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Collateral miracle: adequate cerebral circulation with only right ICA

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ABSTRACT

Objective: Collateral circulation is essential for cerebral perfusion and the maintenance of cerebral metabolism and function. The clinical factors affecting the collateral circulation in the brain is still unknown. In the presence of slowly developing stenosis, the decrease in cerebral blood flow can be compensated by adequate collateral circulation, and signs of cerebral hemodynamic deterioration may not be observed.

Case: This case with a 6-year retrospective record and adequate cerebral circulation with only right Internal Carotid Artery (ICA) is presented.

Keywords: Collateral circulation, perfusion, ischaemic compensation

INTRODUCTION

Collateral circulation is essential for cerebral perfusion and the maintenance of cerebral metabolism and function. Many studies have demonstrated the importance of adequate hemodynamic compensation via collaterals in patients with cerebral artery stenosis (1). The clinical factors affecting the collateral circulation in the brain is still unknown. In the literature, studies on this subject are limited. It is hypothesized that it may be the direct effect of decreased cerebral blood flow or the resulting hypercapnia (2). In the presence of slowly developing stenosis, the decrease in cerebral blood flow can be compensated by adequate collateral circulation and signs of cerebral hemodynamic deterioration may not be observed (3). Asymptomatic bilateral ICA occlusion or asymptomatic basilar artery occlusion have only been reported as rare case. Since the literature on carotid occlusion accompanying basilar artery occlusion is limited, apart from developmental agenesis; this case with a 6-year retrospective record and adequate cerebral circulation with only right ICA is presented.

CASE

A 57-year-old male patient presented to the emergency department with a complaint of staggering gait in September 2022. The patient had a BMI of 34.1, Diabetes Mellitus, Hypertension, Hyperlipidemia, and he was a smoker with 80 pack/year use. He regularly took acetylsalicylic acid and clopidogrel due to a history of two ischemic strokes in 2016 and 2019, but he had not presented to the hospital for follow up since 2019 due to the Covid-19 pandemic. In the neurological examination, no pathological finding was detected, except for difficulty in walking on a single line. This was a long standing and sequela from his previous stroke. The patient's medical records were reviewed for further information on cerebral circulation: It was learned from his medical documents that he was admitted to the hospital for the first time in 2016 with altered consciousness, behavioral changes, left facial droop, and left 4/5 hemiparesis in his neurological examination. A diffusion MRI revealed a 16 mm ischemic area in the left thalamus. Cardiac examinations were unremarkable. In carotid-vertebral artery Doppler duplex ultrasonography (USG), a fibrofatty plaque formation was reported, which extends from the left bulbus level to the left proximal internal carotid artery (ICA) causing 50-70% stenosis in the lumen, and forward high resistance flow patterning the left vertebral artery. CT angiography was recommended if necessary in terms of distal stenosis. In cervical MR angiography (MRA), 50% stenosis in the left ICA, widespread atherosclerotic changes in the vertebral arteries, widespread dolichoectatic enlargements in the vertebral basilar system and basilar artery were detected. Antiplatelet therapy, control of risk factors, and neurological follow-up were recommended for the patient (Picture 1).

