MENTORS IN ORTHOPEDICS

UPDATE ON TREATMENT OF THE INFECTED NICOMPARTMENTAL KNEE ARTHROPLASTY

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SUMMARY

Background: Periprosthetic joint infection (PJI) following unicompartmental knee arthroplasty (UKA) is a rare but serious complication, with an incidence ranging from 0.1% to 1.0%. While the rate of infection is significantly lower than that observed in total knee arthroplasty (TKA), the optimal management strategy remains a subject of clinical debate due to the unique anatomical considerations of the partially resurfaced joint and a paucity of high-level evidence.

Objective: This review aims to evaluate current epidemiological data, diagnostic criteria, and surgical management strategies for infected UKA, specifically comparing the efficacy of debridement, antibiotics, and implant retention (DAIR) against one-stage and two-stage revision procedures.

Key Points: Diagnostic protocols for UKA infection mirror those of TKA, utilizing serum inflammatory markers and synovial fluid analysis; however, synovial white blood cell counts may be higher in UKA. Management options include DAIR for acute presentations and staged revision to TKA for chronic cases. Although DAIR is less invasive, registry data indicate higher failure rates (29%–45%) compared to two-stage exchange. The presence of native cartilage in the non-resurfaced compartments may serve as a nidus for persistent infection, potentially compromising the success of implant retention. Conversely, the preservation of native tissue and smaller metallic volume may enhance local immunological defenses.

Conclusion: While UKA infection is infrequent, its management requires a multidisciplinary approach. DAIR may be appropriate for early infections, but chronic PJI typically necessitates conversion to TKA. Further large-scale registry studies are required to establish standardized treatment algorithms and optimize long-term functional outcomes.

KEYWORDS

Arthroplasty, Replacement, Knee; Osteoarthritis, Knee; Prosthesis-Related Infections; Reoperation; Debridement

INTRODUCTION

Infection in UKA is substantially less than that of Total Knee Arthroplasty (TKA), with an incidence varying from 0.1% to 1.0% [3]. This uncommon but severe complication is not well studied, but due to the different morphology of UKA, treatment protocols maybe different than the standard expected management of TKA infection. In this article we will review the current knowledge how to treat infected UKA and discuss the different role of DAIR compared to infected TKA.

EPIDEMIOLOGY

The reasons for Unicompartmental Knee Arthroplasty (UKA) failure are aseptic loosening, polyethylene dislocation with mobile-bearing systems, progression of arthritis, periprosthetic fractures, wear, bone implant impingement, retaining of cement debris, ankylosis of the knee, recurrent hematoma, persistent pain and infection [1-4]. Focusing on infection as a complication, UKA infection incidence varies from 0.1% to 1.0%.

Kim et al reported a total of 1,576 UKAs performed between January 2002 and December 2014. Out of 89 complications (5.6%), he recorded 5 cases of infection (0,3%) [1]. Hernandez et al retrospectively reviewed 22 years of Mayo Clinic data and noted only 15 UKA infections out of a total of 1440 UKAs (1.0%) [5]. Bergeson et al. published on 1000 consecutive medial UKAs, in which there was one stated infection (0.1%) [2]. Only 8% of knee replacements done each year in the UK are UKRs, the majority of UK knee surgeons do not regularly undertake UKR. In a study of Liddle et al analyzing the English and Welsh registries, 25 334 UKRs were matched to 75 996 TKRs on the basis of propensity score: this is one of the most comprehensive comparison of UKR and TKR performed. The NJR of England and Wales is the largest joint replacement database in the world. Data were collected between April 1, 2003 and August 28, 2012. The study showed a significantly greater number of TKRs than UKRs revised for infection and the authors affirmed that patients undergoing TKR are twice as likely to have deep infection compared to UKR [6]. The Society of Unicondylar Research and Continuing Education in a multicenter revision study (6 separate institutions), reported 28 infected cases out of 259 consecutive UKAs revised for failure between April 1995 and May 2011 (10,8% of revision cases) [7]. Epinette et al [8] in a multicentre retrospective study (25 french centres) analysed 418 failed UKAs performed between 1978 and 2009; he found 3 isolated deep infections and 5 septic loosenings; the infection rate was 1.91%. Saragaglia et al [12] out of 418 failures refers 8 cases of infection with or without loosening (five and three) making up 2 % of the total.

DIAGNOSIS

Signs and symptoms for UKA infection are comparable to TKA infection and diagnostic algorithm should be the same. An accurate history and physical examination are mandatory. Knee radiographs should be taken and carefully reviewed before surgery. UKA infection can have early or delayed onset, hematogenous seeding is also a possibility.

