INTRODUCTION

A 7-month-old girl developed retropharyngeal abscesses and was intubated. Culture of the abscess yielded multidrug-resistant *Streptococcus mitis*. The antibiogram in our hospital showed that *S. mitis* in children was more resistant to antimicrobials than *S. mitis* in adult patients. This case underlines the potential utility of age-stratified hospital-based antibiogram.

Retropharyngeal abscess is rare in pediatric population (eg, 4 per 100 000 children per annum in the United States).1 Retropharyngeal abscess is a life-threatening situation because the abscess compresses the respiratory tract. The most common causative agent is viridans streptococci.2-5 We report a 7-month-old patient with retropharyngeal abscesses caused by *Streptococci mitis*, a species of viridans streptococci. She was intubated, and the abscesses were surgically incised. Although the *S. mitis* was resistant to many antibiotics, treatment with meropenem and clindamycin was successful.

CASE HISTORY/EXAMINATION

In 2016, a 7-month-old female infant without a remarkable medical history presented with a 39°C fever and wheezing. The patient had developed a low-grade fever and cough 2 weeks prior. Subsequently, she developed a high fever and came to our hospital. She did not use antimicrobials in the recent past. On presentation, the patient's pharynx and tonsils were reddened, but the tonsils were not swollen. There was no palpable mass on her neck. Wheezing was heard in both lungs, and retracted breathing was noted. Although we did not notice any abnormalities in the chest X-ray, laboratory tests were remarkable for a highly inflammatory profile: white blood cell count of 33 300/μL (79% neutrophils) and C-reactive protein of 202 mg/L. Bacterial culture of the pharyngeal aspirate subsequently yielded *Haemophilus influenzae*, *Klebsiella oxytoca*, and *Streptococcus pneumoniae*. She was admitted (day 1) with a tentative diagnosis of severe acute pharyngitis, while...
an alternative differential diagnosis was deep neck infection. From day 1, we started intravenous cefotaxime at 150 mg/kg/day.

On day 2, however, her respiratory distress worsened, with severe retractions and respiratory acidosis. Enhanced computerized tomography (CT) revealed a right-sided peritonsillar abscess and retropharyngeal abscesses (Figure 1). She was intubated immediately. An incision of the posterior pharyngeal wall yielded copious pus.

Empirically, we replaced cefotaxime with 10 mg/kg/day of meropenem from day 3. Additionally, on day 5, 300 mg/kg/day of ampicillin was started. A bacterial culture of the pus from the retropharyngeal abscess, which was incised on day 2, identified Streptococcus mitis on day 6. We replaced ampicillin with 40 mg/kg/day of clindamycin from day 8. Subsequently, a drug susceptibility test using an EIKEN FROZEN PLATE (Eiken Kagaku) reported resistance of the S. mitis to multiple drugs (Table 1). The patient was extubated on day 10. Culture of the blood sample, which was collected on day 1, did not yield any microbe. She was discharged on day 24, with 9 mg/kg/day of oral tebipenem prescribed for 14 days. She has not had any relapse or severe infection to date.

3 | DISCUSSION

Our patient initially showed only mild signs of an upper respiratory infection, but quickly deteriorated. Peritonsillar and retropharyngeal abscesses were diagnosed by enhanced CT. In our facility, 159 cases of peritonsillar abscess were treated between 2013 and 2017. During this period, only 11 cases of retropharyngeal abscess were treated here (Table 2). The rarity of this diagnosis may be due partly to the fact that it occurs in the deep tissue and relies upon imaging studies, particularly enhanced CT, to detect. Airway management was invasive: 5 cases (45%) were either intubated or tracheotomized. Treatment was surgical in most of the cases: 9 cases (82%) were incised.

