Case Report/Case Series

SURGICAL SITE INFECTION CAUSED BY NON-HEMOLYTIC *Staphylococcus aureus* FOLLOWING A TOTAL KNEE ARTHROPLASTY AT A CLASS C HOSPITAL IN INDONESIA

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ABSTRACT

This article presents a case report of a knee arthroplasty surgical site infection caused by non-hemolytic *Staphylococcus aureus*. A 56-year-old woman came to the Orthopedic Outpatient Clinic, with the chief complaint of pain in the left knee for the last three years. After being diagnosed with grade IV osteoarthritis, the patient underwent a total knee arthroplasty. The patient had routine post-operative follow-ups at the Orthopedic Outpatient Clinic. However, the patient complained of swelling, pain, and discharge at the surgical site after three months. The patient underwent a second surgery for debridement, implant removal, and interspacer placement. A broad-spectrum antibiotic (gentamicin) was administered while waiting for the culture and antibiotic sensitivity test results. The culture results showed non-hemolytic *Staphylococcus aureus* presence. The antibiotics were then changed and administered for two weeks according to the culture and antibiotic sensitivity test results. As the results were good, the patient was scheduled for revision surgery for her previous total knee arthroplasty.

Keywords: Surgical site infection; non-hemolytic *Staphylococcus aureus*; total knee arthroplasty; human and health

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Highlights:

1. A patient with grade IV osteoarthritis underwent an arthroplasty and developed a surgical site infection caused by *Staphylococcus aureus.*
2. The treatment for the surgical site infection included antibiotic medications and revision surgery for the previous total knee arthroplasty.

INTRODUCTION

Surgical site infection (SSI) is a microbial infection at the surgical site that occurs within a period of less than 30 days up to one year after surgery (World Health Organization 2019). Surgical site infection is one of the most common types of nosocomial infections, which occur when a patient receives medical care in a hospital or other health care facility. Symptoms that can occur when a patient experiences a surgical site infection include purulent drainage, wound dehiscence, fever, pain or tenderness when pressure is applied, local swelling, and redness. Any of these symptoms can be found during physical examinations or supporting examinations, such as histopathological and radiological examinations (Wenk et al. 2017).

The surgical site infection prevalence among post-operative orthopedic patients is approximately 71%. The incidences of surgical site infection were 1.69% in orthopedic patients who underwent total hip replacement and 2.82% in those who underwent total knee replacement. The surgical site infection prevalence is generally low and closely related to the operating room layout, the surgical technique used by the operator, and the aseptic procedures carried out in a strict and disciplined manner (Ashraf et al. 2018, Saffanah et al. 2020). Total knee arthroplasty is a common surgery performed in the orthopedic

field to treat osteoarthritis, arthritis deformans, and rheumatoid arthritis. Recent studies found prevalent cases of knee osteoarthritis among people older than 55 years (Rositaet al. 2021, Gan et al. 2023). Total knee arthroplasty replaces the abnormal knee joint with an artificial material. The end of the femur is replaced with a metal shell, and the end of the tibia with a metal rod, both of which are then connected with plastic to act as a motion cushion.

A previous study found a 0.5%-2.0% probability of surgical site infection among patients undergoing total knee arthroplasty for the first time (Springer & Scuderi 2013). Surgical site infection will increase patient morbidity and mortality due to longer hospitalization, higher treatment costs, and a heavier mental burden on the patient (Purba et al. 2018, 2020). In order to treat surgical site infection, patients must undergo multiple procedures. Prior studies revealed that methicillin-sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *Staphylococcus aureus* (MRSA), and coagulase-negative *Staphylococci* are the most common causes of infection in total knee arthroplasty (Weiser & Moucha 2015).

CASE REPORT

A 56-year-old woman with the chief complaint of left knee pain that had persisted for the past three years presented to the Orthopedic Outpatient Clinic, Kertosono Regional Hospital, Nganjuk, Indonesia. The patient was diagnosed with grade IV osteoarthritis through clinical and radiological assessments. Figure 1 shows the x-ray of the patient's left knee.

Figure 1. X-ray of the patient's left knee when first presented to the Orthopedic Outpatient Clinic.

After the diagnosis was confirmed, the patient underwent a total knee arthroplasty. Figure 2 presents the x-ray of the patient's left knee after surgery.

The patient presented for the post-operative follow-up a week after the surgery, and the evaluation results were good. However, three months following the surgery, the patient returned for follow-up with complaints of swelling, pain, and discharge at the surgical site. An x-ray was performed on the patient's left knee, as shown in Figure 3.

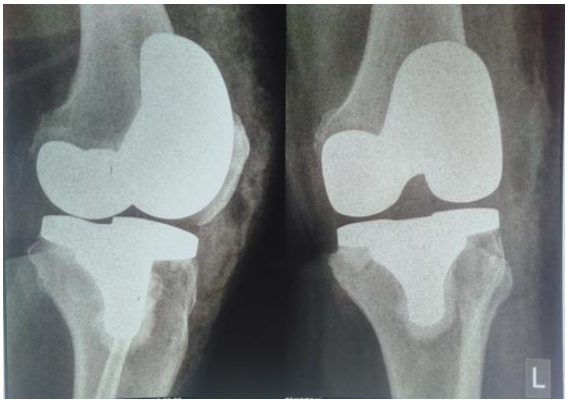

Figure 2. X-ray of the patient's left knee after total kneearthroplasty.