The clinical guidelines published by American Academy of Orthopaedic Surgeons recommend to obtain preoperative screening laboratory evaluation, including erytrocyte sedimentation rate (ESR), and C-reactive protein (CRP), for all patients who are planned for revision joint arthroplasty [9-10]. Based on the clinical suspicion of infection and the laboratory findings (CRP and/or ESR elevated), synovial fluid aspiration is performed and analysed for white blood cell count, polymorphonuclear percentage with differential, and culture.

Periprosthetic joint infection (PJI) is defined as either 2 positive cultures from the joint (defined as growth of organisms on solid media) or meeting 2 of the following criteria: the presence of a sinus tract or gross purulence seen at the time of revision, 1 positive deep culture, or histopathology consistent with infection with a mean of greater than 10 polymorphonuclear cells (PMNs) in the most 5 cellular fields examined.

The Society of Unicondylar Research and Continuing Education reported the criteria of diagnosis of PJI after UKA and found that the optimal cutoff values were 27 mm/h for the ESR, 14 mg/L for the CRP, 6200/microL for the synovial fluid White Blood Cells (WBC), and 60% for the differential. These tests are useful for diagnosing PJI after UKA. Synovial fluid WBC count is the best single test for diagnosing PJI and it has been found to be higher in infected UKA than in infected TKA. The authors thought it could be related to the unsurfaced compartments [7].

The most common bacteria in UKA infections are coagulase-negative Staphylococcus, Staphylococcus aureus, group B Streptococcus, Escherichia coli and Propionibacterium acnes. These organisms are similar to that observed in TKA.

MANAGEMENT

Given the limited available data of UKA infection, the best treatment option remains an area of debate. Currently, management of UKA infection is similar to that of TKA. Acute infections can be managed with irrigation, debridement, polyethylene liner exchange (DAIR) with implant retention and antibiotics. Chronic infections may be treated by one or two stage revision procedures. Revision will usually be to a primary TKA.

DAIR procedure has evolved through a number of stages, but now is accepted as an open procedure with removal of the synovium that is accessible around the implant, removal of and discarding of the polyethylene tibial insert and copious jet or power lavage with at least 4 litres of saline. (Fig 1).

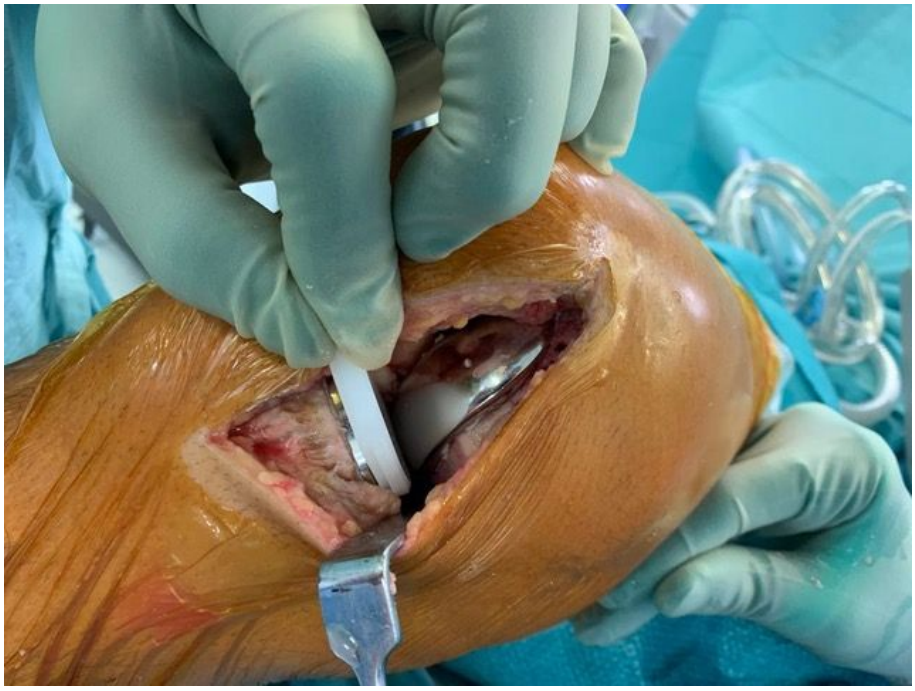

Figure 1. Copious power lavage of implant and synovial with a minimum of 4 litres of saline

Some techniques use a 3% solution of hydrogen peroxide with further 2 litres of lavage subsequently. Culture biopsies are taken at the beginning of the procedure even if the infecting organism is known as some cases will have multiple infective organisms. Mechanical brushing or cleaning of the implant is recommended to break up the bacterial bio film that often forms. A completely new tibial insert is employed after redraping the site and a complete change of gloves and gowns for the operating team (fig 2) Subsequently, intravenous antibiotic appropriate to the infection is administered for two weeks followed by six weeks of oral antibiotic. Technical issues with unicompartmental DAIR include limited access to complete the synovectomy and difficulty accessing the rear of the implant to clean and debride.

