Rare but Fatal Pasteurella multocida Infective Endocarditis: A Case Report and Literature Review

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Abstract

Pasteurella multocida is a small Gram-negative organism that usually causes a localized infection after exposure to cat or dog scratches, bites, or licking wounds. Invasive infections, such as bacteremia and endocarditis, are very rare yet serious conditions that are associated with high morbidity and mortality, particularly in patients with major comorbidities. Here, we report a case of a 47-year-old male who presented to the hospital with altered mental status two weeks after a fall and was found to have a subarachnoid hemorrhage. Further workup revealed Pasteurella multocida bacteremia and infective endocarditis. The patient had a complex hospital course with septic shock and acute congestive heart failure with poor clinical outcomes. A comprehensive review of the literature of all reported cases of definite Pasteurella endocarditis follows.

Categories: Cardiology, Internal Medicine, Infectious Disease
Keywords: septic emboli, heart failure, dogs, cats, septic shock, liver disease, infective endocarditis, pasteurella spp, pasteurella multocida

Introduction

Pasteurella multocida (P. multocida), a small, Gram-negative, nonmotile coccobacillus, is a normal commensal of many animals' oral flora, with cats and dogs representing the majority [1]. It can cause a variety of infections in humans, most commonly skin and soft tissue infections, following scratches, bites, or licking wounds [1]. However, invasive infections, such as bacteremia and infective endocarditis (IE), are very rare though serious conditions that are associated with high morbidity and mortality, especially in patients with major comorbidities [2]. Here, we report a case of a 47-year-old male with liver cirrhosis and diabetes found to have P. multocida bacteremia and endocarditis. His hospital course was complicated by septic shock, hypoxemic respiratory failure requiring intubation, septic emboli to the brain, and multiple organ failure, ultimately resulting in death.

Case Presentation

Our patient is a 47-year-old male with a history of alcohol abuse, alcoholic liver cirrhosis, hypertension, and type 2 diabetes mellitus who presented with altered mental status. Per the patient's wife, his deterioration began after a fall in the shower two weeks before presentation, followed by progressively worsening headache and multiple episodes of epistaxis. His condition continued to deteriorate and 12 hours before presentation, he developed confusion, weakness, and agitation, which prompted his presentation to the emergency department (ED).

In the ED, his vital signs were as follows: temperature 37.2 °C, heart rate 99/min, respiratory rate 20/min, blood pressure 115/66 mmHg, and oxygen saturation 99% on room air. On physical exam, he was ill-appearing, confused, and responding to painful stimuli only, with a Glasgow Coma Scale of 10. Skin examination was pertinent for jaundice, spider nevi, scattered ecchymoses, purpura, and scratch marks to his left lateral leg. Cardiac examination was normal except for tachycardia. Lungs were clear to auscultation, and abdominal examination was benign. The patient had +2 bilateral lower extremity pitting edema more prominent in the left side. Table 1 summarizes initial workup findings, and Figure 1 shows initial CT findings.
| Lab                        | Result     | Reference Range & Units     | Lab                   | Result    | Reference Range & Units         |
|----------------------------|------------|------------------------------|-----------------------|-----------|---------------------------------|
| White Blood Cell Count     | 23.49      | (3.40-10.40) K/mcL          | D-Dimer               | 7424      | <500 ng/mL                      |
| Neutrophils Absolute       | 18.54      | (1.50-6.60) K/mcL           | Fibrinogen            | 437       | (152-445) mg/dL                 |
| Hemoglobin                 | 10 Male: (12.8-17.1) g/dL | C-Reactive Protein       | 239                   | (0-10) mg/L          |
| Hematocrit                 | 28.9 Male: (38.6-52.1) % | Lactic Acid              | 4.1                   | (0.5-2) mmol/L      |
| Platelets                  | <9 (140-377) K/mcL | Ammonia                  | 22                    | (11-32) mmol/L     |
| Sodium                     | 127 (135-145) mmol/L | Troponin I               | 0.027                 | < 0.051 ng/mL       |
| Potassium                  | 3.8 (3.5-5.1) mmol/L | BNP                      | 90                    | <100 pg/mL          |
| Chloride                   | 90 (94-106) mmol/L | Urine Analysis with Reflex Microscopy |
| Blood Urea Nitrogen        | 102 (7-25) mg/dL | Color                    | Dark Yellow          | Straw, Pale yellow, Dark yellow |
| Creatinine                 | 4.02 Male: (0.60-1.30) mg/dL | Appearance               | Cloudy               | Slightly cloudy, Clear, Hazy |
| Glucose                    | 20 (60-100) mg/dL | Glucose                  | Negative             | Negative           |
| AST                        | 26 Male: < 35 U/L | Protein                  | Trace                | Negative-Trace     |
| ALT                        | 51 Male: < 46 U/L | Bilirubin                | 2                    | Negative           |
| Total Bilirubin            | 4.6 (0.2-1.2) mg/dL | Ketones                  | Negative             | Negative           |
| Alkaline Phosphatase       | 816 (45-117) U/L | Specific gravity          | 1025                 | (1001-1035)         |
| Total Protein              | 5.4 (6.2-8.1) g/dL | Leukocyte esterase        | 1                    | Negative           |
| Albumin                    | 1.5 (3.2-5) g/dL | Blood                    | Negative             | Negative-Trace     |
| INR                        | 1.5 (0.8-1.2) | Nitrites                  | Positive             | Negative           |
| Imaging/Test               | Findings   |                            |                       |                      |
| Chest X-ray                | Bibasilar atelectasis and superior mediastinal prominence concerning for adenopathy or mass (Figure 2A) |
| CT head without IV contrast| Left frontal hyperdense focus concerning for subarachnoid hemorrhage (Figure 1C) and nondisplaced right nasal bone fracture. |
| CT chest without IV contrast| Trace bilateral pleural effusion with compressive atelectasis and minimally displaced anterior wedge compression deformity of the superior endplate of T3 without significant height loss. |
| CT abdomen and pelvis without IV contrast | Liver cirrhosis with sequelae of portal hypertension including splenomegaly and portosystemic varices, small hiatus hernia, and choledolithiasis without CT evidence of acute cholecystitis. |
| CT left lower extremity without IV contrast | Stranding within the subcutaneous soft tissues predominantly along the anteromedial aspect of the tibia and the posterolateral lower third of the femur is most suggestive of cellulitis (Figures 1A, 1B). |
| Bilateral lower extremity Doppler ultrasound | Negative for deep venous thrombosis. |
| ECG                        | Normal sinus rhythm with premature atrial complexes, left axis deviation, and incomplete left bundle branch block. |
| 30 minutes EEG             | Evidence of mild to moderate encephalopathy with no seizure activity. |

