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Study of Morphology of Basilar Artery in Jharkhand Population

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Abstract
Introduction: *Basilar artery is a single trunk, formed at the pontomedullary junction, by joining two vertebral arteries. It runs in the median groove of Pons, in the subarachnoid space. It ends by dividing into right and left posterior cerebral arteries, at the upper border of pons.The sound knowledge of morphology and variations of basilar artery and its branches not only help radiologist, in the study of CT angiograms but also helps neurosurgeons in neuroendoscopic surgical procedures. It also helps neurologist to understand clincopathological condition, which may arise due to abnormalities present in the artery.*
Methods: *The morphological study of basilar artery was done by taking 13 human brains, obtained from the cadavers, used in the routine educational dissection for undergraduate students in department of Anatomy,Rajendra institute of Medical sciences, Ranchi, Jharkhand, India, for a period of 1 & 1/2 years from March 2015 to October 2016.The Process was undertaken according to the dissection method as per the Cunningham manual. The variation in length and diameter was noted by using verniercalliper .*
Results*: Formation of basilar artery was at ponto-medullary junction, in 38.46% of cases, above ponto-medullary junction in 38.46% of cases and below ponto-medullary junction in 23.07% of cases. Basilar artery runs in the basilar groove, present on ventral surface of pons. Length of basilar artery was varying between 24mm to 40mm and the mean length was 29.72 mm. At the mid level, the diameter of basilar artery was ranging between 3.5mm to 5mm. The mean value was 4.36mm. Basilar artery terminated at midbrain- pons junction in 53.84% of cases, in 38.46% of cases terminated just above midbrain- pons junction and in 7.69% of cases, basilar artery terminated below midbrain-pons junction.*
Discussion: *Recent advances in interventional radiology, microscopic and neuroendoscopic procedures (i.e. Transluminal angioplasty, vascular stunt and bypass surgeries), morphological study of skull base vessels have gained significance.The branches of vertebrobasilar system supply the most vital structure of our nervous system i.e. brain stem, which increases its significance.*

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I. Introduction

The cerebrovascular diseases (thrombosis, embolism, hemorrhages) are the third most common cause of death worldwide. Therefore an adequate knowledge of blood supply of brain is essential for proper diagnosis and treatment of the diseases. Brain gets its nourishment by a unique structure known as **"circle ofWillis"** which is formed by the terminal branches of internal carotid artery and basilar artery. Circle of Willis forms an anastomotic link between carotid and vertebrobasilar system. Vertebrobasilar system and its branches constitute posterior circulation of brain responsible for 30% of the brain's blood supply.[1] Basilar artery is a single trunk, formed at the ponto-medullary junction, by joining two vertebral arteries. It runs in the median groove of Pons, in the subarachnoid space. It ends by dividing into right and left posterior cerebral arteries, at the ponto-mesencephalic junction just after passing superior to two occulomoter nerves.[2] Normal morphology of basilar artery is essential component of cerebral circulation. Hindrance of blood supply due to any cause, even for short duration (7-8 minutes) would cause severe and irreversible damage to the brain cells.[3] Various branching pattern and morphology of basilar artery may cause abnormal blood flow, which leads to atherosclerotic changes, stenosis, thrombosis and aneurysm.

Aneurysms are more common at the site of termination of basilar artery and may compress the oculomotor nerve. Incidence rate of basilar artery aneurysm is 3-5% of all intracranial aneurysm. Studies shows that rupture rate of small aneurysm (<10mm) is 0.05% and that of large aneurysm (>25mm) is 6%.[4] Unruptured aneurysm can be treated by endovascular coiling, performed during angiogram. In this catheter is inserted into femoral artery and navigated through blood vessels into the aneurysm. Aneurysm packed by the coils, which

prevent blood flow from entering into aneurysm. Stenosis is also common in proximal and mid region of basilar artery. It is the important cause of transient ischemic attack and may progress into posterior circulation stroke. It is diagnosed by angiography and intravascular stenting is done as a therapeutic choice. Posterior circulation stroke can also be caused by basilar artery thrombosis. Recanalization of the basilar artery is the key of successful treatment. It can be done by intravenous/intra-arterial thrombolysis or mechanical endovascular thrombectomy followed by balloon angioplasty.[5] Thus, the sound knowledge of morphology and variation of basilar artery and its branches not only help radiologist, in the study of CT angiograms but also helps neurosurgeons in neuroendoscopic surgical procedures. It also helps neurologist to understand clincopathological condition, which may arise due to abnormalities present in the artery.

II. Material And Methods

The present study entitled "A study on morphology of basilar artery in Jharkhand population" was carried out in department of Anatomy, RIMS, Ranchi by taking 13 human brains, obtained from the cadavers used in the routine educational dissection for undergraduate students in department of Anatomy for a period of 1 & 1/2 years from March 2015 to October 2016 .The brain was removed by dissection method mentioned in cunninghum manual of Practical Anatomy.[6] The study was approved by scientific Review and ethical committee.

