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Original article

Surgical anatomy for hemifacial spasm

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ABSTRACT

Classically in the cerebello-pontine angle the facial (CN VII) and vestibular-cochlear (CN VIII) nerves should run parallel with the anterior inferior cerebellar artery, whereas the lower nerves (CN IX-XI) continue with the posterior-inferior-cerebellar artery (PICA). In fact, this is not always true, particularly when dealing with hemispasm surgery where the relationships between CN VII, CN VIII and PICA are often different and closer. Knowledge of anatomical bases in surgical situation will help neurosurgeons to appreciate anatomical nuances, that are important to increase effectiveness and safety of hemifacial spasm surgery.

1. Surgical anatomy for hemifacial spasm

Classically, in the cerebello-pontine angle (CPA), the facial (Cranial Nerve VII) and vestibulocochlear (CN VIII) nerves should run parallel with the anterior inferior cerebellar artery (AICA), while the lower nerves (CN IX-XI) continue with the posterior-inferior-cerebellar artery (PICA). In fact, this is not always true, particularly when considering the anatomy encountered in hemifacial spasm surgery.

Because the trigeminal nerve, the superior cerebellar artery, the abducens nerve and the hypoglossal nerve are too far away from the cochleo-facial bundles to be in contact during surgery, these structures will not be studied in this chapter.

This chapter will particularly deal with the surgical anatomical features corresponding to the operative conditions of HFS surgery. For this study, we have mixed our 300 personal dissections to the main anatomical papers describing the different structures of theCPA.

2. Descriptive anatomy of neurovascular structures

The CPA is located between the superior and inferior limbs of the cerebellopontine fissure, a V-shaped angular cleft formed by the cerebellum folding around the pons and the middle cerebellar peduncle [1,2] (Fig. 1). The CN VII and CN VIII arise in the midportion of the fissure at the level of the pontomedullary junction (sulcus) and the trigeminal nerve near the superior limb of the fissure. The glossopharyngeal (CN IX vagus (CN X), and accessory nerves (CN XI) arise near the inferior limb, dorsal to the olive, and anterior to the choroid plexus protruding from the foramen of Luschka. The hypoglossal rootlets arise in front of the olive, lateral to the corticospinal tract.

3. Cranial nerves

3.1. The facial and the cochleovestibular nerves

The CN VII and the CN VIII emerge from the lateral surface of the brainstem close to the caudal border of the pons. These nerves are in close proximity during their course through the subarachnoid space and the internal acoustic meatus. The CN VIII lies dorsal and slightly caudal to the CN VII, which is therefore located somewhat more ventrally and slightly above the CN VIII; thus, via the suboccipital retromastoid approach the CN VII may be entirely hidden by the CN VIII.

The facial nerve (CN VII) is composed of a large motor root and a smaller mixed sensory and parasympathetic root, the nervus intermedius which lies between the CN VII motor portion and the CN VIII. The average CN VII cisternal length is 16 mm (10–26 mm) with an equal length within the canal [3]. The CN VII neurovascular compression location has been divided in four zones according to Campos-Benitez and Li [4,5]: (1) nerve root exit point, (2) attached

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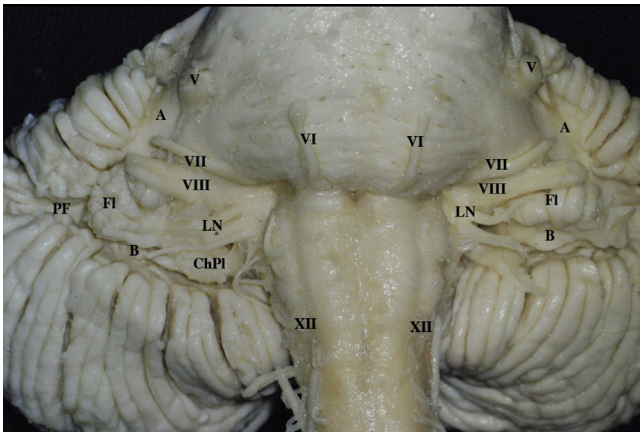

Fig. 1. Anterior view of brainstem and cerebellum: A: cerebello-pontine fissure superior limb; B: cerebello-pontine fissure inferior limb; PF: petrous fissure; V: trigeminal nerve; VI: abducens nerve; VII: facial nerve; VIII: cochleo-vestibular nerve; LN: lower cranial nerves; XII: hypoglossal nerve; Fl: flocculus; ChPl: choroid plexus.

segment, (3) nerve root detachment point (that corresponds to the transition zone between central and peripheral axonal myelination) and transition to the sub-arachnoid segment, and (4) cisternal portion (Fig. 2
).

The eight nerve (CN VIII) consists of the cochlear and vestibular nerves, which are 17–20 mm in total length; between the brainstem and the porus acusticus they measure 10–13 mm (15 mm for Lang [3]). The cochlear part constitutes the more ventral and caudal portion of the nerve and passes dorsally over the inferior cerebellar peduncle (restiform body), whereas the vestibular part forms the more posterior portion of the nerve and enters in the vestibular nuclei at the junction between pons and medulla.

