A Detailed Topographic Neurovascular Anatomy for Vestibular Neurosurgery

Vestibüler Nöroşirurji için Detaylı Topografik Nörovasküler Anatomi

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ABSTRACT

Objective: The posterior cranial fossa and the cerebello-pontine angle, with their complex structures, require an understanding of detailed anatomy. In this study it is aimed to examine the superior petrosal vein, fissure veins, choroid plexus, superior cerebellar, anterior inferior cerebellar, posterior inferior cerebellar, vertebral, and labyrinthine arteries in vivo for their connections to the cranial nerves (intermediate, abducent, facial, and vestibulocochlear nerves) of the middle neurovascular complex.
Methods: The operation records of the 109 patients were evaluated to clarify the topographic interaction in the posterior cranial fossa. Meanwhile, the percentage of uncommon relations among the neurovascular structures in the middle complex area was evaluated.
Results: The vestibulocochlear nerve's topographic relationships were studied in connection with the surrounding neurovascular structures. Out of 109 cases, the superior petrosal vein was seen in 39, the superior cerebellar artery in 14, the anterior inferior cerebellar artery in 66, and the labyrinthine artery in 22. Patients with facial and vestibulocochlear nerves were found in all cases. Intermediate and abducent nerves were found in 8 and 14 cases respectively.
Conclusions: It's crucial to comprehend and pay attention to anatomical variations during vestibular neurectomy. Our results, based on live surgical observations, may be beneficial in planning surgical approaches.

Keywords: Vestibular nerve dissection, vestibular neurectomy, posterior cranial fossa, cerebello-pontine angle

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ÖZET

Amaç: Fossa cranii posterior ve angulus pontocerebellaris, kompleks yapıları nedeniyle detaylı bir anatomi bilgisi gerektirir. Bu çalışmada vena petrosa superior, fissural venler, plexus choroideus, a. superior cerebelli, a. inferior anterior cerebelli, a. inferior posterior cerebelli, a. vertebralis ve a. labyrinthi'nin orta nörovasküler kompleksin kranial sinirleri (n. intermedius, n. abducens, n. facialis ve n. vestibulocochlearis) ile bağlantılarının in vivo olarak incelenmesi amaçlanmıştır.
Yöntem: Fossa cranii posterior'daki topografik ilişkiyi netleştirmek için 109 hastanın ameliyat kayıtları değerlendirildi. Bu esnada, orta kompleks'teki nörovasküler yapılar arasındaki nadir ilişkilerin yüzdesi değerlendirildi.
Bulgular: Nervus vestibulocochlearis'in topografik ilişkileri, çevredeki nörovasküler yapılarla bağlantılı olarak incelendi. 109 olgunun 39'unda vena petrosa superior, 14'ünde a. superior cerebelli, 66'sında a. inferior anterior cerebelli ve 22'sinde a. labyrinthi görüldü. Olguların tümünde n. facialis ve n. vestibulocochlearis saptandı. Nervus intermedius ve n. abducens sırasıyla 8 ve 14 vakada gözlendi.
Sonuç: Vestibüler nörektomi sırasında anatomik varyasyonları anlamak ve bunlara dikkat etmek önem taşımaktadır. Canlı cerrahi gözlemlere dayanan sonuçlarımızın, cerrahi yaklaşımların planlanmasında faydalı olabileceği düşünülmektedir.

Anahtar Sözcükler: Vestibüler sinir diseksiyonu, vestibüler nörektomi, fossa cranii posterior, angulus pontocerebellaris

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INTRODUCTION

Vestibular neurectomy developed as a means of treating Meniere's disease, chronic or uncompensated vestibular neuritis, vestibular hydrops, positional vertigo, traumatic labyrinthitis, acoustic neuroma, and post stapedectomy vertigo (1–9). For the first time, Frazier dissected the vestibular nerve through the posterior cranial fossa to relieve vertiginous symptoms of Meniere's disease in 1904 (10–12). Later in 1961, vestibular neurectomy was reintroduced to otologists by Dr. William House with the use of the middle cranial fossa approach (1). Then, Silverstein and Norrell described vestibular neurectomy via the retrolabyrinthine approach (13). An alternative approach is the suboccipital retrosigmoid selective vestibular neurectomy (14). The technique for vestibular neurectomy has been gradually improved in time and nowadays many otologists and neurosurgeons prefer retrosigmoid and/or retrolabyrinthine approaches(1, 11, 15) However, the methods call for detailed anatomical knowledge of the region and high surgical competence to avoid post-operative complications such as facial nerve palsy and cerebrospinal fluid leakage (1).

