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AJNR Am J Neuroradiol 1998, 19 (3) 502-504
http://www.ajnr.org/content/19/3/502

Pseudoaneurysm of the Petrous Internal Carotid Artery after Skull Base Infection and Prevertebral Abscess Drainage

Hisashi Tanaka, Uresh Patel, David A. Shrier, and John U. Coniglio

Summary: A 37-year-old woman with a skull base infection sustained massive oropharyngeal bleeding after incisional nasopharyngeal biopsy and drainage of a prevertebral abscess. A pseudoaneurysm originating at the petrous portion of the internal carotid artery was initially misinterpreted on MR images as typical postoperative change within a resolving abscess cavity. Follow-up MR imaging and conventional angiography ultimately disclosed the pseudoaneurysm.

Pseudoaneurysm of the internal carotid artery (ICA) is an uncommon sequela of skull base infection. We report a case of pseudoaneurysm of the petrous portion of the ICA that developed after incisional biopsy and drainage of a prevertebral abscess.

Case Report

A 37-year-old woman with diabetes mellitus and end-stage renal failure presented with an acute palsy of the right hypoglossal nerve. She had a 2-month history of headache, nasal congestion, midface pressure, and pain in the right ear and right side of the jaw. Magnetic resonance (MR) examination of the head revealed a $3 \times 1 \times 1$-cm area of high signal intensity on T2-weighted images in the right prevertebral area. This lesion showed an enhancing rim on T1-weighted images after contrast administration (Fig 1A), suggesting the diagnosis of prevertebral abscess. There was also abnormal signal in the bone marrow of the clivus associated with an irregular margin of the anterolateral aspect of the clivus. This was believed to represent changes of osteomyelitis. On the basis of the imaging findings and clinical symptoms, the patient was admitted 2 days after the MR examination.

On admission, the patient was afebrile but had tongue deviation to the right, consistent with right hypoglossal nerve dysfunction. Other cranial nerves were normal. A computed tomography (CT) examination, performed on the same day, showed widespread bony demineralization in the skull base, including the cortical margins of the foramen lacerum, right side of the clivus, vidian canal, and hypoglossal canal (Fig 1B). The CT findings were consistent with the diagnosis of skull base osteomyelitis, and treatment was initiated with broad-spectrum antibiotics.

Two days after admission, the patient underwent incisional biopsy of the clivus and drainage of the prevertebral space abscess via a transpalatal approach. No abnormal bleeding was noted, and estimated blood loss with this procedure was only 75 mL. Analysis of the abscess contents revealed no evidence of tumor, and abscess culture grew *Pseudomonas aeruginosa* and α-hemolytic streptococcus. While under anesthesia, the patient also underwent an examination of the right ear, at which time a pressure equalization tube was placed. The antibiotics were changed to piperacillin, ofloxacin, and vancomycin.

Three days after the biopsy, the patient had secondary generalized tonic and clonic seizures beginning with the left arm, which prompted phenytoin therapy. Bleeding was noted from the right ear, which was thought to be due to the recent tube placement. Healing of the biopsy site was poor, which was thought to be the result of her debilitated state. Three weeks after the biopsy, the patient suddenly bled from the mouth. Her systolic pressure dropped to the range of 90 mm Hg from her usual level of 140 to 150 mm Hg. Hemostasis was obtained by packing with a posterior Foley catheter, which was continued for 2 days. Two weeks later, she again had profuse oropharyngeal bleeding and was treated with the same procedure. The persistent, small amount of bloody drainage from the right ear continued.

Seven weeks after the biopsy, the patient underwent a second MR examination because of a new palsy in the left third nerve. A persistent focus of abnormal signal was noted within the prevertebral space on the right side, which was decreased in size relative to the previous imaging study and now measured only 13 mm in diameter. It was round and well circumscribed, and contained low signal intensity on T2-weighted images centrally and high signal intensity at the periphery (Fig 1C). The lesion showed heterogeneous high signal intensity on T1-weighted images after contrast administration (Fig 1D). It was not obvious on unenhanced sagittal T1-weighted images, and it was erroneously thought to represent postdrainage change and blood breakdown products within the previous abscess area. Abnormal high-signal foci were also seen on long-repetition time pulse sequences in the right centrum semiovale. These foci did not enhance. Additionally, there were multiple high-signal-intensity lesions along the cortical sulci in the right hemisphere on unenhanced T1-weighted images. The latter findings suggested ischemic change in the right hemisphere with small hemorrhagic infarction or cortical laminar necrosis.

After the second MR examination, the patient experienced increasing maxillary and retroorbital pain on the right side.

Received November 4, 1996; accepted after revision April 22, 1997.

From the Departments of Radiology (H.T., U.P., D.A.S.) Surgery (Otolaryngology Division) (J.U.C.), University of Rochester Medical Center, Rochester, NY.

Address reprint requests to Hisashi Tanaka, MD, Department of Radiology, Osaka University Medical School, 2–2 Yamada-Oka, Suita, Osaka 565, Japan.

