



Cerebrovascular disease: A comprehensive overview of condition, diagnosis, treatment, and nursing intervention plans

Abdalurhman Abdulaziz Almubarak, Khalid Obid Abdullah Alruki, Mohammed Menwer Alruwaili, Hatim Bunaydir Bader Aimutairi, Hassan Duairam Thawab Al-Shahrani and Abdulhadi Ali Alqahtani

KSA, Ministry of National Guard Health Affairs, Saudi Arabia

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Abstract

Background: Cerebrovascular disease, primarily manifesting as stroke, is a leading cause of adult disability and the fifth leading cause of death globally. Approximately 85% of strokes are ischemic, with modifiable risk factors such as hypertension playing a pivotal role. Advances in diagnostic imaging and acute interventions have significantly improved outcomes in ischemic stroke management.

Aim: To provide a comprehensive overview of ischemic stroke etiology, diagnosis, treatment modalities, and associated nursing intervention plans.

Methods: A detailed review of epidemiology, pathophysiology, clinical assessment, and management strategies for ischemic strokes was conducted. Emphasis was placed on treatment advancements, including thrombolytic therapy, mechanical thrombectomy, and targeted stroke prevention strategies. The critical role of nursing interventions in acute care and long-term rehabilitation was also explored.

Results: Evidence highlights the importance of timely interventions, including intravenous tissue plasminogen activator (IV tPA) within 4.5 hours and mechanical thrombectomy within 6–24 hours for select patients. Advanced imaging techniques enable precise localization and differentiation between ischemic penumbra and infarct core. Nursing interventions such as monitoring vitals, ensuring medication adherence, and coordinating multidisciplinary rehabilitation significantly contribute to improved outcomes.

Conclusion: Effective ischemic stroke management hinges on early recognition, prompt treatment, and comprehensive post-stroke care. Nursing interventions are critical across all stages of patient care, from acute management to rehabilitation, emphasizing patient education, secondary prevention, and support for functional recovery.

Keywords: Stroke, ischemic stroke, cerebrovascular disease, thrombolytic therapy, mechanical thrombectomy, nursing interventions, stroke rehabilitation

Introduction

A stroke, also referred to as a cerebrovascular accident (CVA), involves an acute disruption of cerebral perfusion or vascular integrity. Approximately 85% of strokes are ischemic, with the remainder being hemorrhagic [1]. This discussion primarily focuses on ischemic strokes. Over the past few decades, the incidence and associated mortality rates of stroke have been on a decline [2]. Stroke remains a leading cause of adult disability globally, making early recognition and prompt treatment essential to mitigate morbidity and mortality. Various factors contribute to stroke occurrence, with hypertension being the most significant cause of ischemic stroke. In younger individuals, additional etiologies include clotting disorders, carotid dissection, and the use of illicit drugs. Rapid history-taking and physical examination are crucial in acute settings, as the adage "time is brain" underscores the importance of minimizing delays. Advances in acute stroke management have enabled the administration of intravenous tissue plasminogen activator

(IV tPA) within 4.5 hours and mechanical thrombectomy within 6 hours. The DAWN trial further extended the therapeutic window for thrombectomy to 24 hours in specific cases involving large vessel occlusion [3].

Etiology

The causes of ischemic strokes can be classified into embolic, thrombotic, and lacunar categories. Common risk factors include hypertension, diabetes, smoking, obesity, atrial fibrillation, and substance use, with hypertension being the most prevalent modifiable risk factor. Hypertension disproportionately affects African-Americans and often manifests earlier in life [1]. The JNC8 guidelines recommend maintaining blood pressure below 140/90 mmHg in stroke patients [4]. Chronic hypertension can lead to small vessel strokes, commonly in areas such as the internal capsule, thalamus, pons, and cerebellum [5]. Lifestyle modifications, including weight loss, salt reduction, and adherence to diets rich in fruits and

