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ORIGINAL ARTICLE

Typical and atypical neurovascular relations of the trigeminal nerve in the cerebellopontine angle: an anatomical study

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Abstract The aim of the present study was to anatomically evaluate in adults the neurovascular trigeminal relations in the cerebellopontine angle (CPA), from a morphological and topographical perspective and thus to improve, detail and debate the pre-existing information, with educational and surgical implications. For the present anatomical study we performed bilateral dissections on 20 human adult skull bases, in formalin-fixed cadavers, at the level of the cerebellopontine angle, using the anatomical superior approach; we also studied 20 additional drawn specimens—cerebellum and brainstems, from autopsied cadavers, in order to better document the vasculature at the trigeminal root entry zone (REZ). The most constant but not exclusive neurovascular relations of the trigeminal nerves were those with the superior cerebellar artery (SCA) and the superior petrosal vein (the petrosal vein of Dandy). The regular possibility for the SCA to appear divided into a medial and a lateral branch and these to represent individual trigeminal relations at the level of the pontine cistern or REZ must not be neglected. The petrosal vein tributaries can also represent superior, inferior, or interradicular trigeminal relations. Arterioles emerging from the SCA or the anterior inferior cerebellar artery (AICA) represented trigeminal relations either at the REZ or were coursing between the trigeminal roots. A dissected specimen presented a radicular trigeminal artery emerging from the basilar artery and entering the trigeminal cavum inferior to the nerve. Another specimen presented two bony lamellae superior to the trigeminal nerve at the entrance in the trigeminal cavum—these lamellae were embedded within the lateral border of tentorium cerebelli and the posterior petroclinoid ligament. So we bring here an evidence-based support extremely useful not only for specialists dealing with this area but also for educational purposes. It appears important not only to consider the typical anatomy at this level but also to take into account the atypical and hardly predictable morphologies that may alter the diagnoses and the specific surgical procedures.

Keywords Pontine cistern · Petrosal vein · Cerebellar artery · Trigeminal artery · Cavum of Meckel

Abbreviations

REZ	Root entry zone
SCA	Superior cerebellar artery
AICA	Anterior inferior cerebellar artery
PICA	Posterior inferior cerebellar artery
TPA	Transverse pontine artery
BA	Basilar artery
VA	Vertebral artery

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PV Petrosal vein
TPV Transverse pontine vein
SPS Superior petrosal sinus
CV Cerebellar vein

Introduction

The trigeminal nerve emerges from the pons, as a large sensory and a small motor root; there may be contact or aparrent compression of the sensory root by branches of the basilar artery which may be important in trigeminal neuralgia [30].

Dandy reported finding vascular compression of the trigeminal sensory root in 30% of cases and suggested that this might be a cause of neuralgia; his theory was later supported by Gardner and confirmed by the work of Janetta. Most frequently, the offending vessel is represented by the superior cerebellar artery (75%) but also the following arteries may be involved: the anterior inferior cerebellar artery, the posterior inferior cerebellar artery, the vertebral and basilar arteries, the labyrinthine artery and other unspecified small arteries, as it resulted from the studies of Janetta performed in 1967. The same studies revealed that associations of vein and artery are the compressive vessels in 56% of cases and veins alone in 13% of cases. Although the microvascular compression is widely accepted, there are apparent inconsistencies as arterial contact may also be encountered in patients without trigeminal neuralgia [24].

The microvascular decompression (MVD) procedure, developed for conservative treatment of idiopathic trigeminal neuralgia (TN) is based on the neurovascular conflict theory [25].

The fact that large arteries are commonly in contact with the trigeminal nerve is important not only because of the controversial relationship of neurovascular contact to trigeminal neuralgia, but because of the possibility that major vessels may be encountered and injured during rhizotomy and other posterior fossa operations on the trigeminal nerve [8].

As Matsushima et al. [14] already pointed out the fact that the increasing use of microsurgical decompression for trigeminal neuralgia has created a need for more detailed anatomical information about the approach.

We designed the present study in order to evaluate, based upon evidence, the anatomy of the neurovascular relations of the trigeminal nerve in the cerebellopontine angle (CPA) in human adults and thus offer an additional relevant support for the neurosurgeons dealing with the trigeminal nerve decompressions, and a general educational support for students and physicians. Being an anatomical study, we considered the superior approach as suitable to address our general purpose.

Materials and methods

For the present anatomical study we performed bilateral dissections on 20 human adult formalin fixed skull bases (sex ratio: 9:11, average age: 61.15 years, min. 45 years, max. 77 years), after the removal of calvaria, opening of the dural sac and removal of the cerebral hemispheres. Tentorium cerebelli was exposed, divided and reflected to gain access on the pontine cistern and the cerebellopontine angle where the trigeminal nerve and the surrounding blood vessels were carefully dissected and directly visualized and photographed. As fixation of cadavers may distort the morphometric features and taking into account that the anthropometric features are individual, we considered less relevant to focus on lengths and distances and we decided only to focus upon the topography and morphology of the elements in the cerebellopontine angle.

Moreover, we studied the trigeminal neurovascular relations at the level of the trigeminal root entry zone in other additional 20 human adult specimens—cerebellum + brainstem blocks, drawn at autopsies, unfixed ($n = 15$) and formalin-fixed ($n = 5$).