**TABLE 1: Initial workup including labs, imaging, electrocardiogram (ECG), and 30-minute electroencephalogram (EEG) findings**

ALT: alanine aminotransferase, AST: aspartate aminotransferase, BNP: B-type natriuretic peptide, INR: international normalized ratio
FIGURE 1: Initial CT findings

1A, 1B: CT left lower extremity showing stranding (white arrows) in the subcutaneous fat overlying the anteromedial aspect of the tibia and the posterolateral lower third of the femur respectively. 1C: CT head without IV contrast showing left frontal subarachnoid hemorrhage (yellow arrow).
FIGURE 2: Chest X-ray on admission and two days later

2A: Chest X-ray on admission showing blassenatelectasis and superior mediastinal prominence concerning for adenopathy or mass. Two days later (Figure 2B), new moderate pulmonary edema developed.

The patient received intravenous (IV) fluids and platelet transfusion, resulting in improved creatinine to 3.31 mg/dL, platelets to 22 K/mcL, and lactic acid to 1.8 mmol/L. He was then admitted to the Medical Intensive Care Unit (MICU) and started on IV vancomycin and cefepime for sepsis. Two sets of blood cultures grew Gram-negative rods 11 hours after collection. Identification of *P. multocida* was done using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). The disk diffusion test revealed susceptibility to penicillin, ampicillin, ceftriaxone, and levofloxacin. Urine culture was negative for any bacterial growth. Further questioning of the patient’s wife revealed a history of scratch by an outdoor cat to his left leg two weeks before presentation.

Two days later, the patient developed tachypnea, tachycardia, and increased work of breathing. Chest X-ray showed increased infiltrates concerning for moderate pulmonary edema (Figure 2B) that was not found on the initial chest X-ray (Figure 2A). He was intubated and started on vasopressors for septic shock. Transthoracic echocardiogram (TTE) revealed a 1.5 cm x 1.3 cm vegetation attached to the posterior leaflet of the mitral valve (Figures 3A, 3B), severe mitral regurgitation (MR) (Figure 3C), and an estimated left ventricular ejection fraction (LVEF) of 61%.
Repeat blood culture the next day was negative. Antibiotics were switched to IV ceftriaxone 2 gm q12hr and IV metronidazole 500 mg q8hr to cover for possible meningitis and aspiration pneumonia given his worsening mentation. Four days after admission, brain MRI showed signs of subacute lacunar infarcts with distribution suggestive of embolic phenomena (Figure 4). Spine MRI was negative for osteomyelitis, discitis, or spinal abscess. Cardiothoracic surgery was consulted and recommended repeating a TTE in one week. The patient was deemed a poor surgical candidate for surgical mitral valve replacement given his high MELD Na of 29, Child C liver cirrhosis, and subarachnoid hemorrhage.
FIGURE 4: Magnetic resonance imaging (MRI) of the brain

Diffusion-weighted MRI (4A, 4C, 4E) and fluid-attenuated inversion recovery (FLAIR) MRI (4B, 4D, 4F) of the brain showing subacute lacunar stroke (yellow arrows) with distribution suggestive of embolic phenomena.

