Propionibacterium acnes Infections in Shoulder Surgery

John G. Horneff, MD, Jason E. Hsu, MD,
G. Russell Huffman, MD, MPH*

KEYWORDS

• *Propionibacterium acnes* • Shoulder joint • Infection • Revision surgery

KEY POINTS

- *Propionibacterium acnes* is a common cause of bacterial infection postoperatively in patients who have undergone shoulder surgery.
- *P acnes* is a common gram-positive bacteria found commonly in the hair follicles and sebaceous glands that are abundantly common in the shoulder region.
- The key to characterize a *P acnes* infection is to have a high clinical suspicion in a patient who continues to complain of pain and stiffness even if the other prototypical signs of infection are absent. A comprehensive physical examination, radiographs, and prolonged culture times are often necessary to accurately diagnose a *P acnes* infection.
- Proper preventive care with the use of sterile techniques in the operating room is often not as effective in the treatment of *P acnes* as they are for other common orthopedic infections. When an infection with *P acnes* does occur, treatment options include antibiotics, surgical debridement, and revision surgery.

INTRODUCTION

Propionibacterium acnes is a gram-positive anaerobic bacillus bacterium that is found to preferentially colonize the neck, chest, and shoulder region. In years past this slow-growing, indolent bacterium was considered a contaminant of many intraoperative cultures taken at the time of shoulder surgery. Recently, however, there have been a growing number of reports in the literature that *P acnes* is an organism capable of colonizing the shoulder joint and causing disorder in the perioperative period. Although indolent in its course, *P acnes* infection of the shoulder can lead to failure of surgery including rotator cuff repair and arthroplasty. Most of the literature has described such infection in the setting of joint replacement, but *P acnes* colonization of the skin in the shoulder region certainly places all patients undergoing shoulder surgery at risk.

Patients with postoperative *P acnes* shoulder infection often describe substantial pain and limitation of range of motion in active and passive shoulder function. When a patient presents with continued difficulty of the shoulder even years after the operative procedure, the index of suspicion for infection should increase and proper intervention should be initiated. Unfortunately, the evaluation and treatment of a *P acnes* infection is not as well described and can often be subtle in its presentation. The determination of an infection with *P acnes*

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Department of Orthopedic Surgery, Hospital of University of Pennsylvania, 2 Silverstein, 3400 Spruce Street, Philadelphia, PA 19104, USA
* Corresponding author.
E-mail address: Russell.huffman@uphs.upenn.edu

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requires a comprehensive physical examination, and often includes the need for radiographic imaging and laboratory studies. Treatment options include antibiotic therapy, debridement surgery, and, in the case of arthroplasty, revision surgery. Perhaps even more important to the treatment of *P acnes* infection in the shoulder is the practice of prevention via proper preparation of the surgical site.

INFECTIONS OF THE SHOULDER JOINT

Common Pathogens

Many of the bacteria responsible for infection in patients who undergo shoulder surgery are the same organisms that can cause an infection in any orthopedic patient. Typically, bacteria that are normally found as skin flora are most likely to invade the shoulder joint following any procedure that violates the skin barrier. *Staphylococcus aureus, Staphylococcus epidermidis,* and other coagulase-negative *Staphylococcus* species are the most common potential pathogens that colonize human skin.[1–3] In several case series, *S aureus* has been found to account for as much as 60% of native joint infections.[4–6] Similarly, when it comes to prosthetic joint infections *S aureus* and coagulase-negative *Staphylococcus* have been found to be responsible for as much as 23% and 43% of cases, respectively.[7] These pathogens, however, are not unique to the shoulder and are usually the first targets of directed antibiotic therapy when an infection following orthopedic surgery is suspected. More unique to the shoulder is *P acnes*, which has been found to be responsible for as much as 51.3% of postoperative shoulder infections.[8,9] A study by Patel and colleagues[1] looked to characterize the colonization of bacteria at various sites common for orthopedic surgery, and found that although the burden of *S aureus* was increased at hip, knee, and shoulder compared with *P acnes*, the burden of *P acnes* was significantly greater for the shoulder region than for the lower extremity. This higher concentration of *P acnes* in the shoulder region has even led some to speculate that the bacterium is responsible for shoulder abnormality even before surgical treatment. Levy and colleagues[10] collected shoulder aspirates and tissue samples from 55 consecutive patients before primary joint replacement, and found that 41.8% of patients were positive for *P acnes* colonization.

MICROBIOLOGY

P acnes is a non–spore-forming, gram-positive anaerobic bacillus. Although it is considered as part of the normal superficial skin flora, *P acnes* tends to live deep in the hair follicles and sebaceous pores of the skin rather than on the surface. The metabolic by-products found in the oily sebum produced by sebaceous glands serve as a source of energy for the bacteria. The neck, axilla, and chest wall each have an increased number of these glands and follicles in comparison with other regions of the body. For this reason, *P acnes* is often found in increased numbers in these areas of the body compared with other anatomic regions common for orthopedic surgery such as the hip or knee.[1,11,12] Male patients tend to have an even higher concentration of hair follicles and sebaceous glands, placing them at further risk.[11,12] Similarly, patients with excess activity in these glands who are sufferers of dermatologic acne can have an elevated number of colonies of the bacteria living on their skin. In most cases, however, *P acnes* tends to be isolated from healthy moist skin that would not be expected to have any sort of colonization.[13] *P acnes* has also been found to colonize other regions of the body, including eye mucosa and layers of the respiratory and digestive tracts. Given these numerous regions of colonization, *P acnes* has been implicated as a pathogen in infections including endocarditis, meningitis, conjunctivitis, and various abscesses. For many years its implication as an infective agent in shoulder surgery had been ignored or, when present in cultures, assumed to be a contaminant. This historical perspective was mostly propagated by the indolent course of *P acnes* infections and the organism's slow growth cycle. Over the past few decades, however, its role in shoulder infections has become more recognized.

PROPHYLACTIC TREATMENT OF INFECTION

One of the best ways to treat a potential surgical-site infection is to prevent it from ever occurring. There are certain strategies to decrease the chance of infection that can be performed in the preoperative and perioperative periods. Many of these strategies have become the standard of care for orthopedic surgical care.

Surgical-Site Preparation

Preoperative surgical-site preparation with an antiseptic solution is often performed in the operating room just before incision. Various iodine and alcohol-based solutions are available that have been shown to have varying efficacy. Saltzman and colleagues[14] performed a randomized prospective study of 3 commercially available solutions: ChloraPrep (2% chlorhexidine gluconate and 70% isopropyl alcohol; ChloraPrep, Leawood, KS, USA), DuraPrep (iodine povacrylex