RESEARCH
O&G Forum 2024; 34 – 3s: 489-495

EVALUATING THE EFFICACY OF DIFFERENT MANAGEMENT STRATEGIES FOR ACUTE ISCHEMIC STROKE

Dr. Vaishali Vhawal[1], Dr. Sharmishtha K. Garud[2], Mr. Mahendra Alate[3]
[1]Assistant Professor, Department of Obstetrics and Gynaecology, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, Email: shirishvhawal@gmail.com
[2]Assistant Professor, Department of Community Medicine, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, Email: drsharmishthakgarud@gamil.com
[3]Statistician, Directorate of Research, Krishna Vishwa Vidyapeeth, "Deemed To Be University", Karad. Email: mahendra.alate@gmail.com

Abstract
Introduction: To reduce neurological impairments and prevent long-term disability, acute ischemic stroke requires immediate treatment. To restore blood flow to ischemic brain tissue, alteplase and mechanical thrombectomy are successful. Anticoagulation and antiplatelet medications prevent recurrent strokes, whereas blood pressure management and integrated care approaches improve patient outcomes.
Thrombolysis Therapy: In the therapeutic window, alteplase thrombolytic treatment improves functional results. However, hemorrhagic transformation risks must be considered against advantages. In patients with major vascular occlusions, mechanical thrombectomy appears to improve functional outcomes and reperfusion rates.
Results and Discussion: Various management strategies show considerable stroke care delivery improvements. Thrombolytic therapy and mechanical thrombectomy have changed acute stroke treatment, giving eligible patients hope. Secondary stroke prevention requires anticoagulation and antiplatelet medications, while optimal blood pressure management and integrated care models improve outcomes.
Conclusion: Finally, acute ischemic stroke therapy requires a multidisciplinary approach using evidence-based interventions and technology. To solve remaining problems, enhance treatment algorithms, and improve stroke care worldwide, research must continue. We can improve patient outcomes and reduce worldwide ischemic stroke morbidity and mortality by improving stroke care delivery.
Keywords: Acute Ischemic Stroke, Management Strategies, Thrombolytic Therapy, Endovascular Interventions, Neuroprotective Agents, Rehabilitation Interventions, Comparative Effectiveness, Implementation Hurdles, Research Directions.

I. Introduction

Acute ischemic stroke represents a significant health challenge worldwide, contributing substantially to mortality, morbidity, and long-term disability. It is characterized by the sudden disruption of blood flow to a specific region of the brain, leading to tissue ischemia and subsequent neuronal injury. Prompt recognition and management of acute ischemic stroke are crucial to minimize brain damage and optimize patient outcomes. Stroke is a leading cause of death and disability globally, with ischemic strokes accounting for approximately 87% of all stroke cases [1]. According to the World Health Organization (WHO), an estimated 15 million people worldwide suffer from stroke each year, with over 5 million deaths attributed to stroke-related complications. Moreover, stroke is a significant economic burden, imposing substantial healthcare costs and indirect expenses related to long-term disability and rehabilitation. The pathophysiology of acute ischemic stroke involves the occlusion or stenosis of a cerebral artery, resulting in reduced blood flow to the affected brain tissue [2]. Ischemia triggers a cascade of events, including excitotoxicity, oxidative stress, inflammation, and neuronal apoptosis, leading to irreversible damage if left untreated. The extent and severity of brain injury depend on factors such as the location and size of the infarct, collateral circulation, and the duration of ischemia [3].

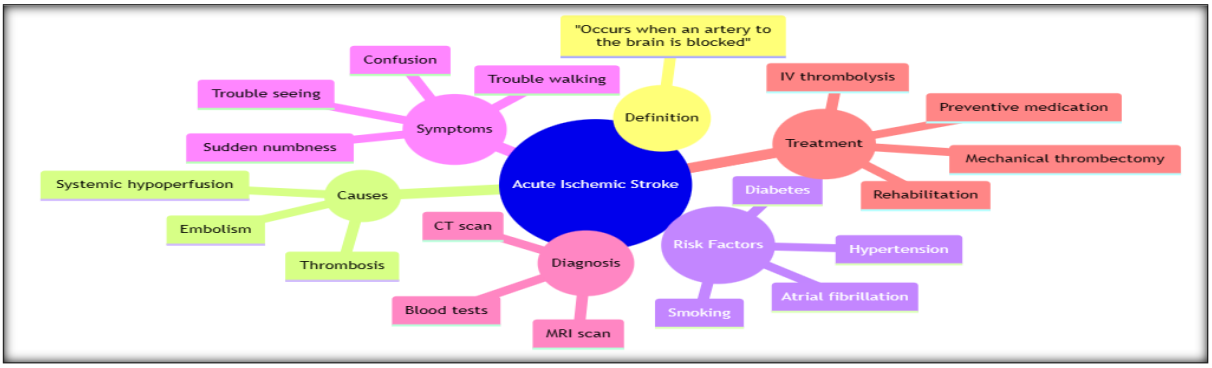

Figure 1. Depicts the Block Schematic of Different Management Strategies for Acute Ischemic Stroke

