

TIPS & TRICKS

Crossing Acute Large Vessel Occlusions

Insight into how best to cross acute large vessel occlusions and avoid complications.

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As rapidly as our understanding of acute ischemic stroke evolves, so do the nuances of its safe and effective treatment. When encountering a large vessel occlusion (LVO) stroke, the goal is undeniably simple: open the vessel. Within this simplicity, however, hide many subtle complexities, controversies, and unanswered questions.

In even the most straightforward case, numerous actions must be executed, and countless decisions must be made when performing successful endovascular thrombectomy. This article focuses on one of these technical steps—crossing the clot. We hope to provide some insight into crossing acute LVOs and suggest how best to approach these lesions, emphasizing successful revascularization and avoiding complications.

CROSSING ACUTE LVOs

Informal polling at recent neurointerventional society meetings in the United States suggests a relatively even split between direct aspiration and stent retriever as a first-choice tool for mechanical thrombectomy. With direct aspiration, the catheter can be advanced to the proximal edge of the clot without ever needing to cross it, but for physicians who opt for a stent retriever, crossing the clot with a microcatheter first is a necessary maneuver to facilitate stent retriever deployment. To do so, one usually maneuvers a microwire through the occlusion into the distal vasculature, but there is inherent risk associated with blindly crossing these occlusions. Broadly, these risks can be divided into two categories: (1) subarachnoid hemorrhage due to vessel perforation and (2) distal territory emboli caused by clot fragmentation.

Vessel Perforation

The rate of subarachnoid hemorrhage caused by vessel perforation that occurs during thrombectomy has

been well established by multiple observational studies and retrospective analyses. Angiographically occult and asymptomatic hemorrhages from vessel perforation/injury have been seen at a rate as high as 16% in some series, but in the majority of these cases, there were no significant clinical sequelae. On the other hand, the rate of angiographically apparent hemorrhages ranges from 0.6% to 2.9%, and they are associated with a mortality rate > 50% at 90 days.¹⁻³ The most common mechanisms by which these hemorrhages occur are through microwire vessel perforation and vessel injury associated with stent retriever use.⁴

Proper training and experience lead to better outcomes, but even in the best hands, vessel perforation can occur. In our experience, and with that as the starting point, there are some strategies that can be employed to reduce these risks.

The role of imaging. An occluded intracranial vessel does not usually allow for real-time angiographic visualization of the distal course of that vascular distribution. When a leading wire is blindly advanced into the intracranial circulation with only a mental picture of where that vessel should be in typical anatomy, it is important that the mental picture be as complete as possible. This means careful analysis of preprocedural imaging, which is usually in the form of a CTA. On CTA, the course and caliber of the occluded vessel can often be delineated, and the vessel may even recanalize distal to the occlusion, allowing for full inspection of the distal territory to be used for navigation. Unfortunately, this is not always the case, and when it occurs, we have found that evaluating the contralateral vasculature on cross-sectional imaging often gives a sense of what that occluded vasculature may have in store, because the majority of patients will have “mirror image” intracranial vascular anatomy. Perhaps the best-case scenario is that of a patient with prompt collateral flow to the

occluded territory. When performing angiography, it is essential to allow time for delayed collateral perfusion to reach the occluded territory. In these patients, retrograde flow may reach the distal edge of the clot, demonstrating where to attempt to position the distal wire and microcatheter.

Microwire and microcatheter technique. In general, crossing the clot with a J-shaped microwire tip is considered less traumatic (Figure 1). However, this is not always possible and comes at the cost of potentially fragmenting or displacing the embolus into the distal vasculature. A recent publication advocates the use of a microcatheter-only technique, through which a microcatheter is pushed through the occlusion without a leading wire. The authors report a significantly reduced risk of vessel perforation and subarachnoid hemorrhage with this method.⁵ Regardless of how the clot is crossed, confirmation that the catheter is intravascular is the next important step. Microcatheter injection of 0.1 to 0.3 mL of contrast is advisable to confirm that the catheter is positioned in a suitable location for stent retriever deployment. Recent analysis of SWIFT PRIME data has shown this to be safe, dispelling a commonly held dogma that injecting a small amount of contrast into the occluded vasculature is dangerous or toxic.⁶

Of note, when perforations are encountered, the site of perforation is generally in the distal (M3 middle cerebral artery [MCA] segment and further) vasculature.¹ As such, navigating the microcatheter out only as far as you need to is an important caveat. However, this point is tempered with the knowledge that if you are treating a distal occlusion or need distal access for support through tortuous or otherwise challenging vascular anatomy, you may have no choice. Furthermore, distal microcatheter placement may be preferred, as there is evidence suggesting that recanalization rates are improved when a stent retriever is

deployed with as much open stent beyond the thrombus as possible.⁷

Distal stent retriever deployment. With regard to optimizing recanalization rates, distal stent retriever deployment appears to improve first-pass recanalization by allowing more chances for clot reintegration if the clot rolls or slips along the stent during the retrieval process. For this same reason, longer stents are also preferred.⁸ Another useful pearl when encountering M1 occlusions is that data support that, when given the option, selecting the inferior M2 MCA division for deployment of the distal aspect of the stent retriever provides superior first-pass recanalization rates compared to selecting the superior M2 MCA division.⁹

Distal Emboli

Recent studies have confirmed that clinical outcomes are directly tied to not only vessel recanalization rates but also to reperfusion scores, which focus on evaluating the distal branches for thromboemboli.

