Vertebrobasilar Dolichoectasia: Evaluation with CT Angiography

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Summary: We present three patients who were admitted to our institution with vertebrobasilar dolichoectasia diagnosed at CT angiography. Two patients had associated intraarterial thrombi and one patient had basilar artery dissection. Shaded surface display images were useful in showing arterial anatomy relative to the skull base. Source images and curved-reformatted images were helpful in diagnosing thrombi and dissection. CT angiography is a minimally invasive means of diagnosing and following up these patients.

Index terms: Computed tomography, three-dimensional; Arteries, abnormalities and anomalies

Dilatation and elongation of the vertebrobasilar arterial system has long been a recognized clinical entity. Other names for this disorder include *dolichoectasia, megadolichoectasia, fusiform aneurysm of the vertebral and basilar arteries,* and *tortuous vertebrobasilar system* (1). In a review of all patients who had computed tomographic (CT) angiography of the intracranial circulation performed in our department over the last 3 years, we identified three patients with dolichoectasia of the vertebrobasilar arterial system. These patients each met the diagnostic criteria of this disorder as outlined by Smoker et al (1).

Case Reports

Case 1

A 64-year-old man had experienced dizziness, falling, and left-sided numbness with pain over his right eye for several hours before admission. Physical examination revealed a slight decrease in left-sided strength and sensation to light touch. An unenhanced CT scan disclosed a recent right cerebellar infarct. CT angiography at this time showed dolichoectasia of the basilar artery with extensive mural thrombus (Fig 1A and B). Treatment with heparin and warfarin resulted in improvement in the patient's signs and symptoms, and he was discharged. Repeat CT angiography 1 month later showed resolution of the thrombus (Fig 1C).

Case 2

A 73-year-old woman with a history of hypertension, alcohol abuse, and Parkinson disease presented with a 2-week history of blurred vision, loss of balance, and lightheadedness. Physical examination was unremarkable. CT angiography showed marked vertebrobasilar dolichoectasia with thrombus within the lumen of the basilar artery (Fig 2). The patient was started on aspirin and antiplatelet therapy with improvement of symptoms. She has remained asymptomatic on this therapy for 2 years. Follow-up CT angiography has not been performed.

Case 3

A 60-year-old man with hypertension presented with a 5-day history of occipital headache. On admission, he had horizontal nystagmus on right lateral gaze, diplopia on lateral gaze bilaterally, and right-sided ptosis. CT angiography revealed dolichoectasia of the vertebrobasilar system (Fig 3A). A crescentic mural thrombus was also identified on source images and was considered consistent with arterial dissection (Fig 3B). He was treated with heparin systemically. A chest radiograph revealed a right upper lobe coin lesion, and anticoagulation was discontinued so a biopsy could be performed (pathologic findings were consistent with a hamartoma). Six hours after the heparin was stopped, bilateral tingling developed in the extremities, accompanied by slurred speech and limb ataxia. Repeat CT angiography showed an increase in the size of the dissection within the basilar artery lumen (Fig 3C). Three months after discharge, while on Coumadin, the patient had cardiac arrest. A CT angiogram at this time again showed dissection of the basilar artery with new subarachnoid hemorrhage in the basilar cisterns and diffuse hypodensity of the midbrain. Clinical examination and a nuclide brain flow study were consistent with brain death. Autopsy confirmed the radiographic findings of dissection.

Technique

All three patients were initially studied by unenhanced CT at presentation to exclude recent intracranial hemor-

