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IMPROVING THE EFFECTIVENESS OF ENDOVASCULAR TREATMENT IN ACUTE ISCHEMIC STROKE: OPTIMIZED PATIENT SELECTION, REPERFUSION STRATEGY, AND POST-THROMBECTOMY MANAGEMENT.

Hamrayeva Navro'za Mahammadi qizi
Ne'matova Shahlo Dadajon qizi
Vahobova Dilafruz Ulmas qizi
Specialized Scientific and Practical Center of Neurosurgery and Neurorehabilitation at Samarkand State Medical University

Abstract.

Background. Endovascular thrombectomy has fundamentally changed the treatment of acute ischemic stroke caused by large-vessel occlusion. Despite technically successful reperfusion in a substantial proportion of treated patients, functional independence is not achieved in many cases. The discrepancy between angiographic success and clinical recovery emphasizes the importance of optimizing the entire treatment pathway rather than focusing exclusively on clot retrieval.

Objective. To analyze contemporary approaches for improving the effectiveness of endovascular treatment in acute ischemic stroke, with particular attention to patient selection, imaging strategy, treatment time, bridging intravenous thrombolysis, first-pass reperfusion, large-core infarction, posterior circulation stroke, and post-thrombectomy management.

Materials and Methods. A targeted clinical review of landmark randomized controlled trials, meta-analyses, and current international recommendations concerning endovascular treatment of acute ischemic stroke was performed. Published clinical data were analyzed with emphasis on 90-day modified Rankin Scale outcomes, reperfusion success, symptomatic intracranial hemorrhage, mortality, and procedural factors associated with favorable neurological recovery.

Results. Modern evidence demonstrates that the benefit of thrombectomy extends beyond patients with small infarct cores and conventional early treatment windows. Selected patients with large ischemic cores and patients with basilar artery occlusion can obtain clinically meaningful benefit from endovascular treatment. Treatment delay remains a major determinant of outcome. Effective stroke systems therefore require rapid vascular imaging, parallel preparation for thrombolysis and thrombectomy, minimization of door-to-puncture and puncture-to-reperfusion intervals, and maximization of first-pass complete or near-complete reperfusion. Recent evidence also supports careful post-procedural hemodynamic management and avoidance of excessively intensive blood-pressure reduction after successful reperfusion.

Conclusion. Improving endovascular treatment effectiveness requires integration of rapid diagnosis, expanded but evidence-based patient selection, efficient reperfusion techniques, appropriate intravenous thrombolysis, standardized peri-procedural management, and structured post-thrombectomy care. Implementation of a unified neurovascular pathway may improve clinical outcomes in tertiary neurosurgical centers.

Keywords: acute ischemic stroke; mechanical thrombectomy; endovascular treatment; large-vessel occlusion; reperfusion; large ischemic core; basilar artery occlusion; modified Rankin Scale; NIHSS; neurointervention.

O‘TKIR ISHEMIK INSULTDA ENDOVASKULYAR DAVOLASH SAMARADORLIGINI OSHIRISH: BEMORLARNI OPTIMAL TANLASH, REPERFUZIYA STRATEGIYASI VA TROMBEKTOMIYADAN KEYINGI BOSHQARUV

Hamrayeva Navro'za Mahammadi qizi
Ne'matova Shahlo Dadajon qizi
Vahobova Dilafruz Ulmas qizi
Samarqand davlat tibbiyot universiteti huzuridagi Neyroxirurgiya va neyroreabilitatsiya ixtisoslashtirilgan ilmiy-amaliy markazi

Annotatsiya.

Dolzarblik. Yirik tomirlar okklyuziyasi natijasida yuzaga keladigan o‘tkir ishemik insultni davolashda endovaskulyar trombektomiya zamonaviy reperfuzion terapiyaning asosiy usullaridan biriga aylandi. Texnik jihatdan muvaffaqiyatli reperfuziyaga ko‘plab bemorlarda erishilishiga qaramay, barcha holatlarda ham funksional mustaqillik tiklanmaydi. Angiografik muvaffaqiyat va klinik tiklanish o‘rtasidagi ushbu tafovut faqat trombni olib tashlashga emas, balki butun davolash algoritmini optimallashtirish zarurligini ko‘rsatadi.

