

The interplay among a dental procedure, infective endocarditis, and an acute ischemic stroke

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ABSTRACT

Background. This case report highlights the rare association among a dental procedure, infective endocarditis, and an acute ischemic stroke.

Case Description. A 54-year-old woman who experienced an acute ischemic stroke 5 weeks after a tooth extraction is described. The initial symptoms of this patient included mild to moderate word-finding difficulty and right facial droop. Computed tomographic angiography revealed a left M1 segment middle cerebral artery occlusion (thrombolysis in cerebral infarction scale, 0) with reconstitution of the distal middle cerebral branches through arterial collaterals. After initial administration of tissue plasminogen activator, endovascular thrombectomy was successfully performed with thrombolysis in cerebral infarction scale 3 (complete) recanalization. After the procedure, the patient showed improvement in language and neurologic deficits. Imaging showed multifocal, bilateral, cortical, and deep brain hemorrhages. Blood cultures grew *Streptococcus mitis*, ultimately leading to the diagnosis of endocarditis. Echocardiographic imaging revealed moderate to severe aortic insufficiency, a mitral valve vegetation, and mild mitral valve regurgitation. After evaluation by the cardiothoracic surgery team, the patient was discharged with intravenous antibiotics and short-term outpatient follow-up with the cardiothoracic surgery team.

Practical Implications. Dental procedures, although generally safe, can introduce oral bacteria into the bloodstream, leading to bacterial seeding of cardiac valves and subsequent infective endocarditis. Recognizing infective endocarditis subsequent to a dental procedure, including a tooth extraction, as a potential cause of an acute ischemic stroke is vital so that prompt treatment can be initiated.

Key Words. Case report; infective endocarditis; *Streptococcus mitis*; large-vessel occlusion; stroke.

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Stroke is a substantial cause of morbidity and mortality, often resulting in long-term disability and increased health care costs.¹ Although strokes are commonly attributed to cardiovascular risk factors such as hypertension and atrial fibrillation, other, less conventional, causes should be considered, particularly in cases with atypical manifestations.^{2,3} We describe a patient who developed an acute ischemic stroke (AIS) 5 weeks after undergoing a routine outpatient tooth extraction and subsequently received a diagnosis of *Streptococcus mitis* endocarditis. Our case highlights the rare, but potential, association among a dental procedure, infective endocarditis, and a stroke, emphasizing the importance of recognizing such complications.

Dental procedures, although generally considered safe, can introduce oral bacteria into the bloodstream, which may lead to infective endocarditis, an infection of the endocardial surfaces of the heart, in susceptible people.^{4,5} The risk of developing endocarditis after dental procedures has been well documented in the literature, particularly in patients with underlying cardiac abnormalities or compromised immune systems.^{4,6} However, the occurrence of AIS secondary to a large-vessel occlusion because of infective endocarditis after a tooth extraction is a rare phenomenon, warranting further investigation and reporting.

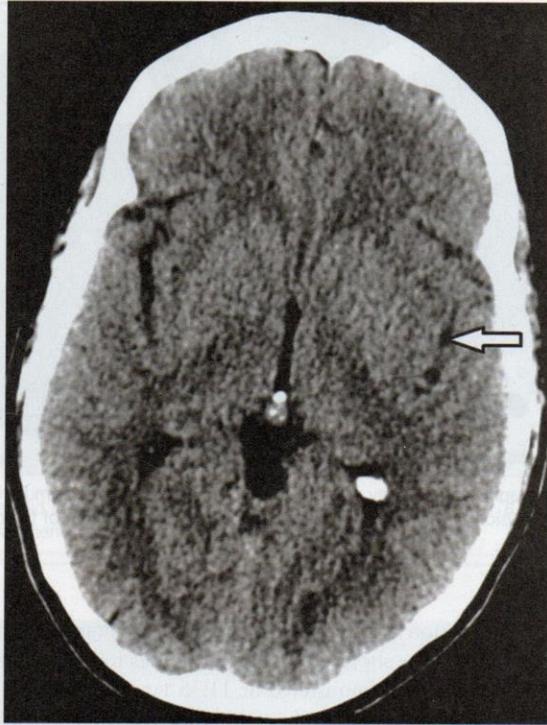


Figure 1. Axial noncontrast head computed tomographic scan, showing a subtle asymmetric area of low attenuation with loss of gray-white differentiation involving the left insular cortex (arrow).