Following points had been observed:

1. Site of formation of basilar artery in respect to ponto-medullary junction.
2. Length of basilar artery from point of formation to point of termination.
3. Diameters of basilar artery at different levels (at point of formation, atmid-level, at point of termination).
4. Site of termination of basilar artery in respect to midbrain-pons junction.

Inclusion criteria: Undamaged specimen of brain with intact Circulus arteriosus and basilar artery.
Exclusion criteria: Damaged Circulus arteriosus.

III. Results

Formation of basilar artery was at ponto-medullary junction, in 38.46% of cases, above pontomedullary junction in 38.46% of cases and belowponto-medullary junction in23.07% of cases **(Lower point of the junction was taken as level).**

Length of basilar artery was taken between point of formation and point of termination. In present study length of basilar artery was varying between 24mm to 40mm and the mean length was 29.72 mm. At the level of formation, the diameter of basilar artery was ranging between 3mm to 6mm. The mean value was 4.65mm. At the mid level, the diameter of basilar artery was ranging between 3.5mm to 5mm. The mean value was 4.36m. At the level of termination, the diameter of basilar artery was ranging between 2 to 5mm.The mean value was 3.77 mm.Throughout its course, basilar artery usually was of uniform diameter and uniform morphology with slight variations.Basilar artery divides into two terminal branches at the upper border of pons. In present study, basilar artery terminated at midbrain- pons junction in 53.84% of cases and in 38.46% of cases terminated just above midbrain- pons junction. In 7.69% of cases, basilar artery terminated below this level.

IV. Discussion

Over the past 40-50 years, due to recent advances in interventional radiology, microscopic and neuroendoscopicprocedures (i.e. Transluminal angioplasty, vascular stunt and bypass surgeries), morphological study of skull base vessels have gained significance. The branches of vertebrobasilar system supply the most vital structure of our nervous system i.e. brain stem, which increases its significance.A wide range of variability is noted in basilar artery with regard to formation, length, shape, termination and branching pattern. Variation in the length and position may be due to ageing and hemodynamic factors but variation in the branching pattern is mostly congenital

Variations noted at the level of formation of basilar artery

In present study, basilar artery was formed above PM junction in 38.46% o cases, at PM junction in 38.46% of cases, below PM junction in 23.04% of cases.Padmawathi et al (2011) found that, the level of formation at PM junction in 44.4% of cases and below PM junction in 38.9% of cases. In present study there was equal frequency of formation of basilar artery at and above PM junction. HospatanaMamtha et al found that, in maximum number of cases (65%), basilar artery formed at PM junction. Sultana et al also found the same type of results i.e. in maximum number of cases (72.2%) basilar artery formed at PM junction but they did not get any formation above PM junction.

Table 1 : Comparative study of level of formation of basilar artery

STUDY	SAMLE SIZE	AT PM JUNCTION	ABOVE PM JUNCTION	BELOW PM JUNCTION
Present study	13	38.46%	38.46%	23.07%
Wankhede et al[7]	40	62.50%	29%	12.50%
Patel Shilpa et al[8]	60	88.33%	6.67%	5%
Padmawathi et al[2]	54	44.4%	16.7%	38.9%
Vare and Bansal et al[9]	56	79.4%	4.5%	16%
HospatanaMamtha et al[10]	20	65%	10%	25%
Sultana et al[11]	70	72.2%	0%	35.7%
Kalaivannan j et al[12]	50	62%	16%	22%

Variations noted in the length of basilar artery

Length of basilar artery was taken between point of formation and point of termination. Variations in the length were quoted in various literatures. In present study, the length varied between 24mm-40mm. The mean length was 29.72mm. Pai et al (2007) noted that length of basilar artery was ranging between 24mm - 36mm.[13] Seiki and Rhoton (1977) found that, length of basilar artery varies between 15mm to 40mm.[14]Idowu et al noted that length of basilar artery varies between 20-40mm.[15] Similarly, Iqbal s. noted that length of basilar artery was ranging between 18-37mm.[16]Patel shilpa et al noted that length of basilar artery varies between 20.01mm to 42.02mm.[8] The minimum length was documented by Seiki and Rhoton that was 15mm.[14]

Table 2: Comparative study of length of basilar artery

Studies	Specimens no.	Length
Present study	13	24-40mm
Saeki and Rhoton (1977)[14]	50	15-40mm
Kamath[17] (1979)	100	22-45mm
Padmawathi et al (2011)[2]	54	25-38mm
Hospatanaetal (2012)[10]	20	25-37mm
Wankhede eta l(2014)[7]	40	24-36mm
Patel Shilpa et al (2015)[8]	60	20.1-42.02mm