Our patient was also intubated and incised. S. mitis, which was cultured from the abscess, was resistant to multiple antimicrobials. S. mitis belongs to viridans streptococci species, which are commensal to the oral cavity. Viridans streptococci are the most common cause of deep neck infections, followed by Staphylococcus species and anaerobes. Viridans streptococci are assumed to be susceptible to penicillins and cephalosporins. Among viridans streptococci, however, S. mitis is known to be highly resistant to multiple antibiotic drugs. Cephalosporin resistance is highly prevalent in S. mitis in Japan. In addition, S. mitis possesses various molecular strategies to compete with other bacteria in the oropharynx, promoting its virulence in opportunistic infections. Consistently, infections with S. mitis are associated with high morbidity and mortality, particularly among immunocompromised patients. In contrast, our patient was immunocompetent and had not taken antimicrobials prior to this episode. This led us to review the medical records from our facility to understand the microbes that cause retropharyngeal abscess, especially S. mitis.

Table 2 reveals that retropharyngeal abscesses frequently yielded anaerobes, including Prevotella, Peptostreptococcus, and Fusobacterium, in patients from our hospital. Viridans streptococci were identified in three patients, including the present case. Three patients were infected with more than one of these four microbial groups. In particular, one patient was infected with all four microbial groups. These microbes, other than the S. mitis in the present case, were susceptible in vitro to cefmetazole or sulbactam/ampicillin (data not shown). As a result, treatment with these antibiotic drugs had been effective in all cases, except the case reported here.

In contrast, S. mitis in our patient was highly resistant to cephalosporins, macrolides, and fluoroquinolones and was intermediate resistant to penicillins (Table 1). This resistance may explain why our initial treatment with cefotaxime was not effective. Instead, S. mitis in the present case was susceptible to meropenem and clindamycin. Therefore, our empirical choice of these drugs was fortunately adequate.
The clinical microbiology laboratory of our hospital regularly issues the antibiogram—the profile of resistance and susceptibility to antimicrobials, based upon the bacterial culture database (La-vietal MB®, Sysmex) which was introduced into our hospital in 2012. Upon our request, the clinical microbiology laboratory extracted records, accumulated between 2013 and 2017, that contained “S. mitis”. We examined the case record from the electric medical record system, corresponding to these bacteriological records. As is shown in Table 3, there was no significant difference in the origin of samples between pediatric and adult patients (P = .4080 by two-sided Fisher's exact test). The antibiogram for S. mitis, stratified by age-group (ie, pediatric patients of 15 years or younger, or adult patients), was compiled. This age-stratified antibiogram showed that S. mitis in our facility was more drug-resistant in the children than in the adults (Figure 2). This may give a clue to our initial question: why retropharyngeal abscess, a very rare disease in children, occurred in a healthy infant? The high prevalence of antimicrobial resistance of S. mitis in the children in our community may have increased the probability that a healthy child encounters a multidrug-resistant strain of this species which caused a severer disease than susceptible strains.26 It was previously suggested that frequent use of antibiotic treatment in pediatric and immuno-compromised populations have increased the rate of drug-resistant viridans streptococci in these populations.13,27

### TABLE 1
Susceptibility and resistance of the *Streptococcus mitis* identified in the retropharyngeal abscess of the present case to antibiotic drugs

| Antibiotics            | MIC<sup>a</sup> defined as being susceptible (µg/mL) | MIC<sup>a</sup> in the present patient (µg/mL) | Susceptibility<sup>b</sup> |
|------------------------|---------------------------------------------------|---------------------------------------------|----------------------------|
| 1. Penicillins         |                                                   |                                             |                            |
| Penicillin-G           | ≤0.12                                             | 2                                           | I                          |
| Ampicillin             | ≤0.25                                             | 2                                           | I                          |
| Amoxicillin            | ≤0.25                                             | 1                                           | I                          |
| Piperacillin           | ≤0.25                                             | 1                                           | I                          |
| Sulbactam/ampicillin   | ≤0.12/0.25                                        | 2                                           | I                          |
| 2. Cephalosporins      |                                                   |                                             |                            |
| Cefotaxime             | ≤1                                                | >4                                          | R                          |
| Ceftriaxone            | ≤1                                                | >4                                          | R                          |
| Cefditoren             | ≤0.5                                             | >1                                          | R                          |
| Cefdinir               | ≤0.5                                             | >1                                          | R                          |
| Cefcapene              | ≤0.5                                             | >2                                          | R                          |
| 3. Carbapenems         |                                                   |                                             |                            |
| Meropenem              | ≤0.5                                             | 0.12                                        | S                          |
| Panipenem              | ≤0.12                                             | <0.12                                       | S                          |
| 4. Macrolides          |                                                   |                                             |                            |
| Azithromycin           | ≤0.5                                             | >4                                          | R                          |
| Clarithromycin         | ≤0.25                                             | 16                                          | R                          |
| 5. Quinolones          |                                                   |                                             |                            |
| Levofloxacin           | ≤2                                                | >8                                          | R                          |
| Tosufloxacin           | ≤0.5                                             | >1                                          | R                          |
| 6. Tetracyclines       |                                                   |                                             |                            |
| Minomycin              | ≤2                                                | <0.25                                       | S                          |
| Clindamycin<sup>c</sup>|                                                   |                                             | S                          |

