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Carotid Sinus Syndrome and Embolization Procedures

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Summary: Two patients developed carotid sinus syndrome following embolization procedures. One patient had undergone balloon occlusion of the internal carotid artery; in the other patient, embolization of a carotid body tumor had been performed. The method of diagnosis as well as the etiology and treatment are discussed.

Index terms: Arteries, carotid (common); Interventional neuroradiology, complications of

Carotid sinus syndrome can result in bradycardia, hypotension, syncope, and even death. Fortunately, this syndrome is rare. It is usually reported in elderly people with hypertension or atherosclerotic vascular disease who undergo carotid massage or surgical manipulation of the carotid. It is also associated with masses near the carotid bifurcation such as primary tumors or lymph node enlargement secondary to inflammatory or metastasic disease. There are three variants of carotid sinus syndrome: cardioinhibitory, vasodepressor, and mixed. The cardioinhibitory variant is most common.

Clinical Cases

Case 1

A 54-year-old man underwent transsphenoidal surgery for removal of a pituitary mass. The right internal carotid artery was inadvertently lacerated during surgery. The sella and sphenoid were packed; the patient recovered and was discharged a few days later. Approximately 1 week after discharge, the patient had severe epistaxis that soaked eight towels. Upon arrival to a local emergency room his blood pressure was zero. He was successfully resuscitated. Angiography later demonstrated a false aneurysm of the cavernous carotid bulging into the sphenoid sinus (Fig. 1A).

The patient was transferred to our institution for balloon occlusion of the carotid artery and the false aneurysm. Laboratory tests including a chest x-ray and electrocardiogram were normal. Direct balloon occlusion of the false aneurysm with preservation of the carotid was not possible because of the previous extensive bony resection of the sella and sphenoid sinus. Therefore, the patient underwent a 30-minute carotid test occlusion, which he tolerated well. The carotid artery was then occluded with three balloons (Fig. 1B and 1C). The distal balloon was placed just below the origin of the ophthalmic artery and completely covered the neck of the aneurysm. A second balloon was placed in the midcervical carotid. A third balloon was placed in the carotid bulb to accomplish a balloon carotid stumpectomy. The balloons were silicone detachable balloons (Interventional Therapeutics Corp., South San Francisco, CA). Each balloon was filled with isoosmolar metrizamide (190% mg of iodine per milliliter). Transcranial Doppler revealed reduction in middle cerebral artery flow velocities after carotid occlusion when compared with baseline measurements. Even though the patient was normal neurologically, he was placed on ephedrine and heparinized because of this finding. The goal was to increase flow through the middle cerebral artery and to prevent thrombosis secondary to low flow. Over the next 3 days, the patient had two episodes of profound bradycardia (10–20 bpm) and hypotension (systolic < 40 mm Hg). Each episode resulted in transient hemiparesis. The patient responded promptly and favorably to atropine and fluid administration in each episode. The ephedrine was continued and a scopolamine patch was placed behind his ear. Despite these measures, the patient had two more similar episodes over the following 2 days. Digital carotid massage resulted in hypotension and bradycardia, confirming the clinical diagnosis of carotid sinus syndrome. Since there was concern that hypotension would result in infarction in the hemisphere that was jeopardized by diminished cerebral blood flow associated with the carotid occlusion, the patient was taken to fluoroscopy where a 22-gauge spinal needle was used to puncture the balloon in the carotid bulb. The patient had no more episodes of bradycardia or hypotension following deflation of this balloon. He was discharged and has remained symptom-free since his discharge 2 months ago.

Case 2

A 44-year-old man presented with a left neck mass that raised the possibility of a carotid body tumor; this was confirmed angiographically (Fig. 2A). The patient underwent standard preoperative embolization of the tumor. This

