ASK THE EXPERTS

Stroke Intervention: Essential Tips for Trainees

A successful neurointerventional procedure relies not only on mastering technique but also knowledge of anatomy and neurologic function, preprocedure preparation, awareness of clinical history and timeline, and a standardized workflow.

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Disclosures: None.

There is nothing quite as rewarding in clinical practice as watching a patient walk out of the hospital after a successful stroke intervention, saving them from a lifetime of disability. Broadly, you can classify two essential skills needed to provide your patient with the best chance for recovery when performing a stroke neurointervention.

1. **Cognitive.** A solid knowledge of cerebrovascular anatomy and corresponding neurologic function is essential. This involves appreciating variants and gaining facility in anticipating which fluoroscopic views will display the target anatomy best by having a firm understanding of bony landmarks, cerebral vessel relationships, bifurcation patterns, and neurovascular embryology. I can't emphasize how important the application of this knowledge is for successful decision-making during a stroke intervention.

2. **Technical.** Optimizing manual technique with an appreciation of vessel course and tortuosity in the context of catheterization is important for successful catheterization and subsequent intervention. This means understanding how to manage variables of catheter manipulation, wire manipulation and purchase, guide catheter stability, and the catheter support necessary to gain the stability needed for the planned stroke intervention. It includes finding the most efficient route to the target vessel, with consideration toward selecting the tools necessary to achieve rapid access. Trainees should pay attention to catheter shapes, guide catheter sizing and length when planning for the procedure, picking tools that best fit with the presumed underlying pathology, stroke mechanism, and vessel anatomy.

It is very helpful for a trainee to start by becoming adept at the rapid setup of the operative table and preparation of tools. This is a good way to gain experience with preparing devices specific to stroke neurointervention, paying attention to the setup for different stroke etiologies, device prep, and the procedural steps.

Having a clear understanding of the patient's anatomy and tailoring a plan to the pathology encountered is crucial when performing a stroke intervention. This may mean adopting a more supportive system for anticipated angioplasty and/or stenting or choosing transradial access for a posterior circulation stroke or bovine variant to the left carotid artery.

Finally, have a plan of attack in mind and share it with the operative team to deliver rapid care. Stroke neurointervention cases can be the most challenging with difficult anatomy, and the pressure of performing the procedure quickly to maximize timely recanalization can add significant stress. Having good communication skills when conveying the plan is essential to optimize the chance for success.

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Disclosures: None.

Successful thrombectomy starts with targeted preparation before the patient enters the suite. Carefully review the preoperative imaging, including the noncontrast head CT—taking note of ASPECTS (Alberta Stroke Program Early CT Score)—and the CT perfusion and CTA. Take time for thoughtful patient selection and proper consent. Have a mentality of working calmly and efficiently, not faster. Safety is of paramount importance during thrombectomy. This is the case for all invasive procedures, but particularly in these cases when complications can be fatal and the vast majority of thrombectomies achieve successful recanalization.

Be efficient but meticulous in your operative plan. Assess the aortic arch and path to the occlusion to select the best catheter construct for your patient. In patients with bovine, type II, or type III aortic arches, even when going to the right internal carotid artery, a Simmons 2 catheter is optimal. Save time by forming the Simmons wirelessly along the arch by rotating the catheter and applying gentle forward pressure while aspirating on a syringe. Have several techniques in your toolkit to climb difficult anatomy, including supportive wires (eg, Glidewire Advantage [Terumo Interventional Systems]) or "grappling hook" methods with balloons/stent retrievers.

When reviewing the CTA, take note of the caliber of the target vessel to properly size the aspiration catheter (or stent retriever). Attend to branch points or curves distal to the occlusion so you can plan if and how you will cross the lesion. Attending to the length of the occlusion allows you to safely "engulf" the lesion with gentle forward pressure on your aspiration catheter.

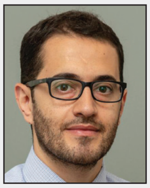
In addition to careful review of the imaging, make sure you understand the clinical history and timeline. Have knowledge of the relevant medications in play and a working theory about stroke etiology. If the stroke is cardioembolic, it is efficient and safe to perform pure aspiration; however, an intracranial atherosclerotic lesion will often require a stent retriever (in combination with aspiration) and, at times, intra-arterial thrombolysis, angioplasty, and/or stenting to maintain recanalization. Each clinical and anatomic scenario is unique, and a good neurointerventionalist will have multiple constructs and techniques to tailor to the situation.

