosis of peri-prosthetic crystal arthropathy is often overlooked, however over the last three decades multiple case reports and case series have been published describing this complication in the setting of hip and knee arthroplasty. A greater awareness of this rare complication can result in complete symptom resolution using conservative measures alone with the avoidance of invasive surgery usually performed for suspected sepsis.

Keywords: Hip replacement; Knee replacement; Gout; Pseudo-gout; Crystal arthropathy

Introduction

Crystal deposition in the native knee and hip joints is a well-recognized cause of inflammatory arthritis. The presentation pattern in such cases is acute and often resembles that of septic arthritis. The examination and investigation protocols are often designed to exclude a septic source and identify the type of crystals deposited for a definitive diagnosis of either gout or pseudogout. The diagnosis of prosthetic joint crystal arthropathy is often overlooked due its rarity, with a limited number of published case reports available on the topic.

Following arthroplasty surgery, infection represents the fourth most common complication leading to revision surgery following total knee replacement and fifth most common following total hip replacement, according to the UK national joint registry [1]. Infection following arthroplasty surgery can result in significant morbidity and mortality and often requires complex surgery in the form of staged procedures in order to successfully eradicate infection. This is a lengthy process incurring sizeable cost to any healthcare system and often results in significant disability to patients between procedures. Infection in the setting of a prosthetic joint also differs from that in the native joint with a wide variation in presentation patterns as described by Fitzgerald et al. [2]. It is for these reasons that correctly diagnosing crystal arthropathy in suspected cases of infection is paramount to avoiding invasive, costly and debilitating interventions. With only a small number of case reports and case series describing this phenomenon, it is difficult to determine an accurate incidence and prevalence.

Presentation

Prosthetic joint infection can present acutely with features including erythema, localized warmth around the joint, effusion, pyrexia and general lethargy. The early stages of inflammatory arthritis generally mimic these features leading to the diagnostic dilemma often faced by physicians. A thorough history is essential in determining the correct

diagnosis in these cases. A previous history of gout or pseudogout or the presence of risk factors for increased uric acid production should immediately alert the treating physician to the potential underlying diagnosis of prosthetic joint crystal arthropathy, with a large number of the previously reported cases occurring in patients with a background history of the condition.

Physical examination findings of prosthetic joint crystal arthropathy are largely non-specific. Systemic features of infection, including pyrexia, lethargy and night sweats have been described in cases of acute prosthetic joint crystal arthropathy affecting both the hip and knee joints [3,4]. Examination features including joint effusion, joint line tenderness and reduced range of motion are common to both inflammatory and septic sources of arthropathy. A thorough examination can be useful in excluding an infective source with gross negative findings however.

Investigations

Serum inflammatory markers in the form of the erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) are often raised in both circumstances, with previous literature indicating poor sensitivity and specificity of such serum parameters [5]. Serum white cell count is often difficult to interpret in the setting of suspected prosthetic joint crystal arthropathy as this parameter may also be elevated in this setting [3]. The degree of serum elevation in white cells is usually borderline ($11.7 \times 10^9/L$) in comparison to the marked elevation evident in true septic cases. During an acute attack of gout affecting a native joint, serum uric acid levels can be within the normal range in up to one third of cases [6]. This has also been shown to be the case in acute gout attacks affecting prosthetic joints, limiting the use of this serum parameter in the work-up of such patients [3]. A normal serum uric acid level has been shown to be more likely during acute attacks in patients undertaking long term preventative treatment with allopurinol [7].

Plain radiography is often unhelpful in the acute setting of suspected prosthetic joint septic arthropathy [8]. Signs of loosening may suggest but are not a feature specific to infection. In the setting of

prosthetic joint crystal arthropathy radiographic features are similarly non-specific, with only 19% of cases demonstrating either signs of calcification or loosening [3]. Radiography is recommended as part of a routine workup in order to exclude other mechanical causes of joint pain. Ultrasonography is useful in demonstrating an effusion within the deeper hip joint or subtle effusions within the knee, difficult to elicit on clinical examination. The use of colour doppler flow ultrasonography is commonly used in this setting, with synovial blood flow an indicator of inflammatory activity in the joint. This may highlight an acute event but is not reliable in distinguishing an infective from an inflammatory cause [9].

Joint fluid aspiration is generally performed in the next phase of the investigation timeline. A definitive diagnosis of crystal arthropathy is dependent on the visualisation of either monosodium urate (MSU) or calcium pyrophosphate dihydrate (CPPD) crystals using the gold standard method of polarized light microscopy for gout and pseudogout, respectively. Assessing the degree of birefringence under polarized light microscopy, this technique aims to distinguish between MSU and CPPD according to the shape and elongation of the crystals. Crystal identification is not however consistent between observers using bright field microscopy. Furthermore with CPPD crystals only weakly negative birefringent under polarized light, up to 80% can go unnoticed if this is the principle technique used. Confirmation of MSU crystals is more reliable using this technique with crystals strongly positively birefringent [10].

