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Pacemaker infection and endocarditis due to parvimonas micra: A case report and systematic review

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**Pacemaker infection and endocarditis due to *Parvimonas micra*: A case report and
systematic review**

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¹ Abbreviations: CDIE, Cardiac device infective endocarditis; CT, Computed tomography; GNAR, Gram-negative anaerobic rods; GPAC, Gram-positive anaerobic cocci; IE, Infective endocarditis; MALDI-TOF MS, matrix-assisted laser desorption/ionization and time-of-flight mass spectrometry; PPM, Permanent pacemaker; TEE, transesophageal echocardiography; WBC, White blood cell count.

16 **ABSTRACT**

17 Infective endocarditis caused by *Parvimonas micra* is rare. Its clinical features are
18 presented in this systematic review. We also describe the case of an 82-year-old man
19 with infective endocarditis and pacemaker infection due to *P. micra*. There are some
20 reports of recurrence during antimicrobial therapy; hence, careful follow-up is
21 necessary.

22

23 **Keywords:** *Parvimonas micra*, pacemaker infection, endocarditis

24

25 **Introduction**

26 Infective endocarditis (IE) is associated with high morbidity and mortality [1-3] and is
27 defined as a systemic septic disease with various manifestations [4]. The risk factors for
28 endocarditis include increasing age [5], male sex [6], poor dentition [7], and cardiac
29 implantable electronic devices [8]. Permanent pacemaker (PPM)-related infection has
30 been recognized since the 1970s [9], with an occurrence of 1.19% during the lifetime of
31 a device [10]. Cardiac device infective endocarditis (CDIE) has remarkably higher
32 mortality than cardiac device infections without endocarditis. Approximately 60%–80%
33 of causative pathogens of CDIE are of staphylococcal species, whereas other Gram-
34 positive cocci accounted for only 4% of all cases [11].

35 *Parvimonas micra* (*P. micra*) is a Gram-positive anaerobic coccus that forms part of
36 the normal commensal flora in the oral cavity and gastrointestinal tract [12]. Despite its
37 low virulence, some patients may develop bacteremia [13], lung abscess [14],
38 meningitis [15], cerebral and brain abscesses [16], spondylodiscitis [17], and iliopsoas
39 abscesses [18]. *P. micra* endocarditis is uncommon, with few reports published
40 previously [19,20]. Additionally, their pathogenic implication has been underestimated
41 because of their slow growth and difficulty in identification.

42 This is the first report of right-sided IE involving a pacemaker by *P. micra*. Another

strength is that the patient deteriorated clinically despite negative blood cultures, emphasizing the importance of frequent follow-up with echocardiography given *P. micra* is difficult to grow. Herein, we present the case of pacemaker infection and a systematic review of endocarditis due to *P. micra*.

Description of the Case

An 82-year-old man came to our hospital with acute onset of fever and dizziness. He had a past medical history of pacemaker implantation due to sick sinus syndrome, undergoing synthetic graft replacement for an abdominal aortic aneurysm two decades ago, and hypertension. He was regularly taking aspirin 100 mg once a day and olmesartan medoxomil 10 mg once a day before admission. He was a social drinker but had no history of smoking. His occupation was a businessman, now retired, living in a retirement home, and originally independent in his daily activities, and he was walking with a cane. On admission, he was in acute distress, and his vital signs were clear consciousness; temperature, 38.4°C; blood pressure, 114/75 mm Hg; pulse rate, 74 beats/min (not pacemaker rhythm); respiratory rate, 18 breaths/min; and oxygen saturation, 94% at room temperature. Physical examination revealed a grade III diastolic murmur that was most audible in the left third intercostal space. He had poor oral hygiene and dental caries. No

immunological phenomena (Roth spots or Osler nodes) or vascular phenomena (Janeway lesions, conjunctival petechiae, or splinter hemorrhage) were observed. Lungs were clear to auscultation, and no abnormal abdominal findings were found. Neurological findings showed no sensory or motor deficits and no abnormalities related to central nervous system. Laboratory investigations revealed a total white blood cell count (WBC) of 15,000/ μ L (WBC differential comprising 87% neutrophils, 4% lymphocytes, 6% monocytes, and 3% eosinophils), hemoglobin level of 13.3 g/dL, platelet count of 121,000/ μ L, aspartate aminotransferase at 19 U/L, alanine aminotransferase at 8 U/L, lactate dehydrogenase of 314 IU/L, total bilirubin at 1.4 mg/dl, alkaline phosphatase of 189 IU/L, blood urea nitrogen 18 mg/dL, creatinine 0.96 mg/dL, and C-reactive protein level of 2.51 mg/dL. Urinalysis was negative for urinary white or red blood cells and nitrites, and the urine bacteriology test was negative. Contrast-enhanced computed tomography (CT) of the chest-abdomen-pelvis area revealed no inflammation or artificial blood vessel infection. After admission, we started ceftriaxone (2.0 g intravenously [IV]) every 24 hours empirically.

