Case Report

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Asymptomatic Common Carotid Artery Occlusion and Occipital-Vertebral Artery Anastomosis: A Case Report and Literature Review

무증상의 총경동맥폐쇄 및 후두동맥-척추동맥 문합: 증례 보고 및 문헌 고찰

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Common carotid artery occlusion (CCAO) is a very rare disorder that has rarely been studied. CCAO causes several neurological symptoms but can sometimes be asymptomatic due to the development of various anastomoses. Herein, we report the case of a 70-year-old male patient diagnosed with asymptomatic CCAO due to anastomotic flow. The patient underwent transfemoral cerebral angiography (TFCA) and was found to have CCAO with two collateral pathways, including an occipital artery-vertebral artery anastomosis. We emphasize the importance of TFCA when CCAO is suspected and review the types and anastomotic pathways of CCAO.

Index terms Common Carotid Artery Occlusion; Collaterals; Occipital Artery; Vertebral Artery; Case Report

INTRODUCTION

Common carotid artery (CCA) occlusion (CCAO) is a very uncommon disorder, and the associated anastomotic pathways are rarely known (1). In patients with symptomatic cerebro-

vascular disease, the incidence of CCAO ranges from 1% to 5% (2). As a result of cerebral hypoperfusion and embolism, the majority (88.7%) of patients with CCAO exhibit symptoms including transient ischemic attacks (TIAs) and hemiparesis (3, 4). In this respect, not only is CCAO rare, but asymptomatic CCAO is even rarer. According to Riles classification (Fig. 1A), the four types of CCAO in descending order of incidence are (5): 1A, 1B, 2 and 1C (3, 4).

Thrombosis of advanced atherosclerotic plaques is the most common cause of CCAO, while additional factors such arteritis, trauma and fibromuscular dysplasia have also been observed (6). Atherosclerotic plaques are commonly seen in the carotid bifurcation, and plaques can extend retrogradely along the CCA (3, 6). However, due to collateral circulation, the ipsilateral internal carotid artery (ICA) and external carotid artery (ECA) are frequently patent (1). Occipital artery (OA)–vertebral artery (VA) anastomosis is one of the most prevalent collateral pathways between the external carotid and vertebrobasilar systems. Owing to this anastomosis, CCAO can be occasionally asymptomatic and is incidentally depicted on a cerebral angiography in situations of carotid or vertebral artery occlusion (7).

Here, we present a case of asymptomatic CCAO in a male patient with OA-VA and additional anastomoses. We also present a review of anastomotic pathways and their patterns.

CASE REPORT

A 70-year-old male with a history of cerebrovascular accident visited our neurology outpatient clinic for medical treatment. The patient also presented with mild cognitive impairment without a history of head injury. There was no focal neurological deficit on neurological examination. MRI and MR angiography (MRA) showed right CCAO with right cerebral hemispheric perfusion delay and old infarcts without evidence of acute infarction (Fig. 2A).

The patient was hospitalized for further evaluation. Diagnostic transfemoral cerebral angiography (TFCA) showed right proximal CCAO as well as a patent ICA and ECA with OA-VA anastomosis (Fig. 2B, and schematic diagram in Fig. 1B, far left). This pattern can be classified as type 1A as per the Riles classification, and it is the most common pattern of CCAO seen. Additionally, in this patient, there was another collateral pathway supporting the right ICA flow: the costocervical trunk (CCT) – deep cervical artery (DCA) – OA – ECA (Fig. 2B, middle and Fig. 1B, middle left). Additional findings of the TFCA included a left dominant A1 segment of the anterior cerebral artery without a sufficient blood supply of right cerebrum via the anterior communicating artery. The right distal VA was completely occluded, and reverse flow was noted from the left distal VA (Fig. 2B, right).

Because the patient had no symptoms of CCAO, no additional endovascular treatment or surgery was required. He is currently on medical treatment with aspirin, clopidogrel, and rosuvastatin and is being followed up on an outpatient basis.

This case report was approved by the Institutional review board at Seoul Medical Center. Informed consent requirement was waived (IRB No. 2022-05-003).

