Ultrasonographic, CTI and MRI of Aberrant Internal Carotid Artery: Infrequent but Important to Know

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Abstract

Keywords

- ▶ aberrant internal carotid artery
- ▶ artery
- ▶ duplex
- ▶ internal carotid artery
- ▶ retrotympenic mass
- ▶ stroke
- ▶ vascular anomaly

This article describes the aberrant course of the internal carotid artery (ICA) through the middle ear as an extremely rare vascular anomaly. On the basis of a case report, the findings of magnetic resonance imaging, computed tomography imaging, and especially color-coded duplex sonography are presented. The diagnosis of an aberrant ICA is important to avoid severe surgical complications of a retrotympenic mass as well as unnecessary diagnostic or therapeutic approaches in expectation of a stroke.

Aberrant course of the internal carotid artery (ICA) through the middle ear is an extremely rare vascular anomaly and can cause pulsatile tinnitus and retrotympenic mass. The clinical manifestation includes hearing impairment, tinnitus, recurrent otitis media, or vertigo. Aberrant course of ICA can be associated with a cerebral arteriovenous malformation or intracranial aneurysm.^{1–3}

We present a case of aberrant course of ICA with a small common carotid artery (CCA) and absence of a regular CCA bulb. On the basis of a case report, the findings of magnetic resonance imaging (MRI), computed tomography imaging (CTI) and color-coded duplex sonography are presented.

Case Report

A 58-year-old woman presented in our emergency department with an in the course of a routine examination

suggested occlusion of the left ICA on the basis of an outpatient ultrasonographic examination and MRI scan. MRI revealed next to a suggested occlusion of the left ICA, a high variant of the CCA bulb and extraordinary extra-intracranial anastomosis. The medical history shows a difficult surgery of an osseous fixation of the malleus in 2002 and a pulse-synchronous tinnitus left. Physical and neurological examination showed no abnormalities. In color-coded duplex ultrasonography, we found atherosclerotic plaques with a local degree of stenosis at 30% in the right carotid bulb and a stenosis of the right external carotid artery. Also, we found a significant difference in the diameter of the CCA (left 3.8 mm, right 5.6 mm) and a small effect of compression of the suggested external carotid artery left (–Figs. 1–3; Philips HD 15, Eindhoven, the Netherlands; Linear Transducer 12 MHz, Eindhoven, Nordbrabant, the Netherlands).

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Fig. 1 Ultrasonographic findings of the right common carotid artery in longitudinal section, diameter 0.564 cm.

With intracranial color-coded duplex ultrasonography, we found regular anatomic and hemodynamic findings with exception of a small, nonsignificant difference of blood flow in the siphon of the ICA without a difference in pulsatility. On the basis of the diameter difference of the CCA and the absence of other pathological hemodynamic parameters, we diagnosed an aberrant course of the ICA. The contrast-enhanced magnetic resonance angiography (CE-MRA) revealed a difference in diameter of the CCA without a regular bifurcation on the left side (► Fig. 4; Philips Intera, Eindhoven, TE: 10 milliseconds, TR: 1,007 milliseconds, contrast material gadobutrol 7.5 mL, 2.5 mL/s). The external carotid artery right was shown regular. The A1 segment of the left anterior cerebral artery was hypoplastic. There was no significant stenosis of the intra- and extracranial vessels at all in CE-MRA as well as in colored-coded duplex sonography. CT of the temporal bones showed a course of the left ICA through the

Fig. 2 Ultrasonographic findings of the left common carotid artery in longitudinal section, diameter 0.389 cm.

middle ear. The carotid canal on the left side was clearly smaller as compared with the right side, which established in summary the diagnosis of an aberrant ICA (► Fig. 5).

Discussion

Aberrant course of the ICA through the middle ear is a rare but important vascular anomaly with typical clinical manifestation of hearing impairment, tinnitus, or vertigo. The incidence is still unknown. Mayerson et al reported an incidence approximately 1%.⁴ Aberrant ICA can rarely occur bilaterally.^{5,6} Embryologically, the vascular anomaly is a maldevelopment of the aortic arch I–III^{2,7} with a hypoplasia of the carotid canal in the temporal bone. Some variants of the maldeveloped segments of the aortic arch, CCA, and ICA with different kind of collateral anastomoses are known.^{2,7,8} Aberrant ICA can be identified in otoscopy as a retrotympanic mass. Lapayowker et al established diagnostic criteria with typical CT angiographic findings including a lateral extension of the ICA beyond a “vestibular line.” This was defined as a vertical line right down from the vestibule of the middle ear.⁹ Lo et al described other diagnostic findings which include the absence of the vertical carotid canal, an enlargement of the inferior tympanic canaliculus, an aberrant course of the artery through the hypotympanum, and a dehiscence of the carotid plate through which the artery enters into the horizontal carotid canal.¹⁰ Misdiagnosis before a middle ear surgery can lead to stroke, hemorrhage, or loss of hearing.

This case report is the first that described ultrasonographic findings in case of an aberrant ICA. It seems important that in neurovascular ultrasound a significant difference in the diameter of the CCA and a small effect of compression of the suggested aberrant ICA in combination with absence of other pathological hemodynamic findings may lead to the diagnosis. Up to now, there are no data defining a reliable normal range of the ICA diameter due to agenesis or hypoplasia.¹¹

This patient had an anomalous ICA, origin from the CCA as well as a cerebral hypoplasia of the left anterior cerebral artery and aberrant course of the ICA in the temporal bone. Moreover, the carotid canal is often missing or very small. This might speak for the diagnosis of an aberrant course of the ICA, but it can also be a sign for a chronic inflammatory disease such as a chronic middle ear infection.¹² Differential diagnosis should include a high dehiscent jugular bulb, a glomus jugulare tumor or glomus tympanicum tumor⁵ or a pulsatile tinnitus because of a stenosis of the ICA.¹³

We have shown that neurovascular ultrasound may lead the way to the diagnosis of an aberrant course of the ICA. Moreover, the differential diagnosis of this rare vascular anomaly should be kept in mind in the diagnosis of an occlusion in younger asymptomatic stroke or patients with TIA.

Conclusion

The aberrant course of the ICA is a rare vascular variant. Specific findings in duplex sonography such as significant difference in the diameter of the CCA and a small effect of compression of ICA in combination with absence of other pathological

Fig. 3 Colored-coded duplex ultrasound of the left internal carotid artery with small effect of compression (arrow) and normal pulsatility.

hemodynamics can differentiate aberrant ICA from other clinical disorders, especially from an ICA occlusion. The diagnosis of an aberrant ICA is important to avoid severe surgical complications of a retrotympenic mass as well as unnecessary diagnostic or therapeutic approaches in expectation of a stroke.

Fig. 4 Contrast-enhanced magnetic resonance angiography shows the aberrant course of the thin left internal carotid artery. (a) Lateral view from right (b) anteroposterior view.

Fig. 5 Bone window cranial computed tomography scan showing narrowing of the left carotid canal and aberrant course of the artery through the hypotympanum (arrows).

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