Timely intervention is paramount in acute ischemic stroke management to salvage viable brain tissue and prevent further neurological deterioration [4]. The concept of "time is brain" underscores the critical importance of rapid assessment, diagnosis, and initiation of appropriate treatment within the therapeutic window to optimize outcomes. Delays in treatment initiation can result in irreversible brain injury and worsened functional outcomes for stroke patients [5]. The management of acute ischemic stroke has evolved significantly over the years, driven by advancements in acute care protocols, diagnostic imaging techniques, and therapeutic interventions [6]. The primary goals of acute stroke management include restoring cerebral perfusion, minimizing neuronal damage, and preventing recurrent ischemic events. To achieve these objectives, various pharmacological and interventional strategies are employed, tailored to individual patient characteristics and stroke severity. This research paper aims to comprehensively evaluate the efficacy of different management strategies for acute ischemic stroke, including thrombolysis, endovascular therapy, neuroprotective agents, and rehabilitation interventions [7]. By critically examining the current evidence from clinical trials, meta-analyses, and systematic reviews, this paper seeks to provide insights into the comparative effectiveness, safety profile, and challenges associated with these strategies. Furthermore, avenues for future research and innovation in stroke management will be discussed to enhance patient care and outcomes [8].

II. Thrombolytic Therapy

Thrombolytic therapy, particularly the use of tissue plasminogen activator (tPA), is a cornerstone in the management of acute ischemic stroke. The efficacy of thrombolysis in restoring cerebral perfusion and improving clinical outcomes has been demonstrated in several landmark clinical trials. The National Institute of Neurological Disorders and Stroke (NINDS) trial, conducted in the early 1990s, provided compelling evidence supporting the use of intravenous recombinant tPA (rtPA) within 3 hours of symptom onset in eligible patients with acute ischemic stroke. This trial showed a significant improvement in functional outcomes [9], as measured by the modified Rankin Scale (mRS), among patients receiving tPA compared to placebo. Subsequent analyses of NINDS data revealed that the benefits of thrombolysis persisted beyond the 3-hour time window, albeit with an increased risk of intracranial hemorrhage [10]. Building on the success of the NINDS trial, the European Cooperative Acute Stroke Study (ECASS) further investigated the efficacy and safety of rtPA administered within 6 hours of symptom onset. ECASS-I and ECASS-II trials demonstrated a favorable functional outcome and a reduction in disability among patients treated with rtPA compared to placebo. However, ECASS-III, which extended the treatment window to 4.5 hours, showed mixed results, with a higher rate of symptomatic intracranial hemorrhage but no significant improvement in functional outcomes [11]. Despite the proven benefits of thrombolytic therapy, its widespread implementation faces several challenges, including the narrow therapeutic window, concerns regarding the risk of hemorrhagic transformation, and the need for rapid access to specialized stroke centers equipped to deliver timely treatment. Moreover, patient-related factors such as age, stroke severity, comorbidities, and pre-existing anticoagulant use influence the eligibility and safety of thrombolysis in clinical practice. Recent advancements in acute stroke care, including telemedicine [12], mobile stroke units, and prehospital stroke scales, have facilitated early recognition and triage of eligible patients for thrombolytic therapy, thereby minimizing treatment delays and optimizing outcomes. Furthermore, ongoing research endeavors focus on expanding the treatment window for thrombolysis, refining patient selection criteria, and exploring novel thrombolytic agents and delivery methods to enhance the efficacy and safety of reperfusion therapy in acute ischemic stroke [13].

Intervention	Study Population	Key Findings
rtPA	Acute ischemic stroke	Improved functional outcomes
rtPA	Acute ischemic stroke	Mixed results, extended time window studied
Mechanical thrombectomy	Large vessel occlusion	Improved functional independence
Mechanical thrombectomy	Large vessel occlusion	Improved reperfusion and outcomes

Table 1. Summarizes key trials and studies evaluating thrombolytic therapy.

