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Motor Vehicle Collision Patient with Prominent Suboccipital Cavernous Sinus: A Case Report

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ABSTRACT

The suboccipital region has complex vascular anatomy, housing the vertebral artery and its branches, spinal nerves, periarterial neural plexus, and venous compartment. The anatomy is convoluted by the plethora of pathologies that can arise within this region, including congenital, vascular, degenerative, neoplastic, and traumatic diseases. We report a pediatric case where anatomical knowledge was critical in management.

Keywords

Suboccipital cavernous sinus, Anatomical variant, Trauma.

Introduction

Normal anatomic variants can mimic pathology and cause a diagnostic dilemma. The suboccipital region contains complex vascular anatomy that is highly susceptible to various normal anatomic variants [1]. A basic understanding of the suboccipital region can help delineate traumatic and malignant pathologic processes from congenital abnormalities or anatomic variants. We report a pediatric case where anatomical knowledge was critical in management.

Case Report

A pre-teen female patient with no past medical history presented to a level 1 trauma center after being struck by a vehicle at a speed of 20 miles per hour. The patient denied any loss of consciousness or significant head trauma. She was hemodynamically stable and neurologically intact, with no deficits in the primary survey. The secondary survey revealed midline cervical spine tenderness, and she was placed in a cervical collar.

Cervical radiographs demonstrated apparent anterior subluxation of C1-C2 with concern for disruption of both the anterior and posterior vertebral lines (Figure 1A). This finding was further evaluated with a non-contrast computed tomography (CT) scan of the cervical spine, which revealed no evidence of acute fracture of subluxation (Figure 1B and 1C).

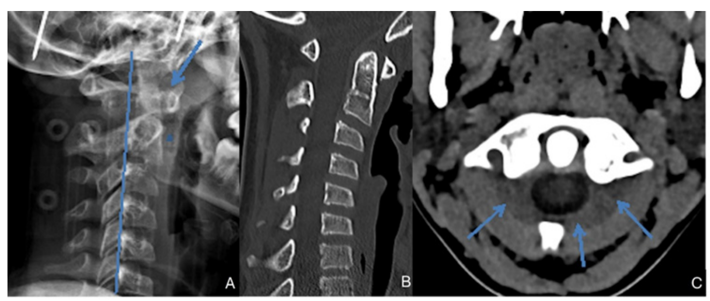

Figure 1: Lateral radiograph (A) of the cervical spine in an 11-year-old girl who presents following a pedestrian-motor vehicle collision demonstrates mild subluxation of C1-C2 (arrow) with disruption of the posterior vertebral lines (blue line). There is apparent prominence of the prevertebral soft tissues (star). Non-contrast CT of the cervical spine in sagittal bone windows (B) shows normal alignment without fractures or subluxation, as suspected on the radiograph. However, axial non-contrast CT of the cervical spine in soft tissue windows (C) illustrates a crescent-shaped hypo-attenuated region within the posterior elements of C1 and C2 (blue arrows).

When attempting to remove the cervical collar, the patient reported continued midline cervical tenderness and radicular pain shooting down to her right foot with passive flexion to 45 degrees at her hip. Non-enhanced magnetic resonance imaging (MR) of the cervical spine was subsequently obtained, which confirmed normal cervical spine alignment without acute osseous abnormality or ligamentous injury. However, during the examination, bilateral heterogeneous hyperintensities on T2-weighted sequences were located posterior to the thecal sac between the posterior elements of C1 and C2 (Figure 2A and 2B). There was corresponding hypodensity on the previously performed CT (Figure 1C). The overnight preliminary read by a radiology resident attributed these findings to traumatic injury. After further review by an experienced board-certified neuroradiologist, this was most consistent with prominent suboccipital cavernous sinus/venous plexus - a normal anatomical variant.

