REVIEW ARTICLE ON HEART STROKE: PATHOPHYSIOLOGY, DIAGNOSIS, MANAGEMENT, AND FUTURE PERSPECTIVES

ABSTRACT:

Stroke a leading cause of death and disability worldwide, is classified into ischemic and haemorrhagic types, each with distinct causes and outcomes. This review covers stroke's epidemiology, pathophysiology, risk factors, clinical presentation, diagnosis, and treatment strategies. Ischemic stroke results from blood flow blockage, while haemorrhagic stroke involves bleeding in the brain. Key risk factors include hypertension, diabetes, and smoking. Acute treatments such as thrombolysis and thrombectomy, along with secondary prevention and rehabilitation, are vital for recovery. Recent advances like novel therapies, endovascular techniques, and telemedicine have improved outcomes. Future research focuses on biomarkers, AI, and regenerative therapies. Despite progress, challenges like care access and economic barriers persist, highlighting the need for ongoing research to improve stroke care.

1. INTRODUCTION:

Stroke commonly known as heart stroke, is a complex clinical syndrome caused by a disturbance in the cerebral circulation. It is broadly classified into ischemic and haemorrhagic types, each with distinct pathophysiological mechanisms and clinical outcomes. Given its substantial impact on public health, continuous research and comprehensive reviews are essential for enhancing patient care and guiding future research [1,2].

Keywords: stroke, ischemic stroke, haemorrhagic stroke, cerebral infarction, cerebrovascular accident.

2. EPIDEMIOLOGY AND PUBLIC HEALTH IMPACT:

Stroke is the second leading cause of death and a major cause of long-term disability globally. The prevalence and incidence vary geographically, with significant disparities between high-income and low-income regions. In recent decades, improvements in preventive care have reduced incidence in some areas; however, an aging population continues to increase the overall stroke burden [3,4].

Table 1. Global Stroke Statistics (Example Data)

Region	Incidence (per 100,000)	Mortality Rate (%)	Disability-Adjusted Life Years (DALYs)
North America	150	15	1200
Europe	160	17	1300

Commented [RS1]: The term "heart stroke" is not medically correct. Stroke is a disorder of the brain, not the heart.

Correction needed: “Heart stroke” is not a standard medical term for cerebral stroke. Just use “Stroke” or “Cerebrovascular Accident”.

troke commonly known as heart stroke..."
"Stroke, also known as cerebrovascular accident (CVA), is a complex clinical syndrome..."

Commented [RS2]: There is no typical IMRAD (Introduction, Methods, Results, Discussion) structure in modern review articles.

The first sentence is missing a verb: “Stroke a leading cause…” → should be: “Stroke is a leading cause…”

Commented [RS3]: Introduction is Too short. Does not explain why the article is important (rationale).

Does not mention the review method (e.g. narrative, systematic, literature time, database, inclusion criteria).

Add global data background (e.g. WHO), and review objectives:

This review aims to synthesize current evidence on stroke mechanisms, diagnosis, and management, while highlighting recent advances and future directions.”

Commented [RS4]: The table is messy and lacks source information (“Example Data”).

There is no specific discussion of changing trends in developing countries.

Suggestion:
Use the latest WHO/Global Burden of Disease data (e.g. GBD 2020).

“Low- and middle-income countries bear more than 80% of the global stroke mortality burden.”

Asia	200	20	1600
Africa	250	25	1800

Table 1 shows estimated data on stroke incidence, mortality, and DALYs [5].

3. HISTORICAL EVOLUTION OF STROKE MANAGRMENT:

- Overview: Trace the development of stroke treatment from early clinical observations to the latest interventional and pharmacological strategies.
- Key Points: Milestones in stroke care, evolution of diagnostic techniques, and paradigm shifts in therapeutic approaches.
- Example Citation: "Historical reviews reveal a dramatic shift from supportive care to acute intervention in stroke management over the past 50 years" [6].