vegetables (e.g., the Mediterranean diet), have been shown to lower blood pressure effectively [6]. A reduction of 10 mmHg in blood pressure correlates with a one-third decrease in stroke risk during primary prevention efforts [7]. Elevated low-density lipoprotein (LDL) levels, affecting one-third of adults in the United States, contribute to plaque accumulation within intracerebral vasculature, eventually precipitating thrombotic strokes. In older populations, atrial fibrillation significantly raises the risk of cardioembolic strokes [8]. Approximately 20% of strokes are hemorrhagic, resulting from factors such as hypertension, aneurysm rupture, arteriovenous malformations, venous angiomas, cocaine use, hemorrhagic metastases, amyloid angiopathy, and less common etiologies. Lacunar strokes, constituting around 20% of ischemic strokes, occur due to occlusion of small penetrating arteries, including branches of the middle cerebral artery, vertebral artery, basilar artery, or lenticulostriate vessels. These strokes are often caused by microemboli, fibrinoid necrosis from hypertension or vasculitis, amyloid angiopathy, or hyaline arteriosclerosis.

Epidemiology

Stroke ranks as the fifth leading cause of death in the United States, affecting approximately 800,000 individuals annually. It is also the leading cause of disability [9]. While stroke incidence has declined, associated morbidity has increased due to extended life expectancies, particularly among women. Globally, stroke results in over five million deaths annually and leaves millions of survivors with disabilities.

Pathophysiology

The pathophysiological basis of stroke involves ischemia within a specific brain region. The dysfunction of Na⁺/K⁺ ATPase pumps arises from reduced adenosine triphosphate (ATP) production and impaired aerobic metabolism. Ischemia leads to cellular depolarization, calcium influx, lactic acid accumulation, acidosis, and the generation of free radicals. Cellular death amplifies glutamate release, initiating a cascade of excitotoxic chemical processes [10].

History and Physical Examination

A critical component of stroke evaluation is determining the time of symptom onset or the last known normal state, as this information dictates eligibility for thrombolytic therapy or endovascular interventions [11]. Additional historical factors to assess include risk factors for atherosclerosis and cardiovascular disease, diabetes, smoking, atrial fibrillation, substance use, migraines, seizures, infections, trauma, or pregnancy. Stroke assessment involves a rapid, multi-disciplinary approach. While clinical staff obtain vitals, initiate telemetry, and establish IV access, the physician conducts a swift neurological evaluation. The National Institutes of Health Stroke Scale (NIHSS) is a standard tool for baseline assessment. Key components of the examination include evaluating consciousness, language, dysarthria, motor strength (e.g., detecting subtle arm weakness through pronator drift), visual field deficits, eye movements, facial symmetry (e.g., observing the patient's smile), and ataxia (e.g., finger-to-nose coordination). These assessments aid in localizing the stroke and identifying associated syndromes.

Stroke Syndromes

Stroke syndromes vary based on the affected vascular territories. Anterior cerebral artery (ACA) infarctions are rare due to robust collateral circulation and involve Broca's area, primary motor and sensory cortices, and prefrontal cortex, leading to motor aphasia, personality changes, and contralateral leg weakness or numbness, with sparing of the hand and face. Middle cerebral artery (MCA) strokes affect the M1 trunk supplying the basal ganglia and M2 branches supplying parietal, frontal, and temporal lobes, causing contralateral arm and facial weakness, gaze deviation, and either aphasia (left-sided) or neglect (right-sided). Posterior cerebral artery (PCA) strokes typically involve the occipital lobe, thalamus, and parts of the temporal lobe, presenting with homonymous hemianopsia, cognitive impairments, hemisensory loss, hypersomnolence, or cortical blindness accompanied by denial (Anton-Babinski syndrome) [12]. Cerebellar infarctions manifest as ataxia, dysarthria, nausea, vomiting, and vertigo. Lacunar strokes, resulting from small vessel occlusions, are characterized by pure motor, pure sensory, or ataxic hemiparetic presentations, sparing memory, cognition, consciousness, and speech. Stroke severity is quantified using the NIHSS, assessing visual function, consciousness, sensation, neglect, motor and cerebellar functions, and language, with higher scores indicating proximal vessel occlusion.

