CASE REPORT

Unique Anastomosis Between the Condylar Emissary Vein and Extracranial Venous Plexus: An Anatomic and Histologic Case Report

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INTRODUCTION

When present, the condylar emissary vein (CEV) is a valveless vessel that traverses the condylar canal of the occipital bone.⁸ Most often, the CEV connects the intracranial sigmoid sinus to the extracranial suboccipital venous plexus, but it may also allow venous drainage into the superior bulb of the internal jugular vein.¹,⁶,⁹,¹⁰ It is one of the most ubiquitous cranial emissary veins, with some studies suggesting a prevalence of nearly 80%.³,¹¹ The CEV can become very clinically relevant when tumors and other space-occupying lesions are surgically removed from the cranial base. When present, CEVs must be identified and care should be taken not to disrupt them during surgery.
The CEV drains the sigmoid sinus during upright positions and is present bilaterally in about half of the reported cases.\textsuperscript{3,10} Blood draining from the CEV into the suboccipital venous plexus arrives at the subclavian vein through one of two routes.\textsuperscript{1,6,8,9} The first route is via the vertebral venous plexus (VVP), which is a network of small veins that encircles the vertebral artery (VA) as it ascends the cervical spine.\textsuperscript{2} The VVP drains the suboccipital area and ultimately coalesces into the vertebral vein (VV) at the level of the C6 vertebra.\textsuperscript{9} The VV then passes through the transverse foramen of the C7 vertebra to anastomose with the subclavian vein.\textsuperscript{9} The second route is via the deep cervical vein (DCV), which also drains the suboccipital venous plexus, and then courses parallel to the cervical spine, occasionally anastomosing with the VVP.\textsuperscript{9} The DCV joins with the VVP between the C6-C7 vertebrae and then becomes part of the VV.\textsuperscript{9}

In the current case, rather than either of the aforementioned routes, the CEV directly connected to the DCV with a prominent anastomotic venous branch (AVB) to the VVP at the level of the C1 vertebra. The gross appearance of this arrangement was that of an arteriovenous anastomosis with the VA, and histologic preparation followed by light microscopy was necessary to rule out this possibility. To our knowledge, neither this variation nor the histology of the condylar emissary vein have been reported in the literature. Awareness of either may assist neurosurgeons, radiologists, and pathologists who diagnose or treat pathology of the craniocervical region.

MATERIALS AND METHODS

Dissection of a 77-year-old, formalin-fixed Caucasian female cadaver during a medical school anatomy course revealed an unusually large blood vessel on the left side that was positioned posterolateral to the cervical spine. Gross appearance of the vessel led to an initial hypothesis of a supernumerary VA. Further blunt and sharp dissections revealed that the vessel might have originated from the subclavian artery. There also appeared to be a direct anastomosis with the V3 segment of the VA at the level of the C1 vertebra.\textsuperscript{2} However, further analysis of this anastomosis revealed that it was a variant between the CEV, DCV, and VVP.

The skin, subcutaneous fat, fascia, and superficial muscles were carefully removed. The splenius capitis and splenius cervicis muscles were dissected completely from their attachments onto the cranium and cervical spine, respectively, then reflected caudally and removed. The longissimus capitis, semispinalis capitis, and spinalis capitis muscles were dissected from their attachments onto the cranium and reflected medially. The exposed suboccipital muscles were dissected from their attachments onto the cranium and reflected medially. Blunt dissection was used to expose the cervical laminae and posterior arch of the C1 vertebra. A cervical laminectomy was then performed that included removal of the posterior arch of the C1 vertebra. Removing the bone and attached muscles allowed for complete visualization of both the unknown vessel and the ipsilateral VA (for comparison purposes). The length of the unknown vessel (from the point of perceived origin from the subclavian artery to entry into the condylar canal), the VA, and the AVB was measured. For histologic staining, three sections were removed from the unknown vessel inferior to the AVB (eventually we found that one section was from the DCA and two sections were from the DCV), and one section was taken from a vessel after the AVB that entered the skull (the CEV). For comparison purposes, one section was removed from the AVB and four 0.5-cm sections were removed from the VA. The diameter of each section was meas-
ured with digital microcalipers (Hawk, Inc., Cleveland, OH). All sections were placed in 10% formalin solution for transport. Sections were stained with hematoxylin and eosin, Verhoeff’s elastic stain, and/or trichrome stain and then permanently fixed onto slides for light microscopic examination. Subsequently, a literature search was performed to gather information on venous drainage of the craniocervical region with emphasis on uncovering the identity of the unknown vessel.

RESULTS

Morphometric data are found in Table 1. As expected, the VA had a thicker tunica media compared to its tunica adventitia, and its tunica intima was thickened in some areas, which is a common finding in older individuals (Figure 1). The portion of the unknown vessel that comprised the DCA was verified by having a comparable architecture (Figure 1). The DCV was also verified by its typical presentation of a thin tunica media and a thick tunica adventitia (Figure 1). The AVB was found to be a vein. While the tunica media was larger

Table 1: Morphometric Data.

<table>
<thead>
<tr>
<th>Blood Vessel</th>
<th>Length (cm)</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anastomotic venous branch (AVB)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Condylar emissary vein (CEV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep cervical artery (DCA)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep cervical vein (DCV)</td>
<td>19.5</td>
<td>5</td>
</tr>
<tr>
<td>Section 1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section 2*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertebral artery (VA)</td>
<td>18.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Section 1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section 2*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section 3*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>section taken 1 cm from left subclavian artery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>section taken at C5-6 vertebral level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>section taken at C2-3 vertebral level</td>
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</tbody>
</table>

Figure 1: Left posterolateral view of the neck of a 77-year-old female cadaver (see inset in right upper corner for orientation). Histology insets: Histologic sections described in Table 1. The leaders connecting these insets to vessels are placed at the areas where the sections were taken. Vertebral artery (VA), deep cervical artery (DCA), deep cervical vein (DCV), anastomotic venous branch (AVB), and condylar emissary vein (CEV).
than the one found in the DCV, the noticeably larger tunica adventitia, compared to its tunica media, was conclusive (Figure 1). The CEV was unequivocally venous, but arterialized (Figure 1). Unlike typical veins, the CEV had extensive, yet discrete, elastic fibers throughout both tunicae (Figure 2). The arterialization may be an age-related change that developed over time due to increased pressure, which may have led to incorporation of elastic fibers into its tunicae.

**DISCUSSION**

As a valveless vein, the CEV provides direct and unfettered access into and out of the cranium.\textsuperscript{7,8} Infection or metastasis that originates in the suboccipital region or cervical spine can be transmitted through this venous network by means of the anastomotic variation that we have reported.\textsuperscript{7,8} Furthermore, there have been published cases of emissary abnormalities causing neurologic deficits such as tinnitus.\textsuperscript{5} A case was reported in the literature where a hypoglossal neurinoma was surgically removed and resulted in coagulation of the CEVs.\textsuperscript{4} The coagulation led to dural venous sinus thrombosis, cerebellar infarction, and eventual death of the patient.\textsuperscript{4} Therefore, knowledge of this anastomosis and the histology of the CEV is important during neurosurgery to ensure that coagulation within the veins does not occur.

**ACKNOWLEDGMENTS**

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES