

WHAT WOULD YOU DO?

Basilar Thrombus and Occlusion of the Left Vertebral Artery

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CASE PRESENTATION

A man in his 70s with a history of coronary artery disease and pacemaker implantation is last seen in his normal condition at 8:00 PM. At 7:00 AM, the patient is found by his wife with dysarthria and right-sided weakness and numbness. He is evaluated at the hospital with an initial National Institutes of Health Stroke Scale (NIHSS) score of 14. Findings of a CT scan at the hospital are read as normal, but images are not available. He is transferred to our hospital for further evaluation; his NIHSS score has worsened, with progressive dysarthria, weakness, and loss of gag reflex and responsiveness. His NIHSS score is 28 upon arrival (9:30 AM). He is intubated in the emergency department, and a CT of the head is repeated and is again read as normal.



What is your next step? MRI/MRA, CTA, or take the patient directly to the angiography suite?

Dr. Satti: For this patient, we would probably perform a CT of the head and head/neck. At our institution, our ideal approach is the following:

- For symptom onset < 8 hours, we perform a CT of the head without contrast and assess the Alberta Stroke Program Early CT Score and CTA of the head/neck to confirm the large vessel occlusion (LVO).
- For symptom onset 8 to 24 hours in the anterior circulation, we perform CT of the head and head/neck, as well as CT perfusion, if possible.

- For symptom onset \geq 8 hours in the posterior circulation, we perform CT of the head and head/neck; however, if the patient is intubated and therefore unable to undergo CT, we consider a stat MRI of the brain to assess brainstem/thalamic infarction volume.

We are actively seeking to obtain the commercial version of the RAPID software (iSchemiaView, Inc.) to allow standardized CT perfusion in all patients beyond 6 to 8 hours with acute ischemic strokes, NIHSS scores > 6 (or major stroke), and suspected LVO.

Dr. Rai: This is, in essence, a wake-up stroke. The time that he was last seen as normal at 8 PM the previous night could be misleading. It is possible that the patient's symptoms are due to an acute LVO that occurred close to the time he awakened. We would give this patient the benefit of the doubt and initiate a full stroke workup that includes noncontrast CT, CTA, and CT perfusion. It is imperative to identify the site of underlying vascular occlusion before proceeding further.

Dr. Frei: A CTA of the head and neck is performed on every patient with suspected LVO to document the presence or absence of an emergent LVO (ELVO). If an ELVO is present, the CTA also helps preplan the thrombectomy procedure. Aortic arch anatomy will determine what catheter shape is best to directly access the appropriate artery with a sheath or whether an alternative access is necessary, such as use of the radial artery

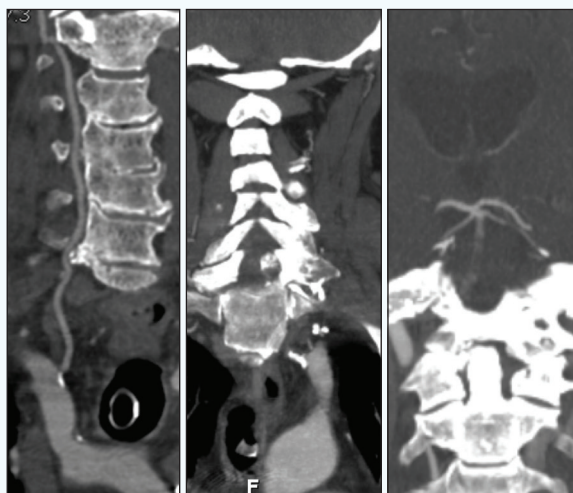


Figure 1

or a direct common carotid artery puncture. CTA may also provide a clue as to the source of occlusion. If there is calcification at the point of occlusion, there may be underlying atherosclerosis. If tandem lesions are present, administration of rectal aspirin and stenting the occluded cervical segment may be necessary. If the patient has had a head CT and head and neck CTA at the transferring facility within 1 hour, and the clinical presentation has not changed, we do not usually repeat this imaging.