Results

The trigeminal neurovascular relations in the cerebellopontine angle involved the most frequent the superior cerebellar artery and the petrosal vein, as vessels located in a superior layer to the trigeminal nerve layer and the anterior inferior cerebellar artery, in an infratrigeminal layer. The SCA and PV represented the most constant vascular relations of the trigeminal nerve at that level (with several morphological alternatives that we shall discuss in the following paragraphs) and can serve as limits for a topographic supratrigeminal triangle, together with the SPS; individual topographic vascular course lead to a narrower/larger triangle. The borders of this triangle may present morphological and numeric variations but can be constantly identified (Fig. 1).

The vessels we found closely related to the trigeminal nerve in the cerebellopontine angle are identified in Table 1.

The morphology of the superior cerebellar artery varied: in only 35% the arterial trunk was closely above the trigeminal nerve (Figs. 2, 3) and in the remaining 65% of specimens it appeared divided into two branches, medial and lateral. The lateral branch of the SCA was a direct relation of the trigeminal nerve in 65% of specimens (Figs. 4, 5a, b) while the medial branch of SCA was

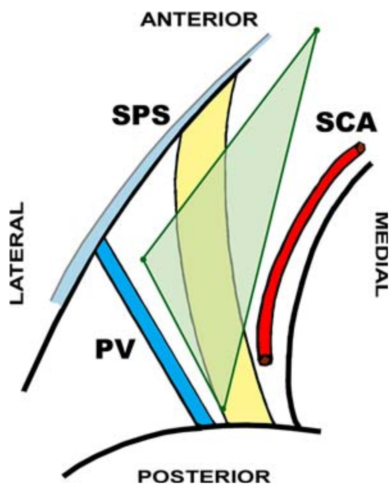

Fig. 1 Between the superior cerebellar artery (SCA), the petrosal vein (VP) and the superior petrosal sinus (SPS) a vascular triangle can be defined above the cisternal trigeminal nerve

Table 1 Distribution of the blood vessels topographically related to the trigeminal nerve in the cerebellopontine angle, at the dissected specimens ($n = 20$)

Vascular elements anatomically related to the trigeminal nerve at the level of the pontine cistern	Superior to the trigeminal nerve roots	Inferior to the trigeminal nerve roots	Trans/interradicular trigeminal
SCA—the trunk	7 (35%)		
SCA—lateral branch	13 (65%)		
SCA—medial branch	6 (30%)		
AICA—the trunk		2 (10%)	
AICA—rostral branch		1 (5%)	3 (15%)
TPA	5 (25%)		
Arterioles at the REZ of the 5th nerve	5 (25%)	1 (5%)	1 (5%)
PICA—rostral branch	1 (5%)		
PV	13 (65%)		
TPV	5 (25%)	2 (10%)	2 (10%)
Venular plexus in the pontine Cistern	2 (10%)		
Cerebellar vein	6 (30%)		

switched laterally before approaching cerebellum in 30% of specimens (Fig. 6). In only one specimen (Fig. 5b) we found the medial and lateral branches of SCA with separated origins from the basilar artery, both arteries looping above the cisternal trigeminal nerve.

The second constant relation of the trigeminal nerve was represented by the petrosal vein that was draining in the superior petrosal sinus and crossed the superior aspect of the trigeminal nerve, near its REZ (Figs. 5b, 6, 7). Being supplied mainly by cerebellar veins, the PV were either distanced superior, posterior and lateral to the trigeminal

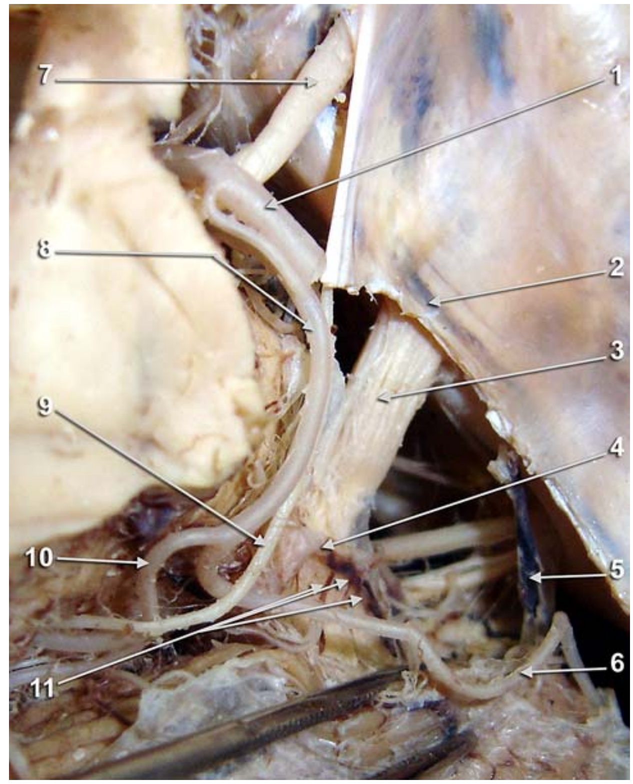

Fig. 2 The right cerebellopontine angle—postero-superior view of the trigeminal nerve. *1* posterior cerebral artery, *2* superior petrosal sinus, *3* trigeminal nerve, *4* ascending branch of the anterior inferior cerebellar artery, *5* cerebellar vein, *6* lateral branch of the superior cerebellar artery, *7* oculomotor nerve, *8* superior cerebellar artery, *9* trochlear nerve, *10* medial branch of the superior cerebellar artery, *11* venules at the trigeminal root entry zone

