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Research Paper

The Effectiveness of Debridement, Antibiotics and Irrigation for Periprosthetic Joint Infections after Primary Hip and Knee Arthroplasty. A 15 Years Retrospective Study in Two Community Hospitals in the Netherlands

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Abstract

The aim of our study was to evaluate the effectiveness of debridement, antibiotics, irrigation and retention (DAIR) in patients who developed a periprosthetic joint infection (PJI) after primary hip or knee arthroplasty in two community hospitals in the Netherlands. We retrospectively collected data in two hospitals in the Netherlands on all episodes of PJI after primary hip (THA) and knee arthroplasty (TKA) from 1998-2012. In 109 of 8234 THA (1.32%) and 65 of 5752 TKA (1.13%) a PJI developed. DAIR was used as treatment in 84 patients after THA (77.1%) and 56 patients after TKA (86.2%). 34 Patients only received antibiotics or were immediately revised. After 1 year follow-up, prosthesis retention was achieved in 81 THA patients (74.3%) and 48 TKA patients (73.8%). Acute infections showed a better survival compared to late infections (84.0% vs 46.6% respectively; $p<0.01$). Furthermore, a young age was associated with an increased revision risk ($p<0.01$). In conclusion, debridement, antibiotics and irrigation in acute PJI may lead to retention of the prosthesis in a majority of cases. Large patient cohort studies can provide data on PJI outcome, complementing National Registries which have limited detail.

Key words: Hip and knee arthroplasty, periprosthetic joint infection, debridement and irrigation, prosthesis survival.

Introduction

Periprosthetic joint infections (PJI) have major consequences for patients with a hip or knee prosthesis. PJI may lead to re-operation including revision surgery, worsening the quality of life for these patients. An important goal in joint arthroplasty surgery is to prevent PJI and thereby prevent potential revision surgery. To reach this goal, evidence-based protocols on prevention and treatment are necessary, but due to low PJI incidence large patient cohort studies are needed to evaluate these prevention and treatment strategies. Incidence rates in large cohort studies range from 0.5% and 1.4%.[1-3] The most common micro-organisms causing PJI are coagulase-negative staphylococci and *Staphylococcus aureus*.[2,4,5] The rate of prosthesis survival, i.e. a successful treatment, is 76.8% to 83.0% depending on the definition and follow-up.[3,6] There are a limited number of large cohort studies on PJI,

and authors use different methods of diagnosis, treatment and outcome definitions. In 2013, delegates from 52 countries participated in an international consensus meeting regarding current practice for PJI management.[7] After discussing 207 questions, many PJI topics were still in need of further research, including the development of a gold standard on how to treat PJI in patients with a hip or knee prosthesis. Data on the PJI incidence, treatment and survival of primary hip and knee prosthesis from large cohorts might be used to answer these questions. The aim of our study was to evaluate the effectiveness of debridement, antibiotics, irrigation and retention (DAIR) in patients who developed PJI after primary hip or knee arthroplasty in two community hospitals in the Netherlands.

Patients and methods

We retrospectively reviewed the records of patients who developed PJI after primary elective total hip or knee surgery between 1998 and 2012 in two community hospitals in the Netherlands. Only patients with a hip or knee replacement due to osteoarthritis were included. Periprosthetic joint infections were classified as: acute (<3 months after primary surgery) or late (>3 months after surgery). The infections were defined as two positive periprosthetic cultures with phenotypically identical organisms, or a sinus tract communicating with the joint, or having three of the following minor criteria: elevated serum C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), elevated synovial fluid white blood cell (WBC) count or ++change on leukocyte esterase test strip, elevated synovial fluid polymorphonuclear neutrophil percentage (PMN%), positive histological analysis of periprosthetic tissue, a single positive culture.[7] Micro-organisms were identified according to standard local protocols. Data on total hip arthroplasty (THA) and total knee arthroplasty (TKA) were retrieved from the hospital electronic databases and included patient demographics (length, weight, gender, age and comorbidity), primary surgery, micro-organisms, treatment (debridement, antibiotics and irrigation), any revision surgery or patient death. All data were introduced in a specifically designed database. All cases were critically reviewed by 2 authors (LdV and WvdW). Any controversy or contradiction found was double-checked by the investigator at each hospital.

Both arthroscopic and open debridement and irrigation were performed in both hospitals in acute presentation of infection (<3 weeks of symptoms). Antibiotic therapy was prescribed according to current guidelines.[8] A successful treatment was defined as eradication of PJI with prosthesis retention and no occurrence of PJI-related mortality (by causes such as sepsis or necrotizing fascitis) at 12 months follow-up.