Reperfusion scores. The most widely used scoring system is the thrombolysis in cerebral infarction (TICI) score, and we now have a better understanding of what is a “successful” TICI reperfusion score.¹⁰ Studies have shown that TICI 3 reperfusion correlates with a more favorable outcome (modified Rankin Scale ≤ 2) at 90 days compared to patients who only achieve TICI 2b reperfusion. This difference in outcome is substantial, with 90-day independence of 70% in patients who have TICI 3 reperfusion versus only 50% for patients with TICI 2b reperfusion.¹¹

Catheter selection. With clear evidence regarding the impact of distal emboli on patient outcome, how do we prevent their formation when crossing intracranial occlusions? Bench models have shown that when catheters cross acute intracranial occlusions, distal emboli

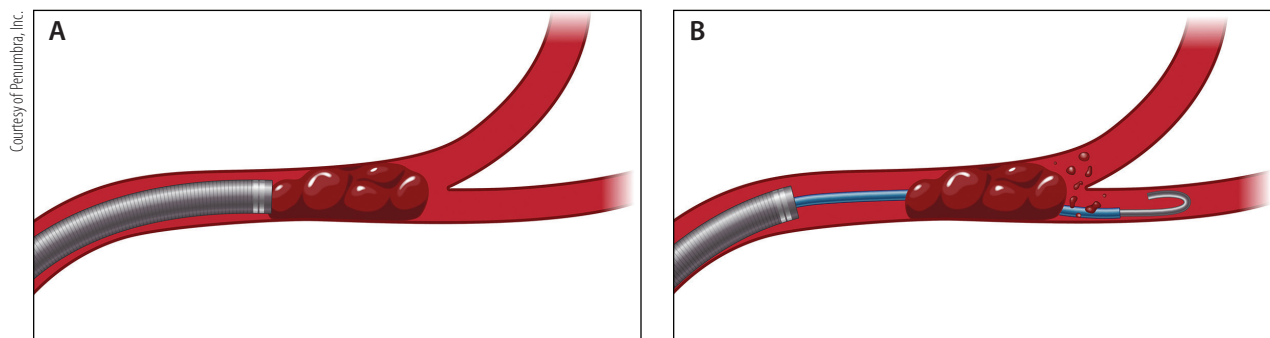


Figure 1. Aspiration catheter positioned at the proximal edge of the occlusion (A). This method eliminates the need for and risk of crossing the occlusion. Microcatheter navigation across the clot is often needed for successful revascularization (B). A J-shaped wire configuration, smaller delivery microcatheters, and adjunctive local aspiration may reduce the risk of vessel injury and distal thromboemboli.

are formed, which can lead to suboptimal reperfusion rates. The formation of these distal emboli may seem unpreventable, but selecting a larger catheter appears to promote more emboli compared to using smaller catheters to transverse the clot.¹² The logical implication is that choosing the smallest microcatheter possible to facilitate stent retriever placement should be beneficial in reducing distal emboli.

OUR TECHNIQUE

Because we know that the act of advancing a microwire and microcatheter through a thrombus could in and of itself produce distal emboli and/or cause vessel perforation, the obvious question to ask is, “Do I need to cross this clot at all?” We would encourage you not to cross the clot, as our preferred first-pass method is direct aspiration alone. Recent trials performed in Europe and the United States show statistically equivalent recanalization rates and clinical outcomes with direct aspiration compared to stent retriever use, with a propensity for faster procedure times with aspiration.¹³⁻¹⁵ What this tells us is that both of these tools are effective for achieving recanalization, but if the vessel can be opened without crossing the clot, perhaps aspiration is the best approach.

Our standard setup for LVOs starts with a 6-F, 90-cm-long sheath over a 6-F Simmons 2 coaxial catheter with a 0.038-inch, 180-cm Glidewire (Terumo Interventional Systems). This allows the vasculature to be selected from a femoral or radial approach in the majority of cases. Once the long 6-F sheath is in position, a large inner diameter (ID) aspiration catheter and a coaxial 0.035-inch catheter are advanced over a 0.016-inch guidewire (ideally in a J shape) (Figure 1). We prefer a larger 0.035-inch ID “inner” catheter because it provides more support and reduces the ledge effect when tracking the largest available aspiration catheter to the proximal edge of the clot. While advancing the aspiration catheter, we make every effort to keep the 0.035-inch ID catheter and 0.016-inch microwire proximal to the occlusion to avoid manipulating or crossing the clot prior to pump aspiration.

SUMMARY

We advocate direct aspiration as a first-pass technique for acute LVOs, which eliminates any risk associated with crossing the clot. However, in our experience, we recognize that this action is often a necessary step in performing a successful endovascular stroke procedure. As such, it is important to familiarize yourself with the potential pitfalls of crossing the clot and how to best avoid them. When you do need to cross the clot, as in cases of failed aspiration or when distal access

is required to support catheter delivery, consider the following advice: know where you are going, use the smallest microcatheter possible to get there, only go as far as necessary, and confirm the catheter position before device deployment. Above all else, always proceed with caution and intention, because we do not realize how important seemingly small actions are until we take the wrong one. ■

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