Janetta, a pioneer in establishing cerebellopontine angle with microsurgery, has defined clinical symptoms such as spasms and neuralgia which are linked to compression to trigeminal, facial and glossopharyngeal nerves since 1967 (16–20). In the region of the cerebellopontine angle, neurovascular anatomy varies to a great extend raising the need for a detailed anatomical understanding of neurovascular contents of the posterior cranial fossa [48]. Rhoton has defined "three neurovascular complexes" inside the posterior cranial fossa; the upper complex, the middle complex, the lower complex (22). In the initial stages of vestibular surgery, the surgeon reaches the complicated middle complex area, containing vast neural and vascular anatomical interactions. In our study, we aimed to reveal the middle complex containing the inferior anterior cerebellar artery, pons, middle cerebellar pedicle, suboccipital surface of the cerebellum, cerebellopontine fissure, abducent nerve, facial nerve, and vestibulocochlear nerve.

METHODS

The records of retrosigmoid vestibular neurectomy surgery were used to look at the important anatomical structures that are seen in surgery of the vestibular nerve (23–25).Images taken during "retrosigmoid approach to posterior cerebral fossa" procedures at Gazi University Faculty of Medicine's Department of Otorhinolaryngology (Ear-Nose-Throat) were analyzed. Ethical approval was given by the Gazi University Clinical Research Ethics Committee (130411-73). The parameters were evaluated retrospectively for 109 patient images. Table-1 shows the diagnoses of the patient undergoing retrosigmoid surgery.

The presence or absence of the fissure vein (inside the cerebellomedullar and cerebellopontine fissures), labyrinthine artery, posterior inferior cerebellar artery (PICA), abducent nerve, and vertebral artery along with the vestibulocochlear nerve's cleavage plan, location of the facial nerve, the superior cerebellar artery, and the superior petrosal vein (Dandy vein) were all revealed. The topography of the anterior inferior cerebellar artery (AICA) and the vestibulocochlear nerve has been described as "top, middle, bottom, loop-shaped," as well as "number of cases with visible artery -number of cases without visible artery." Rarely seen structures, such as the intermediate nerve and choroid plexus, were investigated.

Table-1. Patient diagnose and the type of the operation. MVD, Microvascular decompression; HFS, hemifacial spasm; TN, trigeminal neuralgia; RSVN, retrosigmoid vestibular neurectomy.

	MVD/HFS	MVD/TN	RSVN	RSVN+HFS+TN	Total
Right	1	3	36	-	40
Left	2	0	66	1	69
Total	3	3	102	1	109

Statistics

Data were calculated based on the surgical imaging findings that were examined retrospectively. The parameters were analyzed using SPSS 19.0 software and the descriptive statistics method, with the results documented in the crosstabs' dialog box.

RESULTS

There were 109 cases in this study, with 102 (94%) having vestibular neurectomy, 3 (3%) having microvascular decompression due to hemifacial spasm, and 4 (4%) having microvascular decompression due to trigeminal neuralgia. The retrosigmoid approach was used in 40 cases (37%) on the right side and 69 cases (63%) on the left side.

Arteriovenous Structures

A cerebellopontine fissure vein in 4 (4%), a cerebellomedullar fissure vein in 3 (3%) of the 109 cases were observed (Fig. 1e, f). Both fissure veins were identified together in two cases.

The superior petrosal vein (Dandy vein) was detected in 39 (36%) of the 109 cases, in 38 (35%) cases appeared as a single vein, and in 1 (1%) case appeared double (Fig. 1c, d). In 4 of these 38 cases, a fissure vein appeared inside the cerebellopontine fissure, and in 3 cases a fissure vein appeared inside the cerebellomedullary fissure. In 10 of the 38 cases, the superior petrosal vein was identified being in contact with the trigeminal nerve (Fig. 1g, h).

The superior cerebellar artery was detected in 14 (13%) of 109 cases. The trigeminal nerve runs along with the superior cerebellar artery (medial and lateral braches) in 6 of these cases and the AICA was also observed in middle complex area in 11 of these 14 cases (Fig. 1g, h).

AICA was found in 66 (61%) of the 109 cases studied. These cases were categorised as being above, in between, below, or in the form of a loop depending on their relationship to the vestibulocochlear and facial nerve complex.

In terms of the nerve complex, AICA was found to be above in 33 (Fig. 1i, j, k, l, Fig. 2a, b), between in 9 (Fig. 1e, f), and below in 6 of the cases (Fig. 2a, b). The loop shape was seen in 18 of the 66 cases (Fig. 2e, f, g, h). In 8 of the 33 cases where the AICA was observed above the nerve complex, the posterior surface of the petrous part of the temporal bone was convex (Fig. 2i, j). A labyrinthine artery was also discovered in 10 of the 43 cases where AICA was not connected with the nerve complex.