nerve (Fig. 3) or were replaced by a cerebellar vein/veins draining in the SPS (Figs. 2, 4). Two specimens presented each a venous plexus with cerebellar and pontine affluents located superior and between the trigeminal nerve roots in the pontine cistern, draining in the SPS; such one (Fig. 5a) presented a loaded vascular supratrigeminal layer, with an arterial layer superposed on the venous peritrigeminal plexus described—the looping lateral branch of the SCA and a transverse pontine artery were closely related to the trigeminal nerve roots. Pontine tributaries of the PV were found passing between (3 specimens) the trigeminal nerve roots (Figs. 4, 7) or through (2 specimens) the motor trigeminal root (Fig. 5b). One specimen presented several bridging veins draining in the SPS: one cerebellar, located postero-superior to the trigeminal nerve and other three pontine, located inferior to the trigeminal nerve and draining in the SPS, the two posterior, and in the cavernous sinus, the anterior one (Fig. 8). In the last specimen, the labyrinthine artery was evidenced as an inferior and distanced relation of the trigeminal nerve, separated from it by the petrosal bridging veins we described previously (Fig. 8).

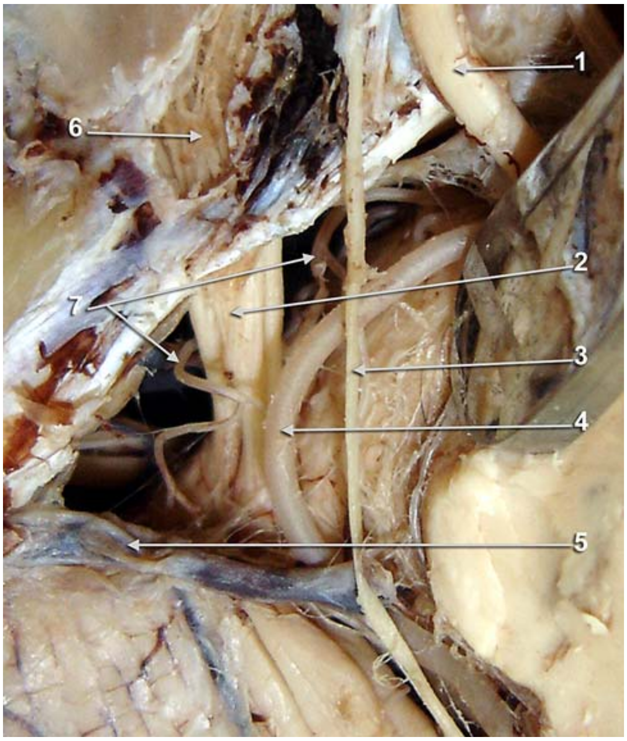

Fig. 3 The left cerebellopontine angle—superior view of the trigeminal nerve. *1* oculomotor nerve; *2* trigeminal nerve, *3* trochlear nerve, *4* superior cerebellar artery, *5* petrosal vein, *6* triangular plexus of Valentin, cavum of Meckel, *7* anterior inferior cerebellar artery—rostral branch

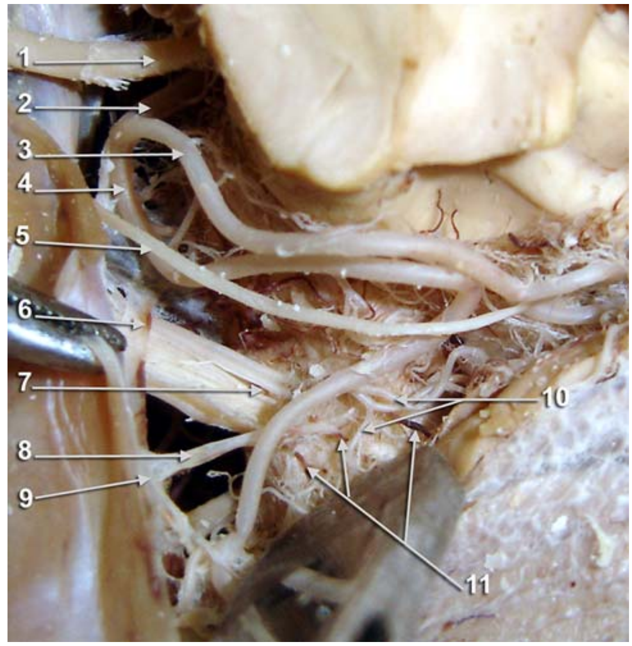

Fig. 4 The left cerebellopontine angle—postero-superior view of the trigeminal nerve. *1* oculomotor nerve, *2* superior cerebellar artery, *3* medial branch of the superior cerebellar artery, *4* lateral branch of the superior cerebellar artery, *5* trochlear nerve, *6* pontine vein, *7* transfixing venule of the trigeminal nerve, *8* cerebellar vein, *9* short superior petrosal vein, emptying in the superior petrosal sinus, *10* small branches of the lateral branch of the superior cerebellar artery, closely related to the trigeminal root entry zone, *11* cerebellar/peduncular venules

The anterior inferior cerebellar artery was never found superior to the trigeminal nerve roots; its main trunk passed inferior to the trigeminal nerve roots in two specimens while more frequently we found the rostral branch of the AICA as a trigeminal relation (20%), inferior (Fig. 3) or between the trigeminal nerve roots (Fig. 7). The AICA in 15% of specimens and the SCA in 20% represented the main sources sending arterioles in close to the trigeminal nerve at its REZ (Figs. 4, 2).