Commented [RS5]: Bullet points only.

Doesn't explain the paradigm shift narratively.

Make it a complete paragraph. Add important milestones such as:

"The use of CT scans in the 1970s and the introduction of intravenous thrombolysis in the 1990s marked revolutionary changes in stroke care."

4. CLASSIFICATION OF STROKE:

Stroke is classified mainly into two types:

4.1 Ischemic Stroke

Ischemic strokes result from occlusion of cerebral arteries due to thrombosis or embolism. The mechanisms include large artery atherosclerosis, small vessel occlusion (lacunar infarcts), and cardio embolism [7].

4.2 Haemorrhagic Stroke

Haemorrhagic strokes involve bleeding into or around the brain, including intracerebral hemorrhage and subarachnoid haemorrhage. These strokes are associated with high morbidity and mortality, partly due to the mass effect and secondary injury caused by blood products [8].

Commented [RS6]: Lack of detail on hemorrhagic (ICH vs SAH not explained).

No mention of TIA stroke or TOAST classification.

Ischemic Attack (TIA), although not causing permanent damage, is an important warning sign and included in the stroke spectrum."

5. RISK FACTORS AND ETIOLOGY:

Multiple risk factors predispose individuals to stroke. They can be grouped into modifiable and non-modifiable factors.

5.1 Non-modifiable Factors

- **Age:** Incidence increases with age.

- **Sex:** Males are at a slightly higher risk; however, females experience worse outcomes.

- **Genetic predisposition:** Family history and specific genetic markers.

5.2 Modifiable Factors

Commented [RS7]: Table is not formatted properly (rows are not aligned).

No mention of ethnic, socioeconomic, or environmental risk factors.

Refresh table and add:

"Social determinants, including access to care and educational status, also influence stroke risk."

- **Hypertension:** The leading modifiable risk factor.

- **Diabetes Mellitus:** Associated with vascular complications.

- **Hyperlipidemia:** Elevated cholesterol levels contribute to atherosclerosis.

- **Smoking:** Significantly increases the risk.

- **Obesity and Sedentary Lifestyle:** Linked to metabolic syndrome.

- **Cardiac Disorders:** Atrial fibrillation and myocardial infarction elevate embolic risk [9,10].

Table 2. Major Modifiable Risk Factors for Stroke

Risk Factor	Mechanism	Management Strategies
Hypertension	Vessel wall stress and damage	Antihypertensive therapy, lifestyle
Diabetes Mellitus	Endothelial dysfunction, atherosclerosis	Glycemic control, diet, exercise
Hyperlipidemia	Plaque formation	Statin therapy, dietary modifications.
Smoking	| Oxidative stress, endothelial injury	Statin therapy, dietary modifications
Atrial Fibrillation	Cardio embolism	Anticoagulation, rhythm control

Table 2 summarizes key modifiable risk factors and their management [11].

6.PATHOPHYSIOLOGY:

Commented [RS8]: Figure-1 is missing from the document.

Lack of illustration or explanation of biological cascade.

Include a schematic or flowchart of the pathophysiological process if possible.

Add a brief explanation of inflammation, apoptosis, BBB disruption.

6.1 Ischemic Stroke Mechanisms

Ischemic injury begins with a reduction in blood flow, leading to hypoxia and energy failure in neural tissue. The cascade of excitotoxicity, oxidative stress, and inflammation ultimately results in cell death. The concept of the ischemic penumbra—the area surrounding the infarct core that remains salvageable—is central to therapeutic strategies [12].

6.2 Haemorrhagic Stroke Mechanisms

In haemorrhagic stroke, rupture of cerebral vessels causes blood extravasation, leading to a sudden increase in intracranial pressure, tissue compression, and subsequent ischemia. Secondary injury mechanisms, including inflammation and cytotoxicity due to blood breakdown products, contribute to poor outcomes [13].

