Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Fatal glomerulonephritis associated with *Neisseria zoodegmatis* infection in a captive smooth-coated otter (*Lutrogale perspicillata*) in Italy: a case report

Donato Antonio Raele

donatoantonio.raele@izspb.it

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Leonardo Marino

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Loredana Capozzi

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Eleonora Buzzi

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Viviana Manzulli

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Domenico Galante

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Pietro Laricchiuta

ZooSafari Fasano

Antonio Parisi

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Antonio Petrella

Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata

Case Report

Keywords: Glomerulonephritis, Lutrogale perspicillata, MALDI-TOF MS, Neisseria zoodegmatis, Smooth-coated otter, Zoonosis, Case report

Posted Date: October 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11035728/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Neisseria zoodegmatis is an opportunistic commensal of the oral cavity of domestic and wild carnivores, occasionally causing severe bite-wound infections in humans. However, its role as a primary systemic pathogen in wildlife remains poorly characterized. We describe a rare case of fatal septicemia and acute necro-purulent glomerulonephritis in an adult male smooth-coated otter (*Lutrogale perspicillata*) housed in a zoological park in Southern Italy.

Case presentation:

An adult male smooth-coated otter presented severe emaciation and multi-organ congestion at postmortem examination following sudden death. Histopathology demonstrated acute suppurative glomerulonephritis associated with massive bacterial emboli replacing the glomerular tufts. *Neisseria zoodegmatis* was isolated from kidney tissue in pure culture and identified via matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) and 16S rRNA gene sequencing. In the absence of acute bite trauma, severe periodontitis was identified as the potential mucosal portal of entry leading to hematogenous dissemination.

Conclusions

This case highlights the systemic pathogenic potential of *N. zoodegmatis* in captive aquatic mammals and underscores the One Health implications for veterinary staff handling captive wildlife.

Background

Neisseria zoodegmatis (formerly Centers for Disease Control and Prevention group EF-4b) is a fastidious, Gram-negative, rod-shaped bacterium that routinely colonizes the oral mucosa and upper respiratory tract of domestic and wild carnivores, particularly dogs and cats [1]. Although considered an opportunistic commensal within its primary reservoir hosts, *N. zoodegmatis* possesses well-documented zoonotic potential in humans, where it causes cellulitis, abscesses, and systemic bacteremia following animal bites or scratches [2, 3]. Despite its recognized relevance to public health, the clinical significance of *N. zoodegmatis* as an invasive pathogen capable of inducing primary systemic, fatal disease in wildlife populations remains poorly characterized. Fatal systemic infections caused by commensal *Neisseria* species in aquatic mammals are increasingly recognized. For instance, fatal *Neisseria animaloris* bacteremia has been reported in harbor porpoises (*Phocoena phocoena*) secondary to bite trauma inflicted by grey seals (*Halichoerus grypus*) [4, 5]. However, systemic dissemination stemming from non-traumatic oral pathology is rare. Here, we report a case of fatal systemic infection and necro-purulent glomerulonephritis caused by *N. zoodegmatis* in a captive smooth-coated otter (*Lutrogale perspicillata*).

