

# *Propionibacterium acnes*: Time-to-Positivity in Standard Bacterial Culture From Different Anatomical Sites

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## Abstract

**Background:** *Propionibacterium acnes* infections are likely under-recognized and underreported. This is partly because of low clinical suspicion, perceived non-pathogenicity, or lack of adequate culture incubation time. We conducted a study to assess the optimal incubation period to recover *P. acnes* from specimens acquired during the workup of suspected clinical infections.

**Methods:** A 5-year retrospective chart review was conducted between January 2010 and December 2014 at a single tertiary-care hospital. All patient cases from which *P. acnes* was recovered were included for analysis. Source of infection, antibiotic use, and culture time-to-positivity (TTP) were recorded.

**Results:** Implanted devices comprised the single most common source of *P. acnes* infection. In the majority of cases, *P. acnes* was the only organism identified. The mean incubation TTP for all isolates was 5.73 days.

**Conclusions:** Standard 5-day culture incubation periods are insufficient to recover *P. acnes*. As a result, *P. acnes* is likely a much more common etiology of a variety of clinical infections than previously reported.

**Keywords:** *Propionibacterium acnes*; Time-to-positivity; Prosthetic joint infection; Implanted electronic cardiac device infection

## Introduction

*Propionibacterium acnes*, an anaerobic, non-sporulating, Gram-positive rod has classically been identified as the etiology of acne vulgaris [1]. In more recent years, however, it has been increasingly recognized as a causative agent of invasive

infections, including prosthetic joints, cardiac devices and neurosurgically implanted materials [2-4]. *P. acnes* is a part of the normal human skin microbiota, residing in sebaceous glands and hair follicles, conjunctiva, external ear canal, oral cavity, and gastrointestinal tract [5, 6]. Similar to other bacterial skin flora such as *Staphylococcus* species, *P. acnes* has high affinity to adhere to implanted devices by production of biofilm [7, 8]. This property of *P. acnes* assumes an important role in pathogenesis of infection of prosthetic materials and devices.

Studies have shown that *P. acnes* is responsible for up to 1.9% of all total shoulder arthroplasty infections [9-11]. In cases of CSF shunt infections, it has been reported to be the third most common pathogen [12]. In cardiac implantable electronic device infections, *P. acnes* has accounted for around 1.2% of cases [13]. Infections due to *P. acnes* may have been underdiagnosed due to a longer incubation period needed for this organism to grow in standard bacterial culture medium.

We identified a significant number of clinical isolates of *P. acnes* from multiple body sites in our institution; many of them were implicated as pathogens. We sought to compile all cases of probable *P. acnes* infections over a 5-year period at our hospital. Specifically, we wanted to better define the time-to-positivity (TTP) of *P. acnes* in standard cultures, and observe if it differed based on the sites of infection.

## Materials and Methods

A retrospective chart review was conducted at our 600-bed tertiary care institution. All cultures with growth of *P. acnes* isolated over a 5-year period (January 2010 to December 2014) were included for analysis, regardless of the specimen source. The study was conducted as a quality improvement (QI) project after approval from the Institutional Review Board.

Charts associated with each positive *P. acnes* isolate were reviewed, and the following information was collected: patient's gender, diagnosis, antibiotic use, specimen site, and TTP of cultures. These data were tabulated in terms of number of cases of infection per body site, as well as range and median TTP.

## Results

A total of 146 specimens from 121 patients were analyzed. The 146 *P. acnes* isolates were categorized, in order of decreasing frequency, into central nervous system, blood, bone and joint,

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**Table 1.** A Summary of the Anatomical Sites of *Propionibacterium acnes* Isolates With Respective Time-to-Positivity (TTP)