Three days later, the patient was extubated, following commands, and off vasopressors. He was then transferred to the medicine floor. However, after a few days, he developed severe pulmonary edema requiring bilevel positive airway pressure (BiPAP). Furthermore, he developed intermittent fever and anemia requiring blood transfusion. Physical exam was pertinent for diffuse anasarca, a blowing systolic murmur best heard at the lower left sternal border, and diffuse crackles bilaterally. B-type natriuretic peptide (BNP) was 1200 pg/mL and troponin I 0.22 ng/mL. ECG showed sinus tachycardia and was negative for acute ischemic changes. CT pulmonary embolism (PE) study was negative for PE but showed marked worsening bilateral infiltrates, bilateral moderate to large pleural effusions, and right heart chamber predominant cardiomegaly. The patient was started on bumetanide drip 1 mg/hr and antibiotics were switched to IV vancomycin and piperacillin-tazobactam to cover for healthcare/ventilator-associated pneumonia. He was then transferred to the MICU and was re-intubated.

A repeat TTE revealed an increase in the size of mitral valve vegetation to 2.2 cm x 1.5 cm. The MICU course was complicated by anemia and hemoptysis concerning for diffuse alveolar hemorrhage requiring blood transfusion; however, while receiving blood, the patient developed worsening oxygenation likely due to severe MR caused by the enlarging vegetation and volume overload. Blood transfusion was held, and the patient’s diuretic regimen was increased.
Unfortunately, the patient’s mental status did not improve and given his multiple comorbidities precluding him from aggressive interventions and prolonged complicated hospital course, his family decided to pursue comfort measures. He was palliatively extubated and transferred to the inpatient hospice service where he eventually passed comfortably.

**Discussion**

*Pasteurella* species (spp) are normal commensals of many animals’ oral bacterial flora, primarily cats and dogs [1]. Human infection by *Pasteurella* usually causes localized skin and soft tissue infections [1]. However, infective endocarditis is rare, with only 42 cases, including ours, reported in the literature. A PubMed search was conducted using keywords “*Pasteurella*” and “endocarditis.” Only cases that met the Modified Duke infective endocarditis criteria [3] and with microbiologically proven *Pasteurella* infection were included and reviewed manually. Further studies were identified from the references of the selected cases. The number of reported cases has been increasing, especially in the last two decades (Figure 5). Males were affected more than females, comprising 62% of the reported cases. The mean age was 56.7 ± 16.5, ranging from 17 to 88 years. Table 2 summarizes the literature review of all reported cases of definite *Pasteurella* endocarditis. Table 3 shows a detailed review of all cases.

![Number of Published Case Reports](image)

**FIGURE 5:** A chart showing the increasing number of case reports from 1960 to present

| Variables                  | Number of Cases (%) N=42 |
|----------------------------|---------------------------|
| **Age (mean ± SD) years**  | (56.7 ± 16.5)             |
| < 35 years                 | 3 (7%)                    |
| 35-70 years                | 10 (24%)                  |
| >70 years                  | 29 (69%)                  |
| **Gender**                 |                           |
| Male                       | 26 (62%)                  |
| Female                     | 15 (36%)                  |
| Unspecified                | 1 (2%)                    |
| **Location**               |                           |
| USA                        | 15 (36%)                  |
| France                     | 9 (21%)                   |
| Japan                      | 4 (10%)                   |
| UK                         | 3 (7%)                    |
| Saudi Arabia               | 2 (5%)                    |
| Others (countries that reported 1 case only) | 9 (21%) |
| Risk Factors                          | Count (Percentage) |
|--------------------------------------|--------------------|
| Substance Abuse (Smoking, Alcohol, or IVD) | 10 (24%)           |
| Liver Disease                        | 7 (17%)            |
| Heart Disease                        | 20 (48%)           |
| Previous Endocarditis                | 4 (10%)            |
| Diabetes Mellitus                    | 2 (5%)             |
| Solid Organ Transplant               | 1 (2%)             |
| Immunosuppressive Therapy            | 1 (2%)             |
| Cancer                               | 1 (2%)             |
| Healthy With No PMH                  | 6 (14%)            |
| **Pasteurella Spp**                  |                    |
| Multocida                            | 29 (69%)           |
| Non-Multocida Spp                    | 11 (26%)           |
| P. Haemolytica                       | 3 (7%)             |
| P. Dagmatis                          | 3 (7%)             |
| P. Pneumotropica                     | 3 (7%)             |
| P. Ureae                             | 2 (5%)             |
| Unspecified                          | 2 (5%)             |
| **Exposure**                         |                    |
| Exposed to Animals                   | 31 (74%)           |
| Cats, Dogs, or Both                  | 29 (69%)           |
| Sheep                                | 2 (5%)             |
| Fish                                 | 1 (2%)             |
| Known Bite, Scratch, or Lick         | 15 (36%)           |
| Not Exposed                          | 7 (17%)            |
| Unknown                              | 4 (10%)            |
| **Valve affected**                   |                    |
| Native Valve                         | 35 (83%)           |
| Mitral                               | 16 (38%)           |
| Aortic                               | 14 (33%)           |
| Tricuspid                            | 4 (10%)            |
| Pulmonary                            | 1 (2%)             |
| Prosthetic Valve                     | 8 (19%)            |
| Aortic                               | 7 (17%)            |
| Mitral                               | 1 (2%)             |
| Unknown                              | 1 (2%)             |
| Dual valve affected                  | 2 (5%)             |
| Native Mitral and Tricuspid          | 1 (2%)             |
| Native Tricuspid and Aortic prosthesis | 1 (2%)         |
| **Treatment**                        |                    |
| Antibiotics                          | 41 (98%)           |
### TABLE 2: Summary of literature review of all reported cases of definite Pasteurella infective endocarditis

