



Case report

Wrist abscess due to drug-resistant *Pasteurella multocida*Abraham Wei^{a,*}, Nehal Dhaduk^b, Basil Taha^a^a Rutgers New Jersey Medical School, Division of Infectious Diseases, Newark, NJ 07101, USA^b Rutgers New Jersey Medical School, Newark, NJ 07101, USA

ARTICLE INFO

Article history:

Received 16 August 2021

Accepted 31 August 2021

Available online xxxx

Keywords:

Pasteurella
Drug resistance
Animal bites

ABSTRACT

Many cases of cat and dog bites are associated with *Pasteurella* spp. infections. Antimicrobial therapy usually entails a β -lactam- β -lactamase inhibitor combination such as amoxicillin-clavulanic acid. Drug resistance in human *Pasteurella* spp. infections has rarely been reported in literature. In this report, we introduce the first documented case of a human *Pasteurella* spp. infection with resistance to amoxicillin-clavulanic acid. The potential emergence of drug-resistant *Pasteurella* spp may alter our therapeutic approach to animal bites in the future. This case highlights the need for further epidemiologic studies on *Pasteurella* spp antibiotic susceptibility patterns in both humans and cats.

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Introduction

Pasteurella spp is a small, facultative-anaerobic, Gram-negative coccobacilli highly prevalent amongst the oral flora of many animal species. Most human *Pasteurella* spp infections are due to cat and dog bites. The bacteria can cause a wide range of symptoms in humans ranging from cellulitis to meningitis and septic shock [1,2]. Cellulitis can be potentially dangerous as it can lead to chronic local infections in deep tissues and osteomyelitis [3]. Treatment for animal bites with suspected *Pasteurella* spp usually entails a combination of amoxicillin and the β -lactamase inhibitor clavulanic acid. For patients with penicillin allergy, doxycycline, a fluoroquinolone or trimethoprim-sulfamethoxazole, plus either metronidazole or clindamycin can be alternatives [4]. Drug resistance in *Pasteurella* spp human infections has rarely been reported in literature [5,6]. We present the first documented case of a soft tissue infection due to drug-resistant *Pasteurella multocida* secondary to a cat bite.

Case presentation

A 24-year-old female with a past medical history of type 2 diabetes mellitus and congenital heart disease status-post surgical repair presented to the emergency department with inability to move and pain in her right hand and wrist for one day. The day prior, the patient was bitten by her cat on the lateral aspect of the right hand

near the first carpometacarpal joint. She used antiseptic spray and antibiotic cream on the wound without significant improvement.

The following day, the patient's right hand and forearm had swollen with green, malodorous discharge draining from the puncture sites. She reported increased pain and redness of her right hand and wrist, but denied any numbness or paresthesia. She denied any prior similar incidents. She denied any fevers, chills, nausea, or vomiting. The patient's cat was up to date on vaccinations; it was reported to be an indoor cat without any recent illness or antibiotic treatment.

At presentation, the patient was afebrile (36.7 °C) with blood pressure of 160/103 mmHg. The lateral aspect of her right hand and wrist was swollen with erythema, and fluctuance palpated in the volar and dorsal aspect of the wrist. Laboratory results were significant for glucose 405 mg/dL (normal: 70–109 mg/dL), serum bicarbonate 19 meq/L (normal: 23–30 meq/L), C-reactive protein 19 mg/L (normal: 0–5 mg/L), and a hemoglobin A1c of 13.4% (normal: 4.8–5.9%). X-ray of the right hand/wrist/elbow showed soft tissue swelling at the wrist. The patient was given acetaminophen, 1 L of Lactated Ringer's, sliding scale insulin, and started on intravenous ampicillin-sulbactam 3 g every 6 h. Tetanus vaccination was given as well. Plastic surgery was consulted and performed bedside incision and drainage (I&D) of the wrist abscess on day of presentation. After I&D, patient indicated significant improvement with less pain and increased range of motion of her wrist. Blood cultures drawn prior to initiation of antibiotics did not reveal any growth. On the third day of hospitalization, patient had only mild swelling of her wrist and she was discharged on amoxicillin-clavulanic acid 875 mg twice a day for 14 days.

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Abscess fluid from the I&D underwent Gram stain testing showed rare quantity of Gram negative rods with few polymorphonuclear leukocytes. Abscess fluid culture had growth on blood and chocolate agar, but not on MacConkey agar. The culture isolates showed oxidase test positivity were then identified as *Pasteurella multocida* using biochemical testing (Analytical Profile Index [API] 20 NE, bioMérieux, Marcy-l'Étoile, France). API 20 NE performance data showed that out of 4305 bacterial strains of various origins tested, 91.8% of strains correctly identified, 2.7% not identified, and 5.5% misidentified [7]. A second biochemical test (MicroScan NUC75 B1017-427, Beckman Coulter, Brea, California) was completed on the subculture 2 days later to confirm bacterial identification. MicroScan performance data showed 97.4% of various bacterial isolates tested were correctly identified, and only 3.1% of isolates required additional tests to confirm a low-probability species identification [8].

