



PERSISTENT PRIMITIVE TRIGEMINAL ARTERY – A NOTEWORTHY INTRACRANIAL VASCULAR VARIANT – A CASE REPORT

Tushar Kalekar., Raunak Raj., Vigyat Kamal and Rajul Bhargava

Department of Radiology, Dr. DY Patil Medical College & Research Center, Pimpri, Pune

ARTICLE INFO

Article History:

Received 23rd May, 2016
Received in revised form 17th
June, 2016 Accepted 9th July, 2016
Published online 28th August, 2016

Key words:

- Magnetic Resonance Angiography (MeSH unique ID: D018810).
- Intracranial Thrombosis (MeSH unique ID: D020767).
- Basilar Artery (MeSH unique ID: D001488).
- Carotid Arteries (MeSH unique ID: D002339).
- Vertebral Artery (MeSH unique ID: D014711).

Copyright © 2016 Tushar Kalekar et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Multiple arterial anastomosis exist between anterior and posterior circulation in the brain early in the gestational period. These consist of the otic, proatlantal intersegmental, primitive trigeminal and hypoglossal arteries, which represent the arterial anastomosis between the carotid and vertebrobasilar circulations.^[1]

Persistent trigeminal artery (PTA) is one of the cephalic most variants of persistent carotid vertebrobasilar anastomoses with an incidence of 0.2 % on angiographic study. ^[2]PTA was initially demonstrated on angiography by SUTTON in 1950.^[3] Its origin is from the internal carotid artery after its retreat from carotid canal and it is seen to anastomose with mid basilar artery. Caudal to this anastomotic junction basilar artery is hypoplastic.^[4]

Case Report

A 64 years old female patient came to medicine OPD with complaints of altered sensorium since 10 days and generalized

ABSTRACT

Amongst the fetal carotid-basilar anastomotic arteries, the trigeminal artery is the most prominent vessel which persists for the longest embryonic period. This artery usually regresses and obliterates after the development of the posterior communicating artery. The etiology of the persistence of this primitive artery in adulthood is not known. Various variants with their configurations and relation to the rest of the cerebral arterial tree and the other surrounding structures have been reported on angiographic studies. Persistent trigeminal artery can be associated with many other vascular anomalies and disorders including aneurysms, arteriovenous malformations and carotidcavernous fistulae. Detailed understanding of the anatomy and angiographic features of this persistent artery is essential before planning surgical procedures or endovascular intervention for any pertinent pathological condition near the sella.

tonic clonic seizures since last 3-4 days. There was no history of trauma to the head, loss of consciousness. She was a known case of diabetes and hypertension since last 3 years. She was referred to us for MRI brain which revealed chronic white matter ischaemic changes in the form of focal FLAIR hyperintensities in bilateral periventricular white matter, corona radiata and centrum semiovale. However, there was no evidence of any acute infarct or space occupying lesion. MR angiography was performed which revealed normal bilateral intracranial internal carotid arteries, middle cerebral, anterior and posterior cerebral arteries. There was evidence of arterial channel connecting left sided internal carotid artery with the basilar artery which was found out to be the persistent primitive left sided trigeminal artery (figure 2, 3) with small calibre and hypoplastic mid-distal portion of basilar artery and intra-cranial vertebral artery (figure 1). There was no evidence of any aneurysms.

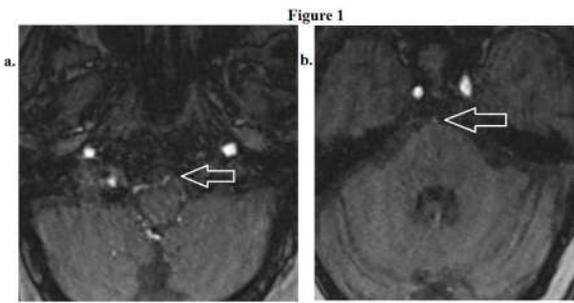


Figure 1 MR angiography showing (a) hypoplastic vertebral artery fusing to form basilar artery. (b) Basilar artery also appears hypoplastic in the mid and distal portion.

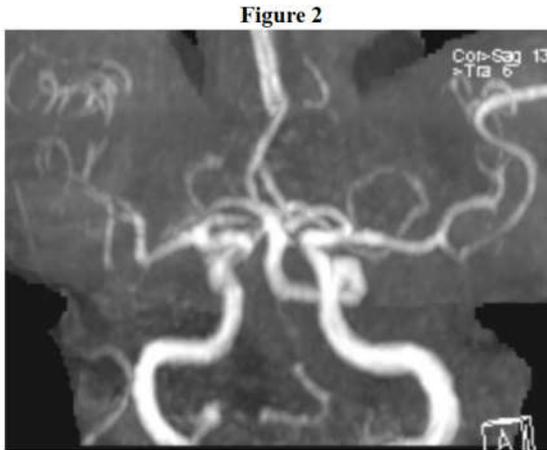


Figure 2 MR angiography MIP projection showing persistent trigeminal artery arising from left sided internal carotid artery to join into the basilar artery.

