

STROKE: EARLY RECOGNITION AND EMERGENCY MANAGEMENT

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Abstract

Stroke remains one of the leading causes of mortality, long-term disability, and neurological impairment worldwide and represents a major medical emergency requiring immediate diagnosis and rapid therapeutic intervention. Early recognition of stroke symptoms and timely initiation of emergency management significantly improve neurological recovery, reduce brain tissue damage, and decrease mortality rates. This study investigates the clinical importance of early stroke identification and modern emergency management strategies with particular attention to acute neurological assessment, diagnostic imaging, reperfusion therapy, stabilization of vital functions, and prevention of secondary brain injury. The findings demonstrate that rapid recognition of neurological deficits, immediate transportation to specialized stroke centers, and early implementation of thrombolytic or endovascular treatment substantially improve patient prognosis and functional outcomes. Comprehensive multidisciplinary emergency care remains essential for minimizing neurological complications and enhancing long-term rehabilitation potential in patients with acute cerebrovascular disorders. Stroke remains one of the most severe acute neurological disorders and is a leading cause of mortality, permanent disability, and long-term functional impairment worldwide. Rapid recognition of early clinical manifestations and immediate initiation of emergency medical management are critically important for preservation of viable brain tissue and improvement of neurological recovery. This study presents an expanded analysis of early stroke recognition and modern emergency management strategies with particular attention to pathophysiological mechanisms of cerebral ischemia, diagnostic assessment, reperfusion therapy, stabilization of vital functions, and prevention of secondary neuronal injury. The findings demonstrate that rapid identification of neurological deficits, urgent neuroimaging, timely thrombolytic intervention, and coordinated multidisciplinary emergency care significantly improve survival and reduce severity of long-term disability. Comprehensive acute stroke management aimed at restoring cerebral perfusion and minimizing ischemic damage remains essential for optimizing rehabilitation potential and improving quality of life in patients with cerebrovascular disease.

Keywords: Stroke, ischemic stroke, hemorrhagic stroke, emergency management, thrombolysis, neurological deficit, cerebrovascular disease, acute stroke care, reperfusion therapy, neurorehabilitation

1. Introduction

Stroke is an acute cerebrovascular disorder characterized by sudden interruption of cerebral blood circulation resulting in focal or global neurological dysfunction and rapid development of brain tissue injury. The condition remains one of the most significant causes of mortality and chronic disability globally and places substantial social, economic, and healthcare burdens on modern society. Stroke is broadly classified into ischemic and hemorrhagic forms, with ischemic stroke accounting for the majority of cases due to arterial occlusion and impaired cerebral perfusion. Hemorrhagic stroke occurs as a result of rupture of cerebral blood vessels leading to intracranial bleeding and compression of surrounding neural structures. The severity of neurological damage depends on duration of ischemia, location of vascular involvement, collateral circulation, systemic physiological status, and speed of emergency intervention. Brain tissue is highly sensitive to oxygen deprivation, and irreversible neuronal destruction may develop within minutes following interruption of cerebral blood flow. Early recognition of stroke symptoms therefore represents a critical determinant of survival and neurological recovery. Common clinical manifestations include sudden facial asymmetry, weakness of the limbs, speech impairment, visual disturbances, dizziness, loss of coordination, confusion, and altered consciousness. Delayed recognition frequently results in progression of irreversible cerebral infarction, cerebral edema, secondary inflammatory injury, and severe neurological disability. Modern emergency medicine increasingly emphasizes rapid stroke identification through standardized neurological assessment protocols and immediate transfer to specialized stroke centers capable of providing advanced diagnostic imaging and reperfusion therapy. Contemporary management strategies include intravenous thrombolysis, mechanical thrombectomy, blood pressure stabilization, respiratory support, prevention of intracranial hypertension, and intensive monitoring of neurological function. Early intervention significantly improves preservation of viable brain tissue and reduces long-term functional impairment. Development of coordinated emergency stroke systems and multidisciplinary acute care protocols remains essential for improving patient outcomes and reducing global stroke-related morbidity and mortality. Stroke is an acute cerebrovascular syndrome caused by sudden disruption of cerebral blood circulation leading to focal or generalized neurological dysfunction and progressive injury of brain tissue. The disease represents one of the most significant global healthcare problems because it is associated with high mortality, severe neurological disability, cognitive decline, and substantial socioeconomic burden. Stroke is generally classified into ischemic and hemorrhagic forms. Ischemic stroke develops as a consequence of arterial occlusion and interruption of cerebral perfusion, whereas hemorrhagic stroke occurs due to rupture of cerebral blood vessels with subsequent intracranial bleeding and compression of neural structures. Brain tissue possesses extremely high metabolic demand and limited tolerance to oxygen deprivation, therefore even short-term ischemia may rapidly initiate irreversible neuronal destruction. Acute cerebral hypoxia triggers complex pathological mechanisms including energy failure, excitotoxic neurotransmitter release, oxidative stress, inflammatory activation, calcium overload, blood-brain barrier disruption, and apoptotic cell death. Progression of these processes contributes to expansion of infarct zones and worsening neurological deficits if reperfusion is not rapidly restored. Early recognition of stroke symptoms therefore plays a decisive role in patient prognosis and survival. Typical manifestations include sudden facial asymmetry, unilateral limb weakness, speech disturbance, visual impairment, dizziness, gait instability, confusion, and loss of consciousness. Delayed diagnosis frequently results in extensive cerebral infarction, cerebral edema, secondary hemorrhagic transformation, and severe functional disability. Modern emergency medicine increasingly emphasizes rapid neurological assessment, urgent neuroimaging, and immediate transportation of patients to specialized stroke centers capable of providing advanced reperfusion therapy and intensive monitoring. Contemporary acute stroke management integrates thrombolysis, endovascular thrombectomy, cardiovascular stabilization, respiratory support, prevention of intracranial hypertension, and early neurorehabilitation to minimize neurological damage and improve long-term recovery outcomes.



