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【 CASE REPORT 】

Streptococcus oralis Meningitis with Gingival Bleeding in a Patient: A Case Report and Review of the Literature

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Abstract:
An 81-year-old man with a history of gingival bleeding presented with a fever, headache, and drowsiness. His mouth and full dentures were unsanitary. Laboratory tests revealed *Streptococcus oralis* meningitis caused by odontogenic bacteremia. We reviewed eight reported cases, including the present case, because *S. oralis* meningitis is rare. Our review indicated that *S. oralis* meningitis needs to be considered when encountering cases of a fever, disturbance of consciousness, and headache with episodes of possible odontogenic bacteremia.

Key words: gingival bleeding, hematogenous transmission, meningitis, odontogenic bacteremia, poor oral hygiene, *Streptococcus oralis*

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Introduction

Odontogenic bacteremia is a phenomenon in which oral microorganisms invade the bloodstream through wounds or inflammatory conditions in the oral cavity (1). Causes of odontogenic bacteremia include iatrogenic factors that develop due to medical practice (e.g., tooth extraction, scaling), personal oral hygiene factors that develop due to a poor lifestyle (e.g., brushing or chewing with teeth with periodontal disease), and host-side factors (e.g., through neutropenia, immunosuppressant therapy) (1).

Streptococcus oralis is a viridans streptococcus that resides in the oral cavity. The organism is part of the normal flora of the nasal, oropharyngeal, skin, gastrointestinal, and female genital systems (2). The species usually shows low pathogenicity and virulence (2). However, the viridans group (including *S. oralis*) is widely recognized as an important causative bacteria for infectious bacterial endocarditis (3). Previous case reports have indicated that meningitis with *S. oralis* is associated with dental manipulations (4-7), spinal anesthesia (8), malignancy (9), and cerebrospinal fluid leak (10). However, *S. oralis* meningitis is rare and poorly recognized, and few clinicians have experienced the clinical course.

We herein report a case of *S. oralis* meningitis after gingival bleeding with an unsanitary oral environment and review seven previously reported cases.

Case Report

An 81-year-old man visited the emergency room with transient oral hemorrhaging 10 days before admission. No persistent bleeding was observed at the time of visit. An examination by the emergency doctor did not identify any hematemesis or hemoptysis, so the patient was referred to an otolaryngologist at a later date. A few days later, an otolaryngologist examined the patient from the nasal cavity to the upper respiratory tract with a fiberscope, and a gastroenterologist examined the upper gastrointestinal tract with a fiberscope, but no obvious bleeding sites other than the gingiva were observed. The patient visited the emergency room on two more occasions, five and two days before admission, again with chief complaints of a fever and malaise.

On the day of hospitalization, he visited the emergency room a fourth time with a fever and headache. He had a history of diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, paroxysmal atrial fibrillation, aortic valve re-

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placement (bioprosthetic valve) for aortic stenosis, and stent placement for angina pectoris. He had been taking clopidogrel at 75 mg/day and apixaban at 5 mg/day as antithrombotic therapy. He had full dentures but had received no dental care for over 10 years. The dentures had been poorly cleaned and showed marked plaque adhesions. Marked absorption of the alveolar ridge due to periodontitis was identified. He presented with a high fever (39.1℃), headache, and drowsiness (Glasgow Coma Scale score 14). No nausea, vomiting, skin rash, seizure, or photophobia were observed. No pathological heart murmur was identified. A neurological examination revealed no evidence of Kernig sign or Brudzinski sign, but he showed mild neck stiffness and head jolt sign. No mydriasis, disturbance of light reflex, abducens nerve palsy, hearing impairment, motor paralysis, or aphasia were observed.

Laboratory tests showed the following: white blood cells, 13.0×10^3/μL (84% neutrophils, 12% lymphocytes, and 4% monocytes); hemoglobin, 10.7 g/dL; platelet count, 10.1×10^4/μL; creatinine, 1.87 mg/dL; C-reactive protein, 10.17 mg/dL; blood sugar, 650 mg/dL; HbA1c, 12.2%; activated partial thromboplastin time, 64.8 seconds; and prothrombin time (international normalized ratio), 1.06. This patient showed the classical triad of a fever, neck stiffness, and altered consciousness, and laboratory tests suggested the presence of infection, likely bacterial meningitis. Cerebrospinal fluid (CSF) studies showed increased levels of protein (60 mg/dL) and glucose (261 mg/dL) as well as pleocytosis with predominant polynuclear cells (476/mm^3; 96% polynuclear, 4% mononuclear). No bacteria were found from CSF cultures, but *S. oralis* was confirmed from blood cultures (2 of 2 sets).