Case presentation

In April 2026, an adult male smooth-coated otter (body weight: 6.5 kg) housed at Zoosafari di Fasano (Apulia region, Southern Italy; 40°50'N, 17°22'E) died acutely without prior overt clinical signs. The animal shared its enclosure with four conspecifics, with no physical access to stray carnivores. None of the co-housed otters presented overt signs of infectious disease or had received recent antimicrobial therapy. The carcass was submitted to the Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata (Foggia, Italy) for comprehensive postmortem evaluation. At necropsy, the animal exhibited marked emaciation, poor body condition, skin inelasticity, prominent osseous profiles, and generalized skeletal muscle atrophy (Fig. 1). Examination of the oral cavity revealed severe chronic periodontitis characterized by pronounced gingival erythema and heavy dental calculus deposits (Fig. 4), providing a plausible anatomical portal of entry for hematogenous dissemination. No active or deep cutaneous bite wounds were observed. The kidneys displayed bilateral cortical congestion and scattered, pinpoint necro-purulent foci. Tissue samples from major organs (kidney, liver, lung, heart, spleen) were fixed in 10% neutral buffered formalin, processed routinely, embedded in paraffin, sectioned at 4 µm, and stained with hematoxylin and eosin (H&E) for histopathological analysis. Histopathology confirmed severe, acute, necro-purulent glomerulonephritis. Glomerular architectures were multifocally effaced by extensive bacterial macrocolonies consisting of dense coccobacillary elements, which completely replaced the glomerular tufts with amorphous hyaline material (Fig. 2). The myocardium exhibited diffuse interstitial edema accompanied by sporadic inflammatory foci surrounding localized bacterial emboli. Splenic tissue showed marked follicular lymphoid depletion, whereas the lungs presented severe alveolar edema and patchy atelectasis. Parasitological evaluations performed on fecal samples using standard flotation and Baermann techniques yielded negative results. Molecular screenings (PCR/RT-PCR) for *Toxoplasma gondii*, *Leptospira* spp., *Francisella tularensis*, Canine Distemper Virus, Avian Influenza Virus, and Coronaviridae were negative. Standard bacteriological cultures for *Salmonella* spp. and general aerobic pathogens were performed on liver, spleen, intestinal, and lung tissues; aerobic cultures from these tissues were negative for significant bacterial growth. Renal parenchyma was cultured under standard aerobic conditions and yielded heavy, pure growth of bacterial colonies (strain IZSPB_L.perspicillata, microchip ID 900200000844257). Isolated colonies were identified using MALDI-TOF Mass Spectrometry (MALDI Biotyper Sirius, Bruker Daltonics, Bremen, Germany) with log(score) thresholds > 2.0, identifying the organism as *Neisseria zoodegmatis*. Confirmation of species identity was performed via partial 16S rRNA gene amplification and Sanger sequencing using universal primers 517F and 1514R [6]. Sequence alignment and phylogenetic tree reconstruction were conducted using Maximum Likelihood methods in MEGA7 [7]. The 919-bp 16S rRNA sequence (GenBank accession no. PZ695206) shared 99.57% identity (100% query coverage) with reference sequences of *N. zoodegmatis*. Maximum Likelihood phylogenetic analysis placed the isolate firmly within the *N. zoodegmatis* clade (90% bootstrap value), clustering with reference strains N15a (JQ979306.1), LMG 23012 (NR_043459.1), A-2-10B-AP (MT492089.1), and ATCC 29859 (KY847915.1), distinct from closely related species such as *N. weaveri*, *N. subflava*, *N. sicca*, and *N. zalophi* (Fig. 3).

Discussion and conclusions

The clinical, postmortem, and histopathological findings indicate that severe acute necro-purulent glomerulonephritis secondary to *N. zoodegmatis* bacteremia was the direct cause of death. The presence of dense intratubular and intravascular bacterial macrocolonies strongly supports active bacterial seeding and intravascular proliferation rather than an immune-complex-mediated glomerulonephritis. Because *N. zoodegmatis* is an oral commensal and not an environmental pathogen, mucosal or cutaneous breach is required for systemic invasion [2]. Although no active, deep cutaneous bite wounds were observed during postmortem examination, the chronic emaciation points to an ongoing subclinical process. We hypothesize that systemic entrance occurred either via a minor, healed intraspecific bite trauma or, more likely, through mucosal lesions in the oral cavity stemming from severe chronic periodontitis. Our findings confirm that commensal *Neisseria* species can exhibit highly invasive behavior in mustelids under predisposing local conditions such as severe periodontitis. From a One Health perspective, zoological environments represent an interactive interface between captive animals, wildlife management staff, and veterinary personnel. Demonstrating the invasive capacity of *N. zoodegmatis* underlines an underappreciated occupational risk for zoo staff, given the propensity of this organism to cause severe soft-tissue infections and bacteremia in humans [3]. Systematic postmortem diagnostics coupled with molecular identification remain essential to monitor emerging zoonotic pathogens within zoological collections and to mitigate potential occupational risks for handlers and veterinary staff.

