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Neurosurgery

CADAVERIC STUDY ON BASILAR ARTERY AND ITS VARIATIONS IN OUR REGION

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ABSTRACT

AIM OF STUDY: Basilar artery is the main artery of posterior circulation with complex position for surgical approach and with considerable variations. The surgical approach is complicated due to the compact bony structures and the vital neural structures attached to basilar artery like brain stem and the complex cisterns and complex vascular structure like perforating branches and the twisting of the vessels around the cranial nerves. Aim of the study is to document the microsurgical anatomy of the basilar artery and its variations which may coincide with the western literature studies compare to our region

MATERIALS : 50 Cadavers from the Forensic medicine Department, Thanjavur Medical College were included in the study after getting the legal and academic approval. inclusion criteria: all nontruama cadavers.
The exclusion criteria: death due to head injuries, murder.

RESULT OF THE STUDY: The origin of basilar artery was at pontomedullary junction commonly coinciding with the lower border of clivus, in pontomedullary citern. The Straight course of the basilar artery maintained in 60% of specimen. If tortuous the bifurcation moves little above and to the diapharma sellae. All the Branches of the basilar artery well studied and all the branches were present except the left AICA absent in one specimen. The posterior cerebral artery was larger in diameter compare to previous studies by one mm.

KEYWORDS : .

AIM OF STUDY

Basilar artery is the main artery of posterior circulation with complex position for surgical approach and with considerable variations. The surgical approach is complicated due to the compact bony structures and the vital neural structures attached to basilar artery like brain stem and the complex cisterns and complex vascular structure like perforating branches and the twisting of the vessels around the cranial nerves. Aim of the study is to document the microsurgical anatomy of the basilar artery and its variations which may coincide with the western literature studies compare to our region. Senior authors studied and concentrated the anterior circulation since 1953 -64. Recent work on Vertebra basilar system was done by Zeal and Rhoton (1978) and Fuji et al.Huber and Lasjaunias made significant contribution to the understanding of vertebral artery anatomy. The aneurysms and other vascular malformation like AVM and cerebro vascular accidents are common in Vertebro basilar junction, upper basilar trunk and posterior cerebral arteries. So the anatomical variations in the basilar artery may useful in its surgical approaches. For example, the perfect straight course of the basilar artery is usually present in 25% of the cadavers in western studies. Most of the findings coincide with the literature but some findings like the straight course of the artery in our study was 60%.

The intracranial portions of the vertebral arteries join to form the basilar artery usually at the level pontomedullary junction. Both vertebral arteries are around 3.57mm in diameter (0.92-4.09mm). The arteries penetrate the atlanto occipital membrane after they leave the foramen transversarium of the atlas and through the foramen magnum arteries enter the posterior cranial fossa. From the lateral cerebello medullary cistern, it courses anteromedially along the medulla below the hypoglossal rootlets to reach the pontomedullary sulcus and joins the opposite counterpart and forms the basilar artery. Reinforcing fibers of arachnoid at ponto medullary sulcus demarcate the beginning of the prepontine cistern and basilar artery. The bony landmark at the vertebrobasilar junction is usually at the lower border of the clivus but this position is variable due to tortuosity of the arteries, but the straight course is maintained in 25% cases. Fenestrations and duplication of the vertebral arteries are reported but these anomalies were usually associated with other vascular malformations like AVM and aneurysms. The main branches of the basilar artery are Anterior inferior cerebellar artery,Labrynthine artery(15%), Paramedian pontine branches, Circumferential pontine branches at trunk. Superior cerebellar artery, Posterior cerebral artery at bifurcation.

Around 15% of aneurysms mostly saccular in type occur in the posterior circulation. 63% of which occur at the basilar bifurcation. Congenital duplications, fenestrations and hypoplasia present are prone for aneurysmal occurence. Apex aneurysm at the bifurcation arises usually at the posterior cerebral arteries and from the basilar artery. The junction points upward in the direction of the long axis of the basilar artery. Hypoplastic variations of posterior cerebral artery are more prone for aneurysms. Aneurysms are visualized by carotid and vertebral angiography especially in P1 segment. Aneurysm from the basilar and its branches initially seems to confirm poorly to the first three facets of anatomy. The basilar and vertebral arteries are coursed straight arteries, with the cerebellar arteries usually originating at right angles from them. The tortuosity of the aneurysm harbouring artery causes change in direction of blood flow. The curves near the origin of cerebellar arteries create hemodynamic stress on the wall of the basilar artery.

MATERIALS

50 Cadavers from the Forensic medicine Department, Thanjavur Medical College were included in the study.

Inclusion criteria: all nontruama cadavers.
Exclusion criteria: death due to head injuries, murder.

Unclaimed bodies excluded due to medicolegal reasons. The institutional ethical committee approval obtained in advance. Permission obtained from the professor in charge of the Forensic Medicine department. Cadavers were examined after explaining the study purpose and after obtaining the informed consent in their regional language from the relatives.

METHODS

When cadaver comes for postmorterm examination, we used to conduct the study. Prior informed consent obtained in written from relatives. The vertebral artery was dissected at the level of thyroid cartilage by anterior approach. As routine method of forensic cadaveric examination, the bicoronal scalp incision made. The skull skeletanised and drilled and the base of the brain dissected. The circle of willis visualized and dissected. The anterior cerebral arterial system ligated to prevent leakage of the dye. Beveled cut tygon tube inserted into the vertebral artery on both sides. Around 50 ml of indian ink dye injected. Then the brain dissected from the cranial cavity without disturbing the posterior circulation at the level of cervical cord level including around 1-1.5 cm of the vertebral artery. Then the specimens examined for variations and given back to keep in to the body. The caliber and diameter of the vertebral artery, vertebra basilar junction in relation to ponto medullary sulcus read and recorded. Diameter of basilar artery and length measured and included in the study. The

course of the basilar artery in the prepontine groove was studied and recorded. The origin of anterior inferior cerebellar artery in relation to vertebrobasilar junction and its diameter was recorded. Diameter of the superior cerebellar artery and its origin in relation to basilar artery bifurcation recorded. The bifurcation of basilar artery in relation to mamillary body, the distance was noted. The length of P1 segment and its diameter were recorded. And the measurements analyzed comparing with western literature studies.

OBSERVATION

We observed that there are some difficulty in dissecting the brain specimen in toto with the vertebral artery since while dissecting the brain from the cranial cavity at the level of foramen magnum is difficult in cases of narrow foramen and the vertebral artery is adherent to the clivus and teared while delivering the specimen. Some cadaver brains were in semi solid state and the vessels are fragile and became unfit for study and omitted.

The following observations were made:

The vertebral arteries were teared in seven cases and could not measure. It was observed that in one case the left vertebral artery absent and right vertebral artery continuous as basilar artery. The average diameter of vertebral artery on the right side2.28mm and in the left is 2.12 and the range from 1-5mm.

The length of basilar artery range from 20-50mm and the average is 38.5mm. The diameter of the basilar artery range from 2-6 mm and the average is 3.7 mm. The average origin of basilar artery is ponto medullary sulcus is 4-8 mm below the junction the Ponto Medullary junction. The basilar bifurcation is 0-5 below the mamillary body. The tortuasity of artery is correspondingly increased with age. The straight course in prepontine sulcus maintained in 60% of specimens.

The origin of Anterior Inferior Cerebellar Artery from the basilar artery is between 0-3mm on both sides. The average origin of right AICA is2.5mm and left AICA is2.3mm. In one specimen it was observed that the left AICA was absent. The diameter of the anterior inferior cerebellar artery range from 1-3mm, mean is 2.1mm.

The numbers of paramedian pontine branches were range from 1-5 in numbers. The circumflex pontine branches were range 1-4 in numbers.

The origin of superior cerebellar artery was just below basilar bifurcation the distance range from 1-2mm. The average diameter of the SCA was range from1-4mm. the mean diameter were 2.1 mm on both sides

The common Bifurcation of basilar artery in to posterior cerebral artery was below the mamillary body .The distance range from1-3mm. In three specimens it reaches the diaphrama sellae. The P1 segment length was 2-6 mm with the mean on the right side was4.1mm and left side was3.8mm. The diameter of the PCA range from 1-5mm.The mean diameter of the PCA was3.1mm on both sides.

RESULT OF THE STUDY

The origin of basilar artery was at pontomedullary junction commonly coinciding with the lower border of clivus, in pontomedullary citern.

The Straight course of the basilar artery maintained in 60% of specimen. If tortuous the bifurcation moves little above and to the diapharma sellae.

All the Branches of the basilar artery well studied and all the branches were present except the left AICA absent in one specimen.

The posterior cerebral artery was larger in diameter compare to previous studies by one mm.

DISSCUSSION:

VERTEBRO BASILAR JUNCTION:

Distance from ponto medullary junction (in mm)	Number of specimen
0-5	6
5.1-6.0	40
6.1-7.0	3
7.1-8	1

MEAN: 5.84Median: 6mmMODE: 6mm

Standard deviation: 1.26 P value<0.01

The origin of BA was at pontomedullary sulcus up to 10 mm below it (means 5.55 mm) according to yasergil et al. In our study it was between 0-8mm and the average is 5.84mm. The Straight course was maintained in 21% of specimens, and with the increasing age the straight course was become tortuous. The will very important in the case of anerysmal surgeries which course to be confirmed by angiogram prior to intervention (1,13,17). In our study the straight course was maintained in 60% of cases.

DIAMETER OF VERTEBRAL ARTERY:

DIAMETER (in mm)	No.of specimens Right	Left
0-1.5	9	13
1.6-2.5	16	15
2.6-3.5	22	21
3.6-4.5	3	1

MEAN: 2.3mm Median: 3.0mm MODE: 3mm
Standard deviation: 1.07 P value<0.03

In our study the diameter of the vertebral artery ranges from 1.5mm to 4.5mm which is between0.9mm-4.09mm compare to yasergil et al., almost coincide with western studies.

BASILAR ARTERY:

LENGTH OF BASILAR ARTERY:

Basilar artery length(mm)	No. of specimen
0-25	2
26-35	17
36-45	29
46-55	2

MEAN: 38.5mm Median: 44mm MODE: 45mm
Standard deviation: 5.8 P value <0.4

DIAMETER OF BASILAR ARTERY

Diameter in mm	No. of specimen
0-3	21
3.1-4.0	20
4.1-5.0	4
5.1-6.0	5

Mean: 3.7mmMedian 3.5mmmode:4
Standard deviation: 1.35P value<0.01

The diameter of basilar artery ranges from 2.7-4.3mm (mean3.5mm) and length varied from 34-40 mm (mean of 34.5 mm) according to yasergil et al.in our study, the diameter range from2-6mm and the length range from25-55mm(22). No fenestration duplication triplication and hypoplasia were noted in the basilar artery. BA gave off paramedian and circumferential perforating was restricted to cisternal anatomy.

PONTINE BRANCHES

Paramedian branches

No. of branches	No. of specimen
0-2	9
2.1-3.0	27
3.1-4.0	9
4.1-5.0	5

Mean: 3.2 median: 3.0 mode: 3.0
Standard deviation: 0.98 P value<0.02

Circumferential branches:

No. of branches	No . of specimen
0-2	10
2.1-3	28
3.1-4	12

Mean: 3.2median: 3.0mode: 3.0
Standard deviation: 0.7P value <.09

Paramedian branches are the small branches that leave the BA. The paramedian pontine branches were present 1-5 in numbers (mean3.5) and the circumferential branches were 1-7 (mean3.8) in yasergill et al. In our study the paramedian branches were one to five in numbers (mean3.2). The circumferential arteries go laterally and course around pons and supply lateral portion of pons were 1-5 in numbers (mean3.2).

