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Sequential Multi-organism Periprosthetic Joint Infection after Total Hip Arthroplasty: A Case Report

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Learning Point of the Article:

Repeated cultures and careful reimplantation timing are important when a hip replacement infection recurs with different organisms over time.

Abstract

Introduction: Periprosthetic joint infection after total hip arthroplasty is uncommon but morbid. Reports usually focus on a single organism or a persistent recurrent infection. This case is important because it describes sequential infections with four distinct and therapeutically challenging organisms in the same arthroplasty, illustrating how management must be repeatedly re-evaluated rather than anchored to the initial culture result.

Case Report: A 62-year-old woman with hypertension, chronic anemia, and a history of methicillin-resistant Staphylococcus aureus infection underwent robotic-assisted left total hip arthroplasty. Her ethnic background was not available in the deidentified record. Over 16 months, she developed four culture-confirmed periprosthetic joint infections caused by Pseudomonas aeruginosa, Candida glabrata, methicillin-resistant S. aureus, and Serratia marcescens. Each episode was managed with repeat culture acquisition before antimicrobial therapy, surgical debridement with spacer exchange when indicated, and organism-directed antimicrobial or antifungal treatment. Definitive reimplantation was delayed until the wound was healed, inflammatory markers had normalized, and repeat aspiration after an antimicrobial-free interval was negative. At 9 months after reimplantation, she remained free of recurrent infection and was improving with physical therapy. The patient did not have diabetes mellitus, and her serology status was negative. No patient-specific clinical wound photographs or intraoperative photographs were available for publication. The available operative descriptions note debridement through the prior incision with removal of infected tissue and placement or exchange of a temporary antibiotic-loaded cement hip spacer. Available susceptibility reports showed that the P. aeruginosa isolate was susceptible to all tested antipseudomonal agents, the methicillin-resistant S. aureus isolate was susceptible to vancomycin, and the S. marcescens isolate was reported as multidrug-resistant and carbapenem-resistant but remained susceptible to cefepime. The C. glabrata report confirmed organism growth, but an antifungal susceptibility panel was not available in the provided report.

Conclusion: This case emphasizes that recurrent hip periprosthetic joint infection during staged management should be treated as a new diagnostic event until proven otherwise. Repeated cultures, multidisciplinary antimicrobial selection, and individualized timing of reimplantation may improve decision-making in complex sequential infections and may be useful to orthopedic surgeons managing difficult revision arthroplasty cases.

Keywords: Total hip arthroplasty, periprosthetic joint infection, staged revision, Candida glabrata, culture-guided reimplantation.

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Author's Photo Gallery

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Introduction

Periprosthetic joint infection remains one of the most serious complications after total hip arthroplasty [1]. Although contemporary diagnostic frameworks, including International Consensus Meeting criteria and Infectious Diseases Society of America guidance, have improved evaluation and treatment, clinical decision-making remains difficult when infection is chronic, resistant, polymicrobial, or recurrent [2,3].

Staphylococci remain the predominant organisms in total hip arthroplasty infection, but Gram-negative bacilli account for a clinically important subset and may be associated with antimicrobial resistance patterns that limit standard therapy [4]. Pseudomonas aeruginosa is difficult to eradicate and has variable outcomes across debridement, antibiotics, implant retention, and component-exchange strategies [5,6]. Serratia marcescens is much less common, with most available literature limited to isolated cases or small reviews [7,8].

Fungal periprosthetic joint infection is also uncommon. Candida species represent a small subset, and Candida glabrata is particularly challenging because of reduced azole susceptibility. Current guidance generally supports prosthesis removal, staged revision when appropriate, and prolonged antifungal therapy [9,10]. Methicillin-resistant Staphylococcus aureus is another difficult pathogen in arthroplasty infection and is associated with increased risk of treatment failure [11,12,13]. We report a rare case of sequential, culture-confirmed infections with P. aeruginosa, C. glabrata, methicillin-resistant S. aureus, and S. marcescens after a single total hip arthroplasty.