Abbreviations

- **H&E:** Hematoxylin and Eosin
- **MALDI-TOF MS:** Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry
- **PCR:** Polymerase Chain Reaction
- **RT-PCR:** Reverse Transcription Polymerase Chain Reaction

Declarations

Ethics approval and consent to participate

Not applicable. The study was conducted on a carcass submitted for routine diagnostic necropsy to determine cause of death; no live animals were used or euthanized for the purpose of this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analyzed during the current study are available in the GenBank repository under accession number PZ695206 (https://www.ncbi.nlm.nih.gov/nuccore/PZ695206).

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

DAR and **APe** conceptualized the study. **APe**, **LM**, **LC**, **EB**, **VM**, **DG**, and **PL** performed sample collection and diagnostics. **DAR**, **APe**, and **APa** conducted data analysis and drafted the manuscript. All authors reviewed, edited, and approved the final manuscript.

Acknowledgements

The authors thank the staff of ZooSafari Fasano and the diagnostic laboratories of Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata for technical assistance.

References

1. 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(8):1801–5.
2. Heydecke A, Andersson B, Holmdahl T, Melhus Å. Human wound infections caused by *Neisseria animaloris* and *Neisseria zoodegmatis*, former CDC Group EF-4a and EF-4b. Infect Ecol Epidemiol. 2013;3:20312.
3. Merlino J, Gray T, Beresford R, Baskar SR, Gottlieb T, Birdsall J. Wound infection caused by *Neisseria zoodegmatis*, a zoonotic pathogen: a case report. Access Microbiol. 2021;3(5):000196.
4. Foster G, Whatmore AM, Dagleish MP, Malnick H, Gilbert MJ, Begeman L, et al. Forensic microbiology reveals that *Neisseria animaloris* infections in harbour porpoises follow traumatic injuries by grey seals. Sci Rep. 2019;9:14338.
5. Gilbert MJ, IJsseldijk LL, Rubio-García A, Gröne A, Duim B, Rossen J, et al. After the bite: bacterial transmission from grey seals (*Halichoerus grypus*) to harbour porpoises (*Phocoena phocoena*). R Soc Open Sci. 2020;7(3):192079.
6. Nossa CW, Oberdorf WE, Yang L, Aas JA, Paster BJ, DeSantis TZ, et al. Design of 16S rRNA gene primers for 454 pyrosequencing of the human foregut microbiome. World J Gastroenterol. 2010;16(33):4135–44.

7. Kumar S, Stecher G, Tamura K. MEGA7: Molecular Evolutionary Genetics Analysis version 7.0 for bigger datasets. Mol Biol Evol. 2016;33(7):1870–4.

Figures



Figure 1

Male smooth-coated otter specimen during post-mortem examination. Marked emaciation and generalized skeletal muscle atrophy observed upon necropsy.