Maqsad. O‘tkir ishemik insultda endovaskulyar davolash samaradorligini oshirishning zamonaviy yondashuvlarini tahlil qilish, bunda bemorlarni tanlash, neyrovizualizatsiya strategiyasi, davolash vaqti, ko‘prik trombolitik terapiyasi, birinchi urinishda reperfuziya, katta ishemik yadroli insultlar, orqa qon aylanish tizimi okklyuziyalari hamda trombektomiyadan keyingi davolash tamoyillariga alohida e’tibor qaratish.

Material va usullar. O‘tkir ishemik insultni endovaskulyar davolashga bag‘ishlangan yirik randomizatsiyalangan klinik tadqiqotlar, meta-tahlillar va zamonaviy xalqaro tavsiyalar asosida maqsadli klinik tahlil o‘tkazildi. Nashr etilgan klinik ma’lumotlar 90 kunlik modifikatsiyalangan Rankin shkalasi, reperfuziya muvaffaqiyati, simptomatik intrakranial qon ketish, o‘lim ko‘rsatkichi hamda ijobiy nevrologik natijalar bilan bog‘liq protseduraviy omillar bo‘yicha tahlil qilindi.

Natijalar. Zamonaviy ma’lumotlar trombektomiya samarasi faqat kichik ishemik yadroli va erta vaqt oynasidagi bemorlar bilan cheklanmasligini ko‘rsatadi. Katta ishemik yadroli ayrim bemorlar hamda bazilyar arteriya okklyuziyasi bo‘lgan bemorlarda endovaskulyar davolash klinik jihatdan ahamiyatli foyda beradi. Davolashning kechikishi funksional natijalarni yomonlashtiruvchi asosiy omillardan biridir. Shu sababli insultni davolash tizimi tezkor tomir vizualizatsiyasi, trombolizis va trombektomiyaga parallel tayyorgarlik, shifoxonaga kelishdan arteriya punksiyasigacha hamda punksiyadan reperfuziyagacha bo‘lgan vaqtni qisqartirish, birinchi urinishdayoq to‘liq yoki deyarli to‘liq reperfuziyaga erishishga qaratilishi lozim. Muvaffaqiyatli reperfuziyadan keyin arterial bosimni haddan tashqari agressiv pasaytirishdan saqlanish ham muhim ahamiyatga ega.

Xulosa. Endovaskulyar davolash samaradorligini oshirish tezkor diagnostika, dalillarga asoslangan kengaytirilgan bemor tanlovi, samarali reperfuzion texnika, tegishli vena ichiga trombolitik terapiya, standartlashtirilgan perioperatsion boshqaruv va trombektomiyadan keyingi tizimli davolashni birlashtirishni talab qiladi. Yagona neyrovaskulyar klinik algoritmni joriy etish uchlamchi darajadagi neyroxirurgik markazlarda davolash natijalarini yaxshilashi mumkin.

Kalit so‘zlar: o‘tkir ishemik insult, mexanik trombektomiya, endovaskulyar davolash, yirik tomirlar okklyuziyasi, reperfuziya, katta ishemik yadro, bazilyar arteriya okklyuziyasi, modifikatsiyalangan Rankin shkalasi, NIHSS, neyrointervensiya.

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ЭНДОВАСКУЛЯРНОГО ЛЕЧЕНИЯ ОСТРОГО ИШЕМИЧЕСКОГО ИНСУЛЬТА: ОПТИМИЗАЦИЯ ОТБОРА ПАЦИЕНТОВ, СТРАТЕГИЯ РЕПЕРФУЗИИ И ВЕДЕНИЕ ПОСЛЕ ТРОМБЭКТОМИИ

Хамраева Навроза Махаммади кизи
Нематова Шахло Дадажон кизи
Вахобова Дилафруз Ульмас кизи
Специализированный научно-практический центр нейрохирургии и нейрореабилитации при Самаркандском государственном медицинском университете

Аннотация.

Актуальность. Эндоваскулярная тромбэктомия стала одним из основных методов реперфузионной терапии при остром ишемическом инсульте, обусловленном окклюзией крупных церебральных сосудов. Несмотря на достижение технически успешной реперфузии у значительной части пациентов, функциональная независимость восстанавливается не во всех случаях. Расхождение между ангиографическим успехом и клиническим восстановлением подчёркивает необходимость оптимизации всего лечебного маршрута, а не только механического удаления тромба.

