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Identifying and Managing Stroke: Prevention to Recovery

Section 1: Introduction

Stroke is the cause of approximately seven million deaths around the world each year, making it the second leading cause of death not due to communicable disease. Stroke is also responsible for over 160 million disability-adjusted life years lost (DALYs) every year, making it the third leading cause of death and disability worldwide. This devastating health event has an estimated global monetary cost of over $890 billion US dollars each year, and that cost is expected to almost double by 2050 (Feigin et al., 2025).

A stroke is almost always sudden and unexpected, but outcomes can be affected by nurses who are prepared to respond when a stroke occurs. Nurses who understand what a stroke is, who is at risk, what the signs and symptoms are, how stroke is diagnosed and treated, and what the nurse's role is as part of the multidisciplinary team can respond appropriately when a stroke occurs. Nurses who are knowledgeable about stroke can promote optimal outcomes by applying evidence-based care, implementing best practices, and providing effective patient education in the clinical setting.

Section 2: What is a stroke?

Stroke, also known as a cerebrovascular accident (CVA) or brain attack, occurs when blood flow to a region of the brain is impaired (Tadi et al., 2023). When circulation to the brain is interrupted, the affected area cannot receive oxygen and nutrients. Within minutes, affected brain cells begin to die (NHLBI, 2023c). In fact, it is estimated that two million brain cells die each minute during a stroke (NINDS, 2025a). This rapid rate of cell death causes irreversible damage, leading to possible long-term disability or even death. Stroke is considered a medical emergency, and prognosis depends on rapid identification and treatment (NHLBI,

2023c). In 2021, stroke was the cause of 1 in 6 deaths from cardiovascular disease. Approximately 25% of strokes occur in individuals who have previously experienced a stroke. Stroke is the leading cause of long-term disability, and more than half of individuals aged 65 and older who experience stroke experience chronic mobility limitations (Lui et al., 2025).

The disruption of blood flow to the brain that occurs during a stroke can result from many different causes. The symptoms and treatment of a stroke depend on the cause of circulation disruption, and identification of what type of stroke is occurring is essential to facilitating an optimal outcome. To guide treatment, stroke is differentiated into two primary types, ischemic and hemorrhagic. A less severe version of stroke can also occur, which is known as a Transient Ischemic Attack (TIA) (CDC, 2024b).

An ischemic stroke occurs when a blockage occurs in an artery within the brain (CDC, 2024b). This happens when a thrombotic or embolic event prevents perfusion to the brain (Lui et al., 2025). A thrombus occurs when a clot forms in a vessel, blocking blood flow (Cleveland Clinic, 2023). Thrombotic events most often occur due to atherosclerosis, arterial dissection, fibromuscular dysplasia, or inflammatory conditions. When an embolic event occurs, debris from another part of the body, such as atherosclerotic plaque or a clot, travels to a more distal vessel and occludes a cerebral vessel (Lui et al., 2025). Acute ischemic stroke is the leading cause of death and disability in the United States, affecting approximately 700,000 people each year (Walter, 2022). Lacunar strokes are a type of ischemic stroke that occurs when there is an occlusion of the small penetrating branches of the middle cerebral artery, vertebral or basilar artery, or the lenticulostriate vessels. Lacunar strokes make up approximately 20% of all ischemic strokes and are typically caused by microemboli, fibrinoid necrosis due to vasculitis or hypertension, amyloid angiopathy, and hyaline arteriosclerosis (Khaku & Tadi,

2023). Ischemic strokes make up approximately 87% of all strokes (Lui et al., 2025).

The cause of an ischemic stroke can vary. Cardiogenic strokes are caused by an embolus that originates from the heart. Individuals experiencing a stroke who have had a previous TIA or stroke are most likely to be experiencing a cardiogenic stroke. Large-artery atherosclerosis can cause an occlusion of a major cerebral artery or a cortical branch artery. Stroke due to small vessel occlusion most often occurs in patients with a history of hypertension or diabetes mellitus. Stroke can have an undetermined etiology, called cryptogenic stroke, meaning the exact cause of the stroke cannot be identified. This often happens when the patient has multiple potential causes of stroke. Stroke can also be of other determined etiologies. This category includes those with less common causes of stroke, such as nonatherosclerotic vasculopathies, hypercoagulable states, or hematological disorders (Lui et al., 2025).

A hemorrhagic stroke occurs when an artery in the brain leaks or ruptures (CDC, 2024b). Hemorrhagic strokes make up approximately 10-20% of strokes and are most commonly due to uncontrolled hypertension (Unnithan et al., 2023). Hemorrhagic strokes can also occur when there is an issue with the integrity of the vessels. Aneurysms, arteriovenous malformations, cavernous malformations, capillary telangiectasias, venous angiomas, and vasculitis all compromise the integrity of the vessels and are common causes of hemorrhagic strokes (Tadi et al., 2023). Hemorrhagic stroke is associated with high mortality. It is estimated that 25-30% of individuals in high-income countries and 30-48% of individuals in low-to middle-income countries do not survive an intracranial hemorrhage (Unnithan et al., 2023).

Hemorrhagic stroke can be categorized as an intracerebral hemorrhage (ICH) or a subarachnoid hemorrhage (SAH). ICH occurs when bleeding occurs in the brain

parenchyma, whereas SAH is characterized by bleeding in the subarachnoid space. The most common sites of hemorrhagic stroke include the basal ganglia, making up 50% of all hemorrhagic strokes, followed by the cerebral lobes, the thalamus, pons and the brain stem, and the cerebellum. When a hematoma forms, it disrupts the neurons and glia, leading to reduced cerebral blood flow, neurotransmitter release, mitochondrial dysfunction, and cellular swelling. Thrombin activates microglia, which leads to inflammation and edema (Unnithan et al., 2023). The most common cause of an intracerebral hemorrhage is hypertension, while subarachnoid hemorrhages are most often caused by an aneurysm, arteriovenous malformation, or trauma (Johns Hopkins Medicine, 2025). When a hemorrhagic stroke occurs, the primary injury is due to compression of the brain by the hematoma, increasing intracranial pressure. The secondary injury is caused by inflammation, disruption of the blood-brain barrier, edema, overproduction of free radicals, and the release of hemoglobin and iron from the hematoma (Unnithan et al., 2023).

A transient ischemic attack (TIA) occurs when there is a brief period of stroke symptoms due to a temporary interruption of blood flow to the brain. Symptoms typically only last a few minutes, though they can last up to 24 hours, and do not cause long-term damage. TIAs can be called warning strokes or ministrokes, as approximately 1 in 3 individuals who experience a TIA will eventually have a stroke, with half of those occurring within a year after the TIA. TIA can serve as a warning of a stroke and, when identified, can help the patient and healthcare team prevent a future stroke (Mayo Clinic Staff, 2024b).

A brainstem stroke can occur due to either hemorrhagic or ischemic causes and is associated with significant morbidity and mortality. It is estimated that 10-15% of all strokes occur in the brainstem, which includes the midbrain, pons, and medulla oblongata. It is the most lethal form of stroke. Atherosclerosis and vertebral artery dissections are the most common causes of brainstem strokes, though they can

also be caused by thromboembolism, lipohyalinosis, tumor, or trauma. The most common cause of hemorrhagic brainstem strokes is hypertension. Ischemic brainstem strokes occur more frequently than hemorrhagic brainstem strokes (Gowda et al., 2024).

A hemorrhagic transformation of an ischemic stroke occurs when areas of the brain affected by the ischemic infarction appear as a cerebral hemorrhage on radiologic images. This can happen after venous or arterial thrombosis or embolism, when the blood-brain barrier is disrupted, and reperfusion injury leads to the leakage of blood cells into the brain tissue. When an ischemic injury occurs, the capillaries in the brain can become weakened and more prone to leaking. This complication can occur as a natural progression of an ischemic stroke or can be worsened by reperfusion therapy. This complication is a life-threatening condition and is likely to lead to death in patients with ischemic stroke (Hong et al., 2021).

Identifying the type of stroke as soon as possible is essential in stroke care. Early identification guides prompt and appropriate treatment, promoting a more favorable outcome. An optimal outcome following a stroke includes improved consciousness, preserved motor and sensory function, intact ability to ambulate, speak, and swallow, no signs of neurologic deficits, and stable vital signs (Tadi et al., 2023).

Section 2 Personal Reflection

What is a stroke? What are the two primary categories of stroke? How are they similar? How do they differ? What is a primary stroke injury? What causes a secondary stroke injury? Why is TIA often considered a warning stroke? Why do you think hemorrhagic transformation of an ischemic stroke frequently leads to a poor outcome?

Section 3: Risk Factors

Ischemic and hemorrhagic strokes have many of the same risk factors. Some risk factors, however, are specific to one type of stroke (NHLBI, 2023a). Most stroke risk factors can be categorized as modifiable or non-modifiable. Modifiable risk factors can be changed or controlled through medical care and lifestyle changes. Modifiable risk factors include hypertension, hypercholesterolemia, diabetes, smoking, and substance use disorder. Non-modifiable risk factors cannot be changed or controlled. Non-modifiable risk factors include age, biological sex, family history, race and ethnicity, and history of a prior stroke or heart attack. Other risk factors may not clearly fall into either category. These include living in the "stroke belt", atrial fibrillation, cerebral amyloid angiopathy, aneurysm, and arteriovenous malformations (AVMs) (NINDS, 2025c). When risk factors are combined, such as a family history of stroke and smoking, the risk for stroke increases even more (CDC, 2024d).

Hypertension, defined as a blood pressure of 140/90 mmHg or higher, is the most critical risk factor for stroke (AANS, 2024). Hypertension is often asymptomatic, necessitating regular blood pressure monitoring (CDC, 2024d). When an individual experiences hypertension for a long time, the arteries become damaged as the media degenerate, the elastic lamina breaks, and the smooth muscles within the vessels become fragmented. Microaneurysms can also occur in the arterioles (Unnithan et al., 2023). Men with hypertension have a 91% probability of experiencing a stroke, while women with hypertension have a 70.7% likelihood. When hypertension is persistent, the risk increases over time as the blood vessels experience long-term damage (Li et al., 2022).

Individuals with certain blood vessel conditions are at increased risk for stroke. An aneurysm occurs when a balloon-like bulge in an artery stretches and then ruptures, leading to a hemorrhagic stroke. An arteriovenous malformation occurs

when arteries and veins are poorly formed in the brain, resembling tangles, that can easily rupture. With this condition, blood can sometimes travel directly from arteries to veins without first going through capillaries. This can expose the veins to increased blood pressure. Since the vessel walls of veins are not as strong as those of arteries, increased pressure can cause them to rupture (NINDS, 2025c). Hypertension increases pressure on the interior walls of the arterial vessels. This makes them more vulnerable to rupture, especially if they are already weakened due to an aneurysm or other blood vessel condition (NHLBI, 2023a).

