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Anatomy

CADAVERIC STUDY OF POSTERIOR CEREBELLAR ARTERY AND ITS VARIATION

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ABSTRACT **Background:** The brain receives blood from two sources,internal carotid arteries, which arise in the neck where the common carotid arteries bifurcate, and the vertebral arteries.the right and left vertebral arteries, branches of first part of subclavian artery.

Material And Methods: The posterior cerebral artery is the terminal branch of basilar artery. Posterior cerebral artery observed for variation and branching pattern in the PCA of the 10 brains obtained from department of Anatomy NMCH Patna, cadavers used in routine educational dissection for first year mbbs students.

Conclusion: The present study was done in 20 posterior cerebral arteries in the department of anatomy all the 10 brains the posterior cerebral artery (PCA) was present on either side.

KEYWORDS : posterior cerebral artery, internal carotid artery

INTRODUCTION

The brain is an organ that serves as the centre of nervous system. It is the master regulator of the whole body function containing about 15-33 billion neurons. This regulating function of the brain on the rest of the body allows rapid and coordinated responses to changes in the environment. The anatomy and physiology of the brain are complex and essential to sustain life.

Many complex functions are directly or indirectly controlled by the brain like planning and initiation of voluntary movements, behavior, memory, sensory and motor functions, hearing, vision and regulation of all visceral functions. Despite all the exhaustive studies in brain till date, there is still much more room to explore.

The brain receives blood from two sources: **internal carotid arteries**, which arise in the neck where the common carotid arteries bifurcate, and the **vertebral arteries**.

The internal carotid artery begins in the neck as one of the terminal branch of common carotid artery at the level of upper border of thyroid cartilage. It courses through the neck within the carotid sheath, and then enters the skull in petrous part of the temporal bone through carotid canal. It then runs forward through the cavernous sinus, lying in the carotid groove on the side of the body of the sphenoid bone. The internal carotid arteries finally end below the anterior perforated substance by dividing into two major cerebral arteries, **the anterior and the middle cerebral arteries.**

The right and the left vertebral arteries, branches of first part of subclavian artery, come together at the level of pons on the ventral surface of the brain stem to form the midline basilar artery. The basilar artery joins the internal carotids in an arterial ring at the base of the brain (in the vicinity of the hypothalamus and cerebral peduncles) called the circle of Willis. **The posterior cerebral artery arises** as the terminal branch of basilar artery. The two small bridging arteries, the **anterior and the posterior communicating arteries** join the two major sources of cerebral vascular supply. They presumably improves the chances of any region of the brain continuing to receive blood even if one of the major arteries becomes occluded as seen in the case thrombosis of one anterior cerebral artery which remains asymptomatic due to the flow from contralateral anterior cerebral artery through anterior communicating artery.(Standring S,2001)

POSTERIOR CEREBRAL ARTERY

The posterior cerebral artery is the terminal branch of basilar artery. It curves laterally over the crus cerebri of midbrain, parallel to superior cerebellar artery but separated from it by third and fourth cranial nerves. After being joined by the posterior communicating artery, it passes to the tentorial part of the inferior surface of the cerebrum. Posterior cerebral artery supplies the occipital lobes and the posteromedial temporal lobes.

METHOD:

The posterior cerebral artery was observed for variation in its course and branching pattern in the 20 posterior cerebral artery of the 10 brains (20 cerebral hemisphere) obtained from cadavers used in routine educational dissection for undergraduate students in department of Anatomy nalanda medical college and hospital patna bihar. The dissection was done carefully to clean the artery and then digital photography was taken.Head was supported on a block and a saggital cut was given through the epicranial aponeurosis from the root of the nose to the external occipital protuberance. Skin, superficial fascia and epicranial aponeurosis was pulled laterally and detached from the temporal lines. Periosteum was stripped from the external surface of the vault of the skull upto the level below the attachment of the temporalis muscles. Now to remove the skull cap or calveria, a pencil mark was made on the skull by encircling it with a string passing no more than 1 cm above the orbital margins and the external occipital protuberance and drawing around it.

