7 Endovascular Reperfusion of Acute Large Vessel Occlusion Stroke

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Introduction

Intra-arterial (IA) thrombolysis in acute ischemic stroke was first reported in the early 1980s [1, 2] when endovascular recanalization was performed as a lifesaving measure in patients with acute vertebrobasilar arterial occlusions. These reports signaled a meaningful benefit with IA therapies and paved the way for further endovascular studies of not only thrombolytics but also mechanical devices. Several mechanical thrombectomy (MT) devices have been approved by the US Food and Drug Administration for the treatment of acute large vessel occlusion (LVO) stroke as the sole therapy or in combination with intravenous thrombolysis (IVT) [3]. These devices include the Merci retrieval and Penumbra aspiration systems, as well as the second-generation Solitaire-FR and Trevo stentrievers. Additionally, stentrievers and aspiration systems are frequently used in combination to optimize MT times and recanalization rates. Five randomized controlled trials were published in 2015 that demonstrated significant clinical benefits of MT for LVO within 6 h from last known well (LKW). Meta-analysis of these trials demonstrated a number needed to treat of 2.6 to improve neurological outcome at 90 days [4]. In 2018, two additional landmark LVO trials, DAWN and DEFUSE 3, established the benefit of MT in the extended time window up to 24 h LKW in select patients with favorable perfusion imaging [5, 6]. Most recently in 2020, the DIRECT-MT trial randomized thrombolysis-eligible LVO patients to IVT with MT versus MT alone and concluded that the two strategies were noninferior [7]. The SKIP study shared a similar randomized design but did not show noninferiority of direct MT compared to combined IVT and MT with respect to favorable outcomes [8]. The ASTER trial demonstrated that combined IVT and MT resulted in improved functional outcome with higher recanalization and lower mortality when compared to MT alone [9]. Additional study of direct to MT for IVT eligible LVO is needed to understand this treatment approach that parallels cardiac systems of care for myocardial infarction.

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Endovascular Recanalization Techniques

Intra-Arterial Thrombolysis

The use of IAT as a stand-alone therapy or adjunct to mechanical clot removal has become

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rare. It involves infusion of a thrombolytic agent through a guide catheter in the cervical internal carotid artery or a microcatheter advanced intracranially into or immediately proximal to the occlusive thrombus. The Prolyse in Acute Cerebral Thromboembolism (PROACT) II trial demonstrated improved outcomes in patients with acute middle cerebral artery (MCA) occlusions treated with IA infusion of prourokinase compared to controls when treated within 6 h of onset, despite an increased incidence of symptomatic intracranial hemorrhage (ICH) [10]. Prourokinase did not receive FDA approval, but numerous other thrombolytic agents including urokinase, reteplase, recombinant tissue plasminogen activator (tPA), and tenecteplase have subsequently been used. Although IAT appears safe after the administration of IV tPA [11–14], there is no dose equivalence among various thrombolytic agents in terms of safety or efficacy [15, 16]. Prior to approval of MT devices, mechanical clot disruption with a J-shaped microwire or an ultrasound microcatheter was shown to be safe and potentially enhance the IA fibrinolytic process [17, 18].

Mechanical Thrombectomy Devices

Merci Retriever

The Merci retriever (Stryker, Kalamazoo, MI) became the first FDA thrombectomy device in 2004 [19]. While no longer widely used, it is of historical interest. It is a corkscrew-shaped device with helical loops made of nitinol that engage the clot when deployed through a microcatheter. The device and the clot are subsequently pulled out through a large bore guide catheter positioned in the proximal parent artery. Up to six passes with the retriever were permitted to achieve recanalization in the occluded artery. The next-generation Merci retriever [20] showed further improved recanalization rates; however, favorable clinical outcomes (modified Rankin Scale 0–2) only occurred in 36%, and symptomatic intracerebral hemorrhage was 9.8%. The Merci retriever had certain limitations: Tortuous arterial segments and thrombus extending into distal arterial branches negatively impacted recanalization rates [21] as did fibrin-rich clots [22]. Investigators also demonstrated that up to three passes with the Merci retriever were optimal and that additional passes were not only unlikely to achieve recanalization but also potentially increase complication risks [23].