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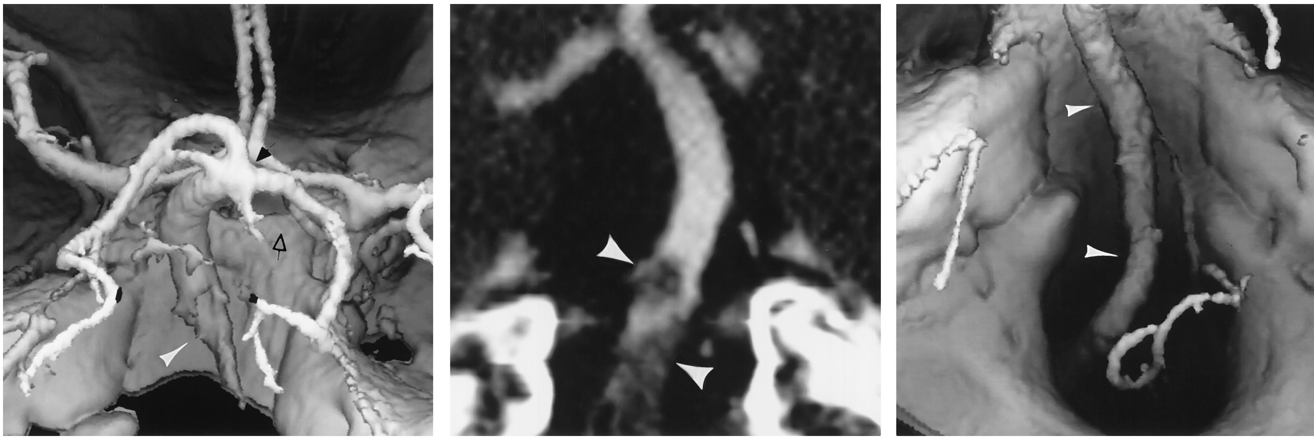


A B C

Fig 1. Case 1: 64-year-old man with dolichoectasia of the basilar artery with mural thrombus.

A, Shaded surface display CT angiogram at presentation, viewed from above and behind (patient's right is on the right). The basilar artery is elongated and dilated, with the basilar tip (*solid black arrow*) projecting well above the dorsum sella (*open black arrow*). The expected locations of the proximal basilar artery and distal left vertebral artery (*white arrowhead*) are not seen because of intraluminal thrombus.

B, Curved reformatted image oriented along the long axis of the vertebrobasilar system, same data set as *A*. This image approximates an oblique coronal view (patient's left is on the right). Filling defects are visible within the low vertebrobasilar system (*arrowheads*).

C, Repeat CT angiogram, 1 month after treatment. Shaded surface display, seen from similar orientation as in *A*. The distal left vertebral and proximal basilar arteries (*arrowheads*) now fill normally.

rhage. CT angiography was performed using a helical scanner with parameters of 120 kV, 280 mA, 1-second scan time, 1-mm collimation, 1:1 pitch, and a 12.8-cm field of view. Sixty axial source images were obtained from the foramen magnum through the circle of Willis after intravenous administration of contrast material, which was delivered via an antecubital vein at 2 mL/s for a total of 100 mL. Acquisition of source images was started 30 seconds after the start of contrast injection. Images were transferred to a workstation and, after review of source images, each data set was then reconstructed using both shaded surface display (with a threshold of 100 Hounsfield units) and curved reformatted images, which were oriented along the long axis of the basilar artery.

