Case report

Cellulitis and Bacteremia due to Neisseria weaveri following a dog bite

Takashi Shinha*

A B S T R A C T

Neisseria weaveri is a gram-negative rod that can cause skin and soft tissue infections associated with dog bites. Although N. weaveri is a less well recognized zoonotic Neisseria species, its potential pathogenicity merits recognition since N. weaveri can cause severe septicemia in humans.

Introduction

Dog bites are one of the most frequently encountered skin injury. In general, the microbiology of infected dog bite wounds reflects bacteria colonizing the canine oral cavity; therefore, a wide variety of bacteria are isolated from dog bite wounds. Among Neisseria species of animal origin, Neisseria weaveri, originally designated as CDC group M-5 [1,2], is part of the normal oropharyngeal flora of dogs [2]. Significant dog bite infections due to this bacterium in humans, including bacteremia, have been described in the literature [3].

Case report

A 72-year-old woman with a past medical history significant for type 2 diabetes mellitus was in her usual state of health until 9 days before presentation when she was bitten by a dog in the neighborhood on her left thigh multiple times. Subsequently, the patient developed extensive left thigh cellulitis and abscess. The patient was prescribed amoxicillin/clavulanate by her primary care physician without clinical improvement. No bacterial wound cultures were obtained at that time. 5 days later, the patient developed fever, chills, and worsening left thigh erythema, which prompted the patient to present to a local emergency room.

In the emergency room, the patient was uncomfortable due to left thigh pain, but in no acute distress. Her vital signs were blood pressure, 112/72 mmHg, pulse rate, 97/min, respiratory rate, 20/min, temperature, 101.1°F and oxygen saturation 97% on room air. Her heart sounds were regular without murmurs. Her lungs were clear to auscultation. Her abdomen was soft and non-tender. Her left thigh was diffusely erythematous and indurated, suggestive of abscess formation. Few puncture wounds were also observed.

Laboratory studies disclosed a white blood cell count of 14,500 cells/mm³ with 80% neutrophils, hemoglobin of 12.7 g/dL, and platelets of 19,000 cells/mm³. The level of sodium was 135 mmol/L, potassium 4.4 mmol/L, bicarbonate 22 mEq/L, urea nitrogen 11.0 mg/dL, creatinine 0.7 mg/dL, erythrocyte sedimentation rate 50 mm/h and C-reactive protein 80.3 mg/L. After being empirically started on ampicillin/sulbactam and vancomycin, the patient underwent incision and debridement on the left thigh abscess. The wound culture obtained at the time of debridement and two sets of blood culture grew aerobic, gram-negative rods. Sheep blood agar yielded alpha hemolytic colonies. Catalase and oxidase reactions were positive. The isolate was identified as N. weaveri by the RapID NH biochemical panel. The isolate was sent to a reference laboratory, where it was definitively identified as N. weaveri by molecular testing.

Discussion

Dog related injury to humans, including bites and scratches, can cause a wide array of infections, such as abscesses, septic arthritis, tenosynovitis, and osteomyelitis. In general, direct inoculation of bacteria from the oropharyngeal flora of dogs into the injured site is the main pathophysiology, though normal skin flora of the human could also become a causative infectious agent for infected dog bite wounds.

Numerous bacteria are isolated from the oral cavity of dogs. In a multicenter prospective study where 50 dog bite wounds were analyzed, 48% of the dog bite wounds were polymicrobial [4]. The most commonly isolated aerobic bacteria were Pasteurella (50%), Staphylococcus (46%), Streptococcus (46%), and Neisseria (32%) species. Among Neisseria species, the most frequently isolated species related to dog bites was N. weaveri (14%), followed by N. zoodegmatis (10%), N. animaloris (6%), and N. subflava (2%).

Among many zoonotic Neisseria species of clinical importance, N. weaveri, N. animaloris and N. zoodegmatis are commonly associated with dog bites [4-6]. From 1960 through 1992, numerous isolates of bacteria resembling Moraxella were evaluated at Centers for Disease Control and Prevention (CDC) for identification, and the isolate was...
designated as CDC group M-5 [7].