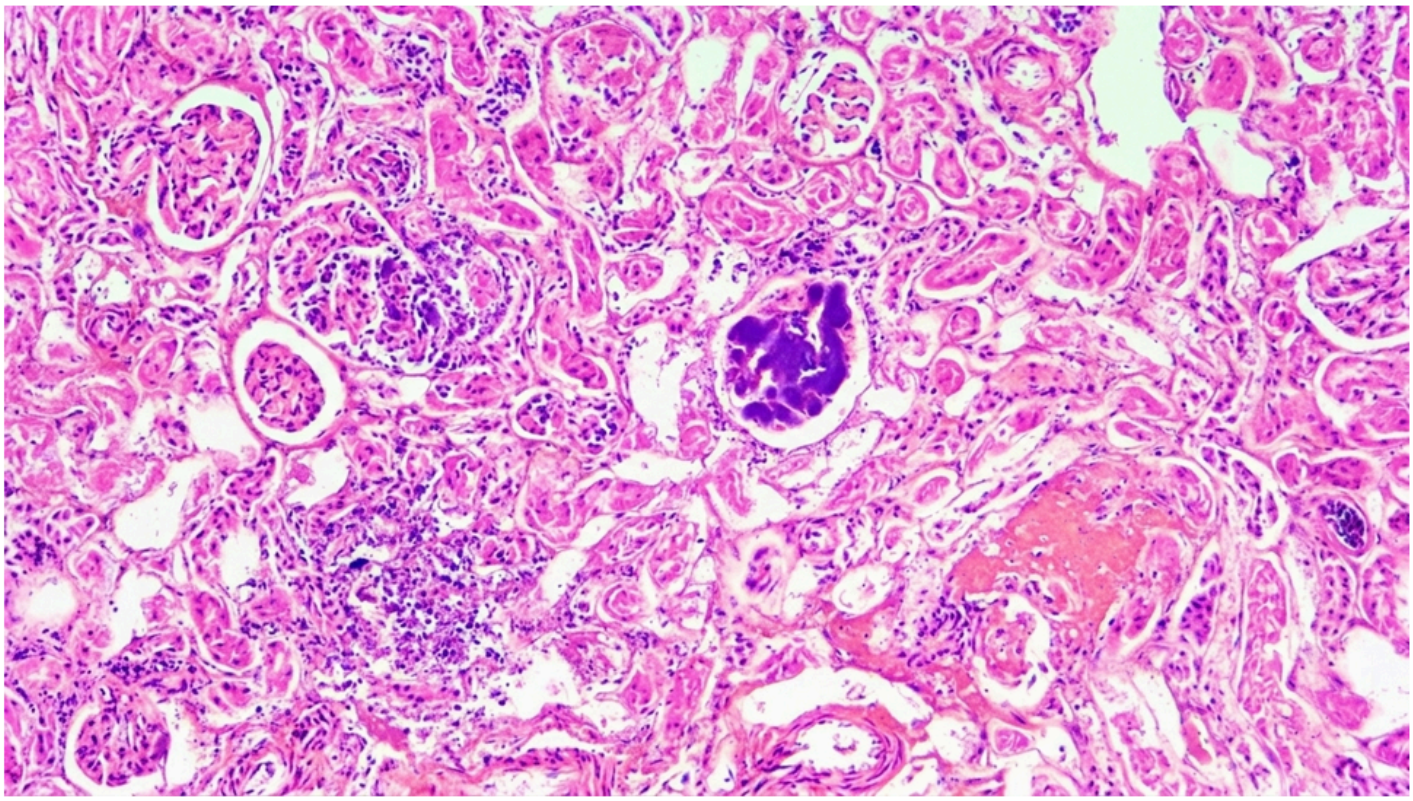


Figure 2

Histopathological section of the kidney showing severe, necrotic-purulent glomerulonephritis. Massive intralesional bacterial macrocolonies of *Neisseria zoodegmatis* effacing glomerular architecture (Hematoxylin and eosin stain).