In 22 (20%) of the 109 cases, the labyrinthine artery was visible (Fig. 2). The facial nerve was found cranially in eleven of these cases, caudally in five, and centrally in six (Fig. 2r, f).PICA was found in 10 (10.9%) of the 109 patients (Fig. 3a, b, c, d). In one of the ten cases, flocculus was prominent.In five cases, AICA and PICA were found together. The AICA was found above the nerve complex in four of these cases, and it was in the form of a loop in one of them.

In 2 (2%) of the 109 cases, the vertebral artery was found inside the middle complex (Fig. 2c, d). It was raised up to the vestibulocochlear nerve in one of these cases. Only one case had the vertebral artery, PICA, and lower cranial nerves all visible at the same time.There was only one example where the superior cerebellar artery, vertebral artery, AICA, and PICA were all seen collectively.Furthermore, choroid plexus was identified in 5 (5%) of 109 cases in the location where middle complex structures were revealed (Fig. 2i, j).

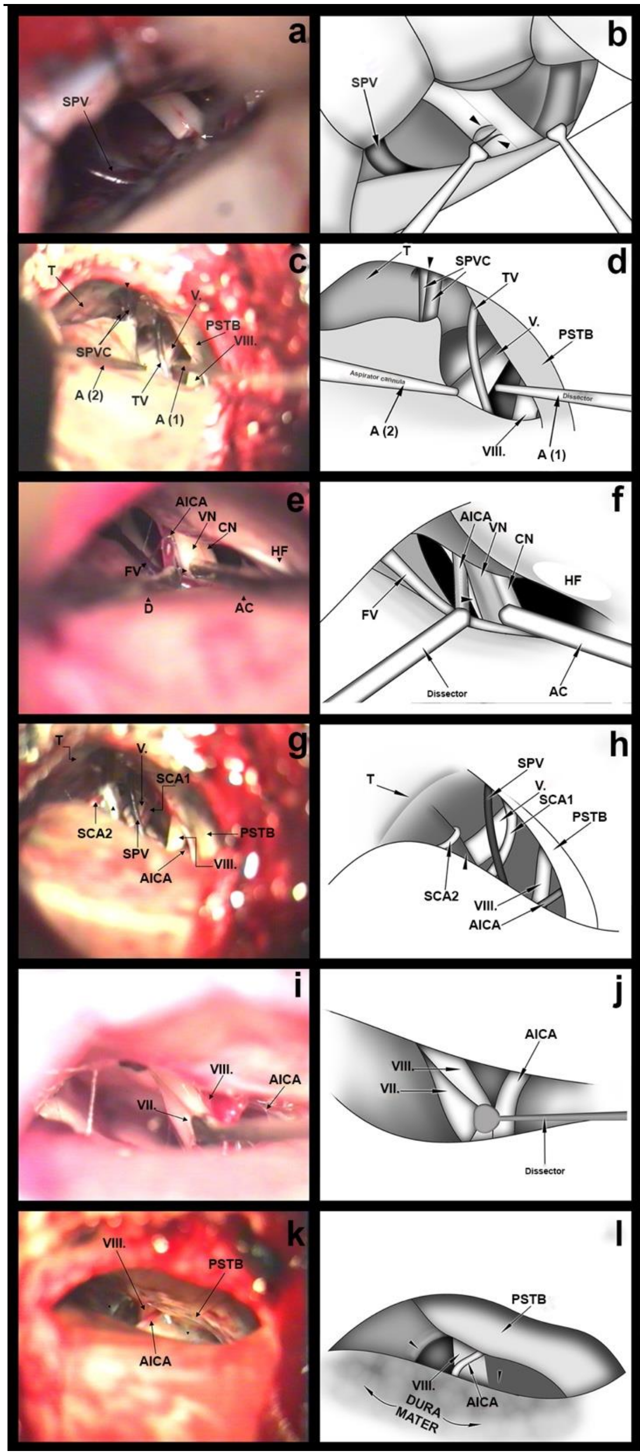

Fig. 1. a,b; Picture showing the course and neighborhoods of the superior petrosal vein at the right cerebellopontine angle (CPA). SPV: Superior petrosal vein, White and black arrow heads: Dissected vestibular nerve. **c,d;** In the right CPA (cerebellopontine angle) case, superior petrosal venous complex structure and double superior petrosal vein variation is observed. The entrance of the superior sinus is shown with the black arrowhead. V.: Trigeminal nerve, PSTB: Posterior surface of petrous part of temporal bone, VIII.: Vestibulocochlear nerve, A (1): Dissector, TV: Trigeminal nerve, A (2): Aspirator cannula, SPVC: Superior petrosal venous Vestibulocochlear nerve complex, Tentorium. e**,f;** Fissural vein (cerebellopontine fissure) is observed in the right CPA. AICA: Anterior inferior cerebellar artery, VN: Vestibular nerve, CN: Cochlear nerve, HF: Herb's Fold, AC: Aspirator cannula, D: Dissector, FV: Fissural vein, Black arrow head: Facial nerve in cranial position. Herb's fold refers caudal position. **g,h;** Relations of vascular structures and trigeminal nerve is seen in right CPA. V.: Trigeminal nerve, SCA1: Lateral branch of superior cerebellar artery, SCA2: Medial branch of superior cerebellar artery, PSTB: Posterior surface of petrous part of temporal bone, VIII.: Vestibulocochlear nerve, AICA: Anterior inferior cerebellar artery, SPV: Superior petrosal vein, T: Tentorium. **i,j;** In the right CPA, facial nerve is observed in cranial position and AICA is on top. VIII.: Vestibulocochlear nerve, VII.: Facial nerve, AICA: Anterior inferior cerebellar artery. **k,l;** In the right CPA, the PSTB is observed as straight and above the AICA nerve complex. VIII.: Vestibulocochlear nerve, PSTB: Posterior surface of petrous part of temporal bone, AICA: Anterior inferior cerebellar artery. The formations indicated by two black arrowheads are the remaining arachnoidea mater parts after opening of the pontocerebellar cistern. The right side of the picture is the caudal.