A saw cut was made along its line carefully to avoid cutting deeper than marrow cavity. A blunt chisel was introduced into the saw cut and inner table was divided.Endocranium which is fused with dura was separated from it. Falx cerebri was detached from crista galli, cranial nerves and important blood vessels present at the base of the brain was cut to preserve it with brain.Tentorial attachment to petrous temporal bone was divided. Spinal medulla and vertebral artery was cut and the brain was carefully removed from the cavity. Dura along with its fold and adherent arachnoid was removed. Blood vessels on superolateral surface and base of brain were cleaned from piamater on the external surface on which it lies.

AIMS AND OBJECTIVES

Present study is focused on analysis of origin, course, relation and branching pattern of posterior cerebral artery.

The study was conducted with the following aims and objectives:

As the artery supplies very important areas of the central nervous

system, it becomes important to know the variations in the artery.

To facilitate better understanding of pathogenesis of various diseases involving posterior cerebral artery perfused regions of brain.
To facilitate better understating of angiographic imaging and interventional techniques.

REVIEW OF LITERATURE

Human arterial system is one of the systems that show a large number of variations. Appropriate knowledge of the normal and cerebral vasculature is essential not only for the anatomist but also for the clinicians and neurosurgeons. Many studies have been performed in past and many variations have been reported.

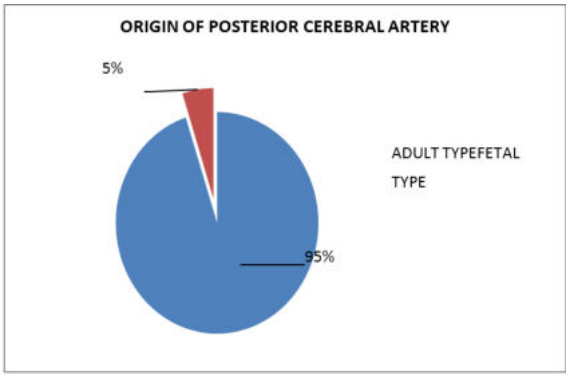
Circulus arteriosus (Cerebral arterial circle) was first described by Thomas Willis in 1662 which connects the internal carotid system with vertebrobasilar system. The left and right internal carotid arteries arise from the left and right common carotid arteries respectively. The posterior communicating artery is given off as a branch of the internal carotid artery just before it divides into its terminal branches - the anterior and middle cerebral arteries. The anterior cerebral artery forms the anterolateral portion of the Circle of Willis, while the middle cerebral artery does not contribute to the circle. Posterior cerebral artery is a terminal branch of the basilar artery formed at the upper posterior border of Pons where it joins the posterior communicating artery to complete the circulus arteriosus cerebri in human being. Posterior part of circle is formed by the posterior cerebral arteries (PCA), the terminal branch of basilar artery (BA), connected to internal carotid arteries (ICA) by the posterior communicating arteries (PCommA). The PCommA arises as a branch osupraclinoid part of ICA and passes backwards and medially, medial to oculomotor nerve and joins the PCA at the junction of P1 and P2 segments of PCA. The right and left posterior cerebral arteries arise from the basilar artery, which is formed by the left and right vertebral arteries. The vertebral arteries arise from the subclavian arteries. Arteries involved in forming the circle of Willis give off cortical and central branches. The central branches supply the interior of the Interpeduncular fossa. The cortical branches are named for the area they supply.

OBSERVATIONS

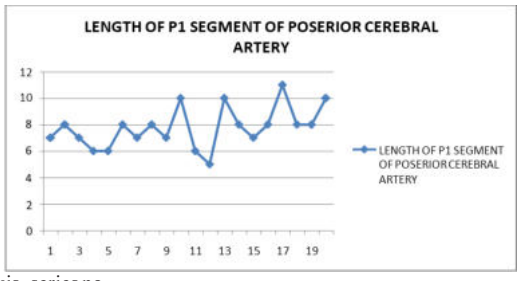
In all the cadaveric brains posterior cerebral artery originates as the terminal bifurcation of basilar artery opposite the upper border of pons in the interpeduncular fossa.In one brain there was unilateral foetal origin of posterior cerebral artery on the left side (photo no.2 and 4). In this case the thickness of left side of posterior cerebral artery was visibly less than the thickness of posterior communicating artery on the same side. This anomaly led to the major part of blood supply to the left side of occipital lobe from internal carotid artery through posterior communicating artery instead of basilar artery.