Although AIS is often attributed to traditional risk factors such as hypertension, diabetes, tobacco use, and atherosclerosis, it has been reported that infective etiologies, including infective endocarditis, can also contribute to stroke occurrence.^{7,8} Infective endocarditis can lead to the formation of emboli that can travel to the cerebral vasculature, causing an ischemic stroke.^{7,9} Dental procedures may cause transient bacteremia and potential seeding of cardiac valves and ultimately endocarditis, particularly in patients with underlying cardiac conditions, particularly those with compromised valves or immune systems.¹⁰

The association between infective endocarditis and stroke has been described, primarily attributed to embolic events caused by infected cardiac valves or vegetations.^{7,9} However, the specific role of *S mitis* as an etiologic agent in stroke development is not well established, necessitating further exploration. Furthermore, the temporal relationship between the dental procedure and the subsequent clinical manifestation in our case raises questions regarding the potential mechanisms underlying this association.

The goal of our case report is to increase awareness regarding the possible relationship among a dental procedure, infective endocarditis, and an AIS while discussing the intricacies of diagnosis, acute treatment, and long-term treatment of patients in this unique clinical scenario.

The case was submitted to the University of Michigan institutional review board and was provided an exemption.

CASE HISTORY

A 54-year-old woman sought treatment for witnessed sudden-onset word-finding difficulties and right facial droop at 9:45 PM. The patient had no known medical conditions. Initial assessment in the ED, using the National Institutes of Health Stroke Scale,¹¹ revealed a score of 3, for mild through moderate aphasia, mild dysarthria, and facial droop. Noncontrast head computed tomographic (CT) imaging showed an absence of intracranial hemorrhage; however, there was subtle loss of gray-white differentiation of the left insular ribbon (Figure 1). CT angiography revealed an occlusion of the left M1 segment of the middle cerebral artery (thrombolysis in cerebral infarction

ABBREVIATION KEY

- AIS:** Acute ischemic stroke.
- CT:** Computed tomographic.
- TICI:** Thrombolysis in cerebral infarction.

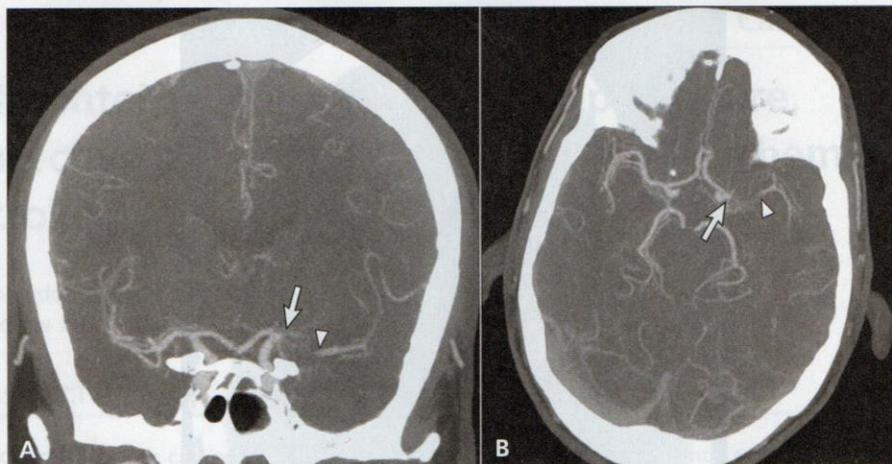


Figure 2. Computed tomographic angiography of brain coronal (A) and axial (B) maximum intensity projection reconstructions, showing occlusion of the left M1 segment (arrow) and reconstitution of the distal left middle cerebral artery branches (arrowhead).