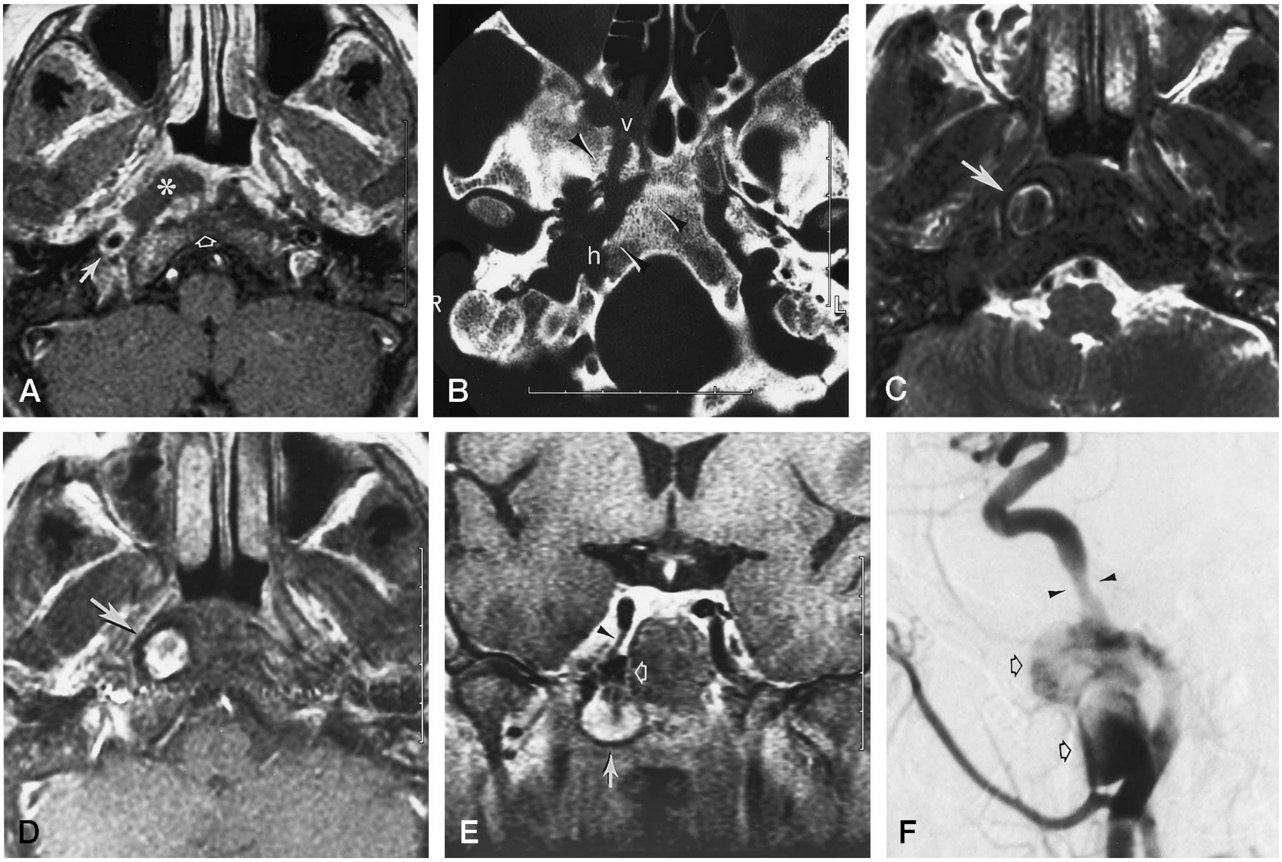

FIG 1. 37-year-old woman with diabetes mellitus and end-stage renal failure and acute palsy of the right hypoglossal nerve.

A, Axial contrast-enhanced T1-weighted (600/17/2 [repetition time/echo time/excitations]) MR image with fat suppression shows an area of low signal intensity (*asterisk*) surrounded by enhancing high signal intensity in the right prevertebral space, suggesting the diagnosis of prevertebral abscess. The right ICA is also surrounded by high signal intensity (*closed arrow*). The anterior border of the clivus appears irregular (*open arrow*).

B, Axial CT scan through the skull base shows demineralization along the margins of the foramen lacerum and the petroclival synchondrosis (*arrowheads*), consistent with the diagnosis of osteomyelitis. The carotid artery makes its curve just above the foramen lacerum, and it appears that this is the point of abscess formation.

C, Axial T2-weighted (4000/105/1) MR image, obtained 7 weeks after transpalatal biopsy and drainage, shows a well-demarcated round lesion in the prevertebral space (*arrow*). The periphery of the lesion is hyperintense and most of the inner part is hypointense.

D, Axial contrast-enhanced T1-weighted (450/31/1) MR image, obtained 7 weeks after biopsy and drainage, again shows the well-demarcated round lesion with inhomogeneous high signal intensity (*arrow*).