Case Report

A 62-year-old woman with hypertension, chronic anemia, and a prior methicillin-resistant S. aureus infection underwent robotic-assisted left total hip arthroplasty without immediate complications. Ethnic background was not available in the deidentified record. She did not have diabetes mellitus, and her serology status was negative. Two months postoperatively, she developed worsening hip pain, swelling, and localized warmth. Blood cultures and joint aspiration grew P. aeruginosa. Through the original incision, all components were removed, extensive debridement was performed, multiple deep tissue samples were obtained before antibiotic administration, and an antibiotic-loaded cement spacer was placed. She received 3 weeks of intravenous (IV) antipseudomonal beta-lactam therapy followed by 12 weeks of oral ciprofloxacin based on susceptibility testing. The P. aeruginosa isolate was susceptible to all tested agents on the provided panel, including cefepime, ceftazidime, ciprofloxacin, meropenem, piperacillin-

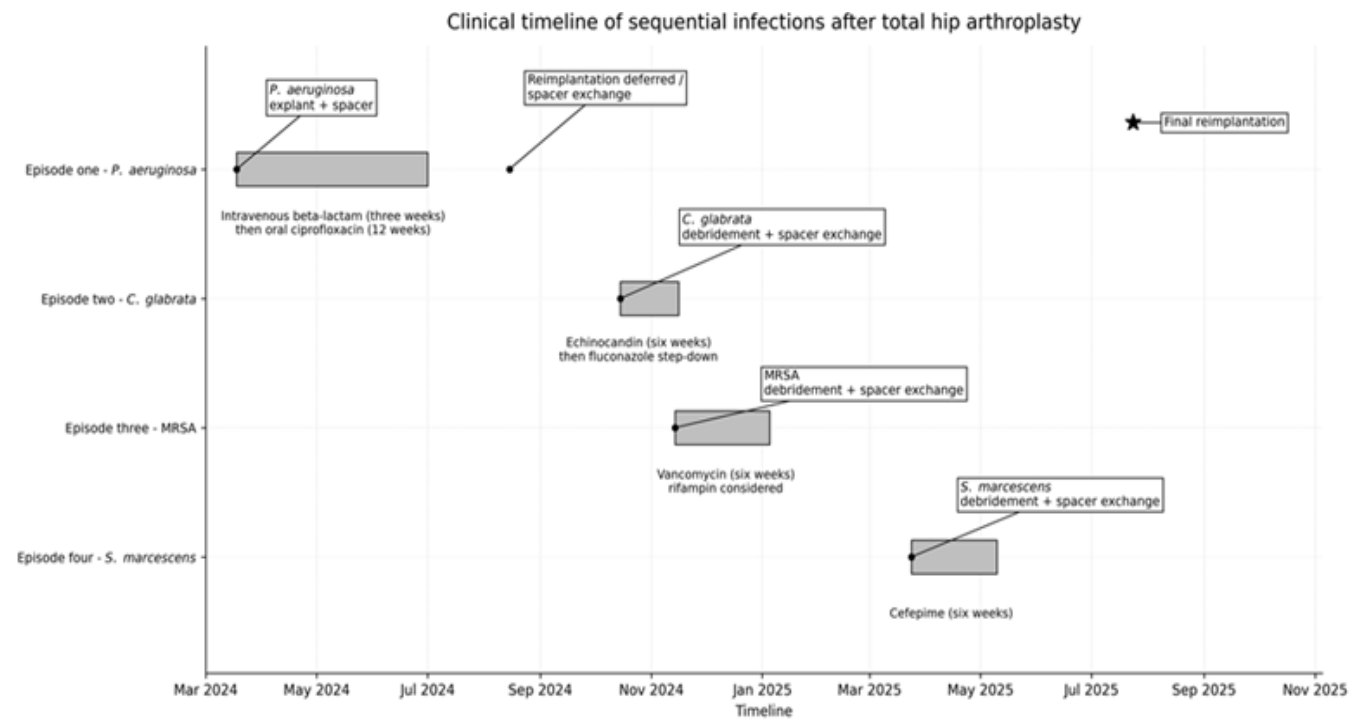

Figure 1: Timeline of sequential infections. Clinical timeline of four culture-confirmed periprosthetic joint infections after left total hip arthroplasty. Dots mark culture confirmation, shaded bars show organism-directed therapy, and the star marks final reimplantation. Reimplantation was deferred at the 4-month review because of persistent concern for infection.

