

Novel Surgical and Antibiotic Strategy for Treating Septic Arthritis after Total Knee Arthroplasty caused by *Serratia Marcescens*: A Case Report

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Abstract

Introduction: Septic arthritis is a dreadful condition affecting joints which warrants an emergency arthrotomy in tandem with debridement followed by intravenous antibiotics during the peri-operative period. It generally affects larger joints, namely the hip, knee, shoulder, ankle and elbow. *Serratia marcescens* causing septic arthritis is uncommon in an immunocompetent individual and the available literature on the same, is limited.

Case presentation: A 73-year-old female diabetic patient, had presented to the casualty with swelling in the right knee with local rise of temperature and limited movements for five days. She had undergone left total knee arthroplasty four months ago with no post-operative complications and was ambulating well. The radiographs did not show signs of gross abnormality. Synovial fluid aspirated from the affected knee was found to have *Serratia marcescens* infection localized to the joint, as the blood culture was negative for the same organism. Left knee arthrotomy with debridement was done along with polyethylene liner exchange and local antibiotic delivery via calcium sulphate crystals mixed with vancomycin, tobramycin and gentamicin. Following this, she was given intravenous antibiotics based on the culture and sensitivity report.

Conclusion: Septic arthritis of the knee joint caused by *Serratia marcescens* is a rare occurrence, especially following total knee arthroplasty. Hence special attention had to be given for surgical planning and treatment regimen. Knee effusion with painful limitation of movements is a pathognomonic sign of a septic knee. Initial antibiotic cover remains the mainstay of the treatment but in an acute setting, knee arthrotomy with debridement and application of local antibiotic delivery gave excellent results.



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INTRODUCTION

Septic arthritis is an orthopedic emergency and usually requires immediate debridement. It



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is defined as an emergent articular disease of mainly amphiarthrodial and diarthrodial joints. Early diagnosis and surgical management with antibiotics have been the mainstay of the treatment. In 1902, Walter Whitehead reported the primordial case of septic arthritis of the knee.¹ It typically occurs in large joints which include the knee, hip, ankle, shoulder and elbow with knee being the commonest. The causative agent can comprise of a wide spectrum of organisms including bacteria, viruses and fungi. On an average, Gram-positive cocci occupy 75-80% of the cases amongst which, *Staphylococcus aureus* is the most common.² Gram-negative organisms are uncommon and are often seen in immunosuppressed individuals. They cause extensive joint destruction and require longer duration of treatment. We present a case report of septic arthritis of the knee caused by *Serratia marcescens* in an immunocompetent patient who underwent total knee arthroplasty (TKA) to stress up on the importance of early intervention for obtaining better functional outcome.

CASE PRESENTATION

A 73-year-old female patient who is a known case of Type-2 Diabetes Mellitus (T2DM), had undergone left TKA about four months ago and had presented to the casualty. She complained of sudden onset swelling in her left knee, which was gradually progressive, localized to the knee and was associated with painful restricted movements

in her left knee for five days. She also complained of two episodes of fever with maximum temperature reaching 101.7^o Fahrenheit. She denies any traumatic events to the limb, sudden weight loss and no previous history of Tuberculosis. She is currently on the oral hypoglycemic agents (OHA) for T2DM.

On examination, attitude of the limb was slightly in external rotation with hip in 10^o flexion and knee in 10^o flexion. There was diffuse swelling of the left knee. On palpation, tenderness was elicited over the entirety of the knee and was associated with local rise of temperature. The active and passive flexion at knee were about 10^o and 30^o respectively with visual analog scale (VAS) coming up to 10 indicating severe pain. Her vitals were relatively normal, with temperature of 98.9^o Fahrenheit and was maintaining saturation of 96 % on room air. Her blood workup revealed that hemoglobin was 8.7 gram per deciliter, total leukocyte count (TLC) was 15140 cells per cubic millimeter with predominance of neutrophils, erythrocyte sedimentation rate (ESR) was 46 and C-reactive protein (CRP) was 11.7. The anemia was corrected pre-operatively with transfusion of two pints of packed cell red blood cells (PRBCs) and the amended value came up to 10.6 gram per deciliter. The radiographs of the left knee in antero-posterior and medio-lateral views were taken and showed no signs of osteolysis around the implants in-situ nor reduction in the joint spaces but associated soft tissue edema was well appreciated (Fig. 1).