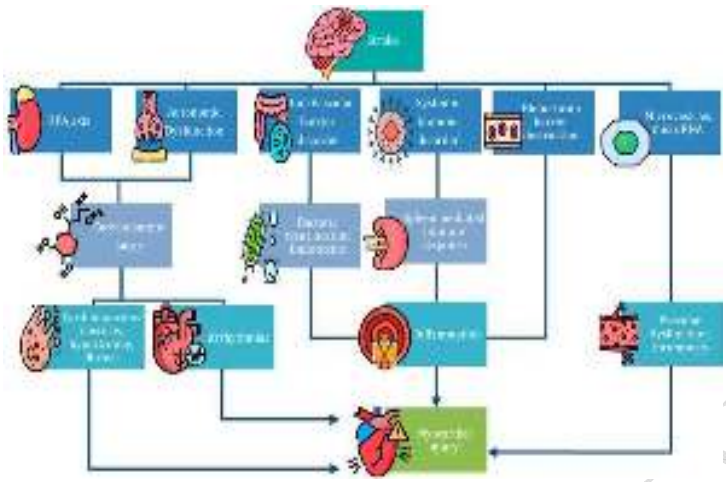

Figure-1: SHS pathophysiology. Legend: this image provides a visual depiction of the different elements that lead to cardiac damage after a stroke, summarizing the mechanisms underlying SHS [14].

7. CLINICAL PRESENTATION AND DIAGNOSTIC CRITERIA:

Commented [RS9]: no use of clinical scales (eg NIHSS, Glasgow).

The role of cardiac examination (ECG, echocardiogram) is not mentioned.

Add clinical diagnostic aids and role of holter/ECG:

"NIH Stroke Scale (NIHSS) is commonly used to assess stroke severity upon admission."

7.1 Clinical Symptoms

The clinical presentation of stroke varies with the affected brain region. Common symptoms include:

- Sudden weakness or numbness, particularly on one side of the body.

- Difficulty speaking or understanding speech.

- Visual disturbances.

- Dizziness, loss of balance, or coordination.

- Severe headache (especially in haemorrhagic stroke) [15].

7.2 Diagnostic Workup

7.2.1 Imaging Modalities

- CT scan: Rapid assessment to distinguish between ischemic and haemorrhagic stroke.

- Magnetic Resonance Imaging (MRI): More sensitive in detecting early ischemic changes.

- Angiography: Evaluates cerebral vasculature for occlusions or aneurysms [16].

7.2.2 Laboratory Tests

Routine blood work includes:

- Complete blood count (CBC)

- Coagulation profile

- Lipid profile

- Glucose levels

- Cardiac biomarkers (if cardioembolic stroke is suspected) [17].

Table 3. Diagnostic Modalities and Their Uses

Diagnostic Tool	Strengths	Limitations
CT scan	Fast, widely available	Less sensitive in early ischemia
MRI	High sensitivity for ischemia	Time-consuming, less available
Angiography	Detailed vascular mapping	Invasive, requires contrast

Table 3 highlights the main imaging tools used in stroke diagnosis [18].

8. TREATMENT STRATEGIES:

Commented [RS10]:
No mention of treatment time limits, contraindications, or treatment options if the patient is ineligible.

No discussion of neuroprotective therapy.

"Alteplase is recommended within 4.5 hours of symptom onset. Mechanical thrombectomy is effective up to 24 hours in selected patients."

8.1 Acute Management

8.1.1 Ischemic Stroke

- Thrombolytic Therapy: Administration of tissue plasminogen activator (tPA) within a critical time window.

- Mechanical Thrombectomy: Endovascular removal of clots for eligible patients [19].

8.1.2 Haemorrhagic Stroke

- Blood Pressure Control: Critical to prevent further bleeding.

- Surgical Intervention: Craniotomy or minimally invasive procedures to remove hematoma.

- Management of Intracranial Pressure: Use of osmotherapy and other supportive measures [20].