One specimen presented above the trigeminal nerve at the entrance in the cavum of Meckel 2 bony lamellae, one in front of the other (Fig. 6), embedded in the tentorial border above the trigeminal notch. Between the two lamellae and also between these lamellae and the bones (the petrous apex and the lateral border of the dorsum sellae) there were evidenced thin fibrous bands. The oculomotor and trochlear nerves were passing superior to these lamellae while inferior to them there were the trigeminal and abducent nerves. At the same specimen, on the same right side, we identified a venous variation: the SPS continued the PV posterior to the trigeminal notch, while the anatomic connection of the cavernous sinus and the SPS was solved by a communicating vein crossing above the trigeminal nerve and partially hidden below the two lamellae.

In a specimen (5% of the 20 dissected cadavers) we evidenced a radicular trigeminal artery emerging from the basilar artery and entering the trigeminal cavum on the inferior surface of the trigeminal nerve. In its course, that artery passed superior to the abducens nerve and the AICA at the level where that artery gave rise to the labyrinthine artery (Fig. 9).

The results of the dissections on the skull base corroborated with those obtained from the drawn specimens (Fig. 10) leading us to a general diagrammatic representation (Fig. 11) of the main neurovascular trigeminal relations in the cerebellopontine angle and their topographic variations. The length of the main trunk of the SCA and the presence of its medial and lateral branches are the variables that mainly give the superior arterial relation of the trigeminal nerve roots. The variable longitudinal disposition and number of the transverse pontine arteries may bring these in close relation with the trigeminal nerve, the arteries usually being superior to the nerve and closer to its REZ (Fig. 10). The petrosal vein is a superior trigeminal relation while its larger tributaries may be superior or between the trigeminal nerve roots and can even pass through the roots; nevertheless, the superficial pontine venous plexus (Fig. 10) always surrounds the REZ of the

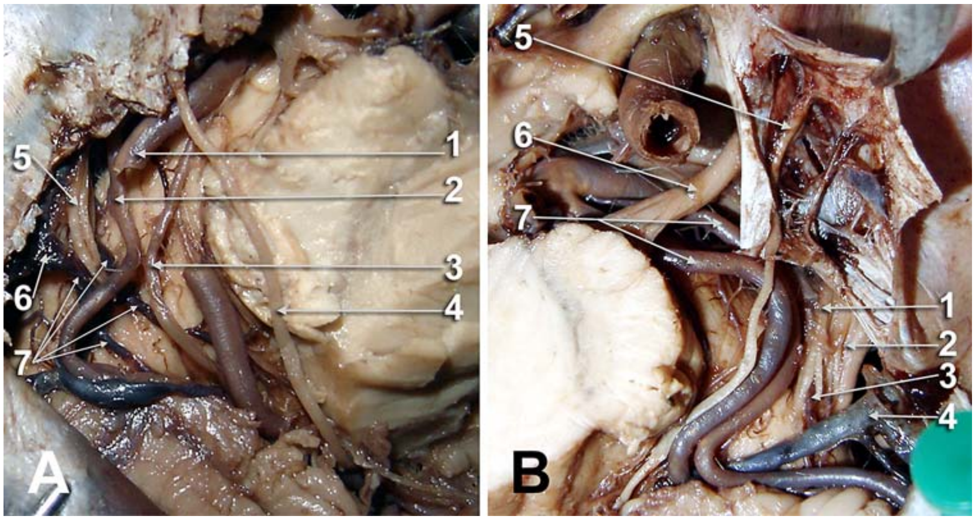

Fig. 5 **a** The left cerebellopontine angle—superior view of the trigeminal nerve. *1* medial branch of the superior cerebellar artery, *2* lateral branch of the superior cerebellar artery, *3* transverse pontine artery, *4* trochlear nerve, *5* motor trigeminal root, *6* petrosal vein, *7* plexus of cerebellar veins around the trigeminal entry zone. **b** The right cerebellopontine angle—superior view of the trigeminal nerve. *1* motor trigeminal root, *2* sensory trigeminal root, *3* transfixing vein of the motor trigeminal root, *4* petrosal vein draining in the superior petrosal sinus, *5* trochlear nerve entering the cavernous sinus, *6* oculomotor nerve, *7* lateral and medial branches of the superior cerebellar artery, separately emerged from the basilar artery