Evaluation

The initial evaluation of a stroke patient necessitates prompt stabilization of the airway, breathing, and circulation (ABC). Concurrently, a concise history and physical examination, including the National Institutes of Health Stroke Scale (NIHSS), should be conducted while intravenous access, cardiac monitoring, and laboratory workup are initiated. A non-contrast head computed tomography (CT) scan, or a combination of CT, CT angiography, and perfusion imaging, must be obtained urgently to exclude hemorrhage. Timeliness is critical, as effective interventions such as recombinant tissue plasminogen activator (rtPA) must be administered within 4.5 hours of symptom onset. Preparations for rtPA should commence during imaging, and administration should follow as soon as hemorrhage is excluded, after thoroughly discussing risks, benefits, and contraindications. Subsequent evaluation of CT angiography determines eligibility for endovascular therapy.

The earliest radiological indicator of stroke is the hyperdense vessel sign, most frequently observed in the middle cerebral artery (MCA). CT perfusion imaging differentiates between infarct core (matched deficits in cerebral blood volume and mean transit time) and ischemic penumbra (prolonged mean transit time with preserved cerebral blood volume). On magnetic resonance imaging (MRI), early hyperacute strokes demonstrate increased signal intensity on diffusion-weighted imaging (DWI) and reduced apparent diffusion coefficient (ADC) values, while late hyperacute strokes exhibit high T2 signal intensity in fluid-attenuated inversion recovery (FLAIR) sequences. Significant advancements in acute stroke care have emerged, including evidence from 2015 trials demonstrating superior outcomes with endovascular thrombectomy within

six hours for large vessel occlusions. The DAWN trial in 2017 further extended the treatment window to 24 hours in select patients using perfusion imaging, significantly broadening eligibility for intervention. All stroke patients require antiplatelet agents, statins, and comprehensive diagnostic evaluation. Hypertension, commonly encountered in acute stroke, should not be aggressively managed. Baseline electrocardiography and laboratory investigations, including a basic metabolic panel (BMP), complete blood count (CBC), cardiac markers, coagulation profile, lipid panel, and hemoglobin A1C, are essential. Additional evaluations such as transthoracic echocardiography, telemetry monitoring, and neck vessel imaging are critical for determining the stroke etiology.

Treatment and Management

Patients with acute ischemic stroke who meet the eligibility criteria for intravenous rtPA should receive treatment promptly, provided there are no contraindications. Those with large vessel occlusions should be evaluated for potential endovascular interventions. A comprehensive neurological assessment, including carotid artery imaging via ultrasound, CT angiography (CTA), magnetic resonance angiography (MRA), or conventional angiography, is necessary. Transthoracic echocardiography helps identify cardiac sources of embolism, low ejection fraction, or patent foramen ovale. Continuous electrocardiogram (ECG) monitoring and telemetry assess arrhythmias such as atrial fibrillation. Laboratory evaluations, including fasting lipid profiles, hemoglobin A1C, hypercoagulable panels for younger patients, and specific tests such as vitamin B12 or syphilis in selected cases, are recommended.

For ischemic stroke, intravenous rtPA within 4.5 hours remains the standard of care. However, patients presenting within the 3–4.5-hour window are excluded if they meet specific criteria, such as age over 80 years, severe strokes (NIHSS > 25), prior diabetes and stroke history, or oral anticoagulant use. Contraindications for rtPA include an unclear onset of symptoms, intracranial hemorrhage, recent cranial or spinal surgery, active internal bleeding, and severe hypertension uncontrolled below 185/110 mmHg, among others. Mechanical thrombectomy with a stent retriever is indicated for patients older than 18 years with minimal pre-stroke disability, causative occlusion in the internal carotid artery or proximal MCA, NIHSS \geq 6, an Alberta Stroke Program Early CT Score (ASPECT) \geq 6, and treatment eligibility within six hours of symptom onset. Hemorrhagic transformation is a potential complication of fibrinolytic therapy, classified into hemorrhagic infarction and parenchymal hematoma. Factors predisposing to this include extensive infarction, gray matter involvement, atrial fibrillation, cerebral embolism, acute hyperglycemia, thrombocytopenia, and inadequate collateral circulation. Aspirin is advised within 24–48 hours post-stroke, except for patients treated with rtPA, where it is deferred for 24 hours.