DISCUSSION

We have summarized the pattern of collateral supplies in patients with CCAO that can ex-

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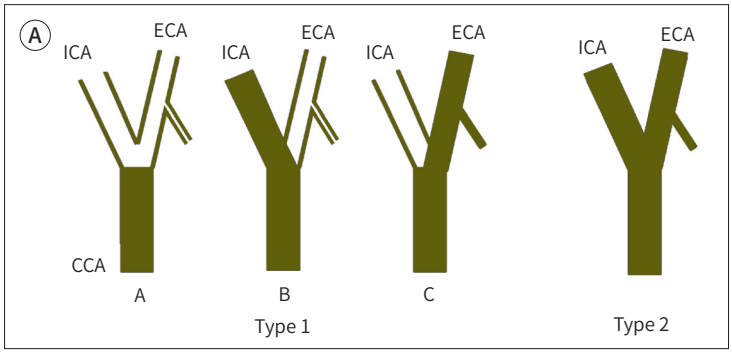
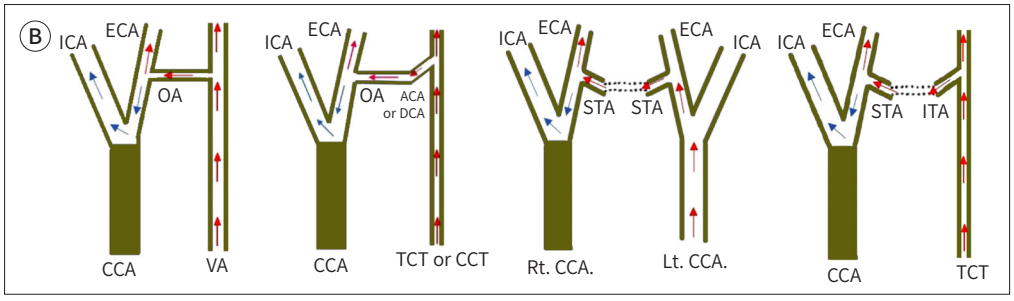
Fig. 1. Schematic diagrams of classification and collateral pathways.
A. Riles classification of four types of CCAO: type 1A (far left) with a patent ICA and ECA, type 1B (middle left) with an occluded ICA and patent ECA, type 1C (middle right) with a patent ICA and occluded ECA, and type 2 (far right) with an occluded ICA and ECA.
B. Schematic diagram of anterior and posterior circulation anastomosis. Pathway 1 (far left): ipsilateral VA – OA – ECA – ICA. Pathway 2 (middle left): ipsilateral TCT or CCT – ACA or DCA – OA – ECA – ICA. Pathway 3 (middle right): contralateral ECA – contralateral STA – ipsilateral STA – ipsilateral ECA – ICA. Pathway 4 (far right): ipsilateral TCT – ITA – STA – ECA – ICA.
C. Possible various anastomoses between the anterior and posterior circulation of the head and neck.
ACA = ascending cervical artery, AICA = anterior inferior cerebellar artery, CCAO = common carotid artery occlusion, CCT = costocervical trunk, DCA = deep cervical artery, ECA = external carotid artery, ICA = internal carotid artery, ITA = inferior thyroid artery, OA = occipital artery, PCOM = posterior communicating artery, PICA = posterior inferior cerebellar artery, SCA = superior cerebellar artery, STA = superior thyroid artery, TCT = thyrocervical trunk, VA = vertebral artery