Table 1: Culture and susceptibility results by infection episode. This table summarizes the available culture reports, Gram stain findings, antimicrobial susceptibility interpretations, and visible minimum inhibitory concentration values. For Candida glabrata, the available report confirmed growth but did not include an antifungal susceptibility panel.

Episode	Organism and culture report	Susceptible agents (MIC dilution where reported)	Resistant or intermediate agents/unavailable details
Episode one	Rare Pseudomonas aeruginosa. Gram stain showed few polymorphonuclear leukocytes and no organisms seen.	Amikacin (≤16), aztreonam (≤4), cefepime (≤2), ceftazidime (4), ciprofloxacin (≤1), gentamicin (≤4), imipenem (≤1), levofloxacin (≤2), meropenem (≤1), piperacillin-tazobactam (≤16), and tobramycin (≤4).	No resistance or intermediate susceptibility was reported on the provided panel.
Episode two	Rare Candida glabrata. Gram stain showed few polymorphonuclear leukocytes and no organisms seen.	No antifungal susceptibility panel was included in the available report. The patient received echinocandin therapy followed by high-dose fluconazole step-down based on clinical and infectious disease management.	Specific antifungal MIC values and the antifungal resistance pattern were not available in the provided report.
Episode three	Rare methicillin-resistant Staphylococcus aureus. Gram stain showed rare polymorphonuclear leukocytes, rare epithelial cells, and no organisms seen.	Clindamycin (≤0.5), daptomycin (1), gentamicin (≤4), levofloxacin (≤1), linezolid (4), moxifloxacin (≤0.5), quinupristin-dalfopristin (≤1), rifampin (≤1), tetracycline (≤4), trimethoprim-sulfamethoxazole (susceptible), and vancomycin (1).	Resistant: amoxicillin-clavulanate (≤4/2), ampicillin-sulbactam (≤8/4), cefazolin (≤4), erythromycin (>4), and oxacillin (>2). Intermediate: ciprofloxacin (2).
Episode four	Rare Serratia marcescens, reported as MDRO/CRE. Gram stain showed rare polymorphonuclear leukocytes and no organisms seen.	Amikacin (≤16), cefepime (≤2), ceftazidime (8), ceftazidime-avibactam (≤8), ciprofloxacin (≤1), gentamicin (≤4), levofloxacin (≤2), piperacillin-tazobactam (≤16), tobramycin (≤4), and trimethoprim-sulfamethoxazole (≤2/38).	Resistant: ampicillin (>16), ampicillin-sulbactam (>16/8), aztreonam (>16), cefazolin (>16), cefoxitin (16), ertapenem (>1), meropenem (>8), and tetracycline (>8). Intermediate: ceftriaxone (2).

AUC: Area under the curve, CRE: Carbapenem-resistant Enterobacterales, IV: Intravenous, MDRO: Multidrug-resistant organism, MIC: Minimum inhibitory concentration

tazobactam, and aminoglycosides (Table 1). After an approximately 2-week antibiotic-free interval, repeat aspiration was performed. At 4 months, persistent concern for infection led to spacer exchange rather than reimplantation.

Approximately 3 months later, she again developed hip pain and swelling. Aspiration and intraoperative cultures grew C. glabrata. Repeat debridement and spacer exchange were performed after cultures were obtained. She completed 6 weeks of echinocandin therapy followed by high-dose fluconazole. Reimplantation was again deferred because of ongoing concern for infection. The available C. glabrata report confirmed rare growth, but it did not include an antifungal susceptibility panel (Table 1).

