Clinical Case Review

Assessment of Basilar Artery Thrombus Using Vitrea® Software

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INTRODUCTION

The patient is an 89-year-old white female brought to the West Virginia University (WVU) Hospital's Emergency Department (ED) with acute left-sided shaking and sudden onset of aphasia witnessed by her daughter. Her initial National Institute of Health Stroke Scale (NIHSS) in the ED was 7. The ED suspected left hemispheric involvement. However, left involvement did not correspond with the left-sided shaking.

METHOD

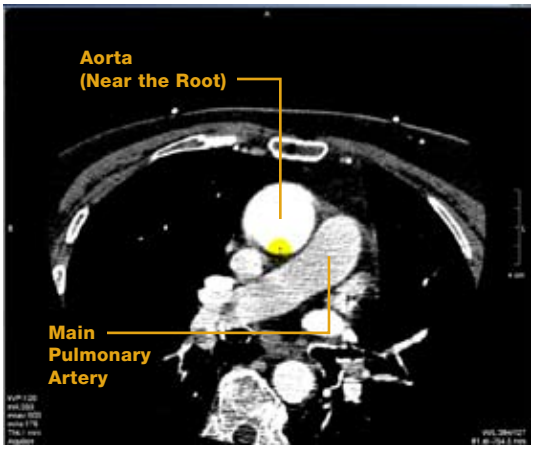
Because the ED did not have good localization of a possible stroke site, a Computed Tomography (CT) stroke protocol was ordered.

FINDINGS

Accepted practice for handling a stroke in the acute phases at WVU Hospital is initially to look at original axial data and then to examine reformatted coronal images. The CT angiography (CTA) images in Axial view were reviewed on the Vitrea® system (*see Figure 1*). Substantial arthritis (not atypical for a patient of this age) and the presence of osteophytes (*see Figure 2*) were noted.

Due to the patient's aphasia, interest initially focused on the anterior circulation. The mid-cerebral arteries all looked fine (*see Figure 3*). The patient did have some bilateral atherosclerotic calcifications, but nothing hemodynamically significant or ulcerative to suggest that she may have thrown a clot.

Figure 1: CTA Visualization in Axial View



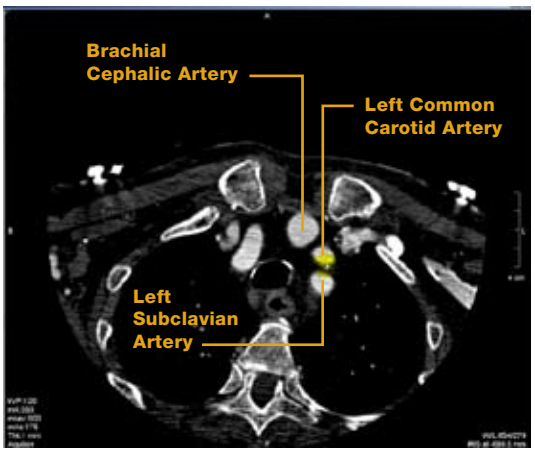
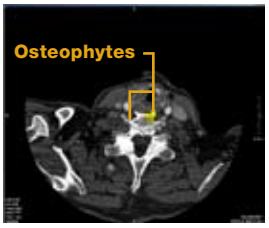
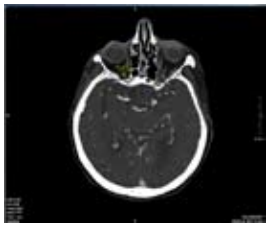


Figure 2: Visualization of Arthritis

Figure 3: Evaluation of Mid-Cerebral Arteries





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Next attention was turned to the vertebral basilar system. Visualization of the right vertebral artery (RVA) was missing (*see Figure 4*).

Continuing to follow the RVA and about a centimeter past the origin of the RVA, visualization of the vessel blanked out (*see Figure 5*), indicating occlusion of the RVA. By itself, this type of occlusion may be asymptomatic as long as a good sized left vertebral artery (LVA) exists. Next attention was given to exploration of the LVA.

Following the LVA up from its origin, the LVA was very robust as it made its way through all the arthritic facet joints (*see Figure 6*).

While evaluating the path of the LVA, the distal basilar artery (BA) with an occlusion (*see Figure 7*) was visualized. A relatively recent RVA occlusion had embolized to the basilar tip, causing the patient's crossed findings. Localization to a single hemisphere could not be identified initially due to this brain stem involvement.

