A Cadaveric Cerebellar Tonsillar Decent with its Rare Variation in Blood Supply

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ABSTRACT

The cerebellar tonsils are encountered in many surgical corridors including approaches to the fourth ventricle, supra and subtonsillar, the median suboccipital and different surgical procedures for CMI. Hence, the knowledge of possible variations in the position of cerebellar tonsils is a basic prerequisite for a surgeon operating in this area and relevant vascular anatomy also assumes importance to avoid inadvertent injury to the anterior and posterior, inferior cerebellar arteries.

Key Words: *Anterior portal vein; Structures within the hepatoduodenal ligament; Replaced common hepatic artery*

INTRODUCTION

The Arnold chiari malformation Type 1(ACM I) is a congenital malformation, generally asymptomatic during infancy, often manifests with headaches and other cerebellar symptoms [1]. CMI is frequently seen on imaging and is diagnosed on the basis of level of cerebellar tonsil for at least 5mm below the foramen magnum [2-3]. A blockage in the CSF flow due to the tonsillar displacement may form syrinx, eventually leading to Syringomyelia [4]. The position of the cerebellar tonsils can also be affected in many other congenital disorders, including raised intracranial pressure, myelomeningocele, posterior fossa hypoplasia and idiopathic scoliosis. The tonsils are supplied by the posterior inferior cerebellar arteries (PICA), or they may arise from anterior inferior cerebellar arteries (AICA) [5].

The cerebellar tonsils are encountered in many surgical corridors including approaches to the fourth ventricle, supra and subtonsillar, the median suboccipital and different surgical procedures for CMI. Hence, the knowledge of possible variations in the position of cerebellar tonsils is a basic prerequisite for a surgeon operating in this area and relevant vascular anatomy also assumes importance to avoid inadvertent injury to the anterior and posterior, inferior cerebellar arteries [6].

To the best of our knowledge, there is no cadaveric study which gives the detailed anatomy of cerebellar tonsils in Chiari malformation patients, especially with regards to its blood supply. Here, we present a cadaveric case report on surgical anatomy of the tonsils, including the morphology, location and vascular supply for safer surgical interventions.

CASE REPORT

A body of 80 year old man from Ambala (Haryana) was brought to the department of anatomy, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh on 16.06.2014 under the body donation program. According to his death certificate he died a natural death due to old age. According to his medical history, he was suffering from pain in the posterior aspect of the neck and head for the last eight years; he was hypertensive for the last 15 years and was operated twice for cataract.

Dissection Findings

To expose the cerebellum, the skin, fascia and the musculature of the posterior aspect of the neck was divided. Occipital squama was cleared and craniotomy was done with the help of a bur. The Dura mater was exposed, which was found to be thickened. The thickness at craniovertebral junction (CVJ), above the CVJ and below the CVJ was found to be 1.7 mm, 0.6 mm and 0.6 mm respectively. The measurements were taken with the help of digital vernier caliper (accuracy of 0.02 mm).

The inferior poles of both the cerebellar tonsils were present below the foramen magnum. The minimum distance of the inferior poles from the inferior margin of the foramen magnum were 6.8 mm on the right side and 9.5 mm on the left side. The minimum depth from the dura mater to the tonsillar surface was 5.8 mm on the right side and 6.2 mm on the left side. The minimum distance between the inferior pole of the tonsils and the posterior arch of the atlas was 1.7 mm and 0.6 mm on the right and left sides respectively.

On examining the cerebellum in situ, the loop of the left posterior inferior cerebellar artery (PICA) was found to be absent, while the right PICA loop was present.

The cerebellum was detached from the posterior cranial fossa (PCF) along with the intra Dural part of the vertebral arteries (VA). Both VAs were injected with a colored latex solution. The external diameter (at the beginning of intramural part of VA) was 1.5 mm on the right side and 4.5 mm on the left side, there was remarkable difference of 2.5 mm in diameter of two vertebral arteries, The length of intramural VA was 18.3 mm and 38.6mm on the right and left sides respectively. The left tonsil was supplied by the AICA, a branch of basilar artery.