Because no formal antifungal susceptibility panel was included in the available C. glabrata report, antifungal treatment was selected under infectious disease guidance, using echinocandin therapy followed by high-dose fluconazole step-down; complete antifungal minimum inhibitory concentration (MIC) data were not available in the deidentified record.

One month later, recurrent symptoms prompted repeat evaluation, and cultures yielded methicillin-resistant S. aureus. She underwent repeat debridement with spacer exchange, with multiple deep cultures obtained before antibiotics. She completed 6 weeks of IV vancomycin using area-under-the-curve-guided dosing. Rifampin was considered after wound stabilization. The interstage plan again included protected weight-bearing, multidisciplinary follow-up, an antibiotic-free interval, and repeat aspiration.

The methicillin-resistant S. aureus susceptibility report showed resistance to oxacillin, erythromycin, cefazolin, amoxicillin-clavulanate, and ampicillin-sulbactam, intermediate susceptibility to ciprofloxacin, and susceptibility to vancomycin, daptomycin, linezolid, rifampin, trimethoprim-sulfamethoxazole, clindamycin, gentamicin, levofloxacin, moxifloxacin, quinupristin-dalfopristin, and tetracycline (Table 1).

Approximately 4 months later, she experienced a fourth recurrence, and cultures grew S. marcescens. Management again included debridement through the existing incision, spacer exchange, and culture-directed antimicrobial therapy. She received 6 weeks of IV cefepime, followed by an antimicrobial-free interval and repeat aspiration.

The S. marcescens isolate was reported as a multidrug-resistant organism and carbapenem-resistant Enterobacterales. It was resistant to multiple agents, including ertapenem and meropenem, but remained susceptible to cefepime, ceftazidime, ceftazidime-avibactam, ciprofloxacin, piperacillin-tazobactam, aminoglycosides, levofloxacin, and trimethoprim-sulfamethoxazole (Table 1).

After approximately 4 months of negative cultures, a well-healed wound, and normalized inflammatory markers, definitive reimplantation was performed. At 9 months after reimplantation, there was no evidence of recurrent infection, and the patient was regaining function with physical therapy. The susceptibility results are summarized in Table 1, and the sequential management decisions are summarized in Table 2 and Fig. 1.

Discussion

A PubMed-focused literature review was performed using combinations of the following keywords: total hip arthroplasty, periprosthetic joint infection, staged revision, P. aeruginosa, C. glabrata, methicillin-resistant S. aureus, S. marcescens, spacer exchange, and reimplantation. The available literature describes these pathogens individually in prosthetic joint infection, but the sequential emergence of four distinct pathogens in the same hip arthroplasty is rarely represented. This makes the case educational because each recurrence required a fresh diagnostic and therapeutic approach rather than simply extending the prior treatment plan.

Given the complexity of this case, the available culture and susceptibility information is summarized in Table 1. The bacterial reports allow reporting of sensitive, resistant, and intermediate interpretations with MIC dilutions where visible in the available reports. The only remaining missing susceptibility detail is the antifungal susceptibility panel for C. glabrata, which was not included in the provided report.

The Gram-negative episodes contributed substantially to management complexity. In chronic P. aeruginosa prosthetic joint infection, revision with component exchange has been associated with higher success than debridement, antibiotics, and implant retention in many settings, and prolonged targeted therapy remains important [5,6,14]. Oral fluoroquinolone therapy is generally most appropriate when susceptibility is confirmed. S. marcescens prosthetic joint infection is uncommon, but reported cases emphasize the importance of adequate debridement and organism-directed antimicrobial

Table 2: Sequential infection episodes after left total hip arthroplasty. This table summarizes the timing, culture-confirmed organism, diagnostic method, treatment, and outcome during staged management. Definitive reimplantation was performed once cultures remained negative, the wound had healed, inflammatory markers had normalized, and aspiration after an antibiotic-free interval was reassuring. No patient-specific clinical or intraoperative photographs were available; operative records described use of a temporary antibiotic-loaded cement hip spacer.