Цель. Проанализировать современные подходы к повышению эффективности эндоваскулярного лечения острого ишемического инсульта с особым акцентом на отбор пациентов, стратегию нейровизуализации, временные параметры лечения, мостовую внутривенную тромболитическую терапию, реперфузию с первой попытки, инсульты с большим ишемическим ядром, окклюзию базилярной артерии и ведение пациентов после тромбэктомии.

Материалы и методы. Проведён целенаправленный клинический обзор ключевых рандомизированных клинических исследований, метаанализов и современных международных рекомендаций, посвящённых эндоваскулярному лечению острого ишемического инсульта. Опубликованные клинические данные анализировались с учётом исходов по модифицированной шкале Рэнкина через 90 дней, частоты успешной реперфузии, симптоматических внутричерепных кровоизлияний, летальности и процедурных факторов, связанных с благоприятным неврологическим восстановлением.

Результаты. Современные данные показывают, что эффективность тромбэктомии не ограничивается пациентами с небольшим ишемическим ядром и ранними временными окнами. Отдельные категории больных с большим ишемическим ядром, а также пациенты с окклюзией базилярной артерии могут получить клинически значимую пользу от эндоваскулярного лечения. Задержка лечения остаётся одним из наиболее значимых факторов, ухудшающих функциональный исход. Поэтому эффективная система оказания помощи при инсульте должна включать быструю сосудистую визуализацию, параллельную подготовку к тромболизису и тромбэктомии, сокращение интервалов от поступления до пункции артерии и от пункции до реперфузии, а также стремление к полной или почти полной реперфузии с первой попытки. После успешной реперфузии также важно избегать чрезмерно интенсивного снижения артериального давления.

Заключение. Повышение эффективности эндоваскулярного лечения требует интеграции быстрой диагностики, расширенного, но основанного на доказательствах отбора пациентов, эффективных методов реперфузии, обоснованного применения внутривенной тромболитической терапии, стандартизированного периоперационного ведения и структурированного наблюдения после тромбэктомии. Внедрение единого нейроваскулярного клинического алгоритма может улучшить результаты лечения в специализированных нейрохирургических центрах.

Ключевые слова: острый ишемический инсульт, механическая тромбэктомия, эндоваскулярное лечение, окклюзия крупных сосудов, реперфузия, большое ишемическое ядро, окклюзия базилярной артерии, модифицированная шкала Рэнкина, NIHSS, нейроинтервенция.

Introduction. Acute ischemic stroke remains one of the major causes of mortality and long-term neurological disability worldwide. Occlusion of a major intracranial artery is particularly important because large-vessel occlusion is associated with extensive cerebral ischemia, severe neurological deficits, malignant cerebral edema, and a high risk of permanent disability or death. The introduction of modern mechanical thrombectomy represented one of the most important advances in cerebrovascular medicine and neurointerventional surgery. The pivotal randomized trials published in 2015 demonstrated that mechanical thrombectomy in appropriately selected patients with anterior-circulation large-vessel occlusion provides substantially better neurological outcomes than medical therapy alone [1,2]. The subsequent HERMES individual-patient meta-analysis, which included 1,287 patients from five major randomized trials, demonstrated a strong shift toward lower disability after thrombectomy, with an adjusted common odds ratio of 2.49 and an estimated number needed to treat of approximately 2.6 to achieve at least a one-point improvement on the modified Rankin Scale (mRS) [3].

Nevertheless, successful reopening of an occluded cerebral artery does not automatically guarantee neurological recovery. A considerable proportion of patients remain functionally dependent despite technically successful reperfusion. This phenomenon, frequently termed **futile recanalization**, reflects the complex interaction between infarct-core volume, collateral circulation, treatment delay, microvascular reperfusion, age, baseline functional status, stroke severity, anesthesia-related physiological changes, procedural complications, hemorrhagic transformation, cerebral edema, and post-reperfusion management.