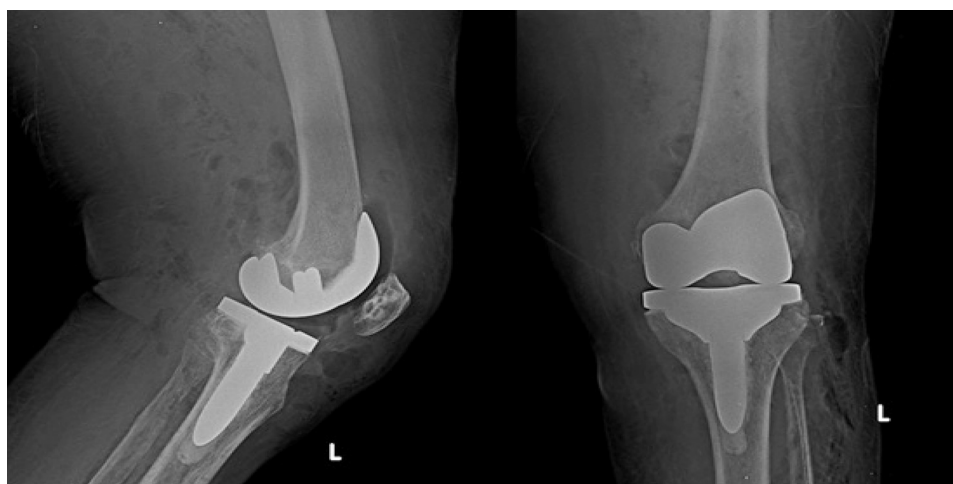


Fig. 1: Radiographs in antero-posterior and medio-lateral views depicting femoral and tibial components following TKA with no obvious bony abnormalities but shows soft tissue edema surrounding the implants

Initially, soft tissue ultrasonography of the knee was done and was found to have measured 65 milliliters of fluid a collection within the joint

cavity 18-gauge needle and syringe, 40 milliliter of synovial fluid was aspirated and sent for culture and testing antibiotic sensitivity, which

came positive for *Serratia marcescens* organism in blood agar and CLED agar culture media (Fig. 2). She was planned for knee arthrotomy. A midline incision was made over the previous surgical scar and copious purulent viscous collection was found, which was thoroughly evacuated. Following which thorough debridement of slough and devitalized tissue was done and joint arthrotomy performed. Purulent pus surrounding the polyethylene liner area was visualized. The infected polyethylene liner was removed, a mixture of povidone-iodine and hydrogen peroxide wash was given thrice (1:1 ratio) followed by two liters of sterile normal saline wash. A new polyethylene liner was placed in-situ and now, in order to provide localized antibiotic cover, Stimulan (Biocomposites, Canada), which are synthetic absorbable pellets composed of

calcium sulfate which in this case, due to the sensitivity pattern, was mixed with Vancomycin, Gentamicin and Tobramycin in the ratio of 4:1:1 and was molded into 4.8-millimeter sized pellets over fifteen minutes and placed within the joint capsule and structures were closed in layers (Fig. 3). Post-operative radiographs were taken to visualize the Stimulan pellets placed in-situ (Fig. 4). Based on the minimum inhibitory concentration (Table 1), Meropenem one gram BD was given intravenously for a period of two weeks. Regular dressings were being done along with special focus on restoring knee mobility and supportive physiotherapyimmediate post operative period was uneventful. Patient has been followed up for a period of one year, with good healing of the scar and has pain free active knee flexion up to