The artery then curves laterally over the crus cerebrii of the mid brain parallel to superior cerebellar artery but separated from it by the third cranial nerve. It joins the posterior communicating artery at the lateral margin of the interpeduncular cistern. The artery divided into four parts along its course as described earlier. Branches of posterior cerebral artery supply the inferior surface of the temporal and occipital lobes. The central branches supply the thalamus, midbrain, choroid plexus, and wall of third and lateral ventricles.

Pie Chart Representation Of The Type Of Origin Of Posterior Cerebral Artery

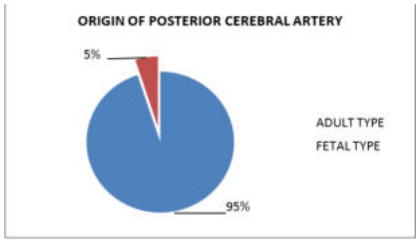


GRAPHICAL REPRESENTATION OF LENGTH OF P1 SEGMENT

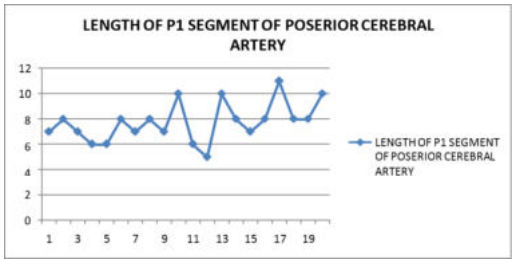


X axis- series no.
V axis- length of P1 segment (in mm)

PIE CHART REPRESENTATION OF THE TYPE OF ORIGIN OF POSTERIOR CEREBRAL ARTERY

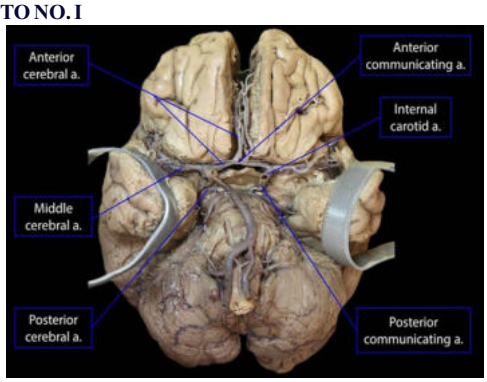


GRAPHICAL REPRESENTATION OF LENGTH OF P1 SEGMENT



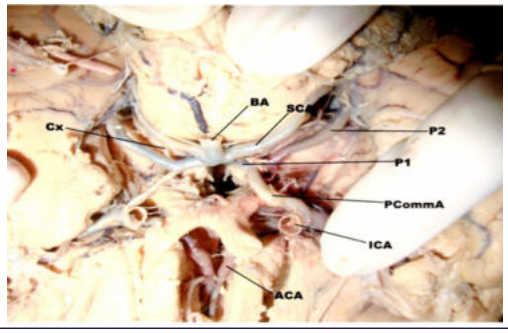
X axis- series no.
V axis- length of P1 segment (in mm)

PHOTO NO. I



Brain showing the Circle Of Willis in the interpeduncular fossa.

PHOTO NO. 2



Brain showing the fetal origin of P1 segment on the left side with hypoplastic P1 and thickened Posterior communicating artery (PCommA) BA- Basilar artery

P1 and P2 segments of posterior cerebral artery SCA- Superior cerebellar artery

PCommA- Posterior communicating artery Cx- Circumferential Artery

ICA- Internal carotid artery ACA- Anterior cerebral artery

DISCUSSION

The microsurgical anatomy of posterior cerebral artery has attracted many researchers especially with the advent of microneurosurgical techniques in cerebrovascular surgery (Zeal AA, Rhoton AL et al 1978, Slobodan V. Marinkovic 1987, Pai B S and Verma R G 2007, Richard Gonzalo Párraga 2011 were the principal ones). Awareness of the microanatomy and variations of the posterior cerebral artery is important for confident surgical and endovascular interventions.

