Delayed onset of deep infection after total knee arthroplasty: comparison based on the infecting organism

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ABSTRACT

Purpose. To identify the organisms causing delayed deep infection following primary total knee arthroplasty (TKA) and to compare the differences in outcome based on the infecting organism.

Methods. Between the period April 1998 and March 2004 inclusive, patients presenting with delayed deep infection following primary TKA and/or those who underwent a salvage procedure (amputation or arthodesis) were retrospectively studied.

Results. Organisms were isolated in 27 patients; 44% were methicillin-resistant Staphylococcus aureus and Staphylococcus epidermidis. When the organism was resistant, the mean number of surgical procedures per patient was significantly higher and the proportion of patients with satisfactory outcomes was significantly lower.

Conclusion. Deep infection with methicillin-resistant S. aureus or S. epidermidis is increasing. Strict infection control measures must be in place to combat such problems.

Key words: arthroplasty, replacement, knee; drug resistance, multiple; infection; Staphylococcus aureus; Staphylococcus epidermidis

INTRODUCTION

Failure of total knee arthroplasty (TKA) is commonly due to deep infection, with an incidence varying from 0.5 to 12%.1–6 Various treatment modalities include: antibiotic suppression, arthroscopic/open washout, debridement, implant removal, and staged revision.7 Arthrodesis, excision arthroplasty, and amputation may be considered as salvage procedures for patients not responding to conventional treatment.7 The success rates of various treatments were between 80 and 95%.8,9 The incidence of peri-prosthetic infections by multi-drug resistant bacteria has been increasing.8,10 We aimed to identify the organisms, and compare differences in outcome based on the infecting organism.

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MATERIALS AND METHODS

Between April 1998 and March 2004 inclusive, all patients who presented with delayed deep infection following primary TKA were identified from the hospital database. Approval from the institutional audit department was obtained. Delayed deep infection was defined as joint infection present at least 3 months after primary TKA. Organisms were considered multi-drug resistant when they were resistant to commonly used first-line antibiotics. Clinical records and radiographs of the patients were reviewed retrospectively. Some patients had their primary operation performed as early as 1988. Patients with confirmed delayed deep infection and/or those who underwent a salvage procedure (amputation or arthrodesis) were included. Patients were excluded if they were: (1) currently being investigated for suspected infection of the knee, (2) awaiting definitive treatment for infected TKA, or (3) followed up <24 months after debridement or staged revision TKA.

Diagnosis was based on a combination of clinical, radiological, microbiological, and haematological parameters. Isolation of pathogenic organism either from the aspirate or tissue specimens was the primary criterion for the diagnosis. When a pathogenic organism was not isolated, diagnosis was based on the presence of clinical signs (localised erythema, and/or increased temperature, presence of pus in the joint, elevated inflammatory parameters, and radiological loosening).

A standard treatment protocol was followed. All patients underwent open washout and debridement; the implant was removed if it was loosened. Patients were first treated with intravenous flucloxacillin and benzyl penicillin (erythromycin for penicillin allergic patients) for a minimum of 6 weeks. The antibiotics were reviewed after culture and sensitivity results were available. Methicillin-resistant Staphylococcus aureus (MRSA) and Staphylococcus epidermidis (MRSE) infections were treated with intravenous vancomycin and oral rifampicin also for a minimum of 6 weeks. Close liaison was maintained with the microbiologist regarding the dose and duration of antibiotics.

In patients with retained implants, no further intervention was undertaken if they responded well to debridement and antibiotics. Subsidence of clinical evidence of infection (pain, swelling, erythema, effusion, fever) and rapidly falling C-reactive protein and erythrocyte sedimentation rate were considered a good response. In patients with retained implants and persistent signs of infection after debridement, the implant was removed followed by staged revision of the TKA. In those whose implant was removed at the time of debridement, revision TKA was performed once the infection was controlled (C-reactive protein and erythrocyte sedimentation rate remained stable under 20). The minimum period between implant removal and revision TKA was 3 months. Antibiotic-impregnated cement spacer and/or gentamicin beads were used for the latter cases. Arthrodesis or amputation was carried out as a salvage procedure when staged revision had failed or when infection could not be controlled with repeated debridement and prolonged antibiotic treatment.

The infecting organism, sensitivity of the organism to antibiotics, number of surgical procedure carried out, and the treatment outcome were analysed. The treatment was considered successful when the patients were able to retain the implant after either debridement alone or staged revision TKA, with knee range of movement of ≥70º and a fixed flexion deformity of <20º. The treatment was considered to have failed when the patients had persistent pain or an unstable knee, or eventually underwent arthrodesis, amputation, or excision arthroplasty, or died from complications of knee infection.

Fishers’s exact test for categorical data and the Mann-Whitney U test for the non-parametric numeric data were used for statistical analysis. A p value of <0.05 was considered statistically significant.