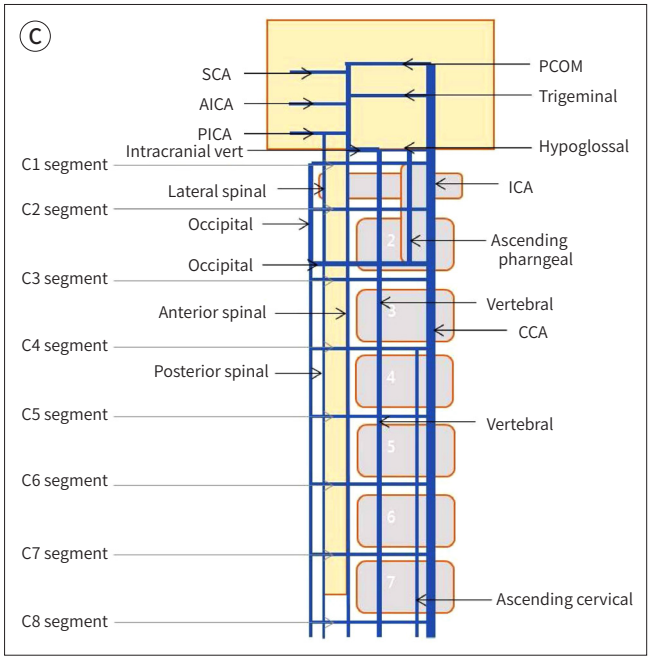
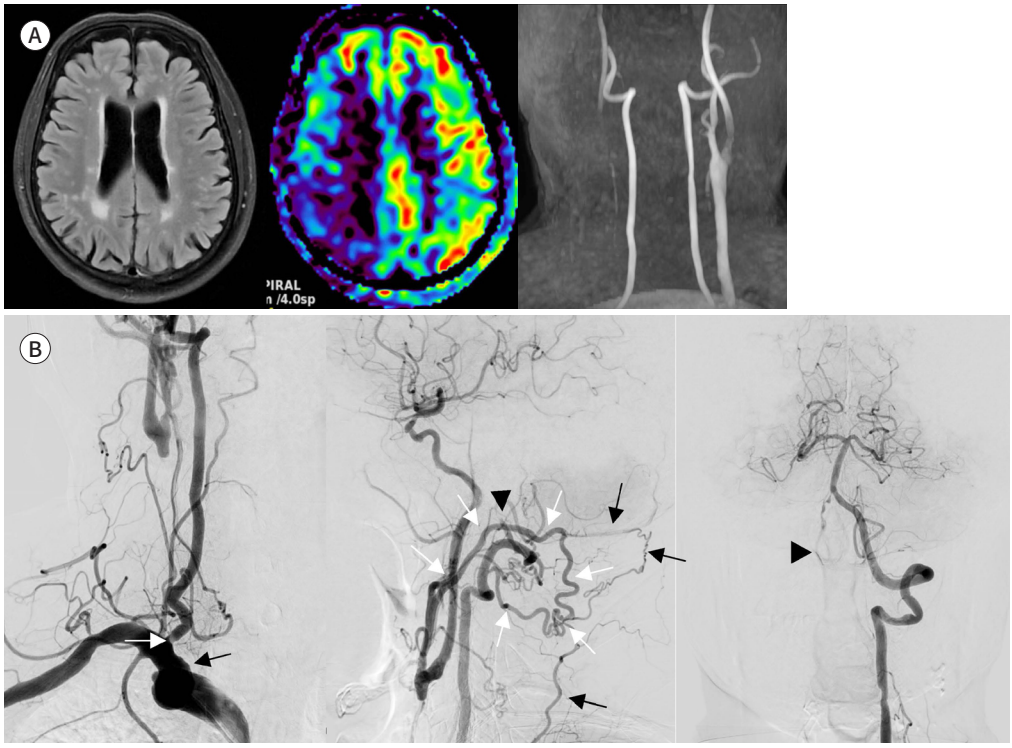


Fig. 2. CCAO and OA-VA anastomosis in a 70-year-old male.
A. Brain MRI and neck MRA. T2 FLAIR (left) shows mild small vessel disease without infarction in the anterior and middle cerebral artery territory. CBF perfusion MRI (middle) depicts perfusion delay in the right cerebral hemisphere. Neck MRA (right) depicts the non-visualized right distal CCA, proximal ICA, and ECA.
B. Transfemoral cerebral angiography. Right common carotid angiography AP view (left) shows total occlusion of the right distal CCA with only visualization of the stump (black arrow) and mild stenosis of the right VA orifice (white arrow). Right VA angiography lateral view (middle) reveals OA-VA anastomosis (white arrows) and CCT – DCA – OA – ECA anastomosis (black arrows). There is total occlusion of the right distal VA (arrowhead). Left VA angiography AP view (right) also demonstrates total occlusion of the right distal VA (arrowhead).
CBF = cerebral blood flow, CCA = common carotid artery, CCAO = common carotid artery occlusion, CCT = costocervical trunk, DCA = deep cervical artery, ECA = external carotid artery, FLAIR = fluid-attenuated inversion recovery, ICA = internal carotid artery, MRA = MR angiography, OA = occipital artery, VA = vertebral artery