Statistical analysis

Descriptive statistics were used to explore data. Students t test was used for comparisons of continuous data. The chi-square test was used for comparison of categorical data with crosstabs used as required. The associations between each variable and prosthesis retention within 1 year after infection were examined with univariate logistic regression analyses. Predictors associated with the outcome in univariate analyses (p-values <0.10) were included in multivariate logistic regression analyses. P-value of <0.05 was considered significant. Data were analyzed using SPSS statistics (version 21.0, IBM Corporation, Somers USA).

Results

In 109 of 8234 hip replacements (1.32%) and 65 of 5752 knee replacements (1.13%) a PJI developed. Patients' characteristics are presented in table 1. Mean age at time of infection was 70.9 years (THA) and 71.5 years (TKA). Median time from primary surgery to infection was 20 days after THA (0 – 13 years) and 24 days after TKA (0 – 8 years). In THA, 87 infections occurred within 3 months after surgery (79.8%) and in TKA, 44 infections arose within 3 months after surgery (67.7%).

Table 1. Demographic data of 174 patients with a deep prosthetic joint infection after THA or TKA.

	THA	TKA
Number of deep infections	109	65
Age at time of infection (mean (SD))	70.4 (8.5)	70.8 (9.7)
Gender (M / F)	41 / 68	34 / 31
ASA (median (range))	2 (1 – 4)	2 (1 – 3)
Infected side (R / L)	58 / 51	30 / 35
BMI (mean (SD))	29.6 (5.3)	29.1 (5.0)
Days from primary surgery to infection (median (range))	20 (0 – 4894)	24 (0 – 2977)
Days from symptoms to DAIR (median (range))	4 (0 – 677)	1 (0 – 304)

None of the variables were significantly different.

Of 174 infections, 80 (46%) were caused by a mixture of micro-organisms and another 80 (46%) were caused by a single micro-organism. In 12 patients (6.9%) no growth of micro-organisms was found despite clinical and intra-operative findings of an infection. Data of cultures from 2 patients were incomplete. The most common micro-organisms associated with PJI after total hip replacement and total knee replacement were coagulase-negative

staphylococci (49.5% and 35.4% respectively) and *Staphylococcus aureus* (37.6% and 43.1% respectively), figure 1.

After 1 year follow-up, prosthesis retention was achieved in 81 THA patients (74.3%) and 48 TKA patients (73.8%), figure 2. Acute infections showed a significant better prosthesis retention compared to late infections (84.0% vs 46.6% respectively; p<0.01). Multivariate logistic regression analyses showed that a younger age (odds ratio (OR) 0.947; 95% confidence intervals (CI) 0.907 to 0.989; p = 0.013) and a longer time from primary surgery to infection (OR 1.001; 95% CI 1.000 to 1.002; p = 0.007) were significantly associated with an increased risk of revision within 1 year after infection, table 2. In total, 7 patients were lost to follow-up during the first year after infection.

Debridement, antibiotics and irrigation treatment was used in 84 patients after THA (77.1%) and in 56 patients after TKA (86.2%). 34 Patients only received antibiotics or were immediately revised, mainly because these were late infections. Of 56 patients after TKA who were treated with debridement and irrigation there were 37 cases of open debridement (66.1%), 13 arthroscopically (23.2%) and 6 cases both open and arthroscopically (10.%). The median frequency of debridement and irrigation was 2 times (range 1 - 5).

Table 2. Results from univariate and multivariate logistic regression analysis prediction revision surgery within 1 year after infection.

Univariate analyses				Multivariate analyses	
	Reference category	p-value	OR (95% CI)	p-value	OR (95% CI)
THA or TKA	THA	0.946	1.025 (0.509 – 2.064)		
Gender	male	0.052	0.506 (0.255 – 1.006)	0.116	0.550 (0.261 – 1.160)
Age		0.006	0.946 (0.910 – 0.984)	0.013	0.947 (0.907 – 0.989)
BMI		0.486	0.975 (0.907 – 1.047)	-	-
Fixation technique*	cemented	0.468	1.328 (0.617 – 2.859)	-	-
Time from primary surgery to infection		0.003	1.001 (1.000 – 1.002)	0.007	1.001 (1.000 – 1.002)
DAIR category	no DAIR	-	-	-	-
- vs open		0.013	0.353 (0.156 – 0.799)	0.839	1.183 (0.234 – 5.978)
- vs arthroscopic		0.865	0.893 (0.241 – 3.308)	0.622	1.680 (0.214 – 13.178)
- vs mixed		0.719	0.714 (0.115 – 4.451)	0.511	2.267 (0.198 – 26.019)
DAIR frequency		0.808	1.042 (0.751 – 1.445)	-	
Time from infection to first DAIR		0.021	1.001 (1.000 – 1.002)	0.219	1.001 (0.999 – 1.003)

