Case Report

Newly developed twisted carotid bifurcation on the left side incidentally diagnosed by magnetic resonance angiography

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A B S T R A C T

We herein report a case of left twisted carotid bifurcation (TCB) that newly appeared on follow-up examination. The patient was a 71-year-old woman with neck bruit and hyperlipidemia underwent neck magnetic resonance angiography. The left carotid bifurcation showed a normal branching pattern. Two years later, a follow-up examination was performed, and the left internal carotid artery (ICA) ran medial to the external carotid artery (ECA), indicating TCB. On the right side, the ICA ran dorsal to the ECA. The prevalence of TCB is reported to be 3.6%-15.1%. According to a review of the relevant literature, >80% of TCBs were found on the right side. TCB is generally considered to be a result of excessive lateral migration of the ECA during embryogenesis, and age-related atherosclerotic elongation and tortuosity of the carotid arteries may be another cause. In the case of TCB, carotid endarterectomy (CEA) is slightly difficult and slightly dangerous, because the affected ICA lies behind the ECA, and superior laryngeal nerve injury rarely occurs. TCB is not uncommon, but there is greater frequency on the right side. It may also newly develop. It is important to conduct a radiological evaluation of TCB before performing CEA.

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Introduction

Usually, the internal carotid artery (ICA) lies posterolaterally to the external carotid artery (ECA). Sometimes, however, the ICA lies posteromedially to the ECA. This variation has several names: (1) lateral position of the ECA [1,2], (2) dorsal/dorsomedial ICA origin [3], (3) complete transposition of carotid bifurcation [4], and (4) twisted carotid bifurcation [5–8]. In this case report, we used the name twisted carotid bifurcation (TCB).

The reported prevalence of TCB ranges from 3.6% [4] to 15.1% [7]. It most frequently occurs on the right side [2,3,5–8]. We herein report a case of left TCB that newly developed dur-
ing 2 years of follow-up, which was diagnosed by magnetic resonance (MR) angiography.

**Case report**

A 71-year-old woman with neck bruit and hyperlipidemia underwent neck MR angiography, cranial MR angiography, and cranial MR imaging with 3.0-Tesla scanner (Signa Architect, GE Healthcare, Milwaukee, WI, USA). MR angiography of the neck was performed using a standard 3-dimensional time-of-flight technique. The imaging parameters were as follows: repetition time, 18.0 s; echo time, 3.4 s; and slice thickness, 1.8 mm.

MR angiography of the neck revealed mild stenosis of the right ICA at its origin, which was located dorsal to the right ECA. The left ICA was normally located posterolateral to the left ECA (Fig. 1). Cranial MR angiography showed no significant sten/oocclusive arterial lesions (not shown). Cranial MR imaging revealed no abnormality, with the exception of nonspecific small white matter lesions.

Two years later, follow-up examinations were performed using the same machine with the same imaging protocol. During the 2-year period, she did not experience neck surgery or neck trauma. She had no new neck lesions. MR angiography of the neck revealed no progression of mild stenosis of the right ICA origin, which was located posterior to the right ECA. The left ICA was newly located posteromedial to the left ECA, indicating TCB (Fig. 2).

The patient was not examined with other imaging modalities, such as ultrasound, computed tomography angiography, or catheter angiography. She was treated conservatively with HMG-CoA (3-hydroxy-3-methylglutaryl-coenzyme A) reductase inhibitor. Her clinical course was uneventful.

**Discussion**

The origin of the ICA is one of the most common regions for atherosclerotic stenosis. Both carotid endarterectomy (CEA) and carotid artery stenting (CAS) are common treatments for carotid artery stenosis. In the case of TCB, CEA is slightly difficult because the affected ICA lies behind the ECA during the anterolateral neck approach. Marcucci et al. [4] reported that superior laryngeal nerve injury occurred in 2 of 11 TCB cases treated by CEA. Thus, a preoperative diagnosis of TCB is important. In contrast, CAS can be performed easily and safely. Because CAS is operated under fluoroscopic guidance. Using 58 consecutive CEA cases that were preoperatively examined by catheter angiography, Kamide et al. [6] classified patients into 3 groups: type 1 (ICA runs laterally, normal, n = 24), type 2 (ICA runs behind ECA, n = 30), and type 3 (ICA runs medially, TCB, n = 4). In 3 of the 30 type 2 cases, the ICA ran behind the ECA during the anterolateral neck approach. Thus, the prevalence of TCB on angiography was 6.9% (4/58), while that at surgery was 12.1% (7/58). TCB does not seem to be uncommon, especially in the elderly population. Its
reported prevalence is between 3.6% [4] and 15.1% [7]. This wide range may be due to different diagnostic methods and criteria. The right side of our patient showed type 2, and the left side dramatically changed from type 1 to type 3.

TCB most frequently occurs on the right side [2,3,5–8]. According to a literature review, more than 80% of TCBs were found on the right side [7]. The reason for the right-side predominance is unclear; however, structural differences such as the presence of the brachiocephalic trunk on the right side might be involved [4]. Katano and Yamada [5] reported a female predominance in TCB among CEA patients; male (3/65, 4.6%) and female (4/10, 40%). However, no other authors mentioned sex predominance.

Our patient was an elderly woman with hyperlipidemia and left TCB, which newly appeared at a follow-up examination. To our knowledge, no similar cases have been reported in the relevant English-language literature. TCB is generally considered to be a result of excessive lateral migration of the ECA during embryogenesis (congenital factor), and age-related atherosclerotic elongation and tortuosity of the carotid arteries (acquired factor) may be another cause [4]. From the common carotid artery to the cervical ICA, the artery runs up within the loose soft tissue of the neck. This is the reason why the cervical ICA can take a tortuous course. Our patient had no history of surgery or trauma involving the left neck. Thus, the TCB of our patient is considered to have been formed as a result of progression of atherosclerotic elongation. Baba et al. reported cases of wandering carotid artery diagnosed by computed tomography [9] and MR angiography [10].

TCBs are usually asymptomatic and are not clinically significant, except for during CEA. Ueda et al. [1] reported a case of hypoglossal nerve palsy that was caused by the combination of TCB and high carotid bifurcation. In that case, the right hypoglossal nerve, at the level of just above the carotid bifurcation, was compressed toward the outside. Among patients with TCB, the cervical ICA sometimes takes an extremely tortuous course, and reaches the midline retropharyngeal space. This type of aberrant ICA is dangerous during pharyngeal surgery [9,11].

**Conclusion**

We reported a case of left TCB that newly developed. TCB is not uncommon. Although the reason is unknown, it most frequently occurs on the right side. TCB is clinically significant during CEA. Because in the case of TCB, the affected ICA lies behind the ECA during the anterolateral neck approach.

**Patient consent**

Informed consent was obtained from the patient for publication of the case report.
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