8.2 Secondary Prevention

Post-stroke management includes:

- Antiplatelet and Anticoagulant Therapies: To prevent recurrence.

- Statin Therapy: For atherosclerotic risk reduction.

- Lifestyle Modifications: Diet, exercise, and smoking cessation.

- Rehabilitation Programs: Multidisciplinary approach to maximize recovery [21].

9. REHABILITATION AND LONG-TERM MANAGEMENT:

Stroke rehabilitation is a cornerstone of long-term management. It encompasses:

- Physical Therapy: Focuses on regaining mobility and strength.

- Occupational Therapy: Aids in adapting to daily life activities.

- Speech Therapy: Addresses communication and swallowing difficulties.

- Psychological Support: For cognitive and emotional rehabilitation [22].

Research indicates that early and intensive rehabilitation improves functional outcomes significantly.

Commented [RS11]: Too general, no guidelines or average duration of rehabilitation are mentioned.

Suggestion:
Add evidence-based citation:

"Early, intensive rehabilitation initiated within 72 hours has been associated with improved functional outcomes [22]."

10. RECENT ADVANCES IN STROKE MANAGEMENT:

Commented [RS12]: Does not address the limitations or challenges of integrating these innovations.

"Despite promising results, the adoption of AI tools in clinical practice is limited by regulatory and data privacy concerns."

10.1 Novel Pharmacological Agents

Recent trials have evaluated newer thrombolytics and neuroprotective agents aimed at reducing ischemic injury and improving outcomes.

10.2 Endovascular Techniques

Advances in device technology have improved the success rates of mechanical thrombectomy, expanding the therapeutic window for many patients [23].

10.3 Telemedicine and Mobile Stroke Units

Telemedicine has revolutionized acute stroke care by providing rapid assessment and intervention in remote areas. Mobile stroke units equipped with CT scanners and specialized staff are becoming more common in urban settings [24].

Table 4. Summary of Recent Advances in Stroke Management

Innovation	Description	Impact on Outcomes
Novel Thrombolytics	Extended time window and reduced haemorrhage risk	Improved recanalization rates
Endovascular Devices	Advanced stent retrievers and aspiration systems	Increased functional recovery
Telemedicine	Remote evaluation and management	Reduced door-to-needle times
Mobile Stroke Units	On-scene imaging and treatment	Faster treatment initiation

Table 4 summarizes recent innovations and their clinical impacts [25].

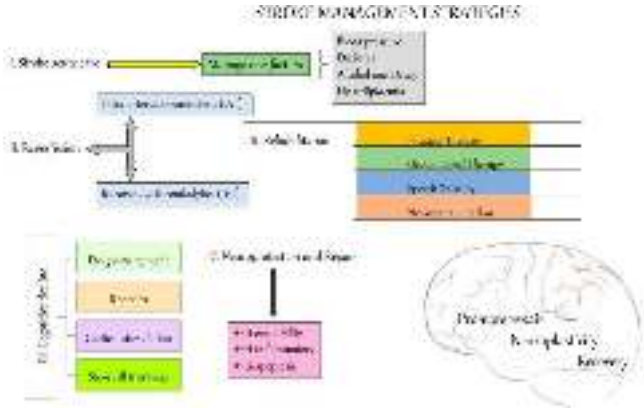

Figure-2: stroke treatment. This is the general procedure for controlling the occurrence of stroke [26].

11. PREVENTIVE STRATEGIES AND LIFESTYLES MODIFICATIONS:

Prevention is vital in reducing the stroke burden. Strategies include:

- Public Health Initiatives: Community awareness programs targeting hypertension, smoking, and obesity.

- Screening Programs: Regular monitoring for atrial fibrillation and diabetes.

- Patient Education: Empowering patients with information about stroke warning signs and when to seek medical help.

- Dietary Recommendations: Adoption of heart-healthy diets (e.g., Mediterranean diet) to lower vascular risk [27].

