CASE REPORT

Haematogenous infection of a total knee arthroplasty with *Klebsiella pneumoniae*

Wojciech Pepke,[1] Burkhard Lehner,[1] Isabelle Bekeredjian-Ding,[2] Marcus Egermann[1]

[1]Department of Orthopaedics and Trauma Surgery, University Hospital Heidelberg, Heidelberg, Germany
[2]Department of Infectious Diseases, Medical Microbiology and Hygiene, University Hospital Heidelberg, Heidelberg, Germany

Correspondence to
Dr Wojciech Pepke, Wojciech.Pepke@med.uni-heidelberg.de

To cite: Pepke W, Lehner B, Bekeredjian-Ding I, *et al*. *BMJ Case Rep* Published online: [*please include* Day Month Year] doi:10.1136/bcr-2013-008588

SUMMARY

This case report describes a prosthetic joint infection due to the haematogenous spread of *Klebsiella pneumoniae* from a genitourinary focus. Prior to the infection, the patient was diagnosed with early stage prostatic carcinoma, which had been successfully treated with surgery. However, in the time period following surgical treatment, the patient suffered recurring urinary tract infections. During the course of these recurring infections, he developed a concurrent bacterial infection of his total knee arthroplasty. Two sequential joint aspirates revealed *K pneumoniae* to be the cause. Therefore, two-stage revision total knee arthroplasty was performed. This case reiterates the fact that invasive therapeutic procedures can cause bacteraemia resulting in infection of a joint replacement. We would therefore like to emphasise the importance of prophylactic antibiotic treatment prior to invasive therapies, particularly in organs with potentially large counts of bacteria.

BACKGROUND

Postoperative infection of the knee joint after total arthroplasty is one of the most devastating complications and affects less than 1% of the patients undergoing primary knee replacement surgery.[1 2] Clinical case control and cohort studies have identified a number of risk factors for deep postoperative infection after knee arthroplasty.[1 3] Major adverse consequences of postarthroplasty infection are the loss of function or the need for prosthesis removal and a death rate of 2.7—18%.[4 5] Prophylactic antibiotics seem to be effective in hindering the haematogenous spread of microbial pathogens. Implant associated septic arthritis is most commonly caused by *Staphylococcus aureus*, followed by *Staphylococcus epidermidis*, Group B streptococci, enterococci and Gram-positive bacilli.[6 7] In contrast, enterobactericeae such as *Klebsiella spp* are rarely seen to be the causative agents of septic arthritis, and the majority of joint infections with the diagnosis of *Klebsiella spp* are observed in paediatric patients.[8]

Generally, *K pneumoniae* species is considered to be normal gut flora. However, when found in other regions of the body, it can cause a wide range of infections, most notably pneumonia, urinary tract infections, septicaemia, ankylosing spondylitis and soft tissue infections,[9] with pneumonia representing the most common non-nosocomial infection. In marked contrast, prosthetic joint infections due to *K pneumoniae* are extremely rare, and up to now very few publications report on prosthetic infection with this bacterial species.

Prostate cancer develops in men generally over the age of 50. Although it is one of the most prevalent types of cancer in men, due to its slow growth it is often asymptomatic for a long time and can therefore remain undiagnosed and untreated until metastatic disease arises. Occasionally, however, prostate cancer does cause symptoms, which are often similar to those seen with benign prostatic hyperplasia. These include oliguria, polyuria and haematuria, which all result from urethral dysfunction, since the prostate gland surrounds the urethra and the carcinoma can compress the urethra and damage the urethral wall, thus impeding urinary flow. This enables urinary tract infections to arise and provides bacteria access into the lymphatic and blood vessels. In addition, therapeutic interventions such as prostate biopsy and transurethral prostatic resection increase the risk for bacteriuria and subsequent bacteraemia.[10 11]

In this case report, we describe a patient who suffered a *K pneumoniae* infection of his total knee arthroplasty resulting from the haematogenous spread of a urinary tract infection. To the best of our knowledge, this is the first reported case of prosthetic infection with *K pneumoniae* due to urinary tract infection in a patient with prostatic carcinoma.