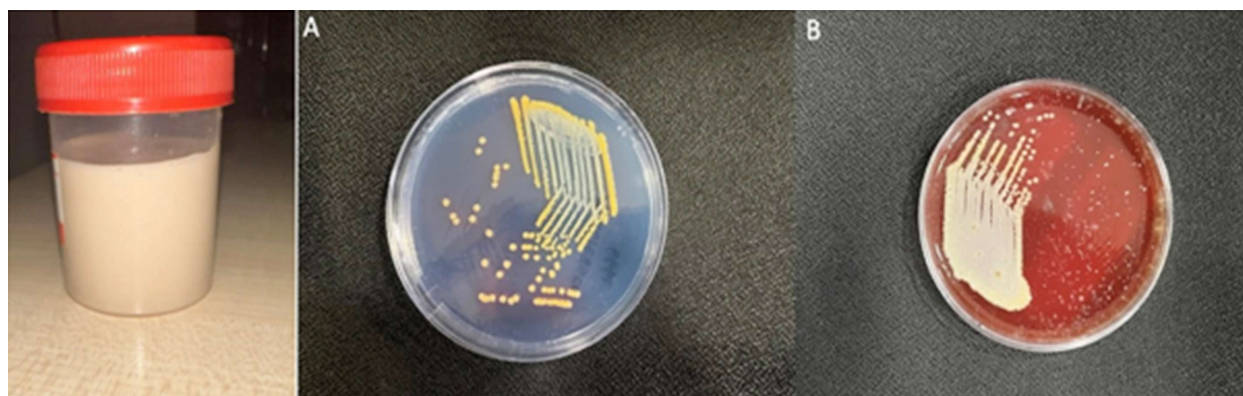


Fig. 2: Purulent aspirate obtained from left knee. *Serratia marcescens* growth seen in (A) CLED agar and (B) blood agar

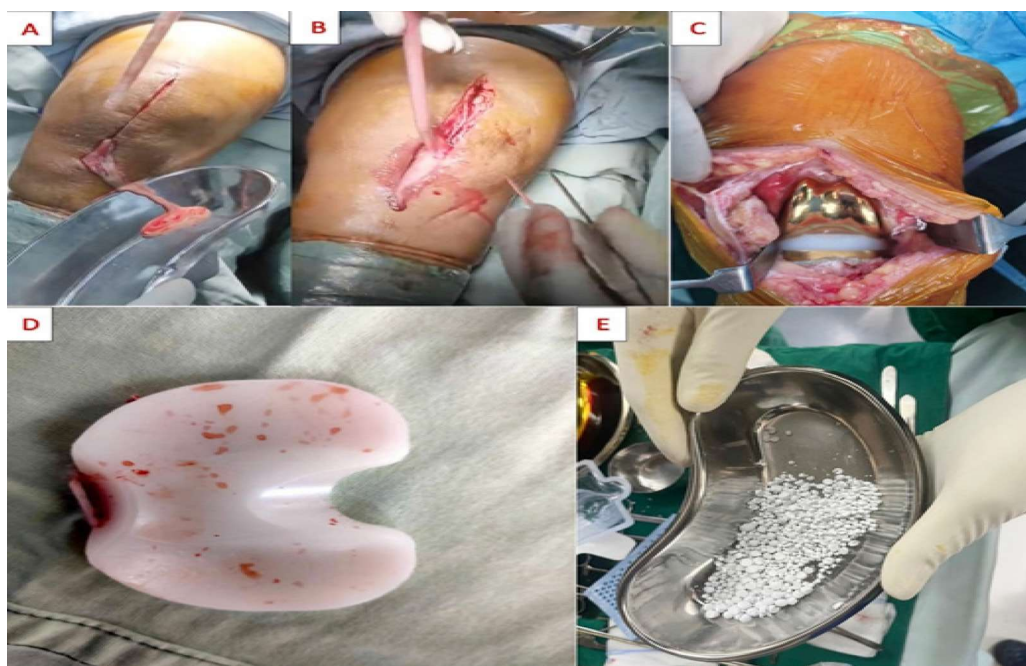


Fig. 3: A & B images show the purulent viscous discharge pouring down from the surgical site on making the incision. C image shows the joint cavity with implants in-situ after thorough debridement. D image shows the infected tibial polyethylene liner that was removed. E image shows the preparation of Stimulan pellets (4.8mm) mixed with triple antibiotics



