ACCESS MICROBIOLOGY

CASE REPORT

Hino and Veltman, *Access Microbiology* 2022;4:000355

DOI 10.1099/acmi.0.000355

MICROBIOLOGY SOCIETY

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Capnocytophaga tricuspid valve endocarditis: a case report and literature review

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Abstract

Capnocytophaga canimorsus is a Gram-negative zoonotic pathogen capable of causing serious infection following dog or cat bite. Infections often manifest as sepsis, fatal septic shock, gangrene, bacteraemia, meningitis and endocarditis. Here we report a case of *C. canimorsus* bacteraemia complicated by tricuspid valve infective endocarditis and septic pulmonary emboli.

INTRODUCTION

Capnocytophaga canimorsus is a facultative anaerobic Gram-negative bacilli that belongs to the normal oral flora of healthy dogs and cats [1]. Zoonotic transmission occurs often as a consequence of a bite or scratch and may present as a serious infection manifesting as severe sepsis, gangrene of digits or extremities, high-grade bacteraemia, meningitis, brain abscess, mycotic aneurysm, respiratory tract infection, endocarditis and rare ocular infections [2–4]. Cases of *C. canimorsus* infection described in the literature show a 28–30% fatality rate, but it is probable that less severe infections are underreported in the literature and local infections from dog bites may be treated effectively with empirical antibiotics [5–7]. Here we report a patient with *C. canimorsus* bacteraemia complicated by tricuspid valve infective endocarditis (IE) and bilateral septic pulmonary emboli.

CASE DESCRIPTION

A man in his sixties with a history of type 2 diabetes mellitus, tobacco use, homelessness, methamphetamine abuse, and no prior history of heart disease or intravenous drug use presented to an outside hospital with fevers, chills, dyspnea on exertion and left sided back pain. His initial laboratory results were notable for a white count: 14.8 and lactic acid: 2.5. Due to the patient's report of a recent syncopal episode with palpitations, he was subsequently evaluated by echocardiography, which demonstrated a large 1.9×2.9 cm mobile vegetation on the tricuspid valve with severe tricuspid regurgitation. A CT angiogram also performed on admission showed multiple pulmonary emboli with a large pulmonary artery embolus involving the entire right lower lobe pulmonary artery. One of two blood cultures on admission grew out Gram-negative rods, which were sent out for anaerobic culture identification and antimicrobial susceptibility testing provided by Mayo Clinic (test ID: ANAID and MMLSA). He was treated empirically with cefepime and ciprofloxacin for 1 week for Gram-negative rod bacteraemia. Given the large vegetation observed on the tricuspid valve, the pulmonary embolism was presumed to be septic. However, since a thrombotic embolism could not be ruled out, he was started on a continuous heparin drip. He was then transferred to our hospital for evaluation for tricuspid valve replacement.

The patient reported that he had lived with his Rottweiler dog for the past 3.5 years. While he could not recall recent dog bites or his dog licking his wounds, he reported that his dog bit him a couple times approximately 1 year ago. He further reported living in close proximity with his dog, often eating food out of the same bowel.

Received 09 October 2021; Accepted 28 March 2022; Published 04 May 2022

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Keywords: *Capnocytophaga canimorsus*; infective endocarditis; dog bites; tricuspid valve.

Abbreviations: Ao, aorta; AV, aortic valve; CLL, chronic lymphocytic leukaemia; COPD, chronic obstructive pulmonary disease; ESRD, end stage renal disease; F, female; HD, hemodialysis; ICD, implantable cardioverter defibrillator; IE, infective endocarditis; LA, left atrium; LV, left ventricle; M, male; MV, mitral valve; ND, not documented; RA, right atrium; RV, right ventricle; RVOT, right ventricular outflow tract; T2DM, type 2 diabetes mellitus; TV, tricuspid valve.