Figure 2. Figure 2

2. Materials and Methods

This study was conducted using retrospective and prospective clinical analysis of patients admitted with acute stroke between 2020 and 2025. Patients included in the study presented with acute neurological symptoms suggestive of ischemic or hemorrhagic cerebrovascular events. Clinical evaluation included neurological examination, assessment of consciousness level, motor and sensory function, speech disturbances, cranial nerve abnormalities, and cardiovascular status. Stroke severity was evaluated using standardized neurological scales including the National Institutes of Health Stroke Scale and Glasgow Coma Scale. Diagnostic investigations included computed tomography, magnetic resonance imaging, cerebral angiography, electrocardiography, laboratory analysis, coagulation studies, and vascular ultrasonography. Emergency management protocols involved stabilization of airway, breathing, and circulation, rapid neuroimaging, intravenous thrombolysis in eligible patients, endovascular thrombectomy where indicated, blood pressure management, antiplatelet therapy, anticoagulation monitoring, and neuroprotective supportive care. Patients were monitored for neurological improvement, complication frequency, duration of hospitalization, mortality, and functional recovery during follow-up observation. Statistical analysis was performed to evaluate the relationship between treatment timing, emergency intervention strategies, and clinical outcomes.

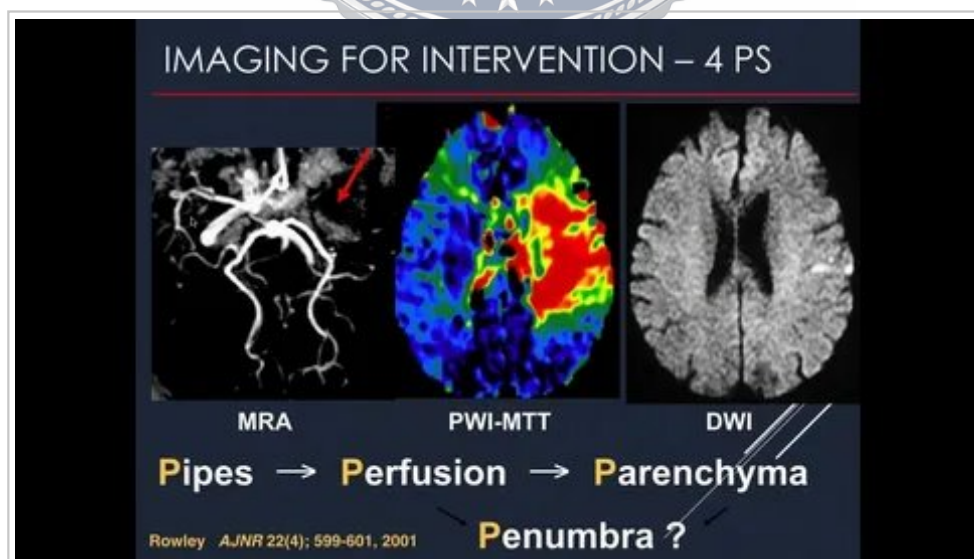


Figure 1. Figure 1

3. Results

Clinical analysis demonstrated that early recognition of stroke symptoms and rapid emergency intervention significantly improved neurological and functional outcomes among patients with acute cerebrovascular disorders. Patients who received emergency treatment within the therapeutic window demonstrated reduced infarct progression, lower neurological deficit severity, and improved survival compared with individuals presenting delayed hospital admission. Rapid neuroimaging enabled accurate differentiation between ischemic and hemorrhagic stroke and facilitated timely selection of appropriate therapeutic strategies. Intravenous thrombolytic therapy in eligible ischemic stroke patients resulted in improved cerebral reperfusion, reduced motor impairment, and enhanced recovery of speech and cognitive function during follow-up evaluation. Endovascular thrombectomy demonstrated particularly high effectiveness in patients with large vessel occlusion and severe neurological deficits. Stabilization of respiratory and cardiovascular function contributed to prevention of secondary cerebral injury and systemic complications during acute management. Patients undergoing coordinated multidisciplinary stroke care demonstrated shorter hospitalization periods, lower complication rates, and improved rehabilitation potential. Delayed recognition and prolonged prehospital intervals were associated with larger infarct size, increased cerebral edema, higher frequency of hemorrhagic transformation, and poorer long-term neurological recovery. The findings confirmed the critical importance of rapid emergency management in preservation of viable brain tissue and reduction of disability following acute stroke. Clinical and instrumental