

Clinical Case Review

Assessment of Vasospasm Following Ruptured Aneurysm Using Vitrea® Software

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INTRODUCTION

The patient is a 48-year-old male. He originally presented with a hemorrhagic stroke from a ruptured aneurysm that was diagnosed nine days prior. The right middle cerebral arterial (MCA) aneurysm was clipped. Immediately following surgery, the patient experienced some left-sided arm weakness that remained stable. Due to the relatively high rate of vasospasm following subarachnoid hemorrhage, velocities in the MCA distribution and the basilar artery (BA) were closely followed by transcranial Doppler. (The instance of vasospasm increases relative to the amount of bleeding, and this patient originally presented with a large amount of blood in the subarachnoid spaces.) Over the course of 24 hours, the patient's velocities increased and he developed new right-sided weakness with arm involvement greater than leg.

Dr. Jeffrey Carpenter imaged and evaluated the patient.

METHOD

A non-contrast head Computed Tomography (CT) was ordered to assess the presence of hemodynamically significant vasospasm.

FINDINGS

Volumes were loaded into the Vitrea® system using the CT Stroke Protocol. Some abnormalities were expected in the images due to the recent aneurysm rupture. The aneurysm clip was visualized in the Sylvian fissure (see Figure 1), the craniotomy in the parietal region and post-surgical scalp changes (see Figure 2). The parenchymal hemorrhage that occurred when the aneurysm ruptured (see Figure 2) was also visualized.

Some areas of decreased attenuation were noted around the hemorrhage and the hematoma, which usually have an inflammatory component and become more prominent over the first few days and then resolve. However, some areas of decreased attenuation that were not necessarily around the hematoma were also noted and might relate to a small infarct (see Figure 3).

Figure 1: Identification of Aneurysm Clip

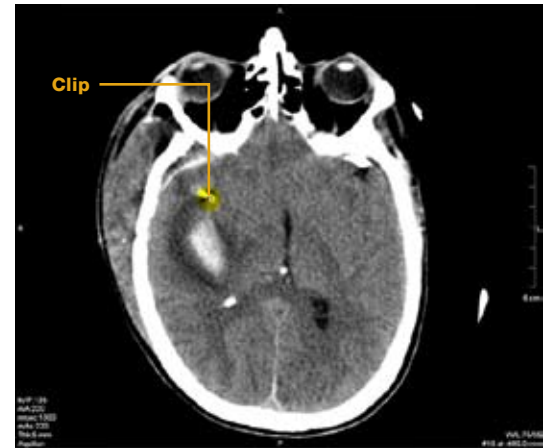


Figure 2: Visualization of Expected Abnormalities

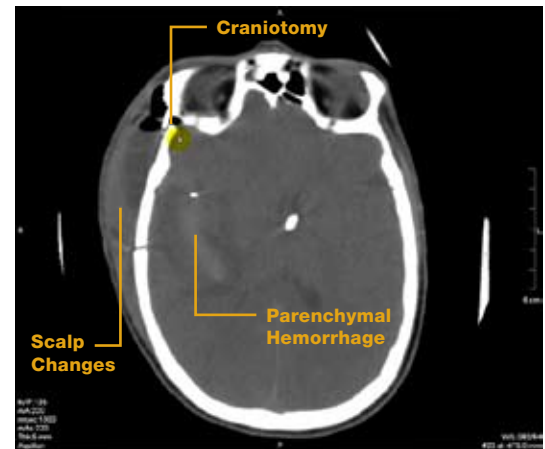
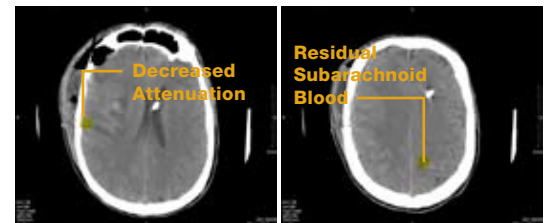


Figure 3: Area of Possible Infarct

Figure 4: Evaluation of Left Hemisphere



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Because the patient's new symptoms were on the right side, the left MCA distribution was studied more than the right. While the left hemisphere was unremarkable, the patient did have some residual subarachnoid blood (see *Figure 4*) nine days out.