Sites of isolation (total: 146)	N (%)	TTP (range in days)	Median (days)
Blood	26 (17.8)	4 - 6	5
Central nervous system			
Epidural tissue	12 (8.2)	3 - 7	6
Cerebrospinal fluid from ventriculo-peritoneal shunt	12 (8.2)	3 - 7	5.5
Craniotomy site	29 (19.8)	3 - 8	6
Brain tissue	1 (0.68)	7	-
Subdural hematoma	1 (0.68)	7	-
Musculoskeletal			
Native joints	5 (3.4)	4 - 7	5
Prosthetic joints	11 (7.5)	5 - 6	6
Vertebral spine tissue	8 (5.4)	5 - 8	7
Skin and soft tissue			
Cardiac implantable electronic devices	8 (5.4)	5 - 10	7
Lymph node	1 (0.68)	6	-
Abdominal			
Biliary drain	2 (1.36)	7	7
Peritoneal fluid	2 (1.36)	6	6
Arteriovenous graft	1 (0.68)	5	-
Pleural fluid	5 (3.4)	5 - 8	6

skin and soft tissue, implanted cardiac devices, pleural fluid, abdominal fluid, lymph node, and arteriovenous graft tissues sites of infection (Table 1).

The majority (122/146; 83.5%) of specimens were sampled from sterile sites while the remaining 16% (24/146) were collected from superficial wound swabs. In 85.7% of all isolates, *P. acnes* was the sole microbe identified. The remainder (14.3%) were recovered from superficial wound swabs as a part of polymicrobial culture growth.

The TTP for all *P. acnes* specimens ranged from 3 to 11 days, with a mean of 5.73 days, median of 6 days, and a standard deviation of 1.25 days (Table 1). Male patients comprised 77% (94) of specimen sources.

Implanted devices accounted for 21.9% (32/146) of specimen sites, including ventriculoperitoneal shunts 37.5% (12/32), prosthetic joints 35.4% (11/32), cardiac implantable electronic devices 25% (8/32), and arteriovenous grafts 3.1% (1/32). All of these patients were treated with antimicrobial agents with activity toward *P. acnes*. All infected cardiac devices were extracted, and patients with prosthetic joint infections underwent explanation of prostheses or debridement with hardware retention. A majority of ventriculoperitoneal shunts were surgically revised or extracted; the infected arteriovenous graft was surgically revised.

## Discussion

Our study affirms that *P. acnes* is commonly associated with

prosthetic infections. We additionally found that it may be isolated in many different body sites, including native tissues. In our study, we noted that male gender constituted more than two-thirds of patients with positive *P. acnes* culture. A proposed hypothesis of higher incidence of *P. acnes* infection in males compared to females is more hair follicles and increased sebaceous gland activity secondary to higher androgen levels [14, 15].

*P. acnes* frequently requires an incubation period longer than 5 days to grow using routine culture methods, given the slow growth rate of this bacterium [16, 17]. When clinical suspicion is high, extending culture incubation duration beyond the standard 5 days is important, thereby maximizing the recovery of *P. acnes*. It has been previously reported that a minimum of 13 days of culture incubation on both aerobic and anaerobic media is needed to optimally recover *P. acnes* [18]. Therefore, in our hospital when *P. acnes* infection is suspected, we had requested the microbiology laboratory to hold cultures up to 14 days. However, our study suggests that a 6 to 10-day incubation period may be sufficient, depending upon the site of infection. Defining an appropriate culture incubation period would be beneficial in decreasing overall laboratory cost and workload while ensuring that clinical infections by *P. acnes* are not overlooked.

Major limitations of this study included its retrospective design and the lack of a uniform extension of the traditional incubation period for all cultures. Because of the relatively small sample size in each infection, the estimated TTP in each culture site cannot be generalized and its interpretation requires

caution. All *P. acnes* isolates identified beyond 5 days were extended on request by physicians to the microbiology lab. Therefore, we feel that *P. acnes* infections are underestimated. A prospective study implementing universally longer incubation periods is needed to better assess TTP and resultant clinical implications.

### Conclusions

Our data add to the understanding of *P. acnes* as a cause of various infections of both native tissues and prosthetic devices. *P. acnes* TTP is frequently longer than the standard 5-day bacterial culture incubation period; based on our study, this microbe is detectable by routine culture methods within 11 days. Routine implementation of longer incubation periods would likely increase the detection of *P. acnes* and help clinicians choose targeted antimicrobial therapy.

### Conflicts of Interest

There are none to report for all authors.

### Grant Support

None.

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