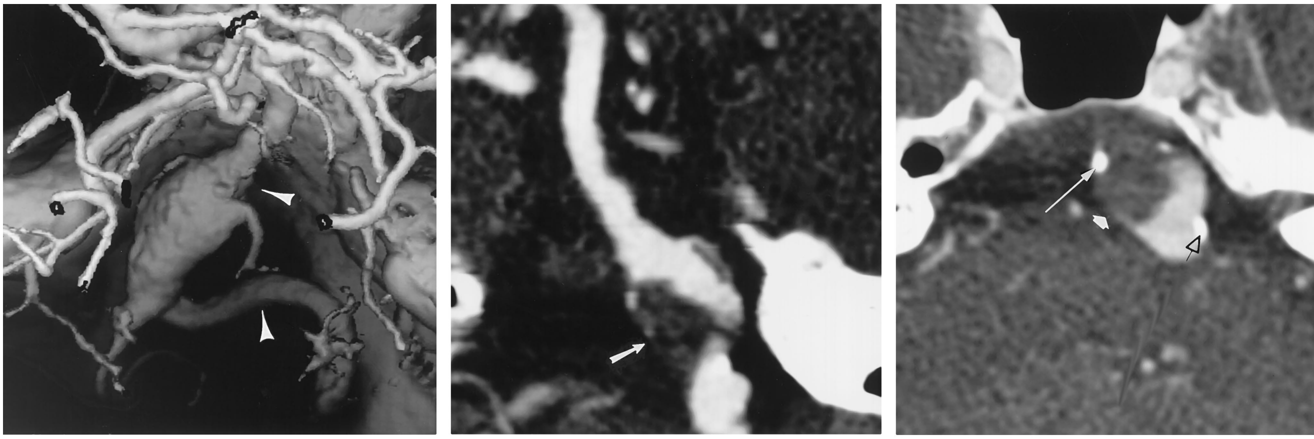
Discussion

Dolichoectasia of the vertebrobasilar system, a finding of uncertain pathogenesis, is an elongation and dilatation of the major arteries of the posterior fossa. The vertebrobasilar system can be considered elongated if the basilar artery lies lateral to the margin of the clivus or dorsum sellae, or if it bifurcates above the plane of the suprasellar cistern (1). Ectasia can be considered to be present if the basilar artery has a diameter greater than 4.5 mm (1).

We found three cases of vertebrobasilar dolichoectasia among the 430 patients who underwent CT angiography at our institution over a period of 36 months. All patients were symptomatic at presentation. The true prevalence of vertebrobasilar dolichoectasia is unknown.

While many patients are asymptomatic, these cases illustrate some of the diversity of symptoms associated with vertebrobasilar dolichoectasia. Patients may present with cranial nerve dysfunction (case 3), transient ischemic attacks (cases 1, 2, and 3), hydrocephalus, and subarachnoid hemorrhage (2, 3). In addition, one of our patients (case 3), had a midbrain infarct associated with vertebral artery dissection, an unusual complication of dolichoectasia (4).

Traditionally, the diagnosis of vertebrobasilar dolichoectasia has been based on findings at catheter angiography. With the advent of CT, dolichoectasia can be diagnosed noninvasively (1). More recently, several authors have reported magnetic resonance (MR) findings in vertebrobasilar dolichoectasia. MR imaging has the ability to display vascular anatomy and its relation to posterior fossa structures, to delineate mural thrombi, and to show dissections (5–7). However, relatively long scan times and limited availability of this technique could prohibit its use in severely ill patients. CT angiography has recently been applied to the evaluation of intracranial aneurysms (8, 9). Potential advantages of CT angiography over conven-



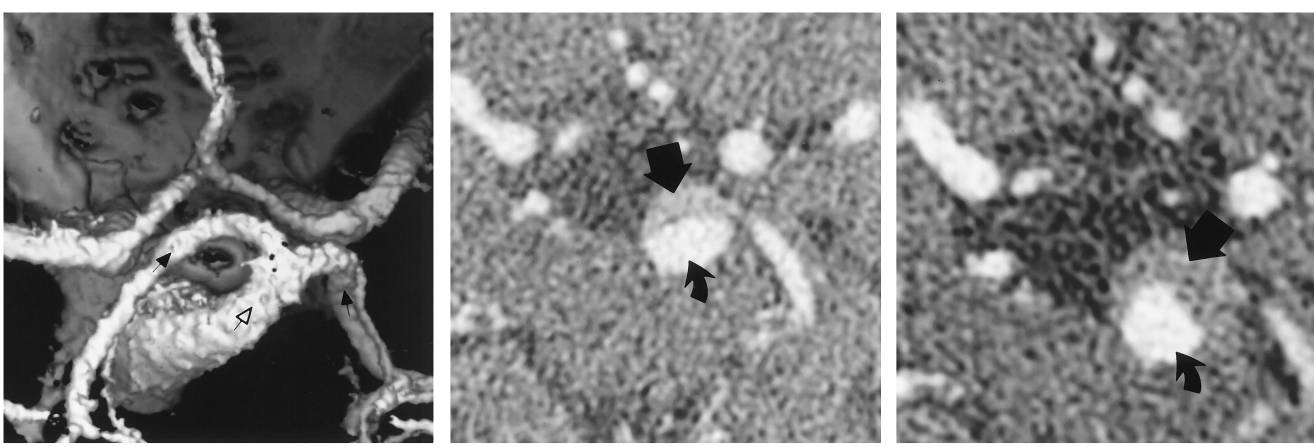
A B C

Fig 2. Case 2: 73-year-old woman with vertebrobasilar dolichoectasia with thrombus in basilar artery lumen.