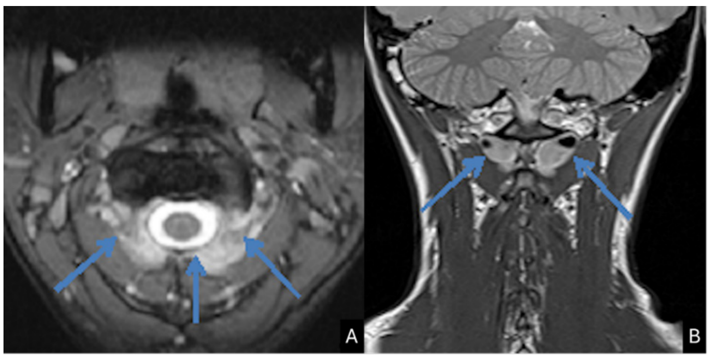

Figure 2: Incidental prominent suboccipital cavernous sinus and venous plexus. Axial T2-weighted image (A) and coronal proton density (B) images show a well-defined region of heterogeneous hyperintensity (blue arrows) between the posterior elements of C1 and C2.

On repeat physical exam, the patient reported decreased cervical tenderness with full cervical range of motion and was discharged without immediate complications.

Discussion

The suboccipital region has complex vascular anatomy housing the vertebral artery and its branches, spinal nerves, periarterial neural plexus, and venous compartment. The anatomy is further convoluted by the plethora of pathology that can arise within this region, including congenital, vascular, degenerative, neoplastic, and traumatic diseases [2]. Therefore, a basic understanding of the lesser-known venous plexus can aid in better clinical and surgical implications.

The venous plexus within this region has been described as the suboccipital cavernous sinus due to its morphological resemblance with the cavernous sinus, including similar skull-based location, venous cushioning, supporting fibrous structures, periarterial autonomic neural plexus, and adjacent nerves [2,3]. The suboccipital venous plexus surrounds the horizontal segment of the vertebral artery at the skull base and is located between the intermediate and deep muscular layers with an enclosing fibrous capsule [1,2,4]. The periosteal ring forms the proximal boundary, whereas the dural ring forms the distal boundary. Anteriorly, the atlanto-occipital condylar joint borders it. Posteriorly, it is bordered by the posterior atlanto-occipital membrane [2].

Several communications of suboccipital venous plexus have been described within the anatomical surveys of this region. Studies have also shown that suboccipital vertebral venous plexus drains the cranial cavity, which can impact intracranial pressure [5]. It becomes a critical drainage pathway in the setting of jugular circulation compromise and during shunting episodes (e.g., Valsalva maneuver) [1,6]. Arnautović et al. dissected ten cadaver heads, examining the anatomical interconnections of the venous plexus and described several major communications, including 1) connection to jugular bulb via the hypoglossal canal through an anterior condylar vein; 2) connection to jugular bulb via posterior condylar canal adjacent to occipital condyle through a posterior condylar vein; 3) connection to internal jugular vein at the lateral aspect of the occipital condyle through a lateral condylar vein; 4) connection with the vertebral veins at the level of axis through the vertebral venous plexus; 5) connection with the occipital and basilar venous sinuses at the margin of atlantooccipital ligament through the marginal sinus; and 6) connection with internal and external components of vertebral venous plexus [2].

Shunting from internal jugular circulation in healthy upright patients can result in physiological enlargement of the cervical vertebral venous plexus [5,7]. Pathological enlargement of this venous plexus can result from several causes, such as vascular malformations, disc disease, spinal cord compressive lesions, and obstructive venous lesions [1,8]. Caruso et al. have also reported a case of venous enlargement in the post-craniotomy setting. They hypothesized that craniotomy defect exacerbated by increased intracranial pressure reduces the cerebral blood flow with a resultant increase in venous pressure, causing the shunting of blood into the epidural and spinal cord venous systems [7]. Furthermore, as spinal cord compressive lesions have been shown to result in venous enlargement, Dickaman et al. reported a case of myelopathy developing secondary to epidural varicose veins [9].

Imaging resolution of the intracranial venous system has improved with technological advancements in CT and MR. Anatomical variations of craniocervical venous system can readily be identified using contrast-enhanced CT [4]. Detailed evaluation of the intracranial venous system, including the cranio-cervical junction, can readily be assessed using MR imaging techniques. Several sequences have been described in the literature, including contrast-enhanced three-dimensional fast spoiled gradient–recalled acquisition in the steady state and three-dimensional contrast-enhanced magnetization-prepared rapid gradient-echo [3,10].

In conclusion, the suboccipital cavernous sinus anatomy can cause a diagnostic dilemma. A fundamental understanding of vascular anatomy within this region can facilitate examination interpretation with improved accuracy and can be crucial in differentiating normal variants from pathological processes, particularly in cases where acute trauma may be of concern.

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