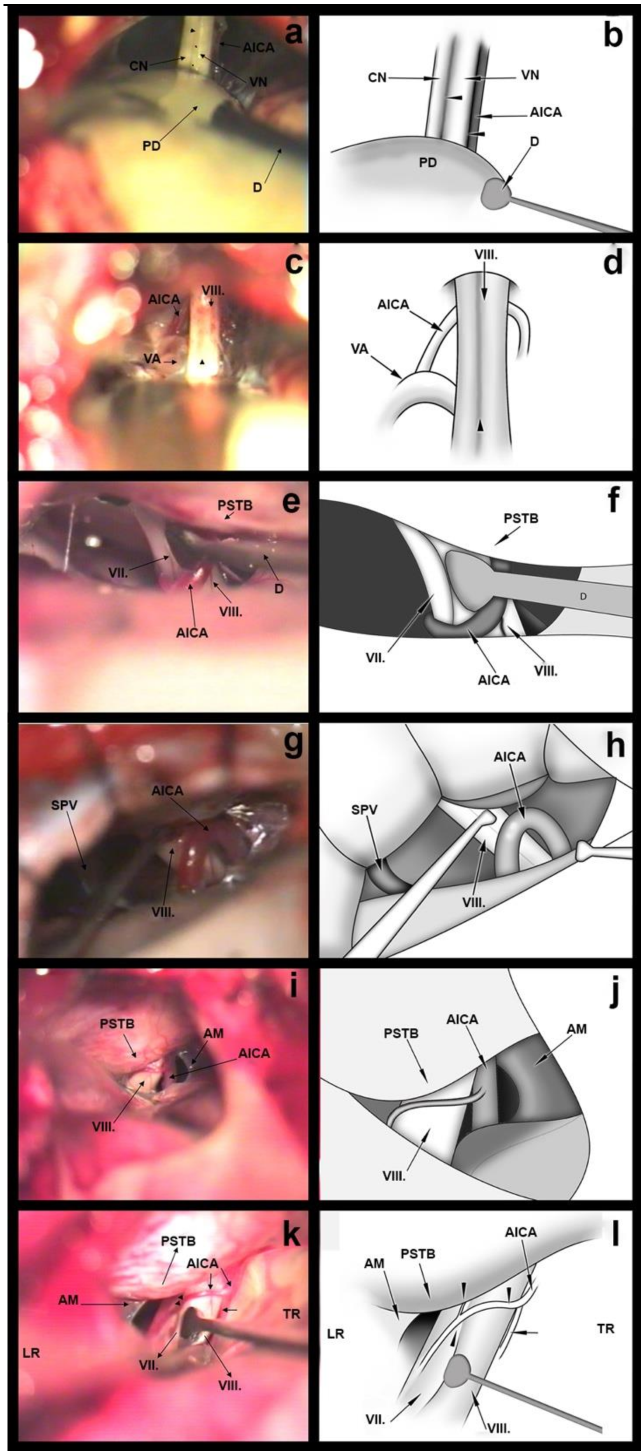

Fig. 2. a,b: Cochleovestibular cleavage is shown in the left CPA. AICA: Anterior inferior cerebellar artery, VN: Vestibular nerve, D: Dissector, PD: Penrose drain, CN: Cochlear nerve. The arrowhead shows the sulcus (groove), or cleavage, between the vestibular nerve and the cochlear nerve, which is the most commonly used indicator to distinguish two nerves from each other. **c,d;** In left CPA, the vertebral artery is seen elevated up to the vestibulocochlear nerve. VIII.: Vestibulocochlear nerve, VA: Vertebral artery, AICA: Anterior inferior cerebellar artery. The black arrowhead indicates the groove-shaped vestibulocochlear cleavage. **e,f;** In the right CPA, the facial nerve is seen in the center and AICA above it. PSTB: Posterior surface of petrous part of temporal bone, D: Dissector, VIII.: Vestibulocochlear nerve, AICA: Anterior inferior cerebellar artery, VII.: Facial nerve. **g,h;** In the right CPA, the anterior inferior cerebellar artery is observed as loop on top. AICA: Anterior inferior cerebellar artery, SPV: Superior petrosal vein, VIII.: Vestibulocochlear nerve. **i,j;** In the left CPA, PSTB is seen clearly and AICA is seen above the nerve. PSTB: Posterior surface of petrous part of temporal bone, AM: Arachnoid mater, AICA: Anterior inferior cerebellar artery, VIII.: Vestibulocochlear nerve. **k,l;** In the left CPA, the labyrinthine artery and facial nerve are seen caudally and also above the AICA nerve complex. PSTB: Posterior surface of petrous part of temporal bone, AICA: Anterior inferior cerebellar artery, TR: Trigeminal region (upper region), VIII.: Vestibulocochlear nerve, VII.: Facial nerve, LR: Lower region, AM: Arachnoid mater.

Neural structures