Direct Aspiration Systems

The Penumbra system (Penumbra, Inc., Alameda, CA) is a suction thrombectomy device that received FDA approval in 2008 for use within 8 h of onset in patients with acute intracranial LVO [24]. Unlike the Merci retrieval device, the Penumbra aspiration system was designed for direct clot aspiration which minimizes risk of thrombus fragmentation with distal emboli or emboli to new vascular territory [25]. The Penumbra system showed better recanalization rates [26, 27] than those reported in the MERCI trials, and recent randomized studies of first-line therapy with a direct aspiration first-pass technique (ADAPT) have shown noninferiority when compared to stentrievers [28, 29]. Additional aspiration systems include Medtronic Riptide (Covidien, Irvine, CA) and Imperative Care Zoom (Campbell, CA) that received FDA approval in 2018 and 2019, respectively.

Retrievable Stents (Stentrievers)

Stentrievers are widely used, second-generation, MT devices and have demonstrated significant improvement in recanalization rates and time to recanalization, when compared to prior devices [30]. The two most commonly used, FDA-approved stentrievers are Solitaire X (Covidien, Irvine, CA) and Trevo XP (Stryker, Kalamazoo, MI). Meta-analysis of multiple randomized controlled trials demonstrated that early MT with a stentriever was associated with high rates of functional independence and successful recanalization [31].

Combined Aspiration and Stentriever

Today, aspiration catheters and stentrievers are not only used individually as first-line therapy but often combined to optimize recanalization times and rates. The combination of large bore aspiration catheter with a stentriever has been called "Solumbra" and provides several potential synergistic effects. Localized aspiration at the site of the thrombus may promote entrapment of the clot within the stent. It can also reduce the incidence of thrombus fragmentation and distal embolization. Studies of the combined techniques have shown good recanalization rate and favorable mRS outcomes at 90 days [32].

Technical Considerations

Pre-Procedural Preparation (See Chap. 6)

It is important to review the treatment plan and equipment being used with the support personnel including the anesthesiology team. There is often a delay in obtaining thrombolytic agents and glycoprotein IIb/IIIa agents prepared and delivered from the pharmacy. If the use of these agents is being considered, it is advisable to notify the pharmacy prior to beginning the intervention.

Tool Review (See Chap. 1)

Chemical Thrombolysis

- *Sheath*: A 6- to 8-French sheath is generally adequate, but depending on the guide catheter size, a larger sheath may be needed to allow for continuous intra-arterial blood pressure monitoring if a radial arterial line is not available. A long (35-cm or greater) sheath is recommended given the high incidence of femoroiliac tortuosity and abdominal aortic aneurysms in this patient population.
- *Guiding Catheter*: A 6-French guiding catheter with a distal segment designed to be positioned within the distal cervical to cavernous segment is currently the norm. These catheters combine a stable proximal end with a flexible, atraumatic, distal tip. A heparinized flush is connected to the guiding catheter via a three-way stopcock and Y adaptor.
- *Access Wires*: A standard hydrophilic 0.035-in. access wire is used to select and catheterize the great vessels. At times a wire with more body such as a 0.035″ stiff Glidewire (Terumo, Somerset, NJ) is useful to access tortuous vessels.
- *Intermediate/Suction Thrombectomy Catheters*: See discussion above.
- *Microcatheter*: A 0.014-in. diameter or larger microcatheter is generally used to infuse t-PA once the clot is accessed.
- *Microwire*: A variety of 0.014″ microwires may be used to navigate the intracranial vessels. If vessel selection becomes difficult, the Synchro 14 microwire (Stryker, Kalamazoo, MI) allows excellent 1:1 torque. Additionally, larger microwires including the Fathom-16 (Boston Scientific, Marlborough, MA) and Asahi Chikai-18 (Asahi Intecc, Irvine, CA) may be used for additional intracranial support when advancing microcathers and thrombectomy systems.
- *Thrombolytic/Antiplatelet Agents*: In rare cases, IA t-PA can be used with several milligrams administered distal to the clot and several within the clot. The remainder is slowly infused into the proximal 1/3 of the clot. It is important to frequently image the thrombus and to advance the microcatheter as the clot lyses. Glycoprotein IIb/IIIa agents are infrequently administered in an acute stroke; the exception being when emergent cervical or intracranial stenting for refractory atherosclerosis is necessary.

