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Infective endocarditis due to *Propionibacterium* species

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Abstract

Propionibacterium species rarely cause infective endocarditis. When identified in blood cultures, they may be inappropriately disregarded as skin flora contaminants. The purpose of this study was to characterize the clinical presentation and management of endocarditis due to *Propionibacterium* species. All cases of endocarditis due to *Propionibacterium* species that were treated at the Mayo Clinic, Rochester, USA were retrospectively reviewed, and the English language medical literature was searched for all previously published reports. Seventy cases, which included eight from the Mayo Clinic, were identified (clinical details were available for only 58 cases). The median age of patients was 52 years, and 90% were males. In 79% of the cases, the infection involved prosthetic material (39 prosthetic valves, one left ventricular Teflon patch, one mitral valve ring, one pulmonary artery prosthetic graft, three pacemakers, and one defibrillator). Blood cultures were positive in 62% of cases. All 22 cases with negative blood cultures were microbiologically confirmed by either positive valve tissue cultures (n = 21) or molecular methods (n = 1). Endocarditis was complicated by abscess formation in 36% of cases. The majority (81%) of patients underwent surgery, either for valve replacement and debridement of a cardiac abscess, or removal of an infected device. Crude in-hospital mortality was 16%. The median duration of postoperative antibiotic treatment was 42 days. Patients were commonly treated with a penicillin derivative alone or in combination with gentamicin. On the basis of the above data, it is recommended that infective endocarditis should be strongly suspected when *Propionibacterium* species are isolated from multiple blood cultures, particularly in the presence of a cardiovascular device.

Keywords: Acne, endocarditis, granulosum, infection, native valve, *Propionibacterium*, prosthetic valve
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Introduction

Propionibacterium species are micro-aerophilic, non-spore-forming, pleomorphic, Gram-positive coccobacilli that are ubiquitous; they are constituents of the normal human skin microflora. Major species include *Propionibacterium acnes*, *Propionibacterium granulosum* and *Propionibacterium propionicum*. When identified in blood cultures, propionibacteria are often regarded as skin contaminants. Although generally non-pathogenic, *Propionibacterium* species have been implicated in serious infections, including brain abscesses, osteomyelitis, endophthalmitis, cerebrospinal shunt infections, subdural empyema, parotid and dental infections, and infective endocarditis [1]. In the case of endocarditis, *Propionibacterium* species usually cause prosthetic valve infection.

Propionibacterium species are probably underestimated and under-reported, but potentially serious, causes of infective endocarditis. Thus, both our institutional records and the published English language medical literature that describes cases of infective endocarditis due to *Propionibacterium* species were reviewed.

Patients and Methods

All cases of *Propionibacterium* endocarditis managed at the Mayo Clinic, Rochester, USA were retrospectively reviewed. Cases of *Propionibacterium* endocarditis were identified from a prospective database of endocarditis cases maintained by the Division of Infectious Diseases [2] from 1967 to 2005, and from the computerized diagnostic index of the Mayo Clinic. Patients who consented to the use of their medical records for research were included in the study, following approval of the protocol by the Mayo Clinic Institutional Review Board.

All previously published case reports of *Propionibacterium* endocarditis were reviewed. The English language medical

literature was searched using the online bibliographic databases of the National Library of Medicine (MEDLINE, PubMed). Search terms included *Propionibacterium*, *P. acnes*, *P. granulosum*, *Propionibacterium* species, endocarditis, infection, infective endocarditis, prosthetic valve, pacemaker, and implantable cardioverter-defibrillator. An extensive bibliography search of the articles identified through the MEDLINE and PubMed was also performed.

Case definition

It is difficult to make an accurate count of valid cases of endocarditis due to *Propionibacterium* species as described in the earlier literature, because of inconsistencies in the nomenclature and insufficient microbiological characterization of the infecting organisms. Only cases that fulfilled the modified Duke criteria [3] for diagnosis of definite infective endocarditis were included in the review. Cases with a single positive blood culture for *Propionibacterium* species only, or positive valve tissue cultures in the absence of histopathological evidence of endocarditis, were excluded.