[TICI] score, 0) with reconstitution of the distal middle cerebral branches through arterial collaterals (Figures 2A and 2B). Given the short time frame from ictus to manifestation in the ED, tissue plasminogen activator was promptly administered at 11:38 PM. A discussion with the family and patient was undertaken by the stroke team members about the risks and benefits of thrombectomy in a patient with a low National Institutes of Health Stroke Scale score (<6). Although the symptoms were mild, the presence of a large-vessel occlusion increased the risk of a possible large territorial infarction and permanent neurologic deficits. It was agreed that the potential risks of forgoing the procedure outweighed those associated with the intervention. The patient consented and proceeded to the angiography suite for attempted thrombectomy.

Patient's dental history

The patient had a history of moderate gingivitis and no history of periodontitis. All probing depths were less than 4 mm. In addition, tooth no. 30 had a mesio-occlusodistal amalgam restoration placed a decade ago. She experienced a fracture of tooth no. 30 due to a popcorn kernel, resulting in class II mobility. At the time of injury, probing around tooth no. 30 indicated a 6-mm depth on the lingual side and a substantial 10-mm depth in the buccal furcation area. There was no exudate present, and immediate treatment was administered. Given the low-risk status of our patient, antibiotics were not prescribed before the procedure.

After the tooth extraction, the patient experienced persistent pain at the extraction site for a duration of 2 weeks. However, the patient did not receive any follow-up care calls from the dentist, nor did she initiate contact regarding her ongoing discomfort. Subsequently, once the pain subsided, the patient reported the onset of progressive fatigue.

Procedure and outcome

Cerebral angiography confirmed an occlusion of the proximal left middle cerebral artery (TICI score, 0) (Figures 3A and 3B). After 3 thrombectomy passes, there was complete reperfusion of the left middle cerebral artery territory with a TICI score of 3 (Figures 4A and 4B). However, after the procedure, the patient exhibited increased drowsiness and was unresponsive to commands. Nevertheless, the patient was successfully extubated and began responding to instructions. A postprocedure head CT scan revealed multifocal, bilateral, cortical, and deep brain hemorrhages (Figure 5A). No significant edema or midline shift was observed. Extensive investigations were initiated to identify the underlying cause, including a broad infective and malignant workup involving magnetic resonance imaging of the brain (Figures 5B and 5C) and spine, CT imaging of the chest, abdomen, and pelvis as well as a right upper quadrant ultrasonographic scan, the results of which were unremarkable except for areas of hemorrhage within the brain and a subacute infarction

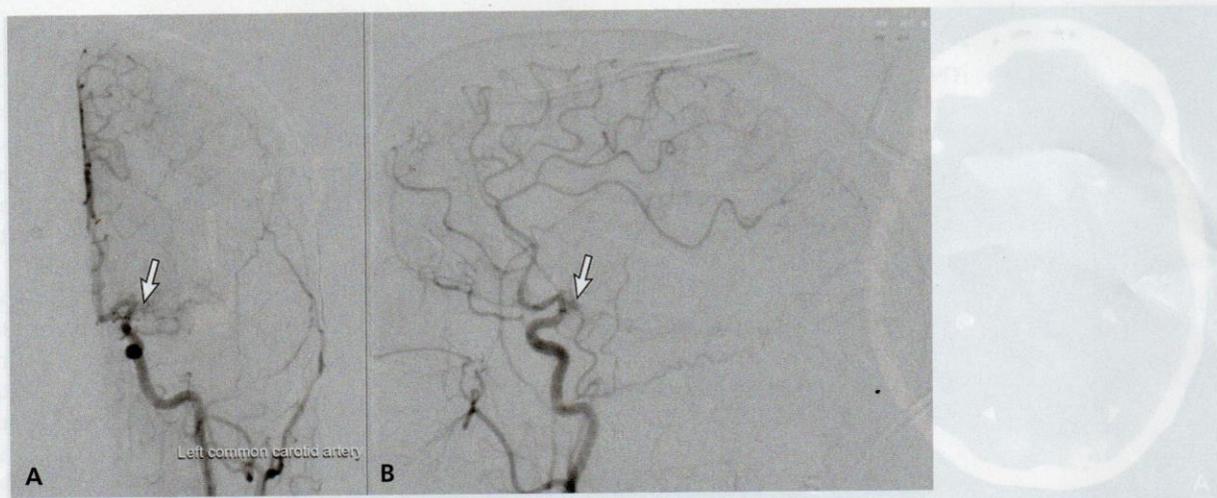


Figure 3. Left internal carotid angiogram, anterior-posterior view (A) and lateral view (B), showing complete occlusion (arrows) of the left M1 segment flow (thrombolysis in cerebral infarction score, 0).