Figure 4: Visualization of Vertebral Basilar System

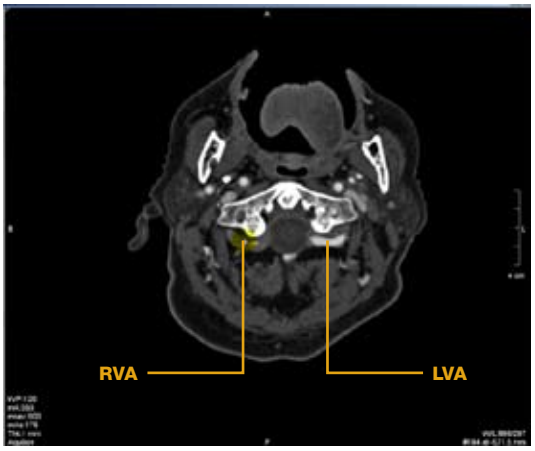
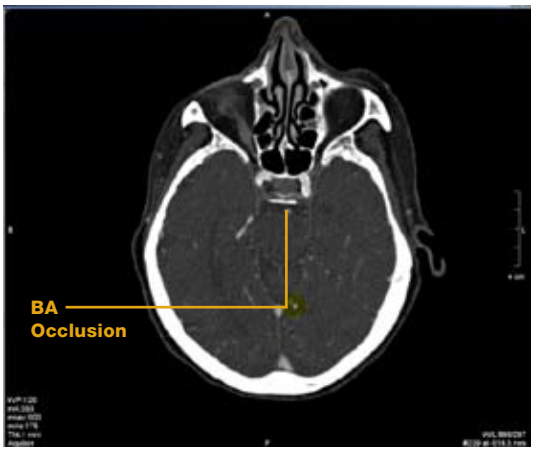


Figure 5: Visualization of RVA Occlusion

Figure 6: Visualization of Robust LVA

Figure 7: Identification of BA Occlusion



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Because vertebral BA strokes are most often picked up in coronal reformats, the coronal images were loaded to visualize and evaluate the vessels in this view (*see Figure 8*). Occlusive thrombus at the apex and upper third of the BA were identified.

Some blood flow to the BA tip was being supplied by the posterior communicating arteries (*see Figure 9*), but the origins of the superior cerebellar arteries (SCAs) weren't visualized well. These coronal findings was used to confirm distal embolus within the BA. By thickening the images in the anterior segment of the coronal view, the anterior communicating arteries and the MCAs were visualized, which both appeared normal (*see Figure 10*).

Next, the lower levels of the CT perfusion study were loaded. (The upper level volumes near the vertex were not used because they had nothing of value to add to the case review.) Although CT perfusion imaging has a role in evaluating strokes in the BA and posterior cerebral arteries (PCAs), it is less well understood due to the amount of artifact that occurs in the posterior fossa secondary to dense petrous bones.

The Brain Perfusion CT protocol automatically picked up two vessels, which were identified as the left supraclinoid internal carotid artery and a portion of the left sigmoid sinus (*see Figure 11*). While there was some motion artifact at the end of the study, all computations would be complete before that point.

Figure 8: Coronal Evaluation of BA

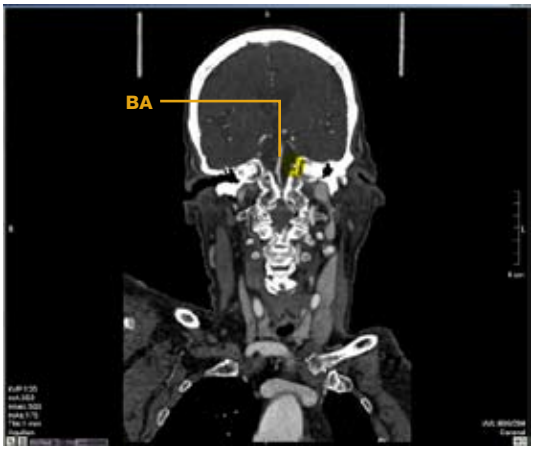


Figure 9: BA Blood Flow from Posterior Communicating Arteries

Figure 10: Evaluation of Vessels in the Anterior Segment

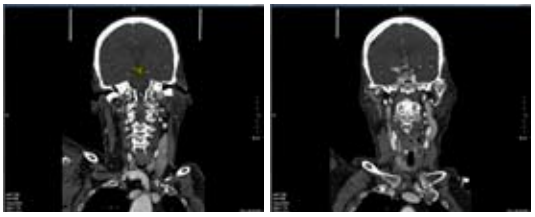
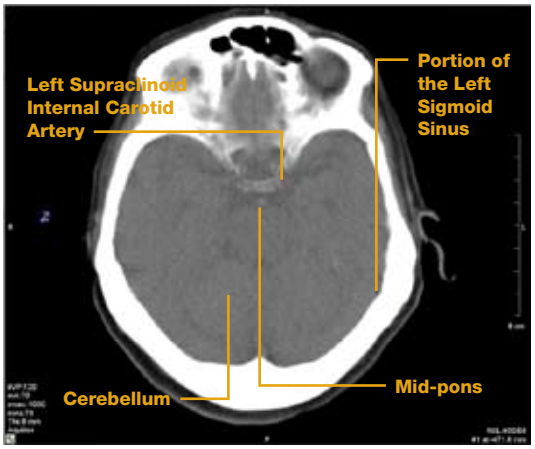