CASE PRESENTATION

A 79-year-old man presented with pain in the right knee accompanied by local hyperthermia and swelling having lasted for several weeks in the absence of fever. The medical history revealed that total knee arthroplasty had been performed 8 years earlier due to osteoarthritis. Until now, the clinical performance had been good; the patient reported neither pain nor functional limitation in the affected knee. Furthermore, there were no chronic comorbidities such as diabetes mellitus, coronary artery disease or chronic alcoholism. Prior to this incident, the patient had undergone a transurethral prostate resection for prostatic carcinoma without metastases. Prophylactic antibiotic shielding had not been given prior to invasive therapeutic treatment. The patient also reported suffering symptomatic urinary tract infections during the time period when the prostate biopsy and transurethral resection of the gland were performed. These infections had been repeatedly treated with antibiotics.

INVESTIGATIONS

Synovial fluid was aspirated at two different time points, and displayed no relevant turbidity. In both instances, microbial cultures revealed the growth of *K pneumoniae*. Antimicrobial susceptibility testing

showed resistance to aminopenicillins and tetracyclines. At this time point the patient had neither symptoms of a urinary tract infection nor evidence of leukocyturia or bacteriuria.

Upon initiation of oral antibiotic therapy with cefuroxim 500 mg given every 12 h, the levels of C reactive protein dramatically decreased. The symptoms of pain and hyperthermia mitigated and repeated radiographs revealed no signs of loosening (figure 1). The antibiotic treatment was continued for 6 weeks and the general state of health improved over time.

TREATMENT

The follow-up visit was scheduled 4 weeks after discontinuation of antibiotic therapy. Again, the patient described progressive pain in his right knee and *K pneumoniae* was detected in the microbial analysis of the synovial fluid. This prompted us to proceed by removing the knee arthroplasty and perform radical synovectomy, debridement and cement spacer implantation. After 6 weeks of antibiotic treatment (cefuroxim 500 mg orally twice a day) and a 2 week antibiotic-free interval, subsequent arthrocentesis of the knee revealed negative microbial cultures. Reimplantation of a total knee arthroplasty was performed 12 weeks after removal of the implant (figure 2).

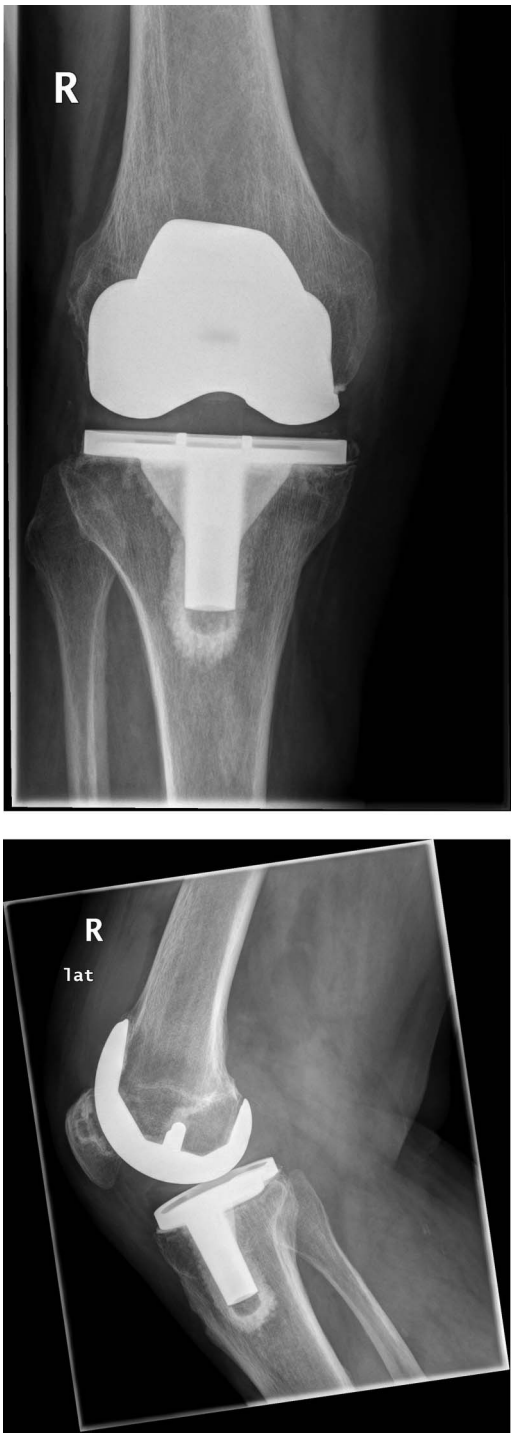

Figure 1 Anteroposterior and lateral radiographs of the right knee with no signs of hardware loosening.