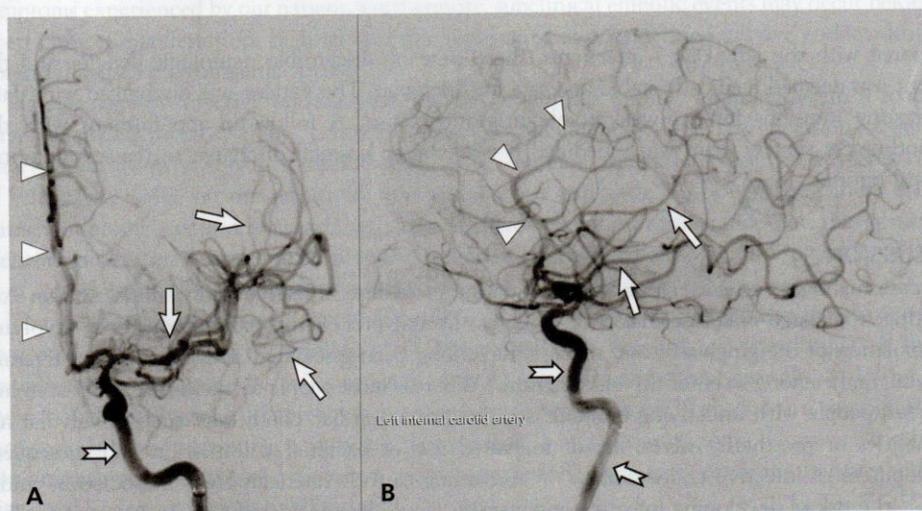


Figure 4. Cerebral angiography performed after injection of the left internal carotid artery (notched arrows). Anterior-posterior (A) and lateral (B) views revealing the widely patent left middle cerebral artery flow (arrows) and the anterior cerebral artery (arrowheads) after 3 thrombectomy passes.

within the left putamen. The day after manifestation, the patient developed a fever, leading to initial treatment with vancomycin and with piperacillin and tazobactam (Zosyn). Blood cultures revealed the growth of *S mitis* in both bottles, prompting a switch from vancomycin to ceftriaxone. Further investigation revealed that the patient had undergone an uncomplicated tooth extraction 5 weeks before her onset of stroke and, since the dental procedure, she reported persistent fatigue.

During the course of her hospitalization, the condition of the patient continued to improve. With blood cultures showing sensitivity to ceftriaxone, vancomycin was discontinued, and the patient continued with ceftriaxone monotherapy for a 6-week course. Although the patient remained asymptomatic for endocarditis, transesophageal echocardiography conducted during the hospitalization revealed moderate to severe aortic insufficiency, with no obvious vegetation but thickening and abnormality of the aortic valve. The transesophageal echocardiogram also identified a 0.5-cm vegetation on the mitral valve with a small perforation and mild mitral regurgitation. By post-procedural day 6 the dysarthria had resolved, and the patient exhibited grossly normal strength in her upper extremities bilaterally, with minimal dysmetria on finger-to-nose testing in the right hand