Stage	Timing	Organism and diagnosis	Treatment	Outcome
Episode one	Two months postoperatively	Pseudomonas aeruginosa from blood cultures and joint aspiration; deep intraoperative cultures obtained before antibiotics	Explantation of all components, extensive debridement, antibiotic-loaded cement spacer, 3 weeks of IV antipseudomonal beta-lactam therapy, then 12 weeks of oral ciprofloxacin	Repeat aspiration after an approximately 2-week antibiotic-free interval
Interstage decision point	Four months	Persistent concern for infection despite interval management	Spacer exchange rather than reimplantation	Reimplantation deferred
Episode two	Approximately 3 months later	Candida glabrata from aspiration and intraoperative cultures	Repeat debridement and spacer exchange; 6 weeks of echinocandin therapy followed by high-dose fluconazole	Reimplantation deferred pending reassuring clinical and microbiologic findings
Episode three	One month later	Methicillin-resistant *Staphylococcus aureus* from repeat cultures	Repeat debridement and spacer exchange; 6 weeks of IV vancomycin with AUC-guided dosing; rifampin considered	Interstage protocol repeated with antimicrobial-free interval and repeat aspiration
Episode four	Approximately 4 months later	Serratia marcescens from cultures	Debridement through existing incision, spacer exchange, and 6 weeks of IV cefepime	Proceed toward reimplantation once cultures, wound status, and inflammatory markers were reassuring
Definitive reimplantation	After approximately 4 months of negative cultures	Clinical, serologic, and microbiologic criteria reassuring	Definitive reimplantation	At 9 months after reimplantation, no recurrent infection and functional improvement with physical therapy

therapy [7, 8].

The identification of C. glabrata required a major change in strategy. Because this organism may have reduced azole susceptibility, guidelines favor prosthesis removal and prolonged antifungal therapy, often beginning with an echinocandin and transitioning to fluconazole only when susceptibility and clinical response support that approach [9,10,15]. In this patient, repeat deep cultures were prioritized before treatment changes, and reimplantation was deferred until clinical, serologic, and microbiologic parameters were reassuring.

When methicillin-resistant S. aureus was isolated, vancomycin was administered with area-under-the-curve-guided dosing to balance efficacy and nephrotoxicity risk [16]. Rifampin was considered because of its activity against staphylococcal biofilm, but its role must be individualized, particularly because available evidence is mixed and may depend on the surgical strategy used [12, 13,17].

The central lesson from this case is that recurrent infection during staged arthroplasty management should not be assumed to represent persistence of the original organism. Repeat cultures changed management at each episode. Similarly, reimplantation was not performed according to a fixed timeline; it was delayed until the wound was quiet, inflammatory markers had normalized, and aspiration after an antimicrobial-free interval was negative. This approach is consistent with guidance emphasizing clinical judgment and microbiologic confirmation before reimplantation [3,18,19].

This case report is limited by its single-patient design and short-term follow-up after final reimplantation. The sequential emergence of distinct organisms may reflect host factors, prior antimicrobial exposure, healthcare-related exposure, or other variables that cannot be fully separated in a case report. Nonetheless, the case provides a practical example of culture-driven decision-making in a rare and complex periprosthetic hip infection.

Additional limitations include the absence of patient-specific clinical or intraoperative photographs and the lack of an antifungal susceptibility panel for the C. glabrata isolate in the provided report. The bacterial susceptibility reports were available and are summarized in Table 1, but interpretation remains limited by the single-patient design and the retrospective nature of the case report.

Conclusion

Sequential periprosthetic hip infections can disrupt standard staged-revision pathways when new pathogens emerge between procedures. This case highlights the importance of repeated culture acquisition, organism-directed antimicrobial therapy, thorough debridement with spacer exchange when indicated, and individualized reimplantation timing. For orthopedic surgeons and infection specialists, the case reinforces that each recurrence should be treated as a new diagnostic event until culture data prove otherwise.

Clinical Message

In recurrent or staged hip periprosthetic joint infection, a new positive culture should not be assumed to represent persistence of the original organism. Re-culturing, targeted therapy, and individualized reimplantation timing are essential when sequential pathogens emerge.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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