The patient was then advised to undergo a second procedure for debridement, removal of the previously inserted implant, and placement of an interspacer. Initially, the patient declined and requested outpatient treatment.

Figure 3. X-ray of the patient's left knee at three months after total knee arthroplasty.

After six months, the patient eventually agreed to undergo surgery. The surgery was therefore performed, as seen in Figure 4.

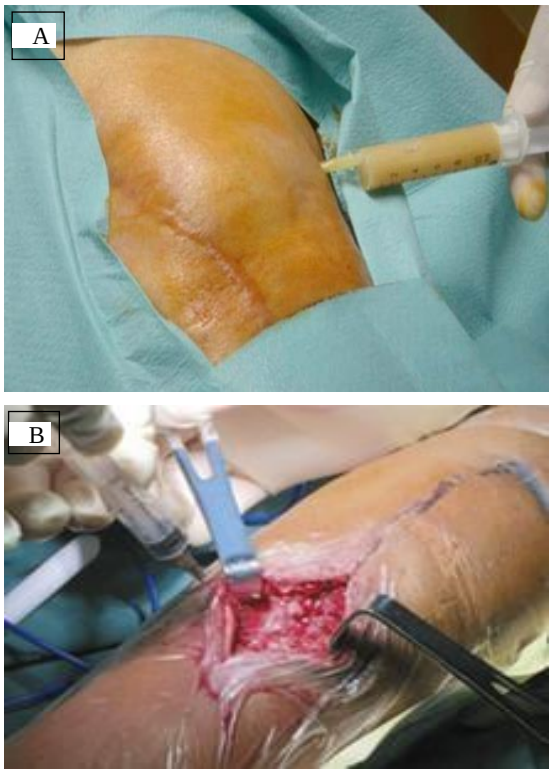

Figure 4. The patient's left knee before debridement and implant removal (A) and during debridement (B).

While waiting for the results of the culture and antibiotic sensitivity tests, the patient was administered a broad-spectrum antibiotic (gentamicin). Figure 5 depicts the x-ray of the patient's left knee after the second surgery.

Figure 5. X-ray of the patient's left knee after debridement,implant removal, and interspacer placement.

A week following the second surgery, the results of the culture and antibiotic sensitivity tests came out, as shown in Table 1. A non-hemolitic Staphylococcus infection was discovered in the patient. The antibiotic medications were then adjusted according to the results of the culture and antibiotic sensitivity tests and administered for two weeks. The patient attended the post-operative follow-up a month following the second surgery. The evaluation results were satisfactory. She was then scheduled for a revision surgery for her prior total knee arthroplasty.

Table 1. Results of the culture and antibiotic sensitivity tests.

Material: Pus
Objective: AcrB culture = Antibiotic sensitivity testing
Culture: Biological organism: Non-hemolytic *Staphylococus*

Antibiotic sensitivity test:					
No.	Antibiotics		No.	Antibiotics	
I	Penicillin		V	Aminoglycoside	
	Ampicillin			Amikacin	R (0)
	Penicillin-G			Eictuamyca	
	Amoxycillin			Dibekacin	
	Oxacillin			Kanamycis	
II	β-lactamase inhibitor		VI	Tetracyclin	
	Ampicillin-Sulbactam			Tetracyclin	
	Amoxycillin-Clavulanic acid	S	VII	Phenicol	I (13)
	Ticancillin-Clavulanic acid			Chloramphenicol	
	Celoperarone-Salbactam		VIII	Macrolide	
	Piperacillin-Tazobactam	S		Erythromycin	
III	Cephalosporin			Clindamycin	R (0)
	1st generation		IX	Fluoroquinolone	
	Cepharolin			Ciprofloxacine	R (0)
	Cephalotin			Ofloxacin	
	Cephradine			Gatlonacis	
	2nd generation			Levofloxacin	
	Cefaroxime			Norfloxacin	
	Cefotiamin			Moxfloxacin	R (14)
	Cefoprozil	S	X	Carbapenem	
	3rd generation			Imipenem	S
	Cefoperaxone			Meropenem	
	Cefotaxime	S			
	Ceftriaxone		XI	Glycopeptides	
	Ceftazidime			Vancomycin	
	Cefpododime			Teicoplanin	
	Cefixine		XII	Others	
	4th generation			Fosfomycin	
	Celepime	S		Nalidoic acid	
	Cefpirom			Onezolid	S (33)
IV	Sulfa-Trimetoprime				
	Trimetoprime sulfametoksazole	R (0)			

S: sensitive; R: resistant

DISCUSSION

The patient in this study was a 56-year-old woman with no known comorbidity. Several studies on surgical site infection risk factors found that age and female sex are not risk factors for surgical site

infection. On the other hand, studies discovered that advanced age was a protective factor, but male sex was a risk factor for surgical site infection (Baier et al. 2019, Resende et al. 2021, Li et al. 2022). The patient in this study developed grade IV osteoarthritis, which necessitated a total knee arthroplasty. Because of its high success rate and low complication rate, total knee arthroplasty is the surgical procedure of choice for patients with end-stage knee arthritis. However, there were studies that reported 27% of surgical site infection cases within 30 days and 65% within a year after total knee arthroplasty (Lin et al. 2018, Chung et al. 2021).

