Acute Propionibacterium acnes Infection After Carpal Tunnel Release

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Propionibacterium acnes (P. acnes) is a gram-positive, anaerobic, commensal organism found on non-glabrous skin, including the face, scalp, chest, and axilla. Recently, P. acnes is one of the more frequently recognized organisms causing postoperative infections in implant surgery of the shoulder, second to only Staphylococcus aureus (S. aureus), yet it is a rare postoperative complication of the wrist and hand. Multiple factors, including slow growth, multiorganism involvement, and selective growth media, complicate attributing a primary infection to P. acnes. We present a case of primary, acute P. acnes infection after carpal tunnel decompression, demonstrating the need for considering P. acnes for persistent postoperative hand and wrist infections.

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Carpal tunnel syndrome is the most common compression neuropathy in the United States, with more than 600,000 carpal tunnel release procedures annually. Carpal tunnel release relieves the symptoms of numbness in the sensory distribution of the median nerve, pain, and/or weakness of the thenar muscles. Procedure-related complications, including infection, scar tenderness, wrist stiffness, and nerve injury, are rare after an elective decompression surgery, but remain important postoperative considerations.

Propionibacterium acnes (P. acnes) is a non-spore forming, gram-positive, gas-forming, anaerobic bacillus. It is a commensal organism of the skin and mucosal flora and is typically found on the face, chest, axilla, and thorax. P. acnes primarily infects the nutrient-rich, immunologically privileged synovial sites such as the shoulder, hip, and knee after surgery, and it is currently the second most common pathogenic organism following shoulder arthroplasty, behind only Staphylococcus aureus (S. aureus). Although well-known to shoulder surgeons because of P. acnes’ preferred habitat within hair follicles of the axilla, P. acnes infection has been rarely reported to cause an infection in the glabrous hand or wrist. To the best of our knowledge, we report the first case of acute P. acnes infection after open carpal tunnel decompression. We aim to broaden the awareness among hand surgeons for the potential for P. acnes infection following hand and wrist surgery and to recommend the creation of formal, evidence-based guidelines for the treatment of deep-tissue P. acnes infection.

Case Description

Initial presentation

A 49-year-old female patient with a past medical history notable for hypertension, type 2 diabetes mellitus (glycated hemoglobin = 7.8 at 5 days before surgery with normal fasting glucose), morbid obesity (body mass index = 42.8 kg/m²), chronic kidney disease, peripheral neuropathy, chronic obstructive pulmonary disease, and hypoaalbuminemia presented to our institution with numbness and pain in her right and left hands. A physical examination was consistent with bilateral carpal tunnel syndrome and cubital tunnel syndrome, which was worse on the right side. Electrodiagnostic studies confirmed bilateral carpal and cubital tunnel syndromes.

The patient underwent a single, multisite operation, including right, open carpal tunnel release, followed by right decompression and anterior transposition of the ulnar nerve at the elbow under general anesthesia and supraclavicular nerve block. A preoperative dose of cefazolin (3 g) was administered as per the hospital protocol for all clean, elective surgeries, and the skin was prepared with Hibiclens Antiseptic Skin Cleanser (Hibiclens) and BD ChloraPrep (BD). The carpal tunnel was approached through a standard, 2.5-3-
cm longitudinal incision in the palm, and the cubital tunnel was
approached via a curved longitudinal incision posterior to the
medial epicondyle. The ulnar nerve was subcutaneously transposed
after decompression. Surgery was uneventful, and the patient was
discharged with sterile dressings and a long-arm cast to protect the
cubital tunnel incision. Postoperative wound care instructions
included the removal of the sterile soft bandage on the hand on day
4 after surgery. The hand wound was to be cleaned with soap and
water, dried well, and then covered with a large Band-Aid, which
was to be changed daily or every time the hand was washed. The
patient was scheduled for a follow-up appointment 2 weeks after
surgery for removal of the long-arm cast and the sutures from the
elbow and hand.

