

Carotid artery entrapment by the hyoid bone

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We report a patient with a transient ischemic attack presumably caused by an entrapment of the internal carotid artery by the hyoid bone and without a significant carotid artery stenosis. The patient was operated on, with a release of the right internal and external carotid artery and resection of the right greater cornu of the hyoid bone. One year after treatment, the patient has not experienced any further neurologic symptoms, and a color duplex scan showed no stenosis of the right carotid artery. The hyoid bone is a potential cause of damage to the carotid vessels, depending on the individual's anatomy. Provocative maneuvers can be performed in patients with cerebrovascular symptoms who are not demonstrated to have significant anatomic stenosis with carotid imaging. (*J Vasc Surg* 2008;48:1022-4.)

Several studies have reported cerebrovascular events correlated with kinking and coiling of the carotid arteries.^{1,2} Mechanical interference between the hyoid bone and the carotid arteries as a cause for clinical symptoms is uncommon, and sequelae have rarely been reported. There are only two reports describing repeated trauma by the greater cornu of the hyoid bone to the carotid artery as a cause for traumatic pseudoaneurysm of the common carotid artery (CCA) in one patient and a symptomatic stenosis of the internal carotid artery (ICA) in the other.^{3,4}

In 1948 Eagle⁵ described symptomatic impingement of the external carotid artery and ICA by an elongated styloid process causing face and neck pain. Compression of the arterial lumen and irritation of the sympathetic plexus close to the arterial wall was thought to cause the symptoms. Cerebrovascular symptoms caused by compression of the ICA secondary to an elongated styloid process have been reported recently.⁶ We report a patient with a transient ischemic attack presumably caused by an entrapment of the ICA by the hyoid bone and without a significant carotid artery stenosis.

CASE REPORT

On her way to work in March 2007, a 61-year-old woman (weight, 62 kg; height, 167 cm) suddenly experienced a pressure in her head and chest, a sensory deficit in her left arm and leg, and fainted. The ambulance team that was called noted a muscular weakness of the left side of her face, which was still present when she arrived at the emergency department. Within 2 hours after the onset of symptoms, the patient recovered completely while being treated with infusion therapy with saline.

The symptoms were interpreted as a transient ischemic attack (TIA) because of the focal neurologic symptoms. Cranial computed tomography (CT) imaging showed no signs of bleeding or

ischemic infarction on days 1 and 4 after the onset of symptoms. A color duplex scan of the carotid vessels revealed an ICA stenosis on the symptomatic right side of about 55% according to North American Symptomatic Carotid Endarterectomy Trial criteria, with a peak systolic velocity of 1.4 m/s. The plaque was located 2 cm cranially to the carotid bifurcation and appeared soft, homogenous, and uncalcified, with a marked thickening of the vessel wall. The patient was considered to have a symptomatic ICA stenosis. She was included in a randomized clinical trial of carotid endarterectomy vs carotid artery stenting (CAS) and randomized to CAS.

A CT angiography (CTA) of the neck was conducted 3 days after the color duplex scan to study the arch and carotid anatomy. This study failed to show any ICA stenosis on the symptomatic right side. No vessel wall thickening or intraluminal thrombus was seen; however, it was noted that the carotid bifurcation was fairly proximal at the level of C4-5 (Fig 1).

Three-dimensional reconstruction and multiplanar reformation on a TeraRecon Aquarius workstation (San Mateo, Calif) of the CTA demonstrated that the right greater cornu of the hyoid bone was interposed between the ICA and external carotid artery (Fig 1, Video, online only). The right ICA appeared elongated and medialized to the greater cornu of the hyoid bone, which represents an abnormal anatomic course.⁷ The right CCA and ICA as well as the left carotid vessels appeared otherwise normal, without any significant stenosis or abnormal anatomic path. No further functional assessment such as angiography during swallowing or other provocative movements were performed. The consulting neurologist and cardiologist could not identify other causes for TIA. This entrapment of the right ICA by the hyoid bone was suspected to cause repeated trauma and presumably luminal obstruction of the ICA during provoking movements (Video, online only).