Fig. 4: Post-operative radiographs after arthrotomy and debridement, tibial polyethylene liner exchange and Stimulanfortified with triple antibiotics placed in-situ

Table 1: Purulent aspirate culture and sensitivity report showing the Minimum Inhibitory Concentration (MIC) for various antibiotics

Types of antibiotics	Antimicrobial agent	Minimum Inhibitory Concentration (MIC)
First line	Gentamicin	> = 2 / Intermediate
Second line	Amoxicillin/Clavulanic acid	> = 32 / Resistant
Second line	Amikacin	10 / Intermediate
Second line	Cefapime	> = 32/ Resistant
Second line	Cefaperazone/Sulbactam	32 / Intermediate
Second line	Cefuroxime	> = 64 / Resistant
Second line	Ciprofloxacin	> = 4 / Resistant
Second line	Tobramycin	2 / Sensitive
Second line	Tigecycline	< = 0.5 / Sensitive
Second line	Trimethoprim/ Sulfamethoxazole	> = 320 / Resistant
Second line	Ceftriaxone	> = 64 / Resistant
Second line	Imipenem	1 / Sensitive
Second line	Meropenem	< 0.5 / Sensitive
Second line	Ertapenem	< 0.12 / Sensitive
Second line	Vancomycin	< 0.25 / Sensitive



Fig. 5: Clinical image of the left lower limb after one year follow up. There is good healing of the scar and up to 120° of flexion at knee

120° (Fig. 5). The blood parameters also showed improvement with decline in the TLC, ESR and CRP values (Table 2).

Table 2: The blood parameter assessment throughout the peri-operative period

Parameters	Pre-operative	3 months post-operative	6 months post-operative	9 months post-operative	12 months post-operative
TLC	15140	11180	9654	10745	8456
ESR	46	54	28	32	18
CRP	11.7	3.8	1.7	1.4	<1

DISCUSSION

Septic arthritis, also known as infective arthritis, is defined as joint inflammation which develops consequently to an infectious origin that primarily include bacteria, fungi, viruses, mycobacteria or other pathogens. They are generally seen affecting a single joint but can rarely affect multiple joints as well. The pathophysiology is intricate where the joint synovium with maximum vascularity does not have a limiting basement membrane making it more vulnerable to developing infections through hematogenous spread from systemic infections.³ It can also occur by direct trauma, puncture wounds and intra-articular injections. Based on the duration, prosthetic joint infections can be divided into - early (within three months of surgery), delayed (three months to two year of surgery) and late (after two years of surgery).³ In our case, since the symptomatic onset is after four months post-TKA, it was categorised as delayed infection.

In modern times, it is a known fact that TKA is one of the most commonly performed and sought out surgeries in geriatric group of patients which help in improving their quality of lives with respect to their knees and is an elective procedure. Even though there is much research pertaining to the technical advancements done and safety measures being taken, complications still happen among which infections hold the torch for the deadliest impediment and are often the cause for the failure of implant and hence the procedure. In a study done by Vasso, he mentions about different management methods in case of prosthetic joint infections (PJI) which mainly include suppressive antibiotics, debridement antibiotics implant retention DAIR, single and two stage re-implantation and salvage procedures which comprise of resection arthroplasty, arthrodesis and amputations.⁴ A similar case done in Japan by Furuichi *et al*, in a 72-year-old female patient who had undergone TKA and developed acute septic features in the

knee within six days post-operatively and had followed the DAIR protocol.⁵ In our case, we had decided upon arthrotomy with debridement, polyethylene liner exchange and Stimulan mixed with triple antibiotic placed in-situ, an extended procedure to DAIR.

PJI remain a major threat during the post-operative care and hence spotting the early signs and management is crucial. According to a study done by Zahar, the primary set of investigations include plain radiographs, blood tests and joint aspiration.⁶ In our study, we had followed a similar protocol for investigating and arriving at a diagnosis.