Mechanical Devices

- *Sheath*: Although short sheaths are still used in conjunction with balloon guides and larger aspiration systems, a 6-Fr or wider, 90-cm-

long sheath is most often used for MT procedures.
  - *Neuron MAX or BMX* (Penumbra, Inc., Alameda, CA): Long sheaths designed for distal cervical carotid access. The Neuron MAX 088 delivery catheter is braid/coil reinforced and has a 6F OD with 0.088″ ID. The Benchmark BMX96 delivery catheter is reinforced with a laser-cut stainless steel hypotube and has a 6F OD with 0.096″ ID. Although often used in conjunction with the Penumbra aspiration system (see below), these long sheaths are the workhorses for acute stroke interventions.
  - *TracStar LDP* (Imperative Care, Campbell, CA): Large distal platform is a 0.088″ ID intracranial access catheter designed to reach the distal cavernous ICA with enhanced stability and control. It requires placement of an 8-Fr or larger short sheath in the femoral artery.
- *Balloon guide catheter:* These specially designed guiding catheters come in 8F and 9F. They have a balloon at the distal tip allowing the operator to produce flow arrest by inflating the balloon in the proximal internal carotid. Attaching a large volume syringe and aspirating while withdrawing the thrombectomy device can achieve flow reversal. Products on the market include the Stryker balloon guide (Stryker, Kalamazoo, MI) and the Cello balloon guide (Covidien, Irvine, CA).
- *Access wire*: A standard hydrophilic 0.035″ wire is typically used to select and catheterize the great vessels. It is sometimes easiest to select the target vessel with a diagnostic catheter and use an exchange-length (300-cm) 0.035″ wire to exchange for the guiding catheter or long sheath. This is especially true when using the balloon guide catheters. Alternatively, the Neuron MAX or BMX long sheaths come with select catheters that are used in a co-axial fashion with an 0.035″ wire to selectively catheterize and advance long sheaths into the carotid or vertebral arteries.
- *Microwire*: As described above, there are a variety of microwire sizes ranging from 0.014″ to 0.016″ that may be used to access and cross the target clot.
- *Devices:*
  - *Direct aspiration systems:* The Penumbra (Penumbra, Inc., Alameda, CA), Riptide (Covidien, Irvine, CA), and Zoom (Imperative Care, Campbell, CA) aspiration systems are intended for mechanical clot revascularization and include a family of reperfusion catheters. The Penumbra JET 7, Riptide React 71, and Zoom 88 are the largest aspiration catheters of each lineup. These reperfusion catheters are often delivered to the clot through the use of a triaxial setup including long groin sheath, reperfusion catheter, and microcatheter. Once the clot is crossed with the microwire, the micro and reperfusion catheters are either advanced through or positioned at the proximal clot face. The microwire and microcatheter are removed, and continuous clot aspiration is applied via the reperfusion catheter. The clot may be successfully aspirated or "corked" in the distal tip of the aspiration catheter, after which it is removed from the body.
  - *Stent retrievers*: The two most commonly used stentrievers are Solitaire X (Covidien Medical) and Trevo XP (Stryker Neurovascular) which consist of a nitinol, slotted tube stent attached to a microwire. The Solitaire device comes in 4-mm and 6-mm diameters and 20-mm to 40-mm lengths. It has the unique feature of a longitudinal gap that allows the stent to fold upon itself, potentially creating greater clot engagement. The Trevo XP device varies in size from 3 to 6 mm in diameter and 20–30 mm in length. It has full-length radiopacity within the struts that allows greater visualization and 360 degrees of large cells that potentially allows greater clot engagement. Both stentrievers are deployed through microcatheters with inner diameters ranging from 0.021″ to 0.027″. The delivery microcatheter is positioned across the clot, and the microwire is removed. Next, the stentriever is inserted within the microcatheter and pushed to its distal end. The device is unsheathed while taking care to maintain the stent retriever across the

clot. A recommended period of 5 min is allowed to pass, permitting the stent to become fully enmeshed in the clot. The stentriever is then pulled out of the arterial system. A proximal balloon guide may be used in conjunction with these devices to achieve flow reversal as previously described.