| Case | 1st Author | Age | sex  | Year of publication | Country           | Reported liver disease | Reported heart disease | Previous IE | DM | Current substance abuse | Transplant/ cancer/ immunosuppressive therapy | Exposure | Pasteurella Spp | Antibiotics | Resistance | Valve | Surgery | Outcome |
|------|------------|-----|------|---------------------|-------------------|------------------------|------------------------|--------------|----|------------------------|---------------------------------------------|----------|------------------|------------|------------|-------|---------|---------|
| 1    | Porter [2] | 66  | F    | 2020                | USA               | No                     | Yes                    | No           | No | No                     | Cat                          | Multocida | Yes              | Unknown    | Aortic     | Prosthesis & Tricuspid | Yes | Aortic | Cured |
| 2    | Al-Ghonaim [4] | 50  | M    | 2006                | Saudi Arabia      | No                     | No                     | No           | No | No                     | Sheep                        | Multocida | Yes              | Unknown    | Aortic     | Yes     | Cured |
| 3    | Tirmizi [5] | 34  | M    | 2012                | USA               | No                     | Yes                    | No           | No | No                     | Flail, sheep                  | Pasteurella | Yes              | Unknown    | Aortic     | No      | Died    |
| 4    | Brass [6]  | 40  | M    | 1993                | USA               | No                     | No                     | No           | Yes | No                     | Unknown                      | Unspecified | Yes              | No         | Intravenous | No      | Went into coma |
| 5    | Akrewe [7] | 70  | M    | 2016                | Sweden            | No                     | No                     | No           | Yes | No                     | Cat bite - scratch           | Multocida | Yes              | Unknown    | Aortic     | Yes     | Cured |
| 6    | Branch [8] | 50  | M    | 2015                | Japan             | No                     | No                     | No           | No | No                     | Horse                        | Multocida | Yes              | Unknown    | Piperacillin-Tazobactam | Multicenteral | Aortic   | Yes     | Cured |
| 7    | Koku [9]   | 57  | F    | 2021                | USA               | No                     | Yes                    | Yes                      | No | No                     | Dog lick - bite               | Unspecified | Yes              | No         | Prosthetic  | Mitral | Yes     | Cured |
| 8    | Camou [10] | 79  | F    | 2005                | France            | Yes                    | No                     | No           | No | No                     | Cat bite                      | Multocida | Yes              | Unknown    | Mitral     | No      | Died    |
| 9    | Camou [10] | 61  | F    | 2005                | France            | Yes                    | Yes                    | No           | No | No                     | Cat                          | Multocida | Yes              | Unknown    | Aortic     | Prosthesis and Mitral | No | Died |
| 10   | Sauvet [11] | 78  | F    | 2004                | France            | No                     | No                     | No           | No | No                     | Unknown                      | Multocida | Yes              | Unknown    | Aortic     | Pulmonary Planned | No | Died |
| 11   | Guillet [12] | 74  | M    | 2015                | France            | No                     | Yes                    | No           | No | No                     | Dog lick - scratch            | Multocida | Yes              | E诺macidemir and aminoglycosides | Multicenteral | Aortic     | No      | Died |
| 12   | Mawali [13] | 61  | M    | 1992                | USA               | No                     | Yes                    | No           | No | No                     | Dog lick - scratch            | Multocida | Yes              | Unknown    | Aortic     | No      | Died |
| 13   | Thanakitikul [14] | 17  | M    | 1990                | Thailand          | Yes                    | Yes                    | No           | No | No                     | Horse                        | Multocida | Yes              | Unknown    | Mitral     | No      | Died |
| 14   | Sorrentino [15] | 55  | F    | 1994                | USA               | Yes                    | No                     | No           | No | No                     | Cat bite and scratch          | Pasteurella | Yes              | Unknown    | Mitral     | No      | Cured |