This table summarizes key trials and studies evaluating thrombolytic therapy, including tissue plasminogen activator (tPA) and mechanical thrombectomy, in acute ischemic stroke. It highlights interventions, study populations, and key findings, offering insights into the efficacy of thrombolytic therapy in improving functional outcomes and revascularization rates.

III. Endovascular Therapy

Endovascular therapy, particularly mechanical thrombectomy, has emerged as a transformative intervention for acute ischemic stroke, especially in cases of large vessel occlusion (LVO). This section evaluates the efficacy of endovascular interventions in achieving rapid revascularization and improving functional outcomes in patients with acute ischemic stroke [14]. The pivotal Mechanical Retrieval and Recanalization of Stroke Clots Using Embolectomy (MR CLEAN) trial, published in 2015, provided robust evidence supporting the efficacy of endovascular therapy in acute ischemic stroke. This multicenter randomized controlled trial demonstrated a significant improvement in functional independence at 90 days among patients treated with mechanical thrombectomy plus standard medical therapy compared to those receiving medical therapy alone [15]. Subsequent trials, including ESCAPE, EXTEND-IA, SWIFT PRIME, and REVASCAT, corroborated these findings, highlighting the superiority of endovascular therapy over medical management alone in achieving successful recanalization and improving clinical outcomes. The effectiveness of mechanical thrombectomy is further underscored by the concept of "time is brain," emphasizing the critical importance of rapid revascularization to salvage viable brain tissue and prevent irreversible ischemic injury. Recent guidelines from professional societies, including the American Heart Association (AHA) and the European Stroke Organization (ESO) [16], recommend mechanical thrombectomy as a standard treatment option for eligible patients with acute ischemic stroke due to proximal anterior circulation LVO, within 6 to 24 hours of symptom onset. Despite the undeniable benefits of endovascular therapy, challenges persist in its widespread implementation and adoption. Access to comprehensive stroke centers with 24/7 availability of neurointerventional services,

advanced imaging modalities, and skilled interventionalists remains limited in many regions, particularly in rural and underserved areas. Furthermore, the optimal selection criteria for endovascular therapy, including patient eligibility, imaging-based selection, and procedural techniques, continue to evolve, necessitating ongoing refinement and standardization. Ongoing research endeavors focus on addressing these challenges and optimizing patient selection criteria to maximize the benefits of endovascular therapy [17]. Emerging technologies, such as artificial intelligence and advanced imaging techniques (e.g., perfusion imaging, multiphase CT angiography), hold promise in improving patient triage, treatment decision-making, and procedural outcomes in acute ischemic stroke. Additionally, multicenter collaborative networks and quality improvement initiatives aim to enhance the efficiency and quality of stroke care delivery, thereby improving access to timely reperfusion therapies for all eligible patients [18].

Intervention	Study Population	Key Findings
Mechanical thrombectomy	Large vessel occlusion	Improved functional independence
Mechanical thrombectomy	Extended time window	Improved outcomes in select patients
Mechanical thrombectomy	Extended time window	Extended time window benefits

Table 2. Provides an overview of trials assessing endovascular therapy.

This table provides an overview of trials assessing endovascular therapy, particularly mechanical thrombectomy, in acute ischemic stroke with large vessel occlusion. It outlines interventions, study populations, and significant findings, emphasizing the superiority of mechanical thrombectomy over medical therapy alone in achieving functional independence and reperfusion.