After discussion with an ear, nose, and throat specialist, we decided to resect the right greater cornu of the hyoid bone. This operation entailed the release of the right internal and external carotid artery and resection of the right greater cornu of the hyoid bone (Fig 2). The segment of the ICA in contact with the hyoid bone appeared intraoperatively ectatic but otherwise normal and soft, without an apparent perivascular fibrosis. When the neck was rotated to the contralateral side, the hyoid slid out of the bifurcation into an anterior position.

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Competition of interest: none.

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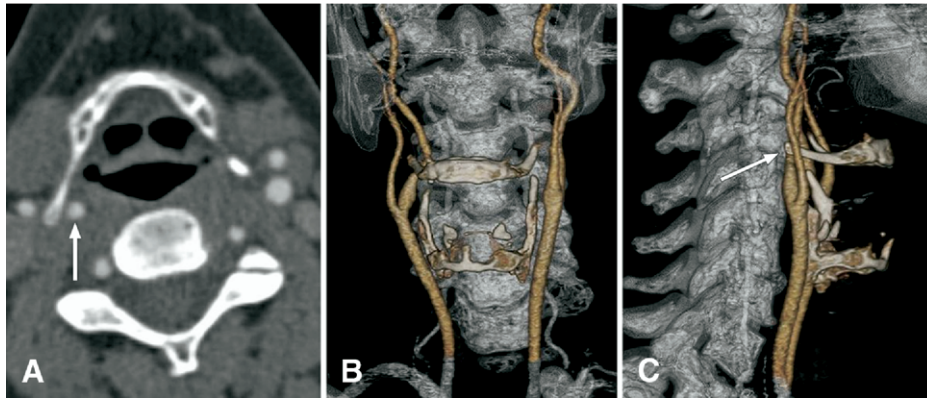


Fig 1. Computed tomography angiography of the neck. **A**, Multiplanar reconstruction (*MPR*) demonstrates the interposition of the right cornu of the hyoid bone between the right carotid arteries. The *arrow* indicates the right internal carotid artery. **B**, Anteroposterior and (**C**) lateral views of a three-dimensional reconstruction show the carotid artery and the cartilaginous and bony structures of the larynx and an osseous background. Note the low carotid bifurcation on the right side at C 4/5. **C**, The *arrow* points at the interposition of the right cornu of the hyoid bone between the right carotid artery.

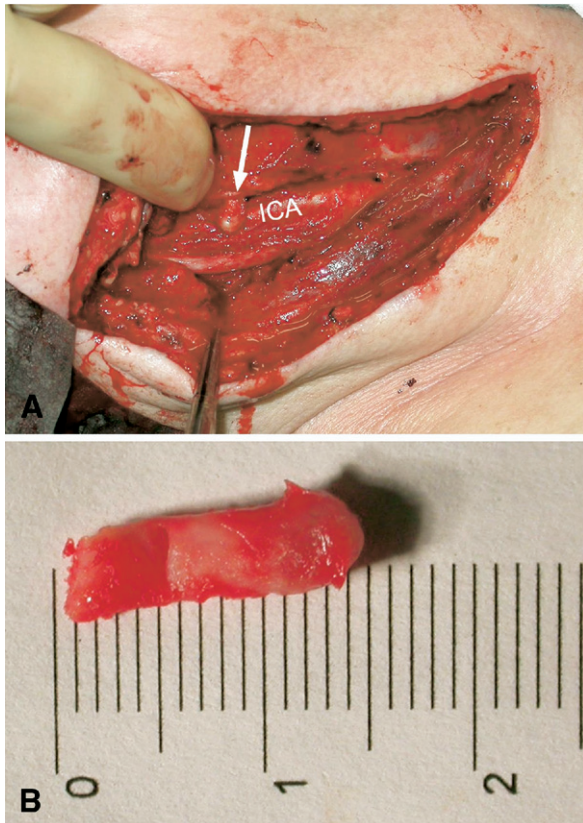


Fig 2. **A**, Intraoperative view shows the right cornu of the hyoid bone (*arrow*) protruding laterally to the internal carotid artery (*ICA*). **B**, Resected right cornu of the hyoid bone with underlying centimeter-scale.