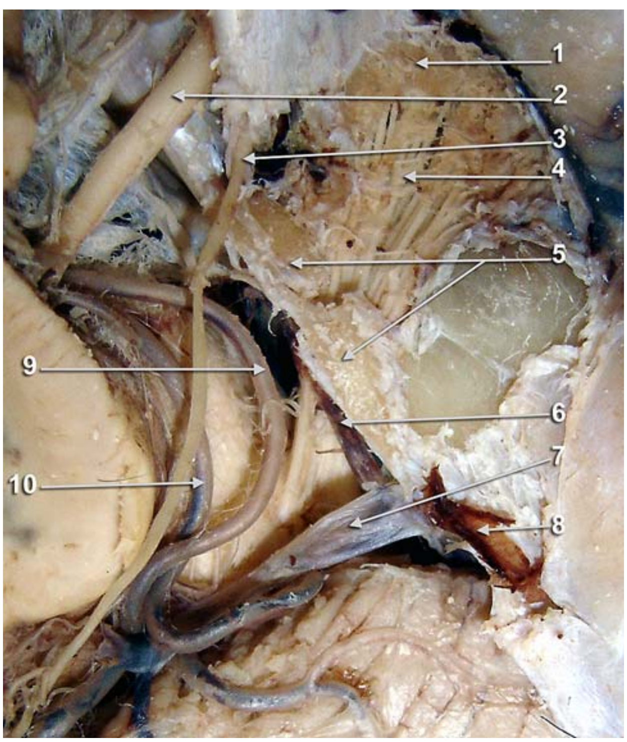

Fig. 6 The right cerebellopontine angle—superior view of the trigeminal nerve. *1* trigeminal ganglion of Gasser, *2* oculomotor nerve, *3* trochlear nerve, *4* triangular plexus of Valentin, *5* bony lamellae, anterior and posterior, within the petroclinoidal ligament and the tentorial petrous border, respectively, *6* anastomotic vein of the cavernous sinus and the superior petrosal vein, *7* petrosal vein, *8* origin of the superior petrosal sinus, *9* medial branch of the superior cerebellar artery, *10* lateral branch of the superior cerebellar artery

trigeminal nerve. Depending upon a variable origin, the AICA or its rostral branch constantly represents an inferior vascular relation of the trigeminal nerve—we found the artery absent, unilaterally in seven specimens and bilaterally in five specimens from the drawn ones, its territory being supplied either by the SCA or by the PICA.

Discussion

Our results serve a double purpose, one educational and the other technical/surgical. Discussing the educational one, we offer here an evidence-based anatomical support for a better medical approach and understanding of the neurovascular trigeminal relations at the level of the cerebellopontine angle—the pontine cistern of the subarachnoid space, based upon an identified gap in the traditional anatomical literature. Most of the existing reports on this topic deal mainly from a diagnostic and therapeutic point of view with the neurovascular trigeminal relations [10, 29] and most of these are built upon the first observations of Jannetta [9] that involved the neurovascular relations as predominant etiologic factors of the trigeminal neuralgia, leading to further developments of the microvascular decompression techniques [7, 12, 16]. The successful long-term outcome of microvascular decompression for trigeminal neuralgia is largely dependent on the maintenance of the isolation between the trigeminal nerve and the offending vessel, avoiding also the development of scar tissue around the nerve. Mitsos et al. [18] suggested an alternative technique

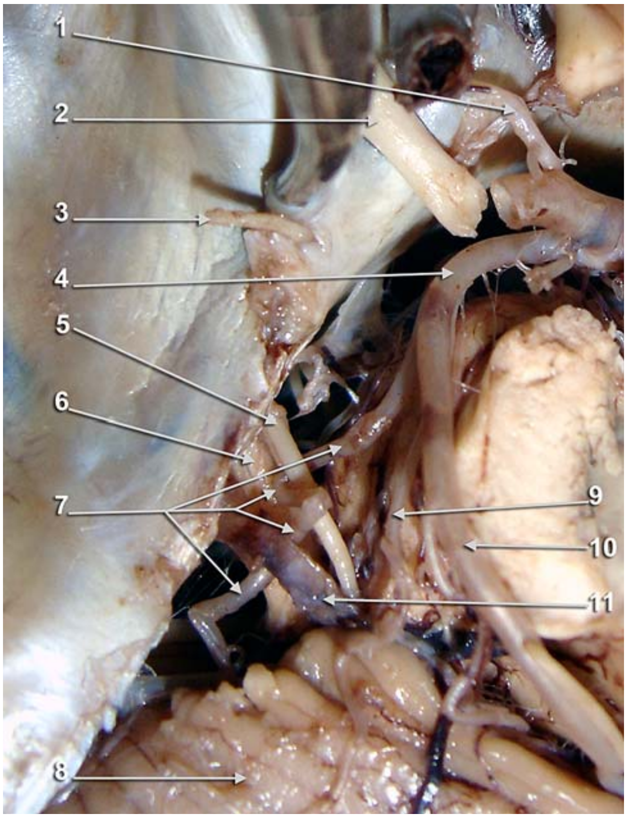

Fig. 7 The left cerebellopontine angle—superior view of the trigeminal nerve. *1* posterior communicating artery, *2* culomotor nerve, *3* trochlear nerve, *4* common trunk of the superior and anterior inferior cerebellar arteries, *5* motor trigeminal root, *6* sensory trigeminal root, *7* anterior inferior cerebellar artery, coursing between the trigeminal roots, *8* cerebellum, *9* lateral branch of the superior cerebellar artery, *10* medial, thicker branch of the superior cerebellar artery, *11* petrosal vein

to achieve this target by "hanging" the offending vessel from the overlying tentorium using a strip of autologous tissue without interposing any foreign material. Nevertheless the anatomical accuracy of the surgical approaches is a prerequisite for a positive result—here we are in accordance with McLaughlin et al. [16] who pointed that microvascular decompression of the trigeminal nerve requires sharp dissection of all arachnoid around the trigeminal nerve and superior cerebellar artery, the most commonly found offending vessel either at the brainstem or distally.