12. FUTURE PERSPECTIVES:

12.1 Emerging Biomarkers

Research into genetic and molecular biomarkers holds promise for early stroke diagnosis and personalized therapy. Studies on microRNAs, inflammatory markers, and neuroimaging biomarkers are ongoing [28].

12.2 Artificial Intelligence in Stroke Diagnosis

Machine learning and AI are increasingly being applied to imaging interpretation and risk stratification. These tools have the potential to enhance diagnostic accuracy and predict treatment responses [29].

12.3 Regenerative Therapies

Stem cell therapy and neuro regenerative approaches are being investigated to repair brain tissue post-stroke. Although still experimental, early-phase clinical trials show promise in enhancing recovery [30].

Commented [RS13]:
Too brief, no mention of community approaches or government regulation.

Suggestion:
Add examples of public programs or primary care roles

Commented [RS14]: Overly Descriptive and Optimistic:

All subsections are presented in a positive tone without mentioning limitations or challenges that may arise in the development and implementation of these innovations.

Under-Specific and Overly General:

No mention of what biomarkers or current studies are promising.

No mention of real-world applications or ongoing clinical validation for AI or stem cells.

Lack of Critical References:

No discussion of ethical or regulatory limitations in the application of AI and regenerative therapies.

No mention that most therapies are still experimental or in early clinical trials.

13. CHALLENGES AND LIMITATIONS:

- **Access to Acute Care:** Regional disparities, particularly in rural areas, delay treatment and worsen outcomes [31].
- **Economic and Resource Constraints:** The high costs of advanced diagnostics and interventional therapies restrict their widespread use [32].
- **Clinical Heterogeneity:** Variability in stroke presentation and patient comorbidities complicates treatment standardisation and trial design [33].
- **Research Gaps:** More extensive, multicentre clinical trials are needed to validate emerging therapies and establish best practices [34].
- **Regulatory and Ethical Concerns:** Integration of AI, gene therapy, and nanomedicine into routine practice requires robust regulatory frameworks and ethical oversight [35].

14. DISCUSSION:

This review has highlighted the multifaceted nature of stroke—from the underlying pathophysiological mechanisms to the latest advances in treatment. Despite substantial progress in both acute and rehabilitative care, significant challenges remain, particularly in addressing disparities in access to care and optimizing personalized treatment strategies. Multidisciplinary efforts combining clinical research, technological innovation, and public health interventions are essential for reducing the global burden of stroke [36].

15. CONCLUSION:

Stroke continues to be a major health challenge with complex clinical presentations and outcomes. Advances in imaging, pharmacology, and interventional techniques have improved the prognosis for many patients. Future research must focus on personalized medicine, novel therapeutics, and system-level strategies to ensure timely and effective stroke care. This review underscores the importance of a comprehensive, multidisciplinary approach in combating stroke and improving patient outcomes [37,38].

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Commented [RS15]: Weaknesses/Criticisms:
Not Deeply Described:

Each point is only mentioned in one sentence without deep elaboration.

Lack of Supporting Data or References:

There is no data to support disparities in access or cost burdens.

No examples of countries or populations affected are mentioned.

Lack of Visual Structure:

The explanation of the 5 consecutive points would be better if a concise table or bullet list was used for clarity.

Commented [RS16]: Too much repetition of content, does not discuss the limitations of the review article itself.

Add critical reflection:

"This review is limited by the non-systematic approach and potential selection bias in cited literature."

Commented [RS17]:
Does not provide policy recommendations or future research priorities.

Add:

"Future research should prioritize equitable access, implementation science, and cost-effective stroke interventions in low-resource settings."

16. REFERENCES:

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Commented [RS18]: Some DOIs are incomplete or not hyperlinked.

No consistent format (some are APA-like, some are not).

Tip:
Make sure to be consistent with the target journal style (APA, Vancouver, AMA, etc.).

Complete all references with active DOIs or URLs if available.

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