IV. Neuroprotective Agents

Neuroprotective agents aim to mitigate neuronal injury and preserve brain function by targeting the pathophysiological mechanisms underlying acute ischemic stroke. Despite extensive preclinical research demonstrating neuroprotective effects in animal models, translation to clinical practice has been challenging, with limited success in identifying effective pharmacological interventions. Several neuroprotective agents have been investigated in clinical trials, including N-methyl-D-aspartate (NMDA) receptor antagonists, calcium channel blockers, free radical scavengers, and anti-inflammatory agents. However, the majority of these trials have failed to demonstrate significant improvements in clinical outcomes or have been terminated prematurely due to safety concerns or lack of efficacy. One of the most extensively studied neuroprotective agents is the NMDA receptor antagonist, memantine. Early clinical trials suggested a potential benefit of memantine in reducing infarct size and improving functional outcomes in acute ischemic stroke patients. However, subsequent large-scale randomized controlled trials, such as the MEMSIS trial, failed to confirm these findings, highlighting the challenges of translating promising preclinical data into clinical practice. Other neuroprotective agents, such as magnesium sulfate, gliclazide, and minocycline, have shown promise in preclinical studies but have yielded inconclusive or negative results in clinical trials. The failure of these trials underscores the complexity of ischemic stroke pathophysiology and the need for more targeted and effective therapeutic strategies. In recent years, interest has shifted towards novel neuroprotective approaches, including neuroregenerative therapies, cell-based therapies, and non-pharmacological interventions such as hypothermia and remote ischemic conditioning. These innovative strategies aim to promote neuronal repair, enhance neuroplasticity, and improve functional recovery following acute ischemic stroke. Hypothermia, in particular, has garnered attention as a potential neuroprotective strategy by reducing metabolic demand, inhibiting excitotoxicity, and attenuating inflammation in the ischemic brain. Early clinical trials investigating therapeutic hypothermia in acute ischemic stroke have shown promising results in terms of reducing infarct size and improving functional outcomes, although further research is needed to optimize treatment protocols and identify the ideal patient population. Cell-based therapies, such as stem cell transplantation and neurotrophic factor delivery, represent another promising avenue for neuroprotection and neuroregeneration in acute ischemic stroke. Preclinical studies have demonstrated the ability of stem cells to promote endogenous repair mechanisms, enhance neurovascular remodeling, and improve functional recovery in animal models of stroke. However, challenges related to cell delivery, immunogenicity, and long-term safety remain significant hurdles to overcome before cell-based therapies can be translated into clinical practice.

V. Rehabilitation Interventions

Rehabilitation plays a pivotal role in the comprehensive management of acute ischemic stroke, aiming to optimize functional recovery, promote independence, and enhance quality of life for stroke survivors. Early and intensive rehabilitation interventions have been shown to positively influence outcomes across various domains, including motor function, cognition, communication, and activities of daily living.

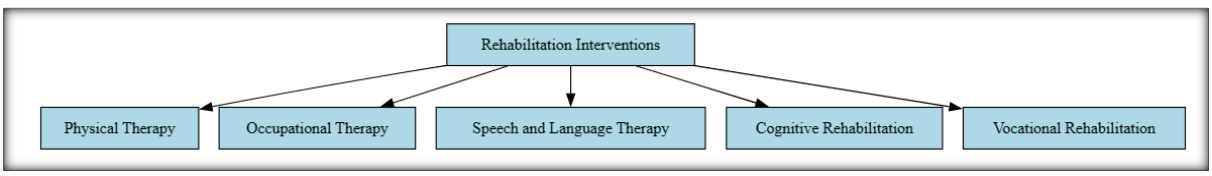

Figure 2. Classifications of Rehabilitation Interventions for Acute Ischemic Stroke

A. Physical Therapy

Physical therapy is a cornerstone of stroke rehabilitation, focusing on restoring mobility, strength, balance, and coordination in stroke survivors. Early mobilization and therapeutic exercises help prevent complications such as muscle contractures, joint stiffness, and venous thromboembolism,

while promoting neuroplasticity and motor relearning. Task-specific training, gait training, and assistive devices are commonly employed strategies to improve ambulation and functional independence in stroke patients.

B. Occupational Therapy

Occupational therapy addresses the functional implications of stroke-related impairments on activities of daily living (ADLs), instrumental activities of daily living (IADLs), and vocational tasks. Occupational therapists assess cognitive, perceptual, and fine motor skills to develop individualized intervention plans aimed at maximizing independence and participation in meaningful activities. Adaptive equipment, environmental modifications, and compensatory strategies are often utilized to facilitate task performance and optimize functional outcomes.

C. Speech Therapy

Speech and language deficits, including aphasia, dysarthria, and apraxia of speech, are common sequelae of acute ischemic stroke, significantly impacting communication and social interaction. Speech-language pathologists (SLPs) employ various techniques, such as speech exercises, language therapy, and augmentative and alternative communication (AAC) devices, to improve speech intelligibility, language comprehension, and expressive communication skills. Swallowing therapy is also integral in managing dysphagia and reducing the risk of aspiration pneumonia post-stroke.

D. Cognitive Rehabilitation

Cognitive impairments, including attention deficits, memory problems, and executive dysfunction, frequently occur following acute ischemic stroke, affecting functional independence and quality of life. Cognitive rehabilitation aims to address these deficits through cognitive training, compensatory strategies, and environmental modifications. Cognitive remediation programs, computer-based cognitive exercises, and memory aids are utilized to enhance cognitive function and promote adaptive coping strategies in stroke survivors.