Other cardiac history impacts the risk of stroke. Individuals who have experienced a prior stroke or who have had a heart attack are at increased risk. Carotid artery disease, or other artery disease, increases the risk for stroke as fatty deposits can become blocked by a blood clot. Hypercholesterolemia, defined as a total blood cholesterol of 240 mg/dL or higher, is a major risk factor for heart disease, which is a major contributor to stroke. Individuals with high levels of LDL and triglycerides are at increased risk of stroke for those with a previous diagnosis of coronary heart disease, ischemic stroke, or TIAs. When HDL levels are too low, this can also increase the risk for stroke (AANS, 2024).

A history of TIAs increases the risk of experiencing a stroke. It is estimated that 30% of strokes are preceded by one or more TIAs in the months before a stroke (AANS, 2024). The risk for experiencing a stroke is greatest during the first 48 hours following a TIA. It is estimated that 10% of individuals who experience a TIA will have a stroke within a few days. The presence of type 2 diabetes, age 60 years or older, hypertension, weakness on one side of the body during the TIA, speech difficulties during the TIA, TIA symptoms that last for an hour or longer, and preexisting cardiovascular disease further increase the risk of a stroke following a TIA (Levine, 2024).

A diagnosis of diabetes mellitus is a risk factor for stroke (AANS, 2024). Prediabetes and diabetes, both type 1 and 2, double an individual's risk for stroke. The risk of mortality after a stroke increases by 20% and these patients are more likely to experience a poor outcome and delayed healing. Individuals with type 2 diabetes typically also have other risk factors for stroke, including hyperlipidemia, hypertension, atrial fibrillation, insulin resistance, and obesity (Alkahtani, 2022).

Chronic inflammation is a contributing factor for stroke, though the mechanism of how inflammation affects risk is not well-known. Researchers have found that inflammation damages blood vessels and contributes to atherosclerosis. Conditions such as lupus and rheumatoid arthritis can lead to inflammation that increases the risk for stroke (NHLBI, 2023a).

COVID-19 is an independent risk factor for ischemic stroke. Before the onset of the COVID-19 pandemic, it had already been established that respiratory infections increase the short-term risk of ischemic stroke. During the height of the pandemic, medical providers observed what seemed to be an increased prevalence of stroke among patients who had COVID-19. It has since been confirmed through research that even when the data is adjusted for preexisting cardiovascular disease, individuals who had COVID-19 experienced an increased prevalence of ischemic stroke. Patients with severe COVID-19 had three times higher incidence of cardiovascular disease compared to those who had a mild-to-moderate case of COVID-19. There are multiple theories about how COVID-19 increases risk, but one prevailing theory is related to the cytokine storm that occurs in COVID-19. This cytokine storm leads to a hypercoagulable state, increasing the risk for ischemic stroke. More research is needed to pinpoint how COVID-19 increases risk for stroke (Belani et al., 2020).

Other medical conditions that increase the risk for stroke include sleep apnea, kidney disease, and migraine headaches (NHLBI, 2023a). Sickle cell disease

increases the risk for ischemic stroke, primarily in Black children. Due to the altered shape of some red blood cells, these cells can get stuck in blood vessels, occluding them and limiting perfusion to the brain (CDC, 2024d). Mental health challenges can increase the risk of stroke. Anxiety, depression, high levels of stress, excessive work, and lack of sufficient contact with family, friends, and people outside the home can increase the risk (NHLBI, 2023a).

Medications can increase the risk of stroke. Bleeding is more likely to occur in individuals who are taking an anticoagulant (NHLBI, 2023a). Oral estrogen hormone replacement therapy and oral contraceptives have been shown to increase the risk of ischemic stroke, though the risk is related to the dose prescribed (Marto et al., 2021). Research suggests that individuals receiving hormone replacement therapy are at a 29% increased risk of experiencing a stroke (AANS, 2024). The risk for ischemic stroke in patients taking oral estrogen therapy was increased for patients over age 35 and for smokers. Glucocorticoids are known to increase the risk of hypertension, hyperglycemia, and dyslipidemia, which all increase the risk for stroke; however, the anti-inflammatory effect of these medications may counteract the increased risk. Darunavir, a drug used to treat and prevent HIV infection, is associated with an increased risk of stroke due to an increased risk for diabetes and dyslipidemia. While intravenous immunoglobulins are not directly associated with risk for stroke, observational studies suggest there may be an increase during and shortly after the infusion. These medications do increase the risk of thrombosis; therefore, lower doses and infusion rates are recommended for patients with high cardiovascular risk. Bevacizumab, Tamoxifen, and Alemtuzumab are associated with increased risk of stroke. NSAIDS can be associated with increased risk for stroke; however, the risk is dependent upon dose and duration of treatment. Antipsychotics also have a dose-dependent effect on stroke risk. High doses of benzodiazepines can increase risk for stroke, though low doses have a protective effect (Marto et al., 2021).

Hereditary factors can increase the risk of stroke. Individuals who have a parent, grandparent, or sibling who has experienced a stroke are at increased risk for experiencing a stroke themselves (AANS, 2024). This risk is increased if the family member experienced a stroke at a younger age. Other genetic factors can increase risk for stroke, including blood type. Individuals with blood type AB are at a higher risk of stroke (NHLBI, 2023a). Research has found that individuals with this blood type are more likely to experience an ischemic stroke before age 60. This is because genetic variants associated with early-onset stroke are linked to the area of the chromosome that determines blood type. Those with blood type A or B are also at increased risk when compared to those with blood type O. While researchers state the increase in risk is minimal, more research is needed (Kotz, 2022).

Living in the "stroke belt" is considered a risk factor for stroke. The "stroke belt" is a group of eleven states that have the highest mortality rates due to stroke. These states include Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. Many of these states also have the highest mortality rates due to cerebrovascular disease. It is thought that this region may have an increased risk of mortality due to stroke, due to geographical or environmental factors, or due to regional lifestyle differences. In these states, there are increased rates of cigarette smoking and a preference for salty, high-fat foods, which can contribute to increased risk of stroke (NINDS, 2025c).

Strokes are more common in older adults, but they can occur at any age (AANS, 2024). Risk is increased for those aged 55 or older (Mayo Clinic Staff, 2024a). The stroke rate doubles for both men and women every 10 years after age 55 (Alkahtani, 2022). Due to the increased prevalence of obesity, hypertension, and diabetes in younger age groups, stroke is now being seen more commonly in

individuals younger than age 55. It is estimated that one in seven strokes occurs in individuals aged 15 to 49 (CDC, 2024d).

Biological sex can determine risk for stroke. Stroke occurs more commonly in men than in women; however, women are at higher risk of death due to stroke. Research suggests that the higher mortality rate in women due to stroke may be due to how women experience stroke symptoms, which contributes to a delay in seeking medical care (AANS, 2024).

Individuals of minority racial groups are disproportionately affected by stroke (Ikeme et al., 2022). Black adults are more than twice as likely to experience a stroke compared to White adults. Hispanic individuals also experience an increased risk of stroke (AANS, 2024). Stroke incidence has increased among Hispanics since 2013 (Ikeme et al., 2022). In the United States, Alaska Natives and American Indians are also at increased risk for stroke (NHLBI, 2023a). Race can also affect outcomes following a stroke. Research has found disparities in treatment timelines, EMS utilization, and the rate at which standard-of-care therapies are implemented. There is evidence of disparity in evaluation and referral to treatment. Minority patients are also less likely to be transferred to endovascular-capable centers and to receive prehospital stroke recognition by EMS (Ikeme et al., 2022). Black individuals are more likely to die after experiencing a stroke than White individuals (CDC, 2024d).

Many factors affect the risk of stroke in minority populations. It is known that hypertension is the leading cause of stroke, and cardiovascular disease is more prevalent in Black individuals. It is estimated that 75% of this population has hypertension before age 55, which is significantly increased when compared to 55% of non-Hispanic White men and 40% of non-Hispanic White women. Black individuals are also at increased risk for hypercholesterolemia, hyperlipidemia, diabetes, and obesity. Other health disparities in the Black population affect

stroke risk, including increased prevalence of chronic kidney disease, sickle cell trait, and HIV. Among Hispanic subgroups, Mexican individuals experience the highest stroke mortality, while Cuban individuals have the lowest stroke mortality. The prevalence of stroke in Asian individuals is similar to that of non-Hispanic White individuals, though the overall stroke-related mortality rate in the Asian population is lower. Mortality due to hemorrhagic stroke is higher among most Asian subgroups, except for Asian Indian individuals. Some Asian subgroups have a higher risk than others. Research has found evidence to suggest Filipino women have a doubled risk for ischemic stroke when compared to non-Hispanic White women. Vietnamese men and Korean women were found to have a higher prevalence of hemorrhagic stroke. In the United States, the risk of stroke-related mortality was higher in Filipino individuals and Japanese and Vietnamese men. Diabetes is a significant risk factor for stroke for many Asian subgroups, regardless of body mass index. Cardiometabolic risk is increased among South Asian and Asian Pacific Islander subgroups. Filipino individuals are more likely to experience hypertension, increasing their risk for stroke (Mital et al., 2021). Historical discrimination, structural racism, and other social factors influence social determinants of health and also contribute to underrepresentation in research (Bushnell et al., 2024).

Social determinants of health are non-medical factors that contribute to inequities in care, health, and healthcare outcomes, including those related to stroke. These factors can include education, economic stability, access to healthcare, neighborhood of residence, experiences of racism, health literacy, food security, and housing security. In populations where these disparities exist, there is an increased prevalence of stroke (Bushnell et al., 2024). Lower socioeconomic status increases risk for stroke, often due to limited access to healthy foods and services. The neighborhood environment also contributes to this increased risk, as there may be limited access to transportation, pharmacies, high-quality primary and

advanced medical care, safe recreational options, and reasonably priced fresh fruits and vegetables. Even among individuals of the same race, the risk of coronary artery disease rises by approximately 20% for those in the most socioeconomically disadvantaged neighborhoods compared to those in the most advantaged neighborhoods. These factors also influenced the risk for ischemic stroke (Mital et al., 2021). Insurance status, literacy level of stroke symptom recognition and preventative measures, and patient mistrust or lack of confidence in the healthcare system can influence this disparity. While minority populations statistically have higher rates of stroke and overall poorer outcomes, the wide health equity gap is a significant factor. The underlying causes of health disparities are complex, but implementing awareness, training, and education interventions can help bridge the gap in health equity (Ikeme et al., 2022).