CN VII and CN VIII, accompanied by the labyrinthine artery, pass laterally and slightly upward to enter into the internal auditory meatus. As they pass across the subarachnoid space and enter the meatus the motor bundle of CN VII tends to lie most anteriorly, the CN VIII posteriorly, with the nervus intermedius between them [6]. Within the meatus, the nervus intermedius typically joins the CN VII motor portion. Then these nerves cross the anterior surface of the CN VIII to lie above it at the distal end of the meatus. The crista transversalis (Bill's bar) divides the lateral extent of the internal

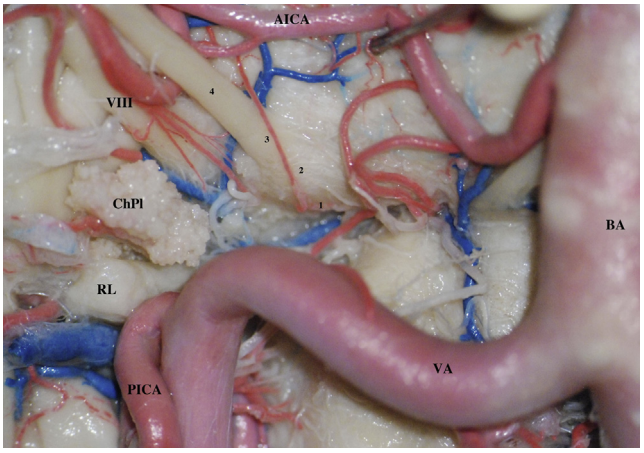

Fig. 2. Right anterior view of the cerebello-pontine angle showing the four portions of the facial nerve: BA: basilar artery; VA: vertebral artery; ChPl: choroid plexus; RL: rhomboid lip; 1: nerve root exit point; 2: attached segment; 3: nerve root detachment point; 4: cisternal portion. The lateral aperture of the fourth ventricle is totally hidden by the choroid plexus.

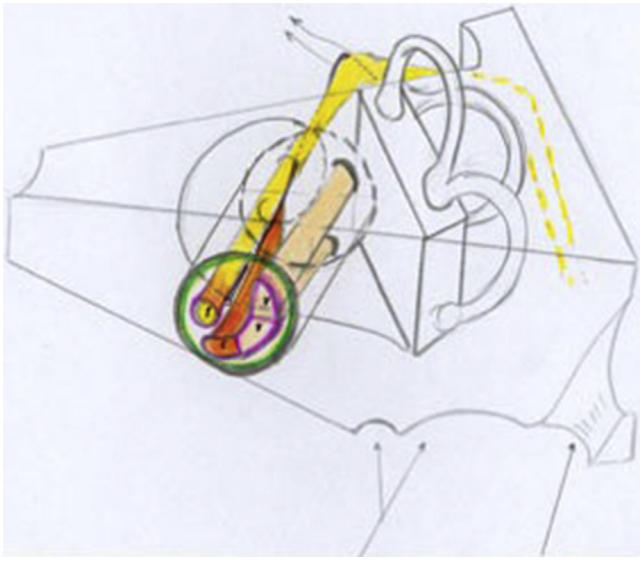

Fig. 3. Right cerebello-pontine drawing showing the nerves rotation inside the facio-cochleovestibular bundle: F: facial nerve with its three different parts (cisternal, tympanic and mastoid); C: cochlear nerve; V: vestibular nerves; the nervus intermedius is not visible.

auditory canal into a superior and inferior compartment. Superior to the crista lie the CN VII (anteriorly) and the superior vestibular nerve (posteriorly) with the nervus intermedius between them. Below the crista lie the cochlear nerve (anteriorly) and the inferior vestibular nerve (posteriorly) (Fig. 3). Commonly the flocculus protrudes behind the CN VII and CN VIII [1,2] and blocks their exposure at the junction with the brainstem in the retrosigmoid approach. Important to notice, there are often adherences between the flocculus and the vestibular nerve.

3.2. The glossopharyngeal nerve

The CN IX arises from the lateral aspect of the medulla just caudal to the pons, in the groove between the olive and the inferior cerebellar peduncle, a few millimeters below the CN VII and CN VIII. It can be made up of a sole big root or of 4 to 5 thin rootlets [7]. From its origin, the CN IX runs laterally and slightly anteriorly with CN X-XI. This is where it usually comes into contact with the PICA. CN IX exits then through the glossopharyngeal part of the jugular foramen, separated from the other nerves by an intrajugular ligament [4,7].

3.3. The vagus nerve

As CN IX, CN X arises from the lateral aspect of the medulla between the olive and the inferior cerebellar peduncle as a series of thin rootlets (10 to 18 to Hovelacque [8]). The CN X rootlets are in line with the cranial CN IX rootlets and the caudal CN XI medullary portion. From their origins, the CN X rootlets run laterally and slightly anteriorly then converge to form the trunk of the CN X and pass through the vagus compartment of the jugular foramen, separated from the CN IX by the intrajugular ligament but closely paralleled with the CN XI (which penetrates the jugular foramen in the vagus compartment [7]). The sigmoid sinus passes through the posterior portion (large) of the jugular foramen, posterior to the accessory nerve to form the superior bulb of the internal jugular vein. The inferior petrosal sinus passes through the anterior portion of the jugular foramen to reach the jugular bulb 5 (Fig. 4).

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