<sup>a</sup>Minimum inhibitory concentration (MIC).  
<sup>b</sup>Resistant (R), intermediate (I), and susceptible (S).  
<sup>c</sup>Susceptibility to clindamycin was estimated by Sensi-Disk (BD; Franklin Lakes, NJ, USA) at the request of the physician.

### TABLE 2
Profiles of 11 cases of retropharyngeal abscess who were diagnosed and treated in our hospital between 2013 and 2017

| Age                  | Mean: 53 y; median: 63 y (range: 7 mo–81 y) |
|----------------------|--------------------------------------------|
| Mode of diagnosis<sup>a</sup> | Enhanced CT (8 cases), laryngoscopy (2), nonenhanced CT (1) |
| Airway management    | Noninvasive (6), intubation (3), tracheotomy (2) |
| Treatment            | Incision and drainage (9), supportive (2) |
| Antimicrobials<sup>b</sup> | Sulbactam/ampicillin (6), cefmetazole (4), clindamycin (4), cefotaxime (2), ampicillin (1), meropenem (1) |
| Number of intravenous antimicrobials<sup>b</sup> | Two (2), three (1), four (1), and one (7) |
| Bacteria in abscess  | *Prevotella* (6), *Viridans streptococcus* (3), *Peptostreptococcus* (2), *Fusobacterium* (1) |

<sup>a</sup>Computed tomography (CT).  
<sup>b</sup>On average, a patient was treated with 1.6 antimicrobial drugs.

### TABLE 3
Compositions of specimens with identified *Streptococcus mitis* from pediatric and adult patients between 2013 and 2017

| Sample collection site<sup>a</sup> | Pediatric patients | Adult patients |
|------------------------------------|--------------------|----------------|
| Blood/spinal fluid                | 6 (35%)            | 19 (39%)<sup>b</sup> |
| Urine                              | 3 (18%)            | 14 (29%)        |
| Sputum/nasal swab                 | 4 (24%)<sup>c</sup> | 4 (8%)          |
| Wound/pus/drainage                | 4 (24%)            | 12 (24%)        |
| Total                             | 17 (100%)          | 49 (100%)       |

<sup>a</sup>Three patients yielded *S. mitis* from multiple body sites. As a result, 61 patients produced 66 isolates.  
<sup>b</sup>One of these isolates was from the spinal fluid.  
<sup>c</sup>One of these isolates was from nasal swab.
The utility of hospital-based antibiogram in assisting in the selection of antimicrobial drug has been well recognized. In addition, it has been reported that the age greatly affects the profile of antimicrobial resistance. Despite the fact that the use of hospital-based antibiogram is increasingly common, age-stratified antibiogram was rarely utilized. Age-specific information of antimicrobial resistance may provide useful input to the pediatric practice.

4 | CONCLUSION

We reported a pediatric case of deep neck infection caused by *S. mitis* that was resistant to multiple antimicrobials. Antibiogram stratified by age-group suggested that *S. mitis* was more drug-resistant in children than in adults, in our hospital. Age-specific and locale-specific profile of antimicrobial resistance will be useful in guiding the treatment of children with severe infections.