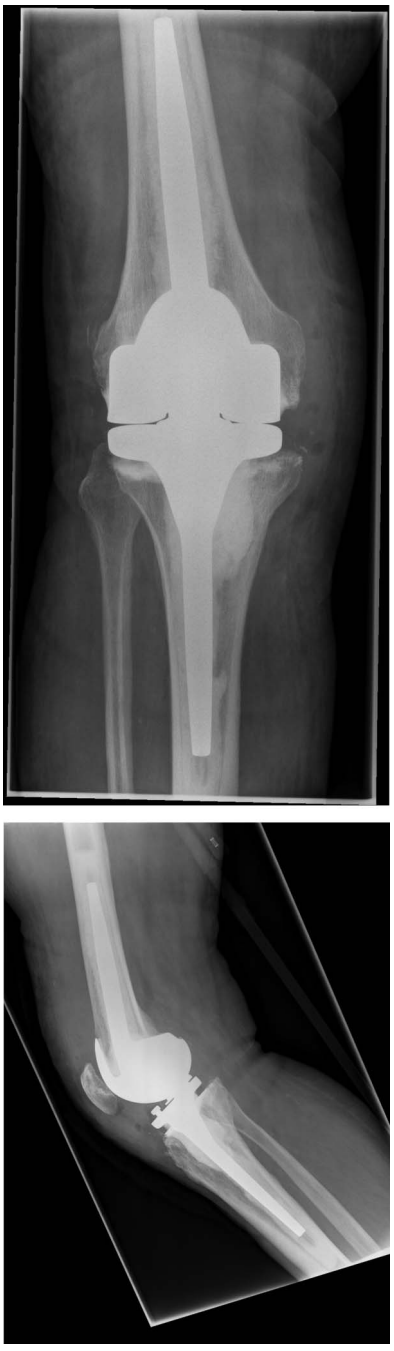

Figure 2 Anteroposterior and lateral radiographs of the right knee after revision knee arthroplasty.

OUTCOME AND FOLLOW-UP

At 2 years after the operation, the patient is free of pain and has an active range of motion with 100° of possible flexion. No reinfection of the knee could be observed.

DISCUSSION

This case shows the importance of considering the possibility of the haematogenous spread of bacteria through invasive therapeutic procedures, which can lead to joint arthroplasty infection.

The rate of early and late deep infection in primary total knee arthroplasty is reported to be very low. Studies on the outcome of primary total knee arthroplasty reveal a 90-day deep-infection rate of 0.4%.[12] Studies of large series of total knee arthroplasties have demonstrated rates of generally up to 2% within the first year. Therefore, most orthopaedic surgeons expect an average rate of deep infection of between 0.4% and 2% within the first year after primary knee replacements.[13] Meanwhile, it is also known that septic arthritis is usually due to haematogenous spread from infectious foci.[14]

Independent of the time point of prosthetic septic arthritis, *K pneumoniae* is rarely the causative microorganism, with only two case reports of patients with *K pneumoniae* prosthetic infection of the knee[15 16] and only a few cases of septic knee arthritis in the absence of prior knee surgery.[8 17–21]

Moreover, joint infections have primarily been described as secondary infections following haematogenous spread to a single joint. This was illustrated in an interesting case report of an elderly patient who became critically ill because of acute urinary tract infection with pyuria and subsequently developed septic monarthritis and osteomyelitis caused by *K pneumoniae*.[22] It is further exemplified in a case report by Chodos and Johnson,[15] who recently described a *K pneumoniae* infection of a total knee arthroplasty in association with an occult adenocarcinoma of the caecum. This indicates that infection with an enteric bacterium may provide an important clue to an underlying disease such as intestinal malignancy that enables the entry of gut flora into the blood stream.