Blood Supply Of The Right Tonsil

The medial ¾ of the tonsil was supplied by the right PICA which was a branch of the right vertebral artery and lateral ¼ by the AICA (a branch of basilar artery).

Posterior inferior cerebellar artery (PICA): The right PICA arose from the ventral aspect of the VA., 7.4 mm below the formation of the basilar artery. The anterior medullary segment of PICA (first segment), crossed anterior to the medulla, where its diameter was 0.78 mm and it's length, up to the rootlets of the spinal assessory nerve, was 13.38 mm. The anterior medullary segment continued as lateral medullary segment, passed through the rootlets of the spinal accessory nerve and made a U loop below the inferior pole of the right tonsil. The diameter at its continuation was 0.9 mm. It was observed that right PICA loop was present 3.7 mm below the inferior pole of the right cerebellar tonsil, 1.24 mm below the arch of the first cervical vertebra and 10.5 mm below the outer margin of the foramen magnum. The area of the right tonsil supplied by the PICA was inferior pole, medial surface, anterior surface, and posterior surface (Figure 1).

Anterior inferior cerebellar artery (AICA): The lateral aspect (¼) and superior pole of right tonsil was supplied by the AICA after taking origin from the basilar artery. Usually the AICA has two loops, the rostral and the caudal. In this case the rostral loop was absent and caudal loop was present over the rootlets of the spinal accessory nerve. After origin, the AICA extended on the superior pole of the right cerebellar tonsil, entered in to

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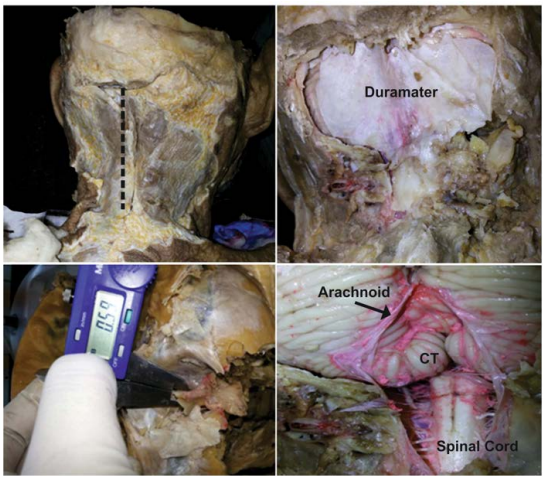

Figure 1) **(A)** *Figure showing the cadaver in prone position, A vertical incision was made in prone position from external occipital protuberance to C7 vertebral level and craniotomy was done* **(B)** *Occipital squama removed and dura was exposed* **(C)** *Thickness of dura was measured at 3 levels* **(D)** *Arachnoid mater was removed and cerebellar tonsil was seen.*

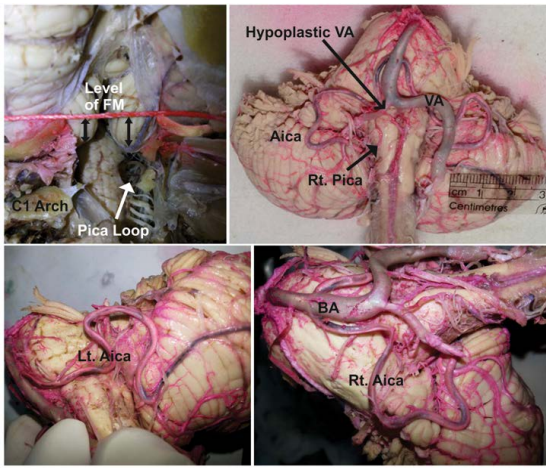

Figure 2) **(A)** *cerebellar tonsils were peg shaped and inferior pole of the both tonsils were placed below the FM* **(B)** *Significant difference was found in between diameter of two VAs, right VA was hypoplastic, Left PICA was absent* **(C)** *left lateral view showing left AICA was supplied the left tonsil* **(D)** *Right lateral view showing right AICA supplies only superolateral aspect of right cerebellar tonsil.*

the tonsillo biventral cleft and terminated by giving the medial, middle and lateral branches. First two supplied the aspect of the right tonsil and lateral supplied the cerebellum (Figure 2).

Blood Supply of the Left Tonsil

Posterior inferior cerebellar artery (PICA): was absent on the left side.