Case series

Demographics, clinical presentation and management of eight patients with endocarditis due to *Propionibacterium* who were treated at the Mayo Clinic are summarized in Table 1.

Illustrative case (no. 5, Mayo series)

The following case illustrates how initial blood cultures positive for *Propionibacterium* species may be disregarded as contaminants from skin flora.

A 64-year-old male was admitted to the referring hospital for evaluation of a 2-month history of intermittent fever, rigors, and fatigue. The patient underwent an aortic valve (AV) homograft replacement in 1988 for bicuspid AV; he subsequently developed enterococcal endocarditis in 2000, and required bioprosthetic AV revision in 2002.

Hospital evaluation for endocarditis, including blood cultures and a transoesophageal echocardiogram (TEE), were negative. The patient received a short course of empirical treatment with ceftriaxone and vancomycin, which was discontinued because of the absence of a specific diagnosis, and the patient was discharged. Following discharge, the patient had a recurrence of symptoms, and was re-admitted 2 months later. Blood cultures were obtained, and a repeat TEE showed a dehisced prosthetic AV with perivalvular leak. Empirical treatment with vancomycin and levofloxacin was initiated, and the patient was transferred to the Mayo Clinic 2 days following admission.

Upon arrival, the patient was febrile (38.3°C) but was haemodynamically stable. Physical examination revealed a loud (grade IV/VI) systolic ejection murmur, and coarse crackles in bilateral lung bases. The peripheral leukocyte count was

TABLE 1. Summary of data concerning eight patients with *Propionibacterium acnes* endocarditis—Mayo Clinic experience

Case no.	Age/ gender	Predisposing/comorbid conditions	Clinical presentation	Echocardiographic findings	Treatment	Outcome (FUP)
1	26/F	RHD, Carpentier–Edwards MV replacement	Fatigue, anaemia (–BC/+VC)[a]	MV regurgitation	Vancomycin × 4 weeks, surgery for perivalvular leak and abscess debridement	Cured (1 year)
2	55/M	Starr–Edwards ball prosthetic MV (re-do secondary to leak)	Fever, shortness of breath, weight loss, sweating (+BC/+VC)[a]	MV regurgitation	Cefazolin × 4 weeks, surgery for valve replacement and abscess debridement	Cured (11 years)
3	76/M	Carpentier–Edwards prosthetic AV	Shortness of breath (–BC/+VC)[a]	AV regurgitation, perivalvular abscess, aortoventricular fistula	Vancomycin + ceftriaxone × 4 weeks, surgery for abscess debridement	Cured (5 years)
4	78/M	RHD, Carpentier–Edwards prosthetic AV	Fever, shortness of breath, syncope (–BC/+VC)[a]	AV regurgitation, periprosthetic leak	Vancomycin × 6 weeks, surgery for valve replacement	Died of infection
5	64/M	Bioprosthetic AV replacement for bicuspid valve	Fever, rigors, fatigue, positive Q-fever serology (+BC/+VC)[a]	Prosthetic valve dehiscence, perivalvular leak	Ceftriaxone–penicillin × 6 weeks, surgery for perivalvular abscess debridement and valve replacement	Cured (2 years)
6	80/M	Prosthetic AV/MV	Right knee septic arthritis (+BC/+VC)[a]	MV vegetation and regurgitation	Ceftriaxone × 6 weeks + gentamicin × 2 weeks, no surgery	Cured (18 months)
7	61/M	PPM	Fever, malaise, fatigue, sweating (+BC/+VC/+ PPM lead cultures)[a]	TV and PPM lead vegetation	Cefazolin × 4 weeks. TV repair and PPM leads extraction	Cured (1 month)
8	46/M	ICD, CHF, non-Hodgkins lymphoma	Fever, fatigue, malaise, hypotension, ICD pocket infection (–BC/+ICD lead and pocket cultures)[a]	ICD lead vegetation	Vancomycin × 4 weeks, percutaneous ICD lead extraction	Cured (18 months)