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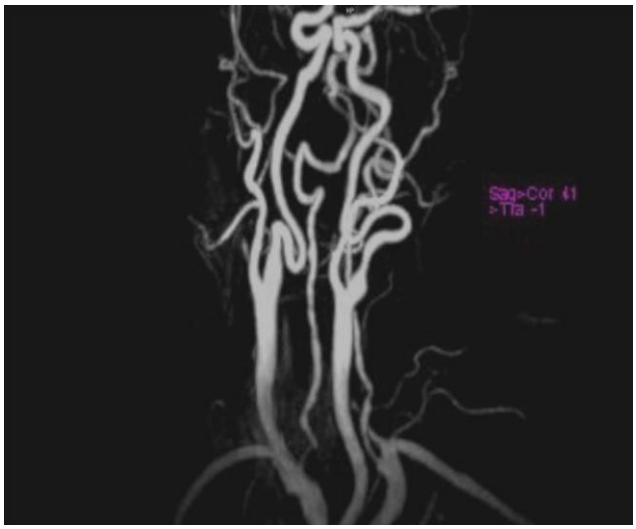
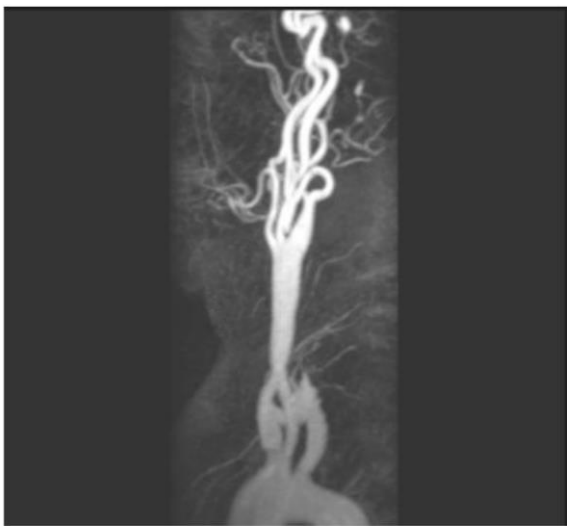
It was discovered that the patient was admitted to the emergency department again in 2019 with speech slurring and difficulty swallowing. In his neurological examination, he had dysarthria, right central facial paralysis, -5/5 strength in the left upper and lower extremities, broad-based gait and could not walk in a single line. Diffusion MRI revealed acute ischemic infarction in the right half of the pons. In cervical MRA, it was seen that there was 50% stenosis in the left ICA, a thrombus in the basilar artery, the posterior system was not observed, and the basilar artery was filled from the posterior communication (**Picture2**).

It was learned that the patient was treated with dual antiaggregant therapy, control of risk factors, and neurological follow-up were recommended, but the patient didn't present to the hospital due to the pandemic. There was no acute ischemia in the diffusion MRI. However, in other sequences, tubular structures with calcified walls were observed in the parietooccipital extra-axial distance in the left cerebral convexity. CT Angiography (CTA) revealed, occlusion of both vertebral arteries and basilar artery and occlusion of left ICA as well as a 9 mm fusiform aneurysmatic enlargement in the distal basilar artery (**Picture3**).

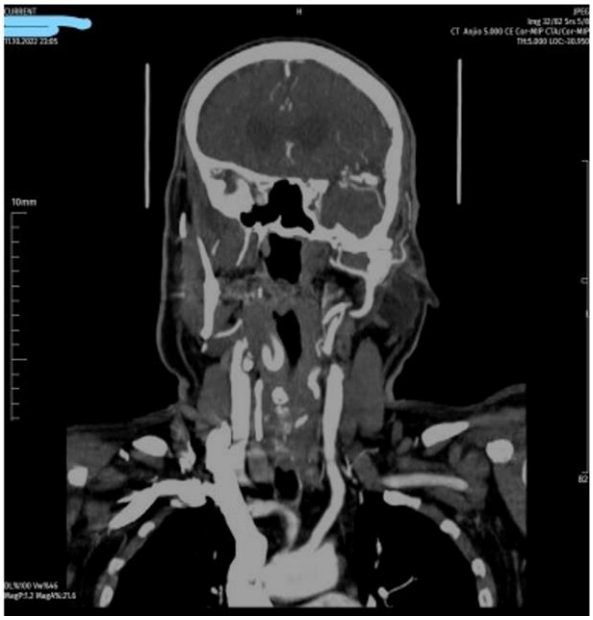
The patient was discussed with interventional neuroradiology and cardiovascular surgery, but intervention was not considered due to the high risk of the procedure. Conservative management and follow-up with best medical treatment was recommended.