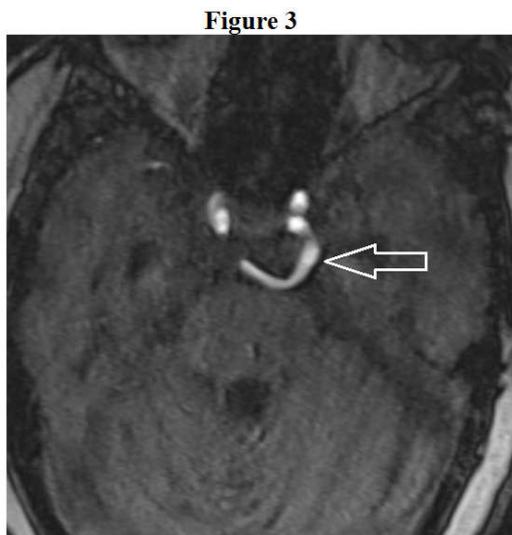


Figure 3 MR angiography showing persistent trigeminal artery arising from left internal carotid artery.

DISCUSSION

The persistent trigeminal artery can be classified according to two broad criteria: firstly, the course of the artery and secondly, according to the configuration of the ipsilateral posterior cerebral artery.

According to course, it is of 2 types (lateral and medial). The medial type progresses a transhypophyseal or intrasellar course traversing posteromedially from its origin, causing compression on the pituitary gland whilst penetrating the dorsum sellae. The lateral type consists of the artery coursing posterolaterally with the trigeminal nerve.

According to the configuration of the posterior cerebral artery of the same side, Saltzan type 1 category consists of the absence of posterior communicating artery and therefore vertebrobasilar system distal to anastomotic site is supplied by the persistent trigeminal artery. In the Saltzan type 2 category, absence of an ipsilateral P1 segment with presence of fetal posterior cerebral artery is seen.^[4]

Saltzman type 3 has also been described. In this, the persistent trigeminal artery is seen originating from internal carotid artery and joins into a cerebellar artery without anastomosing with basilar artery. It terminates as superior cerebellar artery (type 3a), anterior inferior cerebellar artery (type 3b) or posterior inferior cerebellar artery (type 3c).^[3]

The persistent trigeminal artery is associated with other vascular anomalies like intracranial aneurysms in approximately 14% of patients.

Variants of PTA: consists of cerebellar arteries which originate from internal carotid artery proximal to cavernous sinus and are not connected to basilar artery. The prevalence of such variations is approximately 0.76% at MR angiography and 0.18% at conventional angiography. These variants are usually small in calibre and therefore difficult to visualize and diagnose.^[4]

Embryology: At around 35 days of gestational age, 4 major anastomosis form on a temporary basis between carotid and vertebrobasilar systems: namely optical, hypoglossal, trigeminal and proatlantal intersegmental. These persist for 1 week and start regressing and ultimately obliterate in the order of optic artery, consequently followed by hypoglossal, trigeminal and proatlantal intersegmental artery. This regression takes place along with formation of posterior communicants and vertebral arteries. Their presence after birth and in adulthood represents persistent primitive anastomosis.^[5, 6]

Anatomy of persistent trigeminal artery: It may arise from internal carotid artery on either side. Common sites of origin being posterior bowing or lateral wall of the cavernous portion of the carotid artery. Salas et al had reported persistent trigeminal artery arising from the posterolateral aspect of posterior vertical (ascending) cavernous portion of internal carotid artery just medial to 6th nerve at an acute angle to course inferolaterally below 6th nerve to exit cavernous sinus through its reticular layer resulting in a posterior loop around the sphenopetrous ligament with an eventual course in the medial wall of Meckel's cave. In 1993, Ohshiro et al classified persistent trigeminal artery on the basis of autopsy studies into two types: a lateral type wherein the artery is seen coursing between the sensory root of the trigeminal nerve and lateral aspect of sella ultimately penetrating dura mater medial to Meckel's cave, and a medial type wherein the artery courses through dorsum sellae ultimately penetrating dura mater near clivus. The former variety is associated clinically with brainstem ischaemia, trigeminal neuralgia and ophthalmoplegia whereas the latter type is associated with posterior fossa symptoms secondary to steal phenomenon.^[3] Medial type variety is important structure to be recognized in cases of trans-sphenoidal surgery for pituitary adenoma in order to avoid intra-operative damage and haemorrhage.^[7]

Entry point into basilar artery: Persistent trigeminal artery is seen joining the basilar artery between anterior inferior cerebellar artery and superior cerebellar artery (figure 4).



Figure 4 Diagrammatic illustration of entrance of the persistent trigeminal artery (PTA) to basilar artery (BA). PTA joins the BA between the superior cerebellar artery and the anterior inferior cerebellar artery. (Picture courtesy: Azab W, Delashaw J, Mohammed M. Persistent primitive trigeminal artery: a review. *Turk Neurosurg.* 2012; 22(4):399-406. PMID: 22843453).