Lead your neurointerventional team in patient preparation. Confirm medical stability and code status with the triaging physician. Assist with patient positioning. Collaborate with your anesthesiologist on optimal anesthesia; early in your career, general anesthesia is best for every case. Perform safe ultrasound-guided arterial access. Saving time by proceeding on an awake patient who is moving or performing a rushed puncture is not worth it. Long sheaths are helpful; for example, an 8-F, 45-cm sheath can help neutralize tortuosity from the common femoral artery up to the descending aorta. A transradial approach is appropriate for posterior fossa strokes but is not worth the time (or the potential damage a large sheath can cause to the radial artery) in anterior circulation cases.

Take time for visualization of the intracranial vasculature, with magnified views of the occlusion in both planes. It is not worth the risk or time saved to "feel your way" or access the wrong branch and be forced to start again. Try not to cross the clot with your microcatheter if you can smoothly reach an embolus with your aspiration catheter over the microwire to avoid pushing clot downstream. Don't be afraid to use a microwire with body (eg, 0.016-inch Fathom [Boston Scientific Corporation], 0.018-inch Aristotle [Scientia Vascular Inc.]), but take caution until you are accustomed to how these wires feel moving past a clot.

For the junior operator's first distal or medium vessel occlusion (MeVO) thrombectomy, get comfortable going distal in patients where you have performed a proximal thrombectomy and have a second occlusion or distal embolus. Become proficient with visualization and safe technique. Later, you can offer thrombectomy to candidates with MeVOs when clinically warranted for the M2/3, A2, and P2 segments and beyond.

Remember the law of diminishing returns and avoid overtreating the occasional patient with a resistant occlusion. Some cases will have persistent or recurrent occlusions. Set a limit on the number of passes (typically 3-5 depending on style) and what interventions you are willing to offer in the clinical context. An unsuccessful thrombectomy is better than a hemorrhage in addition to the stroke. For atherosclerotic lesions that reocclude, consider core size and clinical value of the territory before acting. Obtain a DynaCT (Siemens Healthineers) without contrast, and if there is no hemorrhage, start with rectal aspirin. Then, reopen the vessel and consider intra-arterial eptifibatide via a microcatheter. Wait and assess for durability, and be prepared to stent in the right context.



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Successful and rapid reperfusion is crucial for improving outcomes in patients with acute ischemic stroke due to large vessel occlusion (LVO). Before the procedure, the neurointerventionalist must be well prepared to achieve rapid reperfusion. A thorough review of the available cross-sectional imaging of the head and neck is necessary to evaluate the brain parenchyma (ASPECTS), characterize the occlusion (length, shape, concomitant occlusions), and assess the collateral status. CTA of the neck is also useful to evaluate the aortic arch and supra-aortic trunks for tortuosity and presence of vascular variants (eg, bovine configuration), as well as to evaluate any extracranial pathological conditions that may cause the intracranial occlusion (eg, aortic or carotid dissection, cervical occlusion in tandem occlusions, atherosclerotic stenosis, carotid web, carotid kinks). These extracranial variants or pathological conditions may make the procedure more complex and require adjustments to the technique or vascular access.

For example, in the setting of tortuous anatomy, a long sheath or stiffer wire may be required. In the case of bovine morphology or type III aortic arch, a reverse angle catheter is usually required; or sometimes, choosing radial access as the primary vascular access may be needed. If extracranial stenosis or dissection is present, patients may also need to be premedicated with dual antiplatelet therapy if stenting is needed. Regarding the thrombectomy technique, the use of a balloon guide catheter is preferred for anterior circulation LVO, and I place it as distal as possible in the cervical internal carotid artery for flow arrest during the stent retrieval. An intermediate catheter is also usually added, especially in cases of tandem or distal occlusions or severe tortuosity. In my opinion, the combination of a balloon guide catheter with both aspiration and stent retriever is the best way to achieve first-pass complete reperfusion. A long microcatheter (> 160 cm) is used, and the microwire is J-shaped to preclude the selection of small branches and typically deliver itself to the occlusion site. Selecting the inferior division of the middle cerebral artery in cases of M1 occlusions is better because of its larger diameter and less tortuous course compared to the superior division. When using an intermediate catheter, the microcatheter is stripped off before retrieval to increase the suction force. Removing the microcatheter also allows it to be reprepared in case a second pass is required.

Regardless of the technique used, it is crucial to optimize and standardize the workflow and process. Adopting a standardized equipment approach for LVO thrombectomy cases can lead to a considerable decrease in recanalization times and improved outcomes. ■