

The Relationship between the Contralateral Posterior Cerebral Circulation Stroke and the Ponticulus Posticus Anomaly: First Report of a Hidden Culprit of the Cause of Stroke

Dear Editor,

Stroke is the second leading cause of disability and the third most prevalent cause of death in India.^[1] Posterior circulation strokes are rare. The primary blood supply for the posterior circulation is the vertebrobasilar system; hence, stenosis or blockage of the vertebrobasilar artery is understandably very concerning.

An important consideration is the cervical spine's morphological characteristics.^[2] There are many anatomical variances in the cervical vertebrae, particularly in the atlas. The atlantoaxial joint accounts for more than half of head rotation.^[3] In this area, an anomaly called the ponticulus posticus (PP) completely or partially encircles the vertebral artery.^[4] It is the emergence of a complete or incomplete bony ridge at the location of the traditional vertebral artery groove (sulcus arteriae vertebralis) on the posterior arch of the atlas.^[5] Signs of vertebrobasilar insufficiency have all been linked to this variant; it can be a risk factor for posterior circulation ischemic stroke. The normal blood flow to the brain and the hindbrain can be diminished by this variant. There have been few comparable in-depth studies of the vertebral artery and analyses of PP-related compromised vertebral artery blood flow to the hindbrain. Currently, imaging tools have shown tremendous progress,^[6] and over the previous 20 years, there has been a notable increase in the incidence of stroke,^[7] but the effect of PP on posterior circulation stroke has not been well known. This paper presents a retrospective analysis of patients who experienced posterior fossa ischemic lesions between 1 January 2017 and 02 July 2023. Informed consent was obtained from all patients. Ischemic lesions in patients were evaluated by an magnetic resonance imaging (MRI). We identified four cases in which posterior circulation ischemic lesions were associated with PP anomalies. All cases were males, with ages ranging between 45 and 56 years old, with a mean age of 50 years old. Atherosclerosis or dissection of the vertebral arteries was not observed.

Case 1: A 53-year-old man was admitted to our hospital with dizziness. Right-side PP grading was 2, and left-side cerebral infarctions associated with hypoplasia of the left vertebral artery were noted on radiological evaluation [Figure 1a-d].

Case 2: A 45-year-old man was admitted to the hospital after a traffic accident. His Glasgow coma scale (GCS) was 12, and a right cerebellar ischemic lesion was detected. Emergent surgical decompression was performed. He recovered completely. In this patient, hypoplasia of the right vertebral artery was associated with left PP. In Figure 2, preoperative

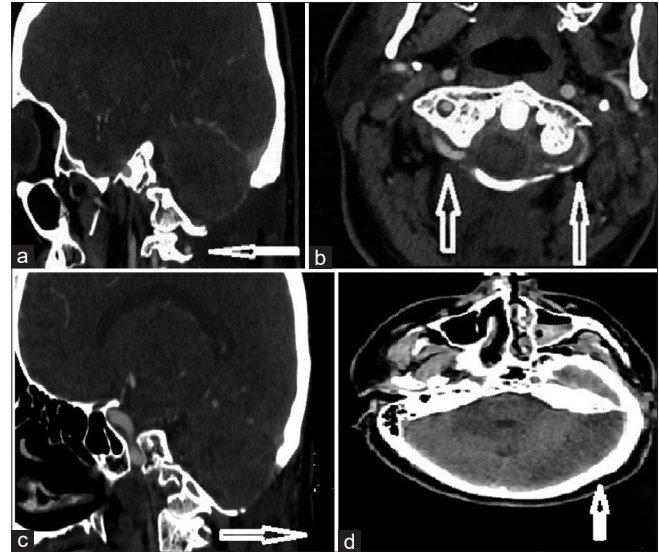


Figure 1: Right-side incomplete PP and contralateral (left-side) cerebral infarctions associated with hypoplasia of the left vertebral artery are shown (a-d). PP: ponticulus posticus

right cerebellar ischemia (a), a hypoplastic right vertebral artery (b and c), and a postoperative view of the posterior fossa with the craniectomy area (d) are shown.

Case 3: A 56-year-old man was admitted to our hospital for headache. Otherwise, his neurological examination revealed no deficit. A right-sided PP anomaly was noted, which was associated with constitutional aplasia of the left vertebral artery and an asymptomatic left-sided cerebellar infarct [Figure 3a and b].

Case 4: A 46-year-old male was admitted to the hospital with vertigo. A bilateral PP anomaly was associated with right vertebral artery stenosis and a large bilateral occipital ischemic lesion [Figure 4a and b]. Understanding the effect of PP anatomy in patients with posterior fossa ischemia is an important issue. A relationship between the presence of a PP anomaly and posterior circulation ischemia has not been reported yet; an association between PP and posterior circulation stroke was shown in this study. The pathologies occurred on the contralateral side of vertebral artery hypoplasia, as can be seen in Figures 1-4. In all cases, other potential causes of ischemic stroke were excluded.