IVD: intravenous drugs, P: Pasteurella, PMH: past medical history, SD: standard deviation, Spp: species
| 15 | Carter | 79 | F | 2021 | UK | No | Yes | No | No | Yes | Cat/Dog | Multicidas | Yes | No | Mitral | No | Died |
| 16 | Guerri | 62 | F | 1960 | France | Yes | No | No | No | Yes | No | Cat/Dog | Multicidas | No | Unknown | Aortic | No | Died |
| 17 | Safa | 36 | M | 2012 | UK | No | Yes | No | No | No | Yes | Cat/Dog | Multicidas | Yes | Unknown | Aortic | Prosthesis | No | Cured |
| 18 | Abaz | 37 | M | 2003 | NW Africa | No | No | No | No | No | No | Unknown | Multicidas | Yes | Penicillin | Mitral | Yes | Cured |
| 19 | Reinsch | 66 | M | 2006 | Germany | No | Yes | Yes | No | No | No | Cat/Dog | Multicidas | Yes | Unknown | Aortic | Prosthesis | Yes | Died from septic shock due to Pseudomonas aeruginosa following a dental procedure |
| 20 | Eady | 54 | F | 1963 | USA | No | Yes | No | No | No | No | Cat/Dog | New species | Yes | Unknown | Unknown | No | Cured |
| 21 | Gump | 44 | M | 1972 | USA | No | Yes | No | No | No | No | Cat/Dog | Multicidas | Yes | No | Mitral | No | Cured |
| 22 | Laahman | 51 | M | 1977 | Norway | No | No | No | No | No | No | nose | Multicidas | singular strain | Yes | Unknown | Unknown | No | Cured |
| 23 | Singh | 50 | M | 1983 | UK | No | No | No | No | No | No | Dog | Multicidas | Yes | No | Mitral | no | Cured |
| 24 | Compriert | 33 | F | 1997 | France | No | No | No | No | No | No | Unknown | Pneumotropica | Yes | Unknown | Mitral | Yes | Cured |
| 25 | Salvoz | 63 | F | 1999 | France | No | No | No | No | No | No | Dog | Multicidas | Yes | Unknown | Aortic | Yes | Cured |
| 26 | Yenacca | 40 | M | 1991 | Saudi Arabia | No | No | No | No | No | No | nose | Haemolytica | Yes | No | Aortic | No | Died |
| 27 | Yenacaca | 59 | M | 1993 | Japan | No | Yes | Yes | No | No | No | nose | Unspecified | Yes | No | Mitral | no | Cured |
| 28 | General | 36 | F | 1996 | Switzerland | Yes | No | No | No | Yes | No | Cat | Multicidas | Yes | Unknown | Aortic | No | Cured |
| 29 | Netles | 72 | F | 1997 | USA | No | Yes | No | No | No | No | Cat | Multicidas | Yes | Unknown | Aortic | Prosthesis | No | Cured |
| 30 | Vavouni | 65 | M | 1998 | USA | Yes | Yes | No | No | No | No | Cat/Dog/ | tick | Multicidas | Yes | Unknown | Aortic | No | Died |
| 31 | Rasczynski | 76 | M | 2001 | USA | no | Yes | No | No | No | No | nose | D. gastritis | Yes | Unknown | Aortic | Prosthesis | No | Cured |
| 32 | Fiasenato | 48 | M | 2002 | Japan | No | Yes | No | No | No | No | Dog | Multicidas | Yes | Unknown | Mitral | Yes | Cured |
| 33 | Fialt | 48 | M | 2003 | France | Yes | No | No | No | No | No | Dog | Multicidas | Yes | Unknown | Mitral | Yes | Cured |
| 34 | Dan | 43 | F | 2005 | Romania | No | Yes | No | No | No | No | Para/ | scrap | Pneumotropica | Yes | Unknown | Mitral | Yes | Cured |
| 35 | Gof | 36 | M | 2007 | Austria | No | No | No | No | No | No | Cat/Dog | Multicidas | Yes | Unknown | Polymyxen | Yes | Cured |
| 36 | Natia | 86 | F | 2009 | Lebanon | No | No | No | No | No | No | Cat | Multicidas | Yes | Unknown | Tricampl | No | Cured |
| 37 | Khan | 62 | M | 2012 | USA | No | Yes | No | No | No | No | Cat | Multicidas | Yes | Unknown | Aortic | No | Cured |
| 38 | Soway | 77 | M | 2012 | USA | No | Yes | Yes | No | No | No | Cat/Dog | D. gastritis | Yes | Unknown | Aortic | Prosthesis | No | Cured |
| 39 | Fayat | 62 | M | 2012 | France | No | No | No | No | No | No | Dog | Haemolytica | Yes | Unknown | Aortic | Yes | Cured |
| 40 | Milakkeet | 60 | F | 2013 | USA | No | No | No | No | No | No | Cat/Dog | Multicidas | Yes | Unknown | Aortic | Yes | Cured |

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Our case satisfied the Modified Duke criteria for the diagnosis of infective endocarditis [3]: one major criterion: evidence of endocardial involvement, and three minor criteria: fever, blood culture, and vascular phenomena (septic emboli to the brain).