Picture 1: cervical MR angiography (MRA)



Picture 2: In cervical MRA, it was seen that there was 50% stenosis in the left ICA, a thrombus in the basilar artery



Picture 3: CT Angiography (CTA) revealed, occlusion of both vertebral arteries and basilar artery and occlusion of left ICA as well as a 9 mm fusiform aneurysmatic enlargement in the distal basilar artery

DISCUSSION

The status of collateral circulation can provide clinicians with an idea about the potential progression of an ischemic event that the patient may experience in the future. Carotid artery stenosis can lead to a decrease in cerebral blood flow and may induce angiogenesis as a result of hypoxia or induced hypercapnia (4). There are studies reporting the association of symptomatic carotid artery stenosis with collateral development (5). In a study conducted on 42 patients with symptomatic carotid stenosis, researchers evaluated the leptomeningeal and opthalmic collaterals with the collaterals in Willis poligon and revealed that any presence of leptomeningeal or ophtalmic collaterals is associated with the increased oxygen extraction fraction of the increased cerebral metabolism (2In a different study involving patients with severe carotid artery stenosis (>90%), their carotid arteries were assessed using MR angiography and carotid-vertebral artery Doppler duplex USG. It was found that collateral development had a positive effect on brain hemodynamics in the group with unilateral carotid artery stenosis (5). Our patient had a BMI of 34.1 and a history of waking up with snoring and shortness of breath at night, suggesting possible obstructive sleep apnea syndrome (OSAS). This situation was also considered as an extra cause of hypercapnia.

In the cranial MRI examination of our case, the tubular structures with calcified walls in the parietooccipital extra axial distance, are thought to be leptomeningeal collaterals.

Occlusion of the basilar artery is mainly of atherosclerotic origin; embolic occlusion, dissecting aneurysm, trauma, and arthritis are less common causes. Basilar artery occlusions are classified into three groups according to the pathological and angiographic findings: segmental (superior, medial, or inferior), multisegmental, and diffuse. Clinically, a prodromic phase is characterized by transient ischemic attacks (dizziness, headaches, visual disturbances, motor deficiency). After a few weeks, decreased level of consciousness and motor anomalies become the most important symptoms (6).

In one of the cases presented by Labauge et al., the association of the basilar artery and left ICA occlusion is mentioned in a patient who presented with hemiplegic stroke and recovered completely. It has been interpreted that long-term survival may occur after basilar artery occlusion if the occlusion is limited to the lower or middle part of the basilar artery and has good collateral feeding from the carotid and cerebellar arteries (7). In addition, congenital developmental anomalies were presented as cases (8).

The 9 mm fusiform aneurysmatic enlargement in the distal basilar artery detected in this case may have been caused by severe arteriosclerosis and hypertension in addition to the increased hemodynamic stress distal to the occlusion (9).

Cerebral vascular variations are classified as fenestrations, examples of vessels in the polygon of Willis, persistent fetal carotid-vertebrobasilar anastomoses, ICA, and annotations of the vertebral artery.

Posterior cerebral artery (PCA) of fetal origin due to regression reproduction of embryonic posterior communicant arter (PcoA), dominant feeding of the occipital lobe is relaxing from the ICA rather than the vertebrobasilar system (10). PCA originates from the ICA rather than the basilar artery. Fetal PCA was not defined in the case, and P1 hypoplasia and PcoA were evaluated as open.

Remains of the first symptoms of families with no new state certainty, almost without sequelae due to their old effects, extracranial artery stenosis was detected in 2016, and it was understood that it became stenotic in 2019. Interventional parodies have been interrupted by the pandemic process. The patient had a BMI of 34.1 and a history of nocturnal snoring and shortness of breath, suggesting possible OSAS. This is an extra cause of hypercapnia. The case gives us a 6-year history of the development of collateral growth and reveals the negative environment to limit the pandemic.

CONCLUSION

When there is enough time, the entire arc of Willis's “miraculous” polygon in the brain is lifesaving..

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