According to the American Stroke Association, LGBTQ+ adults are impacted by stroke at increased rates. This is likely due to a delay in seeking care and unmanaged health problems. Unfortunately, this is more common within the LGBTQ+ community because of a history of bias, stereotyping, discrimination, and a lack of culturally sensitive providers. Social stigma and discrimination also place these individuals at increased risk for mental health disorders and chronic stress, which are known contributors to increased risk of stroke (ASA, 2025).

Physical inactivity and obesity increase the risk for hypertension, hypercholesterolemia, diabetes, heart disease, and stroke (AANS, 2024). It is estimated that only 20% of adults in the United States meet the recommended guidelines for aerobic activity and engage in strength training at least twice per week. BMI is associated with stroke risk. Research suggests that for each 5 kg/m2 incremental increase of BMI, the risk of stroke increases by 10%. Waist circumference, waist-to-hip ratio, and waist-to-height ratio are also associated with the incidence of stroke independent of BMI. Obesity increases the risk of obstructive sleep apnea, which contributes to the risk of stroke. It is estimated

that more than 30% of middle-aged men and 15% of middle-aged women in North America experience obstructive sleep apnea (Bushnell et al., 2024).

Sleep duration can impact stroke risk. Research has found evidence that more than nine hours or less than six hours of sleep in 24 hours increases the risk of stroke. Both insufficient and excessive sleep increase risk for cerebrovascular disease, but there are confounding factors, such as other conditions that disrupt sleep, that could also independently increase risk for stroke. Further research is needed to understand the correlation between sleep duration and stroke risk (Cheng et al., 2025).

Substance use increases the risk of stroke (NHLBI, 2023a). Excessive alcohol consumption increases blood pressure, can trigger atrial fibrillation, interacts with anticoagulant medications, alters how the body responds to insulin, can lead to weight gain, and causes liver damage. These factors increase risk for both ischemic and hemorrhagic stroke (World Stroke Organization, 2025). Illegal drug use can lead to stroke, even on the first use of a substance. Cocaine can cause a stroke during or immediately following use due to the rapid and dramatic increase in blood pressure caused by the substance. This can potentially lead to a hemorrhagic stroke. The substance can also cause constriction or spasms in cerebral blood vessels, thereby reducing blood flow to the brain. Heroin use increases the risk of infections, such as endocarditis, that can lead to stroke. Like cocaine, amphetamines cause a rapid increase in blood pressure. During use, this can cause a stroke, and the overall risk of a stroke is increased with long-term use due to the damage caused by stress on the blood vessels (Holland, 2022).

Smoking increases the risk of experiencing a stroke. This risk is increased for smokers who also use oral contraceptives. Recent evidence suggests that long-term secondhand smoke can also increase the risk of stroke (AANS, 2024). Tar, nicotine, and carbon monoxide are components in tobacco that increase the risk

of stroke, as they cause damage to the vascular endothelium, increase blood viscosity, and reduce oxygen transport. In addition to smoking in general, high smoking quantity, smoking within the household, and higher levels of harmful components contained in the tobacco further increase the risk of stroke (Wang et al., 2024).

Environmental factors can influence stroke risk. Individuals who live or work in areas with significant air pollution are at increased risk for stroke (NHLBI, 2023a). Research suggests that the large global effect of high outdoor temperatures presents an increased risk for stroke for adults older than 65 years old. The rate of heat-related mortality has increased dramatically, with high outdoor temperatures being the cause for almost 2 million DALYs (disability-adjusted life-years) lost from stroke. Outdoor heat-related stroke is more common in North and Central Africa, the Middle East, and South Asia. In 2021, a study found that particulate matter air pollution contributed substantially to the occurrence of subarachnoid hemorrhage (Feigin et al., 2025).

In infants, a perinatal stroke can occur during the last 20 weeks of gestation or up to one month after birth. The incidence of perinatal stroke is approximately 1 in 3500 births and is the most common cause of hemiparetic cerebral palsy (Alkahtani, 2022). The risk of perinatal stroke is increased when the neonate is exposed to smoking, has an Apgar score less than 7, has an infection, or has hypoglycemia. Emergency caesarean section, resuscitation at birth, and abnormal cord blood gas are also indicators of increased risk for perinatal stroke. It is estimated that 95% of neonates who experience a perinatal stroke have multiple risk factors (Roy et al., 2023).

Pregnant women are at increased risk for stroke (AANS, 2024). Risk is also increased in the weeks following delivery (NHLBI, 2023a). Pregnancy can strain the cardiovascular system due to changing hormones and weight gain. Hypertension

during pregnancy is the leading cause of stroke in pregnant or postpartum women. Preeclampsia is a more severe type of pregnancy-related hypertension that can cause vision problems, headaches, swelling in the extremities, prematurity, and low birth weight. It can also lead to seizures or stroke (CDC, 2024a). Women who experience preeclampsia are at increased risk for stroke later in life (NHLBI, 2023a). Gestational diabetes increases the risk for pregnancy-related hypertension during pregnancy, and also increases the risk for cardiovascular disease and stroke later in life. Pregnancy increases the risk of developing a blood clot because swelling in the lower extremities can impair circulation. During late pregnancy, hormone changes increase the blood's ability to clot as a protective measure during childbirth; however, this also increases the risk of stroke. While pregnancy-related stroke is rare, the prevalence is increasing (CDC, 2024a).

Section 3 Personal Reflection

What is the most significant risk factor for stroke? What is the difference between modifiable and non-modifiable risk factors? How can an individual reduce their risk of stroke? Do you think someone can completely eliminate their risk of stroke? How do social determinants of health increase stroke risk? How are some of the risk factors for stroke interrelated?

Case Study

Through this course we will follow a fictional patient to illustrate multiple aspects of stroke care.

Mr. Green is a 79-year-old Black male who lives in a rural area of Georgia. Mr. Green lives with his daughter, Kim, and son-in-law. His daughter brought him to the medical clinic this morning because she noticed during breakfast that his face

was drooping, he had difficulty getting the fork to his mouth, and his speech was slurred. Kim reports her father woke up early and they had a normal conversation this morning at 7:35 AM, about 30 minutes before breakfast. His past medical history includes hypertension diagnosed when he was 46, prediabetes, being overweight but not considered obese, and being a heavy smoker. However, he quit three years ago after he experienced a TIA. Mr. Green tries to walk in his neighborhood daily, but had a fall a few months ago and has not yet returned to his exercise routine. Socially, Mr. Green is retired from work as an English professor and has adequate health insurance. He no longer drives, but his daughter can take time off work to take him to medical appointments. He lives approximately 45 minutes from the nearest hospital. The nearest stroke center to Mr. Green's home is two hours away by car. Mr. Green and his daughter arrive at their local clinic at 8:30 AM, when it opens.

1. What are Mr. Green's non-modifiable risk factors for stroke? Select all that apply.
    a. Age
    b. Race
    c. Sex
    d. Weight
    e. Physical Activity
    f. History of previous TIA
    g. Hypertension
2. What are Mr. Green's modifiable risk factors? Select all that apply.

a. Age

b. Race

c. Weight

d. Physical Activity

e. History of Previous TIA

f. Hypertension

3. What social determinants of health are considered risk factors for Mr. Green? Select all that apply.

a. Living in a rural area

b. Living in the “stroke belt”

c. Living with his daughter

d. Being a retired professor

e. Having adequate health insurance

f. Living far from emergency medical care

g. Race

h. Having reliable transportation to medical appointments

Section 4: Signs and Symptoms

The symptoms of a stroke typically present suddenly (Lui et al., 2025). Common signs and symptoms of a stroke include numbness or weakness in the face, a change in mental status, trouble speaking or understanding speech, and visual disturbances, including homonymous hemianopsia (loss of half of the visual field) and loss of peripheral vision. Patients may experience hemiparesis or hemiplegia, which is weakness or paralysis of the face, arm, and leg on the same side of the body. They may experience ataxia, which is loss of motor coordination leading to an unsteady gait. They may have difficulty forming words (dysarthria), difficulty swallowing (dysphagia), numbness and tingling of the extremities (paresthesia), inability to form understandable words (expressive aphasia), or inability to comprehend spoken speech (receptive aphasia) (Tadi et al., 2023). Lacunar strokes often do not impair memory, cognition, level of consciousness, or speech. Lacunar strokes can occur as pure motor, pure sensory, or ataxic hemiparetic strokes (Khaku & Tadi, 2023).

Symptoms of a hemorrhagic stroke are typically sudden and progressive. Patients usually experience an acute onset of headache, vomiting, neck stiffness, an increase in blood pressure, and rapidly progressing neurological symptoms. Some symptoms can help clinicians identify the location of the hemorrhage. Headache occurs more often with a large hematoma. Vomiting is a symptom of increased intracranial pressure and is more common with cerebellar hematomas. When the hemorrhage involves the reticular activating system of the brainstem, the patient can experience a coma. Seizure, aphasia, and hemianopia are seen with lobar hemorrhage. Sometimes, patients may experience early symptoms of numbness, tingling, and weakness with a lobar bleed. Contralateral sensorimotor deficits can occur following a hemorrhage in the basal ganglia and thalamus. Loss of all senses is indicative of a thalamic hemorrhage. When a thalamic hematoma extends into the midbrain, the patient can experience vertical gaze palsy, ptosis, and unreactive

pupils. A brainstem hematoma can cause cranial nerve dysfunction with contralateral weakness. When a pontine hematoma occurs, the patient typically experiences coma and quadriparesis (Unnithan et al., 2023).

An individual who experiences a cerebellar hemorrhage typically has symptoms of increased ICP, including lethargy, vomiting, and bradycardia. As the hematoma enlarges or edema increases, the neurological status will continue to decline. When a patient experiences a subarachnoid hemorrhage, they report a severe and sudden headache, described as a thunderclap. They also experience vomiting, syncope, photophobia, nuchal rigidity, seizures, and decreased level of consciousness. Patients experiencing a subarachnoid hemorrhage often have signs of meningismus, including a positive Kernig sign. This is when the patient experiences pain when the knee is straightened while the thigh is flexed to 90 degrees. They may also have a positive Brudzinski sign, which is involuntary hip flexion upon flexing the patient's neck (Unnithan et al., 2023).

