



Mycotic Aneurysms Caused by *Pasteurella* and *Capnocytophaga* Species

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ABSTRACT

Infected aneurysms are rare and present with vague symptoms or more severe symptoms at time of sepsis and/or rupture which is associated with significant mortality. Even rarer is presentation with an opportunistic infection from domesticated pets; however, risk factors are well described. Given the fastidious nature of these organisms, a detailed exposure history is important as well as consideration for additional serologic work up. Here, we discuss the epidemiology, diagnosis, and management of common infections from cats and dogs.

Keywords: Vasculitis; Mycotic aneurysm; *Pasteurella*; *Capnocytophaga*

INTRODUCTION

Mycotic aneurysms and vasculitis are serious, life-threatening complications of infections. Mycotic aneurysm was coined in the late 1800s by Osler in reference to the mushroom shape of an aneurysm in an endocarditis patient; however, “mycotic” referenced the infectious etiology, but not specifically fungal infection. Infected (mycotic) aneurysms are a rare complication of a usually pre-existing vascular defect which can be from atherosclerotic disease, aneurysm, or prosthetic/graft device. Infection can develop from seeding while bacteremic or fungemic, *via* embolism from Infective Endocarditis (IE), extension from an adjacent infection, or *via* direct inoculation secondary to trauma. Common locations for vascular infections include the aorta, peripheral, intracranial, and visceral arteries. The incidence of mycotic aneurysm is difficult to estimate but based on studies that rely on autopsy, the incidence may be less than 5% of all aneurysms and it is expected to be much higher in the setting of IE [1,2].

Several species of bacteria can directly cause vasculitis and mycotic aneurysm and some are transmitted from dogs and cats through scratches or bites [3-5]. Skin and soft tissue infections are the most frequent infectious manifestations of bite injury, although invasive infections with poor outcomes may occur through direct inoculation or dissemination [6]. This review focuses on vasculitis and mycotic aneurysms caused by *Pasteurella* and *Capnocytophaga*.

Methods

A literature search was conducted using the following search terms in PubMed/MEDLINE: *Pasteurella* and vasculitis, *Pasteurella* and

aneurysm, *Capnocytophaga* and vasculitis and *Capnocytophaga* and aneurysm. Articles were restricted to the English language and year of publication (January 1, 1996–May 4, 2022). Database query resulted in 48 publications. After title and abstract review, 23 articles were included in this analysis. Fourteen articles reported on *Pasteurella* vasculitis or aneurysm. Nine articles reported on *Capnocytophaga* vasculitis or aneurysm. Results of the literature search were independently reviewed by the authors for relevance.

ETIOLOGY AND PATHOGENESIS

Pasteurella and *Capnocytophaga* cause life-threatening infections, including vasculitis and mycotic aneurysms. *Pasteurella* species are among the most common bacteria that cause infection following dog or cat bite [4,5]. *Pasteurella* are gram-negative facultative anaerobe which are typically short and straight bacilli, although some species may appear as coccobacilli [7]. *Capnocytophaga* species are unique in that they cause serious infections in immunocompromised patients [8]. *Capnocytophaga* species are slow growing, gram-negative, fusiform-shaped bacilli with one rounded end and one tapered end [7].

In our review, all 14 reported cases of *Pasteurella* mycotic aneurysms were diagnosed based on a positive tissue or blood culture [9-22]. Seven of nine reported cases of *Capnocytophaga* mycotic aneurysm or vasculitis had positive cultures whereas 2/9 was diagnosed using molecular methods (16S ribosomal RNA sequencing or polymerase chain reaction) [23-31]. Because 12/14 (85.7%) reported cases of *Pasteurella* vasculitis or mycotic aneurysm had bacteremia or preceding infection at other sites, hematogenous seeding is likely

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how the major vessels were infected. Only three of nine patients with *Capnocytophaga* vasculitis or mycotic aneurysm had bacteremia or infection at other sites. This could be due to fastidious nature of the bacteria or preceding antibiotic use before samples were obtained for culture.

CLINICAL PRESENTATION AND DIAGNOSIS

It is interesting to note that 10/13 (77%) patients with *Pasteurella* were sexagenarian (Table 1). The median age of patients with *Pasteurella* and *Capnocytophaga* vasculitis or mycotic aneurysm was 61 and 69 years, respectively. Nine of 12 (75%) patients with *Pasteurella* mycotic aneurysm were males and 5/9 (55.6%) of patients with *Capnocytophaga* vasculitis or mycotic aneurysm were male.

Because dogs and cats are primary sources of *Pasteurella* and *Capnocytophaga*, history of animal bite or scratch is important. Among 23 *Pasteurella* and *Capnocytophaga* cases, 7 had history of animal bite and 8 had history of animal scratch or leaking of wound site (Table 1 and Table 2). Three had cats or dogs but no history of

bite and scratch. One had no known animal contact.

Capnocytophaga causes severe illness in patients with splenectomy or immunocompromising illness. Table 2 shows that none of the patients had splenectomy, 1 of 9 patients had HIV and 1 had type 2 diabetes mellitus. This indicates that *Capnocytophaga* vasculitis or mycotic aneurysm should be suspected in all patients with history of animal exposure and suggestive clinical findings, regardless of immune status.