+, positive; –, negative; AV, aortic valve; BC, blood culture; CHF, congestive heart failure; FUP, follow-up period; ICD, implantable cardioverter-defibrillator; MV, mitral valve; PPM, permanent pacemaker; RHD, rheumatic heart disease; TV, tricuspid valve; VC, valve culture.
[a]Refers to *P. acnes* cultures.

normal, and the erythrocyte sedimentation rate was 24 mm/h. Repeat blood cultures were performed, and empirical treatment with ampicillin–sulbactam and gentamicin was initiated. Blood cultures from the referring hospital were negative after 72 h of incubation, and the procedure for culture-negative endocarditis was initiated.

Serological studies gave negative results for *Brucella* species, *Francisella tularensis*, *Coccidioides*, *Cryptococcus*, *Histoplasma*, *Borrelia burgdorferi*, and *Legionella*. However, *Coxiella burnetii* serological studies revealed an IgG phase I titre of 1 : 1024, an IgM phase I titre <1 : 16, an IgG phase II titre of 1 : 2048, and IgM phase II titre <1 : 16. These findings were consistent with acute *C. burnetii* [4,5]. The patient reported exposure to farm animals (sheep) 7 months prior to illness. Ongoing antibiotic treatment was discontinued, and treatment with oral doxycycline and hydroxychloroquine was started.

Blood cultures obtained at the referring hospital were reported to have grown Gram-positive rods in the anaerobic bottles on day 6 of incubation, and these were subsequently identified as *P. acnes*. However, with convincing serological evidence of Q-fever endocarditis, these cultures were disregarded as skin contaminants. The blood cultures obtained at the Mayo Clinic remained negative.

A repeat TEE showed a large pseudo-aneurysm of the posterior aortic root with severe paraprosthetic aortic regurgitation and an unsupported AV posteriorly. The patient underwent surgery, and intra-operative findings indicated disruption of the valve annulus, pseudo-aneurysm at the pericardial–aortic anastomosis, and a peri-annular abscess. Abscess cavities were debrided, and the infected prosthetic AV was replaced with a homograft. Valvular pathology showed a 1.6-cm vegetation and active endocarditis with numerous Gram-positive coccobacilli (Fig. 1). AV tissue cultures grew *P. acnes*. The isolate was susceptible to penicillin and clindamycin according to *in vitro* testing. Repeat *C. burnetii* serological studies showed an IgG phase I titre of 1 : 16 384 (four-fold rise as compared to initial testing), an IgM phase I titre >1 : 16, an IgG phase II titre of 1 : 4096, and an IgM phase II titre <1 : 16. Unfortunately, the valve was not sent for *C. burnetii* culture or PCR.

The postoperative course was complicated by nosocomial pneumonia, which required broad-spectrum antibiotics. Following improvement, treatment with aqueous crystalline penicillin G (15 million units per day) was given for 6 weeks (adjusted for renal function), followed by suppression therapy with oral penicillin V (500 mg twice daily) for *P. acnes* endocarditis. Treatment with oral doxycycline (100 mg twice daily) and hydroxychloroquine (200 mg three times daily) was continued, to complete an 18-month course, and this