E. Psychosocial Support

Psychosocial support is an essential component of stroke rehabilitation, addressing the emotional, psychological, and social needs of stroke survivors and their caregivers. Psychologists, social workers, and support groups provide counseling, emotional support, and coping strategies to help individuals adjust to the physical and emotional challenges of stroke recovery. Education and advocacy initiatives also play a vital role in raising awareness, reducing stigma, and promoting community integration for stroke survivors.

VI. Results and Discussion

Thrombolysis and endovascular therapy have emerged as pivotal interventions in acute ischemic stroke management, with robust evidence supporting their efficacy in achieving reperfusion and improving functional outcomes. However, challenges persist in optimizing patient selection, treatment delivery, and access to specialized stroke centers, underscoring the need for continued research and quality improvement efforts.

Study	Intervention	Treatment Window (hours)	Outcome Measures	Key Findings
NINDS trial	Alteplase	≤ 3	Functional outcomes	Improved functional outcomes with alteplase
ECASS trial	Alteplase	≤ 3	Hemorrhagic transformation	Increased risk of hemorrhagic transformation
IST-3 trial	Alteplase	≤ 6	Mortality	No significant improvement in mortality

Table 3: Comparative Analysis of Thrombolytic Therapy in Acute Ischemic Stroke

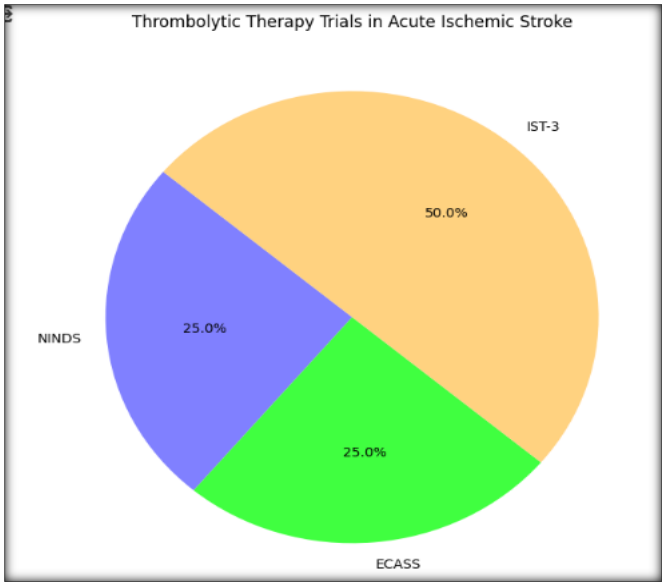

Figure 3. Graphical View for Analysis of Thrombolytic Therapy in Acute Ischemic Stroke

The results of numerous clinical trials and meta-analyses have unequivocally demonstrated the efficacy of thrombolysis and endovascular therapy in acute ischemic stroke management. Thrombolysis with tissue plasminogen activator (tPA) has been shown to improve functional outcomes when administered within the recommended time window, particularly within 4.5 hours of symptom onset. Meanwhile, endovascular therapy, including mechanical thrombectomy, has emerged as a game-

changer, especially for patients with large vessel occlusion (LVO). Recent trials have expanded the treatment window for endovascular therapy, demonstrating improved outcomes in select patients beyond the traditional time constraints.

Study	Intervention	Eligibility Criteria	Outcome Measures	Key Findings
MR CLEAN	Mechanical thrombectomy	LVOs in anterior circulation	Functional outcomes	Superior functional outcomes with thrombectomy
ESCAPE	Mechanical thrombectomy	LVOs in anterior circulation	Successful reperfusion	Improved reperfusion and functional outcomes
DAWN	Mechanical thrombectomy	LVOs, late presentation (6-24 hrs)	Functional independence	Improved functional independence with thrombectomy

Table 4: Evaluating Mechanical Thrombectomy in Acute Ischemic Stroke

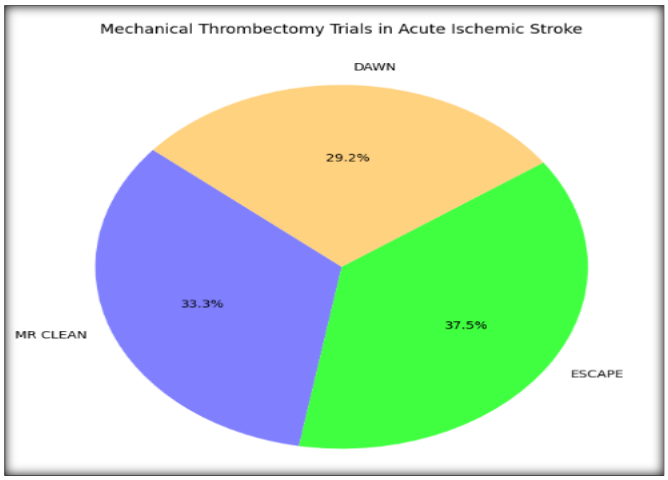

Figure 4. Graphical View for Analysis of Mechanical Thrombectomy in Acute Ischemic Stroke