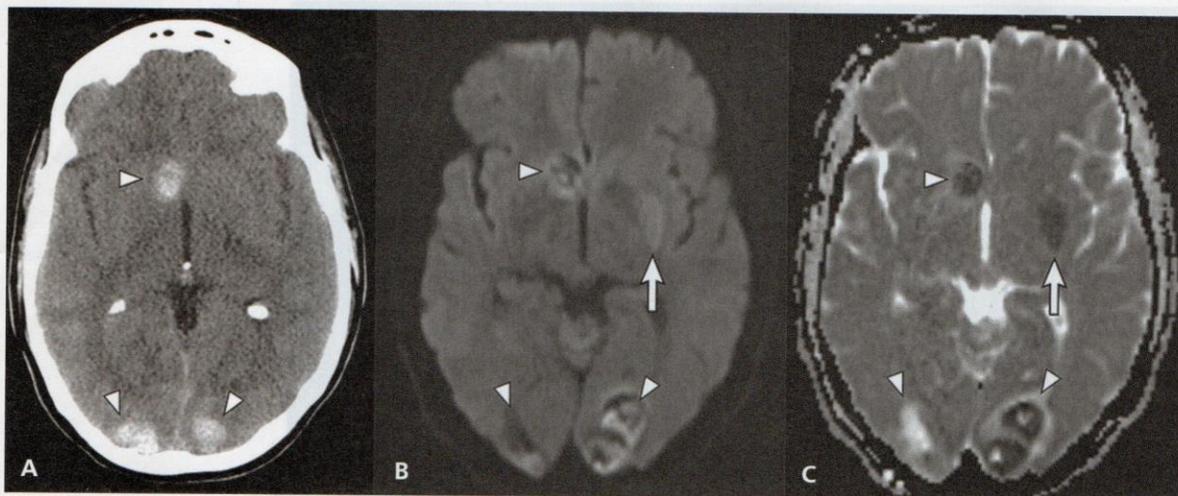


Figure 5. Follow-up imaging. Axial noncontrast head computed tomographic image (A) and axial magnetic resonance imaging diffusion-weighted B1000 (b value of $1,000 \text{ s/mm}^2$) (B) and apparent diffusion coefficient (C) images show areas of hemorrhage within the right caudate nucleus and bilateral occipital lobes (arrowheads). There is also a subacute infarction within the left putamen (arrows).

compared with the left. Day 7 after ictus, there were no discernible neurologic deficits, and the patient was deemed medically stable and safe for discharge. The patient was discharged with daily ceftriaxone infusions for a 6-week total antibiotic course. A follow-up appointment with the cardiothoracic surgery team was scheduled 8 weeks after hospital discharge to reassess potential surgical options.

DISCUSSION

Our case highlights an association among a dental procedure, infective endocarditis, and an AIS resulting from large-vessel occlusion or embolus. Dental procedures, particularly those involving manipulation of the gingiva or oral mucosa, have long been associated with transient bacteremia, allowing oral bacteria to enter the bloodstream.⁶ Whereas most people successfully clear bacteremic episodes, people with underlying immune compromise or cardiac conditions, such as valvular abnormalities or prosthetic valves, are at increased risk of bacterial colonization and subsequent development of infective endocarditis.^{10,12} According to the American Heart Association guidelines,¹³ the risk of developing infective endocarditis would be considered low for our patient. This conclusion was based on her medical history, which lacked any previous cardiac issues, joint replacements, advanced periodontal disease, or diabetes. In addition, the patient maintained a healthy lifestyle as a nonsmoker with minimal alcohol consumption, had no acute or chronic illnesses, and was in the normal body mass index percentile for her age. Consequently, because of her low-risk status, antibiotic prophylaxis was not prescribed before her dental procedure.

Despite her initial low-risk assessment, our patient ultimately developed infective endocarditis as a result of the dental procedure. Thornhill and colleagues¹⁴ examined the incidence of infective endocarditis after tooth extractions without antibiotic prophylaxis in people with employer-provided medical and dental insurance. For high-risk patients, the incidence of infective endocarditis within 1 month of the procedure was 8,967.9 cases per million tooth extractions, whereas for moderate-risk people, it was 104.5 cases per million extractions.¹⁴ Even for low-risk or unknown-risk patients, the incidence stood at 14.6 cases per million extractions.¹⁴ These statistics highlight that although the risk of developing infective endocarditis and associated complications such as stroke is low among low-risk patients, it is not nonexistent, as evidenced by our patient and the 14.6 cases per million extractions reported in Thornhill and colleagues' study.¹⁴

Furthermore, Thornhill and colleagues¹⁴ discovered that antibiotic prophylaxis significantly reduces the subsequent risk of infective endocarditis for high-risk patients ($P = .01$) but not for those at moderate or low risk. In high-risk patients, the incidence of infective endocarditis after a tooth extraction dropped from 8,967.9 cases per million tooth extractions to 939.3 cases per million tooth

extractions with antibiotic prophylaxis, signifying a 90% risk reduction. Therefore, considering the experience of our patient with infective endocarditis, she now falls into the high-risk category, necessitating the administration of antibiotic prophylaxis for any future invasive dental procedures she may undergo. The temporal relationship between the tooth extraction and the subsequent development of infective endocarditis and stroke in our patient raises important considerations regarding the role of oral health and invasive dental interventions in the pathogenesis of systemic infections and cerebrovascular events.