Postsurgical complications

Eleven days after surgery, the patient was evaluated for
increasing redness, pain, and swelling in her right hand over the
right thenar eminence and carpal tunnel, including ascending
lymphangitis and cellulitis of the region (Fig. 1). The elbow wound
was well healed without evidence of infection, and the patient was
afebrile. The patient was admitted for a deep-space infection with
possible compartment syndrome to the thenar compartment and
was scheduled for emergent incision and drainage (I&D),
debridement, and fasciotomy. The I&D revealed cloudy serous fluid
down to the deep carpal tunnel space and purulent tenosynovitis
around the flexor tendons. A tenosynovectomy was performed
around the affected tendons. A subsequent fasciotomy of the thenar
compartment was performed. All other compartments remained
soft at this time. Cultures of the deep spaces and tenosynovium
were sent to the laboratory. The patient was then placed on broad-
spectrum antibiotics consisting of vancomycin and piperillin-tazo-
bactam.

Despite extensive I&D and antibiotics, the infection continued to
worsen. Less than 24 hours after surgery, the patient had worsening
of pain and swelling. The clinical examination was worrisome now
for compartment syndrome of the volar forearm compartment and
remaining compartments of the hand. She went back to the oper-
ating room for a fasciotomy of the affected compartments and
radical flexor tenosynovectomy (Fig. 2). The patient went back to
the operating room 1 more time for I&D 9 days after admission
because of sudden increases in swelling, erythema, and pain and a
high white blood cell count. Reaccumulation of murky fluid was
observed in the carpal tunnel despite previous drain placement,
and there was skin necrosis over the thenar musculature. In the
setting of obvious clinical disease progression, the decision was
made to discontinue the patient’s intravenous piperillin-tazo-
bactam and switch to meropenem.

Laboratory findings and imaging

A wound culture grew coagulase-negative Staphylococcus and
P. acnes on the sixth day after surgery. Laboratory findings were
notable for a persistently elevated white blood cell count (WBC)
(12,910–22,580 WBCs/μL) throughout the infection. A computed
tomography scan of the right upper extremity with contrast was
performed prior to the third debridement to rule out fluid collec-
tion or necrotizing fasciitis. Findings revealed changes related to
the previous surgical intervention and the possibility of phlegmon
and gas formation in the distal thenar eminence (Fig. 3). Plain hand
radiographs showed no evidence of osteomyelitis.

Recovery

After the third debridement and antibiotic change, the patient
made steady improvement with granulating hand wounds, decreas-
ing leukocytosis, and resolving infection until she was sta-
ble to be discharged on day 22 of this admission, which was 32 days
after her initial procedure. She was transferred to a skilled nursing
facility to continue intravenous antibiotics and wound care.
Discharge medications included intravenous vancomycin and
meropenem via a peripherally inserted central catheter line and
oral oxycontin, dilaudid, and pregabalin for pain. Despite leaving
her skilled nursing facility after 12 hours and stopping all antibi-
otics against medical advice, the patient’s infection resolved, and
her wounds healed over the course of 3 months (Figs. 4, 5). The
patient was seen intermittently for follow-up and debridement of
her healing wounds, and she demonstrated resolution of numb-
ness, pain, and tingling in both the median and ulnar nerve dis-
tributions, suggesting successful nerve releases.
Discussion

S. aureus and coagulase-negative Staphylococcus are commensal pathogens known to frequently complicate prosthetic and non-prosthetic procedures and are thus empirically treated for based on their prevalence. However, in antibiotic-refractory cases that continue to grow, Staphylococcal species, P. acnes must be suspected. It is known that P. acnes is a slow-growing organism that resides in the sebaceous glands, making it resistant to routine surface sterilization and allowing it to seed surgical sites during an incision. Because of this, P. acnes is much more prevalent in regions with a high density of sebaceous glands, such as the scalp, face, chest, and shoulder, and is rare in the areas of low sebaceous gland density, such as the wrist and hand. As such, P. acnes may be underreported in instances of postsurgical hand and wrist infection.