The cleavage of the vestibulocochlear nerve, which acts as a landmark between the vestibular and cochlear portions, was noticeable in 61 (56%) of the 109 cases (Fig. 3g, h), whereas it was faint in the remaining 48 (Fig. 3e, f). In 14 of the 48 cases with slight cleavage (Fig. 2g, h), AICA was found in the upper position (Fig. 1k, l), in the intermediate position in 3, in the lower position in 2, and loop shaped in 10 of the 48 cases.,Furthermore, the facial nerve was found to be cranial in 15 (Fig. 1i, j), caudal in 16 (Fig. 3a, b, and Fig. 3i, j), and central in 16 (Fig. 2e, f) of the 48 cases with slight cleavage, while the facial nerve was found cranially in 30 (Figure 2k, l, Fig. 3i, j), and centrally in 14 of the 61 cases with prominent cleavage (Fig. 2e, f).

A classification was made based on the relation between the facial nerve and AICA, and 45 (41.6 percent) of the 108 cases (one case was excluded due to poor visibility) had the facial nerve in the cranial position; in 22 of these cases, no artery was visible, 9 had it above, 4 had it intermediate, 1 had it below, and 9 had it in a loop shape. Meanwhile, the facial nerve was in the caudal position in 33 cases (30.5 %). In 8 of these cases, the artery was not visible, in 13 cases, it was above, 4 were intermediate, 2 were below, and 6 were in a loop shape. Finally, a centrally placed facial nerve was detected in 30 (27.7%) cases, whereas no artery was observed in 12 cases, 11 had an above, 3 had an intermediate, 1 had a below, and 3 had a loop shape.

The intermediate nerve was revealed in 8 (7%) of the 109 cases. In 4 of these cases, the facial nerve was positioned cranially, in 2 cases, it was situated centrally, and in 2 cases, it was located caudally. Abducent nerve was found only in 14 of the 109 cases (13 %).