The patient in this study experienced pain, swelling, and discharge at the surgical site. These clinical symptoms are considered in the diagnosis of surgical site infection. A study found that pain was the main symptom in >90% of cases (Zahar & Sarungi 2021). Following a clinical examination, supporting tests (such as laboratory and radiological examinations) are required to confirm the diagnosis. Plain radiography and blood tests are among the tests that must be performed. Two-plane radiography is utilized to check for solid implant fixation (radiolucent lines), osteolytic changes in the distal femur or proximal tibia, and periarticular ossification. During a blood test, the leukocyte count, differential, C-reactive protein (CRP) level, and erythrocyte sedimentation rate (ESR) are all checked (Cooper & Valle 2014, Shahi & Parvizi 2015). Despite these various tests, bacterial culture remains the gold standard for surgical site infection diagnosis (Goswami et al. 2018, Mühlhofer et al. 2021).

Previous studies indicated that methicillin-sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *Staphylococcus aureus* (MRSA), and coagulase-negative *Staphylococci* were the most common bacterial pathogens causing SSI after total knee arthroplasty. In surgical site infection cases, *Staphylococcus* accounted for 70% to 80% of the bacteria causing infection. Other bacteria commonly found in surgical site infection are Gram-negative bacilli and non-group A *Streptococcus* bacteria (Weiser & Moucha 2015, Gehrke et al. 2015). Several studies attempting to investigate the process of *S. aureus* colonization at the surgical site discovered that patients who had *S. aureus* nasal colonization were more at riskto develop a surgical site infection following total knee arthroplasty. The risk increased up to nine times compared to people who did not have nasal *S. aureus* colonization. Further molecular typing revealed that the *S. aureus* isolates from both sites (the surgical site and the nose) were molecularly identical (Skråmm et al. 2014).

Other than the case in this report, there was anothercase of surgical site infection at Kertosono Regional Hospital, Nganjuk, Indonesia. The patient had aprosthetic joint implanted and developed an infection caused by non-hemolytic *Staphylococcus*. Initial prosthetic joint infection occurs within three weeks after a procedure, whereas the occurence after those three weeks is considered late infection regardless of the stability of the components. A prosthetic joint infection indicates an infection not only at the prosthetic interface, but also in the surrounding bone and soft tissue (Zmistowski 2014). Early prosthetic joint infections are generally managed by aggressive debridement, exchange of modular parts, and retention of fixed components. Conversely, late prosthetic joint infections usually require the removal of the component (Osmon et al. 2013; Zmistowski 2014). The aforementioned patient at the Kertosono Regional Hospital had a late prosthetic joint infection. Several surgical options to treat PJI include debridement, antibiotics, and implant retention (DAIR), as well as single-stage and two-stage revision surgery (Karachalios et al. 2014, Karachalios & Komnos 2021). If all of the patient's reconstructive treatments fail, salvage surgeries (e.g., arthroplasty resection, fusion, and above-the-knee amputation) can be undertaken (Gehrke et al. 2015).

In addition to surgical care, patients must be administered antibiotics to treat the infection. Antibiotics were administered post-operatively in somecases to prevent surgical site infection (Hadi & Ishardyanto 2021). In general, antimicrobial therapy should be pathogen-directed and guided by the results of antimicrobial susceptibility testing where applicable (Osmon et al. 2013, Tande & Patel 2014). The general principles for antimicrobial treatment are to apply the least toxic, most efficacious, narrow-spectrum antimicrobial regimen preferentially. When several agents are deemed equal, the cost and convenience of the administration should also be considered (Chaussade et al. 2017, Bernard et al. 2021).

Strength and limitations

This case report can contribute to recent studies on surgical site infection by identifying the bacteria causing the infection that occurred to the patient in this study. The findings of this study confirm that *Staphylococcus aureus* is among the bacteria most commonly causing surgical site infections. This study also further confirms that treatments for surgical site infection require a second procedure for debridement, implant removal, and interspacer placement. However, this case study may not be able to generalize and demonstrate a cause-effect correlation of the infection.

CONCLUSION

Staphylococcus aureus was found to cause surgical site infection investigated in this study. Treatments for surgical site infection as a post-operative complication are important and should be carried out immediately, which may include debridement, antibiotic medications, and revision surgery.

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Conflict of interest

None.

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None.

Author contribution

STY and EMR participated equally in the design of this study, manuscript preparation and drafting; proposed the main idea; as well as contributed equally to the study design, methodology, supervision, and formal analysis.

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