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Mid-Term results of knee prosthesis infections

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Abstract

The aim of this study was to retrospectively evaluate patients with infected total knee prosthesis and to discuss the results in the light of the relevant literature. Infection in total knee prosthesis, a severe complication that can occur despite all precautions, requires vigilance before, during, and after surgery and highly structured patient management. In our study, we compared and evaluated the clinical, radiological, and laboratory results of debridement, revision, and arthrodesis provided to patients who developed infection after total knee arthroplasty between June 2000 and January 2005 in the Ministry of Health Ankara Diskapi Training and Research Hospital. Although 44 such patients were identified from the records in that 5-year period, some could not be contacted, and some had not completed treatment, which left the 32 knees of 32 patients eligible for analysis. Of them, 24 had undergone revision surgery, four had undergone debridement, and four had undergone arthrodesis. Infection in total knee prosthesis is a severe complication that requires very close follow-up before, during and after surgery. The development of infection despite all precautions requires correct patient management.

Keywords: Infection, total knee prosthesis, debridement, arthrodesis, revision

Introduction

In review articles and extensive series, infection following total knee prosthesis has been reported at rates of 0.5–2.8% [1,2]. The infection rates in revision operations, by contrast, have been reported as 4–32% [3]. Of the several factors known to facilitate the development of infection, the most well-known are rheumatoid arthritis, steroid use, infected skin lesions, obesity, diabetes mellitus, and urinary system infection [4–7].

The pathogen most frequently seen in infected knee arthroplasty is *Staphylococcus aureus*, followed by Gram-positive bacteria and *Enterobacter* micro-organisms [4, 8–11].

The most common complaint in the history and clinical examination of infected knee arthroplasty is pain, at a rate of 96%. If pain continues 6 months after the operation, then the possibility of infection must be considered. Other complaints are swelling and redness, reported at a rate of 77%, and discharge from the wound edges, at a rate of 27% [4].

Sedimentation has been found to exceed 30 mm/hr. in 50% of patients with infected knee prosthesis. That factor and C-reactive protein (CRP) are both elevated in the postoperative period because of surgical trauma. Although sedimentation returns to normal levels after approximately 6 weeks, CRP does so within the first week and is therefore more sensitive and selective in the diagnosis of early infection [12].

Laboratory tests to detect infection include the evaluation of aspiration material. Among the results of those tests, a rate of leukocyte in joint fluid exceeding 25,000/mm³, elevated protein levels, and low glucose levels all indicate infection [4,13]. If aspiration material is suspected in both aerobic and anaerobic media, then seeding in separate media is necessary for tuberculosis and fungi [4].

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When tests suggest infection, another method performed is bone scintigraphy. Although the selectivity of Ga67 and Tc 99 human IG is greater than Tc99, 111-leukocyte is the most selectively marked scintigraphy [14,15].

In infected knee prosthesis, debridement and antibiotics can be applied while protecting the prosthesis in early infections, whereas single- or two-stage revision is necessary in late infections [16–18].

In this study, we aimed to discuss the mid-term results of patients with infected total knee prosthesis.

Materials and Methods

In our study, we evaluated the results of patients who received debridement, revision, or arthrodesis for the treatment of infected knee prosthesis in the Ministry of Health Ankara Diskapi Training and Research Hospital between June 2000 and January 2005. In the first stage of the study, although 44 such patients were identified from the records in that 5-year period, some could not be contacted, and some had not completed treatment, which left the 32 knees of 32 patients eligible for analysis. Patients who had purulent discharge at the incision site and/or persistent pain 6 months after the operation, radiologically loosening, culture positivity or a high level of sedimentation or CRP were included the study.

Of the three types of surgical interventions applied to the patients, debridement and insert replacement were performed in four patients with acute infection within 6 weeks postoperatively. By comparison, two-stage revision surgery was performed in 28 patients who were admitted during the late period (after 6 weeks), and arthrodesis was performed in four patients whose infection persisted after two-stage revision.

While the patients were hospitalized in the clinic for infection, all implants from the first operation were removed, followed by extensive debridement, irrigation, and the placement of an antibiotic-cemented spacer in the joint. In the following 6 weeks, under the supervision of an infectious disease's specialist, specific antibiotic therapy was initiated for patients who had positive cultures, whereas empiric therapy was implemented for ones with negative cultures. Once sedimentation and CRP values returned to normal, revision surgery was performed. (Figure 1-6).

For radiological evaluation, anteroposterior and lateral knee radiographs were taken of all patients. Routine laboratory tests were conducted in all patients as well, and CRP and sedimentation were examined with particular scrutiny. In the evaluation of patients who underwent revision surgery, the Knee Society Scoring (KSS) system was used.

The research was approved by the Antalya Education and Research Hospital Ethics Board (No.2021-065;2/7) and conducted in accordance with the ethical principles in the Declaration of Helsinki. Informed written consent was obtained from all patients.