Urinary tract infection and bacteraemia are well recognised complications of urological procedures. The incidence of bacteraemia in patients undergoing transrectal biopsy is about 73%.[23] In light of this high incidence, prophylactic antibiotic coverage during and after transrectal prostatic biopsy is justified, and should be obligatory in patients predisposed to infection, such as those who have undergone arthroplasty. The preventive antibiotic treatment should be administered as a single dose orally 1–2 h, or intravenously 30–60 min prior to surgery.[24 25]

In this case, long-term administration of cefuroxim was not sufficient to cure the prosthetic infection. This reflects current standard practice, that administration of antibiotics alone is not sufficient to treat most cases of deep joint infection after arthroplasty.[26] Based on study results, surgical debridement including removal of the prosthesis and implantation of a cement spacer augmented with gentamycin represents a successful treatment option for chronic arthroplasty infection.[27]

Chronicity of infection demonstrates that bacteria have successfully adapted to the local host environment and have evolved multiple mechanisms to evade immune recognition and antibiotic treatment. Among these resistance mechanisms is the formation of an antibiotic resistive biofilm, which is a frequent complication associated with orthopaedic implants. Interestingly, *K pneumoniae* has the ability to form such a biofilm. A recent study indicated that *K pneumoniae* biofilm production was susceptible to treatment with ciprofloxacin in an early stage of infection, while older, more mature biofilms present in chronic infection could not be penetrated by ciprofloxacin, so that ciprofloxacin was unable to reduce the bacterial biomass. This may explain the failure of the antibiotic treatment only and could have represented a major problem in our patient, thus, making surgical treatment necessary.[28]

At an early stage of infection, the patient may have benefitted from a combined antibiotic regime including ciprofloxacin to penetrate the immature biofilm. However, because of the increasing resistance spectrum of this species and the recent emergence of multiresistant and carbapenem-resistant strains,[29] prophylactic measures to avoid the spread of infection and biofilm formation should be obligatory in at risk patients. Furthermore, early recognition of late infection of knee prosthesis in our patient could have allowed for one-step prosthesis replacement. One-step replacement with aggressive surgical debridement and the use of antibiotic loaded bone cement seems to be successful in cases with typical bacteria (staphylococci). In all other cases including atypical bacteria (ie, multiresistant strains) two-step revision might be in favour.[26]

Learning point

This case report demonstrates the importance of avoiding bacteraemia resulting from invasive therapeutic procedures in patients with joint replacements because of increased risk of joint infection. We therefore emphasise the importance of sufficient antimicrobial protection to prevent the haematogenous spread of bacteria prior to invasive therapeutic procedures. These should be given preoperatively 1–2 h before treatment in the case of oral and 30–60 min in the case of intravenous antibiotic administration, to decrease the risk of perioperative and postoperative complications. In addition, the early diagnosis of a joint infection by arthrocentesis can minimise the need for two-step revision arthroplasty.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Peersman G, Laskin R, Davis J, *et al*. Infection in total knee replacement: a retrospective review of 6489 total knee replacements. *Clin Orthop Relat Res* 2001:15–23.
2 Phillips JE, Crane TP, Noy M, *et al*. The incidence of deep prosthetic infections in a specialist orthopaedic hospital: a 15-year prospective survey. *J Bone Joint Surg Br* 2006;88:943–8.
3 Jamsen E, Varonen M, Huhtala H, *et al*. Incidence of prosthetic joint infections after primary knee arthroplasty. *J Arthroplasty* 2010;25:87–92.
4 Powers KA, Terpenning MS, Voice RA, *et al*. Prosthetic joint infections in the elderly. *Am J Med* 1990;88:9N–13N.
5 Ahlberg A, Carlsson AS, Lindberg L. Hematogenous infection in total joint replacement. *Clin Orthop Relat Res* 1978:69–75.
6 Gupta MN, Sturrock RD, Field M. A prospective 2-year study of 75 patients with adult-onset septic arthritis. *Rheumatology (Oxford)* 2001;40:24–30.
7 Kaandorp CJ, Dinant HJ, Van de Laar MA, *et al*. Incidence and sources of native and prosthetic joint infection: a community based prospective survey. *Ann Rheum Dis* 1997;56:470–5.
8 Kain Z, Lashansky G, Kilchevsky E. Klebsiella pneumoniae arthritis in a child. *Pediatr Infect Dis J* 1988;7:430–1.
9 Podschun R, Ullmann U. Klebsiella spp. as nosocomial pathogens: epidemiology, taxonomy, typing methods, and pathogenicity factors. *Clin Microbiol Rev* 1998;11:589–603.