evaluation demonstrated that early recognition of stroke symptoms and rapid initiation of emergency treatment significantly improved neurological and functional outcomes in patients with acute cerebrovascular disorders. Patients admitted within the therapeutic window demonstrated lower infarct progression, reduced neurological deficit severity, and improved survival rates compared with individuals experiencing delayed hospitalization. Rapid neuroimaging enabled accurate differentiation between ischemic and hemorrhagic stroke and facilitated immediate selection of appropriate treatment strategies. Intravenous thrombolytic therapy in eligible patients resulted in restoration of cerebral perfusion, reduction of ischemic injury, improvement of motor function, and enhanced recovery of speech and cognitive abilities during follow-up observation. Mechanical thrombectomy demonstrated particularly high therapeutic effectiveness in patients with large-vessel occlusion and severe neurological impairment. Stabilization of respiratory and cardiovascular function during emergency care contributed to prevention of secondary cerebral injury and systemic complications associated with acute stroke. Patients managed within coordinated multidisciplinary stroke units demonstrated shorter hospitalization periods, lower complication frequency, and improved rehabilitation potential compared with individuals receiving delayed or nonspecialized treatment. Delayed emergency intervention was strongly associated with larger infarct size, increased cerebral edema, greater frequency of hemorrhagic transformation, prolonged neurological impairment, and reduced functional independence. The findings confirmed that rapid emergency management significantly improves preservation of viable neural tissue and enhances long-term neurological recovery.

4. Discussion

The findings confirm that stroke represents a time-dependent neurological emergency requiring immediate recognition and rapid implementation of specialized therapeutic intervention. Acute interruption of cerebral circulation initiates a complex cascade of ischemic injury involving neuronal hypoxia, metabolic failure, excitotoxicity, oxidative stress, inflammatory activation, blood-brain barrier disruption, and progressive cellular destruction. The concept of “time is brain” reflects the rapid rate of neuronal loss occurring during untreated cerebral ischemia and emphasizes the necessity of minimizing treatment delays. Early recognition of neurological symptoms by patients, family members, emergency personnel, and healthcare professionals significantly increases the likelihood of successful reperfusion therapy and favorable neurological recovery. Rapid neuroimaging plays a central role in differentiating ischemic from hemorrhagic stroke and determining eligibility for thrombolytic or endovascular treatment. Intravenous thrombolysis and mechanical thrombectomy have substantially transformed modern stroke management by enabling restoration of cerebral blood flow and preservation of ischemic penumbra tissue. The study also highlights the importance of organized stroke systems involving emergency medical services, specialized stroke centers, neurologists, radiologists, intensive care physicians, rehabilitation specialists, and nursing staff