When a patient experiences a TIA, symptoms last a short time, often from a few minutes to a few hours, and then resolve. Symptoms of a TIA are the same as those of a stroke. This includes changes in mental status, such as becoming lethargic or losing consciousness, changes in senses, changes in cognitive ability, dizziness or balance problems, bladder or bowel incontinence, and sensory issues, including numbness or tingling on one side of the body (MedlinePlus, 2025).

Anterior cerebral artery infarctions are rare, but when they do occur. Damage often involves Broca's area, primary motor, primary sensory, and prefrontal cortex regions. This leads to symptoms of motor aphasia, personality changes, and contralateral leg weakness and numbness. With this type of stroke, hands and face are not usually affected (Khaku & Tadi, 2023).

The middle cerebral artery has a main trunk and then divides into two branches. One branch supplies the basal ganglia, while the other branch supplies part of the

parietal, frontal, and temporal lobes. With a middle cerebral artery occlusion, the patient can experience contralateral arm and facial numbness and weakness, gaze deviation toward the affected side, and aphasia for left-sided lesions and neglect for right-sided lesions. Cerebellar strokes typically cause symptoms such as ataxia, dysarthria, nausea, vomiting, and vertigo (Khaku & Tadi, 2023).

Hemineglect occurs when a patient has reduced or absent awareness on one side of space, despite no sensory loss. It most commonly occurs in the left hemispace as a result of a lesion in the right hemisphere of the brain. It can affect the right hemispace if a left-brain lesion occurs, though this is less common. Providers can describe hemineglect in terms of spatial domains. Personal neglect refers to the patient's own body. Peripersonal neglect involves objects and sensory stimulation within arm's reach. Extrapersonal neglect occurs when the deficit extends beyond the arm's reach. Research has determined that the severity of unilateral spatial neglect when a stroke occurs is associated with long-term disability and decline in functional independence (Basagni et al., 2021).

Symptoms of stroke are often missed, as an individual may not recognize the signs of stroke or minimize their importance. Stroke can also lead to anosognosia, which is a symptom of stroke that makes the person unable to identify the symptoms of stroke. An individual may be unable to call for help when experiencing a stroke (NINDS, 2025d). A silent infarction occurs when imaging detects an infarct, but there has been no neurologic dysfunction. It is also possible to experience a silent cerebral hemorrhage. In these cases, imaging will show a focal collection of blood, often as microhemorrhages in the parenchyma or ventricular system (Choi et al., 2022).

Infants who experience a perinatal stroke often do not show symptoms for months or even years. Perinatal strokes are associated with developmental delay. Infants who are experiencing a stroke may have symptoms of seizure activity in

one area of the body, problems eating, dyspnea or apnea, and early hand preference. In older children and adolescents, the first sign of a stroke is often a seizure. Other symptoms include headache, possibly with vomiting, sudden paralysis or weakness on one side of the body, speech and language delays, difficulty swallowing, vision problems, tendency to only use one hand or arm, tightness or restricted movement in the extremities, learning challenges, memory loss, and sudden mood or behavioral changes (Nationwide Children's Hospital, 2025).

Section 4 Personal Reflection

Why do you think symptoms of stroke tend to present suddenly? What are common symptoms of stroke? How does the type and location of a stroke affect symptoms? How can a stroke be missed? Why do you think the symptoms of strokes in infants are not always observed until they are older?

Case Study

Mr. Green appears to have weakness in his facial muscles on one side. He attempts to speak, but his speech is difficult to understand. He can ambulate with assistance, though his daughter reports his ambulation is less steady than usual, and he typically ambulates independently without difficulty. His daughter also reports that he seemed confused when she was trying to get him ready and in the car to come to the clinic.

What symptoms are present that indicate Mr. Green may be experiencing a stroke? Select all that apply.

a. Abrupt change in neurological status

b. Abrupt change in speaking ability

c. Confusion

d. He takes daily walks

e. Decreased independence with walking

f. Abrupt change in coordination while eating

Section 5: Screening Tools and Diagnosis

The goal of the initial diagnostic phase is to ensure medical stability. Airway, breathing, and circulation should be rapidly assessed. Patients with increased intracranial pressure may exhibit respiratory abnormalities. They are at increased risk for aspiration and asphyxiation. Endotracheal intubation may be necessary if the airway is compromised to ensure adequate oxygenation and ventilation. A fingerstick glucose test can rapidly determine whether hypoglycemia is causing the neurological symptoms. Any conditions that are contributing to symptoms should be assessed and reversed. The provider will need to determine if the patient is eligible for IV thrombolytic therapy or endovascular thrombectomy. The initial phase also includes efforts to identify the underlying cause of the symptoms (Lui et al., 2025).

Early identification of stroke is imperative. As a result, a mnemonic was developed to help both individuals in the public recognize stroke symptoms in themselves and others, as well as to aid healthcare workers in the rapid identification of stroke when it occurs in triage or other healthcare settings. The mnemonic FAST stands for face drooping, arm weakness, speech difficulty, and time. If the individual is asked to smile and one side of the face droops, it is an indicator of a stroke. The individual should be asked to raise both arms. If one drifts downward, that is indicative of a stroke. The person should be asked to repeat a simple phrase, and any alterations in their speech should be noted. The T, representing

time, reminds the assessor to call for emergency help immediately if any of the signs of stroke are present. When providing public education, nurses should advise people to call for emergency help immediately rather than attempt to transport the patient themselves, as paramedics can begin treatment during transport. This is critical for stroke, when time is the most significant determinant of long-term prognosis (NHLBI, 2023b). The FAST mnemonic is the most commonly used screening tool for stroke in the prehospital setting (Budinčević et al., 2022). A modified version of this mnemonic is BE FAST, which includes balance and eyes as elements to observe when assessing for the potential presence of stroke. A sudden loss of balance or any vision changes in one or both eyes are considered possible signs of stroke (Cleveland Clinic, 2025).

When a stroke is suspected, a multi-person coordinated rapid exam is completed. The time of symptom onset is critical information. If the time of symptom onset is unknown, the clinical team should obtain the time the patient was last seen at their baseline. This determines treatment options. The clinical team also needs to obtain a medical history to understand risk factors and comorbidities. While the staff obtain vital signs, initiate telemetry monitoring, and obtain IV access, the provider should perform a rapid neurological exam. This assessment includes level of consciousness, language ability, dysarthria, motor status, visual field deficits, eye movement abnormalities, facial paralysis, and ataxia (Khaku & Tadi, 2023).

Stroke severity can be determined using the NIH Stroke Scale (NIHSS). This tool is the most recommended for evaluating stroke in patients in hospital or research settings (Budinčević et al., 2022). This tool uses a numerical scale to rate the patient's status in eleven categories. The NIHSS is a validated tool and can determine impairment, as well as predict the outcome, of patients who experience stroke. The benefits of this tool are that it is both rapid to complete and reliable. This helps the healthcare team make quick decisions about care and standardize communication among clinicians. A limitation of the tool is that it may

underrepresent lesions in the posterior circulation and the right hemisphere (Basagni et al., 2021).

When using the NIHSS, first, the level of consciousness is assessed on a scale of 0-3, with a score of 0 defined as being alert and keenly responsive, a score of 1 representing not alert, but easily arousable, a score of 2 indicating not alert but can respond to repeated or painful stimuli, and a score of 3 indicating response with only reflex motor or autonomic effects, or completely unresponsive, flaccid, and areflexic. The next part of the level of consciousness assessment requires a few questions. The provider asks the patient what month it is and what the patient's age is. The patient is then given a score depending on the accuracy of their answer. A score of 0 is given when the patient answers both questions correctly; a score of 1 is given when they answer one question correctly; and a score of 2 is given if they are unable to answer either question correctly. No partial credit is given for close answers. The answer must be entirely accurate to qualify as correct. Patients who are aphasic or stuporous receive a score of 2. Patients who are unable to speak due to endotracheal intubation, orotracheal trauma, severe dysarthria, language barrier, or any other issue that is not due to aphasia are scored as a 2. The examiner should not provide verbal or nonverbal cues to the patient, and the first answer should be considered for the assessment. The final phase of the level of consciousness exam assesses the patient's ability to follow commands. The patient should be asked to open and close their eyes, and then to grip and release their unaffected hand. If the patient is unable to use their hands, another one-step command can be substituted. A score of 0 is given if the patient can perform both tasks correctly, a score of 1 is given when the patient can perform one task correctly, and a score of 2 is given if the patient is unable to perform either task correctly. The examiner should give credit if the patient attempts to follow the instruction but is too weak to complete it. If the patient does not respond to verbal commands, the tasks should be pantomimed, and

then their ability to repeat them should be scored. Only the first attempt to follow the instructions should be scored (NINDS, 2025b).

The second part of the NIHSS assesses the patient's best gaze. In this test, only horizontal eye movement is tested. If the patient's gaze is normal, the score for this category is 0. If the patient has partial gaze palsy, in which the gaze is abnormal in one or both eyes but can overcome the deviation with voluntary or reflexive activity, the patient is scored as a 1. If the patient is experiencing forced deviation and unable to overcome the gaze paresis with the oculocephalic maneuver (an assessment for doll's eyes reflex), they receive a score of 2 (NINDS, 2025b).

The third section of the tool assesses the patient's visual fields. Patients can be asked to count fingers, or their response to a visual threat may be evaluated. A score of 0 is given if there is no visual loss. If the patient has partial hemianopia, they are given a score of 1; complete hemianopia is assigned a score of 2, and bilateral hemianopia or complete blindness, including cortical blindness, is scored 3 (NINDS, 2025b).

The fourth category of the tool assesses for facial palsy. The patient should be asked, either verbally or through pantomime, to show their teeth or to raise their eyebrows while closing their eyes. If a patient is poorly responsive, the symmetry of their grimace in response to noxious stimuli can be assessed. A score of 0 is given if the patient has regular, symmetrical movements. A score of 1 is assigned if the patient has minor paralysis, including a flattened nasolabial fold or asymmetry upon smiling. Partial paralysis, described as total or near-total paralysis of the lower face, is scored as a 2, and complete paralysis of one or both sides of the face is assigned a score of 3 (NINDS, 2025b).

Motor arm abilities are assessed as the fifth section of the assessment tool. Each limb is tested independently by extending the arm to 90 degrees when sitting or

to 45 degrees when the patient is supine. Palms should face downward. The examiner then assesses for drift before 10 seconds. Pantomime can be used to encourage aphasic patients, but not noxious stimuli. The non-paretic arm should be evaluated first. The examiner can document “untestable” in the case of amputation or joint fusion, but the reason for this score should be clearly documented. A score of 0 is given if there is no drift of the arms for the full ten seconds. A score of 1 is assigned if the patient can hold their arms up as appropriate but drifts down before the full 10 seconds are completed, without hitting the bed or other objects. A score of 2 is given if the patient is unable to achieve or maintain the correct position or drifts back to the bed, but can exert some effort against gravity. A score of 3 is given if the patient cannot produce any effort against gravity and the limb falls. A score of 4 is assigned if there is no movement. Each arm is scored independently (NINDS, 2025b).