CASE CONTINUED

CTA is performed and demonstrates basilar thrombus sparing the top of the basilar artery, a hypoplastic right vertebral artery (RVA) with stenosis at its origin, and occlusion of the dominant left vertebral artery (LVA) at its origin with a calcified plaque (Figure 1).



What do you do next? Please choose one of the following options and explain your decision.

- Do nothing because the thrombus is basilar and there is no level 1 evidence to support treatment
- Do nothing because the patient has exceeded the 12-hour threshold since he was last seen normal
- Perform an MRI to assess for brain damage and then decide a course of treatment
- Proceed to the interventional neuroradiology suite for treatment

Dr. Rai: The case gets interesting as an LVO involving the basilar artery is identified. It is important to note that basilar artery strokes were excluded from all major randomized trials that showed efficacy of endovascular therapy versus medical management. Acute basilar artery occlusions are almost always fatal. Endovascular therapy, although not proven, is the only option to salvage the brainstem. Baseline functional status is important to assess before making this decision, as revascularization with poor baseline cognitive and functional status could be futile. If the patient is clinically a candidate for endovascular therapy, the next step is to go to the interventional neuroradiology suite. CTA demonstrates challenging access, which requires careful preoperative planning. The hypoplastic RVA is a nonstarter as an access approach. It is very important not to underestimate the value of stable access. A tenuous access in a complex neurovascular case can lead to devastating outcomes, especially if a complication is encountered.

Dr. Frei: In our practice, last known normal is not used for decision making for thrombectomy. Every patient has an individual core infarct growth curve. Why would you deny a patient effective therapy (thrombectomy) based on an arbitrary time cutoff if noncontrast CT shows a small core infarction? Data from the DAWN trial certainly support treating patients up to 24 hours after symptom onset.¹ If a patient had an unknown time of last known normal or was more than 24 hours from symptom onset, we would still individualize the therapy based on that individual's collateral circulation. We assess the NIHSS score, evaluate the size of the core infarction on non-contrast head CT, determine the presence of an ELVO on CTA, and then make the decision for thrombectomy in all patients, regardless of the time of symptom onset. In patients with basilar artery occlusion, the mortality rate approaches 100%; therefore, we almost always perform thrombectomy in these patients.

Dr. Satti: If there is an LVO involving the vertebro-basilar system, we perform an immediate MRI of the brain to assess brainstem/thalamic infarct volume. The MRI would be helpful for us in terms of prognosis and, therefore, informed consent. Although some may argue that the natural history of an acute basilar occlusion is so poor that intervention should always be performed, we would contend that informed consent would best be obtained with the additional information that diffusion-weighted imaging provides (eg, prognosis, risk of revascularization, guiding antithrombotic therapy).

CASE CONTINUED

Left subclavian artery angiography confirms the occlusion at the origin of the LVA (Figure 2).



How would you proceed?

Dr. Frei: Options would include:

- Treating the inflow problem first with angioplasty or stenting the vertebral artery origin occlusion, then removing the basilar thrombus. This would require pretreatment with antiplatelet medication (600 mg of rectal aspirin in our practice).
- Traversing the vertebral artery occlusion and performing the basilar thrombectomy first, then addressing the vertebral artery origin. This would require using the Dotter method at the origin occlusion with the guide catheter/inner catheter, then performing thrombectomy. After successful recanalization, the LVA origin lesion can be read-dressed. Using the Dotter method at the origin often corrects the inflow, and the origin lesion can be stented a few days later when you are comfortable starting dual antiplatelet therapy.

The benefit of the first option is correction of the inflow first. When dealing with peripheral artery occlusions, we know that inflow is your friend. If there is no inflow, more distal occlusions will not stay patent over the long term. If we fix the inflow first, we will use a distal protection wire to prevent additional clot burden from dislodging more clot from the cervical segment of the LVA.

The benefit of the second option is faster recanalization of the target lesion. The RVA inflow or collateral flow from the posterior communicating arteries may be enough inflow to keep the basilar artery open while the LVA origin occlusion is addressed.

Dr. Satti: I would confirm that there was no alternative access to the basilar occlusion, such as through the posterior communicating artery (usually baseline CTA imaging is sufficient). Assuming there is no feasible transcirculation option and a hypoplastic right vertebral artery, I would focus on the LVA approach.

