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Case report

Infantile *Pasteurella multocida* meningitisJones T. Nauseef, MD, PhD^{a,1}, Nathan B. Price, MD^b, Kelly E. Wood, MD^{b,*}^a Medical Scientist Training Program, Roy J. and Lucille A. Carver College of Medicine, Iowa City, IA 52242, United States^b Stead Family Department of Pediatrics, University of Iowa Children's Hospital, 200 Hawkins Dr., Iowa City, IA 52242, United States

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Introduction

Bacterial meningitis is a severe illness with potentially dangerous consequences in any patient population. In the years from 2003 to 2007, children less than two years old had the highest estimated rate of bacterial meningitis of any age group. [1] In neonates, not only are the risks of infection profound – including death – the presentation can be atypical, making the likelihood of occult disease all the greater. [2] Unlike older children and adults with meningitis, neonates typically do not present with verifiable meningismus. [3,4] Irritability is a common presenting symptom but it is non-specific [4]. The fact that undiagnosed meningitis is the most common source of medical malpractice claims in pediatric emergency rooms underscores the high requirement for astute and accurate clinical care. [5] Fortunately bacterial meningitis is relatively uncommon, with a rate of 80.69 cases per 100,000 in infants less than 2 months of age in one study [1].

Case

A 31-day-old, previously healthy term infant was transferred from an outside hospital for management of meningitis. One day prior to admission she developed low-grade fever, emesis, loose stools, decreased urine output, and subjective fussiness. Her past medical history was significant only for a murmur noted at birth with a normal echocardiogram. She had no significant travel history and no known sick contacts, although she had been

recently exposed to many family and friends at her baptism celebration. She had been evaluated at a local urgent care prior to admission and diagnosed with a viral respiratory tract infection. Her fevers continued prompting evaluation at a local emergency department. On exam, she was febrile with a bulging fontanel, irritable, and pale. She underwent a diagnostic evaluation including lumbar puncture. Her cerebral spinal fluid (CSF) had 2875 white blood cells/mm³ with neutrophil predominance, hypoglycorrhagia (glucose 2 mg/dL), elevated protein (>150 mg/dL) and gram negative diplococci on gram stain. Lab values were significant for leukopenia with a white blood cell count (WBC) of 2500/mm³ (with an absolute neutrophil count of 1050/mm³), an elevated C reactive protein (5.9 mg/dL), and elevated procalcitonin (14.72 ng/mL). She was treated empirically with intravenous (IV) ampicillin, cefotaxime, and vancomycin prior to transfer.

The patient was continued on IV vancomycin and cefotaxime upon admission to the receiving institution. Based upon the initial reported gram stain, the causative agent was thought to be *Neisseria meningitidis*. On the morning of hospital day 2, the initial CSF and blood cultures performed at the outside hospital were reported growing a presumptive β -lactamase-negative *Haemophilus* species. The cultures were transferred to the State Hygienic Facility for confirmatory speciation. As the culture medium was standard blood agar, the State Hygienic Facility felt *Haemophilus* was unlikely.

On hospital day 3, the State Hygienic Facility reported that the organism was not a *Haemophilus* species but rather *Pasteurella multocida*. Upon further questioning, it was learned that the family had 2 cats and a dog. The dog had been observed licking the infant's face. Based on antimicrobial susceptibilities, vancomycin was discontinued and she continued on cefotaxime monotherapy at meningitic dosing. Despite clinical improvement and appropriate antimicrobial treatment, she remained febrile until hospital day 6. No subdural or parenchymal abscess was seen on brain magnetic resonance imaging (MRI) performed on hospital day 4.

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On hospital day 11, she developed new leukocytosis (WBC 22, 900/mm³) and was found to have a peripheral inserted central venous catheter (PICC) line associated thrombosis. The PICC line was removed with resolution of her leukocytosis. She completed 2 weeks of IV cefotaxime to treat her acute bacterial meningitis from *Pasteurella multocida*. The infection was thought to have been transmitted to the infant via saliva from the family dog. At discharge, she was clinically well and had a normal physical exam.