The sixth category of the tool assesses motor leg ability. The patient is positioned supine, and the leg is placed at a 30-degree angle. Drift is scored if the leg falls before five seconds. Each limb is tested separately, beginning with the non-paretic leg. Like the arm assessment, the examiner can record untestable for patients who have a joint fusion at the hip or have a lower extremity amputation. A score of 0 is given to patients who can hold the leg in position for a full 5 seconds. A score of 1 is given if the patient experiences drift, but the leg does not hit the bed. They are assigned a score of 2 if there is some effort against gravity, even though the leg falls to the bed before five seconds. A score of 3 is assigned if the leg drops to the bed immediately. A score of 4 is assigned if the patient is not able to move their legs (NINDS, 2025b).

Limb ataxia is assessed in the seventh section of the assessment tool. The goal of this item of the tool is to evaluate for evidence of a unilateral cerebellar lesion. The eyes should remain open, and the test should be completed within the patient’s visual field. The finger-nose-finger and heel-shin tests are performed

bilaterally. A patient who is unable to understand or is paralyzed is not considered to have ataxia. A score of zero is assigned if there is no discoordination. A score of 1 is assigned if there is discoordination in one limb, and a score of 2 is given if there is ataxia in both limbs (NINDS, 2025b).

The sensory assessment is the eighth part of the neurological exam. A pinprick or noxious stimuli is used to elicit a sensory response. A report of sensation, grimace, or withdrawal from noxious stimuli confirms sensation. A score of zero is given if there is no sensory loss. A score of 1 is given if there is mild-to-moderate sensory loss. This occurs when the patient feels a pinprick, though it is less intense on the affected side, or when there is no pain to the pinprick, but the patient is aware of being touched. A score of 2 is assigned when there is severe or total sensory loss. This occurs when the patient is not aware of being touched on the face, arms, or legs. A score of 2 is also assigned for patients who are unable to respond to this testing (NINDS, 2025b).

The ninth part of the neurological exam tests for the patient's best language capability. Much of the information needed for this part of the exam is gathered in previous portions of the exam as the clinician interacts with the patient. For this assessment, the patient is shown a black-and-white drawing of a person in a room. There are many elements in this drawing, including the person painting, appearing to fall from a ladder, a puppy with paint-covered paws chasing a mouse, a spilled paint can, a car outside the room's window that has hit a tree, and other elements. The patient is asked to describe what is happening in the picture. In some facilities, the image used may vary, but the basic concept is the same. There is another page with simple drawings of various things, including a bridge, a bicycle, clouds, a mouse, and more. The patient is asked to name items they see on this page. The final part of this exam is to read from a list of simple sentences. Comprehension is assessed using this exam. If vision is altered, the patient can be asked to name objects placed in their hand, repeat phrases, or produce speech.

Intubated patients can be asked to write their answers. A score of 0 is given when there is no aphasia and language is normal. A score of 1 is assigned if there is some loss of fluency or ease of comprehension, but without significant limitation in expressing ideas. A score of 2 is assigned if there is severe aphasia and all communication is fragmented. This may require the listener to question and guess. The patient is limited in the information they can communicate, and the listener carries the burden of communication. A score of 2 is also given if the clinician cannot understand the patient's response. A score of 3 is given only for patients who are completely mute, demonstrating global aphasia. They demonstrate no usable speech or auditory comprehension (NINDS, 2025b).

The tenth portion of the neurological exam assesses for dysarthria. The patient is asked to read or repeat a standard set of words. If the patient has severe aphasia, the examiner can base their score on the clarity of observed spontaneous speech. A score of 0 is assigned if the response is normal. A score of 1 is assigned if there is evidence of mild-to-moderate dysarthria. The patient may slur some words. The listener may have some difficulty understanding the patient's speech, but the patient can still be understood. A score of 2 is given when there is severe dysarthria. For this score, the patient's speech must be so slurred that it is unintelligible, disproportionate to any dysphasia. A patient is also assigned a score of 2 if they are mute. The patient should only be scored as untestable if there are other non-neurological-related barriers to speech, including endotracheal intubation. For this exam, the patient is not informed of the reason for testing, as this may affect the outcome (NINDS, 2025b).

The eleventh and final portion of the neurological exam tests for extinction and inattention. The term previously used for this was "neglect". Much of the information needed for this portion of the exam is obtained in the early parts of the exam. A score of zero is assigned if there is no abnormality. A score of 1 is assigned if there is visual, tactile, auditory, spatial, or personal inattention or

extinction to bilateral stimulation of one of the senses. A score of 2 is assigned if there is profound hemi-inattention or extinction to more than one sense. This may involve the patient not recognizing their own hand or being oriented to only one side of a space (NINDS, 2025b).

Upon completion of the exam, the scores for each section are combined to yield a total possible score of 0 to 42. A score of 0 represents completely intact neurological function, and higher scores indicate degrees of impairment. A score between 1 and 4 indicates a mild stroke. Scores between 4 and 14 indicate a mild-to-moderate stroke. Scores between 15 and 24 indicate a moderate-to-severe stroke, and scores higher than 25 indicate a very severe stroke (Basagni et al., 2021). There is an abbreviated version of this exam for emergency medical services personnel. A modified version of the tool is often commonly used in research settings (Budinčević et al., 2022).

The Los Angeles Prehospital Stroke Screen is known to have the highest sensitivity and specificity in identifying stroke in the prehospital setting (Budinčević et al., 2022). This screening tool is most helpful for identifying ischemic stroke due to large-vessel occlusion (Behnke et al., 2021). This simple, one-page tool assesses only three motor symptoms, including facial paresis, arm strength, and grip strength (Behnke et al., 2021). A quick checklist also helps the assessor rule out other causes of neuromuscular changes. The assessor determines whether the patient is over age 40, has no prior history of seizure disorder, has a new-onset neurological symptom within the past 24 hours, was ambulatory before the event, and has a blood glucose level between 60 and 400. The motor exam is then completed to assess for obvious asymmetry. The patient is asked to smile, and the assessor notes any droop. Grip is assessed for weakness or absence of grip. Finally, arms are raised, and any drift is noted. If the assessor can answer yes to the items and observes abnormal motor exam results, they should notify the receiving hospital of a code stroke so the healthcare team can be prepared to receive the

patient. When using this tool, the assessor should document when the last known well time, or LKWT, was (LA Department of Health Services, 2025).

Other tools are commonly used for screening and rapid assessment of stroke. The Glasgow Coma Scale is often used for patients with suspected hemorrhagic stroke or traumatic brain injury. The Hunt and Hess scale is used to assess prognosis for subarachnoid hemorrhage. The modified Rankin scale is commonly used in clinical and research settings to evaluate outcomes. Disability evaluation is most commonly conducted using the Barthel Index and the Functional Independence Measure (Budinčević et al., 2022). Patients presenting with cerebellar symptoms should be evaluated with the HINTS exam. This mnemonic stands for head-impulse, nystagmus, and test of skew. This test is more sensitive for assessing cerebellar stroke than early MRI (Choi et al., 2022).

In addition to assessment tools, clinical testing is completed to diagnose stroke. Blood tests, computed tomography (CT) scan, electroencephalogram (EEG), and electrocardiogram (EKG) are completed (Cleveland Clinic, 2025). A CT scan can determine whether a stroke or another neurological condition is causing symptoms (Mayo Clinic Staff, 2024a). It is recommended that a CT scan be completed within 20 minutes of the patient arriving at the hospital so that a hemorrhagic stroke can be excluded (Lui et al., 2025). A CT scan is the “gold standard” diagnostic tool for identifying hemorrhagic stroke due to its high sensitivity (Unnithan et al., 2023). The time from triage to CT scan interpretation should be less than 45 minutes. The goal of the rapid CT is to rule out intracranial hemorrhage. Subtle evidence of acute stroke can be seen on approximately 2/3 of CT scans in less than three hours after the injury. This finding is associated with increased morbidity and a higher rate of hemorrhagic conversion of an ischemic stroke (Choi et al., 2022).

An MRI may be performed instead of, or in addition to, the initial CT scan. MRI is a valuable tool because it can distinguish between primary hemorrhage and hemorrhagic transformation of ischemia and detect underlying causes of secondary hemorrhages, including vascular malformations such as cavernomas, tumors, and cerebral vein thrombosis (Unnithan et al., 2023). However, MRI can take longer to obtain and is not always readily available, especially in smaller medical settings (Choi et al., 2022). Diffusion-weighted imaging (DWI) is an MRI technique that measures the diffusion of water molecules within tissue. This test is highly sensitive for identifying acute ischemic strokes because it reveals cytotoxic edema, an early marker of infarction that occurs within minutes of stroke onset (Lui et al., 2025). It is vital that the stroke be classified correctly at diagnosis, as this determines treatment. Quick and effective treatment of the underlying cause of the stroke is the most critical indicator of short-term and long-term prognosis (Choi et al., 2022).

Computed tomographic angiography (CTA) or magnetic resonance angiography is used when evaluating for mechanical thrombectomy. This should be completed within 24 hours of admission. This test assesses for a large vessel occlusion, and clinicians should evaluate for the dot sign (Choi et al., 2022). The dot sign is also known as the middle cerebral artery (MCA) dot sign or the Sylvian fissure sign. This area of hyperdensity indicates a thromboembolism within a segmental branch of the MCA (Gaillard et al., 2024). It is considered an early marker of thromboembolic occlusion of the distal MCA branches. This is a hyperdense vessel sign that can be seen on a CT without contrast. This test can also evaluate for carotid artery stenosis and is used to determine whether the patient is eligible for closure of a patent foramen ovale, if present (Choi et al., 2022).

A perfusion CT or MRI is typically performed within 24 hours when a mechanical thrombectomy for a large-vessel occlusion is being considered. This test provides information regarding regional perfusion hemodynamics. It can reveal areas of the

brain that are irreversibly damaged. It can also be used to determine if a patient is eligible for closure of a patent foramen ovale, if present (Choi et al., 2022).