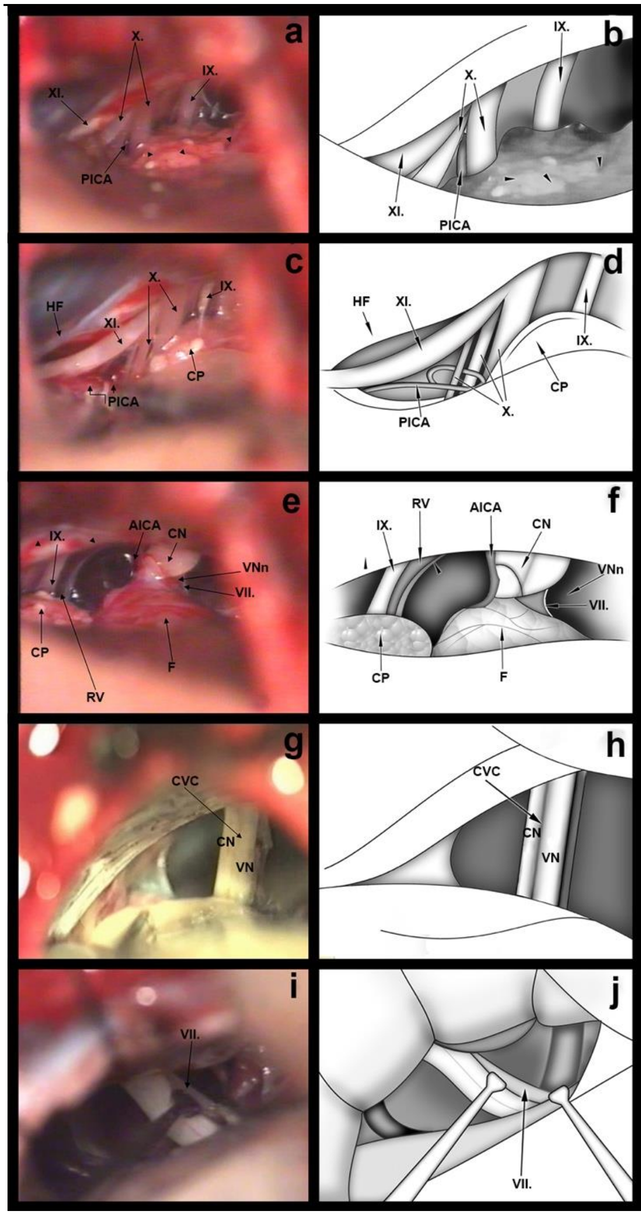

Fig. 3. a,b; Lower neurovascular complex and choroid plexus are seen in the left CPA. IX.: Glossopharyngeal nerve, Black arrows: Choroid plexus, PICA: Posterior inferior cerebellar artery, XI.: Accessory nerve, X.: Vagus nerve. **c,d;** Lower neurovascular complex elements are observed in the left CPA. X.: Vagus nerve, CP: Choroid plexus, PICA: Posterior inferior cerebellar artery, HF: Herb's Fold, IX.: Glossopharyngeal nerve, XI.: Accessory nerve. **e,f;** In the left CPA, flocculus prominent, cleavage indistinct, AICA is seen above. AICA: Anterior inferior cerebellar artery, CN: Cochlear nerve, VNn: Vestibular nerve neurectomy, VII. Facial nerve, F: Flocculus, RV: Root vein, CP: Choroid plexus, IX.: Glossopharyngeal nerve, Arrow head: Herb's Fold. **g,h;** Cleavage is clearly observed in the left CPA. CVC: Cochleovestibular clevage line, CN: Cochlear nerve, VN: Vestibular nerve. **i,j;** The facial nerve is seen in caudal position in the right CPA. VII.: Vestibulocochlear nerve.

DISCUSSION

The anatomical neighborhoods between the blood vessels and the nervous system are crucial in the human body (16). As a result, various studies on the subject have been conducted, indicating both normal and variational anatomical features (16). According to Dandy trigeminal neuralgia is caused by vascular compression of the trigeminal nerve around the pontocerebellar triangle (cerebellopontine angle) in combination with spastic hyperfunction (16).

Understanding of the complexities of the anatomy of the skull base has reached a peak with the advancement of surgical techniques and interventions. These operations demand a thorough knowledge of anatomy (26). One of the goals of surgical operations in this area is to preserve the patient's ability to hear (27). The neurovascular architecture of the cerebellopontine angle area is extremely variable (21). Due to the central segment of the vestibulocochlear nerve being the largest of the cranial nerves, pressure syndromes (tinnitus, paroxysmal vertigo, hemifacial spasm) are more likely to occur (16). As a result of these circumstances, an understanding of the nerve-artery interactions is required.

Endoscopic or retrosigmoid interventions for the posterior cerebral fossa are utilized to treat conditions such as vertigo and auditory neurinoma (2–6, 8, 9).

The retrosigmoid surgical approach has reduced surgical morbidity in vestibular schwannomas by entirely removing the tumor while preserving the neurological functioning of the hearing and mimic muscles (28). As a result, surgical approaches to this area are crucial for a wide range of disorders (29).

Göksu et al. reported in 2005 that severing the vestibular nerve using the retrosigmoid retrolabyrinth approach had low complications, effective vertigo control, and hearing protection (3). Examining the anatomy of this area in terms of normal and unique features that may be discovered based on the surgical method chosen is critical for the surgical technique to perform properly and avoid complications.

Prior research has been conducted on cadavers or individuals with a specific diagnosis in order to define the area (tumor, etc) (9, 20, 21, 26, 28). The purpose of this study was to collect quantitative data on the anatomy of the pontocerebellar triangle in vivo during surgery while preserving its normal anatomic structure.

Masuoka et al. emphasized the crucial function of preserving cerebral deep venous flow, noting that cutting the superior petrosal vein can also have substantial life-threatening complications, including cerebellar edema (30). Ebner et al. studied the superior petrosal vein and its branches in eight cadavers. In all cases, they observed the superior petrosal vein and reported that it empties into the superior petrosal sinus as a single channel lateral to the trigeminal nerve (31). A superior petrosal vein was detected in 36% of the 109 cases examined in our study.