Various method of cadaveric IV injection has been tried with different fixing techniques. Pai and Verma (2007) painted the arteries with water colour after dissection and they took digital photographs through the operating microscope. Richard Gonzalo Párraga et al (2011) injected arteries with red silicone and dissected with microsurgical techniques. Ace Dodevski (2014) did the anatomical analysis of computed tomography angiography (CTA) images. Slobodan V. Marinkovic (1987) perfused specimen with saline solution, then injected with 10% India ink and gelatine or with a radiopaque substance (Micropaque). However in our study meticulous dissection was used to overcome the deficiency.

ORIGIN OF POSTERIOR CEREBRAL ARTERY:

In present study only one out of twenty posterior cerebral arteries showed the unilateral fetal origin of posterior cerebral artery (5% of cases). This case of fetal origin was found on left side. De Silva K and Silva T et al (2009) did a study to reveal 4.4% of foetal and 2.2% of transitional configurations. In Mc Cormick's study in 1969 suggested that fetal configuration was present in 6% of cases. Padmavathi G and Rajeshwari T et al in 2011 reported in their study that fetal type of PCA was noted in 6.5% of the cases. 11% of the cases in their study exhibited a common trunk of origin of both PCA & SCA. Fetal type of PCA was more on the left side and the overall percentage variations of PCA noted was 17.6%.

RESULTS:

The normal anatomy and variation in the origin and branching pattern of the posterior cerebral artery (PCA) is of paramount importance not only in clinical practice and radiological investigations but also in theoretical considerations.The PCA originates from the basilar bifurcation within the interpeduncular cistern. Embryologically, the PCA is a branch of internal carotid artery (ICA); the connection with the basilar artery develops later.The connection with the ICA can later completely regress or persist as a large or small vessel, becoming posterior communicating artery (PCommA). Sometimes fetal origin of the PCA can persist, such that the PCA is largely fed by the ICA through PCommA. In such case the diameter of P1 is less than the diameter of PCommA on the same side.

The PCA is divided into four segments: (1) P1 extends from the basilar bifurcation to the junction with the PCommA; (2) P2 begins at the PCommA and ends lateral to the posterior edge of the midbrain; (3) P3 proceeds posteriorly from the posterior edge of the lateral surface of the midbrain and ends at the anterior limit of the calcarine fissure; and (4) P4 includes the branches distributed to the cortical surface.

Branches from P1 segment includes: posterior thalamoperforating arteries and circumferential arteries.

The posterior thalamoperforating arteries arise from the P1 segment and courses superiorly and posteriorly and they divide into numerous branches that terminate in the interpeduncular fossa. They then penetrate the posterior perforating substance.

The circumferential arteries encircle the brain stem for a variable distance before entering the diencephalon. They are divided into long and short depending upon the course around the brainstem.

Central branches arising from the P2 segment are thalamogeniculate arteries and circumferential arteries. Cortical branches from P2 segment are anterior temporal artery, middle temporal artery, posterior temporal artery and common temporal artery.

Sometimes only common temporal artery is present to supply the inferior surface of temporal lobe. The common temporal artery divides into anterior inferior temporal artery, middle inferior temporal artery and posterior inferior temporal artery.

The terminal branches of the P3 segment are the calcarine artery and the parieto-occipital artery.

Parieto-occipital artery mostly arises from the P3 segment and run in the parieto-occipital sulcus.

CONCLUSION

The present study was done in 20 posterior cerebral arteries (20 cerebral hemispheres) in the department of Anatomy. The following conclusion was derived from the study:

In all the 10 brains the posterior cerebral artery (PCA) was present on either side, arising from the basilar bifurcation.

In one brain fetal configuration of PCA origin was seen on left side in which the posterior communicating artery was visible to be much thicker than the P1 segment of PCA.

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