



# Modern Management of Cerebrovascular Disease: Integrating Advances in Imaging, Intervention, and Medical Therapy

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## DESCRIPTION

Cerebrovascular disease management has undergone remarkable transformation over the past decade, driven by advances in diagnostic imaging, expanding interventional capabilities, and evolving medical therapies. The traditional paradigm of carotid endarterectomy as the principal intervention for stroke prevention has given way to a more nuanced approach incorporating multiple treatment modalities tailored to specific pathophysiologic mechanisms and patient characteristics. This commentary examines key developments across the spectrum of cerebrovascular disease management and their implications for clinical practice.

The refinement of stroke risk stratification represents perhaps the most significant conceptual advance, moving beyond simple stenosis quantification to more sophisticated assessment of both patient and plaque characteristics. Multiple studies have demonstrated that certain plaque features—including intraplaque hemorrhage, thin or ruptured fibrous cap, and large lipid-rich necrotic core—confer elevated stroke risk independent of stenosis severity. Advanced imaging modalities including high-resolution MRI, contrast-enhanced ultrasound, and PET-CT now allow detailed plaque characterization beyond luminal narrowing, potentially identifying "vulnerable plaques" before symptomatic events occur.

Patient-specific risk factors similarly influence management decisions more explicitly than in previous decades. Recognition of sex-specific differences in carotid disease natural history—with women generally deriving less benefit from intervention for asymptomatic stenosis—has prompted more conservative approaches in female patients with asymptomatic disease. Age increasingly factors into decision-making algorithms, with younger patients having longer lifetime stroke risk but also greater procedural risk from comorbidities in older populations. These nuanced considerations have largely supplanted the relatively simplistic stenosis-based decision-making of earlier guidelines.

The timing of intervention following neurological symptoms has become increasingly aggressive based on converging evidence that early revascularization provides maximal benefit. The risk of recurrent stroke following transient ischemic attack or minor stroke is now recognized to be highest within the first 48-72 hours, with one meta-analysis demonstrating an 8% risk within the first week. This recognition has prompted development of expedited evaluation pathways and reconsideration of traditional waiting periods following stroke. Contemporary guidelines now recommend intervention within 14 days of symptoms when feasible, with some centers pursuing even more aggressive timelines for select patients.

Carotid Artery Stenting (CAS) has matured significantly as an alternative to Carotid Endarterectomy (CEA) for selected patients. The initial enthusiasm following the SAPPHERE trial was tempered by subsequent studies demonstrating higher periprocedural stroke rates with stenting, particularly in elderly patients and symptomatic lesions. However, technological advancements including embolic protection devices, mesh-covered stents, and transcatheter approaches with flow reversal have substantially improved safety profiles. The TCAR (TransCarotid Artery Revascularization) procedure, combining surgical common carotid access with endovascular techniques and flow reversal, represents a particularly promising hybrid approach that appears to mitigate the embolic risk of traditional transfemoral stenting while maintaining the minimally invasive benefits of endovascular intervention.

Medical therapy for stroke prevention has similarly evolved beyond simple antiplatelet regimens. Dual antiplatelet therapy with aspirin and clopidogrel demonstrates clear short-term benefits following minor stroke or TIA, though the optimal duration remains debated. Novel antiplatelet agents and combinations continue to be investigated, with particular interest in regimens demonstrating reduced bleeding risk without compromising antithrombotic efficacy. Lipid management has become increasingly aggressive, with evidence supporting intensive statin therapy for all patients with

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cerebrovascular disease regardless of baseline cholesterol levels. Target LDL levels below 70 mg/dL are now widely recommended, with emerging evidence suggesting even lower targets may provide incremental benefit in highest-risk patients.

## CONCLUSION

For acute ischemic stroke, the therapeutic window for intervention has expanded dramatically based on advanced imaging selection rather than rigid time criteria. The DAWN and DEFUSE-3 trials demonstrated benefit from mechanical thrombectomy up to 24 hours from last known well in patients with favorable imaging characteristics, representing a paradigm shift from previous 6-8 hour windows. These studies highlight the concept of "tissue clock" versus "time clock," recognizing that

collateral flow and individual physiology influence the evolution of ischemic injury more than absolute time alone. Modern stroke triage increasingly employs perfusion imaging to identify salvageable tissue regardless of time from symptom onset. The technical aspects of mechanical thrombectomy continue to evolve rapidly, with stent retrievers and aspiration catheters demonstrating similar efficacy in randomized trials. Combined approaches utilizing both technologies simultaneously show promise for difficult occlusions. First-pass effect—achieving complete recanalization on the initial thrombectomy attempt—has emerged as an important procedural goal associated with improved clinical outcomes. Adjunctive neuroprotective strategies during thrombectomy, including conscious sedation versus general anesthesia and blood pressure management protocols, remain areas of active investigation.