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Research Paper

Erysipelas or cellulitis with a prosthetic joint *in situ*

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Abstract

We describe a case of a 60-year old male who developed an acute prosthetic joint infection (PJI) of the knee, secondary to erysipelas of the lower leg due to beta-hemolytic Group G streptococci. As it is unknown how often this phenomenon occurs in patients with prosthetic implants and which patients are most prone to develop this complication, we analyzed: i) the incidence of the development of a PJI in these patients and ii) the clinical characteristics of streptococcal PJI during an episode of erysipelas/cellulitis. Based on a retrospective analysis of patients with a prosthetic implant *in situ* presenting at the emergency department with erysipelas/cellulitis, 1 out of 10 patients developed a PJI. An additional analysis within a multicenter cohort on streptococcal PJI demonstrated in 22 patients that a secondary PJI due to erysipelas/cellulitis mostly develops in young implants (<5 years old). In 20 cases (91%), the skin infection was in the same limb as the joint prosthesis suggesting contiguous spread of bacteria. These data emphasizes the importance of preventive measures to reduce the occurrence of skin infections in patients with prosthetic implants, and if an erysipelas or cellulitis does occur, to monitor patients carefully.

Key words: cellulitis, erysipelas, prosthetic joint infection, contiguous focus, streptococci

Case Description

A 60-year old male presented at the emergency department with erysipelas of the right lower leg. His medical history was unremarkable, with the exception that he underwent an uncomplicated primary knee arthroplasty on the left side one year before and on the right side six months prior to presentation. The day before hospital admission, the patient had been

working on his boat and subsequently developed a painful right lower leg, which he interpreted as a simple muscle ache. However, the next morning, the lower leg started to turn red and he developed a fever of 40°C. He therefore presented to his local hospital where a clinical diagnosis of erysipelas and joint effusion of the right knee was established. According

to the patient, the onset of pain and swelling of the knee had developed rapidly over the last couple of hours. The other knee was asymptomatic. Because an acute prosthetic joint infection (PJI) was suspected, he was taken to theatre for surgical debridement, exchange of the mobile components of the prosthetic joint and pulsed lavage. During surgery, a large amount of pus was evacuated, and gentamicin impregnated beads were inserted into the joint cavity. Intravenous cefuroxime was started after tissue samples were obtained. The next day, synovial fluid and multiple intraoperative tissue samples came back culture-positive for group G beta-hemolytic streptococci. Blood cultures that were taken prior to the start of antibiotic treatment were negative. After two weeks of intravenous antibiotic treatment, the patient was switched to oral clindamycin for an additional ten weeks of therapy. He made a good recovery and remained symptom free during five-years of follow-up.

Introduction

It has been described that arthroplasty is a risk factor for developing erysipelas/cellulitis. Manian et al. demonstrated that in the absence of other local predisposing factors, the odds to develop an acute bacterial skin infection of the ipsilateral extremity after primary knee arthroplasty is seven times higher compared to the contralateral control limb [1]. This higher risk for infection remains for several years after the arthroplasty, and is most likely attributed to damage to the lymphatic and venous vessels, either during surgery or due to postoperative edema or hematoma [2-4]. Considering this pathogenesis, it is reasonable to assume that the highest risk for a skin and/or soft tissue infection is probably in the first months after surgery. Indeed, erysipelas/cellulitis is a common cause of hospital readmission within 90 days after knee arthroplasty, and occurs beyond the surgical site [5]. Our case demonstrates a complicated course of erysipelas in a patient with a knee prosthesis in the same leg, who developed an acute PJI due to a Group G beta-hemolytic streptococcus. It is unknown how often this phenomenon occurs in patients with prosthetic implants and which patients are most prone to develop this complication. Osteoarticular complications of erysipelas in native joints are rare, but have been described [6-9]. As in our case, and as depicted in Figure 1, these secondary osteoarticular infections tend to be localized to the joint contiguous with the skin infection. That the erysipelas was a manifestation of the PJI, instead of causing the PJI, is highly unlikely in our case, since the erysipelas was localized in the lower leg. Considering the fact that the incidence of bacteremia in patients with erysipelas

and cellulitis is very low (5 and 8%, respectively), contiguous rather than hematogenous spread is the most likely route of infection [10-11]. In the absence of bacteremia or a penetrating wound, native joints are protected from bacterial invasion by structures like synovial membrane and periosteum. However, synovial membranes are partly resected during primary and revision arthroplasty, which results in a disrupted anatomical barrier. In addition, bacteria are able to evade the immune system by attaching to foreign material and by the formation of biofilm. For this reason, it is reasonable to assume that patients with a prosthetic joint are more prone to develop a secondary infection during an episode of erysipelas or cellulitis, particularly during the first months after surgery.



Figure 1. Patient with a cellulitis of the right lower leg covering the prosthetic joint that was implanted the year prior to presentation. The scar of the primary arthroplasty is still visible. *Streptococcus dysgalactiae* was cultured in multiple deep tissue biopsies during surgical debridement.

PJI Secondary to Erysipelas or Cellulitis

Based on the case presented, we aimed to: i) establish the incidence of the development of a PJI in patients presenting with erysipelas or cellulitis and ii) describe the clinical characteristics of patients who develop a PJI after an erysipelas or cellulitis due to streptococci.