Time remains one of the most powerful modifiable determinants of treatment effectiveness. Analysis of randomized thrombectomy trials showed that progressive delays to reperfusion were associated with decreasing probability of functional independence. In the HERMES time-to-treatment analysis, functional independence declined as reperfusion was delayed, illustrating the practical principle that “time is brain” remains valid even in the modern thrombectomy era [4].
At the same time, the treatment population has substantially expanded. DAWN and DEFUSE 3 demonstrated that appropriately selected patients may benefit from thrombectomy well beyond the traditional 6-hour window [5,6]. More recently, RESCUE-Japan LIMIT, SELECT2, ANGEL-ASPECT, TENSION and other large-core trials demonstrated benefit in selected patients who previously would have been excluded because of extensive early ischemic changes [7–10]. Randomized data from ATTENTION and BAOCHE similarly established an important role for thrombectomy in basilar artery occlusion [11,12]. The 2026 American Heart Association/American Stroke Association guideline therefore reflects an important change in the conceptual approach to reperfusion therapy. Eligibility is increasingly determined by a combination of clinical condition, vascular anatomy, imaging-defined tissue status, time from last known well, prestroke function, and expected benefit rather than by a rigid time limit alone [13]. For a tertiary neurosurgical institution such as the Department of Neurosurgery of Samarkand State Medical University, improving outcomes requires optimization of the entire stroke pathway: early recognition, rapid neuroimaging, correct selection for thrombolysis and thrombectomy, efficient endovascular technique, neurocritical care, prevention of secondary brain injury, and early rehabilitation.

Materials and methods. This article was designed as a targeted clinical review and evidence synthesis. Landmark randomized controlled trials, patient-level meta-analyses, and contemporary guidelines concerning endovascular treatment of acute ischemic stroke were evaluated. Particular attention was given to evidence published from the beginning of the modern thrombectomy era in

2015 through 2026. The principal clinical domains analyzed were anterior-circulation large-vessel occlusion, extended-window thrombectomy, large ischemic-core infarction, basilar artery occlusion, intravenous thrombolysis before thrombectomy, speed of reperfusion, first-pass effect, procedural success, and post-thrombectomy blood-pressure management. Extracted clinical variables included study population size, treatment window, imaging-selection method, NIHSS where relevant, ASPECTS or infarct-core criteria, successful reperfusion, functional independence or independent ambulation at 90 days, symptomatic intracranial hemorrhage, and mortality.

The principal clinical endpoint used across the reviewed studies was functional status at 90 days according to the modified Rankin Scale. Angiographic effectiveness was evaluated predominantly by the modified Thrombolysis in Cerebral Infarction scale, with mTICI 2b–3 representing successful reperfusion and mTICI 2c–3 representing near-complete or complete reperfusion. No new or unpublished patient information was generated for this article. All clinical numerical data presented below originate from published clinical trials and meta-analyses.

Results.

Evolution of Clinical Effectiveness of Endovascular Thrombectomy. Mechanical thrombectomy became standard therapy after multiple randomized studies demonstrated superior functional outcomes compared with medical therapy alone. HERMES showed that the treatment effect remained detectable across different age categories, baseline NIHSS values and several other clinically important subgroups [3]. The effect of thrombectomy, however, is highly time dependent. Saver et al. demonstrated that every delay between symptom onset and reperfusion progressively decreases the probability of functional independence [4]. Consequently, thrombectomy effectiveness should be considered the product of both **reperfusion quality** and **reperfusion speed**. Late-window trials changed the concept of treatment eligibility. DAWN selected patients using a clinical deficit–infarct volume mismatch and demonstrated benefit from thrombectomy between 6 and 24 hours after last known well [5]. DEFUSE 3 included patients between 6 and 16 hours with proximal anterior circulation occlusion, infarct-core volume below 70 mL and imaging evidence of salvageable tissue. Functional independence at 90 days occurred in 45% of thrombectomy-treated patients compared with 17% receiving medical therapy alone [6].