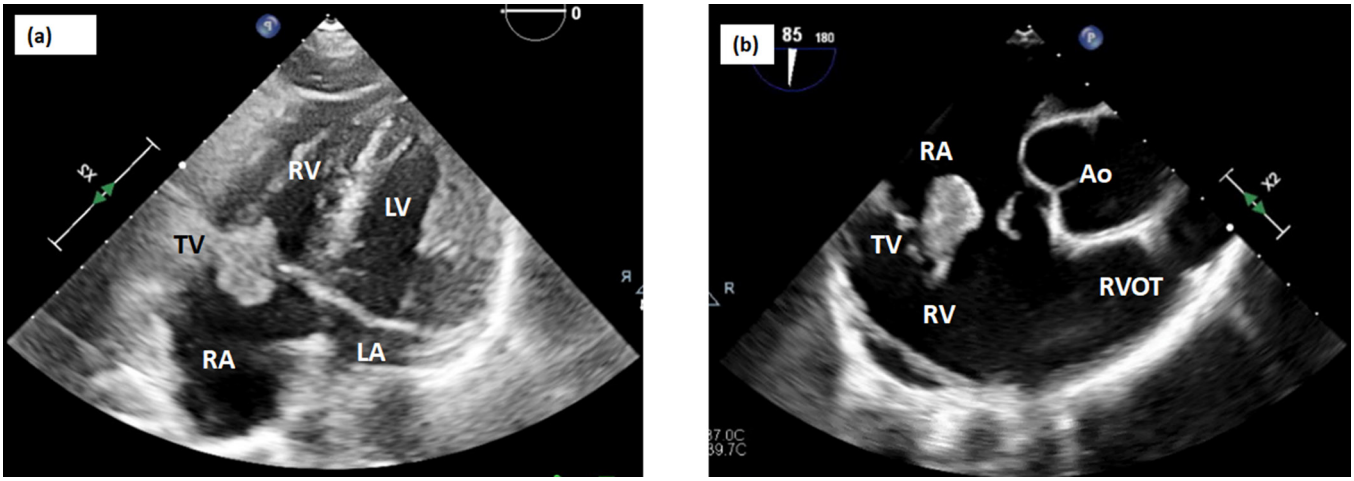

Fig. 1. Transthoracic and transesophageal echocardiogram images. (a) Apical four chamber view and (b) right ventricular inflow–outflow view showing large (~1.8×2 cm) tricuspid valve mobile vegetation attached to the atrial aspect of the anterior tricuspid leaflet. Mass enters the RV during diastole and obstructs tricuspid leaflet closure during systole. LV, left ventricle; RV, right ventricle; LA, left atrium; RA, right atrium; TV, tricuspid valve; Ao, aorta; RVOT, right ventricular outflow tract

On physical examination, the patient was found to be malnourished and underweight (BMI 14.1 kg m^{-2}), with poor dentition, showing multiple tooth fractures. His lungs were clear to auscultation bilaterally. No heart murmur, chest or back tenderness, joint swelling, tenderness or deformities, or suspicious skin lesions were noted on examination. A repeat transthoracic echocardiogram showed severe tricuspid regurgitation, left ventricular ejection fraction of ~50%, and the presence of a 1.8×2.0 cm mobile vegetation that appeared to be attached to the atrial aspect of the anterior tricuspid leaflet. The vegetation was observed to enter the right ventricle during diastole and obstruct tricuspid leaflet closure during systole. Smaller vegetations were also observed in the right ventricular outflow tract. (Fig. 1a). Carotid ultrasound demonstrated 14–25% diameter reduction stenosis of the right and left internal carotid arteries. The patient was empirically started on cefepime for Gram-negative rod bacteraemia, but switched to piperacillin/tazobactam 4.5 g every 8 h after two of four blood cultures obtained from his previous hospitalization were identified as *C. canimorsus* through the previously described outside bacterial identification service provided by Mayo Clinic. Microbial sensitivities could not be obtained due to difficulty in culturing the organism. The decision was made to optimize the patient for future valve surgery, during which time he remained hospitalized for i.v. antibiotics, clearance of blood cultures and planning for tooth extraction to prevent reinfection.

On hospital day 20, a transesophageal echocardiograph (Fig. 1b) noted tricuspid valve vegetation with no notable progression in size. Due to increased right ventricular dilatation and pressure (29 mmHG) the patient underwent surgical debridement and tricuspid valve replacement. During the operation, a large 2 cm vegetation, along with several other smaller vegetations, was removed. The patient received a #33 Epic biological tissue valve prosthesis. Pathological evaluation of valve tissue found benign valvular tissue with adherent fibrinous debris with associated acute inflammation, although no bacterial organisms were identified by Gram stain or culture. Serial blood cultures since admission identified no organisms. The patient gradually improved for 1 week after surgery and completed a 20-day course of piperacillin/tazobactam but chose to leave against medical advice without any antibiotics.