Erysipelas or cellulitis with a prosthetic joint in situ presenting at the emergency room (University Medical Center Groningen, NL)

To answer the first question, we retrospectively evaluated all consecutive patients who presented at the emergency department of the University Medical Center Groningen (NL) between 2009 and 2016 who were diagnosed with erysipelas or cellulitis. Out of the 446 cases, ten patients had a prosthetic joint *in situ*. One of these ten patients developed a PJI. It should be noted that in general, only severe cases of erysipelas and cellulitis are transferred to the emergency department (whilst mild cases are treated by the general practitioner). It is interesting to note that out of the ten cases, only three skin infections were located adjacent to the prosthetic joint, including the one who developed the PJI. Compared to the six month old infected prosthesis, the age of the two implants that remained free of infection were five and eleven years old, respectively. The remaining seven cases had a hip prosthesis, or the prosthesis was located at the contralateral side to the skin infection. None of these cases developed a secondary PJI. This observation supports the concept that patients are at highest risk when the skin infection is located close to the prosthetic joint.

Erysipelas or cellulitis with proven streptococcal PJI (multi-center analysis)

To describe the clinical characteristics of patients who developed a PJI secondary to an erysipelas or cellulitis, we analyzed a cohort of patients taken from a large multi-center retrospective study which described the clinical outcome of patients with a streptococcal PJI treated with debridement, antibiotics and implant retention (DAIR) [12]. We selected all cases that were marked as having a PJI secondary to a contiguous focus. From a total of 36 cases, 17 were marked as erysipelas or cellulitis. Participating centers provided an additional five cases that were treated with revision surgery, resulting in a total inclusion of 22 cases. Clinical characteristics of the cohort are described in Table 1. All of these patients developed acute symptoms of a PJI within one week of onset of the skin infection. Surprisingly, none of the PJIs were caused by *S. pyogenes* despite this being one of the most commonly described cause of erysipelas and cellulitis [8]. We cannot fully explain this finding. A higher affinity of Group B, C and G streptococci to prosthetic implants could be an explanation, which is supported by the low incidence (8%) of PJI caused by *S. pyogenes* in the studied cohort (12). These data also support the concept of contiguous spread of infection, as most of the PJIs developed in knee prostheses adjacent to the infected skin. We would like to

emphasize that the studied cohort were only skin and soft tissue infections caused by streptococci, and thus, our findings cannot be extrapolated to other microorganisms, like *Staphylococcus aureus*. Compared to previous studies describing the incidence of bacteremia in skin infections [10-11], the presence of bacteremia in our cohort was high (44% of the patients in whom blood cultures were obtained [n=9]). Although, we cannot exclude the possibility that the PJI developed hematogenously in these cases, it is most likely that the bacteremia was secondary to the PJI. Indeed, in all of the blood culture positive cases, the PJI was evident during the initial presentation in the hospital. All of the infected implants in our cohort were relatively young: 95% were within five years after arthroplasty. It has been postulated in the past that prosthetic joints are at highest risk for hematogenous infection within the first two years after implantation, because it takes time before anatomical barriers are completely restored and therefore, the migration of bacteria to the implant might be facilitated during this period. For this reason, recommendations concerning antibiotic prophylaxis for invasive dental procedures in patients who are within the first two years after joint placement have been made in the past [14-17]. However, because these recommendations were mostly advisory and based on expert opinion, newer guidelines abandoned this advice [18-19]. The relatively young prosthesis' age in our cohort supports the contiguous spread hypothesis particularly in young implants. Further studies are needed to ultimately conclude on this topic. In accordance with our previous data on streptococcal PJI [12], the prognosis in our cohort of patients was disappointing, with a reported failure rate of 36.4%.

Conclusion

Patients with a prosthetic joint in-situ who develop erysipelas or cellulitis are at risk of developing a secondary PJI, particularly when the implant is young and located close to the infected skin and soft tissues. Unfortunately, no data is available how the development of a PJI in patients with a skin infection can be prevented. There is no evidence that extending the duration of antibiotic therapy and/or increasing the dose of antibiotics provides protection for the implant. Our study indicate that providing optimal foot care and intensive treatment of chronic leg ulcers is of utmost importance in patients with a prosthetic implant *in situ* in order to reduce the occurrence of erysipelas or cellulitis. Moreover, when patients with a prosthetic joint do develop erysipelas or cellulitis, patients should be monitored carefully.

When a PJI is suspected, extensive surgical debridement must be urgently performed [20].

Table 1. Clinical characteristics of patients who developed a streptococcal prosthetic joint infection (PJI) secondary to erysipelas or cellulitis. Data are presented as percentages or median (IQR).

Characteristics	n = 22
Joint	
Knee	86.4%
Hip	9.1%
Elbow	4.5%
Type of implant	
Primary	63.6%
Revised	36.4%
Age of the implant in years	1.5 (0.8 – 3.0)
0 – 2 years	57.1%
3 – 5 years	33.3%
> 5 years	4.6%
Days between skin infection and onset PJI	3 (1 – 7)
Same day	23.8%
1 – 5 days	42.9%
6 – 10 days	14.2%
> 10 days	19.1%
Skin infection adjacent to the prosthetic joint	91.0%
Bloodcultures	
Positive	18.2%
Negative	22.8%
Not performed	59.0%
Isolated <i>Streptococcus</i> spp	
Group B streptococci	
<i>S. agalactiae</i>	22.7%
Not specified	4.5%
Group C streptococci	
<i>S. dysgalactiae</i>	27.3%
Not specified	4.5%
Group G streptococci	
Not specified	27.3%
Beta hemolytic streptococci not specified	13.6%
Surgical approach	
Debridement	71.4%
1-stage revision	4.8%
2-stage revision	23.8%
Failure	36.4%

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Competing Interests

The authors have declared that no competing interest exists.

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