Of 51 cases (74%) who reported exposure to animals, 29 (94%) had exposure to cats, dogs, or both. One had exposure to sheep [4], and another was exposed to fish and sheep [5]. Fifteen (48%) had a known history of scratches, bites, or licking non-intact skin. Of all reported cases, seven (17%) had no history of animal exposure. P. multocida has been isolated from the respiratory tract of healthy individuals who have frequent exposure to animals [1].

P. multocida was the most reported spp; 29 cases (69%). 11 cases (26%) had infection with non-multocida spp, including P. haemolytica (5), P. dagmatis (5), P. pneumotropica (5), and P. ureae (2).

The native mitral valve was the most affected (16 cases), followed by native aortic (14), prosthetic aortic (7), native tricuspid (4), native pulmonary (1), and prosthetic mitral (1) valves. Two cases reported dual valve infection [7,4].

Risk factors included liver disease in seven (17%), heart disease in 20 (48%), prior endocarditis in four (10%), substance abuse in 10 (24%), diabetes mellitus in two (5%), solid organ transplant/immunosuppressive therapy in one (2%), and malignancy in one (2%). However, Pasteurella IE has also been reported in six (14%) healthy individuals. Immuno compromised patients are at higher risk of severe disease and complications such as sepsis, septic shock, and multiorgan failure [2,43]. A comprehensive review of 119 cases of P. multocida bacteremia reported comorbid conditions, such as chronic liver disease, diabetes mellitus, malignancy, and immunosuppressive therapy in 67% of patients, and the mortality rate was 51% at 30 days [43]. On multivariated analysis, having major comorbid conditions was the only factor associated with mortality (OR 2.78, 95% CI 1.01-7.70: P-value 0.04) [43].

The overall mortality rate in previously reported cases of Pasteurella endocarditis was 26% (11 cases), of which 64% (7 cases) had major comorbidities. A recent analysis of 32 cases of Pasteurella endocarditis demonstrated a statistically significant association between comorbid liver disease and mortality rate despite the low number of cases [2].

Our patient had a complex hospital course consisting of sepsis, septic shock requiring vasopressors, and acute hypoxemic respiratory failure secondary to cardiogenic pulmonary edema due to severe mitral regurgitation requiring intubation, resulting in death. Diabetes mellitus and liver cirrhosis were the predisposing conditions that led to severe invasive infection in this case.

Complications are not uncommon and related to bacteremia and valve vegetation. Reported complications included sepsis, septic emboli [8-9], congestive heart failure [2,10-11], septic shock [2,10,12-13,51], mycotic aneurysm [9,14], intracranial hemorrhage [14-15], septic arthritis [12,16], and osteomyelitis [15]. One case reported rhabdomyolysis and hearing loss [41].

There are no clear guidelines for treating Pasteurella endocarditis, and data are limited to a small number of case reports. All patients received antibiotics except one who died shortly after presentation [17]. Pasteurella spp is often susceptible to penicillin [13,18]. Broad-spectrum cephalosporins, piperacillin–tazobactam, and ampicillin–sulbactam can be used alternatively. One case of Pasteurella endocarditis of the prosthetic mitral valve reported successful treatment with six weeks of IV penicillin without surgery [9]. Tirmizi et al. reported successful treatment of P. pneumotropica endocarditis of the native tricuspid valve with six weeks of oral ciprofloxacin [5]. One case of P. multocida endocarditis of the aortic valve prosthesis had a penicillin allergy and was successfully treated with six weeks of IV ceftazi dine [18]. Two cases reported resistance to penicillin and piperacillin–tazobactam, respectively [8,19]. Duration of treatment was variable among reported cases, and it depended on the severity, course of the disease, co-existing conditions, and antibiotic susceptibility. Carter et al. recommended initial six weeks of antibiotics therapy based on the clinical response and the average duration in previously reported patients who were successfully treated with antibiotics only [16]. Of all 29 cases (69%) who survived, 12 (41%) received antibiotics only without surgery.

| 41 Yuji [42] | 50 M 2015 Japan | No No | No | No | No | Yes North | Multocida | Yes Unknown | Mitral | Yes Cured |
| 42 Mahmoud* | 47 M 2022 USA | Yes No | Yes | Yes | No | Cat scratch | Multocida | Yes No | Mitral | No Died |

**TABLE 3: Detailed summary of all case reports of Pasteurella endocarditis**

IE: infective endocarditis, DM: diabetes mellitus, Spp: species, CHF: congestive heart failure, UK: United Kingdom, USA: United States of America, NW: Northwest, *: This case represents the currently presented case.