Although the human body appears to be symmetrical along the midline on the surface, it is actually asymmetrical both morphologically and physiologically.^[8] Vascular asymmetry

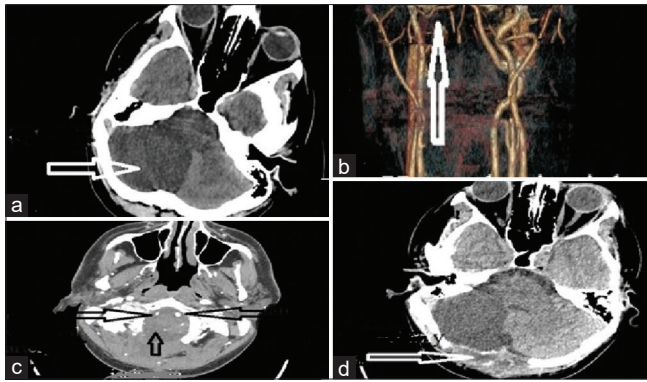


Figure 2: Preoperative view (a), a hypoplastic right vertebral artery (b and c), and a postoperative view of the ischemic lesion in the posterior fossa (d) are shown

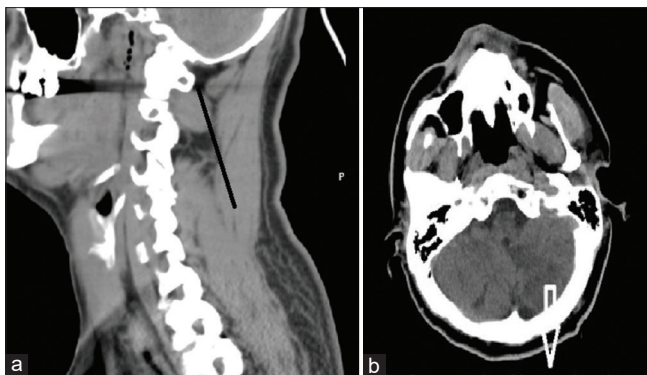


Figure 3: In an asymptomatic case, a PP anomaly on the right side was associated with constitutional aplasia of the left vertebral artery and an asymptomatic left-sided cerebellar infarct (a and b). PP: ponticulus posticus

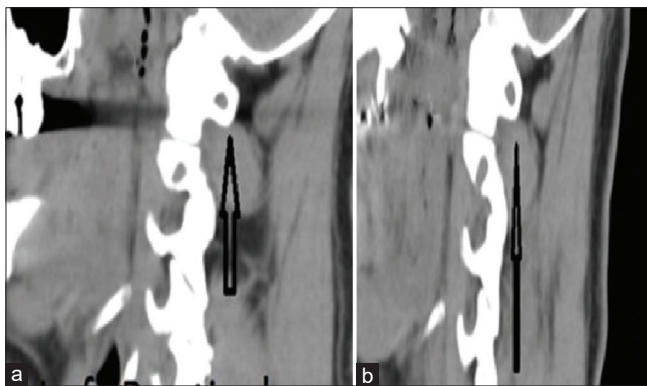


Figure 4: A 46-year-old male with vertigo had bilateral PP anomalies. (a and b). Large bilateral occipital ischemic lesions were also noted in this patient (a and b)

in humans may be impacted by body asymmetry. The contralateral presence of PP-related Vertebral Artery (VA) hypoplasia may be a responsible factor for posterior fossa lesions in all three cases in this study. The PP anomaly may be either unilateral or bilateral. In Case 4, there were bilateral PP anomalies [Figure 4]. The contralateral presence of PP may lead to posterior circulation strokes. Contralateral vertebral

artery hypoplasia associated with a PP anomaly is reported for the first time. We think that vertebral artery hypoplasia associated with a contralateral PP anomaly influences stroke in the posterior circulation. This study, however, serves as a reminder that the laterality of the VA may be associated with the laterality of PP. In the three cases presented, the diameter of the contralateral side (the opposite side of the cerebellar infarct) of the vertebral arteries was relatively larger than that of the ipsilateral side. Hypoplasia or compression of the vertebral arteries in the presence of PP may play a role in blood flow disturbances and aplasia of the vertebral arteries. It is impossible to conclude from these data that VA hypoplasia is not the cause of the stroke. We believe that it is important to learn how PP architecture affects patients with posterior fossa ischemia. Although there is currently no evidence linking PP abnormality to posterior circulation ischemia, this investigation demonstrated a link between the presence of a PP anomaly and contralateral posterior circulation stroke. As seen in Figures 1-4, the lesions arise in the contralateral side of the PP anomaly and the ipsilateral side of vertebral artery hypoplasia. However, this case series contradicts the notion that the infarct is caused by diminished VA blood flow on the ipsilateral side of PP due to dynamic occlusion. We propose that the actual etiology of posterior circulation stroke could be vertebral artery hypoplasia on the contralateral side of the PP anomaly.

There is currently no agreement on PP's preference for gender (male versus female), location (left versus right), or age. All three patients in this study were of old age (over 40 years). We noted that all three cases in this study were male. It is currently unclear how vertebral artery hypoplasia contributes to the pathogenesis of stroke. The three patients in this study did not have any symptoms before the stroke.

For ethical reasons, we were unable to investigate whether these patients had a fetal posterior communicating arteries (PCom). Although angiography was not possible in these patients, we intend to conduct a study in the future on the effect of the fetal Pcom artery in the presence of the ponticulus posticus anomaly.

Narrowing of the vessel lumen is a hallmark of large-vessel cerebral atherosclerotic stenosis, a more severe form of atherosclerotic disease.^[9] Vascular asymmetry in humans may be impacted by body asymmetry.^[10] According to this study, morphological deformation in the vertebrobasilar arterial system may be influenced by the unequal mechanical forces resulting from altered flow associated with the asymmetric PP anomaly. Consequently, these deformations may asymmetrically induce the development of infarcts in the posterior fossa. The PP anomaly-related contralateral hypoplasia of the vertebral arteries in the cases reported in this study can be attributed to both development and regression failures of the vertebral arteries. For the first time, this study suggests that the ipsilateral vertebral artery is protected by the PP anomaly. The information in this report will be helpful

in evaluating imaging of individuals who have had posterior circulation strokes.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and that due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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