– *Solumbra technique*: The combination technique involves advancing a 0.021–0.027″ microcatheter with a 0.014–0.018″ microwire across the clot, removing the microwire, and deploying the stentriever. The stentriever then serves as an anchor by which the large bore aspiration catheter may easily advance to the proximal face of the thrombus. If possible, the delivery microcatheter is removed over the stentriever wire to maximize aspiration. The stentriever is pulled back under continuous aspiration, and ideally, the clot is removed within the stentriever or corked in the aspiration catheter tip. However, in the event that the stentriever is unsuccessful, continued direct aspiration may be performed after stentriever removal. The aspiration catheter should then be removed and flushed on the table before an additional pass is performed.

Acute Middle Cerebral Artery Occlusion

Occlusions of the MCA account for the majority of acute intracranial large artery distribution ischemic strokes. Proximal M1 occlusions have reported recanalization rates of 30% within 2 h of IV t-PA [33].

Illustrative Case 1 (MCA Occlusion)

A 52-year-old woman with COVID-19 was transferred from an outside hospital after acutely developing aphasia and right-sided weakness. She required intubation, and advanced neuroimaging demonstrated a left MCA occlusion with favorable mismatch profile. Cerebral angiogram revealed a tortuous cervical left ICA and an ipsilateral left MCA occlusion. A 90-cm Neuron MAX was placed in the cervical left ICA proximal to the tortuosity. A JET 7 aspiration catheter was then advanced distally with the aid of a Velocity microcatheter and Synchro 14 microguidewire. The microcatheter was advanced through the M1 thrombus, and superselective angiography confirmed placement distal to the thrombus in an M2 branch. Mechanical thrombectomy was then performed with a Solitaire stentriever 6 mm × 40 mm and JET 7 aspiration catheter that advanced to the M1 origin following stentriever deployment. Final DSA examination demonstrated complete recanalization of the left MCA distribution (Fig. 7.1).

Acute Vertebrobasilar Occlusion

Vertebrobasilar occlusions account for about 3% of all acute intracranial large artery strokes [33] with high mortality rates ranging 40–80% in some studies as well as a high likelihood of poor functional outcome among survivors [34, 35]. Achieving recanalization results in significant reduction in mortality [36, 37]. In one study, the length of the occluded segment and extent of collaterals were independent predictors of survival. Even though the time window for achieving recanalization could be longer in the posterior circulation, one study reported higher recanalization rates if treatment was initiated within 6 h of onset [38]. Little is known about thrombectomy treatment of vertebrobasilar artery branch occlusion (VEBABO), including posterior and anterior inferior cerebellar artery and superior cerebellar artery, in acute ischemic stroke. One multicenter study shows that MT for VEBABO is rare but appears to be feasible and effective; however, there is a comparatively high rate of procedure-related hemorrhage [39].