Variations Noted In Diameters Of Basilar Artery At Different Levels

Idowu et al 2010 observed that diameter of basilar artery was relatively constant, throughout its course with few minor variations.[15]In present study, diameter at different levels had been studied. The overall mean diameter was 4.3mm (range: 2mm to 6mm). Idowu et al noted overall average diameter was 3.82mm (range: 2.5mm to 5.5mm).Iqbal s. noted average diameter was 3.9mm (range: 2.8mm to 5.1mm).Patel Shilpa et al(2015) found average diameter was 3.36mm, (range :2.01mm to 4.45mm).Mean diameter of basilar artery at its origin in present study was found to be 4.77mm. Wankhede et al found it 3.63mm.Diameter at mid -level was found to be 3.17mm by Smoker et al[18] and 4.36mm in present study. Diameter at termination was 4.1mm as found by Seiki and Rhoton (1977) and 3.77mm by present study.

Table 3 : comparative study of diameters of basilar artery at different levels

Study	Diameter at origin	Diameter at mid- level	Diameter at termination
Present Study	3mm-6mm Mean-4.65mm	3.5mm-5mm Mean-4.36mm	2mm-5mm Mean-3.77mm
Wankhede et al[7]	3.2mm-4.2mm Mean-3.63mm	3mm-4mm Mean-3.53mm	3.1mm-4mm Mean-3.10mm

Variations Noted In Termination Of Basilar Artery

Basilar artery terminates around the midbrain-pons junction into two posterior cerebral arteries. In present study, level of termination, at PM junction was found to be in 53.84% of cases. Rand (1978) found 88%[19] and Smoker et al (1986) found 92% cases terminate in midbrain-pons junction.[18]

Table 4 : Comparative study of level of termination of basilar artery

Study	At MP junction	Above MP junction	Below MP junction
Present Study	53.84%	38.46%	7.69%
Stopford et al[20]	97.5%	0%	2.5%
Padmawathi et al[2]	44.4%	29.6%	25.92%
Wankhede et al[7]	50%	32.50%	17.50%
Patel Shilpa et al[8]	95%	3.33%	1.67%

MP junction: Midbrain-pons junction

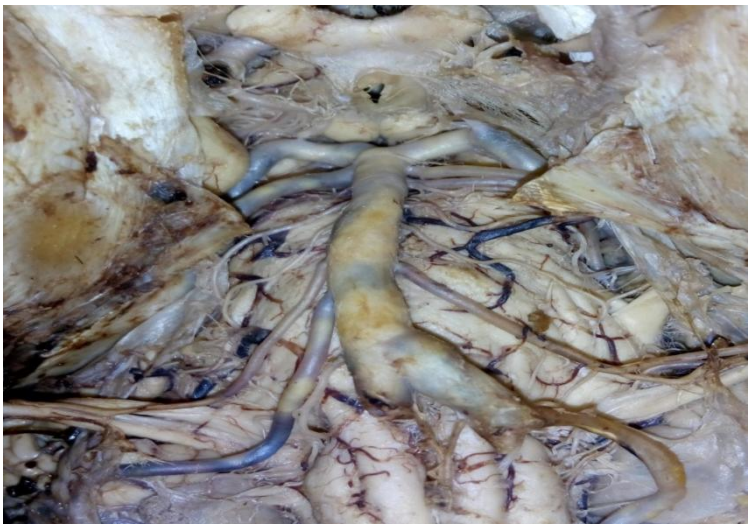

Fig-1 Showing the formation, course and termination of basilar artery.

- Formation at PM junction, straight course in the mid line.
- Terminate above the midbrain-pons junction.
- Type of termination: Bifurcation into 2 PCA

Fig-2 Showing the formation, course and termination of basilar artery.

- Formation at PM junction.
- Straight course in the mid line.
- Terminate at the midbrain-pons junction.
- Type of termination: Bifurcation into 2 PCA

V. Conclusion

The basilar artery is formed above and at PM junction in 38.46% of cases and below PM junction in 23.07% of cases.

- In maximum number of specimens (76.92%), basilar artery ran straight in midline, in basilar groove. Other shapes are uncommon. Shape of the artery is mostly depending upon hemodynamic factors.
- Length of the basilar artery is taken between point of formation and point of termination. The minimum length is found to be 24mm and the maximum length is found to be 40mm.

- The diameter of basilar artery is either decreasing gradually or uniform throughout. Overall mean diameter noted

  At the site of formation: 4.77mm.
  At the midpoint: 4.36mm.
  At the level of termination: 3.77mm.

The maximum diameter is found to be 6mm at site of formation and minimum diameter is found to be 2mm at site of termination.

- Site of termination is described, in respect to midbrain-pons junction. Termination of basilar artery at midbrain- pons junction is in 53.84% of cases and termination above this level is in 38.46% of cases. Termination below this level is noted in only one specimen.

Conflicts Of Interest: All authors have none to declare.

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