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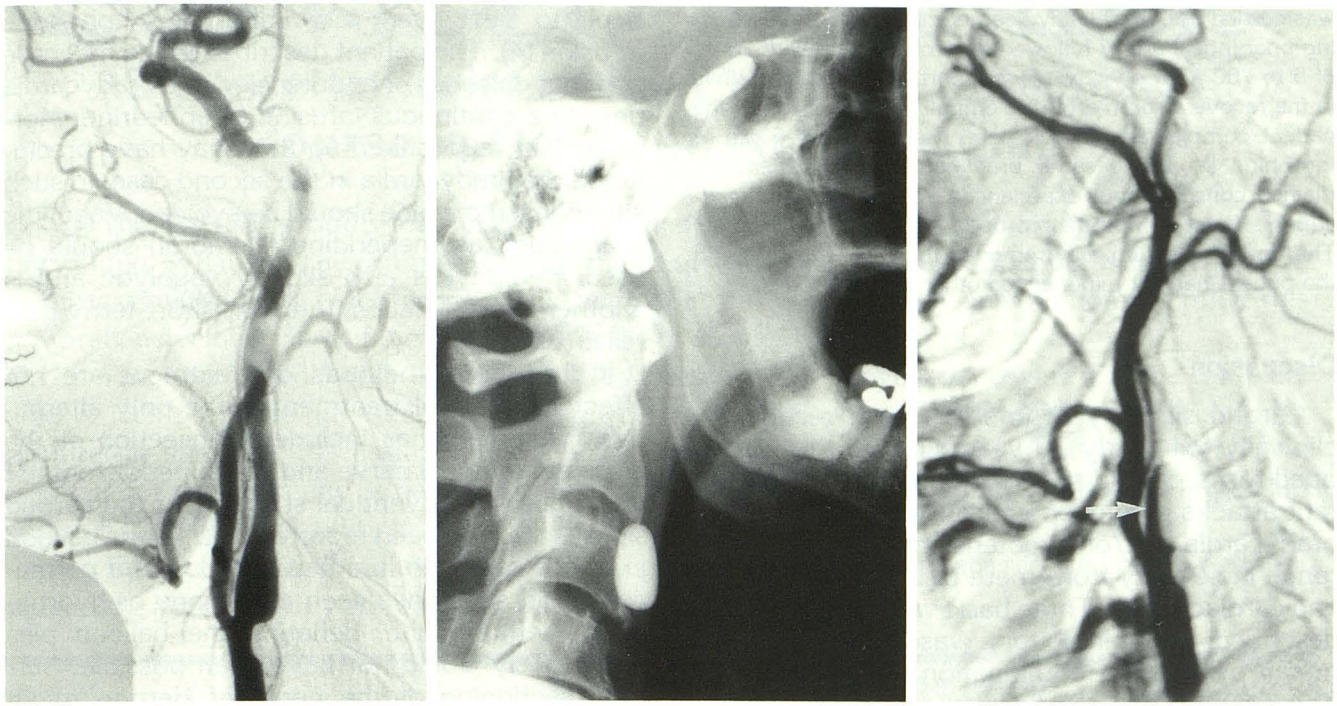

Fig. 1. *A*, Lateral carotid angiogram demonstrates the false aneurysm in the cavernous carotid just below the origin of the ophthalmic artery.

B, Lateral radiograph shows the three balloons placed in the carotid artery.

C, Lateral digital angiogram following balloon occlusion demonstrates the third balloon in the carotid bulb. There is motion artifact (*arrow*) anterior to the balloon. This does not represent contrast flow around the balloon. The external carotid is patent.