Numerous studies focused on the superior cerebellar artery relation with the trigeminal nerve [8, 25, 32]. Within the references we investigated we only found Matsushita that took into account the bifurcation of the superior cerebellar artery as a morphological factor to be considered when approaching the trigeminal nerve [14]. As it results from our study, not only the SCA trunk must be considered as a possible aethiologic vessel in the trigeminal neuralgia, but also one of or both its branches, if the SCA bifurcates rapidly, and so, the surgical studies must take into account

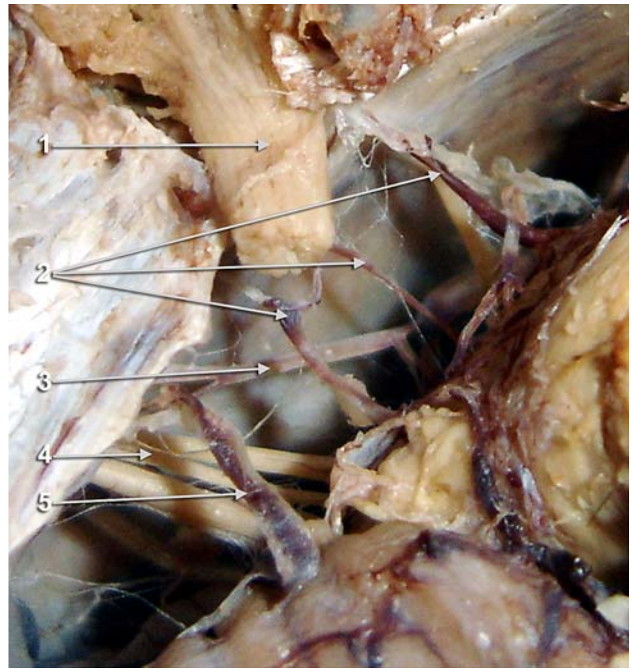

Fig. 8 The left cerebellopontine angle—superior view, the trigeminal nerve being proximally resected. *1* trigeminal nerve, *2* bridging petrosal veins, draining into the superior petrosal and cavernous sinuses, *3* labyrinthine artery, *4* nerves of the internal auditory meatus, *5* cerebellar vein

Fig. 9 Dissection of the right cerebellopontine angle; the trigeminal nerve proximal part is resected to expose a radicular trigeminal artery (*thin arrows*) emerged from the basilar artery, that reaches the petrous apex inferior to the trigeminal ganglion (*thick arrow*)

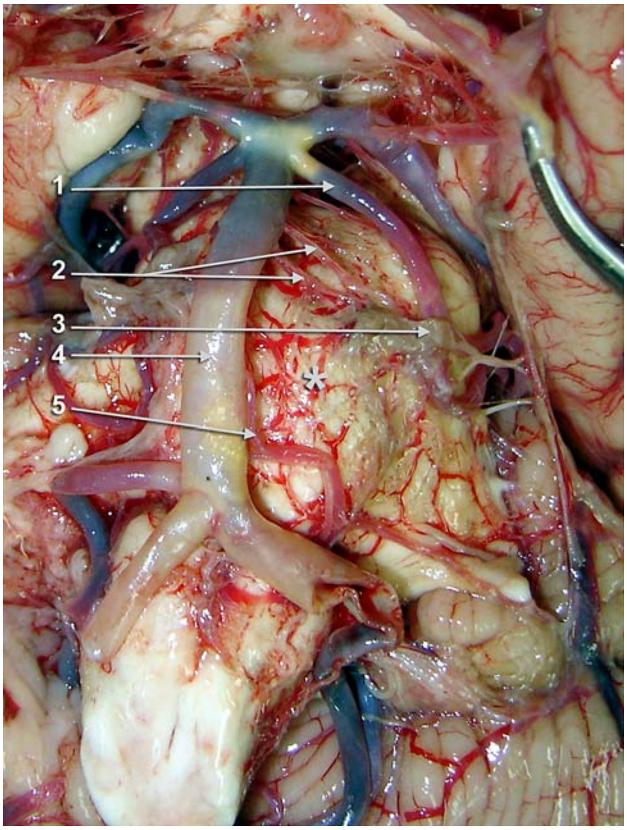

Fig. 10 The vessels on the ventral surface of the pons (*), fresh specimen. *1* superior cerebellar artery, *2* transverse pontine arteries, *3* trigeminal nerve, *4* basilar artery, *5* anterior inferior cerebellar artery