CDC group M-5 was noted to be associated with dog bite wounds in the study conducted by Tatum et al. in 1974 [8]; among 41 cultures that yielded CDC group M-5, 25 isolates were collected from infected dog bite wounds and 4 were isolated from the canine respiratory tract. In a subsequent study by CDC reviewing 75 group M-5 isolates from 1953 through 1980, 66 were isolated from wounds, and 53 were from dog bites [9].

In 1993, CDC group M-5 was named *N. weaveri* after phenotypical DNA–DNA and 16S rRNA sequence analysis [7]. The cellular fatty acid compositions of CDC group M-5 strains were found be different from *Moraxella* species despite its similar biochemical reactions. CDC group M-5 was demonstrated to belong to the genus *Neisseria*, for which the name *Neisseria weaveri* was proposed.

*N. weaveri* is an aerobic, nonmotile, gram-negative rod. Like other *Neisseria* species, oxidase and catalase reactions are generally positive. *N. weaveri* is a commensal *Neisseria* species in the canine oral cavity; it was isolated in 18% of gingival scrapings from 50 dogs [10] and 12% of the oral cavities of another group of 50 dogs [11]. Significant dog bite infections due to *N. weaveri* in humans, including bacteremia, have been described in the literature [3].

**Conclusion**

*N. weaveri* is a zoonotic *Neisseria* species that most commonly causes skin and soft tissue infections associated with dog bites. Among many other dog bite related pathogens, recognition of this organism is of clinical importance since it can cause severe septicemia in humans.

**References**

[1] Andersen BM, Steigerwalt AG, O’Connor SP, Hollis DG, Weyant RS, Weaver RE, et al. *Neisseria weaveri* sp. nov., formerly CDC group M-5, a gram-negative bacterium associated with dog bite wounds. J Clin Microbiol 1993;31:2456–66.
[2] Holmes BI, Costas M, On SL, Vandamme P, Fabro E, Kersters K. *Neisseria weaveri* sp. nov. (formerly CDC group M-5), from dog bite wounds of humans. Int J Syst Bacteriol 1993;43:687–93.
[3] Carlson P, Konttala S, Anttila P, Eerola E. Septicemia caused by *Neisseria weaveri*. Clin Infect Dis 1997;24:739.
[4] Talan DA, Citron DM, Abrahamian FM, Moran GJ, Goldstein EJ. Bacteriologic analysis of infected dog and cat bites. N Engl J Med 1999;340:85–92.
[5] Heydecke A, Anderson B, Holmdahl T, Melhus A. Human wound infections caused by *Neisseria animaloris* and *Neisseria zoodegmatis*, former CDC Group EF-4a and EF-4b. Infect Ecol Epidemiol 2013:3.
[6] Vandamme P, Holmes B, Bercovier H, Coenye T. Classification of Centers for Disease Control Group Eugonic Fermenter (EF)-4a and EF-4b as *Neisseria animaloris* sp. nov. and *Neisseria zoodegmatis* sp. nov., respectively. Int J Syst Evol Microbiol 2006;56:1801–5.
[7] Andersen BM, Steigerwalt AG, O’Connor SP, Hollis DG, Weyant RS, Weaver RE, et al. *Neisseria weaveri* sp. nov., formerly CDC group M-5, a gram-negative bacterium associated with dog bite wounds. J Clin Microbiol 1993;31:2456–66.
[8] Tatum HW, Ewing WH, Weaver RE. Miscellaneous gram-negative bacteria. In: Lennette EH, Spaulding EH, Truant JP, editors. Manual of clinical microbiology. 2nd ed. Washington, D.C: American Society for Microbiology; 1974. p. 270–94.
[9] Graham DR, Band JD, Thornberry C, Hollis DG, Weaver RE. Infections caused by *Moraxella*, *Moraxella* urethralis, *Moraxella*-like groups M-5 and M-6, and *Kingella* kingae in the United States, 1953–1980. Rev Infect Dis 1990;12:423–31.
[10] Saphir DA, Carter GR. Gingival flora of the dog with special reference to bacteria associated with bites. J Clin Microbiol 1976;3:2456–66.
[11] Bailie WE, Stowe EC, Schmitt AM. Aerobic bacterial flora of oral and nasal fluids of canines with reference to bacteria associated with bites. J Clin Microbiol 1978;7:223–31.