Hiwatashi et al. used MRI to examine arteriovenous structures bilaterally in 47 cases (32). The transverse pontine vein was revealed in 40% of cases, the pontotrigeminal vein in 34%, and the vein of the cerebellopontine fissure in 96% of cases (32). In our study, 4 of 109 cases had a fissural vein located in the cerebellopontin fissure, while 3 had a fissural vein located in the cerebellomedullar fissure. There were 2 cases in which both fissural veins were observed concurrently.

Tanriöver et al. investigated the relationship between the trigeminal cave and the internal acoustic meatus along the petrous edge in order to determine the location of the superior petrosal venous complex's discharge into the superior petrosal sinus (33). They classified the shedding of the superior petrosal venous complex into three groups, which aided in surgical planning and prevented venous complications (33).

- Type I; The venous complex drains into the superior petrosal sinus, remaining lateral and above the internal acoustic meatus.
- Type II; The most common type. The venous complex drains into the superior petrosal sinus between the lateral edge of the trigeminal nerve and the medial edge of the facial nerve in the trigeminal cave within an area of approx. 13 mm.
- Type III; The venous complex drains on or medial to the trigeminal cave.

A case with a double superior petrosal vein was classified as type II in our study. According to Habibi et al., in 24 of 31 cadavers, the AICA originates from the lower half of the basilar artery, crosses the acoustic facial complex, and passes between nerve fibers (34). In 5 cases, the AICA enters or reaches the internal auditory meatus, and in 9 cases, it runs medial to the internal acoustic aperture (34). Besides Brunsteins and Ferrieri studied 26 right and left cerebellopontine angles on 15 cadavers and observed the AICA in 24 cases, the PICA attached to the meatal loop in one case, and both arteries in one case (35). Bird et al. examined the cerebellopontine angle in 103 patients using a cisternogram with gas tomography and identified facial and vestibulocochlear nerves in 99 of these cases (36). The facial and vestibulocochlear nerves were found separately in 55 of the 99 cases, and as a single bundle in 44 of the 99 cases. They identified 34 cases of the atypical AICA loop shape. They discovered an intracanalicular loop in 7 of the 34 cases (36). Mitsuoka et al. used magnetic resonance imaging to evaluate the cerebellopontine angle in 95 cases (37).

Cerebellar arteries remained medial to the internal acoustic aperture in 41 cases, forming loops in the cerebellopontine angle. An acoustic neuroma was observed in 44 of 95 patients with normal anatomical morphology (37). Such cases were eliminated from our study due to the possibility of distorting anatomy. In 2004, Yurtseven et al. assessed the cerebellopontine angles of 40 unfixed cadavers using microsurgery and MRI (38). According to the position of the eighth nerve complex, the anterior inferior cerebellar artery was detected ventral in 32.5% and dorsal in 35% of the cases. In 12.5% of cases, the AICA was discovered looping ventral or dorsal to the nerves, and in 32.5% of cases, it was seen between nerve fibers (38). Likewise Sirikci et al. also used MRI to examine the relation between the AICA and the vestibulocochlear nerve in 280 cerebellopontine angles of 140 cases (39). They defined four different types of relation on the basis of the compression of AICA to the vestibulocochlear nerve (39). The researchers detected an anatomical relationship between the vestibulocochlear nerve and the AICA in 19 of the patients. The vertebral artery was also discovered in 2 of the patients (39). In 2003, Oizumi et al. compared surgical results and angiographic data in 70 patients with hemifacial spasm (40). The AICA was found to be dominant in 37% of cases, meanwhile the PICA was found to be dominant in 29% of cases. In 13% of the cases studied, the vertebral artery at the cerebellopontine angle was determined to be the source of compression (40). Grunwald et al. (2006) studied the anatomy of the cerebellopontine angle and discovered that the AICA was either above or below the vestibulocochlear nerve complex, or it was somewhere between these (41). According to the findings of our study, the AICA was found to be associated with the vestibulocochlear-facial nerve complex in 66 of the 109 cases (61%), and it was found to be unrelated to the nerve in 43 of the 109 cases (39 %) according to the findings. In 18 of the related cases, a loop shape was seen in 30% of the cases. The number of cases in which the vein was positioned between the vestibulocochlear and facial nerves was 9 (14%); the number of cases in which the vein was located at the bottom was 6 (10%); and the number of cases in which the vein was located at the top was 33 (50%). The rates found in our study were consistent with those found in earlier studies.

Kim et al. discovered that the labyrinthine artery was a branch of the AICA in 98% of cases and that it originated from the premeatal segment in 19.6% of cases (42). According to Brunstein and Ferrieri, the labyrinthine artery was single (monoarterial system) in 38.5 % and double (biarterial system) in 61.5 % of cases (35). In our study, the labyrinthine artery was found in 22 patients out of a total of 109 and located premeatal. From a total of 22 cases, the facial nerve was identified to be cranial in 11, caudal in 5, and central in 6. The AICA was not observed in 10 of the 22 cases.