A transcranial doppler ultrasound is performed within 24 hours when mechanical thrombectomy for a large vessel occlusion is being considered. Carotid doppler ultrasonography should be completed within 24 hours of admission to evaluate for carotid artery stenosis. Doppler studies are less sensitive than CTA or MRI, though they can also be used to monitor a large-vessel occlusion after rtPA therapy. Lumbar puncture may be necessary if the provider believes there has been a hemorrhagic stroke, but there is no evidence on imaging studies (Choi et al., 2022). Gradient echo imaging may be used for an acute hemorrhage (Unnithan et al., 2023). Digital subtraction angiography is used to evaluate for intracranial large vessel occlusion and carotid artery stenosis (Choi et al., 2022).

Commonly performed blood tests include troponin levels, complete blood count (CBC), electrolytes, blood urea nitrogen (BUN), creatinine (Cr), and coagulation studies. EKG and troponin results are necessary because a stroke is typically the result of coronary artery disease. Anemia or signs of infection can be identified with a CBC. If a patient is experiencing electrolyte imbalances, these should be identified and corrected to avoid confusing the clinical picture. Since contrast imaging is contraindicated for patients with kidney dysfunction, monitoring BUN and creatinine is necessary when obtaining initial labs. Coagulation studies, including PT, PTT, and INR, are obtained because elevated values are indicative of a hemorrhagic stroke or may inform treatment decisions (Lui et al., 2025).

Other laboratory tests that may be ordered in the case of stroke include arterial blood gas, basic metabolic panel, blood alcohol level, D-dimer, lipid panel, liver enzymes, pregnancy test, rapid plasma reagin, and toxicology screen, if clinically indicated.

Section 5 Personal Reflection

What is the initial goal of the diagnostic phase? Why is it important to rapidly identify stroke? How can a rapid neurological exam improve outcomes? How is a standardized neurological examination helpful as a diagnostic and research tool? Why is a CT scan often preferred over an MRI for initial imaging? Why should lab studies be performed in addition to imaging?

Case Study

Emily is the RN working in the clinic this morning.

Once she is given Mr. Green's history, what should her next step be?

a. Review all of Mr. Green's medications
b. Provide education regarding the importance of physical activity
c. Discuss nutrition
d. Use the FAST tool to screen for stroke

Emily uses the FAST tool to screen for stroke. She asks Mr. Green to smile and observes facial asymmetry on one side. She asks Mr. Green to squeeze her fingers. He is able to squeeze on both sides, but one side is much weaker. Emily has already observed Mr. Green's speech and notices it is difficult to understand due to slurring.

According to the next step in the FAST tool, what should Emily do next?

a. Perform the exam again to confirm findings
b. Call 911 and let EMS know the patient is having a suspected stroke, and notify the on-site physician

c. Try to encourage Mr. Green to speak slowly so she can understand him more easily

Why is it important for Emily to ask what time Kim last observed Mr. Green in his normal state?

a. To determine his last known well time

b. Emily does not believe Kim's account of the events of the morning

c. To make sure Mr. Green took his morning medications

While waiting for EMS, the on-site physician utilizes the NIHSS to determine stroke severity.

What are some of the elements of this tool? Select all that apply.

a. Determine the level of consciousness

b. Test vision

c. Assess how quickly the patient can walk across the room

d. Have the patient raise his arms one at a time to evaluate for drift

e. Order a CBC and draw blood for lab work

f. Ask the patient to repeat a standard set of words

Mr. Green's daughter asks if she can drive her father to the hospital instead of waiting for EMS.

What reasons should Emily give Kim to support the need for EMS transport? Select all that apply.

a. The health clinic gets a referral bonus if the EMS company is used

b. Prehospital stroke interventions can be completed while en route to the hospital when EMS is used

c. Mr. Green's condition could worsen on the way to the hospital

d. Mr. Green will be seen by a physician faster if he arrives by EMS

e. Kim probably will not drive fast enough

Section 6: Treatment

Stroke treatment depends on the type of stroke the patient is experiencing. As a result, rapid identification using neurologic assessment tools and CT imaging should be performed to determine the most appropriate course of treatment (Choi et al., 2022). Treatment for an ischemic stroke differs from treatment of a hemorrhagic stroke.

Identification of an ischemic stroke should be completed as quickly as possible to preserve brain tissue in areas where perfusion is reduced, but there has not yet been infarction (Lui et al., 2025). Once the NIHSS score is established and a non-contrast CT is completed to rule out hemorrhage, the provider must determine whether rtPA treatment is appropriate for the patient. If the stroke is determined to be ischemic and their LKW time is within four and a half hours, they are a candidate for rtPA. If a patient wakes up with symptoms of a stroke, they may not be aware of when the onset of symptoms began. Other situations can also make it difficult to determine the time of onset. If the LKW time is estimated to be 4.5-9 hours before the patient's arrival, the provider may order a combination of specialized MRI studies to determine whether the patient would benefit from rtPA administration. Even when the healthcare team is considering mechanical thrombectomy, rtPA should still be given (Choi et al., 2022).

Recombinant tissue plasminogen activator (Alteplase, Activaseâ) is the genetically modified form of the tPA enzyme. In clinical settings, tPA and rtPA are often used interchangeably. This potent thrombolytic agent is used to treat conditions that result from thrombosis and embolism, including ischemic stroke. This medication works by converting plasminogen into plasmin, which promotes clot breakdown and facilitates the restoration of normal blood flow. The dosing is weight-based and must be administered as soon as possible to appropriate patients for optimal outcomes. After administration of rtPA, the healthcare team must monitor the patient closely for complications, including bleeding (Patel & Bollu, 2025).

Guidelines suggest that rtPA can be administered within 4.5 hours of symptom onset. Indications for rtPA treatment include age of 18 years or greater, concurrent acute ischemic stroke and acute myocardial infarction, extra-axial intracranial neoplasm, extracranial cervical dissection, history of ten or less cerebral microbleeds shown on MRI, history of myocardial infarction in the past three months, history of warfarin use with an INR less than or equal to 1.4 or a prothrombin time of less than 15 seconds, initial or corrected glucose levels of 50-400 mg/dL, known unruptured and unsecured intracranial aneurysm of less than 10mm, mild but disabling stroke symptoms, non-contrast CT evidence of mild to moderate early ischemic changes, normal activated partial thromboplastin time and end-stage renal disease being treated with hemodialysis, and sickle cell disease. Treatment with rtPA is also indicated if the patient presents with severe stroke symptoms within 3-4.5 hours of the onset of symptoms (Choi et al., 2022). Unfortunately, it is estimated that only 3-5% of individuals who experience a stroke arrive at the hospital in time to be eligible for rtPA treatment. Even fewer people are actually treated with this medication, as many may have conditions that exclude them from eligibility (AANS, 2024).

Acute reperfusion therapy is administered as a dose of 0.9 mg/kg IV alteplase, with a maximum dose of 90mg. The first 10% of the dose should be administered

as an initial bolus over 1 minute. The rest of the dose should be infused over 60 minutes. Alternatively, Tenecteplase, another fibrinolytic agent, may be considered. This medication has a longer half-life than alteplase and can be administered as a single IV bolus. Tenecteplase is administered as a 30-50mg weight-based IV bolus over five seconds. During the COVID-19 pandemic, this medication became the preferred fibrolytic agent in many healthcare facilities and is comparable in efficacy and safety to alteplase (Lui et al., 2025).

Before rtPA can be administered, the patient must undergo a blood glucose test and a non-contrast CT of the brain (Choi et al., 2022). Symptoms of stroke can present similarly to encephalopathies, infection, electrolyte disturbances, psychogenic conditions, and toxicities. These patients should receive stroke treatment if rtPA is indicated because the benefits of this treatment when the actual condition is stroke outweigh the risk of adverse effects if it is not stroke (Choi et al., 2022).

Some conditions require providers to carefully weigh the benefits of rtPA treatment against the risks associated with other coexisting conditions. These conditions include acute pericarditis, history of more than ten cerebral microbleeds shows on MRI, history of diabetic hemorrhagic retinopathy or other hemorrhagic ophthalmic condition, history or gastrointestinal or genitourinary bleeding, having undergone a lumbar puncture in the past seven days, having undergone major surgery in the previous 14 days, pregnant patients with moderate or severe stroke, recent major trauma not involving the head within the last 14 days, and recent vaginal bleeding that has caused clinically significant anemia (Choi et al., 2022).

Treatment with rtPA is contraindicated for some conditions. If the patient's CT of the brain shows extensive regions of clear hypoattenuation, indicating widespread ischemia and irreversible damage, rtPA is contraindicated. It is also

contraindicated when CT reveals an intracerebral hemorrhage, there has been gastrointestinal bleeding within the past 21 days, there is a history of intracranial hemorrhage, presence of an intra-axial intracranial neoplasm, the patient has undergone intracranial or spinal surgery within the past three months, the patient has experienced an ischemic stroke within the past three months, they have a known or suspected aortic arch dissection, the stroke is categorized as mild and nondisabling (a score of 0-5 on the NIHSS tool), the patient has taken direct thrombin inhibitors or direct factor Xa inhibitors in the past 48 hours, the patient has received a full treatment dose of low-molecular-weight heparin within the past 24 hours, the patient has a platelet count of less than 1000,000 per mm3, an INR greater than 1.7, an activated partial thromboplastin time greater than 40 seconds, or a prothrombin time greater than 15 seconds, has experienced severe head trauma within the past three months, has signs and symptoms of subarachnoid hemorrhage, or symptoms concerning for infective endocarditis. There is insufficient evidence to establish the efficacy or safety of administering rtPA in patients with a current malignancy or known or suspected intracranial arterial dissection (Choi et al., 2022).

Mechanical thrombectomy can be performed in eligible patients before rtPA has had time to take effect. Research has found that endovascular thrombectomy completed within the first six hours of the onset of stroke symptoms produces significantly improved outcomes for patients with certain types of large vessel occlusion. Some patients can benefit from this procedure even up to 24 hours after symptom onset (Lui et al., 2025).

Some thrombectomy procedures utilize a clot retrieval device to remove the occluding thrombus from the vessel. The Merci Retriever is a corkscrew-shaped device that is inserted through a small catheter placed in the patient's groin and guided to the arteries in the neck. When the catheter reaches the target area in the neck, a smaller catheter is guided through the arteries and into the brain until

it reaches the thrombus. Then, a small wire is extended beyond the clot that automatically coils into a corkscrew shape. This corkscrew wire is then pulled back into the clot, grabbing it. After the clot is secured, a balloon is inflated in the carotid artery to occlude blood flow, allowing the device to remove the clot from the brain safely. The clot is then removed through the catheter using a syringe. Penumbra is another microcatheter-based device that uses aspiration to remove the clot. Stentriever devices are the most recently developed devices for removing clots. These work by breaking up the clot and then removing it through aspiration or withdrawal (AANS, 2024). The stentriever can be used to treat large-vessel occlusion stroke. Newer versions of this device continue to be developed to improve safety and efficacy (Ahmed et al., 2023).