The patient's early postoperative course was uneventful, and she was discharged on postoperative day 7. During the 3 months after the operation, she had discomfort in swallowing and dysphagia. Postoperative color duplex scans of the carotid artery at 7

weeks and 1 year showed no stenosis of the right carotid artery. After a follow-up of 1 year, the patient has not experienced any further neurologic symptoms.

DISCUSSION

The hyoid bone is shaped like a horseshoe and serves as an attachment point for several muscles that help to elevate the larynx during swallowing and speech. It is suspended from the tips of the styloid processes of the temporal bones by the stylohyoid ligaments. Its greater cornua project backward and end in a tubercle to which the lateral thyrohyoid ligament is fixed medially to the carotid artery.⁷ The hyoid bone is not present in any of the closest living relatives to man, but it did exist in virtually identical form in Neanderthal man and is therefore useful when found in fossils of human ancestors or their relatives to determine the creature's capability of speech.⁸

This report describes a case of TIA with the unusual anatomic finding of carotid artery entrapment by interposition of the hyoid bone on the symptomatic side. We speculate that repeated mechanical trauma to the wall of the ICA in this patient led to a vessel wall injury with subsequent intimal thrombus formation and cerebral embolization that produced symptoms of a TIA. Alternatively, cerebrovascular flow might have been compromised by luminal obstruction of the ICA during provoking movements.

The role of the bony structures of the neck for the course of the carotid artery is not yet well defined. Anatomic studies of the vasculature of the neck seldom focus on perivascular structures and their impact on carotid function. The carotid arteries lie within a fibrous layer that allows the artery to follow the movements of the neck. Elongation of the carotid artery can alter its course within this fibrous layer and cause mechanical interference with the hyoid bone. Entrapment of the carotid artery is proba-

bly a rare finding, because it requires a combination of elongated greater cornu of the hyoid bone dorsally protruding from the larynx and a low carotid bifurcation. This kind of interference is very unlikely to be detected by color duplex examination and open surgery, however, because an interposition of the hyoid bone will be abolished by neck rotation and therefore is probably underreported.

Color duplex scanning or angiography of the carotid artery during provoking movements and swallowing would probably have been beneficial for the diagnosis because the CT scan is static and lacks dynamic information. This case supports the comments of other authors that the hyoid bone is a potential cause of damage to the carotid vessels, depending on the individual's anatomy, and that CTA can be used to detect interference between the hyoid bone and the carotid vessels.^{3,4} Provocative maneuvers can be performed in patients with cerebrovascular symptoms who are not demonstrated to have significant anatomic stenosis with carotid imaging.

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REFERENCES

1. Metz H, Murray-Leslie RM, Bannister RG, Bull JW, Marshall J. Kinking of the internal carotid artery. *Lancet* 1961;1:424-6.
2. Quattlebaum JK Jr, Wade JS, Whiddon CM. Stroke associated with elongation and kinking of the carotid artery: long-term follow-up. *Ann Surg* 1973;177:572-9.
3. Abdelaziz OS, Ogilvy CS, Lev M. Is there a potential role for hyoid bone compression in pathogenesis of carotid artery stenosis? *Surg Neurol* 1999;51:650-3.
4. Schneider CG, Kortmann H. Pseudoaneurysm of the common carotid artery due to ongoing trauma from the hyoid bone. *J Vasc Surg* 2007;45:186-7.
5. Eagle W. Elongated styloid process: further observations and new syndrome. *Arch Otolaryngol* 1948;47:630-40.
6. Chuang WC, Short JH, McKinney AM, Anker L, Knoll B, McKinney ZJ. Reversible left hemispheric ischemia secondary to carotid compression in Eagle syndrome: surgical and CT angiographic correlation. *AJNR Am J Neuroradiol* 2007;28:143-5.
7. Gray H. *Anatomy of the Human Body*. 39th ed. London: Churchill-Livingstone; 2000.
8. Arensburg B, Tillier AM. Speech and the Neanderthals. *Endeavour* 1991;15:26-8.

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