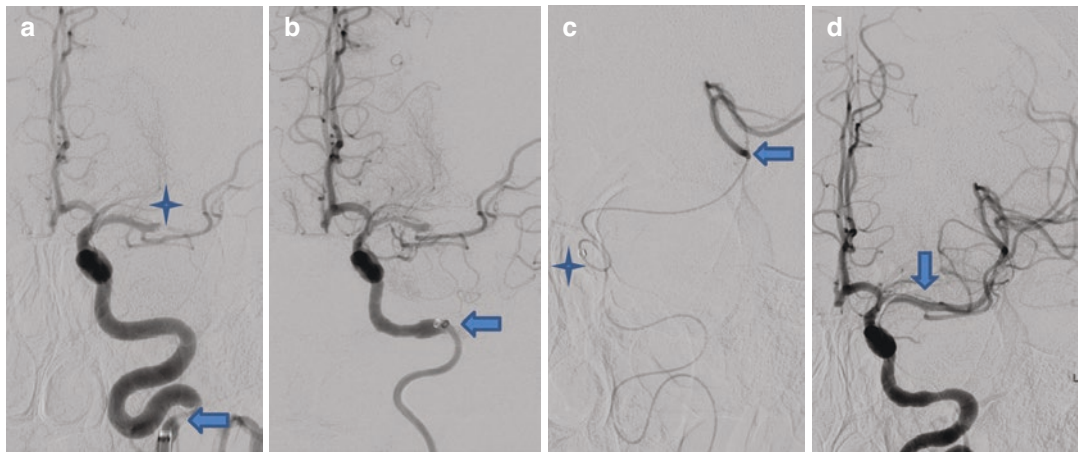

Fig. 7.1 Left MCA thrombectomy. (**a**) Tortuous, cervical left ICA shows vasospasm just distal to the Neuron MAX (*arrow*). The left MCA is occluded at the M1 segment (*star*). (**b**) The JET 7 aspiration catheter is advanced beyond the cervical ICA tortuosity (*arrow*). (**c**) Superselective microcatheter injection demonstrates placement of the microcatheter tip (*arrow*) distal to the clot burden and in a M2 branch. The JET 7 aspiration catheter is further advanced intracranially (*star*). (**d**) The left MCA (*arrow*) remains patent after mechanical thrombectomy with stentriever and aspiration

Illustrative Case 2 (Basilar Occlusion)

A 61-year-old man developed ataxia and difficulty walking for 1 week. His symptoms acutely worsened with right-sided weakness, left gaze deviation, and lethargy. The patient required intubation. Advanced neuroimaging demonstrated bilateral intracranial vertebral artery occlusions with basilar thrombosis which was confirmed with diagnostic cerebral angiography. A Neuron MAX was placed in the left subclavian artery, and a JET D aspiration catheter was advanced with the aid of a Velocity microcatheter and Synchro 14 microguidewire into the distal cervical left vertebral artery. Due to occlusion at the level of C1-C2, the microcatheter could not be advanced intracranially. Therefore, the Neuron MAX was selectively advanced into the right subclavian artery, and the reperfusion system was advanced into the distal cervical right vertebral artery. Under roadmap imaging, a Velocity microcatheter with the aid of the microguidewire was successfully advanced through the occlusion. Superselective angiography confirmed basilar thrombosis, and the microcatheter was further advanced into the proximal left PCA. A mechanical thrombectomy was then performed with a 6-mm × 40-mm Solitaire stentriever and continuous JET D aspiration which was advanced to the V3 segment. Final DSA examination demonstrated complete recanalization of the basilar artery with residual high-grade stenosis of the right vertebral artery V4 segment. TICI 2b reperfusion was achieved due to persistent right PCA occlusion (Fig. 7.2).

Carotid-T Occlusions

Terminal internal carotid artery (ICA) occlusions with the thrombus extending into the origin of ipsilateral A1 and M1 segments are associated with high clot burden, poor collateral flow, and poor outcomes. Earlier studies investigating intra-arterial infusion of thrombolytic agents reported poor recanalization and unfavorable outcomes in carotid-T occlusions [40, 41]. Updated MT studies with stentrievers and aspiration catheters report significant improvement in recanalization rates in patients with ICA-T occlusions without any additional increase in symptomatic intracranial hemorrhage [42].

