# Streptococcus oralis as a Risk Factor for Middle Cerebral Artery Thrombosis

## ABSTRACT

We reported a case of an 8-year-old boy who was presented to the emergency department with left-sided hemiparesis. Computed tomography showed hypodense areas in the territory of the right middle cerebral artery, indicating acute cerebral infarct. Diagnostic evaluation was performed to identify the etiology. On the eighteenth day of hospitalization, cerebrospinal fluid cultures yielded *Streptococcus oralis*. We hypothesized that the source of the oral pathogen was an abscess belonging to his upper left fourth tooth, which, by a transient bacteremia, had invaded the central nervous system, and skipping the meninges caused local inflammatory arteritis of the carotid artery, leading to cerebral infarction. Sulbactam-ampicillin therapy was initiated for 14 days, and he was discharged with anticoagulation therapy. (*J Child Neurol* 2005;20:611–613.)

Stroke in children is more common than once was suspected. There is limited knowledge regarding stroke epidemiology in children. The reported incidence and prevalence of stroke in children have increased over time because of improvements in imaging techniques.

The mechanisms by which ischemic stroke occurs in children include thromboembolism from an intracranial or extracranial vessel or the heart; acute, transient, or progressive arteriopathy; and other rare causes, but in a large percentage of patients, the cause is undetermined.<sup>1,2</sup> On the other hand, the role of infection in the development of thrombosis has been studied. Systemic inflammation has been reported to activate the coagulation system by several mechanisms.<sup>3,4</sup> We previously reported that thrombosis was associated with infection in 68% of thrombotic children.<sup>5</sup>

We report a case of an 8-year-old boy with cerebral infarct who presented with a left-sided hemiparesis with *Streptococcus oralis* in cerebrospinal fluid culture.

### Case Report

An 8-year-old right-handed previously healthy boy was presented to the emergency department with acute onset of the left side of the face and arm and leg weakness. His past history revealed that 5 days before, he had complained of vertigo, nausea, and numbness in his hands, and he had experienced a sudden weakness, making him fall, during which his mouth was pulled to the right. This lasted 30 to 40 seconds, and then he got up to walk. His mother noted his limping and difficulty in pinching objects with his left hand. The attacks of sudden weakness were repeated in the following 5 days, between which he was well, except for limping and failure in fine movements on the left side. Because his last attack lasted longer than the earlier ones, he was taken to the emergency department.

His vital signs at presentation were normal. He was healthy looking, cooperative, and alert. His physical examination revealed that there was flattening of the left nasolabial fold and his left upper and lower extremities were weak. Babinski reflexes were positive on the left. His gait was unsteady, tending to fall toward the left. Cerebellar function on the left was difficult to test because of his weakness. Computed tomography showed the presence of hypodense areas in the territory of the right middle cerebral artery. He was believed to have an acute cerebral infarct and was hospitalized. Magnetic resonance imaging (MRI) showed acute infarct in the region of the right middle cerebral artery (Figure 1, A and B), diffuse stenosis of the right internal carotid artery (Figure 1C), and an old ischemic lesion in the left frontal lobe. Lumbar puncture found normal pressure and normal cerebrospinal fluid, excluding bacterial meningitis. Laboratory data were normal, including echocardiography, viral serology, and tests for connective tissue disorders, homocysteine level, factor V G1691A and prothrombin G20210A mutations, and antiphospholipid antibodies. The work-up for thrombosis was normal except for the elevated levels of factor VIII (495%), which were believed to be secondary to vascular wall intimal damage. The factor VIII levels of the parents were normal.

On the tenth day of hospitalization, digital substraction angiography was performed, and the M1 segment of the middle cerebral artery was found to be totally occluded from the proximal part. Repeat MRI (not shown) showed extension of the infarct, suggesting that ischemic pneumbra was also affected. Low-molecular-weight heparin was added to his anticoagulation therapy. Lumbar puncture was repeated to identify a vasculopathy that might have been indistinguishable in the earlier periods. He was put on a physical therapy and rehabilitation program.