Blood cultures on admission grew clusters of Gram-positive cocci on day 5. Transthoracic echocardiography revealed moderate tricuspid valvular regurgitation and no signs of vegetation; however, on day 7, transesophageal echocardiography (TEE)

revealed vegetation on the tricuspid valve and pacemaker lead (mainly the atrial lead) (Figure 1). Therefore, ceftriaxone was replaced with ampicillin (2.0 g IV) every 4 hours and gentamicin (180 mg IV) every 24 hours. On day 12, we removed the pacemaker and leads surgically and inserted a temporary pacemaker. On day 13, the blood cultured pathogen on admission was confirmed to be *P. micra* using matrix-assisted laser desorption/ionization and time-of-flight mass spectrometry (MALDI-TOF MS) (Bruker Daltonic, Bremen, Germany). Since the patient was receiving appropriate antimicrobial regimens, the culture pathogen tests for the pacemaker body and leads were negative. Modified Duke criteria [21] supported the diagnosis of endocarditis: one major criterion (evidence of endocardial involvement) and three minor criteria (predisposing heart condition, fever over 38°C, and microbiologic evidence). With known susceptibility results, gentamicin was terminated after a total of 6 days, and the subsequent antimicrobial regimen was reduced to ampicillin (2.0 g IV) every 4 hours alone. Follow-up blood cultures were negative. On day 22, repeated TEE was performed, and new vegetation was noted on the temporary pacemaker lead and tricuspid valve (Figure 2). As the patient was not dependent on the temporary pacemaker, it was removed entirely. The patient's clinical signs and symptoms improved, and ampicillin 2.0 g IV every 4 hours was continued for six weeks after removing the temporary pacemaker, and no subsequent

antimicrobial regimen was necessary. We did not change regular medications during the hospitalization or after discharge. The patient was discharged on day 64 without any sequelae, and no recurrence of infection and cardiac events were observed during 12 months of follow-up.

Systematic Literature Review

Two authors independently reviewed the titles and abstracts of database records, retrieved full texts for eligibility assessment, and extracted data (Figure 3). The respective search strategies for PubMed, Embase, and Ichushi-web are described in Figure 3, and twenty-eight articles were retrieved. After removing duplicates and irrelevant reports, four articles were selected [22,23]. After full-text evaluation, four articles comprising four patients were included (Figure 3 and Table 1).

Discussion

P. micra was originally classified as *Peptostreptococcus micros*. The classification of the Gram-positive anaerobic cocci (GPAC) group has been remarkably transformed by a new genetic classification method based on the 16S rRNA gene sequence introduced in the late 1990s. Thereafter, *P. micros* was reclassified as *P. micra* in 2006 [24]. GPAC are

115 bacilli of low virulence detected as frequently as Gram-negative anaerobic rods
116 (GNAR), but their pathogenic implication has been underestimated because of their
117 slow growth and difficulty in identification compared to GNAR [25]. As GPAC
118 sometimes cause serious infections, identification of various GPAC species and
119 recognition of their resistance patterns to antimicrobial agents are important. Recently,
120 as MALTI-TOF MS has been introduced at various facilities, the identification of *P.*
121 *micra* has become practical, and the number of reports has increased [26,27].
122 In the present case, the portal of entry of *P. micra* was considered to be the oral cavity.
123 As *P. micra* is a part of the oral microbiota, the main risk factors for *P. micra* infection
124 are dental procedures, periodontitis, tooth extraction, and abscesses or caries of the
125 tongue apex [28]. Three of the five cases in our literature review had one of these
126 factors.

127 Right-sided IE accounts for 5%–12% of all IE cases [29,30]. Causes of right-
128 sided IE include (1) intravenous drug use, (2) CDIE, and (3) congenital heart disease.
129 The recommended way to remove infected devices is to extract all leads and the pulse
130 generator, which is associated with a complication rate of less than 2% [31]. Immediate
131 removal of infectious devices is associated with a lower recurrence rate and mortality
132 than retention or late removal [32,33]. Fortunately, the infected pacemaker in our case

was implanted approximately six months earlier. Transvenous extraction of leads with less than one year of dwelling time is generally possible with simple traction [34]; therefore, we were able to successfully remove the entire system transvenously.

In the current case, we found that the temporary pacemaker was initially infected with new vegetation, despite two subsequent negative blood cultures. There is limited conclusive evidence on the optimal timing of reinsertion of the cardiac device or central venous catheter after removal in cases of bacteremia. Some studies recommended that new transvenous lead placement should be delayed by at least 14 days after removing infectious devices [35]. Although the negative blood culture was confirmed by appropriate antimicrobial administration, clinicians should observe cases for persistent bacteremia if the patient's clinical signs deteriorate, as it may be difficult to detect *P. micra* in blood cultures because of the characteristics of anaerobic bacteria [36]. A prospective registry of CDIE reported that 11 of 434 enrolled patients with cardiovascular implantable electronic device infections developed another infection within six months [35]. The authors suggested that all such patients should be thoroughly evaluated, and the need for device re-implantation should be reevaluated.