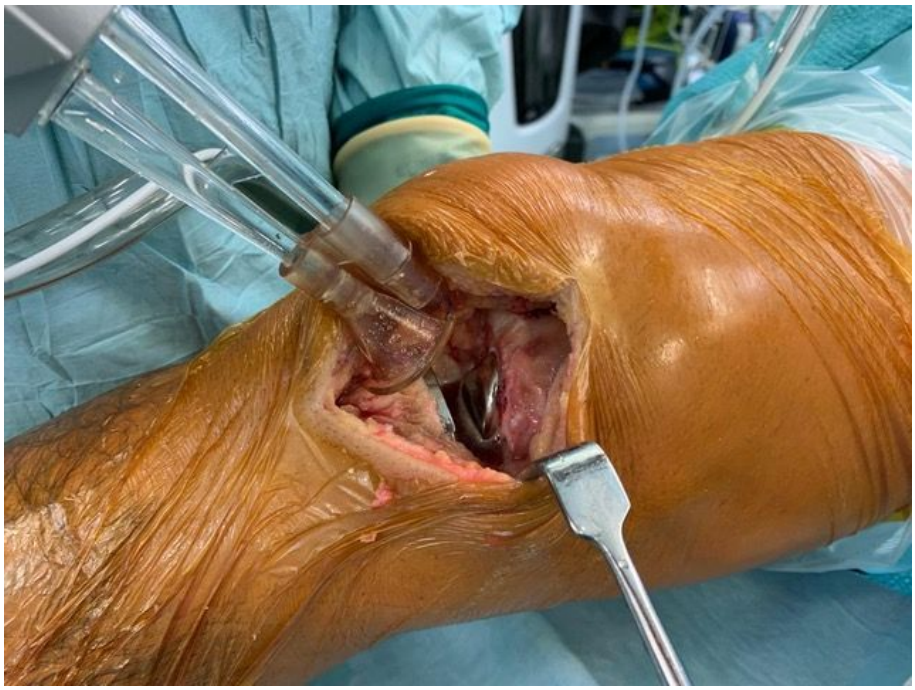

Figure 2. Following debridement and lavage, a change of drapes and reinsertion of a new tibial bearing

One stage procedure is possible when causative bacterium is known and it is characterized by an accurate synovectomy removal of all infected tissues and UKA components. The synovectomy of the post capsule is the critical part, which can be reached only after the bone cuts are done. With one stage exchange it is strongly recommended to remove all drapes and instruments after debridment and explantation and to set up a new set of sterile drapes and equipment before carrying on performing the re-implantation, as if two operations were going to be made. Finally, in most of the cases a primary TKA with a course of intravenous antibiotics can be implanted. A revision knee system with stems and augmentations should be available in the theatre in case of severe bone loss.

A two stage procedure involves deep debridement and synovectomy in all compartments, implant removal and remodelling bone cuts or performing them for the following TKA and antibiotic cemented spacer positioning (articulating or static, customized or off the shelf). During the interval, intravenous antibiotic therapy is continued and the patients clinical and hematological status is monitored with serial ESR and CRP measurements. Commonly, 6 to 12 weeks is the period before secondary procedure can be performed, but in the presence of raised markers for infection, this interval may have to be prolonged until evidence as eradication of infection is seen. Post second stage, intravenous therapy continues for 2 weeks, then subsequently oral therapy follows for 6 further weeks.

PJI in UKA should be managed with a multidisciplinary team approach with the aid of infectious disease specialists. There are no specific postoperative antibiotic protocols to treat UKA infections. Commonly, infection specialists will apply TKA PJI antibiotic protocols to infected UKA, which follows standard treatment practise, but every patient needs a tailored antibiotic treatment depending on preoperative synovial fluid cultures, intraoperative tissues cultures and antibiogram.

