BMJ Case Reports

Learning from errors

Primary total knee arthroplasty infected with *Serratia marcescens*

Samer S S Mahmoud,[1] Saurabh Odak,[2] Zaman Qazzafi,[3] M J McNicholas[4]

[1]Department of Trauma and Orthopaedics, University Hospital Aintree, Liverpool, UK
[2]Department of Trauma and Orthopaedics, Royal Liverpool University Hospital, Liverpool, UK
[3]Department of Microbiology, Warrington Hospital, Warrington, UK
[4]Department of Trauma and Orthopaedics, Warrington Hospital, Warrington, UK

Correspondence to Dr Samer S S Mahmoud, samersamirsayed@yahoo.com

Summary

We report an unusual case of a *Serratia marcescens* infection of total knee arthroplasty 4 weeks after the procedure following aspiration carried out on the ward (contrary to local protocol). This was successfully treated with thorough wound debridement, irrigation, change of the polyethylene liner and systemic antibiotics using intravenous meropenem for 3 weeks followed by oral ciprofloxacin for another 3 weeks. Our patient made an uneventful recovery and there was no reported recurrence of infection at 8 months of follow-up. We are unsure as to whether the infection was introduced at the time of the joint aspiration or was a complication of the initial procedure despite all the standard aseptic measures taken at the time of surgery.

BACKGROUND

This is a rare case of primary total knee arthroplasty infected with *Serratia marcescens* in an otherwise healthy individual. In addition, this case highlights the importance of aspirating prosthetic joints in clean theatre environment.

CASE PRESENTATION

An 81-year-old gentleman with no relevant medical history (American Society of Anesthesiologists Grade I)[1] and no history of haematological or immune problems underwent a bilateral simultaneous total knee arthroplasty for osteoarthritis. The operative wounds had been progressing well with no postoperative bleed or haematoma. On the fourth postoperative day, he suddenly experienced an episode of brief loss of consciousness. There was no accompanying history of trauma to the knee. He was diagnosed with supraventricular tachycardia and required interhospital transfer to a monitored bed in the cardiology ward for further management.

He developed mild serous wound ooze of the left knee on postoperative day 10; however, he was vitally stable. The patient was not on any antibiotics. There was suspicion of joint infection by the attending physicians. Orthopaedic surgeons were not contacted at this point. An unsuccessful attempt at joint aspiration was made in the ward and not under antibiotic cover. This was done after skin preparation using 70% isopropyl alcohol-impregnated swabs, but not under complete aseptic condition producing minimal amount of joint aspirate, serous in nature and the amount was deemed unsatisfactory and discarded. After a period of 3 days of observation, his knee symptoms resolved. He was not administered with any antibiotics. Orthopaedic review on day 13 showed no evidence of joint or wound infection. He was discharged by the physicians on postoperative day 15. However, on postoperative day 28 he attended the emergency department as his knee had become hot, swollen and painful. Upon examination of the left knee it was found red, moderately swollen, hot, exquisitely tender to palpation with severe limitation of the range of motion (5° extension lag to 20° flexion). The patient was admitted to the orthopaedic ward with clinical diagnosis of an acute infected left total knee replacement and temperature of 37.7°C, pulse of 95 bpm.

Remote sources of infection were excluded upon further investigation of the patient. There was no other instance of *S marcescens* infection in any of the wards where the patient was admitted.

INVESTIGATIONS

Investigations done prior to the primary knee replacement procedure revealed: full blood count: haemoglobin (Hb) 13 g/dl, red blood cells (RBCs) 4.8×10^{12}/litre, haematocrit (Hct) 0.42, platelets (Plts) 350×10^{9}/litre, white blood cell (WBC) count 9.4×10^{9}/litre. ECG done at this time did not reveal any abnormalities.

On admission to the orthopaedics ward 28 days after the index procedure: full blood count: Hb 11.2 g/dl, RBCs 3.57×10^{12}/litre, Hct 0.33, Plts 797×10^{9}/litre, WBC count was $16\,000\times10^{9}$/litre, erythrocyte sedimentation rate (ESR) 67, C reactive protein (CRP) 38.

x-Rays did not reveal any evidence of loosening, fractures or bony changes.

TREATMENT

Non-pharmacological treatment

He underwent wound debridement, irrigation, synovectomy, removal of necrotic tissues and exchange of the polyethylene liner. Multiple tissue specimens were obtained at the time of revision surgery which all (6/6) grew *S marcescens*.

Pharmacological treatment

On the basis of culture and susceptibility results and after discussion with the microbiology consultant and having the background of reported case of *S marcescens* resistant to imipenem,[2] the patient was started on 8 hourly intravenous meropenem 1 g for 3 weeks. This was followed by 12-hourly oral ciprofloxacin 500 mg for another 3 weeks.

Meropenem is a broad-spectrum β-lactam antibiotic that penetrates most body fluids and tissues rapidly after intravenous administration. The prescribing information for meropenem indicates that, for elderly patients, no dosage adjustment is required if creatinine clearance is >50 ml/min[3] (this was the case with our patient). This regimen was elected to avoid longer courses of quinolones (eg, ciprofloxacin) in this case especially while being inpatient diminishing the risk of *Clostridium difficile* infection commonly associated with this agent in elderly population. At the time of discharge parenteral meropenem was switched to oral ciprofloxacin to complete the antibiotic course.

OUTCOME AND FOLLOW-UP

The patient subsequently made uneventful recovery with no evidence of recurrence of infection.

Eight months after surgery he had a normal full blood count with Hb 14.5 g/dl, Hct 0.43, Plts 405×10^9/litre, WBC count of 10×10^9/litre, normal differential WBC count and normal inflammatory markers with CRP of <2 mg/litre and ESR of 5 mm/h.