After identification of bacterial species, susceptibility to antimicrobial agents was determined by the disk diffusion method on Mueller-Hinton agar. The following antibiotics were tested based on Clinical Laboratory Standards Institute (CLSI) guidelines [9]: penicillin, ampicillin, amoxicillin-clavulanic acid, ceftriaxone, azithromycin, tetracycline, levofloxacin, trimethoprim-sulfamethoxazole. Disk diffusion assay zone of inhibition sizes for each antibiotic were specified with CLSI susceptibility breakpoints [9] as follows: penicillin (sensitive [S] \geq 25 mm diameter), ampicillin (S \geq 27 mm), amoxicillin-clavulanic acid (S \geq 27 mm), ceftriaxone (S \geq 34 mm), azithromycin (S \geq 20 mm), tetracycline (S \geq 23 mm), levofloxacin (S \geq 28 mm), trimethoprim-sulfamethoxazole (S \geq 24 mm). *Escherichia coli* ATCC 25922 was used as an internal quality control strain. Disk diffusion assay on Mueller-Hinton agar revealed the isolate to be susceptible to azithromycin, ceftriaxone, levofloxacin, tetracycline, and trimethoprim-sulfamethoxazole, but resistant to penicillin, ampicillin, and amoxicillin-clavulanic acid. Disk diffusion assay was repeated and revealed the same susceptibility profile. Cefinase testing was positive for the presence of β -lactamase.

Antimicrobial susceptibility results were finalized 4 days post-discharge, and, based on the results, patient was notified to switch antibiotic therapy to oral levofloxacin 750 mg daily for 14 days. Patient was seen in the infectious diseases clinic 8 days post-discharge and she denied any worsening of symptoms since hospital discharge. Patient continued to have some mild pain of the right wrist but no swelling, erythema, or discharge noted on physical exam.

Discussion

Pasteurella multocida is the most common species of *Pasteurella* spp to infect humans. The bacterium lives in the normal microbiota of the nasopharynx and respiratory tracts of many animals, importantly cats and dogs, and is transmitted to humans through routes such as licking, scratching, and biting [2]. Drug-resistance in *Pasteurella* spp has been documented in other animals such as pigs, but rarely in humans [10]. Literature search revealed a case of *P. multocida* infective arthritis after a dog bite where the organism was resistant to amoxicillin but sensitive to amoxicillin-clavulanic acid; the antibiotic resistance was likely attributed to the β -lactamase TEM-1 gene found on polymerase chain reaction (PCR) assay [5]. Several other documented cases of drug-resistant *Pasteurella* spp infection in humans were localized in the respiratory tract [6,11,12].

Our case is the first to document a soft tissue infection from drug-resistant *Pasteurella* spp after a cat bite. Furthermore, it is also the first documented *Pasteurella* spp infection in humans to show resistance to amoxicillin-clavulanic acid. This is especially troublesome considering this suggests the potential emergence of *Pasteurella* spp resistant to first-line antibiotic; we may eventually need to alter our therapeutic approach to animal bites. With the uncertainty of *Pasteurella* spp resistance profile, there may also be a

need for more rapid antimicrobial susceptibility testing methods – such as biochemical assays, PCR assays, or matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS) – to enable quicker appropriate therapeutic intervention. In our case, disk diffusion test with repeat confirmation testing took 4 days. Fortunately for our patient, she seemed to have achieved significant clinical improvement with I&D of the wrist abscess so the delay in switching to a susceptible antibiotic was not an issue.

The etiology of our patient's *Pasteurella multocida* drug resistance remains unclear. Literature search shows plasmid-mediated TEM-1 and ROB-1 β -lactamase genes have previously been found in human *Pasteurella* isolates [5,13], and the ROB-1 gene is able to harbor mutations that can render it resistant to β -lactamase inhibitors [14]. These two plasmid-mediated genes may have been acquired from horizontal genetic interspecies transfer with *Enterobacteriaceae* spp and *Haemophilus influenzae*, although our patient had no evidence of coinfection with these organisms. Before this hospital admission, the patient herself had not recently been hospitalized or taken antibiotics. It is possible the drug resistant *Pasteurella* originated from the patient's cat, although cats are not usually colonized by *Pasteurella* spp with antibiotic resistance. Epidemiology studies in felines have shown a near 100% susceptibility to ampicillin and amoxicillin-clavulanic acid [15,16]. Our patient's cat had no risk factors for developing drug-resistant *Pasteurella* spp. A possible source could be the cat's food, especially if it contains raw meat. Antimicrobial additives to animal feeds have been attributed to spreading antimicrobial resistance [17,18]. *Pasteurella multocida* isolates resistant to various antibiotics, including amoxicillin-clavulanic acid, have been found in food animals [19,20].