Its branches are pontine perforators and branches to trigeminal ganglion, meningo-hypophyseal trunk and cerebellar arteries.

Associated clinical entities

1. Cerebrovascular anomalies (PHACE syndrome, primitive otic artery, occlusion of bilateral vertebral arteries, hypoplastic basilar and vertebral arteries, occluded internal carotid artery, the absence of both internal carotid arteries, the absence of common carotid arteries, infraoptic course of A1 segment of anterior cerebral artery, ectasia and fenestration of anterior cerebral artery).
2. Aneurysms (in relation to bifurcation formed by persistent trigeminal artery and either internal carotid artery or basilar artery, in relation to trunk of the persistent trigeminal artery or its variant). These patients present with 6th nerve palsy, subarachnoid haemorrhage or carotid cavernous fistula after rupture of these aneurysms. Treatment consists of surgical clipping, endovascular coiling or stent assisted coiling.
3. Vertebrobasilar insufficiency and brainstem ischaemia (due to microembolic occlusion due to communication between the anterior and posterior circulations or occlusion of persistent trigeminal artery resulting in reduced blood flow to basilar artery).
4. Carotid-cavernous fistula or PTA-cavernous sinus fistula.
5. Miscellaneous (neurofibromatosis – 1, Moyamoya disease, Klippel Feil syndrome, supra and infra-tentorial AV malformations).^[3]

Basilar artery hypoplasia along with agenetic appearance of left vertebral artery have been observed with persistent trigeminal artery due to increased frequency of observation of head and neck vascular anomalies in association with persistent trigeminal artery.^[8]

Persistent trigeminal artery has been documented as a rare cause of trigeminal neuralgia. MR angiography is extremely helpful in demonstration of contact of the artery with the root entry zone of trigeminal nerve in patients with trigeminal neuralgia. Usually, tortuous ectatic superior cerebellar artery,

elongated anterior inferior cerebellar artery or vertebral-basilar artery are seen compressing the root entry zone.^[9]

MR angiography is a non-invasive modality which gives useful information about the origin, course and relationship of vessels with adjacent structures using 3D TOF sequence. Frequent sign on MR angiography is “Tau sign” which denotes the appearance of parasellar internal carotid artery with a persistent trigeminal artery arising from it on parasagittal section.^[6]

CONCLUSION

Anatomical details of these vessels should be clearly understood along with their relationship with skull base on CT as well as MR angiographic studies. Recognition of these vessels before planning of endovascular procedures is essential especially because of risk of passage of emboli through these vessels from carotid to vertebra-basilar circulation during embolization therapies with subsequent chances of brainstem and cerebellar ischaemia. Another important factor is consideration of variant vessel anatomy in the region of sella in cases of surgical planning for pituitary masses.

References

1. Russo AM, Sienna MC. Persistent trigeminal artery: case report. *International Journal of Anatomic Variations.* 2011; (4): 157-160.
2. Rhee SJ, Kim MS, Lee CH, Lee GJ. Persistent trigeminal artery variant detected by conventional angiography and magnetic resonance angiography-incidence and clinical significance-*J Korean Neurosurg Soc.* 2007 Dec; 42(6):446-9. PMID: 19096587.
3. Azab W, Delashaw J, Mohammed M. Persistent primitive trigeminal artery: a review. *Turk Neurosurg.* 2012; 22(4):399-406. PMID: 22843453.
4. Dimmick SJ, Faulder KC. Normal variants of the cerebral circulation at multidetector CT angiography. *Radiographics.* 2009 Jul-Aug; 29(4):1027-43. PMID: 19605654.
5. Pereira LP, Nepomuceno LA, Coimbra PP, Oliveira Neto SR, Natal MR. Persistent trigeminal artery: angio-tomography and angio-magnetic resonance finding. *Arq Neuropsiquiatr.* 2009 Sep; 67(3B):882-5. PMID: 19838522.
6. Panda A1, Arora A1, Jana M1. Persistent primitive trigeminal artery: an unusual cause of vascular tinnitus. *Case Rep Otolaryngol.* 2013; 2013:275820. PMID: 24459596.
7. Uchino A1, Sawada A, Takase Y, Kudo S. MR angiography of anomalous branches of the internal carotid artery. *AJR Am J Roentgenol.* 2003 Nov; 181(5):1409-14. PMID: 14573446.
8. Yeniceri O, Cullu N, Deveer M and Kilinc RM. Persistent Trigeminal Artery Anomaly with Concomitant Basilar Artery Hypoplasia. *Austin J Radiol.* 2015; 2(2): 1014.
9. Chidambaranathan N1, Sayeed ZA, Sunder K, Meera K. Persistent trigeminal artery: a rare cause of trigeminal neuralgia - MR imaging. *Neurol India.* 2006 Jun; 54(2):226-7. PMID: 16804286.