Discussion

The epidemiology of bacterial meningitis in infants differs based on age and is often classified as infection originating either within or beyond the neonatal period. During the neonatal period, group B streptococcus (GBS) and *Escherichia coli*, are the most common bacteria that cause meningitis. Historically, *Listeria monocytogenes* was a more common cause of neonatal and infantile serious bacterial infections including meningitis. A recent meta-analysis reported *L. monocytogenes* bacteremia and meningitis in febrile infants to be very uncommon with reported prevalences of 0.03% and 0.09%, respectively. [6] Additional studies have reported similar findings, and have challenged the continued use of ampicillin in empiric treatment of febrile infants. [6–8] Beyond the neonatal period, *Streptococcus pneumoniae* and *Neisseria meningitidis* become common pathogens. [9] Prior to the era of conjugate vaccination, *Haemophilus influenzae* type b (Hib) was the most common cause of meningitis in infants, and should still be considered in the differential, especially in an unimmunized or immunodeficient infant or child. [10] Rapid pathogen identification is important to determine optimal therapy and the need for post-exposure prophylaxis of contacts which may be warranted in the case of meningitis caused by *Neisseria meningitidis* and Hib.

In this case, the organism was identified as *Pasteurella multocida*, a gram-negative coccobacillus that often colonizes the oral cavity of animals, including pets and livestock such as dogs, cats, rabbits, hogs, and deer. [11,12] It is an uncommon cause of meningitis. As per McKelvie in 2013, a total of 38 cases of *P. multocida* meningitis in infants had been reported in the English literature. [11] The age was known in 36 cases with 30 infants ≤3 months of age and of those 18 were under 1 month of age. [11] Non-traumatic source of infection, including meningitis in infants after exposure to animal saliva, has been well described in the literature. [12] Traumatic exposure (bites or scratches) is rare with most meningeal infections resulting from saliva exposure via licking or sniffing by a dog or cat. [2,11,13] Alternatively, exposure may be indirect from being handled by someone who didn't wash their hands after contact with a pet or via contaminated fomites as in the case of an infant who likely acquired her meningeal infection when the infant used her pacifier after the family cat had licked it. [2,11]

Because *Pasteurella* is a rare cause of meningitis, it can be confused initially with other pathogens such as *Haemophilus* or *Neisseria*, especially when a gram negative coccobacillus is seen on gram stain as in this case. [11,14] Biochemical testing and assessment of growth characteristics on various media can assist with the diagnosis, particularly when including such an organism as *Pasteurella* in the differential diagnosis. Attempted growth on blood agar and chocolate agar will show robust growth, in contrast to the factor V- and X-requiring *Haemophilus* species which will not grow on standard blood agar. Indole testing can assist with distinguishing it from *Neisseria* and *Haemophilus* species as *Pasteurella* is typically indole positive while the latter are not. [11,15]

P. multocida is typically susceptible to penicillin and other commonly used antimicrobials including the later generation

cephalosporins, ceftriaxone, and cefixime. [2,11,16] Cephalexin and clindamycin are known to be ineffective against the organism. [17,18] Documentation of acquired resistance has been limited, but includes report of strains producing a β-lactamase. [19] Most infants treated with appropriate antimicrobial therapy recover completely without sequelae. [2,11]

Conclusions

Determining the causative organism in this infant with meningitis proved to be difficult. Correct identification required astute microbiology laboratory practices and a keen clinical eye to carefully evaluate all exposures. This case underscores the need to assess for exposure to pets, in addition to sick contacts, and the importance of educating parents and caretakers on the risks associated with exposures to such animals. It would be wise to advise caretakers to not let animals lick infants and to wash hands after animal contact.

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Consent

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

Conflict of interests

Dr. Price and Dr. Nauseef have no conflicts of interest to report. Dr. Wood receives royalties from McGraw Hill Education for her editorship of a pediatric board review textbook. This conflict did not influence this publication.

Authors' contribution

Dr. Nauseef assisted with the writing of this manuscript. Dr. Price assisted with revising of this manuscript. Dr. Wood assisted with the writing and revising of this manuscript.

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