Lister et al. studied the PICA and its variations in 50 hemispheres from 25 cadavers. In eight cases, the artery was not identified (43). According to Saylam et al., nearly 20% of the cases, the lateral medullary segment of the PICA pushes against the anterior or inferior surfaces of the facial and vestibulocochlear nerves at the cerebellopontine angle, resulting in the formation of an apical fold (lateral fold) (44). Using the retrosigmoid technique, Lang observed 40% of the AICA and 13% of the PICA at the cerebellopontine angle in cadaver studies(17). Rhoton investigated 50 cerebellopontine angles and detected a contact between both the PICA and the vestibulocochlear nerve in 2% of the cadavers (20). Girard et al. (1997) used three-dimensional MRI to study 100 patients with hemifacial spasms. They discovered vascular contact in the location where the facial nerve root originated as well as inside the internal auditory meatus in 96 of the 100 cases studied. The vertebral artery was observed in 18, the PICA in 23, and the AICA in 22 cases (45). PICA was discovered in 10 of the 109 patients in our research. The number of cases in which four arteries are seen together as superior cerebellar artery, vertebral artery, inferior anterior cerebellar artery and inferior posterior cerebellar artery in the cerebellopontine angle is only one. The inferior posterior cerebellar artery was found below the lower cranial nerves in our cases, which is consistent with earlier studies. Because these two arteries have a dominance relationship, it's critical that they're observed together during middle complex surgery. The dominant artery is also known to have a larger diameter.

Rhoton and Funaki et al. discovered that the choroid plexus is a crucial marker for the location where the nerve attaches to the brainstem throughout microvascular decompression surgery of the facial nerve (20, 46). We discovered the choroid plexus in only 5 of 109 patients.

Ozer et al. studied the abducent nerve microanatomy in 40 specimens collected from 20 cadaver skull bases. They reported a high branching rate of 55% during its course, and 10% of this branching was found in the petroclival region (26). In a study conducted with MRI, Ono et al. investigated the anatomy of 47 abducent nerves in healthy individuals. According to the researchers, the length of the cisternal segment was reported to be 6.7–19.6 mm (mean 13.1) in length. They used clivus to quantify an angle ranging from 5 to 90 degrees (mean: 24.5)(47). In our study, the abducent nerve was observed in 14 of the 109 cases.

Alfieri et al. (2012) examined the trajectory of the intermediate nerve and its anatomical surroundings using 43 cadavers (48). They discovered that the nerve had 2 to 5 roots in 76% of the cases, and that the nerve roots originated from the brain stem without making contact with another nerve in 12% of the cases (48). They also stated that, despite the lack of research on the subject, it should be investigated in cases of iatrogenic trauma because the nerve can be readily destroyed (48). An intermediate nerve was detected in 8 of the 109 cases in our study.

Silverstein and Norrell discovered a significant cochleo-vestibular cleavage plane in 70% of the patients they studied (49). The cleavage plane of the vestibulocochlear nerve was apparent in 61 of the 109 cases of our study, and it was faint in the remaining 48 cases.

The anatomy of the posterior cranial fossa is complex, and its variations occur frequently, necessitating a thorough examination of the region. As a result, we investigated at the neighborhood and connections of arteries, veins, and nerves in the region in our study.

Cutting the vena petrosa superior is known to cause life-threatening complications such cerebral edema. As a result, retrosigmoid operations should account for the presence of this unusual structure. Although fissure veins are uncommon, their existence during surgical intervention should not be ignored. It's important to remember that the vertebral artery can be seen in this area and special attention during surgical procedures should be given.

In our study, it was observed that AICA is associated with the vestibulocochlear-facial nerve complex in 61% of the cases. This relationship is very remarkable as it causes increased risks, such as bleeding during surgery.

AICA was found in 10% of the middle complex, despite the fact that it should normally be observed in the lower cranial nerve complex. During retrosigmoid interventions for the middle complex, it's important to keep this in mind.

It is important that the cleavage line of the vestibulocochlear nerve may be faint, as it will make it difficult to distinguish the nerves during surgical interventions. The cleavage line was observed as faint in 44% of our cases.

CONCLUSION

Various arterial, venous, and nervous neighborhoods encountered during vestibular neurosurgery are crucial. Anatomical structures within the middle complex show complicated and variable neighborhoods with each other. Even if some structures are observed at a very low rate, if they are not considered beforehand in the cases in which they are present, they may cause vital complications. Therefore, it is necessary to know and pay attention to the variations determined in our study in surgical interventions. In this study, observations were made during the surgical procedures and the presence and location of anatomical structures were noted. Future studies should be supported by MRI findings as well. In addition, our study contained no information on gender, age, or racial change

Conflict of interest
No conflict of interest was declared by the authors.

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