OR: odds ratio; CI: confidence interval; DAIR: debridement, antibiotics, irrigation and retention
*cemented or uncemented fixation

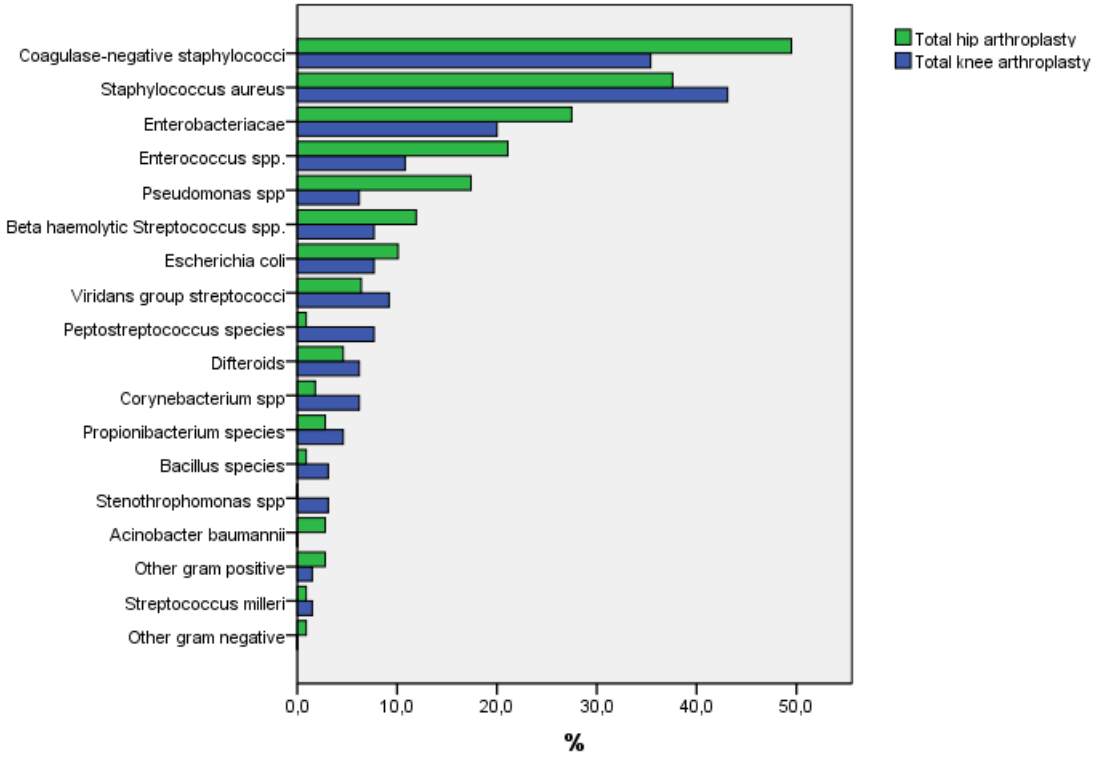

Figure 1. Percentage micro organisms associated with PJI in THA and TKA.