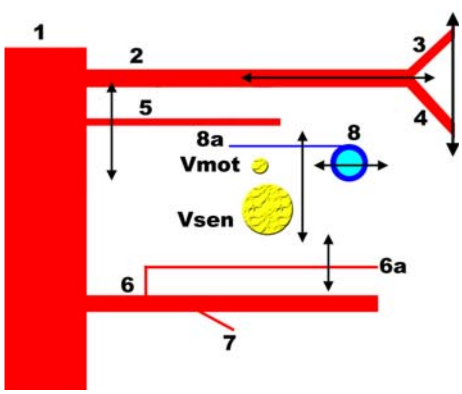

Fig. 11 Diagram describing the main vascular relations of the trigeminal nerve roots, sensory (Vsen) and motor (Vmot) in the cerebellopontine angle; the arrows indicate the possibilities of topographic variations, in vertical and transverse planes. *1* basilar artery, *2* superior cerebellar artery with its lateral and medial branches (*3*, *4*), *5* transverse pontine artery (arteries), *6* anterior inferior cerebellar artery, with its rostral branch (*6a*) and the labyrinthine artery (*7*), *8* superior petrosal vein, *8a* pontine/cerebellar veins

these branches as distinctive parameters to be determined when performing the statistical analysis. In a study performed on 25 cadaveric brain specimens, Pai et al. [20] evidenced the SCA arising as *a* "*double trunk*" in eight instances; the specimen we presented in Fig. 9 has a morphologically comparable origin from the basilary artery as those reported by Pai et al. but following the course of that arteries we determined there were corresponding to the SCA branches (absent trunk of the SCA) and not to a duplicated SCA—this distinction was not made by Pai et al. and we strongly recommend it to be considered in further similar studies.

Similarly, the inferior relation of the trigeminal nerve roots appears described to be with the AICA and we could not find the rostral branch of this artery mentioned as a direct relation of the nerve roots. So, we believe that an accurate identification of the vessels related to the trigeminal nerve can be established only after an exhaustive dissection, due to the fact that the anatomical vascular variation may be important. Undoubtedly preoperative angiograms or MR studies (Fig. 12) may help clarifying the offending vessels [1, 19].

Persistent trigeminal arteries are rare and represent a remnant of the fetal carotid-basilar anastomosis; these arteries typically extend from the internal carotid artery to the basilar artery [2]. These arteries are largely represented in references [3, 5, 6, 31], and may be involved in the trigeminal neuralgia. The radicular trigeminal artery that we evidenced, was not mentioned in the references we studied as a possible vascular relation of the trigeminal nerve roots, except in the works of Paturet [21] who described its possible origin either from the basilar artery or from its pontine branch. This possible arterial relation of the trigeminal nerve must be taken into account when diagnosing the trigeminal offending vessel and distinguishing it from the persistent primitive trigeminal artery that emerges from the ICA. A MRI axial T2 weighted survey of the cerebellopontine angle can accurately identify the course and connections of a persistent primitive trigeminal artery (Fig. 13).

The petrosal veins are divided into superior and inferior, based on whether they enter the superior or inferior petrosal sinus. The superior petrosal veins were initially termed by Dandy, in 1929, as *petrosal veins* only. The inferior petrosal veins are represented by a few bridging veins, but as we evidenced, this disposition may be encountered also for the superior petrosal veins. The superior petrosal veins (of Dandy) may be formed by the terminal segment of a single vein or by the common stem formed by the union of several veins. The most common tributaries of the superior petrosal veins are the transverse pontine and pontotrigeminal veins, the common stem of the lateral group of the superior hemispheric veins, and the veins of the cerebellopontine fissure, and the middle cerebellar peduncle [23]. The superior petrosal veins are subdivided into a lateral, intermediate, and medial group

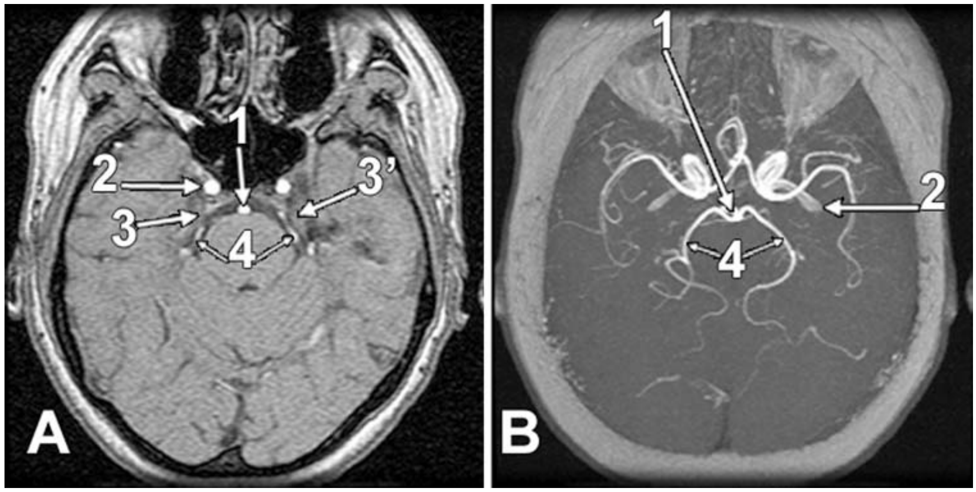

Fig. 12 MRI study of the cerebellopontine angle at an adult patient (**a**) and the corresponding arterial reconstruction (**b**). *1* basilar artery; *2* internal carotid arteries, *3, 3'* trigeminal nerves, *4* loops of the superior cerebellar arteries over the trigeminal nerves