Typically, we use a triaxial approach to stroke intervention. The groin is accessed with a 8-F, 45-cm Brite Tip sheath (Cordis, a Cardinal Health company), 90-cm-long sheath (AXS Infinity [Stryker] or Neuron Max [Penumbra, Inc.]), intermediate catheter (AXS Catalyst 5/6 [Stryker] or Penumbra 068 [Penumbra, Inc.]), and a stent retriever if needed (Trevor Provue



Figure 2

[Stryker] or Solitaire revascularization device [Medtronic]). ADAPT (a direct aspiration first pass technique) or lesional aspiration using the CAPTIVE (continuous aspiration prior to intracranial vascular embolectomy) technique is often attempted as a first-line approach.

In this patient, I would start with a coaxial system of an 8-F, 45-cm Brite Tip sheath and a 90-cm Flexor Shuttle guiding sheath (Cook Medical). In patients with tandem occlusions, I prefer the Shuttle sheath because it provides more column strength, and the provided obturator can cross complete occlusions over a 0.035-inch Glidewire (Terumo Interventional Systems) with minimal shelf. This access is especially helpful in the setting of carotid occlusion where pushability is even more important to cross the heavily calcified and often tortuous bifurcation. After groin access, I generally administer 2,000 units of heparin intravenously (IV) for tandem occlusions where stenting may be needed.

Using an intermediate catheter and a microcatheter in conjunction with a Fathom 0.016-inch microwire (Boston Scientific Corporation), I would try to cross the left vertebral occlusion. If unsuccessful, my wire escalation strategy would be to try a 0.035-inch Glidewire directly through the intermediate catheter, and then finally use a medium heavy-tip coronary or peripheral wire such as an exchange length Asahi Confianza wire (Abbott Vascular).

After crossing the LVA origin, I would attempt to achieve a stable platform for thrombectomy, ideally with the intermediate catheter beyond the proximal occlusion, which is a distal-to-proximal approach (distal thrombectomy and then assess a management strategy of the vertebral origin at the end).

Dr. Rai: The left subclavian angiogram demonstrates critical stenosis at the LVA origin. There is perhaps very slow antegrade flow, and there is reconstitution, albeit minor, of the distal cervical LVA via the ascending cervical artery. At this point, the question is one of commitment to the case. One option is to catheterize the ascending cervical artery, position the microcatheter as distally within it as possible, and administer intra-arterial recombinant tissue plasminogen activator (rtPA). If this option is chosen, it is best to administer 10 to 15 mg of rtPA diluted in 100 mL of saline over a period of 30 minutes, which can lead to recanalization. However, in this case and with the current access and thrombectomy devices, commitment to the case requires opening up the inflow before the outflow can be addressed. In other words, the LVA origin needs to be addressed. This can be achieved via either angioplasty or percutaneous stent placement, with the latter being preferred because it provides a more durable and stable access platform than angioplasty alone.

Successful stent placement requires a large-bore access catheter in the subclavian artery. We would either use a 6-F Shuttle sheath or the Neuron Max guide catheter. After guide catheter placement, we would use a 0.014-inch microwire such as Synchro2 (Stryker) to gently probe and cross the high-grade stenosis. After successful wire crossing, we would utilize a rapid exchange short coronary stent such as 4- X 12-mm premounted balloon-expandable stent.

CASE CONTINUED

A 6-F Envoy XB guiding catheter (Cerenovus, a Johnson & Johnson company) is used, and the occlusion is crossed with a Confianza guidewire (coronary chronic total occlusion wire) and an Echelon 10 microcatheter (Medtronic). The microcatheter is advanced to the distal LVA. An angiogram confirms an intraluminal position. An exchange-length BMW guidewire is advanced through the microcatheter, which is then removed. A balloon-expandable stent is used to perform angioplasty and stenting of the LVA origin (Figure 3), which is successful. Angiography demonstrated non-flow-limiting proximal LVA dissection and confirmed the basilar occlusion.



What is your technique of choice for thrombectomy at this point?