The timing of anticoagulation initiation in atrial fibrillation post-stroke depends on stroke size and comorbidities, typically occurring 7–14 days after smaller strokes with no hemorrhage. For small hemorrhagic transformations, anticoagulation is often deferred for a few weeks without significantly increasing the risk of stroke recurrence.

Patients with significant functional impairments require consultations with physical, occupational, and speech/swallow therapists. Comorbidities such as hyperthermia, hypoglycemia, and hyperglycemia must be managed. Cerebral edema warrants CT imaging, and management strategies include mannitol, hyperosmolar therapy, hyperventilation, or barbiturate coma in selected cases, though corticosteroids are not routinely recommended. Seizures, occurring in approximately 15% of cases during the initial days post-stroke, necessitate long-term treatment for those with recurrent episodes. Palliative care remains an integral component of stroke management, particularly for severely incapacitated patients, and discussions regarding end-of-life care and resuscitation preferences should be undertaken with family members.

Differential Diagnosis

Stroke can present with a range of symptoms that may mimic other medical conditions, necessitating a comprehensive differential diagnosis to ensure accurate identification and management. Transient ischemic attacks (TIAs) are brief episodes of neurological dysfunction caused by temporary ischemia, often preceding a stroke. Similarly, metabolic disturbances such as hypoglycemia and hyponatremia can result in neurological symptoms that resemble stroke presentations. Hemiplegic migraine, a rare subtype of migraine associated with motor weakness, can closely mimic stroke, particularly in younger patients. Encephalitis, an inflammatory condition of the brain often linked to infections, presents with cognitive and motor impairments that can be mistaken for stroke. Space-occupying lesions such as brain abscesses and cerebral neoplasms may cause focal neurological deficits that require imaging to distinguish from stroke. Other conditions, including syncope, a transient loss of consciousness often due to cardiac or neurological causes, and conversion disorder, a psychological condition manifesting as neurological symptoms, are also part of the differential diagnosis [15]. Given the wide array of stroke mimics, clinical assessment must integrate a thorough patient history, physical examination, and diagnostic imaging. Rapid identification and differentiation are essential for implementing timely and appropriate interventions. While imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) are critical in distinguishing these conditions from ischemic or hemorrhagic strokes, biochemical investigations can further aid in identifying metabolic causes. A meticulous approach to differential diagnosis ensures the prevention of misdiagnosis, minimizes delays in treatment, and optimizes patient outcomes.

Prognosis

Stroke is a leading cause of disability and mortality worldwide, presenting significant challenges to patients, families, and healthcare systems. Survival rates after a stroke vary based on its type and severity. One-year survival rates range from 60% to 80%, with ischemic strokes generally associated with better outcomes than hemorrhagic strokes. Despite survival, recovery is often prolonged, and the risk of recurrent strokes remains high. Neurological impairments resulting from stroke frequently limit

functional independence, leaving many survivors unable to return to work or maintain their previous quality of life. Long-term outcomes for stroke survivors are influenced by several factors, including the timeliness of acute treatment, rehabilitation efforts, and the management of comorbid conditions. Stroke patients commonly experience partial or permanent neurological deficits, such as hemiparesis, aphasia, or cognitive impairments. These deficits significantly impact physical, emotional, and social well-being. While advances in acute stroke management, including thrombolysis and mechanical thrombectomy, have improved survival rates, many survivors require intensive post-stroke rehabilitation. Interdisciplinary efforts involving physiotherapy, speech therapy, and occupational therapy are integral to optimizing functional recovery. Furthermore, secondary prevention strategies, such as blood pressure control, anticoagulation therapy for atrial fibrillation, and smoking cessation, are critical to reducing the risk of recurrence. Despite these interventions, the burden of stroke remains substantial. Enhanced public awareness, early recognition of stroke symptoms, and coordinated efforts among healthcare providers are essential to improving prognosis and minimizing the long-term impact of this condition.