This was particularly relevant in the current case. As negative blood cultures may not necessarily indicate improvement in IE due to *P. micra*, clinicians should repeat

151 echocardiograms to evaluate for the presence of IE.

152 In our review, two of the five cases had severe valve dysfunction, eventually requiring

153 surgical intervention [19,20]. Despite appropriate antimicrobial therapy, invasive

154 procedures with CT-guided drainage were also required in one case presenting with a

155 lung abscess [23]. In another case, antimicrobial de-escalation resulted in a flare-up of

156 the infection, and antimicrobial susceptibility was detected [22], suggesting that the

157 possibility of mixed infections caused by anaerobic bacteria should always be

158 considered. Although it is difficult to make generalizations from this small number of

159 cases, *P. micra* sometimes progresses to abscess formation inconspicuously, and some

160 studies have reported cases of mixed infections. Therefore, when blood tests show an

161 increased inflammatory response or fever during the treatment period, it is advisable to

162 consider the possibility of recurrence, new lesions, or mixed infection.

163 In summary, *P. micra* can be a causative pathogen of IE and pacemaker infections.

164 Because of the difficulty in identifying the organism using traditional methods, the

165 introduction of MALDI-TOF MS is expected to improve the diagnostic rate of IE

166 caused by *P. micra*, which can sometimes lead to serious complications, suggesting the

167 importance of frequent follow-up. As only five cases have been reported, the

168 accumulation of future cases is expected.

169

170

171 **Declarations**

172 **Ethics approval and consent to participate**

173 The treatment for the patient was performed in accordance with the tenets of the
174 Declaration of Helsinki. The patient reported in the study provided written informed
175 consent for all procedures.

176 **Consent for publication**

177 The patient enrolled in the study provided written informed consent for the publication
178 of his clinical details and accompanying images. A copy of the written informed consent
179 is available for the journal.

180 **Availability of data and materials**

181 Not applicable.

182 **Conflicts of interests**

183 The authors have no financial disclosures or conflicts of interest to declare.

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Authors' contributions

T.S. wrote a draft of the manuscript. K.I., T.M., Y.K., and N.M. supervised the study and edited the manuscript. Y.K., H.A., and N.K. were the attending physicians of this patient. F.K. and K.I. participated in the literature review. All authors reviewed the final manuscript and approved its contents.

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310

311 **Figure Captions**

312 Figure 1. Vegetation on the atrial lead of the pacemaker and tricuspid valve

313 Transesophageal echocardiography reveals a 15.7-mm fluttering structure in the atrial

314 lead of the pacemaker and a 10.4-mm vegetation-like fluttering structure in the tricuspid

315 valve.

316

317 Figure 2. Removal of the pacemaker atrial lead

318 A red deposit on the pacemaker atrial lead that was removed is shown.

319

320 Figure 3. Flow diagram of the systematic literature review

321

322

Figure Legends

Figure 1. Flow diagram of the systematic literature review

Figure 2. Vegetation on the atrial lead of the pacemaker and tricuspid valve

Transesophageal echocardiography revealed a 15.7 mm fluttering structure in the atrial lead of the pacemaker and a 10.4 mm vegetation-like fluttering structure in the tricuspid valve

Figure 3. Removed pacemaker atrial lead

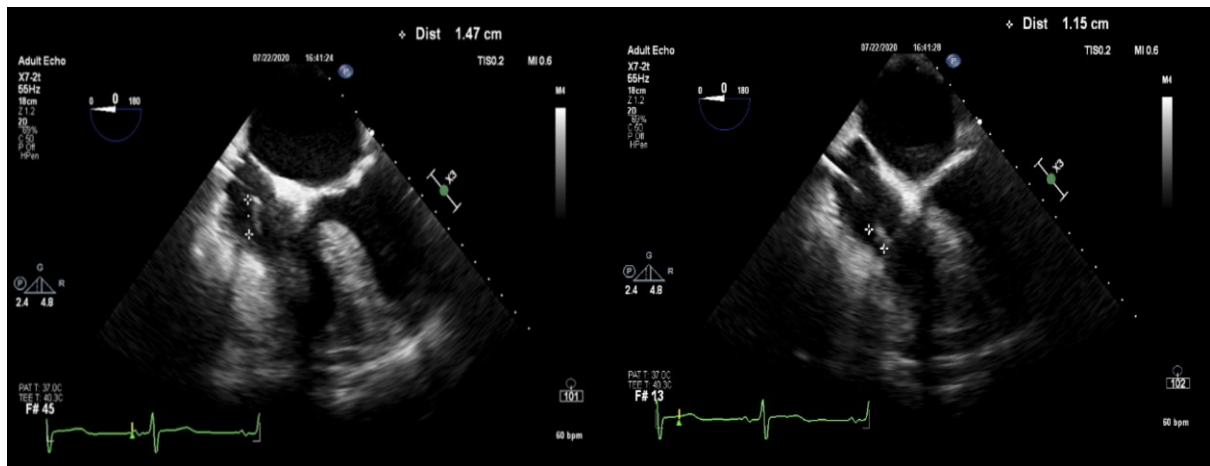
A red deposit on the pacemaker atrial lead that was removed was found