Anterior inferior cerebellar artery (AICA): originated from the basilar artery, 10.1 mm from its formation. The diameter of AICA was found to be 1.9 mm at the origin. After arising from the BA, it passed infero-laterally and formed the rostral loop over the upper pole of the olive and pyramid then crossed the cerebello-pontine angle. It extended over the superior pole of the cerebellar tonsil and terminated by giving three branches, the lateral branch turned backwards and upwards and passed deep to the main trunk and entered into the tonsillo-biventral cleft to supply the cerebellum and the medial & middle trunks supplied the superior and medial surfaces of the left tonsil .

DISCUSSION

Chiari malformation I cases are operated fairly often. In most of the hospitals angiography is not routinely done as a part of pre operative work up of the CM I patient. Hence it is important that vascular variations which might accompany CM I, should be known, so that vascular injury and possible catastrophic outcome can be avoided. Moreover accompanying vascular variation might influence the presenting symptoms of the patient. Vertebral Hypoplasia found in the present case, has been found to be associated with Migraine and vestibular neuritis [7].

Classified cerebellar tonsillar descent (CTD) as grade I (the tonsil descended more than 5 mm below the foramen magnum but did not reach the C1 arch), grade II (the tonsil reached the C1 arch), and grade III (the tonsil descended over the C1 arch). They reported that there were no statistically significant difference between preoperative and postoperative size of the syringomyelia cavity or the rate of clinical improvement of duraplasty and non duraplasty groups in cerebellar tonsillar descent grade I and II, but in CTD grade III, a decrease in the syrinx cavity and clinical improvement were statistically better in the duraplasty group. In the present case, the cerebellar tonsillar descent on right side was 6.7 mm and 9.7mm on the left side, below the FM and reached up to the C1 arch. Hence this case belongs to the grade II [8].

Vertebral artery dominance is a common congenital variation of vertebral artery (VA), which is generally defined as the presence of significant difference in the diameters of both vertebral arteries. Some scholars also call it the vertebral artery hypoplasia (VAH) (Jeng JS 2004). They labeled it as vertebral artery dominance when diameters of both sides of vertebral arteries differed by 0.3 mm. Another study defined the vertebral artery dominance as: the diameter of one side of the vertebral artery is greater than the other side by at least 30%. In the present case study, we found that vertebral artery diameter was significantly larger on the left side (4.08 mm) than on the right side (1.44 mm). The difference in diameter of two vertebral arteries was 3.64 mm. The asymmetry ratio was 1: 2.8. Hence in the present case there was left side vertebral artery dominance and right vertebral hypoplasia. The vertebral artery is a branch of the subclavian artery. On the left side the subclavian artery directly arises from the aortic arch which might cause higher shear stress during development, potentially leading to left sided vertebral dominance. Peculiarly in the present case the PICA was absent on the side of vertebral dominance.

Conventionally, most clinicians have observed an asymmetric VA as a congenital variation which give less importance, unless vertebro basilar insufficiency occurs. However, recent studies had regarded vertebral artery dominance as a risk factor for posterior circulation infarctions and the hypoplastic side has shown increased association with a stroke. The Vertebral artery hypoplasia leads to decreased flow in the posterior circulation which might result in infarction. States that dominance of the vertebral artery can cause the infarctions in the territory of basilar and PICA arteries [9]. The present case might represent an extreme but compensated form of this phenomenon; with complete absence of the right PICA but the right tonsil and associated area was being supplied by AICA [10].

CONCLUSION

Many persons may develop cerebellar tonsillar herniation without any symptoms, patients history verified with family. During dissection cerebeller tonsils were found below the level of foramen maganum. The cerebellum dura mater was thickened at the level of craniovertebral junction(CVJ). Inferior pole of Tonsil of left side was situated 9.49mm below while the right tonsil is 8.4mm below to the foramen magnum. Additionally in this we also found a vascular abnormality The segment 2 (lateral medullary or PICA loop) part of Posterior Inferior Cerebellar artery (PICA) on the left side was absent while on right side it was situated 3.70 mm below the inferior pole of right tonsil and 1.24mm below the arch of first cervical vertebrae.

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