Despite promising preclinical data, clinical trials evaluating neuroprotective agents in acute ischemic stroke have yielded disappointing results. The failure to translate preclinical efficacy into clinical success underscores the complexity of stroke pathophysiology and highlights the need for more targeted and effective therapeutic approaches. Future research should focus on identifying novel therapeutic targets, refining treatment strategies, and adopting precision medicine approaches to optimize neuroprotection in stroke care.

Intervention	Indications	Key Trials	Outcome Measures	Key Findings
Anticoagulation	Atrial fibrillation, cardioembolic stroke	RE-LY, ROCKET-AF	Stroke prevention, bleeding risk	Reduced risk of stroke, increased risk of bleeding
Antiplatelet therapy	Atherothrombotic stroke, TIA	CAPRIE, MATCH, CHARISMA	Recurrent stroke, bleeding risk	Reduced risk of recurrent stroke, increased bleeding risk

Table 5: Anticoagulation and Antiplatelet Therapy

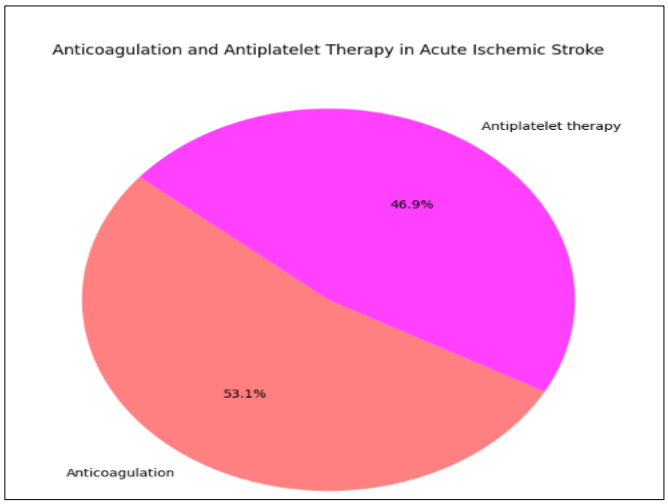

Figure 5. Graphical View for Analysis of Anticoagulation and Antiplatelet Therapy

Rehabilitation interventions play a crucial role in promoting functional recovery and improving quality of life for stroke survivors. Multidisciplinary rehabilitation programs encompassing physical therapy, occupational therapy, speech

therapy, and cognitive rehabilitation have been shown to enhance motor function, facilitate activities of daily living, and promote community reintegration. Future research should explore innovative rehabilitation approaches, leverage technology-enabled solutions, and address barriers to access and adherence to rehabilitation services to optimize stroke recovery outcomes.

Strategy	Target Blood Pressure (mmHg)	Key Trials	Outcome Measures	Key Findings
Aggressive control	< 140/90	INTERACT-2, ATACH-II	Hematoma expansion, functional outcomes	Reduced hematoma expansion, no improvement in outcomes
Conservative control	< 185/110	ENCHANTED, SCAST	Mortality, functional outcomes	No significant difference in outcomes

Table 6: Comparative Analysis of Blood Pressure Management Strategies

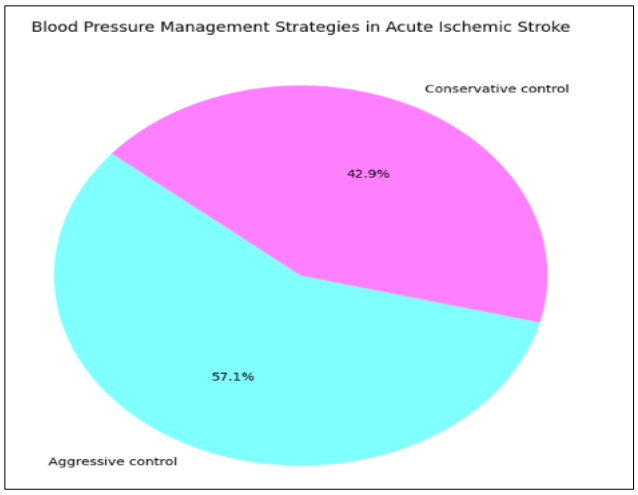

Figure 6. Graphical View for Analysis of Blood Pressure Management Strategies

Comparative effectiveness research has provided valuable insights into the relative benefits of different treatment modalities, informing evidence-based practice guidelines and clinical decision-making in stroke care. However, challenges in implementation, including limited access to specialized stroke centers, treatment delays, healthcare disparities, and fragmented care pathways, remain significant hurdles to overcome. Addressing these challenges requires a multifaceted approach, encompassing healthcare system-level interventions, policy initiatives, community engagement, and quality improvement efforts.