Dr. Satti: If I could not cross the LVA using a Dotter approach, I would attempt primary angioplasty using a 2- to 2.5-mm coronary balloon. If both Dotter/angioplasty failed, I would stent the LVA origin with a balloon-mounted drug-eluting coronary stent (usually 3.5–4.0 X 8–10 mm).

Assuming we have established a stable platform in the mid- to distal cervical vertebral artery (eg, both the intermediate catheter and the Shuttle sheath beyond the LVA origin), I would attempt a thrombectomy using a stent retriever in conjunction with lesion aspiration. Specifically, I cross the basilar occlusion into the right posterior communicating artery using a microwire and one of the previously mentioned microcatheters. After confirming an intravascular position, I would advance the intermediated catheter into the proximal basilar artery about 1 cm proximal to the thrombus. After advancing a stent retriever into the right P1/2 junction (4 X 30 mm), I would turn on aspiration via a pump to the intermediate catheter and then deliver the stent retriever. As I remove the microcatheter (leaving the stent retriever), the intermediate catheter would be advanced to the face of the clot—still under continuous aspiration—until the clot was “corked.” I consider the clot corked when aspiration through the intermediate catheter stops flowing or when the intermediate catheter has been advanced over the proximal 5 to 10 mm of the stent retriever.

I allow the thrombectomy system to remain in place for 3 to 6 minutes and often perform a gentle control hand injection to assess restoration of antegrade flow. The stent retriever is gently removed with the intermediate catheter as a unit, with continuous pump aspiration and hand aspiration of the guiding catheter with a



Figure 3

60-mL syringe by the first assistant. If needed, this technique can be repeated until thrombolysis in cerebral infarction (TICI) 2c or 3 reperfusion is achieved.

I would leave a long 0.014-inch microwire across the left vertebral stenosis as the intermediate catheter and guiding catheter were withdrawn into the subclavian artery. After control angiography, I would access the LVA origin stenosis to decide whether to stent or leave the ostial stenosis alone.

Factors that support stenting include flow-limiting stenosis (with poor collaterals, no posterior communicating arteries, or poor RVA inflow) and mobile thrombus or high likelihood of recurrent embolus from the LVA origin. Factors that do not support stenting include large infarct volume as shown on the brain MRI, if the patient is receiving tPA, and if the patient has not taken antiplatelet medications (not on aspirin/clopidogrel at baseline). Prior to stenting, primary angioplasty is always attempted to see if adequate and stable inflow can be established.

Dr. Rai: Once inflow into the LVA has been established via stent placement at the origin, the next step

is to advance a delivery system that can be utilized to extract the clot from the basilar artery. We would use the established large-bore access in the left subclavian artery to place an intermediate catheter with an internal diameter > 0.060 inch (5MAX or Ace 68 [Penumbra, Inc.]) to allow placement for the thrombectomy microcatheter. We would place the intermediate catheter through the LVA stent and position it in the intradural segment, which would be used to deliver a thrombectomy microcatheter. We would avoid pure aspiration because we want to maintain access in the distal LVA and not have to recross the LVA stent repeatedly if aspiration and removal are performed. The 0.027-inch microcatheter would be delivered through the intermediate catheter over a 0.014-inch microwire with a J-shaped tip. The microcatheter would then be advanced to a distal P1 or proximal P2 segment before using a thrombectomy device, such as the 6- X 25-mm Trevo Provue or 6- X 30-mm Solitaire. After device deployment and angiographic confirmation of recanalization, the device would be removed under pump aspiration from the intermediate catheter.