*Cured* in the outcome is defined as full recovery.
Of all reported cases, 18 (45%) required surgery. Indications for surgical intervention were severe valvular insufficiency, persistent symptoms despite antibiotic therapy, and aortic root abscess. Seventeen out of 18 (94%) cases who underwent surgery were cured while only one patient died four months after discharge due to septic shock secondary to Pseudomonas endocarditis of the native mitral and prosthetic aortic valves four weeks after a dental procedure [20]. Porter et al. suggested that surgery should be offered to all patients who have no absolute contraindications given the cure rate of 100% after surgical valve replacement [2]; however, their analysis did not consider the severity of illness, medical comorbidities, and indications for surgical intervention [16]. Moreover, they did not include the patient who died four months after surgery from Pseudomonas endocarditis [20]. Carter et al. suggested surgical intervention only if there is any indication, as with any case of other bacterial endocarditis [16]. The same study reported a patient with P. multocida endocarditis and septic arthritis successfully treated with antibiotics only despite his comorbidities.

There is no doubt that Pasteurella endocarditis is a rapidly progressive disease and is associated with high morbidity and mortality. It took approximately two weeks for our patient to develop complications following a cat scratch, one week from presentation to develop an increase in the valve vegetation size, and four weeks from presentation to death. He received a total duration of three weeks of antimicrobial therapy, but unfortunately, he was a poor surgical candidate due to significant comorbidities.

Due to its rarity, it is hard to conclude the proper management of Pasteurella endocarditis from the current literature. In the meantime, early recognition of the disease, interval echocardiograms to assess the vegetation size and possible complications, IV antibiotics, and early source control with surgical valve replacement for patients who have indications are the mainstay of treatment.

**Conclusions**

Infective endocarditis caused by Pasteurella spp is a rare though potentially serious and rapidly progressive disease with only 42 cases reported in the literature. It carries a high risk of morbidity and mortality, particularly in patients with comorbid conditions such as liver disease. Treatment is typically IV antibiotics, and surgery for source control should be considered on a case-by-case basis. Due to its rarity, further research is required to study the nature of disease progression, determine the appropriate duration of antimicrobial therapy, and identify the average time from symptom onset to surgery and its correlation with clinical outcomes.

**Additional Information**

**Disclosures**

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**References**

1. Weber DJ, Wolkson JS, Swartz MN, Hooper DC: Pasteurella multocida infections. Report of 34 cases and review of the literature. Medicine (Baltimore). 1984, 63:133-54.
2. Porter RS, Hay CM: Pasteurella endocarditis: a case report and statistical analysis of the literature. Case Rep Infect Dis. 2020, 2020:8990211. 10.1155/2020/8990211
3. Li J, Sexton DJ, Mick N, et al.: Proposed modifications to the Duke criteria for the diagnosis of infective endocarditis. Clin Infect Dis. 2000, 30:633-8. 10.1086/313753
4. Al-Ghonaim MA, Abba AA, Al-Nozha M: Endocarditis caused by Pasteurella multocida. Ann Saudi Med. 2006, 26:147-9. 10.5144/0256-4947:2006.147
5. Tirmizi A, Butt S, Mollitoriz S: First reported case of Pasteurella pneumotropica tricuspid valve endocarditis. Int J Cardiol. 2012, 161:e44-5. 10.1016/j.ijcard.2012.04.007
6. Brass EP, Wray LM, McDuft T: Pasteurella urease meningitis associated with endocarditis. Report of a case and review of the literature. Eur Neurol. 1985, 22:138-41. 10.1159/000115550
7. Ahlsson A, Friberg Ö, Källman J: An angry cat causing Pasteurella multocida endocarditis and aortic valve replacement—a case report. Int J Surg Case Rep. 2016, 24:91-3. 10.1016/j.ijscr.2016.05.021
8. Branch J, Kakutani T, Kuroda S, Shiba Y, Kitagawa I: Pasteurella multocida infective endocarditis: a possible link with primary upper respiratory tract infection. Intern Med. 2015, 54:3225-31. 10.2169/internalmedicine.54.4975
9. Kolli VS, Archibald L, Edwards M, Janelle JW, Hong KW, Kalyatanda G: Pasteurella cerebral mycotic aneurysm: a case report and review of the literature. Cureus. 2021, 13:e13512. 10.7759/cureus.13512
10. Camous F, Guinet O, Perrey S, Gabinosi C, Viallard JP, Mercier P, Pellegrin JL: Endocarditis due to Pasteurella sp. Two cases [Article in French]. Med Mal Infect. 2005, 35:556-9. 10.1016/j.medmal.2005.08.005
11. Sauvet F, Graffin B, Cremades S, Chemsi M, Leryal G, Paris JF, Carli P: Pasteurella multocida endocarditis revealed by inflammatory rachialgia [Article in French]. Rev Med Interne. 2004, 25:530-1. 10.1016/j.revmed.2004.05.003
12. Guillhart M, Zoghebi S, Hichkat AH, et al.: Fatal multifocal Pasteurella multocida infection: a case report. BMC Res Notes. 2015, 8:287. 10.1186/s13104-015-1252-7
of Endocarditis caused by a new species of Pasteurella. Amer Intern Med. 1972; 76:275-8. 10.7326/0003-4819-76-2-275-275.