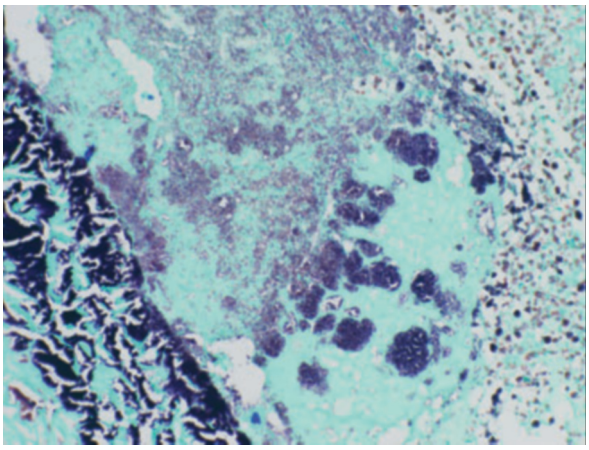

FIG. 1. Aortic valve bioprosthesis, with one vegetation (up to 1.6 cm in greatest dimension) with active infective endocarditis. The image shows blue clumps of Gram-positive bacilli.

was followed by lifelong suppressive therapy for Q-fever with oral doxycycline (100 mg twice daily). Repeat *C. burnetii* serological studies that were performed 3 months following discharge showed an IgG phase I titre of 1 : 2048 and an IgG phase II titre of 1 : 512. *C. burnetii* serological results obtained 6 months following discharge showed an IgG phase I titre of 1 : 1024 and an IgG phase II titre of 1 : 512. The patient was doing well at the last follow-up visit 2 years later.

Results

Seventy cases of *Propionibacterium* endocarditis were identified through a search of the English language medical literature and the Mayo Clinic institutional database [6–35]. However, clinical details were available for only 58 cases (including eight patients from our series) [6,8–12,14–35] to classify them as 'definite' endocarditis using the modified Duke criteria [3]. Demographic characteristics of these 58 cases are summarized in Table 2.

The median age of the patients at the time of presentation was 52 years (range 15–80 years), and 90% were males. Endocarditis involved a prosthetic cardiac device in 79% of cases (Table 2), and prosthetic valve endocarditis (39, 67%) was the most common presentation. Among the 12 patients who did not have a prosthetic device, eight had a documented history of an abnormal native heart valve (stenosis, regurgitation, or degenerative disease) prior to developing endocarditis. Congestive heart failure (16%) and diabetes mellitus (8%) were other commonly reported comorbid conditions (Table 2).

TABLE 2. Clinical characteristics of patients with *Propionibacterium* endocarditis (Mayo Clinic series and review of the literature, *n* = 58)

Age	
Median (IQR) years	52 (40–61) years
Range	15–80 years
Gender	
Male	52 (90%)
Female	6 (10%)
Predisposing conditions/comorbid conditions	
Prosthetic heart valve	39 (67%)
Permanent pacemaker/defibrillator	4 (7%)
Other prosthetic devices[a]	3 (5%)
History of rheumatic heart disease	10 (17%)
Congestive heart failure	9 (16%)
Diabetes mellitus	5 (8%)
Immunocompromised	3 (5%)
History of endocarditis	3 (5%)

IQR, interquartile range.
[a]Include one each of ventricular Teflon patch, mitral prosthetic valve ring, and prosthetic pulmonary artery graft.

TABLE 3. Clinical presentation, microbiology and complications in patients with *Propionibacterium* endocarditis (Mayo Clinic series and review of the literature, *n* = 58[a]).

Variable	Number (%)[a]
Clinical presentation	
Time from valvular replacement/device insertion to endocarditis, median (range), years	4 years (3 weeks to 23 years)
Time from symptom onset to diagnosis, median (range) weeks	4 (1–32) weeks
Systemic symptoms[b] (*n* = 40)[c]	30 (75%)
Leukocytosis (*n* = 23)[c]	13 (57%)
Positive blood cultures[d]	36 (62%)
Positive valve tissue/device lead cultures	28 (48%)
Time to positive blood/valve culture, median (range), days	7 (4–14) days
Histopathological confirmation of valve infection	23 (40%)
Microbiology	
Propionibacterium acnes	37 (64%)
Propionibacterium granulosum	2 (3%)
Propionibacterium species (further identification not available)	19 (33%)
Complications	
Peripheral emboli	9 (16%)
Brain emboli	6 (10%)
Myocardial abscess	21 (36%)
Valvular insufficiency	30 (52%)
Crude in-hospital mortality	9 (16%)
Valvular involvement	
Aortic valve	41 (71%)
Mitral valve	14 (24%)
Tricuspid valve	2 (3%)