E, Coronal contrast-enhanced T1-weighted (600/17/2) MR image, obtained 8 weeks after biopsy and drainage, shows the round high-signal-intensity lesion (*solid arrow*) abutting the right side of the clivus. There is a low-intensity signal, suggestive of flow void (*open arrow*) just above the high-signal-intensity lesion, which appears to be contiguous with the narrowed ICA (*arrowhead*).

F, Right common carotid arteriogram, lateral projection, shows a pseudoaneurysm originating from the horizontal portion of the petrous carotid artery and growing inferiorly (*arrows*). Just above the aneurysmal neck, the ICA is narrowed (*arrowheads*).

Eight weeks after the biopsy, she was again studied by MR imaging because of the increasing pain. Once more, the examination showed a round, well-demarcated focus of abnormal signal in the right prevertebral space with an interval increase in size to 17 mm. Signal void in the upper portion of the lesion contiguous to the petrous portion of the right ICA was noted on contrast-enhanced T1-weighted images (Fig 1E). Abnormal high-signal foci in the right centrum semiovale on long-repetition time pulse sequences were again noted, and these lesions now enhanced after contrast administration. A pseudoaneurysm with microemboli was suspected, and was confirmed on digital subtraction angiography (Fig 1F). The next day, the patient underwent endovascular occlusion of the right ICA with detachable latex balloons and platinum coils. She did well after the embolization and was discharged 10 days later.

Discussion

A pseudoaneurysm is a blood-filled pseudovascular space contiguous to a vessel, the wall of which is formed by reactive connective tissue. Pseudoaneurysms of the ICA usually develop in the cervical segment (1, 2), typically subsequent to trauma or infection (1, 3). Those confined to the petrous portion of the ICA are uncommon. Constantino et al (2) reviewed approximately 10 cases of ruptured aneurysms, including pseudoaneurysms, located in the petrous portion of the ICA. The etiologic factors for these aneurysms included infection, trauma, atherosclerosis, and congenital causes (2). Although the prevalence of pseudoaneurysms caused by infection declined in the 1940s with the use of antibiotics (4), it may now be on the rise (5) owing to the increase of immunocompromised patients and the appearance of drug-resistant strains of organisms. The clinical features of infectious pseudoaneurysms of the neck include recurrent hemorrhage, a protracted clinical course, a lower hemoglobin level than expected clinically, bruit or thrill, cranial neuropathies, and Horner syndrome (3, 4, 6). Among the 10 ruptured petrous ICA aneurysms in the review by Constantino et al (2), bleeding manifested as epistaxis in four cases, otorrhagia in five, and both otorrhagia and epistaxis in one. Their group advocated the triad of epistaxis, otorrhagia, and focal neurologic deficit for ruptured petrous ICA aneurysms (2). Chambers et al (7) described the latent period between blunt injury to the head and epistaxis as ranging from a few days to many years. Fifty-four percent of the patients in the cases they reviewed experienced their first episode of epistaxis within a month after trauma, and 87% had epistaxis within 6 months (7). Repetitive pounding of blood against the arterial wall, which has already been weakened by shearing forces or intramural hemorrhage with trauma, stretches the artery and leads to formation of a pseudoaneurysm (8). This process takes time, which explains the delay between epistaxis and trauma.

The presence of a petrous ICA aneurysm may be established by CT or MR imaging. CT may show a well-demarcated intense homogeneous enhancement in proximity to the ICA (9). Abscess, on the other hand, appears as a low-attenuation area surrounded by an enhancing rim on CT studies (9). There may also be associated osteomyelitis, manifested by destruction of bony structures. The appearance of aneurysms on MR images is variable (10, 11). The typical patent aneurysmal lumen with rapid flow shows flow void on T1- and T2-weighted images, as was observed in our patient. However, aneurysms may also have a laminated appearance, due to clot formation (10), or they may demonstrate a vortex flow pattern. MR angiography is also useful in the detection of aneurysms (10, 11), although conventional angiography remains the definitive method of diagnosis.

In our patient, massive oropharyngeal bleeding occurred 3 weeks after surgical incision and drainage of a prevertebral abscess. Possible etiologic factors for the pseudoaneurysm were mechanical trauma due to surgical debridement, vessel wall erosion caused by adjacent infection, or a combination of the two.

The pseudoaneurysm was diagnosed as postsurgical granulation tissue on the initial postoperative MR study. This misinterpretation was due to a lack of appreciation of the true relationship of the lesion to the ICA and to a lack of available clinical information at the time of interpretation. This error underscores the importance of considering this diagnosis when evaluating lesions closely apposed to the carotid artery.

Conclusion

Pseudoaneurysms are characterized by a well-demarcated, round area of signal void or laminated appearance on MR images. Early diagnosis is critical to prevent recurrent bleeding, which may rapidly lead to exsanguination and death (7).

Acknowledgment

We are grateful to Yuji Numaguchi for his suggestions.

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