ACKNOWLEDGMENTS

We are grateful to Takahisa Tabata for his advice. We thank to Makiko Matsumoto, Mana Tominaga, Naohisa Honjo, and Yuko Okazaki of the clinical microbiology laboratory of our hospital, for their assistance. We did not receive any specific funding.
CONFLICTS OF INTEREST
The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS
YW: involved in the treatment of the patient and drafted the manuscript. YN: edited the manuscript. HE and IY: involved in the management of the patient. MH: endorsed the primary responsibility for the management of the patient. KH: conceptualized this report. All the authors have read the manuscript and approved its submission.

INFORMED CONSENT
Written informed consent was obtained from her guardians.

ORCID
Yoshiro Nagao https://orcid.org/0000-0003-3411-0729

REFERENCES
1. Woods CR, Cash ED, Smith AM, et al. Retropharyngeal and parapharyngeal abscesses among children and adolescents in the united states: epidemiology and management trends, 2003–2012. J Pediatr Infect Dis Soc. 2016;5:259-268.
2. Tan PT, Chang LY, Huang YC, Chiu CH, Wang CR, Lin TY. Deep neck infections in children. J Microbiol Immunol Infect. 2001;34:287-292.
3. Pontell J, Har-El G, Lucente FE. Retropharyngeal abscess: clinical review. Ear Nose Throat J. 1995;74:701-704.
4. Parhiscar A, Har-El G. Deep neck abscess: a retrospective review of 210 cases. Ann Otol Rhinol Laryngol. 2001;110:1051-1054.
5. Martinez Pascual P, Pinacho Martinez P, Friedlander E, Martin Oviedo C, Scola YB. Peritonsillar and deep neck infections: a review of 330 cases. Braz J Otorhinolaryngol. 2018;84:305-310.
6. Japanese Society of Chemotherapy and The Japanese Association for Infectious Diseases. Anaerobic infections (individual fields): dental and oral infections. J Infect Chemother. 2011;17(Suppl 1):112-115.
7. Mitchell J. Streptococcus mitis: walking the line between commensalism and pathogenesis. Mol Oral Microbiol. 2011;26:89-98.
8. McMillan IA, Lee CKK, Silberry GK, Carroll KC, eds. The harriet lane handbook of pediatric antimicrobial therapy, 2nd edn. Amsterdam: Elsevier; 2013.
9. Doern GV, Ferraro MJ, Brueggemann AB, Ruoff KL. Emergence of high rates of antimicrobial resistance among viridans group streptococci in the United States. Antimicrob Agents Chemother. 1996;40:891-894.
10. Levy CS, Kogulan P, Gill VJ, Croxton MB, Kane JG, Lucey DR. Endocarditis caused by penicillin-resistant viridans streptococci: 2 cases and controversies in therapy. Clin Infect Dis. 2001;33:577-579.
11. Knoll B, Tleyjeh IM, Steckelberg JM, Wilson WR, Baddour LM. Infective endocarditis due to penicillin-resistant viridans group streptococci. Clin Infect Dis. 2007;44:1585-1592.
12. Radocha J, Paterova P, Zavrelowa A, et al. Viridans group streptococci bloodstream infections in neutropenic adult patients with hematologic malignancy: single center experience. Folia Microbiol (Praha). 2018;63:141-146.
13. Doern CD, Burnham CA. It's not easy being green: the viridans group streptococci, with a focus on pediatric clinical manifestations. J Clin Microbiol. 2010;48:3829-3835.
14. Chun S, Huh HJ, Lee NY. Species-specific difference in antimicrobial susceptibility among viridans group streptococci. Ann Lab Med. 2015;35:205-211.
15. Mishra NN, Tran TT, Seepersaud R, et al. Perturbations of phosphatidate cytidylyltransferase (CdsA) mediate daptomycin resistance in Streptococcus mitis/oralis by a novel mechanism. Antimicrob Agents Chemother. 2017;61, e02435-16.