Fig. 13 Persistent primitive trigeminal artery in adult, MRI axial T2 weighted image of the cerebellopontine angle. *1* ICA, *2* basilar artery, *3* persistent primitive trigeminal artery, connecting the previous ones, *4* trigeminal nerve

based on the relationship of their site of entry into the superior petrosal sinus to the internal acoustic meatus [23, 27]. Even though a recent study considered the petrosal vein of Dandy as draining either into the superior or the inferior petrosal sinus [13], there are authors considering the vein of Dandy as being the superior petrosal vein only [17, 23].

Matsushima et al. [15] stated that venous compression could cause trigeminal neuralgia by itself and that the transverse pontine vein should be carefully observed because it is most frequently the offending vein; Haines et al. [7] identified 12% of patients suffering from trigeminal neuralagia that exhibited solely venous compressions. Our experience showed that there are several anatomical possibilities for neurovenous conflicts at the level of the pontine cistern that can be classified:

– superficial (*pial*) pontine venules/plexus of the brainstem (pons), surrounding the trigeminal REZ;
– pontine *cisternal* veins, such as:
  - the superior petrosal veins;
  - the tributaries of the petrosal vein: cerebellar and/or transverse pontine veins, that may be closely related either to the trigeminal REZ or to the cisternal part of the nerve; such venous elements are variably related to the trigeminal nerve roots: superior, between or inferior to them and may also configure local plexuses.

Petty et al. [22] considered that the most common cause of trigeminal neuralgia is vascular compression of the fifth cranial nerve at the nerve root entry zone. The need for considering the whole cisternal trigeminal nerve and not only the REZ as site of neurovascular contact or conflict is pointed by Sindou et al. [25], who took into account the neurovascular trigeminal conflict and evidenced in the majority of such cases the offending vessel as being, alone, or in association, the superior cerebellar artery (88% of patients), followed by the anterior inferior cerebellar artery—25.1%, a vein embedded in the nerve—27.6% and the basilar artery—3.5%. The authors located the neurovascular conflict at the level of the REZ in 37.8% of patients, in the midthird of the nerve in 54.3%, and at the entrance in the trigeminal cavum in 9.8%. They also discussed that the neurovascular conflict may not be the only causative factor of the neuralgia [25].

A distinctive discussion must be done on the supratrigeminal bony structures. Currarino and Weinberg [4] stated that the "*os suprapetrosum*" was first mentioned by Meckel in 1748 and is located on the antero-superior surface of the petrous bone near its apex, under the dura mater and usually is bilateral and antero-medial to the trigeminal ganglion. Tubbs et al. [28] reported an anomalous foramen at the petrous bone apex, observed on a dried skull base, with the superior limit made by an anomalous bony transformation of the attached edge of the tentorium cerebelli. So, it seems that our reported anomaly (Fig. 5) rather corresponds to that reported by Tubbs et al. [28] and we cannot consider it os suprapetrosum; moreover our finding was unilateral. As Tubbs discussed, the presence of such bony anomaly makes difficult the surgical maneuvers of the internal carotid artery and may put at risk of compression the trigeminal nerve, thus determining trigeminal neuralgia. Our results on dissections come to improve the evidences on a single dry skull offered by Tubbs et al. (2006) in their report; we present here two adjacent bony lamellae that were found within the lateral border of tentorium cerebelli and the posterior petroclinoid ligament and were in close contact not only with the fifth nerve but also with the third, fourth and sixth cranial nerves, the later at the entrance in the canal of Dorello, anomalies undocumented by dissections within the anatomical literature. As Skrzat et al. [26] discussed, petroclinoid ligaments are rarely described in anatomical literature and books of gross anatomy do not always mention these structures even though knowledge of the topographic anatomy of the paraclinoid area is essential for microsurgical management in this region. Following a head injury the oculomotor nerve palsy may result after stretching of the nerve at the posterior petroclinoid ligament [11]; a similar mechanism may be involved also in the trochlear nerve palsy. So it appears that such bony lamellae we reported here may represent a morphological background for posttraumatic concomitant involvement of the third–fifth cranial nerves in neurological symptoms, determined by the nerves crashing on the bony structures.

The hazard of specimens led us to evidence several anatomical relations that are atypical: the radicular trigeminal artery, the supratrigeminal dural embedded bony lamellae, and the small vessels, arteries and veins, at the trigeminal REZ and/or interradicular trigeminal. In our opinion such atypical anatomical structures, added to the individual variations of the main neurovascular trigeminal relations, make risky a pre-defined attitude of the surgeons before entering the operatory field—they must be prepared for a large spectrum of anatomical evidence and only generally consider any statistical analysis they have studied.

Nevertheless, a good knowledge of the trigeminal neurovascular topography will always represent the background for the specialists to check on anatomical basis the contact/conflict that could lead to compression and neuralgia and take a decision.

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