A, Shaded surface display CT angiogram at presentation, viewed from above and behind (patient's right is on the right). Marked elongation and dilatation of the right vertebral and basilar arteries are seen (*arrowheads*).

B, Curved reformatted image oriented along the long axis of the vertebrobasilar system, same data set as *A*. This image approximates an oblique coronal view (patient's left is on the right). A large filling defect is seen within the most dilated portion of the basilar artery (*arrow*).

C, Axial source image at level of mid-basilar artery, same data set as *A* and *B*. Thrombus can be seen in the ventral aspect of the lumen (*short white arrow*). Calcifications indicate the ventral (*long white arrow*) and left lateral (*open arrow*) aspects of the vessel wall. This filling defect would not be visible on a shaded surface display image viewed posteriorly (see "Discussion").



A B C

Fig 3. Case 3: 60-year-old man with dolichoectasia of the vertebrobasilar system.

A, Shaded surface display CT angiogram at presentation, viewed from above and behind (patient's right is on the right). Marked elongation and dilatation of the basilar (*open arrow*) and posterior cerebral arteries (*closed arrows*) are seen.

B, Axial source image at level of distal basilar artery, at presentation. A crescentic mural thrombus is visible anteriorly (*straight arrow*), with residual opacified lumen posteriorly (*curved arrow*). Findings were thought to be consistent with dissection.

C, Axial source image at level of distal basilar artery 48 hours after presentation, same level as *B*. The patient's symptoms returned after anticoagulation was discontinued. There has been an increase is the size of the mural thrombus (*straight arrow*) at the expense of the residual lumen (*curved arrow*). Dissection of the basilar artery was proved at autopsy.

tional angiography and MR imaging include faster acquisition times, fewer limitations on patient selection, increased patient access, and decreased morbidity and mortality (9). Conventional CT is generally thought to be limited in the evaluation of the posterior fossa owing to beam-hardening artifacts. However, these effects can be minimized with thin (1-mm) collimation (10), as used in our patients. CT angiography has limited vascular resolution as compared with catheter angiography and, unlike MR angiography, requires administration of intravenous contrast material (11). Unlike MR angiography and catheter angiography, CT angiography cannot provide information about directionality of flow. CT angiographic source images can discern the densities of mural calcium, thrombus, intravascular contrast, and the cerebrospinal fluid around the vertebrobasilar system.

Evaluation of shaded surface display images alone without a review of the source images can lead to misdiagnosis. For example, there is no indication of a filling defect within the basilar artery on the shaded surface display image of case 2 (Fig 2A), although the curved reformatted image (Fig 2B) and source image (Fig 2C) clearly show endoluminal thrombus. This technique uses a threshold that excludes data below an operator-defined level and displays the surfaces of the remaining structures as if illuminated by a point source. No information about the internal structure of the objects remaining in the model is available from this display. In these cases, a threshold of 100 Hounsfield units was used. This leaves calcifications, bone, and opacified vasculature within the model, while excluding cerebrospinal fluid, brain, and thrombus. In case 2, the thrombus is situated on the ventral aspect of the lumen adjacent to the clivus (Fig 2C) and is not appreciated as a defect within the contrast column on the shaded surface display image when viewed from behind. In comparison, in case 1, an interruption in the contrast column can be seen in the shaded surface display image obtained at presentation (Fig 1A), as it fills the majority of the lumen. Similarly, in case 3, the shaded surface display image (Fig 3A) gives no indication of dissection, as the source images demonstrate. The smoothly contoured true lumen remains visible while the nonopacified false lumen is excluded. This gives a false impression of simple dilatation of the basilar artery without associated dissection. The detection of intraluminal thrombus or dissection was considered pivotal in the therapeutic management of these three patients.

Evaluation of the shaded surface display images alone could lead to a perceived absence of the associated findings of thrombi or dissection. We therefore recommend routine review of source images to avoid misinterpretation. However, we find the shaded surface models useful in depicting the vasculature in relation to the skull base, a relationship that has been used in diagnosing this disorder (1). We speculate that vertebrobasilar dolichoectasia without compression of the brain stem can become symptomatic when complicated by intraluminal thrombi or dissection.

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