Microcatheter-based surgical intervention for stroke involves using a small microcatheter that is placed through a larger guiding catheter that is inserted in the groin via a small incision. A micro guidewire is used to guide the microcatheter into the brain to the site of the vessel obstruction. Thrombolytic medication can then be administered directly to the thrombus. This provides a more specific treatment than intravenous rtPA and generally requires a lower dose of medication. A benefit of this procedure is that it allows a significantly wider timeframe for initiating treatment than the timeframe during which intravenous rtPA must be given. This procedure is typically only available at comprehensive stroke care centers (AANS, 2024).

Other surgical options may be used to reduce the risk of another ischemic stroke or TIA. A carotid endarterectomy is a procedure that removes the plaque occluding the carotid artery. This procedure carries an increased risk for patients with heart disease. An angioplasty is completed by threading a catheter through an artery in the groin to the carotid arteries. A balloon is then inflated to expand the narrowed segment of the vessel, and a stent is inserted to keep the artery open (CDC, 2024e).

Treatment of hemorrhagic stroke focuses on stopping the bleeding and reducing intracranial pressure (CDC, 2024e). When an aneurysm or blood vessel malformation causes a stroke, surgery can also prevent future strokes. Surgery may focus on sealing off the defective vessel and redirecting blood flow to perfuse the same region of the brain (AANS, 2024).

Surgical options used to treat hemorrhagic stroke include craniotomy, decompressive craniectomy, stereotactic aspiration, endoscopic aspiration, and catheter aspiration. Individuals who experience a lobar hemorrhage within 1 cm of the brain's surface and a GCS greater than 9 with mild neurological deficits may benefit from early surgery. Patients who experience a cerebellar hemorrhage with hydrocephalus or brainstem compression should undergo an emergency surgical evacuation by suboccipital craniectomy. In patients with a cerebellar hemorrhage, those with a hematoma greater than 3cm in diameter have improved outcomes with surgery. Surgery for brainstem hemorrhages is not recommended as it can lead to further harm. Research on less invasive procedures, including stereotactic aspiration, is underway. So far, research on this procedure has suggested that it is beneficial for patients with certain types of spontaneous hemorrhage who can open their eyes in response to noxious stimuli (Unnithan et al., 2023). Surgical treatment for hemorrhagic stroke may include endovascular procedures to repair a weak spot or rupture in the blood vessel. In cases of aneurysm, a metal clip may be placed to stop the hemorrhage (CDC, 2024e).

During the clipping procedure, a small titanium clip with a spring mechanism is applied to the base of the aneurysm, allowing the aneurysm to deflate. There are different clips available for use depending on the size and location of the aneurysm. The clip is permanent and typically is curative (AANS, 2024). After surgery to treat an aneurysm, the recovery course is intense. Patients often require intensive care therapy for 10-14 days. Cerebral angiography or a similar study is completed during the recovery period, and often immediately after

surgery, to ensure that the aneurysm has been completely eliminated and to document that it is no longer present. The risk of delayed cerebral vasospasm is highest towards the end of the initial healing period. Infections, such as pneumonia, are common complications, and there is a risk of developing hydrocephalus (AANS, 2024).

Endovascular treatment can be used to treat hemorrhagic stroke. Advantages of this type of procedure are that an incision is not required on the skull, and the required anesthesia time is much shorter than that required for a craniotomy and microsurgical clipping. This procedure may also benefit individuals with cerebral aneurysms that cannot be treated with conventional coiling. During the endovascular microcoil embolization procedure, a needle is placed in the femoral artery, and a catheter is inserted using X-ray guidance to advance it to one of the cerebral vessels. A smaller microcatheter is then fed into the aneurysm, which advances a coil into the aneurysm. Additional coils are then advanced into the aneurysm to close it from the inside. This prevents flow into the aneurysm, and a clot is formed on the outside. Balloon-assisted coiling uses a small balloon to hold the coil in place, though this is associated with increased risk. Combination stenting and coiling can be done to provide a scaffold for the coiling. This is a newer procedure, and methods are being updated as more evidence is available (AANS, 2024).

Research continues to identify improvements in treatment for hemorrhagic stroke. One recent study tested the administration of rtPA in conjunction with minimally invasive intracerebral hemorrhage evacuation, using image-guided catheter-based removal of the blood clot. This procedure has been shown to reduce perihematomal edema when the clot can be evacuated (Unnithan et al., 2023). A clinical trial called CLEAR IVH, evaluating accelerated resolution of intraventricular hemorrhage, suggested that low-dose rtPA can be safely given to patients with stable intraventricular clots to increase the rate of clot lysis. Due to

studies demonstrating improved clinical outcomes for patients who undergo decompressive craniectomy and hematoma, these procedures are becoming more common as treatment for some types of hemorrhagic strokes. Evidence suggests they may reduce mortality and improve functional outcomes for some patients (Unnithan et al., 2023).

Continuous cardiac monitoring should be in place for at least the first 24 hours following a stroke to detect atrial fibrillation or other arrhythmias (Lui et al., 2025). Blood pressure management is a critical piece of hemorrhagic stroke treatment. Ideally, the patient's blood pressure should be gradually reduced to 150/90 mmHg using beta-blockers, ACE inhibitors, calcium channel blockers, or hydralazine. Monitoring should include assessing blood pressure every 10-15 minutes. For patients who present to the medical facility with a systolic blood pressure between 150 and 220 mmHg, it is clinically safe to lower the systolic blood pressure to 140 mmHg. Patients with a systolic blood pressure greater than 220 mmHg should undergo aggressive blood pressure reduction with a continuous intravenous infusion (Unnithan et al., 2023).

For the treatment of ischemic stroke, blood pressure should be maintained below 180/105 mmHg for the first 24 hours after administration of IV rtPA. Guidelines published by the American Heart Association in 2023 recommend maintaining blood pressure at or below 185/110 mmHg in patients scheduled for mechanical thrombectomy who have not received IV fibrinolytic therapy. An initial 15% reduction in blood pressure is also recommended for patients who have specific comorbidities, including acute heart failure or aortic dissection. Studies have suggested that antihypertensive management does not improve outcomes in patients with blood pressure less than 220/120 mmHg who have not received IV rtPA and who do not have comorbid conditions. One potential downside of antihypertensive management is decreasing the perfusion to ischemic or poorly perfused brain tissue. During the acute phase, adequate perfusion of some parts

of the brain may depend on a hypertensive state. This consideration is most relevant in the initial 48-72 hours following an ischemic stroke. For patients with a blood pressure greater than 220/120 mmHg who have not received rtPA, guidelines suggest it may be reasonable to reduce blood pressure by 15% within the first 24 hours; however, the benefits of this are not well known. Antihypertensives used for patients experiencing ischemic stroke include labetalol, nicardipine, clevidipine, hydralazine, and enalaprilat (Lui et al., 2025).

In cases of ischemic stroke, intracranial pressure can become increased due to cerebral edema. In larger strokes, this can cause worsening neurological deficits and impaired consciousness due to herniation. Cerebral edema typically peaks between three and five days following an ischemic stroke. Increased intracranial pressure from cerebellar edema can cause further brain injury. Signs of worsening neurological status due to cerebral edema include altered or worsening mental status, decreased level of consciousness, respiratory abnormalities, pupillary changes, posturing, and death. Recognition and treatment of intracranial hypertension should be prompt to improve outcomes, as some patients will require neurosurgical intervention to reduce ICP (Lui et al., 2025).

Interventions that can help relieve pressure on the brain tissue include elevating the head of the bed to 30 degrees and administering osmotic agents, such as mannitol or hypertonic saline. When mannitol 20% is administered, the recommended dose is 1.0-1.5 g/kg. After endotracheal intubation and sedation, hyperventilating to a pCO2 of 28-32 mmHg is recommended if ICP continues to increase after osmotic fluid treatment. Patients with a Glasgow coma scale (GCS) less than eight should have parenchymal or ventricular ICP monitoring in place. The benefit of using a ventricular catheter is that cerebrospinal fluid can be drained in cases of hydrocephalus. The goal of ICP-lowering treatment is to maintain cerebral perfusion pressure between 50 and 70 mmHg (Unnithan et al., 2023).

During the first 24 hours following a stroke, blood glucose levels should be maintained between 140 and 180 mg/dL. Hypoglycemia should be promptly treated because the brain's oxidative pathways require glucose for metabolism. The high metabolic demand following a stroke makes the brain more vulnerable to hypoglycemia, which can impair healing ability. Hyperglycemia can also impair reperfusion by oxidizing nitric oxide-dependent pathways, which decreases vascular tone. Research has found that hyperglycemia following ischemic stroke increased the 30-day mortality rate and increased the risk of hemorrhagic conversion (Lui et al., 2025).

Nutrition is essential to healing after a stroke. Early enteral feeding is recommended, and patients with dysphagia may be fed using a nasogastric tube. If the healthcare team expects swallowing difficulties to persist for more than 2-3 weeks, placement of a percutaneous gastrostomy (PEG) tube is recommended. Research suggests early feeding reduces the risk of death following an ischemic stroke (Lui et al., 2025).

Prophylaxis of DVTs is a fundamental element of post-stroke care. In patients who have experienced an ischemic stroke, aspirin is recommended within 24-48 hours of symptom onset to reduce the risk of recurrent ischemic stroke. This treatment has been shown to improve long-term outcomes while not significantly increasing the risk of early intracranial hemorrhage. Full-dose anticoagulation treatment is not recommended during the acute phase of ischemic stroke, except in cases where low-dose anticoagulation therapy is necessary for DVT prophylaxis. Patients who have atrial fibrillation should begin oral anticoagulation therapy within 4-14 days following a stroke. This treatment may depend on the size of the stroke and other comorbidities. Patients who have experienced a small-to-moderate stroke may not begin anticoagulation therapy until 7-14 days following a stroke. It is appropriate to delay anticoagulation therapy in patients who experience a small hemorrhagic conversion. Intermittent pneumatic compression is recommended

for all immobile patients following a stroke. Low-dose heparin or low-molecular-weight heparin may be considered for deep vein thrombosis prophylaxis when the potential benefits outweigh the risk of bleeding (Lui et al., 2025).