When the past history was studied carefully again, the existence of a recurrent tooth abscess attracted our attention, and repeated physical examination revealed an abscess belonging to the upper left fourth tooth. Intravenous subactam-ampicillin therapy was initiated.

On neurologic examination, an improvement in the weakness was observed, especially of the lower extremity.

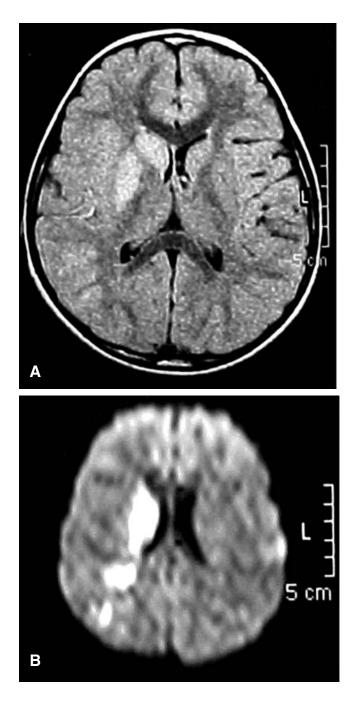
On the eighteenth day, cerebrospinal fluid cultures yielded *S* oralis, which was sensitive to penicillin, erythromycin, vancomycin, and teicoplanin. The second lumbar puncture was also positive for *S* oralis, so the dose of subactam-ampicillin was increased. The high-dose subactam-ampicillin treatment was completed to 14 days, and he was discharged with low-molecular-weight heparin and acetylsalicylic acid therapy.

#### Discussion

The occurrence of a child presenting to the emergency department with an acute loss of function is an uncommon event. When a child presents with an acute hemiparesis, the diagnosis is easily suspected.<sup>6</sup> The purpose of diagnostic evaluation is to confirm the presence of a cerebrovascular lesion and to identify the cause. Unfortunately, even with an extensive evaluation, approximately one third of patients have no identifiable cause for their cerebrovascular events.<sup>7</sup>

In this case, no coagulation abnormality was found except for the high levels of factor VIII. High levels of factor VIII are known to increase the risk of venous thromboembolism and seem to be familially determined.<sup>8</sup> Because the plasma levels of factor VIII for both parents were normal and a second assay after a week for factor VIII showed a decline, it was believed to be secondary to the acute thromboembolic event itself, which is one of the known causes of factor VIII elevation.

On the eighteenth day of hospitalization, when the cerebrospinal fluid cultures yielded *S* oralis, we speculated that the oral pathogen was primarily responsible for the stroke by initiating the intimal damage of the vascular endothelium. Several studies suggested that a preceding infection is an important risk factor for ischemic brain infarction.<sup>9–12</sup> In these studies, however, the infections are mostly respiratory infections, and invasion of the central nervous system has not been mentioned. Periodontal diseases have also been found to be associated with an increased risk of ischemic stroke.<sup>13–15</sup> Periodontal pathogens can evade local host defense mechanisms, and even daily procedures, such as tooth brushing and chewing, can induce transient bacteremia.<sup>16</sup> In our case, the oral pathogen probably reached to the central nervous system by a transient bacteremia, but instead of causing meningeal



inflammation, as reported previously,<sup>17,18</sup> it caused a local inflammatory arteritis of the carotid artery. Chronic infection of atheromatous plaques with periodontal pathogens has been reported.<sup>19,20</sup> However, in this case, the mechanism was unusual; it skipped the meninges, caused a local inflammation in the carotid artery, interfered with coagulation hemostasis, and ended up with an acute cerebral infarction.

In conclusion, the finding of two positive cerebrospinal fluid cultures of a pathogen considered to be oral in origin, in the presence of a dental abscess, is suggestive of an etiology for this infarction: seeding of cerebrospinal fluid and local inflammation.