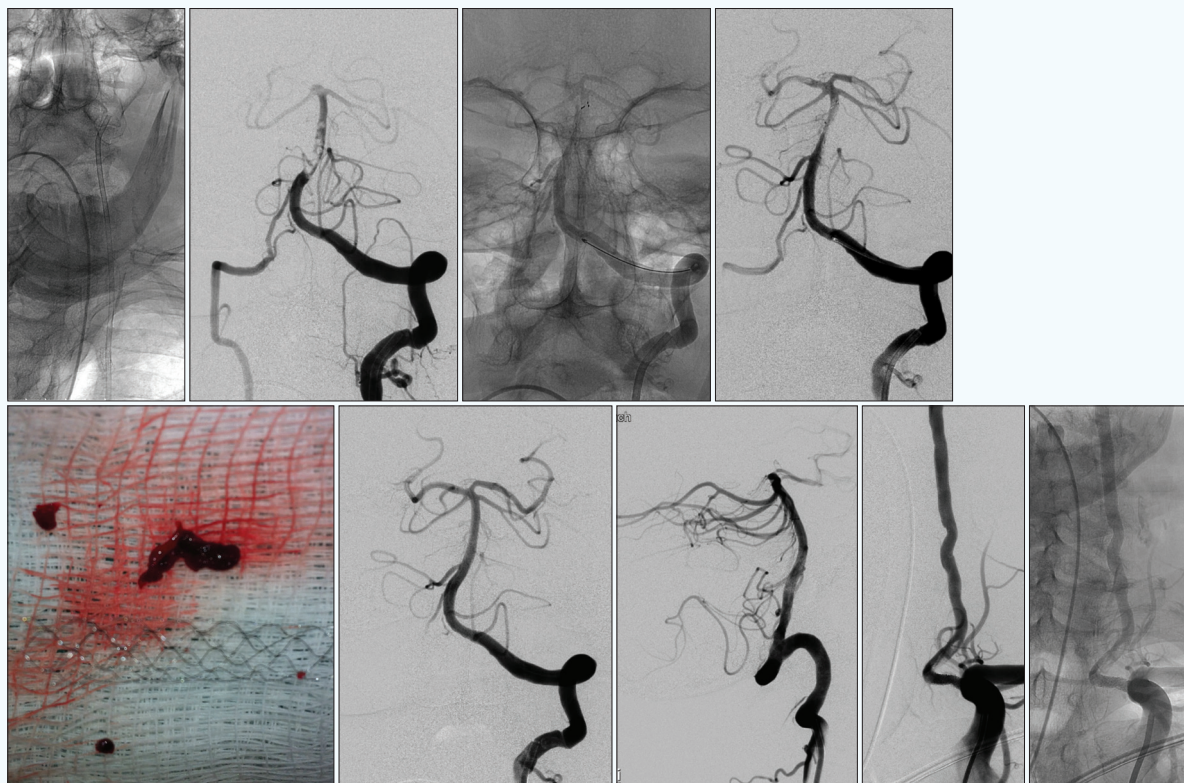


Figure 4

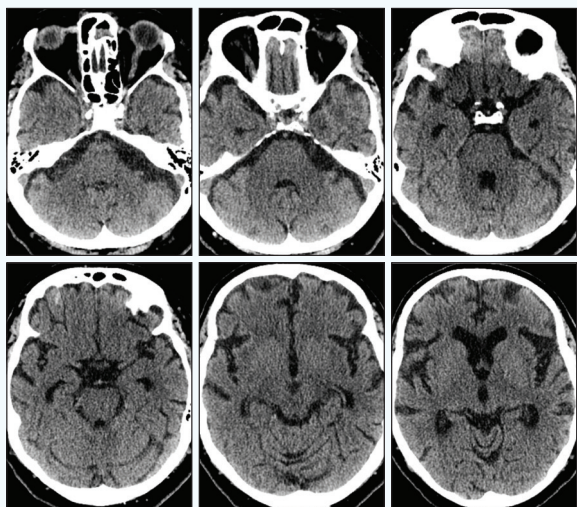


Figure 5

Dr. Frei: When a stent is placed in tandem lesions, we prefer aspiration thrombectomy to stent retriever thrombectomy. A stent retriever being pulled across the vertebral artery origin stent may be problematic. If a stent retriever is the thrombectomy device of choice, then one with local aspiration (the so-called Solumbra technique) would be preferred.

CASE CONTINUED

After the stent is deployed, the balloon system is gently advanced into the cervical LVA for support, and the Envoy guiding catheter is advanced over the system into the distal V2 segment of the LVA. A 6- X 30-mm Solitaire device is used for mechanical thrombectomy, which is successful after one pass, with TIC1 3 reperfusion (Figure 4). Final angiography demonstrates TIC1 3 reperfusion and a non-flow-limiting dissection of the proximal LVA.