Magnetic resonance imaging (MRI) of the brain showed no signal-intensity abnormalities, suggesting cerebrovascular disease (Figure A, B). Fluid-attenuated inversion recovery imaging showed neither edematous changes in the brain nor ventricular enlargement suggestive of obstructive hydrocephalus (Figure C, D). Brain atrophy was attributed to age-related changes. Magnetic resonance angiography of the brain showed irregular walls of the blood vessels, considered to represent arteriosclerotic changes (Figure E). Contrast-enhanced MRI was not performed due to his chronic kidney disease. Transthoracic echocardiography (TTE) showed no evidence of any vegetations or valvular abnormalities (day 2). Transesophageal echocardiography was not conducted because the patient declined to undergo this procedure.

Three famous classical signs of meningitis (fever, neck stiffness, and altered consciousness) were found. *S. oralis* was detected from blood cultures, and this patient showed a potential route of invasion that can lead to odontogenic bacteremia. A CSF specimen showed pleocytosis with predominant polynuclear cells. Although no bacteria were detected from the CSF specimen, the overall diagnosis was *S. oralis* meningitis.

Empirical intravenous antimicrobial therapy was started to cover methicillin-resistant *Staphylococcus aureus* and *Listeria monocytogenes*; ampicillin (ABPC) 6 g/day, ceftriaxone (CTRX) 4 g/day, and vancomycin (VCM) 30 mg/kg/day. The administration of dexamethasone was withheld due to concerns regarding difficulty with controlling blood sugar levels. His fever, headache, and disturbance of consciousness (DOC) slowly improved. We discontinued ABPC and VCM because *in vitro* testing showed that the identified *S. oralis* was sensitive to ABPC, CTRX, and VCM. Antibiotic treatment with CTRX was continued for 28 days due to prolonged headache. TTE performed again on day 27 did not reveal any evidence of infectious endocarditis. In parallel with pharmacotherapy, we consulted with the dental and oral surgery department and requested treatment to maintain good oral hygiene, including his dentures. We also controlled his hyperglycemia, reducing it to within an appropriate range. A complete cure had been achieved by discharge on day 34.

Discussion

We encountered a case of *S. oralis* meningitis caused by a combination of gingival bleeding while taking an antithrombotic agent, poor oral hygiene, and uncontrolled diabetes mellitus. A neurological examination revealed DOC and signs of meningeal irritation. Polynuclear cells were found to be predominant in the CSF, and *S. oralis* was detected from blood cultures. Treatment required long-term antimicrobial administration with instruction in cleaning the dentures.

Bacterial meningitis in adults still shows a high mortality rate and a certain proportion of serious sequelae, even with appropriate antimicrobial therapy (11). Differentiation of bacterial meningitis from other disorders may be difficult at a sufficiently early stage if progressive deterioration occurs over the course of a few weeks (12). The Table provides information on the present and previous cases to clarify the characteristics of *S. oralis* meningitis (4-10). The data presented in the Table revealed that the age and sex of patients varied, but incidence was high after dental procedures, with frequent symptoms of a fever (6 of 8 patients), DOC (6 of 8 patients), and headache (5 of 8 patients). CSF findings showed pleocytosis with predominant polynuclear cells except in one case, and the prognosis was good in response to antibiotics. This fact suggests that if a fever, DOC, and headache are observed after dental treatment, an examination and treatment in consideration of *S. oralis* meningitis may lead to a better prognosis, regardless of age and sex. The data presented in the Table also indicated that CSF findings with *S. oralis* showed a typical pattern of bacterial meningitis, so confirmation of CSF findings would provide a more reliable diagnosis. Furthermore, when classified as elderly patients (≥75 years old), including our case and the others, then all cases showed DOC. Among the patients <75 years old, 3 of 5 (60%) had DOC. This feature was consistent with a report that aging was associated with an altered level of consciousness (GCS score <15), independent of the pres-