Figure 11: Identification of Anatomy in Brain Perfusion Study



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Perfusion analysis was computed and then the axis was adjusted in this region (*see Figure 12*).

Next, the time-to-peak values (*see Figure 13*) were reviewed to illustrate perfusion delays and increased mean transit times for posterior circulation.

Looking at the cerebellum, mid-pons and the region of the clot, very minimal change in the bottom middle image was noted and reliance on symmetry problematic. The pons itself appeared to be dark blue on both the Cerebral Blood Flow (CBF) and Cerebral Blood Volume (CBV) images (bottom left and top middle images). Some perfusion abnormality was observed in the right superior cerebellar artery distribution (*see Figure 14*) in the form of delayed contrast arrival.

Scrolling through the images, one additional image revealed perfusion abnormality (*see Figure 15*). However, both the mid-brain and the mean transit slope looked fairly symmetric. With vertebrobasilar strokes, it is easier to rely more heavily on the CTA to depict the actual clot than it is on the perfusion image to characterize it. The perfusion images can visualize as far down as the lower pons, but the time-to-peak and delay maps are more illustrative.

Figure 12: Perfusion Analysis

Figure 13: Visualization of Time-to-Peak Values

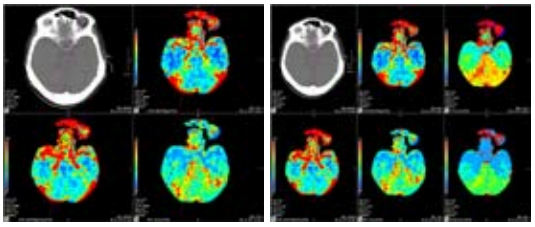


Figure 14: Revelation of Delayed Contrast Arrival

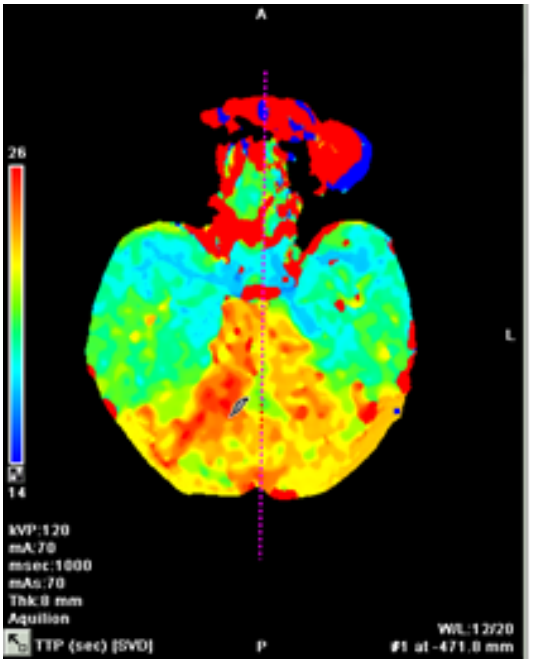
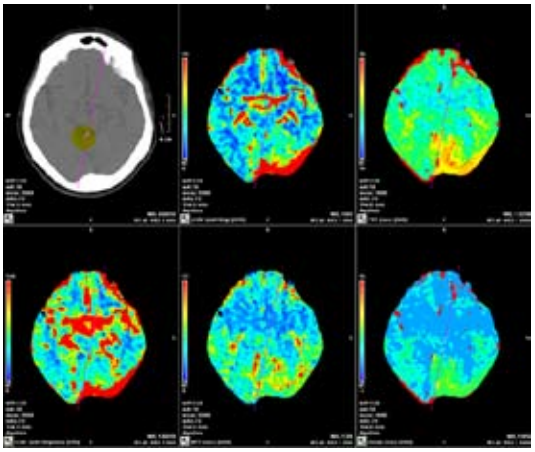


Figure 15: Visualization of Additional Perfusion Abnormality



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The natural history of distal basilar emboli tends to be poor (especially with involvement of the distal third of the BA) unless blood flow is restored. This patient was taken to the Neuro Intervention lab and received 10 mg intra-arterial tissue plasminogen activator (TPA). A pre-TPA angiogram (*see Figure 16*) revealed complete occlusion of the upper BA. This angiogram also helped confirm suspicion that the embolus originated from the right vertebral artery. (Distal BA occlusions tend to be embolic, whereas proximal BA occlusions are often due to intrinsic stenoses.) While the left posterior inferior cerebellar artery (PICA) and right anterior inferior cerebellar artery (AICA) were visible on the angiogram, the superior cerebellar arteries and the basilar apex were not. Therefore, it was determined that the patient had a distal occlusive basilar thrombosis, likely embolic from the right vertebral artery.