DISCUSSION

The frequency of periprosthetic infection following unicompartmental knee arthroplasty is relatively low compared to TKA. UKA can be performed with a small incision, minimal joint exposure, sparing bone resection and shorter surgical time. Following UKA a significantly higher proportion of the knee joint remains of native tissue. This may explain lower rate of infection in comparison to TKA but may alter the response to the rare challenge of infection. Given the limited data available of UKA infection, the best treatment option remains an area of debate.

PJI after UKA can be difficult to treat with DAIR because of the infected native cartilage in the unsurfaced compartments of the knee. The native cartilage surfaces in UKA infection can be compromised and can provide a nidus for ongoing infection, leading to chondrocyte necrosis and potentially speeding up arthrosis of the other knee compartments; in this eventuality the utility of DAIR may be limited. On the other hand, we might have a higher-than-expected usage of DAIR procedure along with a higher success of outcome of this procedure against published data in infected TKA.

As Argenson et al [14] reported “in the event of acute infection after UKA, early irrigation and debridement followed by antibiotic administration with implant retention can be considered. However, if initial treatment effort results in failure or chronic infection is present, the implanted prosthesis should be removed and a one- or two-stage conversion to TKA should be performed in combination with antibiotic therapy.” The authors also refer that “In the setting of UKA, recommendations are weak as only 5 published papers examine the results of failed UKA, including infection, and rate of infection is very low. [...]

We found only two papers directly evaluating the role of DAIR in the setting of UKA. Chamlers [15] described 21 infected UKA from their institutional registry. 16 (76%) were treated with DAIR, 4 (19%) with two stage and one (5%) with one stage revision. Survival free for infection at 1year was 76% for all cases. Survivorship free from all-cause reoperation for DAIR was 55% only at both 2 and 5 years. Hernandez [5] described 15 patients with PJI after UKA from their institutional registry and found a success rate of only 71% for infection-free survivorship at 5 years. There was superior survivorship in the 4 knees treated with two stage exchange (100%) compared to 11 knees with DAIR (61%). Hence, DAIR does appear to have a higher rate of failure than one- and two-stage revision procedures. Additionally, they found only 49% 5-year survivorship free of any revision. One patient from the two-stage exchange cohort underwent femoral component re- revision for aseptic loosening, and two patients from the DAIR group were converted to TKA for disease progression.

It might be suggested that as the higher proportion of the knee is natural around the much smaller implant of UKA, the knee immunological status and natural defenses are more effective than in the case of the larger metallic implant of a TKA and the correspondingly reduced amount of natural tissue. Early diagnosis and DAIR maybe the appropriate treatment for an early UKA infection with a higher rate of success and retention of the prosthesis than accepted data reveals in TKA.

One stage revision to a TKA is employed despite documented infection with similar success. Two stage procedures have a comparable success rate to that accepted for TKA. Kim et al [1] reported 5 cases of late infection; the mean interval from UKA to the occurrence of infection was 5 years and 3 months (range, 1 year and 5 months to 10 years and 10 months). All infected knees (n=5) underwent two-stage TKA for treatment, but the type of spacer used was not described. Labruyère et al [11] in 9 infected patients reported success with a one stage procedure to TKA: 5 of these patients had a previous DAIR. Bohm et al [13] shows 35 revision procedures in 34 patients between 1986 and 1996, with 2 deep infections (0.7% infection rate). One stage revision was done in a patient and a two stage revision in the other. One of them underwent femoral amputation.

CONCLUSION

UKA infection remains a rare complication. It can be early, delayed or with an hematogenous dissemination. A meticulous workup is vital in the diagnosis of infection. Following UKA, a significantly higher proportion of the knee joint remains of native tissue. This may explain lower rate of infection in comparison to TKA but may alter the response to the rare challenge of infection. Surgeons might wish to adopt a slightly different strategy than in TKA infection, with maybe more emphasis on the less invasive and potentially more successful DAIR procedure.

Both one- and two-stage procedures have shown success even in the setting of chronic UKA infection. There is a lack of evidence to support any specific treatment protocol. PJI treatment in UKA should benefit from a multidisciplinary team approach, needing surgical intervention as well as perioperative management with antibiotics, whose duration, dosage and type must be indicated by medicine and infectious disease specialists to achieve best functional results.

More research should be performed, and focus should be given on longerterm survivorship following treatment for PJI after UKA. Larger studies with high level-of-evidence should be performed to establish standard treatment protocols and to analyse complications. It may well be that treatment of the infected UKA requires a different approach. With this aim it would be of significant importance to develop national registries and analyse existing ones, enabling nationwide research.

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