Modified "Extended" Suboccipital Subtonsillar Clipping of a Ruptured Proximal Pica Aneurysm: Technical Note with Relevant Anatomical Demonstration

Alberto Di Somma[1], Palomares Cancela Caro[2], Magdalena Olivares Blanco[2], Teresa Somma[1], Antonio López-González[2], Alvaro Campero[3], Juan Emmerich[4], Javier Márquez-Rivas[2]

Key words
- Cranial base surgery
- PICA aneurysms
- Proximal PICA aneurysms
- Suboccipital subtonsillar
- Vascular control
- Vascular surgery

Abbreviations and Acronyms
CT: Computed tomography
PICA: Posterior inferior cerebellar artery
VA: Vertebral artery

From the [1]Division of Neurosurgery, School of Medicine, Università degli Studi di Napoli "Federico II," Naples, Italy; [2]Department of Neurosurgery, Hospital Universitario Virgen del Rocío, Sevilla, Spain; [3]Department of Neurological Surgery, Hospital Padilla, Tucumán, Argentina; and [4]School of Medicine, National University of La Plata, La Plata, Argentina

To whom correspondence should be addressed: Alberto Di Somma, M.D. [E-mail: albertodisomma87@gmail.com]

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BACKGROUND AND IMPORTANCE: **Lesions located lateral to the lower brainstem, such as proximal posterior inferior cerebellar artery (PICA) aneurysms, are surgically challenging. We report a case of a patient with a left proximal PICA aneurysm that was successfully clipped via a so-called "extended" suboccipital subtonsillar approach, which allowed us to obtain proper vascular control without removal of the atlas. The anatomy relevant for this approach has been studied.**

METHODS: **Three adult cadaveric heads were studied. The relevant neurovascular anatomy related to this approach was exposed. Hence, this technique was applied on the patient herewith reported.**

CASE PRESENTATION: **A 60-year-old man with sudden onset of severe headache, nausea, and vomiting was admitted to our hospital. Computed tomography of the brain showed diffuse subarachnoid hemorrhage, mainly distributed at the level of the perimesencephalic cisterns. Cerebral angiography revealed a 3-mm aneurysm arising at the origin of the left PICA. The aneurysm was considered unsuitable for coil embolization, so it was treated via a "modified" posterolateral suboccipital subtonsillar route. The modification consisted of accomplishing proper proximal vascular control at the extracranial segment of the vertebral artery (V3), without the need of further removal of the posterior portion of the atlas. The patient was discharged neurologically intact.**

CONCLUSIONS: **The technique we suggested allowed no unnecessary removal of bone, with no need to drill the occipital condyle or remove the atlas, offered proper proximal vascular control in the early stage of the surgical procedure, and limited the quantity of temporary vascular clips inside the intracranial surgical field.**

INTRODUCTION

Aneurysms of the posterior inferior cerebellar artery (PICA) are rare.[1-3] Surgery is challenging because of the deep location and intimate relation of the PICA with the medulla and lower cranial nerves. The development and implementation of endovascular therapy have led to a less-invasive approach to cerebrovascular disease, and indications for surgery have been progressively confined.[4-6] Although endovascular treatment of intracranial aneurysms is used increasingly as an alternative to surgery, specific results related to the management of PICA aneurysms with these techniques are not well established, especially if the clinical presentation is a ruptured aneurysm.[7,8]

Different approaches can be used to treat these lesions surgically depending on their anatomic location and morphology, with the paramedian suboccipital craniotomy the most common approach used.[3,9,10] In such cases, proximal control of the vertebral artery (VA) generally is reached directly in the intradural space or by removing the posterior portion of the atlas and/or drilling the occipital condyle, thus localizing the VA in its extracranial course.[11,12] However, both surgical maneuvers have some surgical drawbacks. If on one hand removal of the posterior portion of the atlas and/or drilling the occipital condyle may add some risks of bleeding, unnecessary bone removal, and prolonged surgical time, on the other hand localizing the VA directly in its intradural course, and using temporal clipping accordingly, could reduce the intradural surgical field space.

In this paper, we report a case of ruptured proximal PICA aneurysm that was treated via a modified "extended" posterolateral suboccipital subtonsillar approach. The modification consisted in the exposure of the extracranial segment of the VA without the need of further bone removal. This technique allowed an appropriate proximal vascular control in the early stage of the surgical procedure without narrowing the surgical field with multiple vascular clips (intradurally) or removing further bone. Moreover, in order to highlight the main anatomic structures related to the proposed approach, a dedicated cadaveric demonstration was performed.