In this case, P. acnes was suspected as the primary pathogenic organism despite the growth of coagulase-negative Staphylococcus because of the surgery type, antibiotic sensitivity, computed tomography findings, and infection location. The consulted infectious disease specialist attributed the extent of the infection to P. acnes invasion, stating that coagulase-negative Staphylococcus was an unlikely primary pathogen because there was no surgical hardware involved in the procedure. It has been hypothesized that coagulase-negative Staphylococcus is particularly virulent with involvement of surgical hardware because of its ability to form biofilms and to invade and survive within phagocytes, such as osteoblasts. Furthermore, the patient’s prolonged, refractory antibiotic course was also suspicious for a P. acnes primary infection in the setting of antibiotic pan-sensitive Staphylococcus, especially considering empirical treatment with vancomycin and subsequent confirmation of vancomycin sensitivity by the microbiology laboratory. Additionally, computed tomography with contrast confirmed the presence of a gas-producing organism, which further suggested a P. acnes primary infection. Finding P. acnes in the glabrous region of the palm suggested extensive P. acnes proliferation and invasion from a sebum-producing (nonglabrous) region, such as the pores and hair follicles of the wrist or dorsal hand during surgery; however, it is unlikely that the consecutive, multisite surgery contributed to seeding of the wrist infection because the carpal tunnel release was completed before the cubital tunnel release.

Although the exact cause of such an extensive P. acnes infection is unknown, patient comorbidities, including type 2 diabetes mellitus, hypoalbuminemia, and obesity, likely contributed to the severity of infection. Diabetes considerably increases morbidity and mortality of infections due to immune dysfunction, micro- and macro-angiopathies, and neuropathy, which lead to increased numbers of interventions in this population. Moreover, the development of compartment syndrome as a result of the initial infection with concomitant soft tissue necrosis may have served as a nidus for infection exacerbation and rapid spread, further contributing to the severity of the P. acnes infection.
Propionibacterium acnes' pathogenesis involves its ability to evade destruction by macrophages, chymotrypsin, hydrogen peroxide, and human serum factors, which can potentially be attributed to its ability to inhibit chlorination and its unique secondary cell wall structure. Similar to Staphylococcus epidermitis, P. acnes can also form a biofilm on prosthetic implants, making it especially virulent following implant-replacement surgery. Its long incubation period of up to 21 days (6 days in this case), anaerobic and aerobic growth potential, and the lack of specific growth media may contribute to the paucity of reported P. acnes infections in hand and wrist surgery when compared with the more well-known commensals.

Figure 4. Healing process of the palmar aspect of the hand and wrist after initial I&D. A At 3.5 weeks. B At 6.5 weeks. C At 8.5 weeks.

Figure 5. Healing process of the dorsal aspect of the hand after initial I&D. A At 4.5 weeks. B At 7.5 weeks. C At 11 weeks.
This case demonstrates the importance of considering *P. acnes* in any resistant and persistent postoperative hand and wrist infection. A lack of evidence-based guidelines for *P. acnes* treatment complicates efficient eradication; however, most case-based reviews recommend a similar treatment course to that demonstrated in this case, including a combined regimen of irrigation and debridement as needed and systemic antibiotics with a preference for vancomycin and clindamycin. Combination therapy with rifampin and daptomycin has also shown promise for treating *P. acnes* deep-tissue infections. In this case, although vancomycin and piperillin-tazobactam resistance were never formally demonstrated by the microbiology laboratory, some plausible explanations for resistance include bacterial wall peptidoglycan alteration from D-alanyl-D-alanine to D-alanyl-D-lactate conformation preventing vancomycin binding, and extended-spectrum β-lactamase production for piperillin-tazobactam resistance. In contrast, carbapenems are effective as a last resort for antibiotic-resistant species because of their unique carbapenem-β-lactam molecular structure, which confers resistance against extended β-lactamases. Considering the destructive potential of *P. acnes* deep-tissue infections, as demonstrated in this case, we recommend the creation of formal, evidence-based guidelines regarding the optimal treatment for deep-tissue *P. acnes* infections to prevent similar instances to this case moving forward.

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