The identification of *S mitis*, a commensal bacterium commonly found in the oral cavity, in the blood cultures from our patient further supports the proposed link among the dental procedure, infective endocarditis, and an AIS. *S mitis* is a member of the viridans group streptococci, which are known to colonize the oral cavity and have been implicated in a large proportion of cases of infective endocarditis.¹⁵ These organisms possess the ability to adhere to damaged cardiac valves, forming vegetations that serve as reservoirs for persistent bacteremia and subsequent embolization to distant organs, including the brain.¹⁶

The delayed onset of symptoms, with the patient reporting new fatigue since the dental procedure, adds an additional layer of complexity to the case. Fatigue is a nonspecific symptom that can be attributed to various causes, including systemic infections. Although the precise mechanism underlying the association between fatigue and infective endocarditis remains unclear, it is plausible that the ongoing systemic inflammatory response to the infective process contributed to the symptoms experienced by our patient. Furthermore, subclinical embolic events may occur before the overt clinical manifestation, highlighting the importance of considering infective endocarditis as a potential cause of cryptogenic strokes.

Management of infective endocarditis involves a multidisciplinary approach, with a focus on targeted antimicrobial therapy, control of systemic inflammation, and consideration of surgical intervention for valve repair or replacement.^{17,18} In our case, the patient received a 6-week course of ceftriaxone based on the sensitivity of *S mitis* to this antibiotic. Although the patient showed clinical improvement and remained asymptomatic from an endocarditis standpoint, the subsequent identification of aortic and mitral valve abnormalities necessitated close monitoring and evaluation by a cardiothoracic surgery team to assess the need for surgical intervention.

The prognosis of stroke secondary to infective endocarditis remains guarded, with worse outcomes compared with noninfective etiologies.^{8,19} The presence of hemorrhagic transformation further complicates the prognosis, as it is associated with increased morbidity and mortality.²⁰ In our case, the patient experienced a complete recovery from neurologic deficits, likely due to a combination of intravenous tissue plasminogen activator administration and thrombectomy. However, multifocal hemorrhages outside the infarcted area could contribute to long-term cognitive impairments and necessitate ongoing neurorehabilitation.

Our case report underscores the rare, but potential, association among a dental procedure, infective endocarditis, and an AIS due to a large-vessel occlusion or embolus. It highlights the need for clinicians to be vigilant in recognizing the signs and symptoms of infective endocarditis and considering it as a potential cause of stroke, particularly in patients with a history of dental interventions and underlying cardiac conditions. Proper identification, prompt management, and close interdisciplinary collaborations are crucial in improving outcomes in these cases.

CONCLUSIONS

Dental procedures can be a potential source of bacteremia, leading to the development of infective endocarditis and subsequent complications such as ischemic or hemorrhagic stroke. Vigilance is crucial in recognizing the signs and symptoms of infective endocarditis, particularly in patients who have undergone dental interventions and have underlying cardiac conditions or are immunocompromised. Prompt management and interdisciplinary collaborations are essential in cases of stroke associated with infective endocarditis. Thrombectomy and appropriate antibiotic therapy should be considered in patients with large-vessel occlusion or embolus.

Imaging techniques such as CT angiography and magnetic resonance imaging play a vital role in diagnosing and assessing the extent of cerebral infarctions and hemorrhages, aiding in the identification of potential sources of emboli, and guiding further investigations for infective endocarditis. The presence of *S mitis* in blood cultures emphasizes the need for a comprehensive infective workup,



including echocardiography, to identify and manage endocarditis-related complications such as valve abnormalities and regurgitation.

Our case highlights the importance of maintaining good oral hygiene and considering appropriate antibiotic prophylaxis in people at high risk of infective endocarditis. Further research is needed to explore preventive strategies and optimize management approaches to reduce the risk of both infective endocarditis and stroke associated with dental procedures. ■

DISCLOSURE

None of the authors reported any disclosures.

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