[a]Unless otherwise specified.
[b]Including fever, chills, malaise, fatigue, myalgias, and weight loss.
[c]*n*, number of cases for which data were available.
[d]Two or more positive blood cultures with *Propionibacterium* species were reported in 33 cases. In three patients with single positive blood cultures, *Propionibacterium* endocarditis was confirmed by histopathology (two cases) and positive electrode lead tip culture (one case with pacemaker-associated endocarditis).

The clinical presentation of patients is summarized in Table 3. The majority (75%) had systemic symptoms at initial presentation that included fever, malaise, fatigue, cough, and/or shortness of breath. The median time from symptom onset to diagnosis of endocarditis was 4 weeks. Blood cultures were positive in 36 (62%) cases. Among 22 patients with negative blood cultures, *Propionibacterium* species were identified according to valve tissue cultures (21 patients) or molecular methods (one isolate, 16S rRNA gene PCR amplification) [8]. The median time to blood or tissue culture positivity was 7 days. However, in four cases, it took 10–14 days for blood cultures to become positive [10,27,29,31]. *P. acnes* was the most commonly isolated species (64% cases). *P. granulosum* was identified in two patients, both of whom had native valve endocarditis [6,9].

AVs were the most common sites of vegetation formation (71%), followed by mitral (24%) and tricuspid (3%) valves. One patient had infection of a prosthetic shunt, implanted between the pulmonary artery and right ventricle, that was complicated by pseudo-aneurysm formation [8]. Myocardial abscesses were reported in 21 (36%) patients, and the majority (18, 86%) involved a prosthetic cardiac device. Peripheral emboli were reported in nine (16%) cases (eight aortic valve, and one mitral valve) and eight of these were in patients with prosthetic valve endocarditis. Metastatic foci of infection included septic arthritis involving the knee (*n* = 1), splenic infarction (*n* = 3), renal abscess formation (*n* = 1), pancreatic abscess formation (*n* = 1), and peripheral mycotic aneurysms (*n* = 4). Brain emboli occurred in six patients (four of whom also had peripheral emboli) [14,16,17,20] and only in those with prosthetic AV endocarditis.

The majority of patients (47, 81%) underwent surgery, in addition to prolonged antimicrobial treatment; the remaining 11 (19%) patients were managed with antibiotics alone. Details of antimicrobial treatment were available for only 44 patients. Twenty patients (45%) were treated with a β-lactam or glycopeptide plus aminoglycoside, and the remaining 24 (55%) patients received monotherapy (β-lactams or glycopeptides). The median duration of antibiotics was 42 days (interquartile range 28–42 days). Five patients received chronic suppressive therapy with amoiycillin or clindamycin (for 3–6 months) after prosthetic valve replacement and a 6–8-week course of intravenous antibiotics [8,15,32,35].

Overall mortality in patients with *Propionibacterium* endocarditis was 16% (nine cases; seven patients with prosthetic valve involvement, and two with native valve infection). Demographic and clinical characteristics of these patients are summarized in Table 4 (excluding case no. 4 from the Mayo series, which is listed in Table 1). Three deaths occurred in patients who were managed conservatively with antibiotics alone; two of these patients died within 72 h of hospitalization. Six patients died despite undergoing combined medical and surgical therapy.