Statistical analysis

The descriptive findings were presented with mean $\pm$ standard deviation (SD) or median (min-max) for the continuous data and with frequency and percentage for the categorical data. The

normality assumptions were controlled by the Shapiro-Wilk test. Mann-Whitney U test was used for analysis of non-normally distributed numerical data. McNemar-Bowker test was used to compare paired categorical data. Wilcoxon Signed Ranks test was used for nonparametric comparison of repeated measurements. Statistical analysis was made using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY). Two-sided p values <0.05 were considered statistically significant.



Figure 1. 61 years old female patient shows loosening of prosthesis due to infection

Results

The patients, 24 females and eight males, were 65.6 years old on average (range: 52–77 years). The mean follow-up period was 25 months (12–55 months). The right knee was affected in 14 patients and the left knee in 18.

The first operation was performed in another clinical center in 10 cases (31%) and in our hospital in the remaining 22 (69%).

Preoperative joint aspiration was performed in 20 patients. Bacterial cultures showed growth in 15 patients: eight with *S. aureus*, three with *Streptococcus*, three with *Enterobacter*, and one with *Pseudomonas*.

The mean time from the placement of the spacer to revision was 5.2 months (range: 4–7 months). Among patients who received revision, the sedimentation rate was 52 mm/hr., CRP level was 30 mg/L and leukocyte count was 8,754, all preoperatively. At 6 weeks postoperatively, those values were 20 mm/h, 5.99 mg/L and 7,586, respectively (Figure 7 and 8). The differences between preoperative and postoperative sedimentation and CRP values were statistically significant ($p < .001$).



Figure 2. 61 years old female patient shows loosening of prosthesis due to infection

In the revision group the mean KSS score was 47.5 points preoperatively and 87 points postoperatively (Figure 9), for a difference that was also statistically significant ($p < .001$).

In evaluations of range of motion, mean flexion was 37.5° preoperatively and 67.5° postoperatively, for yet another statistically significant difference ($p < .001$).

In four patients who showed improvement following debridement, superficial infection developed early after the operation. The preoperative and postoperative sedimentation, CRP, and KSS values were evaluated in those patients, but no significant difference could be obtained due to the low number of patients.

In four patients who received revision surgery first, because the infection could not be brought under control, a rescue intervention of arthrodesis was performed.



Figure 3. Images of the same patient in which cement spacer was applied after the prosthesis was removed and debridement was performed

Discussion

The application of modern designs in total knee arthroplasty (TKA) has enabled millions of people to lead lives without knee pain. As the number of patients applied with TKA increases, so does the survival time of their prostheses, which in turn increases the need for revision surgery. However, compared with primary surgery, revision surgery poses significant difficulties for patients as well as surgeons and incurs an economic burden for the country. In the United States, for example, primary TKA incurs costs of US \$15,000, whereas revision surgery incurs costs of \$30,000–\$50,000. Beyond that, the cost to the U.S. economy for infected knee and hip prostheses overall has been reported as \$150–200 million [19,20].

Despite all efforts made to achieve sterilization, infection ranks among the most important problems yet to be overcome following TKA, with reported rates of 0.5–12% [21,22]. The frequency of infection among the patients in our sample was 2.5%.

Several factors have been identified that facilitate the development of infection, including rheumatoid arthritis, diabetes mellitus, ulcerated skin lesions, obesity, recurrent urinary system tract infections, and oral steroid use [23]. In our study, three patients

had rheumatoid arthritis, seven had diabetes mellitus, and one had recurrent urinary system infection.



Figure 4. Images of the same patient in which cement spacer was applied after the prosthesis was removed and debridement was performed

To be able to correctly plan treatment for an infected knee prosthesis, the diagnosis must be correct. The most important laboratory tests used in diagnosing infection are sedimentation rate and CRP. In the literature, CRP has been shown to be the most sensitive, most selective test, for its value returns to normal postoperatively before other values [12]. Our results indicate that CRP was indeed the most reliable blood test, one that can be used in the diagnosis and follow-up of infection.

Another important test for guidance in diagnosing infection is scintigraphy. Among patients who underwent surgery in our sample, scintigraphy was applied to 52%, and among cases applied with Tc99 scintigraphy, sensitivity was 100% and specificity 60%. However, because those values were reached in a small group of patients, making generalizations or comparisons with published results is impossible.

In the literature, the most reliable preoperative diagnostic method is reported to be determining the production of joint aspiration

material. The presence of joint aspiration was examined in 60% of our sample's patients but identified in only 45% of them, and the production rate of both preoperative and perioperative cultures was 65%. The literature, however, does not contain any information regarding the positivity rates of cultures.