A follow-up angiogram revealed a small distal left PCA embolus covering up the left superior cerebellar artery. However, post-TPA the BA itself was widely patent with good flow to the PCAs (*see Figure 17*).

Figure 16: Pre-TPA Angiogram of Left Vertebral Arteryl

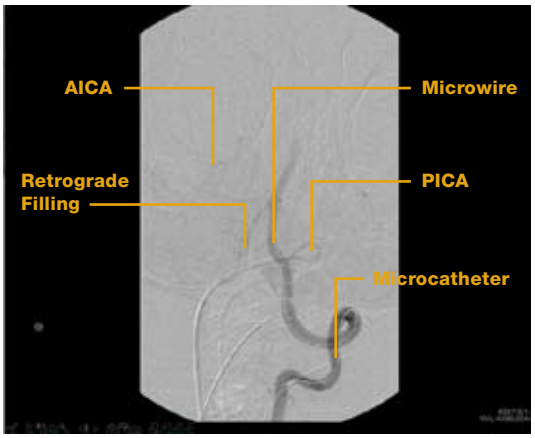
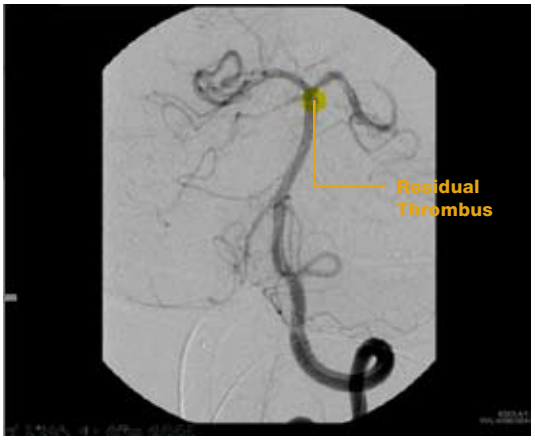


Figure 17: Post-TPA Angiogram of Left Vertebral Artery



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There was not enough data available to allow CT perfusion to fully characterize the damage from this type of stroke. Follow-up MRI and diffusion imaging revealed some patchy strokes in the right PICA territory (*see Figure 18*), tiny emboli in the cortex (likely created during dissolution of original BA embolus) (*see Figure 19*) and a very small infarct in the medial perforators off of the BA (*see Figure 20*). However, the mid-brain was unremarkable and the pons circuitry appeared open.

At the time of discharge, the patient had a NIHSS of 0, no dysphasia, generalized weakness (left greater than right) and intact sensory exam (1+ reflexes throughout with downgoing plantar on the right and upgoing plantar on the left).

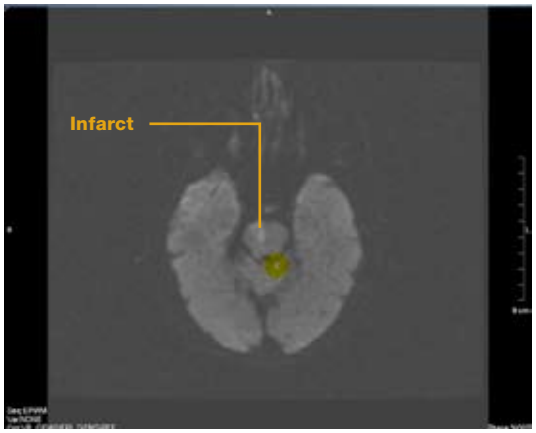
CONCLUSION

Distal embolus in the BA, acute cerebrovascular accident status post-arterial TPA intervention, and bilateral cerebellar left frontal strokes were identified. The system helped visualize a relatively recent RVA occlusion embolized to the basilar tip. Involvement of the brain stem caused the patient's crossed findings and initially obscured single hemisphere localization.

Figure 18: Visualization of Patchy Strokes on Follow-up MRI

Figure 19: Visualization of Emboli on Follow-up MRI

Figure 20: Visualization of Small Infarct on Follow-up MRI



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