Clinical presentation of vasculitis and mycotic aneurysm depends on the vessels involved. Among 14 cases of *Pasteurella* included in this review, abdominal aorta was involved in 6, thoracic aorta in 3, aortic endografts in 2, femoral artery in 1 and cerebral arteries in 2 (Table 1). Among 9 cases of *Capnocytophaga* included in this review, 8 had mycotic aneurysm and one had vasculitis (Table 2). Abdominal aorta was affected in 6 patients. Thoracic aorta, common iliac artery and common femoral artery were affected in one patient each.

Table 1: Reported cases of endovascular infections by *Pasteurella*.

Ref.	Age, sex	Risk factor	Comorbid Conditions	Vessel involved	Associated <i>Pasteurella</i> infection	Antimicrobial	Surgical management	Outcome
[16]	61, M	Owens dogs and cats	Rheumatoid arthritis	Abdominal aorta	Septic joints, bacteremia	Penicillin G	Open surgical repair	Died during surgical repair
[21]	61, F	Cat bite	Not described	Thoracic aorta	None described	Not described	Open surgical repair	Not described
[22]	17, M	No known animal contact	Renal insufficiency	Cerebral aneurysm	Mitral valve endocarditis, bacteremia	Ampicillin	None	Died from CVA
[10]	54, M	Dog lick on psoriatic lesions	Cirrhosis, psoriasis	Thoracic / abdominal aorta	Bacteremia	Amoxicillin, gentamicin	EVAR	Alive 2 years following diagnosis
[13]	64, M	Cats in home	Heavy alcohol abuse	Abdominal aorta	Right leg cellulitis	Cefotaxime	Open surgical repair	Alive 1 year after surgery
[17]	68, M	Cat bite	Heavy alcohol abuse	Abdominal aorta	Right thumb cellulitis, bacteremia	Piperacillin-tazobactam	Open surgical repair	Died
[14]	69, F	Cat bite	Not described	Abdominal aorta	Bacteremia	Penicillin G	Open surgical repair	Alive 8 months following surgery
[18]	61, M	Dog lick	Myelodysplastic Syndrome	Abdominal aorta and aortic arch	Bacteremia	Ampicillin	Open surgical repair	Alive 1 year following surgery
[15]	61, M	Dog bite	Not described	Descending thoracic aorta aneurysm	Bacteremia	Not described	Open surgical repair	Alive 18 months following surgery
[20]	57, F	Dog lick and scratch	Cigarette smoking	Cerebral aneurysm	Mitral valve endocarditis, Bacteremia	Penicillin G	Open surgical clipping	Alive 4 weeks following surgery
[9]	66, M	Cat scratch	HCV with cirrhosis	Aortic endograft infection	Bacteremia Aortic valve endocarditis	Doxycycline and levofloxacin for 3 months	None	No recurrent infection a year after completing treatment

[11]	Not reported	Cat bite and cat lick of abdominal surgical wound	Not described	Aortic endograft	Bilateral psoas abscesses and para-aortic abscess	Ceftriaxone 6 weeks followed by doxycycline lifelong	Drainage tube placement	Complete resolution and no recurrence after 10 months
[12]	68, M	A bite from pet rabbit	Not described	Aortic graft infection	None described	Cipro for 6 months	Open surgery for removal of endograft	Cured
[19]	62, M	Dog scratch	Cirrhosis, Cigarette Smoking	Superficial femoral artery	Bacteremia, paraspinal abscesses	Ceftriaxone	Open surgical repair	No recurrence 9 months after treatment (our patient)

Table 2: Reported cases of endovascular infections by *Capnocytophaga*

Ref.	Age, Sex	Risk factor	Comorbid Conditions	Vessel involved	Associated <i>Capnocytophaga</i> infection	Antimicrobial	Surgical management	Outcome
[23]	80, F	Dog licking excoriation caused by eczema	CAD DM (type 2) Nummular eczema	Infrarenal aorta*	Bacteremia	Ceftriaxone, ciprofloxacin	None	Cured
[24]	49, F	Not reported	IVDU HIV HCV CMV retinitis Hypertension Aortic valve and ascending aorta replacement for dissection	Descending aorta with rupture	Bacteremia	Piperacillin/tazobactam	Open surgical repair	Died
[25]	77, M	Dog bite	Stroke Hypertension Essential thrombocythaemia Alcohol abuse Smoking	L-common femoral artery, popliteal arteries	None	Piperacillin/Tazobactam followed by amoxicillin/clavulanate	Open surgical repair	Favorable
[26]	69, M	Dog bite	CAD Smoking	Infrarenal aorta	Bacteremia Purpura fulminans, multiorgan failure	Imipenem	None	No recurrence after one year
[27]	51, F	Owens cats but no scratch or bite	Achalasia Spinal stenosis	Thoracic aorta	None	Ertapenem followed by amoxicillin/clavulanate	Open surgical repair	Healthy one months after completion of antibiotics
[28]	86, F	Contamination of abrasion with dog saliva	Aortic valve repair Bilateral hip replacements	L-common iliac artery (with rupture)	None	Ceftriaxone followed by amoxicillin/calvulanate	Open surgical repair	No recurrence at 6 months follow up
[29]	63, M	Dog bite	Hepatitis A infection	Juxtarenal and infrarenal	None	Ceftriaxone plus ciprofloxacin followed by amoxicillin/clavulanate	Open surgical repair	Stable at 7 months follow up
[30]	65, M	Dog scratch and licking of scratch	Hypertension CAD Radical prostatectomy Smoking	Abdominal aorta	None	Imipenem followed by ciprofloxacin	Open surgical repair	Improved
[31]	69, M	Dog bite	Hypertension Peptic ulcer disease Smoking	Abdominal aorta with rupture	None	Meropenem followed by ciprofloxacin	Open surgical repair	Stable at 3 months follow up