Figure 5. Post revision images same patient

Our results also reveal insufficient sensitivity in determining micro-organisms from preoperative joint aspiration, likely because many samples for culture must be taken perioperatively from different locations. Among micro-organisms produced in cultures that have been reported thus far, 8–63% have been *Staphylococcus*, 4–22% have been *Streptococcus*, 3–9% have been *Enterobacter*, and 1–10% have been *Pseudomonas* [3,24]. In our study, the micro-organisms determined in the patients' cultures were *Staphylococcus* (65.6%), *Streptococcus* (16.3%), *Enterobacter* (15%), and *Pseudomonas* (3.1%).

After a diagnosis of infection, whether the single- or two-stage technique should be used remains a matter of debate. The single-stage technique affords the advantage of a shorter stay in the hospital, which spares the patient a second operation and reduces morbidity. However, it is also reportedly less successful than the two-stage technique in terms of eradicating infection. If the agents are gram-positive pathogens, if cement with antibiotics is used, and if antibiotics are used for a long period, then single-stage revision may be preferred [18,25].

Windsor et al. reported the 4-year results of the 38 knees of 35 patients who underwent two-stage revision as excellent in 11

cases, good in 13, fair in six, and poor in seven [26]. One patient was excluded from the evaluation due to polyarticular RA. Luther et al. monitored 21 patients who received bilateral knee prosthesis and later developed bilateral infection. Of those cases, three died, resection arthroplasty was performed as the final operation in 10 cases, below-the-knee amputation was performed in one (i.e., because the infection could not be brought under control), and revision surgery was applied in seven [27]. In our series, two-stage revision was performed in 24 cases and arthrodesis in four, and four patients recovered because of early, aggressive debridement together with antibiotic therapy.



Figure 6. Post revision images same patient

Conclusion

Infected knee prosthesis surgery, as a surgery predisposed to surprises, requires patience and prolonged effort. To reduce the risk of irreparable outcomes, such operations should thus be performed by an experienced surgeon and in a specialized center under appropriate technical conditions.

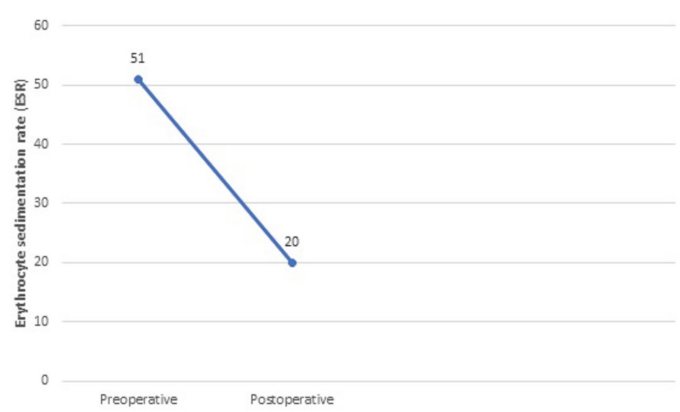


Figure 7. ESR changes in postoperative period

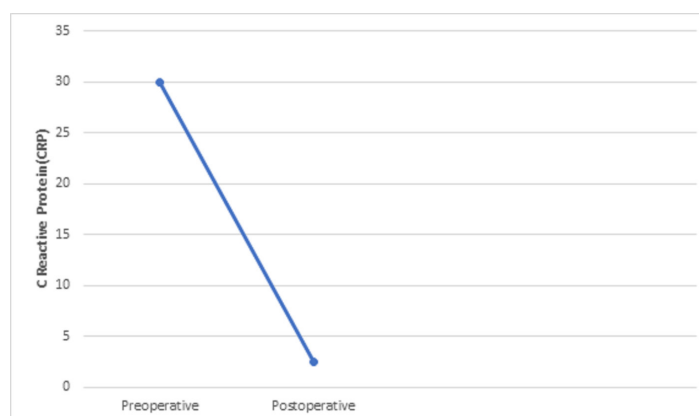


Figure 8. CRP changes from Pre to postoperative period

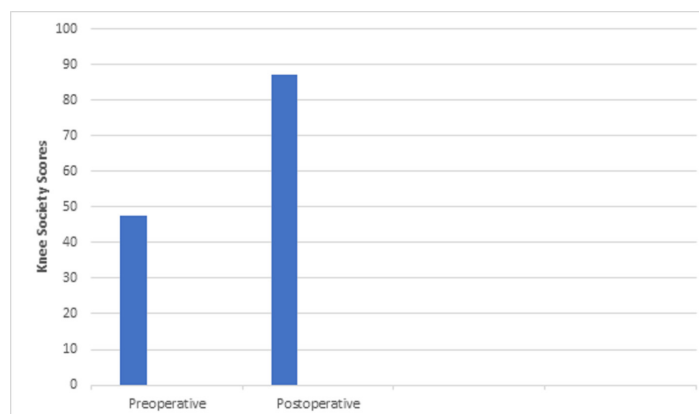


Figure 9. Pre and Postoperative mean Knee Scores

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

The research was approved by the Antalya Education and Research Hospital Ethics Board (No.2021-065;2/7) and conducted in accordance with the ethical principles in the Declaration of Helsinki.

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