plain the asymptomatic status. OA-VA anastomosis is one of the most common collateral pathways between ECA and vertebrobasilar systems (7). It is seen in almost all cases at autopsy, but its prevalence in cerebral angiography varies from 0.8% to 4%. However, in a study of patients who underwent carotid artery stenting due to carotid artery stenosis, the frequency of OA-VA anastomosis was higher at 14.9% (7 out of 47) (8). Among a total of 23 cases of OA-VA anastomosis found in extracranial main arterial trunks occlusive disease, seven cases were ICA stenosis/occlusion and two cases were CCAO, according to a previous literature review conducted by Miyachi et al. (9).

CCAO is a relatively rare condition whose natural history and therapeutic recommendations remain unclear. The use of medical treatment alone is permissible for asymptomatic individuals (3, 4). As treatment alternatives, surgery, thrombectomy and revascularization using a bypass graft might be included. CCAO usually manifests as symptoms of hemispheric stroke and brain hypoperfusion such as amaurosis fugax (3). These symptoms may be pri-

marily caused by decreased cerebral perfusion or, less frequently, by carotid stump emboli that reach the brain (4, 10).

In asymptomatic patients with CCAO, adequate collateral circulation to the proximal ECA branch maintains ICA perfusion and protects against cerebral infarction (6). In the present case, perhaps the most important finding was that total occlusion of the distal CCA was not abrupt since atherosclerotic occlusive disease is a chronic process.

Changes in blood pressure is the primary driving force behind the formation of collateral circulation. When the CCA is blocked, blood pressure in the ipsilateral proximal ICA can be significantly lower than that in proximal ECA. As a direct consequence of this, the blood flow in the ipsilateral ECA may be redirected towards the ipsilateral proximal ICA. Therefore, the ICA "steals" blood from the ECA (1). Following the "steal" phenomenon, there are many collateral circulation pathways, such as pathway 1) ipsilateral VA – OA – ECA – ICA; pathway 2) ipsilateral thyrocervical trunk (TCT) or CCT – ascending cervical artery (ACA) or DCA – OA – ECA – ICA; pathway 3) contralateral ECA – contralateral superior thyroid artery – ipsilateral superior thyroid artery – ipsilateral ECA – ICA; and pathway 4) ipsilateral TCT – inferior thyroid artery – superior thyroid artery – ECA – ICA (schematic diagram in Fig. 1B) (1). Our patient had one 'pathway 1' anastomosis and another 'pathway 2' anastomosis. Because there is a lattice of transverse and longitudinal vessels in the head and neck (Fig. 1C), anastomosis is possible at any time and level of connection.

TFCA is the gold standard for the diagnosis of CCAO with anastomosis. It can show dynamic steal flow over time. It is therefore important to conduct diagnostic TFCA when CCAO is either suspected or diagnosed using CT angiography or MRA.

Author Contributions

Conceptualization, C.Y., B.J.S., C.H.S.; project administration, B.J.S.; supervision, B.J.S.; visualization, C.Y.; writing—original draft, C.Y.; and writing—review & editing, all authors.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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무증상의 총경동맥폐쇄 및 후두동맥-척추동맥 문합: 증례 보고 및 문헌 고찰

최유나[1] · 변준수[1]* · 최현석[1] · 최진교[2] · 김성훈[3]

총경동맥 폐쇄는 비교적 드물고 거의 연구되지 않은 질병이다. 총경동맥 폐쇄는 여러 신경학적 증상을 유발하지만 다양한 문합의 발달 덕분에 때때로 무증상일 수 있다. 저자들은 문합을 통한 혈류로 인한 무증상 총경동맥 폐쇄 환자의 증례를 보고하고자 한다. 환자는 경대퇴동맥 뇌혈관 조영술을 시행하여 총경동맥 폐쇄와 후두 동맥-척추 동맥 연결을 포함한 두 가지 측부 경로가 있는 것으로 확인되었다. 저자들은 총경동맥 폐쇄가 의심되는 경우 경대퇴동맥 뇌혈관 조영술 시행이 중요함을 강조하고, 총경동맥 폐쇄의 유형 및 문합 경로를 문헌고찰하였다.

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