Sinus Pericranii
Color Doppler Ultrasonographic Findings

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Sinus pericranii is a rare abnormality that may appear as a midline nasofrontal mass.1,2 This disorder consists of congenital or acquired anomalous connections between an extracranial blood-filled nodule and the intracranial dural sinuses through dilated diploic and emissary veins of the skull.3 We report a case of sinus pericranii and present the findings on color Doppler ultrasonography (CDUS).

Case Report

A 12-year-old boy was admitted to our hospital with swelling and discoloration in the midline of the frontal region. His parents had noticed the lesion at age 6 months. He was examined by a physician in another hospital for cosmetic reasons at age 11 years. The mass was diagnosed as a hemangioma, and surgery was undertaken. During the operation, coagulation was performed on the bleeding lesion. Over the next year, the mass gradually reappeared under the scar of the previous surgery. Physical examination revealed a 1 × 1.5-cm erythematous, soft, compressible, nonpulsatile, slightly elevated nodule. A small underlying bone defect was palpable. The lesion was not enlarged when the patient was lying down or with the Valsalva maneuver. Plain skull radiography showed an area of irregular thinning of the frontal bone.

For evaluation of the soft tissue lesion, gray scale ultrasonography and CDUS were performed with an SSA-390A (PowerVision 8000) ultrasonographic scanner (Toshiba Medical Systems Co, Ltd, Tokyo, Japan) and a 6- to 11-MHz linear array transducer. Ultrasonography revealed compressible, hypoechocic tubular structures under the skin close to a bone defect of 5 mm in the nasofrontal region (Figure 1). On CDUS examination, both continu-

Abbreviations
CDUS, color Doppler ultrasonography; CT, computed tomography; MR, magnetic resonance; TOF, time of flight
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Figure 1. Longitudinal sonogram of the nasofrontal region shows hypoechoic tubular structures in the subcutaneous area.

Figure 2. A, Longitudinal CDUS image shows flow within the emissary vein as it extends from the subcutaneous part of the venous anomaly through a bone defect intracranially. The venous flow is directed from the extracranial to the intracranial region. B, Color Doppler sonogram reveals an arterialized high–blood flow pattern communicating with the venous anomaly in the extracranial region.

Ous and phasic venous flow were observed in the hypoechoic vascular structures. An emissary was observed, with flow directed from the extracranial to the intracranial venous systems (Figure 2A). In the adjacent subcutaneous area, an arterialized high–blood flow pattern communicating with the venous anomaly was detected (Figure 2B). Computed tomography (CT) with bone window settings showed a groove in the inner table of the frontal bone between the crista galli and superior sagittal sinus and a small bone defect at the nasofrontal region (Figure 3, A and B). Magnetic resonance (MR) imaging and 2-dimensional time of flight (TOF) MR angiography were performed. Magnetic resonance imaging showed a soft tissue mass of mixed signal intensity with area of signal void. Two-dimensional TOF MR angiography showed the prominent anterior part of the superior sagittal sinus, which communicated with a subcutaneous bone defect of the nasofrontal region (Figure 4, A and B). No surgical repair was performed.

Discussion

Sinus pericranii was first described by Hecker in 1845. In 1850, Stromeyer proposed the term “sinus pericranii.” This lesion is a dilated non-muscular venous vessel or angioma that adheres to the outer surface of the cranium and communicates directly with an intracranial venous sinus.3 The etiology of this venous anomaly is congenital, spontaneous, or traumatic. Congenital cases may have coexistence with other congenital vascular anomalies such as venous angioma and aneurysmal malformation of the internal cerebral vein. The spontaneous origin of this anomaly has been attributed to the development of an extracranial venous varix with secondary pressure erosion of the skull. Traumatic sinus pericranii may be due to a skull fracture, a tear in the dural sinuses or emissary veins, a depressed bone fracture leading to a dural sinus tear, or epidural venous hematoma caused by a dural sinus tear.3,4

Fevre and Modec described 3 physiopathologic types of sinus pericranii: (1) circulation in a closed system in which the blood came from the sinus and also returned to it; (2) circulation originating in the sinus with peripheral passage of the venous drainage; and (3) a connection between an angioma and the sinus.3,4
Sinus pericranii can appear at any age. Patients are usually asymptomatic, as in our case, although there are some reports mentioning headache, nausea, vertigo, and pain. Most cases of sinus pericranii are located in the frontal region. A lateral location is unusual. The mass characteristically enlarges with the Valsalva maneuver and decreases in size with direct compression or head elevation. During the Valsalva maneuver, intracranial venous pressure increases, resulting in enlargement of the mass due to increased venous blood flow from the intracranial to the extracranial region via the emissary vein. However, in our patient, the mass was not enlarged with the Valsalva maneuver. This might be the result of increased pressure in the extracranial part of the sinus pericranii due to a probable iatrogenic arterial communication from the previous surgery.

The differential diagnosis is extensive. Most of scalp lesions may appear as soft, compressible masses like sinus pericranii. The clinical differential diagnosis of such a mass would also include subepicranial varix, cavernous heman-

**Figure 3.** Coronal CT image (A) and multiplanar reconstruction midsagittal CT image with bone window settings (B) show a groove (arrow) in the frontal inner tabula and a bone defect (arrowhead) at the nasofrontal region.

**Figure 4.** Midsagittal T1-weighted MR image (A) and 2-dimensional TOF MR angiographic image (B) show an emissary vein that extends through a small bone defect at the nasofrontal region to the anterior part of the superior sagittal sinus.
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gioma, arteriovenous malformation, meningocoele, encephalocoele, dermoid tumor, lipoma, and epidermal cyst.\textsuperscript{5}

Diagnosis of sinus pericranii is made from a combination of clinical and radiologic features.\textsuperscript{4} Radiologically, visualization of a connection between the vascular midline mass and dural venous sinus is essential for the diagnosis.\textsuperscript{7,8} In the diagnosis of sinus pericranii, angiography, CT, and MR imaging have been used. However, the development of CT, 3 dimensional CT, and CT and MR angiography/venography has replaced invasive angiographic studies.\textsuperscript{5,4,8,9–11}

Sinus pericranii can also be diagnosed with ultrasonography and CDUS.\textsuperscript{8–10} To the best of our knowledge, only 1 report has been published related to the ultrasonographic findings of sinus pericranii.\textsuperscript{8} Ultrasonography and CDUS are non-invasive, available, and inexpensive relative to other imaging modalities. The bone defect, extracranial venous tubular structures, and the emissary vein can be visualized with ultrasonographic imaging. Color Doppler ultrasonography can confirm the venous flow in the tubular structures and reveal the direction and pattern of the venous blood flow in the emissary vein. Before the surgery or interventional endovascular procedures, awareness of arterial communication of the venous anomaly and the direction of flow in the emissary vein may be important to prevent complications. Thrombosis of the emissary vein or extracranial tubular venous structures may also be shown with CDUS.

In conclusion, sinus pericranii is a rare entity for which ultrasonography and CDUS may provide important findings to suggest the diagnosis. Therefore, sonographers should have an awareness of this condition for the differential diagnosis of frontal scalp masses.

References