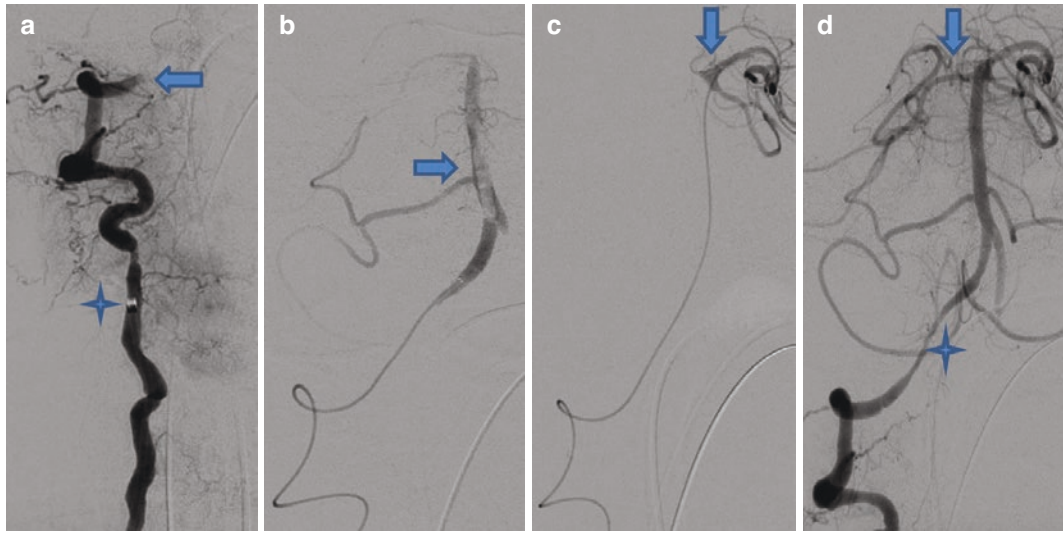

Fig. 7.2 Basilar artery thrombectomy. (**a**) JET 7 aspiration catheter (*star*) is placed in cervical right vertebral artery, and complete occlusion of the V4 segment is seen (*arrow*). (**b**) Superselective microcatheter injection demonstrates basilar artery thrombus (*arrow*). (**c**) Superselective microcatheter injection demonstrates placement of the microcatheter tip (*arrow*) distal to the clot burden in proximal left PCA. (**d**) Final DSA examination demonstrates recanalization of the basilar artery with persistent high-grade V4 segment stenosis (*star*) and right PCA occlusion (*arrow*)

Illustrative Case 3 (Carotid-T Occlusion)

A 32-year-old man with no remarkable past medical history awoke with aphasia, left gaze deviation, and right-sided weakness. He was given IV thrombolysis, and advanced neuroimaging was favorable for MT. Cerebral angiogram was performed with conscious sedation and demonstrated complete occlusion of the left terminus ICA. A 90-cm Neuron MAX long sheath was then placed in the left cervical ICA. Under roadmap imaging, a JET 7 aspiration catheter was advanced with the aid of a Velocity microcatheter and Synchro 14 microguidewire. JET 7 direct aspiration was performed twice resulting in recanalization of the ICA terminus left MCA M1 segment. Persistent distal occlusion was noted in the left MCA M2 inferior branch. The velocity microcatheter was then advanced through the left M2 branch occlusion, and superselective angiography demonstrated catheter tip position distal to the thrombus. A third pass was then successfully performed with a 6-mm × 40-mm Solitaire stentriever. Final DSA demonstrated complete recanalization of the left MCA with TICI 3 reperfusion (Fig. 7.3).

Tandem ICA/MCA Occlusions

Occlusions of cervical ICA and ipsilateral MCA comprise about 7% of all acute intracranial large artery ischemic strokes [33]. Tandem ICA/MCA occlusions are associated with poor outcomes after IVT [43]. Revascularization of the proximal ICA with angioplasty and stent placement followed by mechanical thrombectomy to achieve recanalization of the intracranial arterial occlusion has been demonstrated as safe and feasible with reported good recanalization rates and functional outcomes [44–46]. The American Heart Association/American Stroke Association (AHA/ASA) 2018 guidelines report that treatment of both extracranial and intracranial occlusions when performing thrombectomy may be reasonable. This technique has also been reported to be safe and feasible in tandem ICA/MCA occlusions in the setting of acute ICA dissection [47, 48].