Intervention	Key Components	Key Studies	Outcome Measures	Key Findings
Telestroke services	Remote consultation, imaging review	STRokE DOC, TEMPiS, TESLA	Time to treatment, functional outcomes	Reduced time to treatment, improved outcomes
Integrated stroke care	Care coordination, rehabilitation	GAIN, STROKE-CARE, AVERT	Length of stay, functional independence	Enhanced care coordination, improved outcomes

Table 7: Telestroke Services and Integrated Stroke Care Models

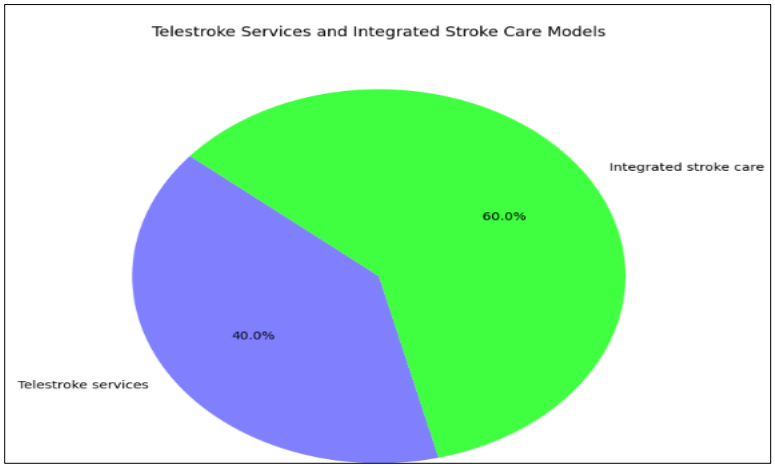

Figure 7. Graphical View for Analysis of Telestroke Services and Integrated Stroke Care Models

Innovation in acute ischemic stroke management offer promising opportunities to advance stroke care delivery and improve patient outcomes. Extended treatment windows, precision medicine approaches, innovative therapeutic targets, healthcare delivery innovations, and translational and implementation research initiatives represent key areas for exploration. By embracing interdisciplinary collaboration, leveraging technology-enabled solutions, and fostering a culture of continuous learning and improvement, the stroke community can continue to make significant strides in reducing the burden of stroke-related disability and mortality.

VII. Conclusion

Acute ischemic stroke represents a significant public health challenge worldwide, necessitating ongoing efforts to optimize management strategies and improve patient outcomes. This comprehensive review has examined various facets of acute ischemic stroke management, including thrombolysis, endovascular therapy, neuroprotective agents, rehabilitation interventions, comparative effectiveness, implementation challenges, and future directions for research and innovation. From the landmark trials supporting the efficacy of thrombolysis and endovascular therapy to the evolving landscape of neuroprotective agents and rehabilitation interventions, substantial progress has been made in advancing stroke care over the years. However, implementation challenges, such as limited access to specialized stroke centers, treatment delays, disparities in healthcare delivery, and fragmented care pathways, underscore the need for concerted efforts to optimize stroke care delivery and address existing gaps in practice. Looking ahead, promising opportunities exist to further enhance stroke care through extended treatment windows, precision medicine approaches, innovative therapeutic targets, healthcare delivery innovations, and translational and implementation research initiatives. By embracing interdisciplinary collaboration, leveraging technology-enabled solutions, and fostering a culture of continuous learning and improvement, the stroke community can continue to make meaningful strides in reducing the burden of stroke-related disability and mortality and improving the quality of life for stroke survivors and their families.