TABLE 4. Summary of data concerning patients who died with *Propionibacterium* endocarditis[a]

References	Age/ gender	Valve	Cardiac abscess	Emboli	Antibiotics	Surgery	Comments
Clayton *et al.* [12]	43/M	Prosthetic AV	Yes	Peripheral	Vanc, Rif	Yes	Patient could not be weaned off CPB and died on postoperative day 1
Clayton *et al.* [12]	56/F	Native MV	No	No	β-Lactam, AG, Rif	Yes	Postoperative course complicated by *Staphylococcus aureus* sternal osteomyelitis, sepsis, and renal failure
Clayton *et al.* [12]	67/M	Native MV	No	No	Vanc, AG, Rif	No	Patient died of sepsis and renal failure. Positive blood cultures reported after death
Huynh *et al.* [17]	46/M	Prosthetic AV	Yes	Peripheral, cerebral	Vanc, AG, Rif	Yes	Patient died from rupture of splenic artery mycotic aneurysm on postoperative day 10
Lalani *et al.* [20]	52/M	Prosthetic valve	No	No	NA	Yes	NA
Lalani *et al.* [20]	75/M	Prosthetic AV	Yes	Cerebral	β-Lactam, AG, Vanc	No	NA
McFadden *et al.* [24]	52/M	Prosthetic AV	Yes	Peripheral	β-Lactam	Yes	Renal, splenic and multiple peripheral vascular infarcts on autopsy. Patient could not be weaned off CPB
Wison *et al.* [34]	57/M	Prosthetic AV	No	No	N/A	No	Patient died due to PV dehiscence on day 3 of hospitalization

AG, aminoglycoside; AV, aortic valve; CPB, cardiopulmonary bypass machine; MV, mitral valve; NA, not available; PV, prosthetic value; Rif, rifampin; Vanc, vancomycin.
[a]Excluding case no. 4 from the Mayo series included in Table 1.

Two patients suffered relapsing infection [20,27]. Both patients had prosthetic mitral valve endocarditis without evidence of cardiac abscess or heart failure, and both were managed conservatively with antibiotics alone. One patient was a 41-year-old male who was initially treated with a 6-week course of ampicillin and gentamicin [27]. He relapsed 5 months later, and received another 4-week course of intravenous penicillin and gentamicin without surgical intervention. The patient remained free of infection during the next 18 months of follow-up. The other patient was a 52-year-old male who was treated with a 6-week course of a β-lactam antibiotic and doxycycline, starting at initial presentation [20]. This patient had three episodes of relapsing endocarditis over the next 4 years but survived.

DISCUSSION

The majority of patients with *Propionibacterium* endocarditis were middle-aged men with prosthetic cardiac devices. In the current review, 79% of cases involved a prosthetic heart valve, permanent pacemaker, implantable cardioverter-defibrillator, or prosthetic valve ring. The propensity of propionibacteria to cause prosthetic valve endocarditis may be due to their ability to adhere to foreign body surfaces and produce biofilm [36,37]. Native valve endocarditis due to *Propionibacterium* species is uncommon, and involved abnormal native valves (secondary to rheumatic heart disease or degenerative changes) in 67% of cases in this study. A preponderance of men among patients with *Propionibacterium* endocarditis is consistent with similar trends observed in patients with endocarditis involving infection of a prosthetic valve due to *Staphylococcus aureus* [38] and infections associated with percutaneous vascular closure devices [39] or endocarditis associated with a permanent pacemaker or implantable cardioverter-defibrillator [40,41]. Whether this prevalence of infection in males is due to a higher rate of implantation of prosthetic devices or, rather, other comorbid conditions remains unclear.

Infection of a prosthetic valve probably results from contamination at the time of the implantation, as propionibacteria form part of the normal human skin flora. However, in cases with very delayed presentations (up to 23 years after valve surgery) [20], endocarditis most likely occurred due to bacteraemia from a distant focus and secondary seeding of the prosthetic valves. Propionibacteria form part of the normal human oropharyngeal flora [42,43] and bacteraemia may result from invasive dental procedures, a pathogenesis mechanism similar to that of endocarditis due to viridans group streptococci.