Table 1. Major clinical evidence supporting optimization and expansion of endovascular treatment

Study	Patients	Main population/selection	Main clinical result
HERMES [3]	1,287	Proximal anterior circulation LVO	Adjusted common OR for lower disability 2.49; NNT ≈2.6 for ≥1-point mRS improvement
DEFUSE 3 [6]	182	ICA/MCA occlusion; 6–16 h; favorable perfusion profile	mRS 0–2: 45% with EVT vs 17% with medical therapy
RESCUE-Japan LIMIT [7]	203	Large core; ASPECTS 3–5	mRS 0–3: 31.0% vs 12.7%
SELECT2 [8]	352	ICA/M1 occlusion; ASPECTS 3–5 or core ≥50 mL; ≤24 h	mRS 0–2: 20.3% vs 7.0%; mRS 0–3: 37.9% vs 18.7%
ANGEL-ASPECT [9]	456	Large-core anterior circulation LVO; ≤24 h	Favorable mRS shift; generalized OR 1.37
TENSION [10]	253	ASPECTS 3–5; primarily NCCT selection; ≤12 h	Adjusted common OR for favorable mRS shift 2.58
ATTENTION [11]	340	Basilar artery occlusion; ≤12 h	mRS 0–3: 46% vs 23%
BAOCHE [12]	217	Basilar artery occlusion; 6–24 h	mRS 0–3: 46% vs 24%

BRIDGE-TNK [17]	550	IVT-eligible LVO; ≤4.5 h	mRS 0–2: 52.9% with TNK+EVT vs 44.1% with EVT alone

Abbreviations: ASPECTS, Alberta Stroke Program Early Computed Tomography Score; EVT, endovascular thrombectomy; ICA, internal carotid artery; LVO, large-vessel occlusion; MCA, middle cerebral artery; mRS, modified Rankin Scale; NCCT, non-contrast computed tomography; OR, odds ratio; TNK, tenecteplase.

Expanding Treatment to Patients With Large Ischemic Cores. One of the most important recent developments is the demonstration that the presence of a large established ischemic lesion does not automatically indicate futility. In RESCUE-Japan LIMIT, 203 patients with ASPECTS 3–5 were randomized to endovascular treatment plus medical therapy or medical therapy alone. An mRS score of 0–3 at 90 days was achieved in 31.0% of patients undergoing endovascular therapy compared with 12.7% in the medical-treatment group [7]. Although intracranial hemorrhage was more frequent after intervention, the functional benefit was clinically important. SELECT2 further expanded these findings. Patients with internal carotid artery or M1 middle cerebral artery occlusion were included when a large ischemic core was demonstrated by ASPECTS 3–5 or a core volume of at least 50 mL. Among 352 randomized patients, functional independence at 90 days occurred in 20.3% of the thrombectomy group compared with 7.0% of controls. Independent ambulation was achieved in 37.9% versus 18.7%, respectively [8]. ANGEL-ASPECT included 456 patients and similarly demonstrated a significant favorable shift in 90-day mRS after thrombectomy in patients with extensive ischemic injury. Symptomatic intracranial hemorrhage occurred in 6.1% of the endovascular group and 2.7% of the medical-management group, demonstrating that expansion of eligibility must still be accompanied by careful assessment of hemorrhagic risk [9].

Tension is particularly relevant to centers where perfusion software is not continuously available. In this trial, many patients with ASPECTS 3–5 were selected predominantly using conventional non-contrast CT. Thrombectomy was associated with a significant improvement in the distribution of mRS scores and lower mortality [10]. These observations are important for stroke care in regional tertiary centers. Advanced CT perfusion or MRI remains useful in selected late-window and diagnostically uncertain patients, but absence of advanced perfusion imaging should not necessarily prevent appropriate thrombectomy when vascular occlusion, clinical severity, and standard imaging provide sufficient evidence for treatment.

Posterior Circulation Stroke and Basilar Artery Occlusion. Basilar artery occlusion is associated with particularly high morbidity and mortality. Earlier randomized studies produced uncertain results, partly because of heterogeneous enrollment, crossover, inclusion of mildly affected patients, and difficulties in patient selection. ATTENTION and BAOCHE substantially changed this evidence base. ATTENTION randomized 340 patients presenting within 12 hours of basilar artery occlusion. Good functional status, defined as mRS 0–3 at 90 days, occurred in 46% of thrombectomy-treated patients compared with 23% receiving medical therapy alone. Mortality was 37% and 55%, respectively [11]. BAOCHE focused on the 6–24-hour window and enrolled 217 patients. An mRS score of 0–3 occurred in 46% of thrombectomy-treated patients versus 24% of the control group [12]. These results established a clear role for endovascular therapy in appropriately selected posterior-circulation stroke. Current guidelines therefore strongly support thrombectomy for selected patients with basilar artery occlusion within 24 hours, particularly when clinically significant neurological deficits are present [13]. For neurosurgical stroke teams, suspected basilar artery occlusion should be treated with the same urgency as anterior-circulation LVO. Symptoms such as abrupt impaired consciousness, tetraparesis, severe dysarthria, oculomotor abnormalities, crossed neurological signs, acute ataxia, or rapidly progressing brainstem dysfunction should prompt immediate vascular imaging.