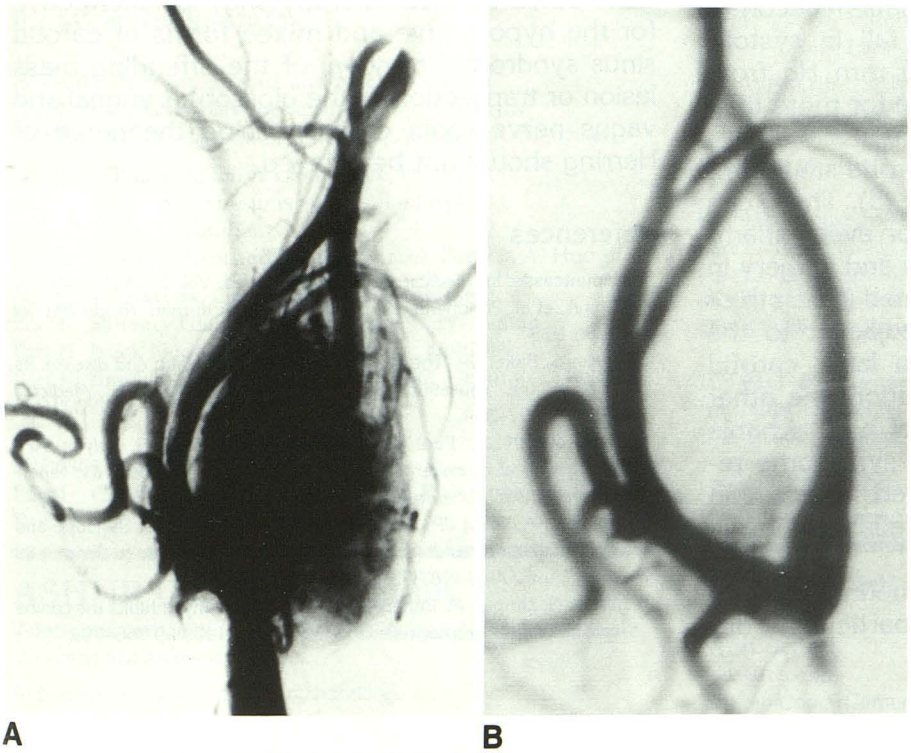

Fig. 2. *A*, Lateral common carotid angiogram demonstrates a hypervascular carotid body tumor separating the internal and external carotid arteries.

B, Lateral common carotid angiogram following embolization shows devascularization of the carotid body tumor.

was carried out via selective catheterization of the ascending pharyngeal artery followed by embolization with 28 cc of 5 to 700 μm polyvinyl alcohol particles (Fig. 2B). While in the recovery room after the embolization procedure, the patient complained of neck pain. He was given 6 mg of morphine IV and became bradycardic. The patient remained conscious but experienced vertigo and lightheadedness. These symptoms promptly reversed with atropine. The tumor was surgically removed the following day, and the patient has not experienced other such episodes.

Discussion

Carotid sinus syndrome has been recognized clinically for nearly 70 years (1–3). In its developed form, carotid sinus syndrome causes recurrent attacks of syncope because of the profound bradycardia and/or hypotension. The symptoms range in severity from mere dizziness to asystole and cardiac arrest. Three basic variants have been described: cardioinhibitory, vasodepressive, and mixed, which is a combination of the first two. These symptoms can develop spontaneously.

Carotid sinus syndrome most often affects patients 40 to 60 years of age (4). Males are affected three times as often as females. The severity of the symptoms increases with age. This is thought to be related to atherosclerotic disease (5).

If the diagnosis is in question, the symptoms can be reproduced by performing carotid massage for 10 to 15 seconds as in case 1. The diagnosis is established when the patient becomes symptomatic and/or there is a fall in systolic blood pressure of more than 30 mm Hg from baseline. Bradycardia and asystole for more than 3 seconds also confirm the diagnosis.

The most common cause of carotid sinus syndrome is mass lesions in the neck (5). These can be benign or malignant tumors or even inflammatory masses. Radiation therapy and surgery in this region have also been implicated (5). Both of our patients had mass lesions adjacent to the carotid body. One patient had a large carotid body tumor of the carotid bifurcation; the other patient had a mass in the form of a detachable balloon in the carotid bulb. The symptoms resolved after the tumor was removed surgically in the first patient; the balloon was deflated fluoroscopically in the second.

Atropine and ephedrine are sometimes of limited benefit. Hypotension can be particularly difficult to treat even with continuous ephedrine infusion (4). The patient described in the first case had four episodes of hypotension and bradycardia despite a continuous infusion of ephedrine. Morphine is a vagotonic drug that may have precipitated the bradycardia in the second case. In such situations, morphine should be avoided. Vagolytic drugs such as meperidine (Demoral) should be used. Fentanyl is also slightly vagolytic and is another suitable substitute for short-term pain relief (6).

If the above methods of treatment are not effective, surgical treatment is the only alternative. Treatment has included transection of the glossopharyngeal nerve and the superior roots of the vagus (4). Adventitial stripping of the carotid sinuses also has been reported (4, 5). If the balloon in the carotid bulb had been filled with a permanent solid substance such as silicone or hydroxyethylmethracryalte, deflating the balloon percutaneously would not have been possible. Surgical sectioning of the nerve of Herring might have been the only acceptable alternative.

Fortunately, carotid sinus syndrome is rare. When it occurs, immediate treatment is critical especially if a carotid artery is occluded. Following carotid occlusion, the patient is relying on collateral blood supply through the anterior and posterior communicating arteries. Any episode of hypotension could easily result in cerebral infarction. Since medical therapy may be ineffective for the hypotensive and mixed forms of carotid sinus syndrome, removal of the offending mass lesion or transection of the glossopharyngeal and vagus nerve roots compromising the nerve of Herring should not be delayed.

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