Next, the first of two separately acquired data sets of CT perfusion imaging were loaded using the Brain Perfusion CT protocol. It was not an ideal data set due to the amount of motion artifact (see *Figure 5*). (It is not uncommon to get this degree of head motion in patients that are ill and experiencing symptoms.) After running Motion Correction, a good artery and a good vein were segmented, rendering it a diagnostic study even with a noisy data set.

At this point, volumes were generated, and the axis adjusted through the images. The study was deemed diagnostically useful due to the availability of mean transit value information. In regard to MCA distribution on the left, mean transit times were relatively increased compared to the right. Cerebral blood flow also appeared to be decreased around the hematoma and in the area of decreased attenuation on the right (see *Figure 6*).

The second acquisition of CT perfusion imaging was equally degraded (see *Figure 7*).

After running Motion Correction and segmenting the vessels, the another diagnostically useful volumes set were generated (see *Figure 8*). While the images weren't ideal, the typical appearance of diffuse vasospasm as patchy involvement of mean arterial times in the anterior cerebral arteries and MCA territory were visualized. Up higher, areas of involvement interdigitated with uninvolved areas were observed. Intervention was required given the new onset of symptoms in this case.

Figure 5: Assessment of Motion Artifact in First Data Set

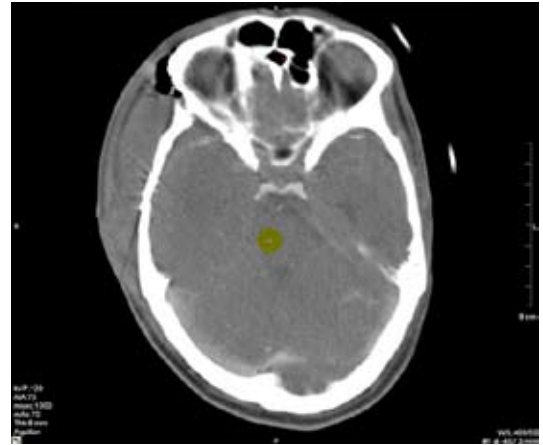


Figure 6: Computation of Volumes from the First Data Set



Figure 7: Assessment of Motion Artifact in Second Data Set

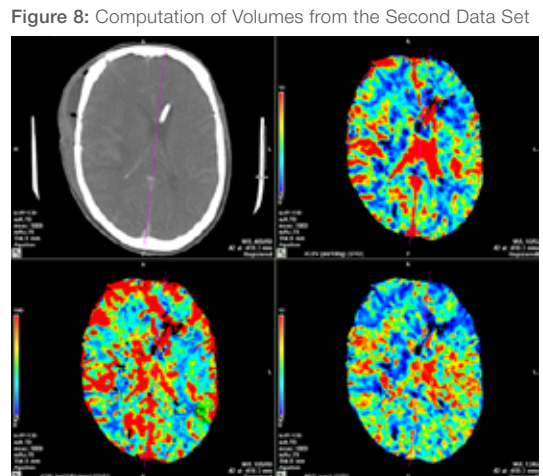


Figure 8: Computation of Volumes from the Second Data Set

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Using the Delay and Time-to-Peak maps (see Figure 9), heterogeneity throughout was observed, supporting the presence of vasospasm.

The CT angiogram (CTA) was used to locate the area of vasospasm. Because the cause of perfusion abnormalities for this patient were known, the images were viewed more quickly than with a stroke case. While doing so, extensive atherosclerotic disease was observed involving the carotid origins (see Figure 10). The disease on the left was relatively impressive for a 48-year-old and measured out to be around 65%. Therefore, secondarily addressing the carotid disease following the acute phase of vasospasm was recommended.

Continuing up through the study images to visualize the MCA, severe vasospasm was visualized on the left and areas of severe vasospasm on the right (see Figure 11). The BA was narrow, but not overly so. The images indicated abnormal perfusion distally with intermittent mean transit time and delay values, as well as some hint of decreased blood flow.