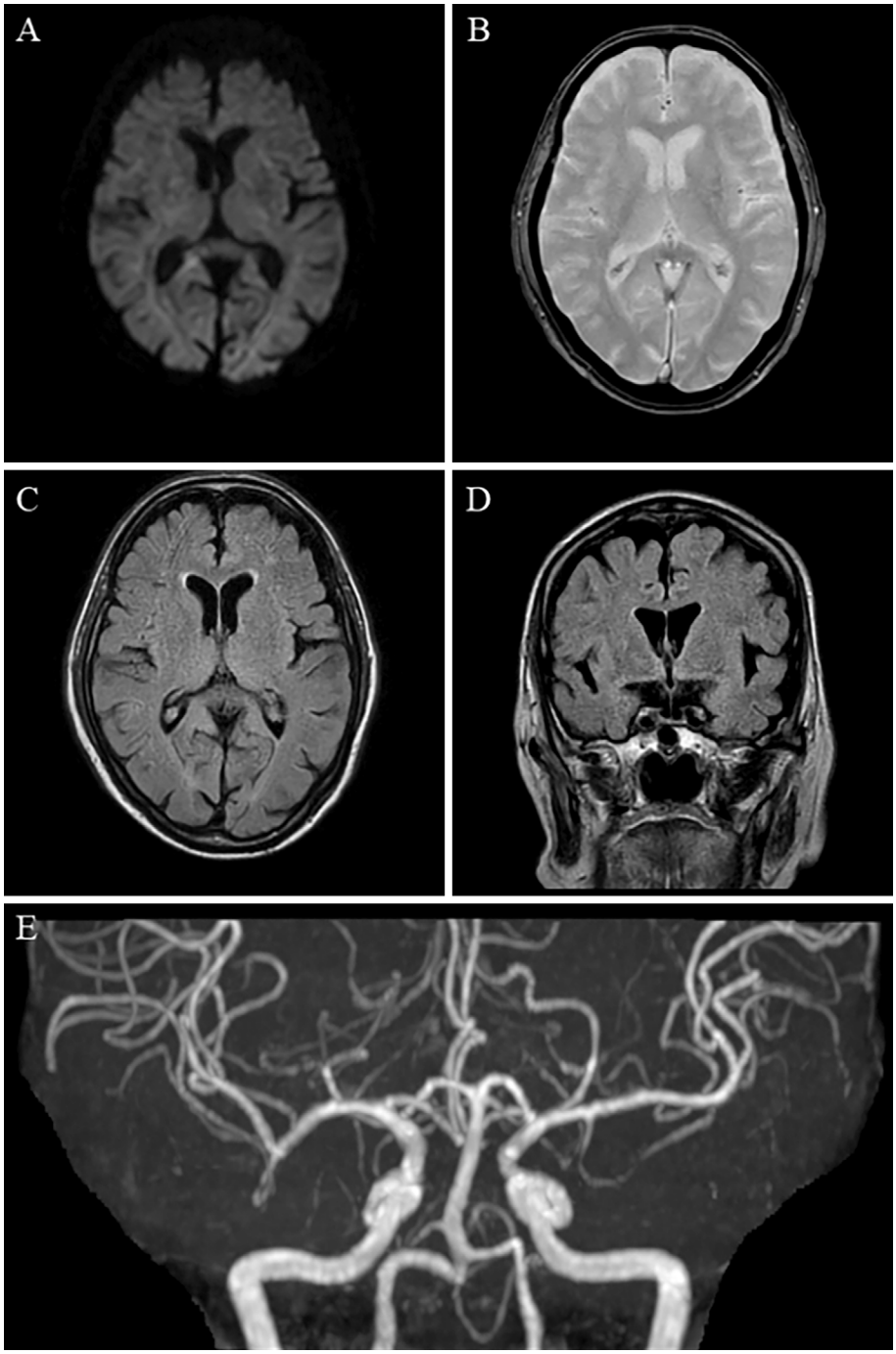

Figure. **Findings from magnetic resonance imaging (MRI) of the brain on admission. Diffusion-weighted imaging (A) and T2*-weighted imaging (B) show no signal-intensity abnormalities. Fluid-attenuated inversion recovery (C, D) shows neither edematous changes in the brain nor ventricular enlargement. Three-dimensional time-of-flight magnetic resonance angiography shows arteriosclerotic change (E). Contrast-enhanced MRI was not performed due to the renal function being reduced by chronic kidney disease.**

ence of comorbidities (13), supporting the tendencies seen in the present case. A slight change in level of consciousness should not be overlooked in order to avoid missing meningitis in the elderly. Neck stiffness was observed in 1 of 3 patients (33%) ≥75 years old and in 3 of 5 patients (60%) <75 years old. Because reports on the relationship between aging and neck stiffness are conflicting (13, 14), we could not conclude that the frequency of neck stiffness decreased with age. However, elderly people show a higher prevalence of Parkinson's disease and cervical spine disease than younger people, which may make neck stiffness difficult to determine.

Bacterial meningitis develops by spreading from adjacent infectious lesions, hematogenous spread from other infected organs, and direct infection by bacteria entering the subarachnoid space (11). We speculated that hematogenous trans-