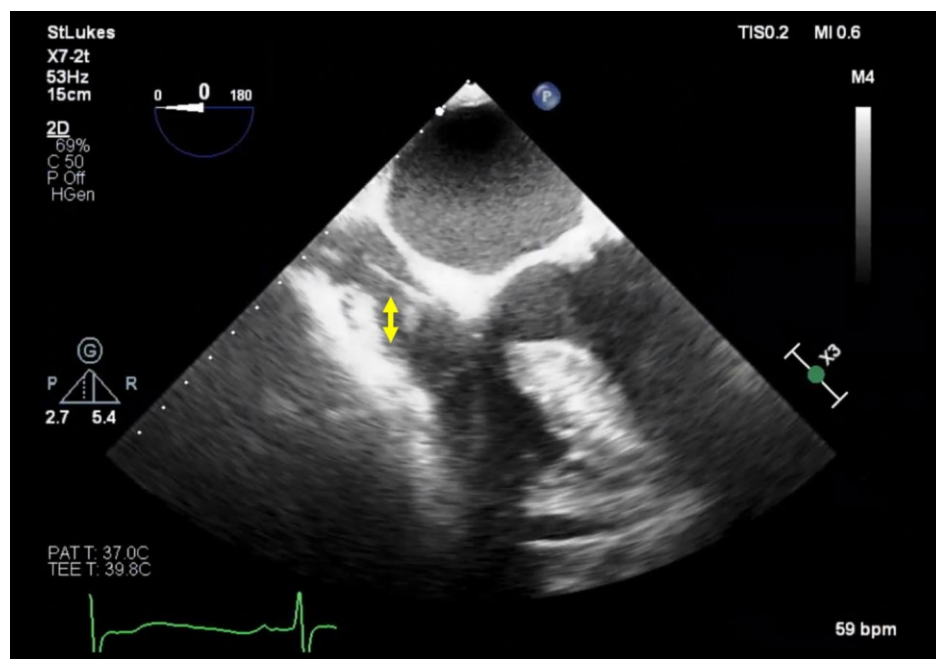
Tables

Table 1. Characteristics of patients with endocarditis due to *Parvimonas micra*

Case	Year of Report	Ref. No	Age (years)	Gender	Risk Factor for Infective Endocarditis	Infected Valves	Echocardiographic findings/Comorbidities	Diagnostic method	Days to Diagnosis	Days to positive Blood Culture	Antimicrobial therapy	Cardiac Surgery
1	2015	[19]	71	M	None	A, M-N	Perivalvular abscess	TEE	8 days	5 days	Vancomycin plus Nafcillin plus Gentamicin → Ampicillin/Sulbactam	Aortic valve and mitral valve replacement
2	2017	[40]	48	F	Tooth Extraction	T-N, PL	Vegetation Septic pulmonary embolism Bloodstream infection of <i>Fusobacterium nucleatum</i> (Co-infection)	TEE	69 days	4 days	Ampicillin/Sulbactam → plus Gentamicin → Ampicillin → Plus Metronidazole	No
3	2017	[39]	78	M	Laryngeal cancer and total laryngectomy, Poor oral hygiene	A-N	Septic Pulmonary embolism, lung abscess	TTE	NA	NA	Ampicillin/Sulbactam → Clindamycin	Drainage for lung abscess
4	2018	[20]	42	M	Tooth Extraction	M-ME	Mobile friable/ vegetations arising from the mitral prosthetic valve	TEE	22 days	NA	Ceftriaxone plus Vancomycin → Penicillin G	Reoperation of Mitral Valve for control heart failure
5	2020	PR	82	M	Poor Oral Hygiene	T-N, PL	Vegetation along pacemaker leads and on tricuspid valve	TEE	7 days	5 days	Ceftriaxone → Ampicillin plus Gentamicin → Ampicillin	Removal of permanent pacemaker

PR: present report; N/A: not available; Valve: T, tricuspid; A: aortic; M: mitral; N: native; P: prosthetic; ME: mechanical; PL: pacemaker lead





Identification

Screening

Eligibility

Included