How do you manage antiplatelet and anticoagulation during and after the procedure?

Dr. Satti: After groin access, 2,000 units of IV heparin are administered. Prior to stent placement, 325 mg of aspirin via nasogastric tube or 300 mg of transrectal aspirin are given if the patient is not on antiplatelet medications at baseline. After stent placement, one-half loading dose eptifibatide is administered intra-arterially through the guiding sheath. After the procedure, we maintain strict blood pressure control with a goal systolic blood pressure of 120 to 140 mm Hg and perform immediate CT of the head to assess stroke infarct volume/evolution and hemorrhagic conversion.

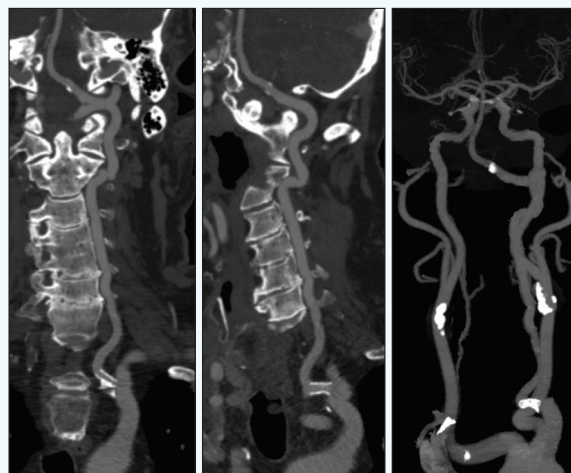


Figure 6

If CT of the head looks “good,” we immediately give a loading dose of clopidogrel 300 to 450 mg. The next day, we perform repeat CT of the head, consider platelet inhibition testing, and then continue aspirin and clopidogrel.

Dr. Frei: In a tandem occlusion scenario, when treating a cervical artery lesion, we administer 600 mg of rectal aspirin if the patient is not on antiplatelet therapy at home. Clopidogrel would not be therapeutic until a few hours after administration via nasogastric tube, so we don’t use dual antiplatelet therapy. We would also give 2,000 units of IV heparin at the beginning of the procedure. The risk of symptomatic hemorrhage probably increases with more antiplatelet therapy; therefore, we prefer not to administer clopidogrel in the setting of acute stroke.

If there is platelet aggregation on the stent and residual stenosis, we would advance a distal protection wire past the stenosis and angioplasty the stent to normal diameter. If there is platelet aggregation on the stent after angioplasty, we would consider intra-arterial administration of abciximab or a loading dose of eptifibatide, but we would not put a patient on a glycoprotein IIb/IIIa IV drip. I believe this significantly increases the risk of symptomatic hemorrhage.

With angioplasty alone of the cervical lesion, there may be a lower risk of platelet aggregation than if a stent were placed. This would mitigate the potential risk of symptomatic hemorrhage if additional platelet aggregation inhibition medication is needed.

Dr. Rai: We would place a nasogastric tube after CTA confirms basilar artery occlusion and LVO stenosis

and administer a loading dose of 600 mg of clopidogrel and 650 mg of aspirin. We would continue with a maintenance dose of 75 mg of clopidogrel and 81 mg of aspirin after that.

CASE SUMMARY

Immediately after confirming the LVA occlusion, the patient is loaded with 325 mg of aspirin and 600 mg of clopidogrel through a nasogastric tube. During the procedure, 3,000 units of heparin is given. The patient continues on clopidogrel 75 mg and aspirin 325 mg for at least 6 months. CT is performed 36 hours posttreatment (Figure 5). Three-month follow-up CTA demonstrates a NIHSS score of 0 (Figure 6). ■

1. Jovin T, Nogueira R. DAWN, DWI or CTP assessment with clinical mismatch in the triage of wake up and late presenting strokes undergoing neurointervention. Presented at ESOC 2017; May 16, 2017; Prague, Czech Republic.

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