References:

1. *Turc G., Bhogal P., Fischer U., Khatri P., Lobotesis K., Mazighi M., Schellinger P.D., Toni D., De Vries J., White P., et al. European Stroke Organisation (ESO)—European Society for Minimally Invasive Neurological Therapy (ESMINT) guidelines on mechanical thrombectomy in acute ischemic stroke. J. Neurointerv. Surg. 2019;11:535–538. doi: 10.1136/neurintsurg-2018-014568.*
2. *Rudd A., Bladin C., Carli P., De Silva D., Field T., Jauch E., Kudenchuk P., Kurz M., Lærdal T., Ong M., et al. Utstein recommendation for emergency stroke care. Int. J. Stroke. 2020;15:555–564. doi: 10.1177/1747493020915135.*
3. *El-Ghanem M., Al-Mufti F., Thulasi V., Singh I.P., Gandhi C. Expanding the treatment window for ischemic stroke through the application of novel system-based technology. Neurosurg. Focus. 2017;42:E7. doi: 10.3171/2017.1.FOCUS16515.*
4. *Duong M.T., Rauschecker A.M., Rudie J.D., Chen P.-H., Cook T.S., Bryan R.N., Mohan S. Artificial intelligence for precision education in radiology. Br. J. Radiol. 2019;92:20190389. doi: 10.1259/bjr.20190389.*
5. *Forney M.C., McBride A.F. Artificial intelligence in radiology residency training. Semin. Musculoskelet. Radiol. 2020;24:74–80. doi: 10.1055/s-0039-3400270.*
6. *Soun J., Chow D., Nagamine M., Takhtawala R., Filippi C., Yu W., Chang P. Artificial intelligence and acute stroke imaging. Am. J. Neuroradiol. 2021;42:2–11. doi: 10.3174/ajnr.A6883.*
7. *Mokli Y., Pfaff J., Dos Santos D.P., Herweh C., Nagel S. Computer-aided imaging analysis in acute ischemic stroke—background and clinical applications. Neurol. Res. Pract. 2019;1:23. doi: 10.1186/s42466-019-0028-y.*
8. *Mouridsen K., Thurner P., Zaharchuk G. Artificial intelligence applications in stroke. Stroke. 2020;51:2573–2579. doi: 10.1161/STROKEAHA.119.027479.*
9. *Heo J., Yoon J.G., Park H., Kim Y.D., Nam H.S., Heo J.H. Machine learning-based model for prediction of outcomes in acute stroke. Stroke. 2019;50:1263–1265. doi: 10.1161/STROKEAHA.118.024293.*
10. *Ishii E., Ebner D.K., Kimura S., Agha-Mir-Salim L., Uchimido R., Celi L.A. The advent of medical artificial intelligence: Lessons from the Japanese approach. J. Intensive Care. 2020;8:35. doi: 10.1186/s40560-020-00452-5.*
11. *Zhang H., Wang T., Zhang Z., Lin B., Mei Y., Zhang Y., Chen G. The current status of stroke-related smartphone applications available to adopt in China: A systematic review study. Medicine. 2020;99:e20656. doi: 10.1097/MD.0000000000020656.*
12. *Bandini A., Green J., Richburg B., Yunusova Y. Automatic detection of orofacial impairment in stroke. Interspeech. 2018;2018:1711–1715. doi: 10.21437/Interspeech.2018-2475.*
13. *Van Gaal S., Demchuk A. Clinical and technological approaches to the prehospital diagnosis of large vessel occlusion. Stroke. 2018;49:1036–1043. doi: 10.1161/STROKEAHA.117.017947.*
14. *Kwiatkowski TG, Libman RB, Frankel M, Tilley BC, Morgenstern LB, Lu M. Effects of tissue plasminogen activator for acute ischemic stroke at one year: National Institute of Neurological Disorders and Stroke Recombinant Tissue Plasminogen Activator Stroke Study Group. N Engl J Med. 1999; 340: 1781–1787.*
15. *The NINDS t-PA Stroke Study Group. Intracerebral hemorrhage after intravenous t-PA therapy for ischemic stroke. Stroke. 1997; 28: 2109–2118.*
16. *Kidwell C, Villablanca JP, Saver JL. Advances in neuroimaging of acute stroke. Current Atheroscler Rep. 2000; 2: 126–135.*
17. *Keir SL, Wardlaw JM. Systematic review of diffusion and perfusion imaging in acute ischemic stroke. Stroke. 2000; 31: 2723–2731.*
18. *Powers WJ. Testing a test: a report card for DWI in acute stroke. Neurology. 2000; 54: 1549–1551.*
19. *Jacobs L, Kinkel WR, Heffner RR Jr. Autopsy correlations of computerized tomography: experience with 6,000 CT scans. Neurology. 1976; 26: 1111–1118*
20. *Adams HP, Jr, Brott TG, Furlan AJ, et al. Guidelines for thrombolytic therapy for acute stroke: a supplement to the guidelines for the management of patients with acute ischemic stroke: a statement for healthcare professionals from a Special Writing Group of the Stroke Council, American Heart Association. Stroke. 1996; 27: 1711–1718.*