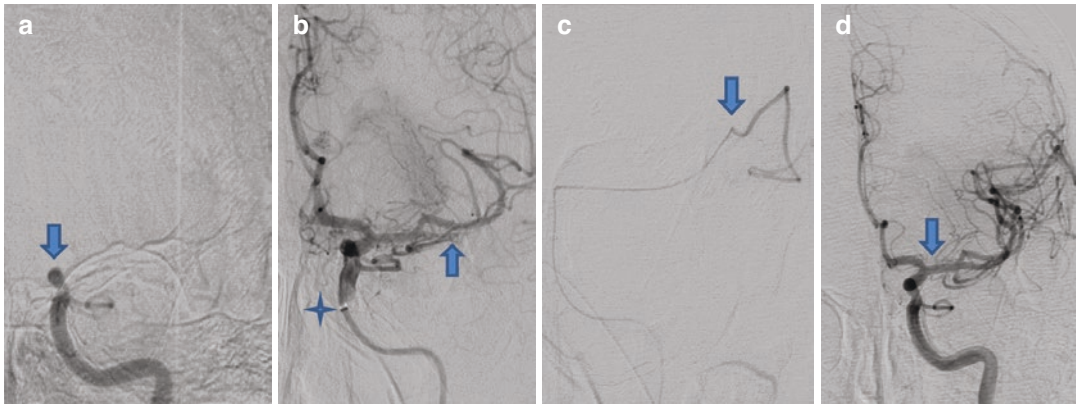

Fig. 7.3 Carotid terminus thrombectomy. (**a**) Complete occlusion of the left ICA terminus is seen at the level of the posterior communicating artery segment (*arrow*). (**b**) The left ICA terminus and proximal MCA are recanalized with JET 7 aspiration catheter (*star*). Residual distal MCA M2 inferior branch occlusion is noted (*arrow*). (**c**) The Velocity microcatheter (*arrow*) is advanced into the occluded left MCA M2, and superselective angiography confirms positioning distal to the thrombus. A mechanical thrombectomy with Solitaire stentriever was then performed. (**d**) Final DSA examination demonstrates complete recanalization of left ICA terminus and MCA occlusions (*arrow*)

Illustrative Case 4 (Tandem ICA/MCA Occlusion)

A 63-year-old man with extensive smoking history was found down unable to speak with profound right-sided weakness. He was determined to be a wake-up stroke, and advanced neuroimaging showed a favorable mismatch profile. Cerebral angiogram was performed under conscious sedation and demonstrated a string sign of the left ICA at the bifurcation with intracranial left M1 occlusion. A 80-cm Neuron MAX long sheath was then placed in the left CCA. The patient was bolused with heparin 4000 units and weight-based Integrilin followed by infusion. A 4-mm × 7-mm embolic protection device was advanced through the stenosis and deployed in the distal cervical ICA. A Viatrac 14 balloon 4 mm × 20 mm was advanced across the stenosis and angioplasty was performed. A Xact carotid stent 6 mm × 8 mm × 40 mm was then successfully deployed across the stenosis. Follow-up angiography showed a patent stent with slow distal flow in the cervical ICA. Under roadmap imaging, a JET 7 aspiration catheter was advanced to the M1 occlusion with the aid of a Velocity microcatheter and Synchro 14 microguidewire. A single-pass JET 7 direct aspiration was performed, and TICI 3 reperfusion was achieved (Fig. 7.4).

Acute Large Artery Occlusion in Anticoagulated Patients

Patients with acute ischemic stroke receiving coumadin (with INR > 1.7) or novel oral anticoagulants are considered ineligible for IVT due to risk of ICH. However, case series have reported safety and feasibility of IAT in patients receiving therapeutic doses of anticoagulants [49, 50]. The American Heart Association/American Stroke Association (AHA/ASA) guidelines promote endovascular therapies as a reasonable approach to treat patients with acute LVO in whom IVT is contraindicated [51].

Complications Associated with IAT in Ischemic Stroke (See Chap. 3)

Certain complications such as arterial dissections and perforations, contrast-induced renal dysfunction, and groin hematomas can occur in any endovascular procedure. Additionally, hem-