In conclusion, our case is the first to report a drug-resistant *Pasteurella* spp infection in humans after a cat bite. This case highlights the need for further epidemiologic studies on *Pasteurella* spp antibiotic susceptibilities in both humans and cats. *Pasteurella* spp infection due to animal bites can be associated with significant morbidity and mortality, so it is important to assess clinical trends in resistance and ensure proper eradication of the infection.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

References

- [1] Armstrong GR, Sen RA, Wilkinson J. *Pasteurella multocida* meningitis in an adult: case report. *J Clin Pathol* 2000;53:234–5.
- [2] Aljameely A, Wali G. *Pasteurella multocida* septic shock: case report and literature review. *Case Rep Infect Dis* 2019;2019:1964161.
- [3] Arons MS, Fernando L, Polayes IM. *Pasteurella multocida* – the major cause of hand infections following domestic animal bites. *J Hand Surg* 1982;7:47–52.
- [4] Chiang AD, Zurlo JJ. *Pasteurella* species. In: Mandell GL, Bennett JE, Dolin R, editors. *Principles and practice of infectious diseases*. Philadelphia, PA: Elsevier; 2020. p. 2774–8.
- [5] Naas T, Benaoudia F, Lebrun L, Nordmann P. Molecular identification of TEM-1 β -lactamase in a *Pasteurella multocida* isolate of human origin. *Eur J Clin Microbiol Infect Dis* 2001;20:210–3.
- [6] Lion C, Lozniewski A, Rosner V, Weber M. Lung abscess due to β -lactamase--producing *Pasteurella multocida*. *Clin Infect Dis* 1999;29:1345–6.
- [7] bioMérieux. API 20 NE – APIweb technical brochure. France: Marcy-l'Étoile; 2019.
- [8] Beckman Coulter. MicroScan Gram negative procedure manual, PU-06 & older panels. Brea, CA; 2020.
- [9] Clinical and Laboratory Standards Institute. *Methods for antimicrobial dilution and disk susceptibility testing of infrequently isolated or fastidious bacteria: M45*. 3rd ed. Wayne, PA: CLSI; 2016.
- [10] Oh YH, Moon DC, Lee YJ, Hyun BH, Lim SK. Antimicrobial resistance of *Pasteurella multocida* strains isolated from pigs between 2010 and 2016. *Vet Rec Open* 2018;5:000293.
- [11] Schmidt ECH, Truitt LV, Koch ML. Pulmonary abscess with empyema caused by *Pasteurella multocida*: report of a fatal case. *Am J Clin Pathol* 1970;54:733–6.

- [12] Nguyen Phuong T, Rosenau A, Philippon A, Moyen EN, Fauche`re JL, Patri B. Human pulmonary infection by a strain of *Pasteurella multocida* producing beta-lactamase. *Presse Med* 1989;18:1886.
- [13] Rosenau A, Labigne A, Escande F, Courcoux P, Philippon A. Plasmid-mediated ROB-1 β -lactamase in *Pasteurella multocida* from a human specimen. *Antimicrob Agents Chemother* 1991;35:2419–22.
- [14] Galan J, Morosini M, Baquero M, Reig M, Baquero F. Haemophilus influenzae bla (ROB-1) mutations in hypermutagenic deltaampC *Escherichia coli* conferring resistance to cefotaxime and beta-lactamase inhibitors and increased susceptibility to cefaclor. *Antimicrob Agents Chemother* 2003;47:2551–7.
- [15] Awosile BB, McClure JT, Saab ME, Heider LC. Antimicrobial resistance in bacteria isolated from cats and dogs from the Atlantic Provinces, Canada from 1994–2013. *Can Vet J* 2018;59:885–93.
- [16] Porfida-Ferreira TS, Felizardo MR, Sena de Gobbi DD, Moreno M, Moreno AM. Antimicrobial resistance and virulence gene profiles in *P. multocida* strains isolated from cats. *Braz J Microbiol* 2015;46:271–7.
- [17] Nuesch-Inderbilen M, Treier A, Zurfluh K, Stephan R. Raw meat-based diets for companion animals: a potential source of transmission of pathogenic and antimicrobial-resistant Enterobacteriaceae. *R Soc Open Sci* 2019;6:191170.
- [18] Guardabassi L, Schwarz S, Lloyd DH. Pet animals as reservoirs of antimicrobial-resistant bacteria: review. *J Antimicrob Chemother* 2004;54:321–32.
- [19] Nedbalcova K, Kucerova Z. Antimicrobial susceptibility of *Pasteurella multocida* and *Haemophilus parasuis* isolates associated with porcine pneumonia. *Acta Vet Brno* 2013;82:3–7.
- [20] Elsayed MS, Eldsouky SM, Roshdy T, Said L, Thabet N, Allam T, Mohammed AB, Nasr GM, Basiouny M, Akl BA, Nader MM, Hasan AS, Salah A. Virulence determinants and antimicrobial profiles of *Pasteurella multocida* isolated from cattle and humans in Egypt. *Antibiotics* 2021;10:480.