Complications

Stroke is often associated with a range of acute and chronic complications, which significantly impact patient outcomes and recovery trajectories. In the acute phase, complications can arise from the progression of the stroke itself, such as the extension of ischemic damage or hemorrhagic transformation. Additionally, medical complications related to prolonged immobility and hospitalization are prevalent. A multicenter study documented the incidence of key complications during the acute phase: recurrent stroke (9%), epileptic seizures (3%), urinary tract infections (24%), pneumonia (22%), pressure ulcers (21%), deep vein thrombosis (2%), pulmonary embolism (1%), depression (16%), and anxiety (14%) [18]. These complications underscore the importance of proactive monitoring and management during hospitalization. Urinary tract infections and pneumonia, often resulting from immobility and aspiration, can exacerbate morbidity and delay recovery. Pressure ulcers, another common complication, highlight the need for meticulous nursing care and early mobilization. Neuropsychiatric issues, such as depression and anxiety, frequently complicate stroke recovery and require integrated mental health support. Long-term complications may include persistent neurological deficits, spasticity, and chronic pain, which necessitate ongoing rehabilitation and pain management. The risk of recurrent strokes further emphasizes the importance of secondary prevention strategies, including anticoagulation, antiplatelet therapy, and lifestyle modifications. Effective management of these complications involves a multidisciplinary approach, integrating medical, nursing, and rehabilitative interventions. Early recognition and treatment of complications are critical to improving recovery outcomes and enhancing the overall quality of life for stroke survivors.

Nursing Intervention Plans

Nursing intervention plans for stroke patients are integral to their recovery and overall outcomes, encompassing acute care, prevention of complications, and support for long-term rehabilitation. These plans require a comprehensive, patient-centered approach tailored to the unique needs and conditions of each individual. During the acute phase, nurses prioritize airway, breathing, and circulation (ABCs) to stabilize the patient. Continuous monitoring of vital signs, neurological status, and oxygen saturation is essential. Nurses play a pivotal role in identifying early signs of neurological deterioration, such as changes in consciousness or worsening motor deficits, and promptly informing the medical team. Ensuring the patient's safety is crucial, which involves fall precautions, head-of-bed elevation, and aspiration risk assessments. Nurses administer prescribed thrombolytic agents, such as intravenous recombinant tissue plasminogen activator (IV rtPA), while closely monitoring for signs of bleeding or adverse reactions. Preventing complications associated with immobility is a key nursing responsibility. Strategies include frequent repositioning to prevent pressure ulcers, using compression devices to reduce the risk of deep vein thrombosis, and promoting pulmonary hygiene through incentive spirometry to minimize pneumonia risks. Nurses also implement bladder and bowel management programs to prevent urinary tract infections and fecal impaction.

Nursing interventions extend to rehabilitation, where nurses collaborate with physiotherapists and occupational therapists to facilitate mobility and self-care activities. They play a critical role in patient and caregiver education, emphasizing secondary prevention strategies, such as blood pressure control, medication adherence, smoking cessation, and dietary modifications. Nurses also educate patients on recognizing early signs of stroke recurrence using the ACT FAST framework. Stroke often leads to emotional distress for both patients and their families. Nurses provide emotional support and coordinate with mental health professionals to address issues such as depression and anxiety. Social support assessments ensure the patient has access to necessary resources and rehabilitation services upon discharge. A well-coordinated nursing intervention plan, executed in collaboration with an interdisciplinary healthcare team, significantly enhances recovery, reduces the risk of complications, and improves the overall quality of life for stroke patients.

Conclusion

Cerebrovascular disease, particularly ischemic stroke, remains a significant global health concern despite advances in treatment modalities and declining mortality rates. The multifaceted nature of ischemic stroke necessitates a rapid, multidisciplinary approach to optimize outcomes. Early recognition and intervention are crucial, underscored by the mantra "time is brain." The integration of thrombolytic therapy within the first 4.5 hours and mechanical thrombectomy for eligible patients up to 24 hours post-onset has transformed the management landscape, offering hope for substantial functional recovery. Advanced diagnostic tools, including CT and MRI imaging, provide detailed insights into stroke characteristics, enabling precise treatment decisions. Comprehensive management extends beyond acute care, requiring a robust framework for