Optimization of Intravenous Thrombolysis Before Thrombectomy. Intravenous thrombolysis and endovascular thrombectomy should not be considered competing treatments in an otherwise eligible early-window patient. Intravenous therapy can begin immediately while the angiographic team prepares for thrombectomy. The 2026 AHA/ASA guideline recommends either alteplase at 0.9 mg/kg or tenecteplase at 0.25 mg/kg, to a maximum dose of 25 mg, for eligible patients treated within 4.5 hours [13]. Thrombolysis should not be delayed by unnecessary advanced imaging, and administration of thrombolytic therapy should not delay transfer to the angiography suite. EXTEND-IA TNK provided important evidence favoring tenecteplase in thrombectomy candidates. Among 202 patients, reperfusion of more than 50% of the ischemic territory or absence of a retrievable thrombus at initial angiography occurred in 22% receiving tenecteplase compared with 10% receiving alteplase [14]. The more recent BRIDGE-TNK trial directly compared tenecteplase followed by thrombectomy with thrombectomy alone in 550 thrombolysis-eligible patients presenting within 4.5 hours. Functional independence at 90 days was observed in 52.9% of patients receiving tenecteplase plus thrombectomy and 44.1% receiving thrombectomy alone [17]. These results reinforce a practical principle: in patients without thrombolysis contraindications, initiation of intravenous thrombolysis should occur rapidly while thrombectomy preparation proceeds in parallel.

First-Pass Reperfusion and Procedural Efficiency. Technical success cannot be evaluated only as final vessel patency. The number of passes and time required to obtain reperfusion are important. The concept of the **first-pass effect** describes complete or near-complete reperfusion achieved after a single thrombectomy attempt. Zaidat et al. demonstrated that first-pass successful reperfusion was associated with shorter procedural time and substantially greater rates of good functional outcome. In their registry analysis, mRS 0–2 at 90 days occurred in 61.3% of patients achieving the first-pass effect compared with 35.3% among those without it [15]. Repeated device passes may increase endothelial injury, distal embolization, vasospasm, procedure duration, contrast exposure, and the probability that salvageable tissue will progress to irreversible infarction. Accordingly, procedural planning should aim at rapid mTICI 2c–3 reperfusion whenever safely achievable. Device strategy should be adapted to clot morphology, vessel diameter, vascular tortuosity, tandem lesions and suspected intracranial atherosclerotic disease. Large-bore aspiration catheters, stent retrievers, balloon-guide catheters and combined techniques should therefore be viewed as components of an individualized reperfusion strategy rather than competing technologies. A predetermined rescue strategy is also important. Failure of the initial thrombectomy technique should trigger rapid reassessment of clot location, arterial anatomy and possible underlying intracranial stenosis rather than indefinite repetition of an ineffective maneuver.

Hemodynamic and Anesthetic Management. The ischemic penumbra is highly vulnerable to reductions in cerebral perfusion pressure. Avoidance of peri-procedural hypotension is therefore a major component of neuroprotection. Whether conscious sedation or general anesthesia is used should depend on neurological status, airway protection, patient cooperation, respiratory condition, hemodynamic stability and expected procedural complexity. The central objective is not a single universal anesthetic technique but prevention of unnecessary treatment delays, hypoxemia, hypercapnia, aspiration and abrupt hypotension. Hemodynamic management remains important after reperfusion. The 2026 AHA/ASA guideline considers blood pressure ≤180/105 mmHg reasonable during and for the first 24 hours after EVT and specifically advises against intensive reduction of systolic pressure to below 140 mmHg after successful recanalization [13]. This recommendation is supported by contemporary randomized evidence. In OPTIMAL-BP, functional independence at three months was observed in 39.4% of patients assigned to intensive systolic blood-pressure lowering below 140 mmHg compared with 54.4% receiving conventional management targeting 140–180 mmHg. The trial was terminated early because of safety concerns [16]. Consequently, post-thrombectomy treatment should avoid both uncontrolled hypertension and

excessive lowering of systemic arterial pressure, particularly in patients who may have incomplete microvascular reperfusion or residual penumbral tissue.