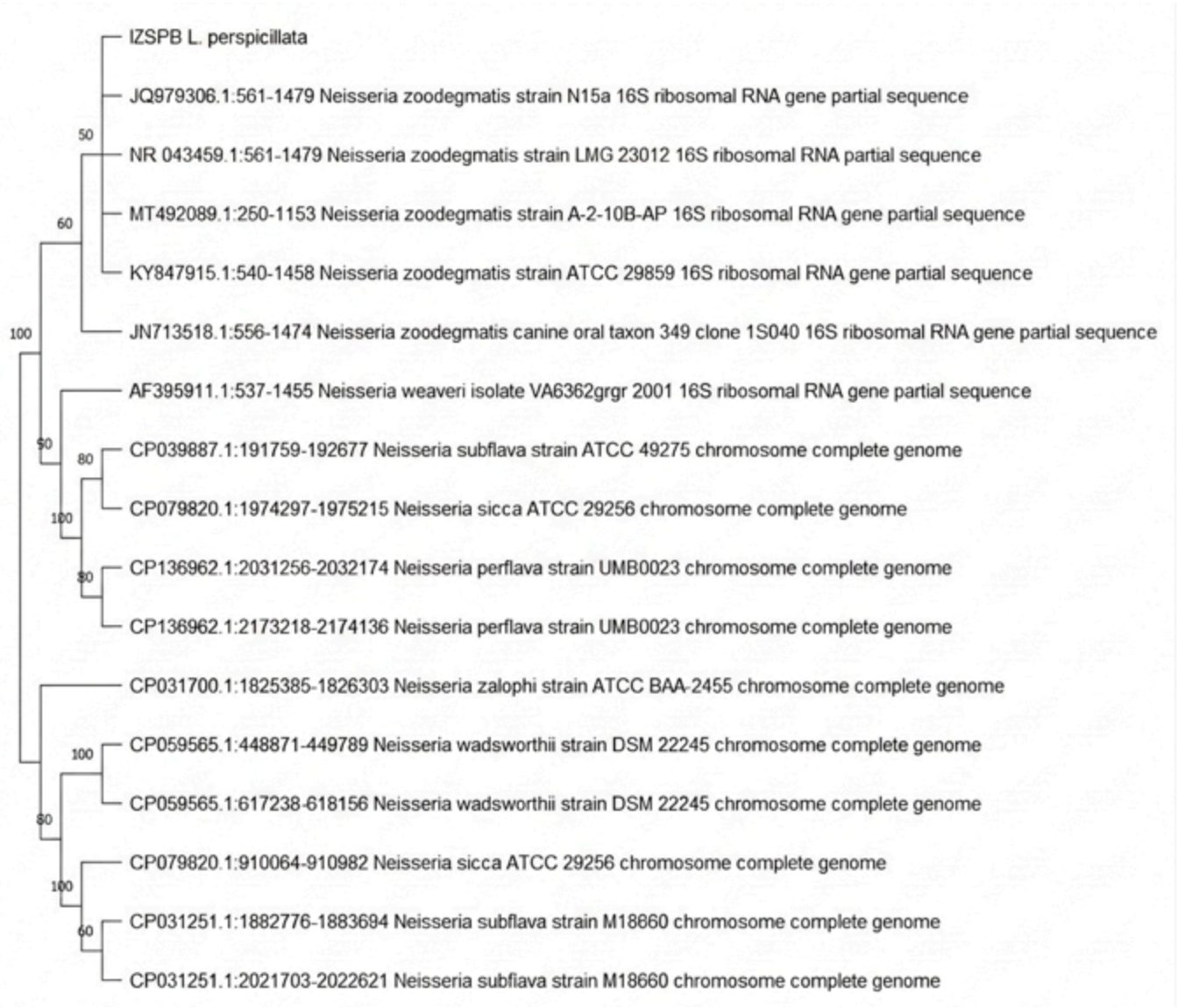


Figure 3

Maximum Likelihood phylogenetic tree based on 16S rRNA gene sequences. Showing the phylogenetic position of the "IZSPB L. perspicillata" isolate within the *Neisseria zoodegmatis* clade. Bootstrap support values (expressed as percentages) are indicated at the nodes. GenBank accession numbers and strain names are provided for all reference sequences.



Figure 4

Post-mortem view of the oral cavity of the captive smooth-coated otter. Severe chronic periodontitis with prominent gingival inflammation and dental calculus accumulation, indicative of a mucosal breach that potentially facilitated systemic *N. zoodegmatis* bacteremia.