Next, the angiogram was loaded in Softread to evaluate vascular interventions (see Figure 12). In the frontal projection of the left side, some narrowing of the distal internal carotid artery (ICA) at the superclinoid and an extremely thin left MCA was visualized, which was responsible for the patient's symptoms. Relatively delayed filling time at the borders of the brain indicated the need for angioplasty.

Figure 9: Delay and Time-to-Peak Maps

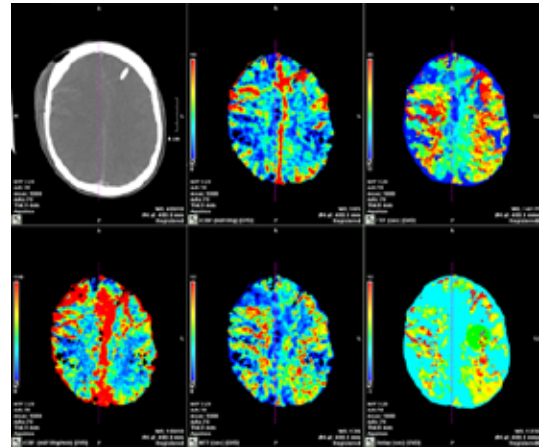


Figure 10: Observation of Atherosclerotic Disease

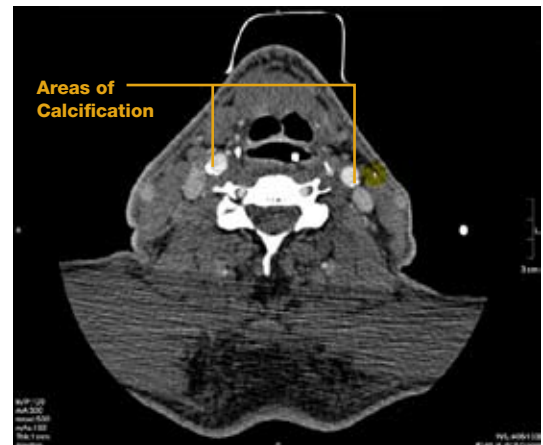
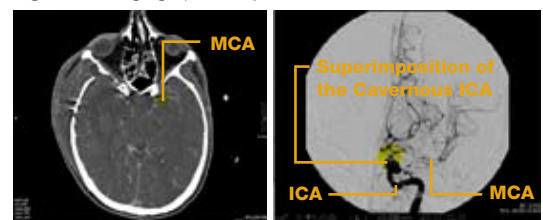


Figure 11: Visualization of MCA Vasospasm

Figure 12: Angiographic Projection of Frontal Left Side



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Angioplasty was conducted with a 4 mm x 10 mm Hyperglide™ in the MCA by passing through the M1 segment and conducting dilatations both there and within the distal ICA (see Figure 13).

On the follow-up angiogram, increased caliber of the MCA and distal ICA (see Figure 14) were observed. (Right-sided angioplasty of the MCA was also conducted, but only the left side is depicted for brevity.) Angioplasty cannot reach distal branch involvement of vasospasm. Even so, some increased flow in this region was observed and administration of calcium channel blockers (CCBs) was recommended for a case this severe.

On the follow-up CT (see Figure 15), a small infarct around the intraparenchymal hematoma from the ruptured aneurysm on the right side was visualized. The left side never did develop any infarcts, so the left hemisphere was salvaged.

CONCLUSION

Even with a noisy data set, render a diagnostically useful study was visualized with Vitrea. Severe vasospasm in the left MCA was identified. Angioplasty was recommended to salvage the left hemisphere (after which the patient's strength improved to baseline) and CCB administration to open distal vessel branches. Secondly addressing the patient's carotid disease (particularly on the left) after the acute phase was also recommended.

Figure 13: Calcifications in Cavernous ICA



Figure 14: Observation of Medial Course

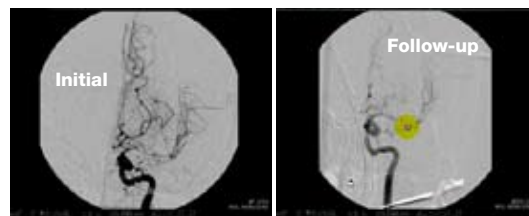


Figure 15: Identification of Clot at M1 Segment of MCA