16. Garcia-de-la-Maria C, Pericas JM, Del Río A, et al. Early in vitro and in vivo development of high-level daptomycin resistance is common in mitis group Streptococcus after exposure to daptomycin. Antimicrob Agents Chemother. 2013;57:2319-2325.
17. Adams HM, Joyce LR, Guan Z, Akins RL, Palmer KL. Streptococcus mitis and S. oralis lack a requirement for CdsA, the enzyme required for synthesis of major membrane phospholipids in bacteria. Antimicrob Agents Chemother. 2017;61, e02552-16.
18. Nakayama A, Takao A. Beta-lactam resistance in Streptococcus mitis isolated from saliva of healthy subjects. J Infect Chemother. 2003;9:321-327.
19. Denapaite D, Bruckner R, Nuhn M, et al. The genome of Streptococcus mitis B6—is what a commensal? PLoS ONE. 2010;5:e9426.
20. Tasaka T, Nagai M, Sasaki K, et al. Streptococcus mitis septicemia in leukemia patients; clinical features and outcome. Intern Med. 1993;32:221-224.
21. Balkundi DR, Murray DL, Patterson MJ, Gera R, Scott-Emuakpor A, Kulkarni R. Penicillin-resistant Streptococcus mitis as a cause of septicaemia with meningitis in febrile neutropenic children. J Pediatr Hematol Oncol. 1997;19:82-85.
22. Matsui N, Ito M, Kuramae H, Inukai T, Sakai A, Okugawa M. Infective endocarditis caused by multidrug-resistant Streptococcus mitis in a combined immunocompromised patient: an autopsy case report. J Infect Chemother. 2013;19:321-325.
23. Basaranoglu ST, Ozsurekci Y, Aykac K, et al. Streptococcus mitis/oralis Causing blood stream infections in pediatric patients. Jpn J Infect Dis. 2018.
24. Westling K, Julander I, Ljungman P, Heimdahl A, Thalme A, Nord CE. Reduced susceptibility to penicillin of viridans group streptococci in the oral cavity of patients with haematological disease. Clin Microbiol Infect. 2004;10:899-903.
25. Nielsen MJ, Claxton S, Pizer B, et al. Viridans group streptococcal infections in children after chemotherapy or stem cell transplantation: a 10-year review from a tertiary pediatric hospital. Medicine (Baltimore). 2016;95:e2952.
26. Poutanen SM, de Azavedo J, Willey BM, Low DE, MacDonald KS. Molecular characterization of multidrug resistance in Streptococcus mitis. Antimicrob Agents Chemother. 1999;43:1505-1507.
27. Mogi A, Nishi JI, Yoshinaga M, et al. Increased prevalence of penicillin-resistant viridans group streptococci in Japanese children with upper respiratory infection treated by beta-lactam agents and in those with oncoclonal hemato logic diseases. Pediatr Infect Dis J. 1997;16:1140-1144.
28. Joshi S. Hospital antibiogram: a necessity. Indian J Med Microbiol. 2010;28:277-280.
29. Swami SK, Banerjee R. Comparison of hospital-wide and age and location-stratified antibiograms of S. aureus, E. coli, and S. pneumoniae: age- and location-stratified antibiograms. Springerplus. 2013;2:63.

30. Adam HJ, Baxter MR, Davidson RJ, ,et al. Comparison of pathogens and their antimicrobial resistance patterns in paediatric, adult and elderly patients in Canadian hospitals. J Antimicrob Chemother. 2013;68(Suppl 1):i31-i37.

31. Robey RC, Drysdale SB, Kelly DF, Bowler IC, Sadarangani M. Age-specific trends in antibiotic resistance in Escherichia coli infections in Oxford, United Kingdom 2013–2014. J Infect. 2017;74:195-198.

How to cite this article: Watanabe Y, Nagao Y, Endo H, Yamane I, Hirata M, Hatakeyama K. An intubated 7-month-old infant with a retropharyngeal abscess and multidrug-resistant Streptococcus mitis. Clin Case Rep. 2019;7:2443–2448. https://doi.org/10.1002/ccr3.2528