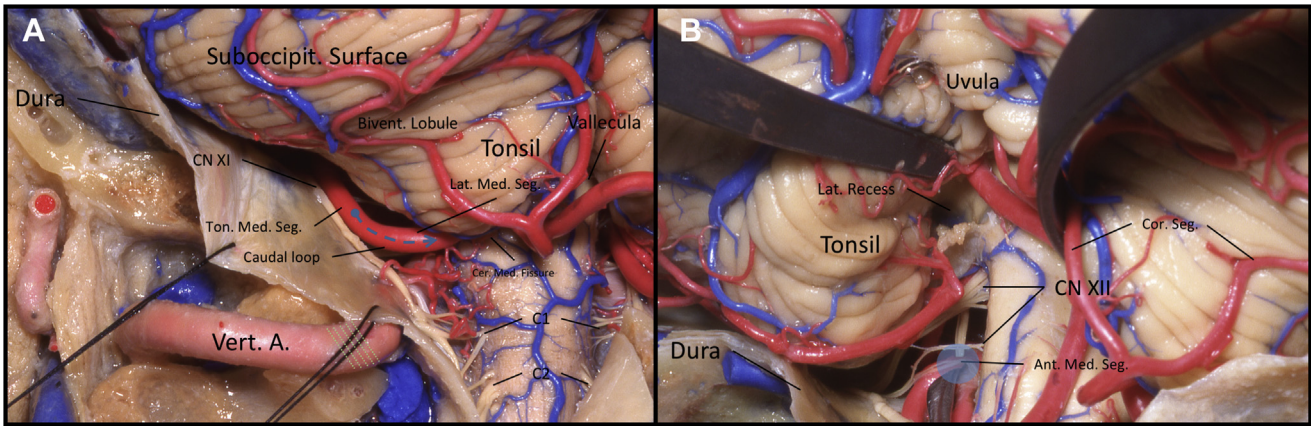

Figure 1. (**A**) Posterior view of the cerebellum and craniovertebral junction. *Dotted green lines* indicate the site of proximal vascular control that can be achieved at the level of V3 segment of the vertebral artery. The *blue arrow* shows the surgical pathway along the posterior inferior cerebellar artery that should be followed backwards, i.e., starting from the tonsillomedullary segment, to reach the origin of the PICA (*blue circle* [**B**]). (**B**) The tonsil has been retracted superolaterally to expose the surface of the medulla as well as the origin of the PICA and its anteromedullary segment. Suboccipit., suboccipital; Bivent., biventricul; Lat., laterally; Med., medullary; Seg., segment; Vert. A., vertebral artery; Cer., cervical; CN XI, accessory cranial nerve; C1 and C2, first 2 cervical nerve roots; Cor., cortical; CN XII, hypoglossal nerve. Ant., anterior.

METHODS

Three adult cadaveric heads, fixed with formaldehyde and injected with colored silicone, were studied. Extensive exposure of the posterior fossa anatomy was performed to provide some key aspects that are relevant when performing the modified "extended" suboccipital subtonsillar approach.

Relevant Intracranial Anatomy of the Modified "Extended" Suboccipital Subtonsillar Approach

The anatomy of the posterior fossa is detailed widely in the pertinent literature.[13-15] Focusing on the relevant anatomy for the surgical approach herewith presented, we will discuss details of some portions of the VA and the PICA (Figure 1).

The VA (one per side) is schematically divided into 4 segments, from its origin from the subclavian artery (V_1) to the intradural join with the contralateral VA (V_4).[16] The third segment (V_3) is intimately related to the foramen magnum and craniovertebral junction and, together with the intracranial VA, is extremely relevant during this modified route. It extends

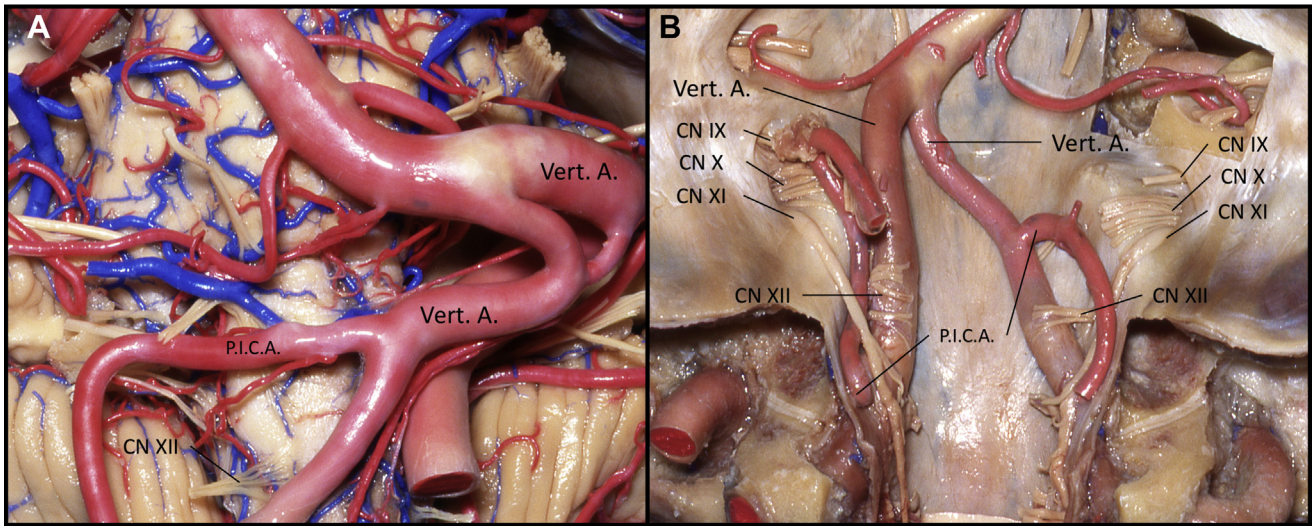

Figure 2. Relevant anatomic relationships of the intracranial vertebral artery (V4) with the surrounding neurovascular structures, anterior (**A**) and posterior (**B**) view. Once inside the dura mater, the V4 ascends from the lower lateral to the upper anterior surface of the medulla and joins its mate of the opposite side near the pontomedullary junction to form the basilar artery. The artery ascends anterior to the cranial nerves IX to XII. CN XII, hypoglossal nerve; P.I.C.A., posterior inferior cerebellar artery; Vert. A., vertebral artery; CN IX, glossopharyngeal nerve; CN X, vagus nerve; CN XI, accessory nerve. (Adapted from Campero et al.[16])