ANTERIOR INFERIOR CEREBELLAR ARTERY ORIGIN

Origin from vertebrobasilar junction distance (in mm)	No.ofspecimen Right	left
0-1	5	9
1.1-2.0	17	18
2.1-3.0	23	19
3.1-4.0	5	4

MEAN: 2.6mm Median: 3.0mm MODE: 3
Standard deviation: 0.95 P value:<0.01

The origin of AICA from the VBjunction were range from 0-3mm. on both sides which coincides with the literature and in one specimen the left AICA was absent which was not significant. The origin of AICA from BA is variable. Yasargil et al have found solitary AICA in 58%, duplicated in twenty percent, triplicated in twenty percent and rarely absent in two percent.[1] The AICA arose from lower third of BA in 84%, from middle third in 14% and 2% in upper third in yasergil et al. In our study, lower third of origin was around 56%and middle third origin was in 42%. The upper third origin was around 9%.This have some variation from the western studies.

DIAMETER OF AICA

Diameter in mm	No of specimens	
	Right	left
0-1	4	4
1.1-2.0	26	30
2.1-3.0	20	16

Median: 2 mm Mean: 2.1mm MODE: 2
Standard deviation: 0.75 and 0.50 P value<0.06

The diameter of AICA ranges from 1.0-3.25(mean2.5) in yasergil et al. in our study mean diameter was around 2.1, this almost coinciding.

SUPERIOR CEREBELLAR ARTERY

Diameter in mm	No. specimen	
	Right	left
0-1.5	7	3
1.6-2.5	35	39
2.6-3.5	8	8

Mean 2.1mm Median 2.0mm MODE: 2
Standard deviation: 0.59 P value <0.06

The superior cerebellar artery has close origin with basilar bifurcation was around 1-3.5mm from the bifurcation. There was no hypoplasia, duplication or triplication noted. The Diameter of the SCA range from 1-4mm with mean 2.1mm on both sides. SCA is most consistent branch of posterior circulation. The SCA frequently have contact with oculomotor, trochlear and trigeminal nerve. Usually bifurcation and trifurcation in 15% of cases. In our study no such variation made out.

LENGTH OF P1 SEGMENT OF POSTERIOR CEREBRAL ARTERY

Length in mm	No .of specimen	
	Right	left
0-2.5	1	1
2.6-4.5	39	39
4.5-6.5	10	10

Mean: 4.1 median: 4.0 mode: 4
Standard deviation: 0.58 P value <0.6

DIAMETER OF POSTERIOR CEREBRAL ARTERY

DIAMETER in mm	NO. OF SPECIMEN	
	right	left
0-2.0	4	5
2.1-3.0	35	35
3.1-4.0	11	10

MEAN: 3.8 MEDIAN: 3.5 MODE: 3

Standard deviation: 0.74 P value <0.6

The PCA arises at basilar bifurcation and is joined the posterior communicating artery (PComA) at Lateral margin of interpeduncular cistern. It encircles Brain Stem passing through crural and ambient cistern to reach quadrigeminal cistern. The lengths of the P1 segment of PCA were 2-6mm with mean 3.5mm on both sides. The adult type of circulation found 67.5% and 25% fetal circulation. There was no fetal circulation made out in our study.

In rhoton series the diameter of PCA was 1-3.5(mean2.5). In our study the diameter PCA on the right side 1-5mm (mean3.5) and on left side 1-5mm (mean3.4).

CONCLUSION

Cadaveric study of the posterior circulation is useful, since microsurgical anatomy is extremely complex and variable.

There are difficulty were encountered while studying the specimen like traumatic loss of vertebral arteries and part of basilar arteries.

The anatomical landmarks of vertebra basilar junction, anatomy of basilar artery were coinciding with literature studies.

The variations noted were

The straight course of basilar artery maintained in 60%.

Apalsia of left AICA noted in single specimen.

Some variations made out in the origin of the Anterior Inferior cerebellar artery.

Superior cerebellar artery present in the entire specimen as constant branch.

There is no fetal type of circulation made out.

It is important for micro neurosurgeon to have a working knowledge of microsurgical anatomy of vascular structures as well as the neural structures in this area.

Familiarity of the anatomical structure and variation in vascular structure will useful to tackle pathological conditions and give confidence in surgical exposure.

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