Patients with abdominal aorta mycotic aneurysm presented from *Pasteurella* and *Capnocytophaga* infection may have worsening abdominal pain with or without abdominal pulsating mass, loss of pulse in lower extremities, fever, chills, nausea, vomiting, diarrhea, generalized weakness, hematuria, back pain, bilateral buttock pain, pelvis pain, night sweats, anorexia, weight loss, and/or mental status change [9-14,16-18,23,24,26,29-31]. Patients with thoracic aorta involvement may have anterior chest pain radiating to both axillae, worsening upper abdominal pain radiating to back, fever and/or chills [10,21,27]. Patients with cerebral mycotic aneurysm may present with focal neurologic signs such as hemiparesis, dilated pupil and mental status change. The patients may also have fever, chills, myalgia and anorexia [20,22]. Patients with mycotic aneurysm of common iliac artery, femoral artery or popliteal artery usually present with worsening leg pain, iliac fossa pain, and swelling, [19,25,28]. In patients included in this review, the main diagnostic imaging modality was Computerized Tomography (CT) which was performed in 19/23 (82.6%) of patients. Positron Emission Tomography (PET)-CT was done in 3 patients [24,28,29]. And MRI was done in one patient [23].

MANAGEMENT AND OUTCOME

Effective management of *Pasteurella* and *Capnocytophaga* mycotic aneurysm includes both surgery and antibiotics. Among 23 patients included in this review, 17 (74%) had open aneurysm surgery, 2 (8.7%) had drainage placement at the site of abscess linked to aneurysm or endovascular aneurysm repair [10,11] and 4 (17.4%) had no surgical intervention [9,22,23,26]. Among a total 15 patients with detail antibiotic treatment report, two were treated with intravenous (IV) antibiotic for 2 weeks [9,23], four for 4 weeks [13,26,31], two for 5 weeks [14,27], and seven for 6 weeks [11,18-20,28,29,30]. IV antibiotics used for the treatment of *Pasteurella* mycotic aneurysm include penicillin G, ampicillin, cefotaxime, and ceftriaxone, [9,11,13,14,18,19]. Oral antibiotics such as amoxicillin for 6 weeks, levofloxacin for 12 weeks, or ciprofloxacin for 24 weeks were used for initial treatment in three patients with *Pasteurella* infection, and these patients treated with oral antibiotics had good outcomes [9,10,12]. IV antibiotics used for treatment of *Capnocytophaga* vasculitis or mycotic aneurysm include piperacillin/tazobactam, ceftriaxone, imipenem, meropenem, ertapenem [23,26-31]. *Capnocytophaga* produces the β -lactamases and use of β -lactam/ β -lactamase inhibitor combination, advanced cephalosporin classes or carbapenem is important for effective treatment [32].

Among 13 total patients with at least 4 weeks of IV antibiotic course, 6 (46%) received oral suppressive treatment [11,27-30,31]. Five of the six patients who received suppressive antibiotic had open repair of aneurysm with graft placement. Oral suppressive treatment ranged from 4 weeks to life-long and includes antibiotics such as doxycycline for *Pasteurella* infection and amoxicillin/clavulanate or ciprofloxacin for *Capnocytophaga* infection [11,27-30,31].

Among reported cases of *Pasteurella* mycotic aneurysm with known treatment outcome, 10 had favorable outcome and 3 died. In patients with *Capnocytophaga* vasculitis or mycotic aneurysm, 8 had favorable treatment outcome and 1 died. The mortality from *capnocytophaga* in patients included in this review is low compared to previous publications which reported mortality rates as high as 29% in patients with history of splenectomy or alcoholism [33]. This difference could be because most reported patients with

vasculitis or mycotic aneurysm had no immunocompromising condition or splenectomy.

CONCLUSION

Pasteurella and *Capnocytophaga* species can cause vasculitis and mycotic aneurysm. A thorough clinical history including history of exposure to cats and dogs is important. Imaging studies are useful to detect aneurysm and any findings suggestive of infection. Confirmation of infection requires positive blood or tissue cultures. In most patients, effective management includes surgery and long course IV antibiotics followed by oral suppressive treatment.

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