Proposed Clinical Pathway for the SamDTU Neurosurgery Department. For a tertiary neurovascular service, improvement in outcomes is most likely when thrombectomy is organized as a continuous institutional pathway rather than an isolated angiographic procedure. A practical departmental pathway should consist of: prehospital notification and immediate stroke-code activation; rapid neurological assessment using NIHSS; non-contrast CT followed immediately by CTA from the aortic arch through the intracranial circulation; parallel evaluation for intravenous thrombolysis and EVT; immediate notification of the neurointerventional team after identification of a treatable occlusion; direct transfer to the angiography suite without avoidable emergency-department delays; selection of the thrombectomy strategy according to occlusion anatomy and clot characteristics; systematic recording of mTICI grade and number of passes; neurocritical monitoring after reperfusion; repeat CT or MRI when clinically indicated; swallowing, mobilization and rehabilitation assessment; and standardized assessment of the 90-day mRS.

The minimum institutional thrombectomy registry should document age, sex, prestroke mRS, vascular risk factors, admission NIHSS, glucose, blood pressure, time last known well, arrival time, imaging time, ASPECTS, occlusion site, thrombolytic agent and dose, arterial puncture time, first-pass time, final reperfusion time, thrombectomy technique, number of passes, final mTICI grade, procedural complications, 24-hour NIHSS, symptomatic intracranial hemorrhage, decompressive surgery, discharge mRS, 90-day mRS, and mortality. Such a registry would allow the Department of Neurosurgery to move from subjective assessment of thrombectomy performance to measurable quality improvement.

Table 2. Key indicators for a departmental endovascular stroke quality program

Domain	Recommended indicator	Clinical relevance
Neurological severity	Admission NIHSS	Baseline stroke severity and prognostic adjustment
Early imaging	ASPECTS and occlusion site	Defines ischemic burden and target vessel
Treatment speed	Door-to-imaging, imaging-to-puncture, puncture-to-reperfusion	Detects avoidable workflow delays
IV thrombolysis	Agent, dose, treatment time	Evaluates bridging therapy
Technical success	Final mTICI grade	Measures angiographic reperfusion
Procedural efficiency	First-pass reperfusion and total passes	Reflects thrombectomy effectiveness
Early neurological outcome	24-h NIHSS change	Early treatment response
Safety	sICH, vessel perforation, dissection, distal embolization	Procedure-related risk
Functional outcome	mRS at discharge and day 90	Principal patient-centered endpoint
Mortality	In-hospital and 90-day mortality	Major safety and effectiveness endpoint

Discussion. The modern concept of successful endovascular stroke treatment extends beyond mechanical removal of a thrombus. The evidence reviewed in this article indicates that outcome optimization requires simultaneous attention to patient biology, imaging, treatment time, technical reperfusion, peri-procedural physiology and post-treatment care. The earliest thrombectomy trials established proof of efficacy, but their selection criteria were relatively restrictive. HERMES demonstrated a large overall treatment effect, while subsequent DAWN and DEFUSE 3 data showed that carefully selected slow progressors retain viable tissue many hours

after stroke onset [3,5,6]. The concept of a uniform therapeutic time window has therefore progressively been replaced by a tissue-based approach. However, imaging sophistication should not itself become a cause of harmful delay. In obvious early-window proximal LVO, acquisition of multiple additional studies that do not alter therapeutic decisions may postpone reperfusion. Conversely, advanced imaging can be extremely valuable when onset is unknown, the infarct appears extensive, clinical and imaging findings are discordant, or the patient presents in a late window.