RESULTS

16 women and 15 men were identified to have delayed deep infection following TKA. Their mean age at the time of primary TKA was 70 (range, 46–92; standard deviation, 11) years. The mean follow-up period post primary TKA was 77 (range, 27–170) months, and the mean American Society of Anesthesiologists score was 2.3. The mean follow-up period since the last surgical procedure for infection was 31 (range, 14–47) months. Cemented TKA was used as the primary procedure. The primary indication for TKA was osteoarthritis (n=26), psoriatic arthritis (n=3), and rheumatoid arthritis (n=2). Co-morbidities included diabetes (n=6), morbid obesity (n=4), and splenectomy (n=1). Three patients each had psoriatic arthropathy and leg ulcers (predisposing to infection).

Organisms were isolated in 27 of the 31 patients; 12 (44%) patients had multi-drug resistant and 15 (56%) had non-resistant organisms. The infecting organisms were Staphylococcus aureus (n=11), Staphylococcus epidermidis (n=1), Streptococcus hemolyticus (n=1), Propionibacterium (n=1), Serratia marcescens (n=1) [all were sensitive to flucloxacillin and methicillin], MRSA (n=6), MRSE
(n=5), and multi-drug resistant *Escherichia coli* (n=1) [Table 1]. No organism was isolated in 4 patients despite repeated cultures of specimens.

Table 2 shows the baseline characteristics of the patients and their outcomes based on the organism isolated. 31 patients underwent a total of 122 (mean, 3.9) surgical procedures in addition to the primary TKA. In the group with sensitive organisms (n=15)
the mean number of additional procedures was 3.3, compared to 4.8 in the group with resistant organisms (n=12); this difference was statistically significant (p=0.0246, Mann-Whitney U test). In the group infected by MRSA (n=6) the mean number of additional procedures was 4.5, compared to 3.2 in the 11 patients infected with methicillin-sensitive S aureus (MSSA); this difference was not statistically significant (p=0.078, Mann-Whitney U test). In the group with MRSE (n=5) corresponding figures were 4.7, compared to 3.5 in the group with no organisms isolated (n=4).

Of the 31 patients, 20 (64.5%) had poor outcomes and 11 (35.5%) had successful outcome. 60% (9/15) of the patients with sensitive organisms had satisfactory outcomes, compared to 17% (2/12) in the group with resistant organisms; this difference was statistically significant (p=0.047, Fisher’s exact test). Specifically in the group with MRSA, only 17% (1/6) of patients had satisfactory outcomes, compared to 64% (8/11) of those infected with MSSA (p=0.050, Fisher’s exact test). Among methicillin-resistant staphylococcus-infected patients (MRSA and MRSE together), 18% (2/11) had satisfactory outcomes, compared to 67% (8/12) in those with methicillin-sensitive staphylococcal infections (p=0.036, Fisher’s exact test). In the group with no sensitive organisms isolated (multi-drug resistant or no organisms isolated), the figure was only 13% (2/16), compared to 60% (9/15) among patients with sensitive organisms isolated (p=0.01, Fisher’s exact test).

DISCUSSION

Overall 36% (11/31) of the infections were caused by methicillin-resistant staphylococci, much higher than in previous studies reporting 15 to 20%, though others have encountered increasing rates.7,10 Success rates between 80 and 95% have been reported for treating infected TKA.8,9 When the infecting organism was multi-drug resistant, success rates were as low as 18%,7 consistent with the present study. The poorer results of the present study could be due to our recruiting patients with only delayed onset of deep infections, the stringent criteria we adopted for defining a satisfactory outcome, and the high proportion of resistant organisms.

Various measures have been used to control the spread of infections (particularly those due to MRSA), including hand hygiene, ward cleaning, isolation of patients and screening.12 Ring fencing of elective orthopaedic beds have successfully reduced MRSA infection rates.13 All these measures are effective in preventing immediate, hospital-acquired infection. However, many patients are found to have acquired presumed haematogenous infection long after their primary operation; for which such measures may not be effective in reducing the incidence of delayed periprosthetic infections.

Our study has inherent limitations due to its retrospective nature. Some patients with successful early outcomes can present with delayed recurrent infection. Only patients with delayed deep infections were considered and thus the number of cases was limited; a larger sample size could have enabled more statistically valid conclusions based on specific organisms. It was confined only to infections following primary TKA, unlike others that evaluated the hip and knee together.7,8 Patients who underwent salvage procedures irrespective of the follow-up duration were included. However, a minimum follow-up of 24 months was required if the patient had had a revision TKA or debridement. This rule might also have biased our results against successful outcomes.

CONCLUSION

Deep infection with MRSA or MRSE is increasing. The number of satisfactory outcome is significantly lower when a multi-drug resistant organism is isolated. Patients infected by multi-drug resistant organisms undergo more surgical procedures than those whose infections are not multi-drug resistant. Outcome is particularly favourable when the isolate is a MSSA. Strict infection control measures must be in place to combat the increasing liability to infection caused by multi-drug resistant organisms.

REFERENCES