10 Lindert KA, Kabalin JN, Terris MK. Bacteremia and bacteriuria after transrectal ultrasound guided prostate biopsy. *J Urol* 2000;164:76–80.
11 Bowden FJ, Roberts J, Collignon PJ. Prostate cancer screening and bacteraemia. *Med J Aust* 2008;188:60.
12 Mahomed NN, Barrett J, Katz JN, *et al*. Epidemiology of total knee replacement in the United States medicare population. *J Bone Joint Surg Am* 2005; 87:1222–8.
13 Windsor RE, Bono JV. Infected total knee replacements. *J Am Acad Orthop Surg* 1994;2:44–53.
14 Mikhail IS, Alarcon GS. Nongonococcal bacterial arthritis. *Rheum Dis Clin North Am* 1993;19:311–31.
15 Chodos MD, Johnson CA. Hematogenous infection of a total knee arthroplasty with *Klebsiella pneumoniae* in association with occult adenocarcinoma of the cecum. *J Arthroplasty* 2009;24:158e9–e13.
16 Lin CC, Hsu HC, Huang CC, *et al*. Late-onset infection of total knee arthroplasty caused by the *Klebsiella pneumoniae* bacteremia. *Orthopedics* 2006;29:1129–31.
17 Ritter MS, Mroch H, Burns MJ. Soaring suppurative sea shells from the sea shore: Pseudomonas aeruginosa and Klebsiella pneumoniae septic arthritis after a marine sea shell injury. *Pediatr Emerg Care* 1993;9:289–91.
18 Kohler JE, Hutchens MP, Sadow PM, *et al*. *Klebsiella pneumoniae* necrotizing fasciitis and septic arthritis: an appearance in the Western hemisphere. *Surg Infect (Larchmt)* 2007;8:227–32.
19 Broom MJ, Beebe RD. Emphysematous septic arthritis due to *Klebsiella pneumoniae*. *Clin Orthop Relat Res* 1988:219–21.
20 Weber RG, Ansell BF Jr. A report of a case of *Klebsiella pneumoniae* arthritis and a review of extrapulmonary Klebiella infections. *Ann Intern Med* 1962;57:281–9.
21 Apple JS, Halvorsen RA, Chapman TM, *et al*. *Klebsiella pneumoniae* arthritis of the hip in a diabetic patient. *South Med J* 1984;77:229–31.
22 Chew LC. Septic monoarthritis and osteomyelitis in an elderly man following *Klebsiella pneumoniae* genitourinary infection: case report. *Ann Acad Med Singapore* 2006;35:100–3.
23 Thompson PM, Talbot RW, Packham DA, *et al*. Transrectal biopsy of the prostate and bacteraemia. *Br J Surg* 1980;67:127–8.
24 Kuong EE, Ng FY, Yan CH, *et al*. Antibiotic prophylaxis after total joint replacements. *Hong Kong Med J* 2009;15:458–62.
25 Wolf JS Jr, Bennett CJ, Dmochowski RR, *et al*. Best practice policy statement on urologic surgery antimicrobial prophylaxis. *J Urol* 2008;179:1379–90.
26 Vanhegan IS, Morgan-Jones R, Barrett DS, *et al*. Developing a strategy to treat established infection in total knee replacement: a review of the latest evidence and clinical practice. *J Bone Joint Surg Br* 2012;94:875–81.
27 Parvizi J, Adeli B, Zmistowski B, *et al*. Management of periprosthetic joint infection: the current knowledge: AAOS exhibit selection. *J Bone Joint Surg Am* 2012;94:e104.
28 Verma V, Harjai K, Chhibber S. Structural changes induced by a lytic bacteriophage make ciprofloxacin effective against older biofilm of *Klebsiella pneumoniae*. *Biofouling* 2010;26:729–37.
29 Kumarasamy KK, Toleman MA, Walsh TR, *et al*. Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study. *Lancet Infect Dis* 2010;10:597–602.