Large-core trials have further changed the definition of treatment futility. RESCUE-Japan LIMIT, SELECT2, ANGEL-ASPECT and TENSION consistently demonstrated that patients with substantial established infarction can still experience an improvement in functional outcome after reperfusion [7–10]. These results are particularly relevant because large-core patients often have severe neurological deficits and historically had few therapeutic options. The expected absolute probability of complete functional independence remains lower in patients with extensive infarction than in patients with small cores. However, outcome improvement should not be interpreted exclusively as achieving mRS 0–2. In severe stroke, a change from mRS 5 to 4 or from mRS 4 to 3 may represent a major difference in mobility, dependence, rehabilitation potential, caregiver burden and quality of life. Ordinal mRS shift therefore provides important information in this population. The posterior circulation represents another major area of progress. ATTENTION and BAOCHE provided robust randomized evidence for basilar artery thrombectomy [11,12]. These results are clinically important because delayed diagnosis remains common in posterior-circulation stroke, where symptoms may initially resemble vestibular, toxic-metabolic or nonspecific neurological disorders. Optimization of bridging thrombolysis is another component of the treatment pathway. The results of different direct-thrombectomy trials have not been completely uniform, and DIRECT-MT demonstrated noninferiority of thrombectomy alone under its prespecified margin [18]. Nevertheless, current guideline recommendations support intravenous thrombolysis in eligible patients, and newer data from BRIDGE-TNK strengthen the rationale for tenecteplase-based bridging therapy in appropriate early-window LVO [13,17].

From the technical perspective, maximizing the first-pass effect represents a rational target. The first-pass concept shifts attention from simple final recanalization toward rapid, high-quality reperfusion [15]. This is particularly relevant in institutions establishing or expanding a thrombectomy program because procedural outcomes should be audited not only by whether the artery was eventually reopened but also by the quality and speed of reperfusion. Post-treatment care deserves equal attention. Even after mTICI 3 reperfusion, the cerebral microcirculation may remain abnormal and autoregulation may be impaired. Excessive blood-pressure reduction can therefore reduce perfusion to vulnerable tissue. OPTIMAL-BP and the 2026 AHA/ASA guideline support avoiding aggressive systolic-pressure reduction below 140 mmHg following successful thrombectomy [13,16]. For Samarkand State Medical University, establishment of a prospective thrombectomy registry would provide several scientific and organizational advantages. It would permit monitoring of treatment delays, comparison of first-pass and multi-pass procedures, identification of predictors of unsuccessful reperfusion, assessment of hemorrhagic complications, evaluation of 90-day outcomes, and development of future original clinical studies.

A future SamDTU prospective or retrospective investigation could evaluate predictors of favorable 90-day outcome after EVT using age, baseline NIHSS, ASPECTS, occlusion level, onset-to-puncture interval, puncture-to-reperfusion time, number of thrombectomy passes, final mTICI grade, bridging thrombolysis, admission glucose and peri-procedural blood-pressure variability. Such a dataset would allow multivariable logistic or ordinal regression analysis and could provide clinically meaningful data from Central Asia, where high-quality published thrombectomy registries remain comparatively limited.

Limitations. This article is a targeted clinical review rather than a formal systematic review or meta-analysis. Differences between randomized trials in patient selection, imaging methodology, thrombolytic treatment, device choice, definitions of symptomatic intracranial hemorrhage, and treatment windows limit direct numerical comparisons. In addition, trial populations may not fully represent elderly patients with severe prestroke disability, extremely large infarct cores, complex intracranial atherosclerotic disease, or patients treated in lower-resource stroke systems. The clinical data presented in this paper are derived from previously published international trials and should not be interpreted as original patient data from Samarkand State Medical University. Prospective collection and independent analysis of local thrombectomy data are necessary for institution-specific outcome assessment.

Conclusion. The effectiveness of endovascular treatment for acute ischemic stroke depends on considerably more than successful mechanical clot extraction. Optimal results require rapid recognition of large-vessel occlusion, efficient imaging, evidence-based expansion of treatment eligibility, prompt intravenous thrombolysis in appropriate patients, minimization of treatment delays, achievement of complete or near-complete reperfusion with as few thrombectomy passes as possible, preservation of physiological stability, and structured post-reperfusion management. Contemporary evidence supports thrombectomy in broader patient populations, including selected patients with large ischemic cores and basilar artery occlusion. At the same time, increasingly broad eligibility makes quality control more important. A standardized neurovascular protocol combined with prospective recording of procedural and functional outcomes could improve both clinical care and scientific productivity at the Department of Neurosurgery of Samarkand State Medical University.

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