The diagnosis of *Propionibacterium* endocarditis may be delayed or difficult to confirm, for several reasons. First, endocarditis may develop several years after valve replacement surgery. Second, blood cultures may be negative in up to one-third of cases (38% of cases in the present study had negative blood cultures). Third, propionibacteria grown in blood cultures may be regarded as contaminants. Case no. 5 from the present series (Table 1) is one example where blood cultures positive for *P. acnes* from a referring institution were regarded as representing contaminants, and a search for culture-negative endocarditis was initiated. Fourth, blood cultures may require longer incubation periods (up to 14 days) [27], and may be reported as negative if blood culture bottles are incubated for only 5 days, which is currently a common practice in many microbiology laboratories. In cases of suspected endocarditis, incubation of blood (aerobic and anaerobic) and valve tissue cultures should be extended to 14 days if they

remain negative in the first week, and if no alternative diagnosis is established.

It is well recognized that valve tissue cultures can be contaminated during the removal and processing of specimens, and *Propionibacterium* species have been identified as valve culture contaminants [44–46]. If surgery is performed, valve tissue specimens should be sent for both histopathological examination and culture to confirm the diagnosis. All cases of *Propionibacterium* endocarditis included in the present study (Mayo series and literature review) were confirmed by a combination of blood culture, valve culture and/or histopathological examination using the modified Duke criteria [3]. *Propionibacterium* endocarditis was confirmed by histopathological demonstration of Gram-positive coccobacilli in cases with positive valve cultures only (negative blood cultures). However, histopathological confirmation of *Propionibacterium* endocarditis was not available in four cases that were diagnosed with valve tissue cultures (n = 3) or PCR (n = 1) only. It is possible that positive valve tissue cultures or PCR in these four cases could be due to contamination of specimens during surgical removal or sample processing.

Complications of *Propionibacterium* endocarditis were more frequent in cases with prosthetic valve infection than in those with native valve infection. Myocardial abscess was reported in 46% (18/39) of cases of prosthetic valve endocarditis, as compared to 25% in cases of native valve endocarditis (3/12). Similarly, most (89%) cases of peripheral emboli (eight of nine patients) and all six cases (100%) of cerebral emboli occurred in patients with prosthetic valve endocarditis.

There was one reported case of rapidly progressive crescentic glomerulonephritis and renal failure associated with *P. acnes* tricuspid valve endocarditis [19]. A diagnosis of glomerulonephritis was confirmed by renal biopsy. The patient was treated with a 2-week course of low-dose corticosteroids and a 6-week course of intravenous penicillin G. Full recovery of renal function occurred during the follow-up period.

Overall in-hospital mortality in the present study was 16% (nine cases). However, there was no significant difference in mortality rate between prosthetic valve endocarditis (7/39, 18%) and that due to native valve infection (2/12, 17%).

Indications for surgical intervention in patients with *Propionibacterium* endocarditis are similar to those for endocarditis due to other pathogens [47]. As most of the published data consist of case reports or small case series, there are no clear guidelines regarding management of *Propionibacterium* endocarditis. In general, patients are treated with a 6-week course of a β-lactam antibiotic, alone or in combination with aminoglycosides. Because of the limited and uncontrolled nature of this study, a comparison of outcomes with single vs. combination therapy cannot be made. Vancomycin is generally used in patients who are allergic or intolerant to β-lactam agents. Rifampin use has been increasingly reported in recent cases of *Propionibacterium* prosthetic valve endocarditis, possibly to take advantage of its biofilm-penetrating ability [8,12,17,25]. Resistance of *Propionibacterium* isolates to penicillin is extremely rare, and only one case of a penicillin-resistant strain causing endocarditis has been reported [23].

Conclusion

Propionibacterium endocarditis should be strongly considered in patients with blood cultures that yield this organism. The clinical significance of the culture results should not be discounted immediately and the findings relegated to a 'contaminant' category. This is particularly relevant for male patients who have either underlying cardiac medical devices or abnormal native cardiac valves. Because many of these patients require surgical intervention for cure, it is imperative that resected cardiac tissue undergo both microbiological and histopathological examination to further support a diagnosis of endocarditis due to *Propionibacterium* species.

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