The patient returned to the emergency room 1 week later after developing sharp, left-sided flank pain and a fever up to 38.3 °C. Given the incomplete piperacillin/tazobactam course and concern regarding resistance, he was started on meropenem for continued treatment of *C. canimorsus* infection. A repeat transesophageal echocardiogram was unremarkable and showed no significant echocontrast, thrombus, masses, protruding atheroma, patent foramen ovale, or paravalvular pathology on the tricuspid or native valves. However, the patient developed a worsening cough and was found to have a right lower lobe pulmonary embolism (previously seen on a prior CT scan from outside hospital) requiring anticoagulation, and a right loculated pleural effusion which resolved with chest tube placement. The patient completed an additional 28-day course of meropenem with no clinical evidence of recurrent infection at follow-up after discharge.

DISCUSSION

C. canimorsus is a rare but emerging zoonotic pathogen that is now recognized as the second most frequently identified organism related to dog bite infections after *Pasteurella multocida* [2]. The increase in frequency associated with *C. canimorsus* infections has

Table 1. Summary of clinical features and treatment outcomes for patients with infective endocarditis caused by *C. canimorsus* reported in the literature based on a PubMed literature search 1977–2021 using the search terms 'Capnocytophaga Canimorsus Endocarditis.'

Case	Age/sex	Comorbidities/risk factors	Source of infection	Valve involved	Surgery intervention	Antibiotic used (duration, days)	Complications	Outcome	Reference
1	50/M	ND	Dog bite	AV	Yes	ND	ND	Died	[14]
2	ND	ND	ND	AV	Yes	Penicillin G	ND	Cured	[14]
3	ND	ND	ND	MV	No	Penicillin G	ND	Cured	[14]
4	64/M	ND	Dog bite	TV, AV	No	Vancomycin+gentamicin	ND	Died	[15]
5	59/F	Atrial myxoma, CLL, steroid use	ND	TV	Yes	Cephalothin+gentamicin (14)	ND	Died	[16]
6	39/M	Alcohol abuse	Dog contact	MV	No	Ampicillin (42)+tobramycin	Glomerulonephritis	Cured	[17]
7	24/M	Heart murmur	Dog bite	AV	No	Penicillin (28)	ND	Cured	[18]
8	47/M	Alcohol abuse	Dog contact	TV	Yes	Vancomycin (14)+gentamicin (14)+penicillin (42)	ND	Cured	[19]
9	56/M	ND	Dog contact	TV	No	Penicillin (42)+gentamicin (NS)	ND	Cured	[20]
10	52/M	Aortic stenosis, pacemaker	Dog bite	AV	No	Penicillin G, aztreonam (35)	ND	Cured	[21]
11	69/F	COPD	None	TV	No	Cefuroxime (7)+gentamicin (7),+flucloxacillin (7), penicillin G (42)	ND	Cured	[22]
12	63/M	Aortic valve replacement	Dog contact	PAV	Yes	Ceftriaxone (28)+gentamicin (28), penicillin G (28)	Anaemia, CHF	Cured	[23]
13	41/F	Rheumatic mitral valve disease	Dog contact	MV	Yes	Ceftriaxone	ND	Cured	[24]
14	42/M	Alcohol abuse	Dog bite	AV	Yes	Ceftriaxone +gentamicin	ND	Cured	[25]
15	55/M	COPD, alcohol abuse, i.v. drug user	Dog	AV, TV	Yes	Meropenem+ciprofloxacin	ND	Cured	[26]
16	65/M	Dislipidemia, aortic stenosis, hypertension	None	AV, TV	Yes	Ampicillin +gentamicin	Anaemia, renal insufficiency	Cured	[27]
17	73/M	Prosthetic atrial valve, atrial fibrillation, diabetes, renal insufficiency	Dog contact	AV	No	Meropenem+ciprofloxacin	Anaemia	Cured	[28]
18	43/M	Alcohol abuse	Lion bite	AV, MV	Yes	Ceftriaxone+gentamicin+vancomycin	None	Died	[29]
19	76/F	ICD	Dog scratch	ICD	Yes	ND	ND	Cured	[30]
20	49/F	None	Dog faeces	TV	Yes	Meropenem (42)	Pulmonary embolism	Cured	[31]
21	46/M	None	Dog bite	AV		Gentamicin +cefazolin, ceftriaxone (28)	ND	Cured	[9]