Table. **Reported Clinical Data of *Streptococcus oralis* meningitis.**

Case	Age (y)/ sex	Underlying condition	Clinical manifestation	CSF study on admission			CSF: serum glucose ratio	Antibiotics and treatment period (days)	Steroid	Outcome
				Cell count (mm^3)	Polynuclear (%)	Protein (mg/dL)				
A (4)	12/F	dental extraction	headache, vomiting, neck stiffness, photophobia	3,200	80	95	0.38	PCG (10)	no	CR
B (5)	35/M	dental fillings	fever, headache, nausea, neck stiffness, photophobia	9,440	polynuclear predominant	820	0.022	CTX, PCG, AMPC (11)	no	CR
C (6)	48/F	dental extraction	fever, DOC	12,600	92	248	0.43	CTX (14)	no	CR
D (7)	75/M	dental scaling, AM, PN, hypothyroid	fever, DOC	984	10	680	0.021	ABPC, CTX (14)	DEX	CR
E (8)	81/F	spinal anesthesia, HT, AF	headache, nausea, DOC	5,120	NA	NA	NA	MEPM (11)	no	CR
F (9)	61/F	breast cancer, ESRD, LC	fever, DOC, seizure	NA	NA	NA	NA	VCM (21)	no	PR
G (10)	58/F	cerebrospinal, fluid leak	fever, headache, DOC, neck stiffness	NA	NA	NA	NA	ABPC, CTRX, VCM (NA)	DEX	CR
Our case	81/M	HT, DL, DM, PAF, CKD, poor oral hygiene	fever, headache, DOC, neck stiffness	476	96	60	0.40	ABPC, CTRX, VCM (28)	no	CR

ABPC: ampicillin, AF: atrial fibrillation, AM: atypical mycobacteriosis, AMPC: amoxicillin, CKD: chronic kidney disease, CR: complete recovery, CSF: cerebrospinal fluid, CTRX: ceftriaxone, CTX: cefotaxime, DEX: dexamethasone, DL: dyslipidemia, DM: diabetes mellitus, DOC: disturbance of consciousness, ESRD: end-stage renal disease, F: female, HT: hypertension, LC: liver cirrhosis, M: male, MEPM: meropenem, NA: not available, PAF: paroxysmal atrial fibrillation, PCG: benzylpenicillin, PN: pyelonephritis, PR: partial recovery, VCM: vancomycin

mission was the infection route in our case. The patient in this case had neither an adjacent source of infection nor a recent history of surgery or procedures involving the central nervous system. A previous study investigating the relationship between oral surgery and bacteremia showed that causes of bacteremia included not only oral procedures, such as dental extractions and intraligamental injection, but also daily mastication (15). Odontogenic bacteremia can thus easily arise depending on personal oral hygiene factors.

We considered that multiple potential risk factors in our case could have contributed to odontogenic bacteremia. First, hygiene for the full denture was extremely poor. Unhygienic dentures provide a hotbed for plaque, and numbers of bacteria colonizing the teeth, especially supragingivally, can increase 2- to 10-fold within a background of poor oral hygiene (16). Dental plaque has been shown to form matrix-embedded biofilms at attachment sites, enhancing pathogenicity (17). Increased plaque also exacerbates gingival inflammation (18). The absorption of the alveolar ridge was marked in our case. Second, the patient had a history of gingival bleeding. Gingival inflammation is likely to cause gingival bleeding, which is used as an objective sign of gingival inflammation (19). Third, the patient was taking clopidogrel and apixaban. Both antiplatelet and anticoagulant drugs have been reported to show adverse events of gingival bleeding (20, 21). Finally, although a few reports have found that the frequency and degree of oral bacteremia was higher in diabetic patients than in healthy subjects, the prevalence of periodontitis has been associated with high levels of glycated hemoglobin (22). Some cases of infection after dental procedures have been reported in patients with uncontrolled diabetes (23, 24). Our case also showed uncontrolled diabetes, and the risk of infection was considered non-negligible. Personal oral hygiene factors (e.g., dental plaque, gingival bleeding) and host-side factors (e.g., antithrombotic drug, uncontrolled diabetes) were interrelated in our case and could all have contributed to odontogenic bacteremia, which hematogenously invaded the central nervous system for involvement in the onset of meningitis.

Several limitations associated with the present study warrant mention. First, no *S. oralis* was detected from CSF culture in our case. The positive rate for CSF culture is known to depend on the volume of CSF collected (25). In this case, the amount of CSF collected may have been insufficient. Second, we encouraged the patient in the present case to try to improve his oral hygiene, including proper denture cleaning, in addition to proper antimicrobial treatment. However, whether or not keeping the oral cavity hygienic is a preventive measure for *S. oralis* meningitis is unclear, as so few cases have been accumulated. In this case, we provided hygiene guidance in consideration of the fact that gingival bleeding can be significantly reduced by maintaining oral hygiene (26).

In conclusion, we encountered a case of *S. oralis* meningitis after gingival bleeding. The number of cases we reviewed was small, but certain characteristics were suggested.

S. *oralis* meningitis should be considered in cases with a fever, DOC, or headache since these are all conditions under which oral bacteria can be transmitted by the blood. The accumulation of more cases will be needed in order to examine the potential risks and preventive methods.

The authors state that they have no Conflict of Interest (COI).

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