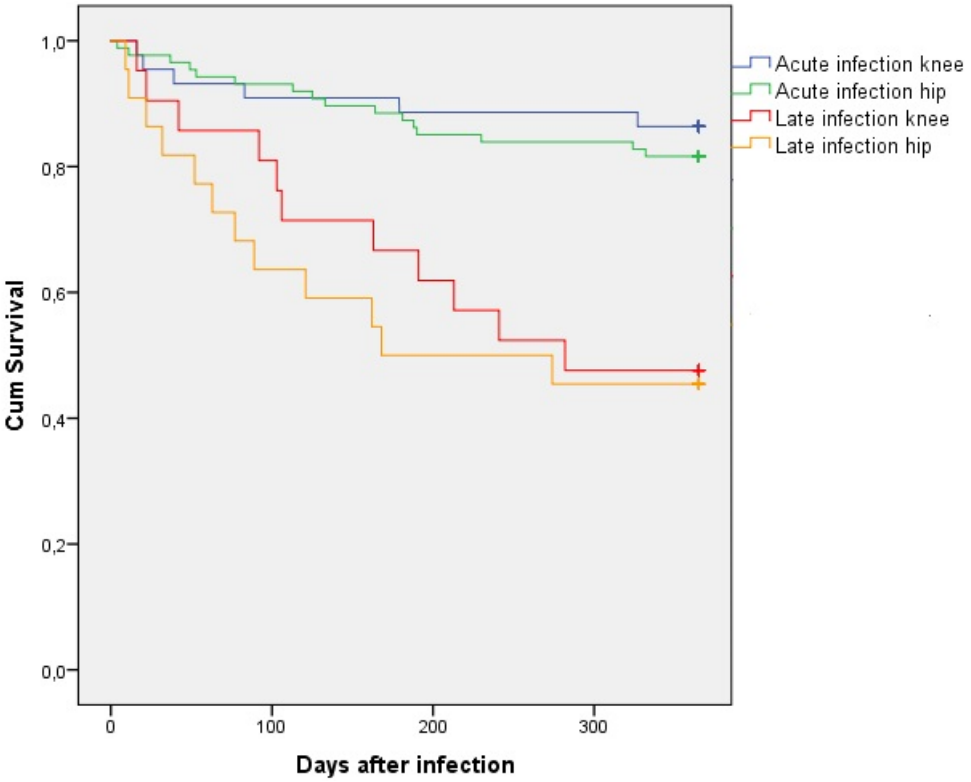

Figure 2. Prosthesis survival until 1 year after PJI.

Discussion

Data of large cohort studies are necessary to get an understanding of diseases with low incidence, like PJI, and enable us to develop optimal treatment protocols. Even though incidence rates of PJI are low, consequences for patients are major. Our incidence rates of PJI for patients with a hip or knee prosthesis were in line with literature and national surveillance data, which showed an incidence of 1 - 2%.[1,3,9,10] Most PJI are acute infections noticed within 3 months after surgery.[2] We found coagulase-negative staphylococci to be the most common infecting organism, followed by *Staphylococcus aureus*, which was according to literature.[2-4,11] The surgical strategy for prosthesis retention after PJI is debridement and irrigation, followed by systemic and/or local antibiotics. The overall success rate of debridement and irrigation in literature is 23 – 89%.[3,12-17] Our results showed prosthesis retention in 74.3% (THA) and 73.8% (TKA). Debridement, antibiotics and irrigation is favoured when the prosthesis is stable, the pathogen is not difficult to treat, symptoms are <3 weeks present and skin and soft tissues are intact.[7,11,18-22] Literature suggests that prolonged infection is associated with increased biofilm formation and potential deep osteomyelitis. If one can intervene before the biofilm becomes firmly attached to the implant, this treatment modality may be successful.[23-25] Our results showed an increased risk of revision surgery in late infections compared to acute infections ($p<0.01$). These results were confirmed by the regression analysis which showed an increased risk of revision surgery for younger patients with a prolonged time between primary surgery and infection. There was no increased risk of revision surgery within 1 year after infection when time from infection to first debridement procedure was prolonged. Also, the type of surgery (THA or TKA), gender, BMI, fixation technique, debridement category and debridement frequency did not influence the risk of revision surgery within 1 year after infection.

Since there is only a recent consensus document about techniques, criteria and frequency of debridement and irrigation, surgeons used different treatment methods. There is still some debate which technique or frequency provides optimal results. In this study, both arthroscopic and open debridement were performed. The results of the multivariate logistic regression showed no significant difference between arthroscopic or open debridement or frequency on the risk of revision. Though some studies suggest multiple debridement surgeries to improve prosthesis retention, Moojen et al[12] concluded that a single debridement with only additional surgery on indication appears to be as successful as multiple surgical debridements in patients with acute THA infection. There is also

debate if arthroscopic debridement is as effective as open debridement after PJI in TKA. Some studies demonstrated that the outcome of debridement and irrigation is worse with arthroscopic debridement.[16,26,27] However, our results showed no increased risk of revision between arthroscopic, open or both of these categories. Overall, debridement and irrigation is a less complex surgery with lower costs compared to revision surgery.

For this study we used a retrospective study design with data from two different hospitals in the Netherlands. Both hospitals used a local protocol for the treatment of PJI. There were no differences in demographic data, infection data and the amount of prosthesis retention between patients from both hospitals. However, there are also no well-established and broadly implemented guidelines for diagnosing PJI, which can interfere with the data collection. Since there is still limited consensus on the definition and treatment of PJI, national registries contain limited data and underrepresent the 'true incidence'.[28] Though revision surgery as a result of infection is registered in national registries, no procedures are described other than exchanging the implant. Therefore, it is important to follow-up large patient groups and monitor the patients well-being. This could result in establishing standard decisions and position each treatment for each patient condition.

In conclusion, debridement, antibiotics and irrigation in acute PJI may lead to retention of the prosthesis in a majority of cases. Large patient cohort studies can provide data on PJI outcome, complementing National Registries which have limited detail.

Competing Interests

The authors have declared that no competing interest exists.

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