The presence of micro-organisms on gram-staining is highly suggestive of infection, however a negative gram-stain does not necessarily exclude infection in this setting [11]. The sensitivity of the gram-stain technique has been reported to be as low as 45% [12]. Synovial fluid culture is widely regarded as the gold standard investigation choice for confirming joint infection [13]. Reliable culturing of samples can take up to 72 hours however with early results available from 24 hours. Antibiotic intake prior to synovial aspiration is not uncommon in the initial phase of presentation with such patients and this can obscure the results of gram-staining and culture of synovial fluid samples [14]. More recently synovial fluid white blood cell count and synovial lactate were two readily available parameters identified as possessing the highest diagnostic potential in the acute setting for determining infection in both the native and prosthetic joint [15].

Management

In scenarios of gout and pseudogout following arthroplasty surgery, a key concern lies with the potentially unnecessary invasive interventions often instituted due to the close clinical and biochemical resemblance of the underlying inflammatory condition with an infective process. Invasive management protocols previously instituted range from an arthroscopic lavage to a staged revision procedure [3]. Invasive treatment can lead to significant immediate post-operative disability, prolonged hospital stay and even the potential risk of introducing infection into inflamed yet sterile joints. According to a previous review by the current author, the rate of invasive treatment was as high as 59% in cases of prosthetic joint inflammatory arthropathy [3]. Following correct diagnosis of crystal arthropathy, treatment can be effectively reserved to routine anti-inflammatory drugs in the acute setting and in the long-term with a xanthine oxidase inhibitor thereby reducing the likelihood of further attacks.

Concurrent infection and inflammatory arthropathy is a well-recognized phenomenon in both the native and prosthetic joint [3,16]. The underlying association between the two conditions is poorly understood. It is thought that the local metabolic septic reaction within the joint, leads to an accumulation of lactic acid, which in turn serves to reduce the solubility of urate, leading to crystal precipitation. In such cases, treatment should be primarily targeted at eradicating infection using local and systemic strategies.

Discussion

To date there have been a total of 30 individual reported cases of gout and pseudogout on the background of a prosthetic knee joint. Following a review of the literature, the authors concluded that such patients often presented with features indicative of infection, and excluding septic arthritis on clinical grounds alone was difficult for physicians in an often acute scenario [3]. Serum and synovial analysis was often performed in the diagnostic work up of patients however these parameters were similarly elevated in cases of inflammatory arthropathy to a degree where infection could not safely be excluded. This review also highlighted the risk of concurrent crystal arthropathy and septic arthritis, with 4 published cases in the literature describing both diagnoses simultaneously.

Cases of gout following total hip arthroplasty are far rarer in the literature with only 4 cases reported [4,17-19]. From the limited literature available on this subject, it is difficult to determine precise patterns of presentation, effective investigation protocols and correct management strategies. In the setting of a hip prosthesis, progressive features of aseptic loosening preceding the presentation of an acute attack of gout seems to be a common feature between the cases available. In contrast, only 3% of crystal arthropathy cases affecting prosthetic knees reported radiographic features of loosening, with 10% reporting intra-articular calcification, and rest unremarkable.

Similarly the occurrence of concurrent infection and crystal arthropathy in the hip joint has been described in a single case report [19]. All but the one infected case of prosthetic joint inflammatory arthropathy of the hip described in the literature (75%) were successfully treated conservatively with anti-inflammatory medication, in contrast to only 41% of cases of gout affecting the knee.

Conclusions

With a continuing growing trend in arthroplasty surgery and a rising incidence of crystal arthropathy, we are more likely to be confronted with cases of prosthetic joint inflammatory arthropathy during acute and elective practice in the future [20]. The literature currently available on this topic remains scarce and limited only to case report and case series publications. With such a close resemblance in the features of prosthetic joint inflammatory arthropathy to septic arthritis, and investigative protocols limited in their discriminatory capabilities, a diagnosis is ultimately dependant on clinician acumen following thorough scrutiny of all clinical, biochemical and radiological findings. A high index of suspicion is required to ensure the diagnosis of prosthetic joint crystal arthropathy is not missed. In cases when infection is safely excluded, correct medical management for the inflammatory arthropathy can result in a rapid recovery from the condition with initiation of preventative treatment reducing the likelihood of any further attacks. Despite this it is clear patients are still undergoing potentially unnecessary invasive intervention in the acute setting. Early results from the recent advents in synovial fluid

biomarkers including leukocyte esterase and α -defensin in detecting prosthetic joint infection are encouraging [21]. Their potential for instant diagnosis using reagent strips raises a promising prospect in aiding physicians to discriminate between inflammatory and infective prosthetic joint arthropathy.

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