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Figure 1. *A*, On transverse fluid-attenuated inversion recovery images (TR/TE/TI: 5000/100/1900 milliseconds), swollen and hyperintense caudate and lentiform nucleus; effacement of hemispheric sulci together with an indentation on the lateral ventricule and mild increased signal intensity over the cortex on the right cerebral hemisphere consistent with acute infarct on the territory of right middle cerebral artery. *B*, Diffusion-weighted magnetic resonance imaging shows a restricted diffusion in the right caudate nucleus and parietal lobe, confirming an acute ischemic event. *C*, Phase-contrast magnetic resonance angiography reveals a diffusely reduced-flow caliber in the right internal carotid artery with no flow in the right middle cerebral artery.

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Correlation of Functional Independence Measure for Children (WeeFIM) With Developmental Language Tests in Children With Developmental Delay

## ABSTRACT

The Functional Independence Measure for Children (WeeFIM) is a simple tool for assessing the functional independence of three domains: mobility, self-care, and cognition. Children are usually apprehensive about performing standardized structured language or developmental tests, and only licensed professionals can administer standardized tests. We attempted to apply the Functional Independence Measure for Children for assessing children with developmental delay and to assess for any correlation of these scores with standardized language tests. We recruited 49 children with developmental delay, and the Functional Independence Measure for Children was administered. Two standardized language tests (Symbolic Play Test and Reynell Language Developmental Scale) were administered to assess language age. There was a significant correlation between Functional Independence Measure for Children scores with both verbal comprehension age and verbal expression age. There was no correlation of Functional Independence Measure for Children scores with gender, age, or having domestic helpers. Having trained staff administer the Functional Independence Measure for Children can reliably correlate the current language ability of a child with developmental delay; thus, the test can be used as a quick screening tool for targeted training. (J Child Neurol 2005;20:613-616).

Functional assessment is essential in any targeted rehabilitation program for children with developmental disabilities. Both hospital- and communitybased health care workers can make a continuum training program targeted for individual needs.

The Functional Independence Measure for Children (WeeFIM) is a developmental adaptation of the Functional Independence Measure (FIM) developed by the National Task Force for Medical Rehabilitation for Adults (1983).<sup>1,2</sup> It is based on the conceptual framework of the World Health Organization (1980) of impairment, disability, and handicap (1998) and the burden of care (type and amount of assistance and resources required to perform basic life activities effectively in terms of social support and economic resources).<sup>3,4</sup>

The Functional Independence Measure for Children can serve as a quick assessment tool to assess the efficacy of any interventional programs by evaluating the age of achieving independence at home and in the community. It emphasizes the rehabilitative and developmental aspects of children with special health care needs, such as developmental disabilities or acquired disabilities.<sup>5–16</sup> The Functional Independence Measure for Children is simple to administer, concise (simple scoring of 1 to 7), comprehensive (covers three domains of mobility, self-care, and cognition), and discipline free (can be administered by trained health, developmental, or educational professionals); it minimizes observer bias (certified training for interviewers); and is useful in assessing functional independence in children aged 6 months to 7 years of mental age. We translated the Functional Independence Measure for Children into Chinese and validated the normative score for 445 children aged 6 months to 7 years.<sup>17</sup> We created the first Chinese normative Functional Independence Measure for Children profile for normal children.

The objectives were (1) to apply the Functional Independence Measure for Children instrument in the assessment of the functional independence of a cohort of children with developmental delay and compare the result with our established Chinese norm and (2) to assess any correlation with standardized language tests such as the Chinese version of the Reynell Language Developmental Scale<sup>18</sup> and the Symbolic Play Test.<sup>19</sup>

#### Method

This study was conducted as part of a research project assessing the use of standardized Chinese language tests for normal children and children with developmental delay.<sup>20</sup> We conducted a cross-sectional study in April to June 2002. We recruited children with developmental delay aged < 6 years from eight Early Education and Training Centres of the Heep Hong Society in Hong