Tande *et al* explains the impact of having risk factors increases the chances of PJI of which obesity, Type-2 Diabetes Mellitus, rheumatoid arthritis, immunosuppressant drugs, neoplasms and arthroplasty procedures are the major concerns.⁷ In this case scenario, our patient not only is a known diabetic, but has also undergone arthroplasty of the knee, which predisposes her to developing joint infections.

The pathogens causing prosthetic joint infections are predominantly of bacterial origin. The most common causative agent for PJI are *Staphylococcus aureus* and coagulase-negative *Staphylococcus* at the pinnacle, followed by *Streptococcus* species, *Enterococcus* species, aerobic Gram-negative bacilli and anaerobic bacteria.⁷ In our case, the causative organism turned out to be *Serratia marcescens*, which is rare in its occurrence.

First discovered growing over “polenta”, traditional Italian dish by Bizio, *Serratia marcescens* is a gram-negative bacillus which is notorious in causing surgical wound, urinary tract and nosocomial infections in immunocompromised patients, usually found in a hospital setting.⁸ Ashish K *et al* had studied the cause for the increase in frequency of isolation of *Serratia marcescens* from hospitalized patients and it was reported that the resistance for Cefotaxime (71.4%), Amikacin

(71.4%) and Gentamicin (85.7%) were much higher when compared to carbapenem group of drugs (14.3%).⁸ Another case report stated that *Serratia* species are innately resistant to clindamycin, penicillin G, linezolid, macrolides, glycopeptides and quinupristin/dalfopristin, first generation cephalosporins, nitrofurantoin, colistin and tetracyclines.^{9,10} In our patient, the cultured species was resistant to Amikacin and she was started on Meropenem post-operatively.

Hadid H *et al* had presented a case of chronic distal tibial osteomyelitis with associated secondary septic arthritis of knee, whose culture was positive for *Serratia marcescens* in an immunocompetent patient for whom multiple washouts of the joint with antibiotic impregnated beads and prolonged course of intravenous antibiotics was given, with periodic check-up.¹¹ Similarly in our patient, after the initial joint aspirate showed moderate growth, immediately intravenous antibiotics were started and later tailored according to the culture sensitivity pattern and surgical arthrotomy of knee with debridement, polyethylene liner exchange and application of Stimulan fortified with triple antibiotics was done.

Another similar case where an 81-year-old male, who had undergone bilateral knee arthroplasty had developed signs of septic arthritis in his left knee within ten days post-operatively for which he had undergone wound debridement, irrigation, synovectomy with removal of necrotic tissues and exchange of polyethylene liner was done followed by administration of intravenous antibiotics during post-operative period.¹² In our case, we had also followed the same protocol but additionally had placed Stimulan fortified with triple antibiotics to increase localized action and to reduce the post-operative intravenous antibiotics dosage.

Stimulan, which is a new age bone cement which is absorbable and additionally has antibiotic carrier properties is being used to treat cases which mainly include diabetic foot ulcers, osteomyelitis, PJI and open trauma injuries.¹³ It is composed of calcium sulfate dihydrate. Due to its unique property, it was mixed with Vancomycin, Gentamicin and Tobramycin (4:1:1) based on the culture and sensitivity pattern and placed in-situ.

For our patient, periodic follow-up was done for a period of one year and there was no recurrence of infection in the joint. Her blood sugar levels and blood pressure were maintained within the physiological limits. Patient is symptomatically

better and has achieved 0-120° range of motion at the knee actively as well and recovering well.

CONCLUSION

Septic arthritis caused by *Serratia marcescens* in a post-TKA patient who is immunocompetent is a rare complication and has to be treated on an emergency basis. Initial diagnosis with blood parameter followed by joint aspirate lays down the foundation for the management. Arthrotomy with debridement with polyethylene liner exchange and administering local Stimulan fortified with triple antibiotics will not only reduce long duration post-operative antibiotics administration but will also provide concentrated localized action. The main purpose of the procedure is to obtain a pain free limb with no restriction of movements at the knee and full weight bearing. This technique provided excellent results in our case.

Consent

Consent was obtained from the patient.

Conflicts of interest

All authors confirm that they are not involved in any organization or entity with a financial interest or financial conflict with the subject matter or materials discussed in this paper.

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