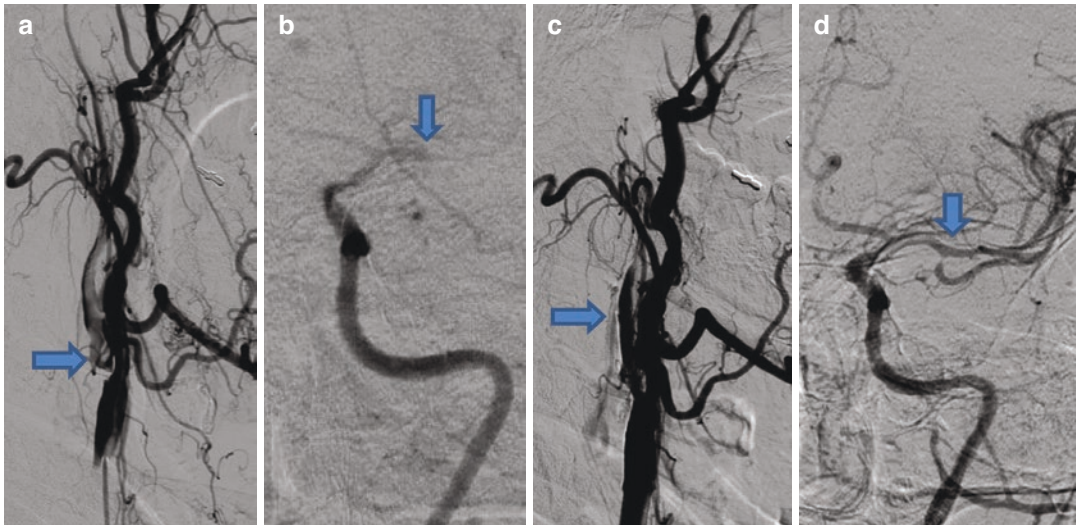

Fig. 7.4 Endovascular treatment for tandem occlusion—carotid artery stenting followed by MCA thrombectomy. (**a**) The cervical right ICA demonstrates a string sign (*arrow*) consistent with a high-grade stenosis. (**b**) Cerebral angiogram distal to the carotid stenosis demonstrates occlusion of the left MCA (*arrow*). (**c**) Successful deployment of a carotid stent across the stenosis results in patent right ICA with slow distal cervical ICA filling (*arrow*). (**d**) Successful mechanical thrombectomy with direct aspiration results in left MCA recanalization (*arrow*)

orrhagic transformation (HT) is a well-known complication of reperfusion injury after MT which can be associated with higher morbidity and mortality. A recent multicenter study reported HT of any degree in 44.5% and parenchymal hematoma in 11.6% of patients at 24 h after MT (accessed according to the European Collaborative Acute Stroke Study Classification). However, the majority of these patients (43%) had an asymptomatic ICH that was considered a marker of reperfusion and did not adversely affect outcomes. The DAWN and DEFUSE 3 trials reported rates of symptomatic HT in the range of 6–7% indicating that MT can be performed safely [5, 6]. To date, studies suggest that predictors of symptomatic HT include higher initial National Institutes of Health Stroke Scale (>18), Alberta Stroke Program Early CT Score of <7, history of prior congestive heart failure, older age, high initial blood pressure and glucose level, very low cerebral blood volume lesions, longer onset to treatment, extended procedure times, general anesthesia, poor collaterals, and embolization to new territory during procedure [52, 53]. Multiple studies have confirmed that MT procedure time is an important predictor of patient outcomes using both older-generation and contemporary devices and techniques [54]. Data suggests that a time window beyond 35 min increases the risk of HT and worsening outcomes [55].

Periprocedural Management (See Chap. 3)

The role of general anesthesia (GA) and intubation pre-procedure is controversial. Meta-analyses suggest poorer neurologic outcomes and higher mortality in patients receiving GA when compared to conscious sedation (CS) or local [56, 57]. However, randomized clinical trials have not found an outcome difference between GA and CS [58]. It has been postulated that treatment delays associated with intubation and blood pressure changes associated with induction of GA could be factors affecting overall prognosis. On the other hand, CS is often associated with patient motion and may delay treatment due to angiographic quality degradation. Operator experience and comfort level with motion artifact are important considerations. Regardless of anesthesia type, patients should be observed closely in an

intensive care unit that follows protocols with attention to neurologic exam and hemodynamic monitoring. Current guidelines recommend BP goal <180/105 in the first 24 h post-reperfusion therapies in ischemic stroke. However, higher post-thrombectomy BP within this goal has been associated with worse outcomes [59]. Whether aggressive post-thrombectomy BP control, particularly in patients with favorable recanalization (TICI 2B or 3), optimizes outcome remains a consideration and is being investigated [60].

Conclusion

Technology continues to improve with larger direct aspiration platforms and stentriever enhancements. These devices may be used independently, together, or in conjunction with IVT to more effectively achieve recanalization. MT continues to be optimized by identifying stroke subgroups (see Chap. 6), enhancing stroke systems of care, and incorporating new devices into the acute LVO triage.

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