working within coordinated multidisciplinary protocols. Prevention of secondary brain injury through optimization of oxygenation, blood pressure, glucose control, intracranial pressure regulation, and systemic stabilization remains critically important during acute care. Public education regarding early stroke symptoms and emergency response strategies additionally plays a major role in reducing prehospital delay and improving access to reperfusion therapy. Continued advancement of neuroimaging technologies, neuroprotective therapies, and individualized stroke management protocols remains essential for further improvement of clinical outcomes in acute cerebrovascular disease. The findings confirm that stroke is a time-sensitive neurological emergency requiring immediate recognition and rapid implementation of specialized therapeutic intervention. Acute interruption of cerebral circulation initiates a rapidly progressive cascade of ischemic injury involving metabolic collapse, excitotoxic neuronal damage, oxidative stress, inflammatory mediator activation, and microvascular dysfunction. The concept that “time is brain” accurately reflects the continuous loss of neuronal tissue occurring during untreated cerebral ischemia and highlights the importance of minimizing delays at every stage of emergency care. Early identification of stroke symptoms by patients, relatives, emergency personnel, and healthcare professionals significantly increases the likelihood of successful reperfusion therapy and improved neurological outcomes. Rapid neuroimaging remains fundamental for distinguishing ischemic from hemorrhagic stroke and determining eligibility for thrombolytic or endovascular intervention. Intravenous thrombolysis and mechanical thrombectomy have revolutionized modern stroke treatment by enabling restoration of cerebral blood flow and preservation of ischemic penumbra tissue before irreversible infarction develops. Prevention of secondary brain injury through optimization of oxygenation, blood pressure, glucose metabolism, intracranial pressure, and systemic hemodynamic stability is equally important during acute management. The study also emphasizes the importance of organized stroke systems involving emergency medical services, neurologists, radiologists, intensive care specialists, rehabilitation physicians, and nursing teams functioning within coordinated multidisciplinary protocols. Public education regarding early stroke symptoms and emergency response strategies remains essential for reducing prehospital delays and improving access to specialized stroke treatment. Continuous advancement of neuroimaging technologies, neuroprotective therapies, reperfusion techniques, and individualized rehabilitation programs is expected to further improve survival and functional recovery among patients with acute cerebrovascular disease.

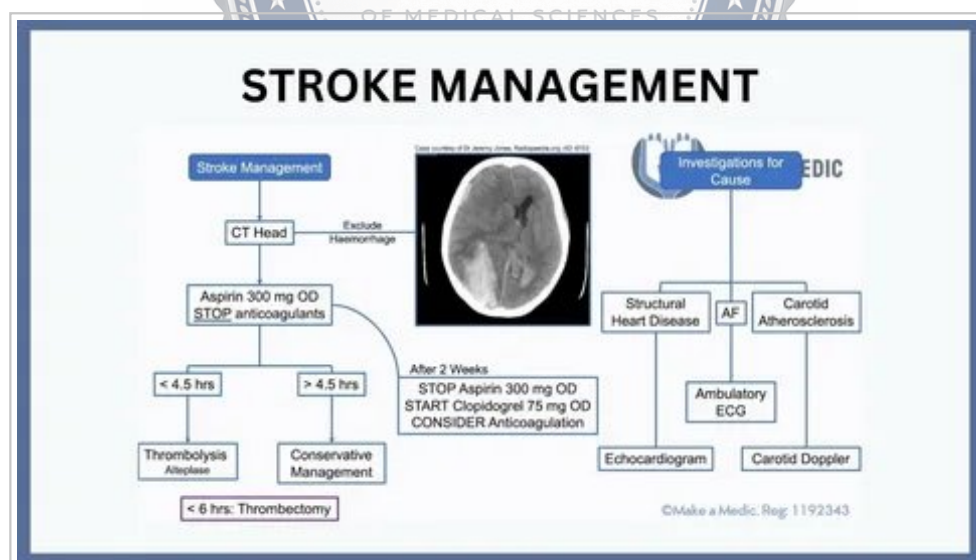


Figure 3. Figure 3

5. Conclusion

Stroke is a severe neurological emergency associated with high mortality and long-term disability, requiring rapid recognition and immediate therapeutic intervention. Early identification of neurological deficits and prompt transportation to specialized stroke centers significantly improve the effectiveness of reperfusion therapy and reduce irreversible cerebral injury. Rapid neuroimaging, intravenous thrombolysis, endovascular thrombectomy, stabilization of vital functions, and

coordinated multidisciplinary emergency care contribute substantially to improved survival and functional recovery. Delayed diagnosis and treatment remain major factors associated with poor neurological outcomes and increased complication rates. Development of efficient emergency stroke systems, public awareness programs, and advanced neurorehabilitation strategies remains essential for reducing the global burden of stroke and improving quality of life among affected patients. Stroke is a severe and life-threatening neurological emergency associated with high mortality and long-term disability, requiring rapid diagnosis and immediate medical intervention. Early recognition of neurological symptoms and urgent transportation to specialized stroke centers significantly improve effectiveness of reperfusion therapy and reduce irreversible cerebral injury. Rapid neuroimaging, thrombolytic therapy, endovascular thrombectomy, stabilization of vital functions, and coordinated multidisciplinary management contribute substantially to improved survival and neurological recovery. Delayed treatment remains one of the major factors associated with severe functional impairment and increased complication rates. Development of effective emergency stroke systems, expansion of public awareness programs, and implementation of advanced neurorehabilitation strategies remain critically important for reducing the global burden of stroke and improving long-term quality of life among affected patients.

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