Continued

Table 1. Continued

Case	Age/sex	Comorbidities/risk factors	Source of infection	Valve involved	Surgery intervention	Antibiotic used (duration, days)	Complications	Outcome	Reference
22	59/F	None	Dog contact	AV	Yes	Meropenem+vancomycin+gentamicin, i.v. benzylpenicillin (28)	ND	Cured	[32]
23	47/M	None	Dog contact	AV	Yes	Meropenem (42)	ND	Cured	[33]
24	70/F	Osteoarthritis, heart murmur, thymoma	Dog contact	TV	Yes	Benzylpenicillin (14)	Pulmonary embolism	Cured	[34]
25	63/M	ESRD on HD, COPD, nephrectomy, prostate/ lung cancer	Dog contact	TV	No	Piperacillin/tazobactam, amoxicillin/clavulanate, ceftriaxone +gentamicin	ND	Cured	[35]

M, male; F, female; ND, not documented, AV, aortic valve; MV, mitral valve; TV, tricuspid valve; ICD, implantable cardioverter defibrillator; COPD, chronic obstructive pulmonary disease; ESRD, end stage renal disease; HD, hemodialysis; T2DM, type 2 diabetes mellitus, CLL, chronic lymphocytic leukaemia.

been speculated to be due to an increase in dog/cat owners leading to greater opportunities for animal bites, and enhanced laboratory and recovery techniques [8]. However, consistent identification and isolation of *C. canimorsus* remains elusive; primarily due to its fastidious, slow- growing nature and requirement for meticulous growth conditions, including enriched agar media and incubation in 5–10% CO_2 [9, 10].

Infective endocarditis caused by *C. canimorsus* is a rare and poorly understood manifestation, accounting for <2% of reported *C. canimorsus* bloodstream infections [10]. To date, only 25 cases of *C. canimorsus* IE have been reported in the literature since its discovery in 1977 (Table 1). Approximately 80% of reported cases of *C. canimorusis* infection were associated with a predisposing condition, such as splenectomy, cirrhosis, alcoholism, lung disease and immunocompromised status [2, 11]. Remarkably, 40% of *C. canimorsus* IE cases presented with tricuspid valve IE, which is in contrast to the fact that tricuspid valve IE accounts for only 5–10% of all IE cases. The present case adds to this body of literature, highlighting that *C. canimorsus* has an increased predilection for tricuspid valve infection that is independent of other known predisposing factors, such as alcoholism, intravenous drug abuse, cardiac implantable electronic devices, central venous catheters or congenital heart disease. While the exact mechanism that predisposes certain micro-organisms such as *C. canimorus* to manifest as tricuspid valve IE remains unclear, some have speculated that intrinsic differences in the endothelium of valves may influence adherence to particular heart valves. [12]

In the present case, we were unable to identify any sites of inoculum, yet *C. canimorsus* infection was consistent with our patient's history of close contact with his pet Rottweiler dog. Furthermore, we were unable to verify *C. canimorsus* by Gram stain and culture on the resected tricuspid tissue. However the observation of fibrinous debris with associated acute inflammation remains consistent with *C. canimorsus* IE, and there are no better alternative explanation for these findings. The difficulty of culturing *C. canimorsus in vitro* makes determining sensitivities challenging, as observed in the present case. Previous studies have shown that *C. canimorsus* is sensitive to imipnem, clindamycin, linezolid and tetracyclines [13]. Here we reported successful resolution of infection through a combination of piperacillin/tazobactam (20 days) and meropenem (28 days) due to initial noncompliance.

CONCLUSION

The presented case highlights the importance of vigilant management and awareness of *C. canimorsus* infection. Given the high case fatality rate for patients with *C. canimorsus* IE and the difficulty of organism identification, a high clinical index of suspicion in patients with animal contact and early intervention with antibiotics such as piperacillin/tazobactam or meropenem is required to prevent the poor outcomes associated with this infection.

Funding information
The authors received no specific grant from any funding agency.

Conflicts of interest
The authors declare that there are no conflicts of interest.

Consent to Publish
Written informed consent for publication of clinical details and clinical images was obtained from the patient.

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