20. Lehmann V, Knutson SB, Raghaldistveit E, Skagseth E, Solberg CO: Endocarditis caused by Pasteurella multocida. Scand J Infect Dis. 1977; 9:247-8. 10.3109/inf.1977.9.issue-3.19.

21. Singh CP, Spurrell JR: Pasteurella multocida endocarditis. Br Med J (Clin Res Ed). 1983; 286:1862-3. 10.1136/bmj.286.6381.1862.

22. Cornaert P, Masson P, Forzy G, Graux P, Camblin J, Dutout A, Crocelle L: Infectious endocarditis caused by rare germs. Review of the literature apropos of 2 cases [Article in French]. Arch Cardiol Angeple (Paris). 1987; 36:87-95.

23. Salmon D, Fantin B, Bricaire F, Vilde JL, Pangoen B, Erassid D: Endocarditis due to Pasteurella multocida with glomerulonephritis. J Infect. 1991; 25:657-75. 10.1086/597637.

24. Yanera EL, Jinah H, Kumari P, Togoo MS: Pasteurella haemolytica endocarditis. J Infect. 1991; 25:657-75. 10.1086/597637.

25. Yamamoto K, Ikeda U, Oghawa C, Fukazawa H, Eto M, Shimada K: Pasteurella ureae endocarditis. Intern Med. 1995; 32:872-7. 10.2169/internalmedicine.32.872.

26. Genoe D, Siegrist HH, Monnier P, Nobel M, Humair L, de Torrente A: Pasteurella multocida endocarditis: report of a case and review of the literature. Scand J Infect Dis. 1996; 28:95-7. 10.3109/00365549609027158.

27. Nettles RE, Sexton DJ: Pasteurella multocida prothetic valve endocarditis: case report and review. Clin Infect Dis. 1997; 25:920-1. 10.1086/597637.

28. Vasquez JE, Ferguson DA Jr, Bin-Sagheer S, Myers JW, Ramska A, Wilson MA, Sarubbi FA: Pasteurella multocida endocarditis: a molecular epidemiological study. Clin Infect Dis. 1998; 26:518-20. 10.1086/517105.

29. Rosenbach KA, Poblete J, Larkin F: Prosthetic valve endocarditis caused by Pasteurella dagmatis. South Med J. 2001; 94:1033-5.

30. Fukumoto Y, Moriayama Y, Iguro Y, Toda R, Taira A: Pasteurella multocida endocarditis: report of a case. Surg Today. 2002; 32:515-5. 10.1007/s00197020000087.

31. Fayaad G, Modine T, Mokhibari S, et al.: Pasteurella multocida aortic valve endocarditis: case report and literature review. J Heart Valve Dis. 2003; 12:261-5.

32. Dan M, Pricacuciu C, Georgescu GI, Georgescu-Arsenesescu C, Tinica G, Buisu D: Subacute bacterial endocarditis due to Pasteurella pneumotropica. Case report [Article in Romanian]. Rev Med Chir Soc Med Nat Iasi. 2005; 109:473-5.

33. Graf S, Bender T, Heger M, Apfalter P, Simon N, Winkler S: Isolated endocarditis of the pulmonary valve caused by Pasteurella multocida. Infect. 2007; 35:83-5. 10.1007/s10119-007-0074-1.

34. Naha MR, Arij GF, Kanafani ZA, Kani SS: First case of Pasteurella multocida endocarditis of the tricuspid valve: a favorable outcome following medical treatment. Int J Infect Dis. 2009; 13:e267-9. 10.1016/j.ijid.2008.11.004.

35. Khan MF, Movaeed MR, Jung J: Pasteurella multocida endocarditis. J Heart Valve Dis. 2012; 21:260-2.

36. Strahm C, Goldenberger D, Gutmann M, Kuhnert P, Graber P: Prosthetic valve endocarditis caused by a Pasteurella dagmatis-like isolate originating from a patient’s cat. J Clin Microbiol. 2012; 50:2818-9. 10.1128/JCM.00973-12.

37. Fayaad G, Modine T, Koussa M, Senneville E, Leroy O: First documented surgical case of human aortic valve endocarditis caused by Pasteurella haemolytica. J Heart Valve Dis. 2012; 21:139.

38. Mikiherbati N, Li TY, Taub CC: Pasteurella multocida infective endocarditis in an immunocompetent patient complicated by rhabdomyolysis and permanent bearing loss. J Cardiovasc Dis Res. 2015; 4:55-7. 10.1016/j.jcdr.2015.02.006.

39. Yuji D, Tanaka M, Katayama I, Noguchi K: Pasteurella multocida infective endocarditis. J Heart Valve Dis. 2015; 24:778-9.

40. Chateles E, Mahieu R, Hamel JF, et al.: Pasteurella bacteraemia: impact of comorbidities on outcome, based on a case series and literature review. Int J Infect Dis. 2020; 92:89-96. 10.1016/j.ijid.2020.01.005.