DISCUSSION

S marcescens is a Gram-negative, rod-shaped bacterium of the family Enterobacteriaceae.[4] It can be isolated from plants, insects and nematodes, also being an opportunistic pathogen of mammals.[5] *Serratia* species are common in the environment but not generally regarded as a component of human gut flora.[6] In humans, *S marcescens* is commonly isolated from urinary tract infections, nosocomial pneumonia, surgical wounds and bloodstream infections, mostly in intensive-care-unit patients.[5] *S marcescens* infections are usually nosocomial and occur in immunocompromised patients or those who had recent surgery and were administered broad-spectrum antibiotic therapy.[4] The incidence of *S marcescens* infections has increased over the last few years. This emergence is mainly attributed to the acquisition of multiple antibiotic resistances and to the ability of the bacteria to adhere and persist on inanimate surfaces.[5]

S marcescens osteoarticular infections are very rare with only two case reports in the literature neither of which was in primary total knee replacement patients nor following joint aspiration.[2 7]

A total of 85 769 knee replacements were carried out in England and Wales in 2011, and the number is rising.[8] The incidence of infection after total knee replacement has been quoted to vary between 0.4% and 2%.[9] This has been reduced over the last decade with implementation of stringent preoperative assessment and modification of risk factors, use of sterile operative techniques including laminar flow theatres and postoperative rehabilitation protocols. Despite these measures, an infected prosthetic joint remains a serious challenge to the treating orthopaedic surgeon.

Deep prosthetic infection is generally classified as early, delayed or late. The microbial source can be grouped as:

1. Direct contact with the wound or air-borne colonisation during the procedure. This leads to early infection, within 3 months of operation (as in our case), or delayed infection within the first year.
2. Blood-borne contamination during or after the procedure, for example during insertion of a urinary catheter, infection of an intravenous cannula or skin or dental sepsis. This type of contamination is the common cause of late infection more than 1 year after operation and can occur after many years.
3. The spread of a superficial wound infection deep to the joint space leading to periprosthetic infection.[10]

Several pathogens have been implicated in the causation of periprosthetic joint infection but *Staphylococcus* species remain the most common organisms infecting knee replacements.[11] Infection of primary total knee replacement secondary to *S marcescens* and following joint aspiration has not been reported in the literature so far.

In the above-mentioned case, we are unsure as to whether the infection was introduced at the time of the joint aspiration done in the ward or acquired during the index procedure, although all standard aseptic precautions for knee replacement were taken during the procedure. However, this case highlights the importance of strict aseptic technique including use of laminar flow theatres for aspiration of joint replacements.[12]

Our patient made a satisfactory early recovery following surgical and medical treatment with all inflammatory markers being normal and patient being systemically well at 8 months postoperative follow-up.

Learning points

- *Serratia marcescens* prosthetic joint infection is a rare and challenging condition that needs thorough investigation and treatment. This was best tackled in this case by the multidisciplinary work between the orthopaedics and microbiology teams.
- It is essential to contact the orthopaedic surgeons as soon as possible if suspecting infection in a patient with a metal implant.
- A strict aseptic technique including the use of laminar flow theatres is the best practice for aspiration of joint replacements. Failing to abide by this can lead to serious consequences.

Competing interests None.

Patient consent Obtained.

REFERENCES

1. **Baxendale BR.** Preoperative assessment and premedication. In: Aitkenhead AR, Smith G, Rowbotham DJ eds. *Textbook of anaesthesia*, 5th edn. The Netherlands: Churchill livingstone Elsevier, 2007:287–8.
2. **Lefort A,** Righi S, Jauréguy F, *et al*. *Serratia marcescens* prosthesis infection successfully treated with meropenem after imipenem failure. *J Infect* 2005;**51**:e45–7.

3. **David PN.** Pharmacokinetic and pharmacodynamic properties of meropenem. *Clin Infect Dis* 2008;**47**(Suppl 1):S32–40.
4. **Donnenberg MS.** Enterobacteriaceae. In: Mandell GL, Bennett JE, Dolin R eds. *Principles and practice of infectious diseases*. Philadelphia, PA: Churchill livingstone Elsevier, 2010:2815–35.
5. **Fedrigo GV,** Campoy EM, Di Venanzio G, *et al*. *Serratia marcescens* is able to survive and proliferate in autophagic-like vacuoles inside non-phagocytic cells. *PLoS One* 2011;**6**:e24054. doi:10.1371/journal.pone.0024054
6. **Ehrenkranz NJ,** Cleary T. *Serratia marcescens* contaminated disinfectants. *Lancet* 1981;1:1154–5.
7. **Svensson O,** Parment PA, Blomgren G. Orthopaedic infections by *Serratia marcescens*: a report of seven cases. *Scand J Infect Dis* 1987;**19**:69–75.
8. **National Joint Registry.** 8th Annual report 2011. http://www.njrcentre.org.uk
9. **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.
10. **Gaine WJ,** Ramamohan NA, Hussein NA, *et al*. Wound infection in hip and knee arthroplasty. *J Bone Joint Surg Br* 2000;**82-B**:561–5.
11. **Garvin KL,** Konigsberg BS. Infection following total knee arthroplasty: prevention and management. *J Bone Joint Surg Am* 2011;**93**:1167–75.
12. The diagnosis of periprosthetic joint infections of the hip and knee. Guideline and evidence report. Adopted by the American Academy of Orthopaedic Surgeons Board of Directors 18 June 2010. http://www.aaos.org/Research/guidelines/PJIguideline.pdf. Reprinted with permission of the American Academy of Orthopaedic Surgeons, Rosemont, Illinois.