secondary prevention through lifestyle modifications, pharmacotherapy, and addressing underlying conditions such as hypertension, diabetes, and hyperlipidemia. Nursing interventions play a pivotal role throughout the care continuum. In the acute phase, nurses monitor vitals, ensure timely administration of medications, and assess neurological status. In rehabilitation, they coordinate multidisciplinary efforts to restore physical, cognitive, and emotional well-being. Patient education on risk factor management, adherence to prescribed therapies, and recognizing warning signs of recurrent strokes is essential to prevent future episodes. Long-term recovery often involves managing complications such as hemiparesis, speech difficulties, and psychological impacts, where nursing expertise in therapeutic communication and personalized care is indispensable. Addressing caregiver support and fostering an inclusive care environment further enhance recovery prospects. In conclusion, the integration of advanced therapeutic interventions with evidence-based nursing care ensures a holistic approach to stroke management. Future advancements should focus on expanding access to cutting-edge therapies and strengthening nursing capacities to meet the growing demands of cerebrovascular care globally.

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مرض الأوعية الدموية الدماغية: نظرة شاملة على الحالة والتشخيص والعلاج وخطط التدخل التمريضي

الملخص:

الخلفية: يُعد مرض الأوعية الدموية الدماغية، الذي يظهر غالبًا على شكل سكتة دماغية، أحد الأسباب الرئيسية للإعاقة لدى البالغين والخامس عالميًا من حيث أسباب الوفاة. تشكل السكتة الدماغية الإقفارية حوالي 85% من الحالات، مع عوامل خطر قابلة للتعديل مثل ارتفاع ضغط الدم الذي يلعب دورًا حاسمًا. وقد ساهمت التطورات في التصوير التشخيصي والتدخلات الحادة بشكل كبير في تحسين نتائج إدارة السكتة الدماغية الإقفارية. الهدف: تقديم نظرة شاملة حول أسباب السكتة الدماغية الإقفارية، وتشخيصها، وأساليب علاجها، وخطط التدخل التمريضي ذات الصلة.

الطرق: تم إجراء مراجعة مفصلة عن علم الأوبئة، الفسيولوجيا المرضية، التقييم السريري، واستراتيجيات إدارة السكتات الدماغية الإقفارية. تم التركيز

على التطورات العلاجية مثل العلاج التخثري، واستئصال الجلطات الميكانيكي، واستراتيجيات الوقاية الموجهة من السكتة الدماغية. كما تم استعراض الدور الحيوي للتدخلات التمريضية في الرعاية الحادة وإعادة التأهيل على المدى الطويل.

النتائج: تؤكد الأدلة على أهمية التدخلات السريعة، بما في ذلك استخدام منشط البلازمينوجين النسيجي الوريدي (IV tPA) خلال 4.5 ساعات واستئصال الجلطات الميكانيكي خلال 6-24 ساعة لعدد محدد من المرضى. تمكّن تقنيات التصوير المتقدمة من تحديد المواقع بدقة والتمييز بين المنطقة القابلة للإنقاذ (الإقفار القلبي) والمنطقة المصابة بالكامل. تساهم التدخلات التمريضية، مثل مراقبة العلامات الحيوية، وضمان الالتزام بالعلاج، وتنسيق إعادة التأهيل متعدد التخصصات، بشكل كبير في تحسين النتائج.

الخلاصة: يعتمد النجاح في إدارة السكتة الدماغية الإقفارية على التعرف المبكر، والعلاج الفوري، والرعاية الشاملة بعد السكتة الدماغية. تلعب التدخلات التمريضية دورًا حيويًا في جميع مراحل الرعاية، بدءًا من الإدارة الحادة إلى إعادة التأهيل، مع التركيز على تثقيف المرضى، والوقاية الثانوية، ودعم التعافي الوظيفي.

الكلمات المفتاحية: السكتة الدماغية، السكتة الدماغية الإقفارية، مرض الأوعية الدموية الدماغية، العلاج التخثري، استئصال الجلطات الميكانيكي، التدخلات التمريضية، إعادة التأهيل بعد السكتة الدماغية.