Hemostatic therapy is used to reduce the progression of the hematoma when a hemorrhagic stroke occurs. For patients who are taking anticoagulants, their coagulopathy will need to be corrected. Options for this include administering vitamin K, prothrombin complex concentrates, recombinant activated factor VII, or fresh frozen plasma. Patients with thrombocytopenia should receive platelet concentrate. Patients with an elevated prothrombin time and INR should be administered intravenous vitamin K and either fresh frozen plasma or prothrombin plasma concentrate. Nurses must monitor patients receiving fresh frozen plasma for allergic transfusion reactions. The benefit of plasma prothrombin concentrate is that it can be administered rapidly. Recombinant activated factor VII is less commonly used because, while it reduces hematoma growth, it does not improve overall outcomes (Unnithan et al., 2023).

Hyperthermia, defined as a body temperature of 100.4° F (38° C) or higher, should be treated with antipyretics. Infections, including pneumonia and urinary tract infections, should be treated promptly. Evidence does not suggest routine use of therapeutic hypothermia in cases of acute ischemic stroke. Research has found that mortality is increased in patients whose temperature exceeds 102.2° F or 39° C within the first 24 hours following an ischemic stroke (Lui et al., 2025).

Seizures most commonly occur in patients with hemorrhagic strokes or cortical infarcts (Lui et al., 2025). Antiepileptic drugs are commonly used for patients who experience stroke, as 3-17% of patients will experience a seizure in the first two weeks following a stroke, and 30% of patients exhibit electrical seizure activity when monitored by EEG. Antiepileptic drugs should be prescribed to individuals with both clinical and electrographic seizures. Patients with decreased level of

consciousness should receive continuous EEG monitoring as hematoma enlargement can lead to seizures and worsening neurological status. Subclinical seizures and non-convulsive status epilepticus can also occur. Prophylactic anticonvulsant medications are not recommended when there has been no evidence of seizure activity (Unnithan et al., 2023).

When hemorrhagic transformation after an ischemic stroke occurs, the first step is to stabilize hemodynamics. The patient will require transfer to a neuro-intensive care unit if possible. Other treatment interventions include temperature and glycemic control, DVT prophylaxis, blood pressure control, and correction of coagulopathies. Intracranial pressure monitoring may be necessary if the patient has hydrocephalus. The neurosurgeon may choose to perform a hematoma evacuation and/or decompressive craniectomy if there is a supratentorial hematoma with continued clinical deterioration and a midline shift or if there is a cerebellar hematoma present that is larger than 3cm, accompanied by worsening clinical status or compression of the fourth ventricle or brainstem. The goal of treatment is to relieve pressure on the brain and reduce the adverse effects of brain bleeding (Hong et al., 2021).

The healthcare team must also be aware of secondary injuries that occur due to stroke, such as inflammation, oxidative stress, and cellular toxicity. These conditions must be treated to protect the brain and prevent adverse outcomes. Efforts to reduce these secondary injuries include medications that reduce inflammatory damage and oxidative stress (Unnithan et al., 2023).

TIAs do not require treatment; however, they do warn of impending stroke, so it is important for individuals who experience a TIA to be evaluated by their physician to develop a treatment plan to reduce their risk of experiencing a stroke. This plan may include an exercise routine, weight loss, smoking cessation, managing hypertension, and other interventions to optimize health. The physician may

choose to prescribe anticoagulants. If the carotid artery was occluded, the patient may need angioplasty to clear the vessel (Mayo Clinic Staff, 2024b).

Following a stroke, patients should be screened for depression. Post-stroke depression impacts approximately 18-33% of stroke survivors. Women, individuals who have experienced a large infarct, those who have had a stroke involving the frontal lobes, and those with limited social support are at increased risk for post-stroke depression (Lui et al., 2025).

Following a stroke, rehabilitation services are often necessary to regain abilities or to adjust to changes in ability. Cognitive rehab can help the patient improve memory, concentration, and other cognitive abilities. Occupational therapy can assist the patient in learning to safely complete activities of daily living, especially those that require precise body movements. Physical therapy helps strengthen muscles, improve balance, and regain gross motor function. Speech therapy can help the patient regain or improve language and speaking abilities. This type of therapy can also help the patient gain control of the muscles used for talking, breathing, eating, and swallowing (Cleveland Clinic, 2025). Early rehabilitation, within the first 24 hours, is not recommended and is associated with less favorable outcomes (Lui et al., 2025). Nurses should advise patients that recovery from stroke can take months to years, depending on the severity of the stroke (AANS, 2024).

Section 6 Personal Reflection

How do treatments for ischemic and hemorrhagic strokes compare? Why is it important that rtPA be administered within a specific time frame? How are surgical procedures used to treat stroke? What other treatments may be necessary when providing care to someone who has had a stroke? What

information is important to convey to a caregiver when they ask how long to expect stroke recovery to take?

Case Study

EMS transports Mr. Green to the nearest hospital. He arrives at the Emergency Department at 9:45 AM. While en route, the paramedic checks Mr. Green's blood glucose, which is 125.

Why is it important for blood glucose to be checked before initiating any stroke treatment?

a. The patient could be faking their symptoms
b. Diabetics are more likely to experience a stroke
c. Symptoms of hypoglycemia can mimic symptoms of stroke
d. The hospital can charge more for care if the patient has high blood glucose

The physician at the local medical clinic has called ahead to the receiving hospital to notify them of the patient's history, exam findings, and NIHSS score. Mr. Green is placed in a patient room and cardiovascular monitoring is initiated.

What is the best next step in providing treatment for Mr. Green?

a. Surgery to remove a clot
b. Admit him for observation
c. STAT CT scan
d. Routine MRI

The radiology staff were prepared for Mr. Green's arrival, so he had a CT scan at 10:00 AM.

According to best practices, by what time, at the latest, should the CT scan be read? Hint: This is based on hospital arrival time, not CT scan time.

a. 10:05 AM
b. 9:45 PM
c. 10:30 AM
d. 10:45 AM

The CT scan is read, and a hemorrhagic stroke is ruled out.

What is the next step in treatment?

a. Evaluation for rtPA treatment and administration, if ordered
b. Surgery
c. MRI to evaluate for blood vessel malformations
d. Admission for observation

Mr. Green receives IV rtPA at 10:25 AM.

What other intervention may be used to treat Mr. Green?

a. A repeated dose of rtPA
b. Mechanical thrombectomy
c. Craniotomy
d. Aneurysm clip placement

Kim asks Mr. Green's nurse about the recovery timeline.

What should the nurse's response be?

a. He will never regain function

b. Mr. Green will likely require therapy to regain skills, but his outcome will take months or more to determine

c. Mr. Green will be back to normal functioning within 30 days

d. Kim should plan for her father to be admitted to a skilled nursing facility

Section 7: Prevention

According to the National Institute of Neurological Disorders and Stroke, the best stroke treatment is prevention through lowering risk. It is estimated that with appropriate lifestyle changes and currently available therapies, Americans will eventually be able to prevent approximately 80% of strokes (NINDS, 2025c).

Methods used for healthcare screening can impact the primary prevention of stroke. Blood pressure should be measured in the clinic, and elevated blood pressure should be confirmed with home or ambulatory monitoring. Screening for cigarette smoking should be conducted via direct questioning in an interview. These questions should have the patient identify themselves as a never, past, or current smoker. This will help to identify patients who are ready to quit and provide an opportunity to discuss smoking cessation treatment options. Screening for diabetes should be performed using blood tests that measure fasting blood glucose and hemoglobin A1c. Diet quality should be assessed through direct questioning in an interview to determine whether the patient's eating pattern emphasizes healthy foods and minimizes less healthy foods. Screening for dyslipidemia should be completed through a blood test, which can be non-fasting. While BMI is the most common measure of weight health, patients should be screened for overweight by measuring central adiposity whenever possible to refine stroke risk. Direct interview questions should be used to ask about physical

activity. Questionnaires are not known to be accurate tools for screening for physical inactivity. Social determinants of health can be screened for using a direct interview or a questionnaire. Screening for sleep disorders can also be completed through a questionnaire. The healthcare team may use a direct interview or a questionnaire to identify patients with substance use disorder who may be at increased risk of stroke. For many risk factors that can be screened for using questionnaires, validated tools are available to ensure accurate identification of patients at increased risk of stroke (Bushnell et al., 2024).

The American Stroke Association and American Heart Association use a "Life's Essential 8" tool to address primary lifestyle factors and health behaviors that affect stroke risk. When using this tool, the healthcare team should be aware of important contextual factors, such as psychological well-being and social determinants of health, that may affect a patient's ability to adhere to "Life's Essential 8". The eight components identified by this tool include a healthy diet, physical activity, healthy weight, healthy sleep, avoidance of tobacco products, and healthy levels of blood lipids, blood glucose, and blood pressure (Bushnell et al., 2024).

Stroke prevention is an important aspect of maintaining health. Individuals who have experienced a stroke are at increased risk for experiencing another stroke; however, specific interventions and lifestyle changes can reduce the risk of a first or subsequent stroke. If the patient has already had a stroke, it is vital to identify the cause of the stroke so that interventions specifically target that cause (CDC, 2024e). The primary ways an individual can lower their stroke risk are by exercise and physical activity, controlling hypertension, eating a healthy diet, controlling cholesterol, managing diabetes, and smoking cessation (NINDS, 2025c). An annual physical is necessary to identify and monitor health conditions. Some individuals may require more frequent physicals. This will help the healthcare team to identify and treat warning signs before a stroke occurs (Cleveland Clinic, 2025).

Prevention of a transient ischemic attack is the same as prevention of stroke (Mayo Clinic Staff, 2024b).

Patients who are at high risk for stroke may be treated with medication. The primary medications prescribed to prevent stroke occurrence or recurrence are anticoagulants and antiplatelets. Anticoagulants prevent clotting by thinning the blood. Heparin can be administered intravenously or subcutaneously and is often used in the hospital as a quick-acting blood thinner. Warfarin is an oral medication and is intended for long-term use. Either of these medications requires close monitoring by a physician due to the risk of bleeding. Antiplatelet medications prevent platelet aggregation by making it more difficult for platelets to stick together, reducing the risk of a clot that can lead to an ischemic stroke (AANS, 2024).

Carotid Endarterectomy (CEA) is a procedure where the neurosurgeon makes an incision in the carotid artery and removes the plaque in the vessel using a dissecting tool. This enables restoration of normal blood flow. The artery is then repaired with sutures or a graft. The patient receives either general or local anesthesia for this procedure, and the procedure typically lasts about 2 hours, with the vessel occluded for 30 minutes. The patient can expect some pain at the incision site and difficulty swallowing in the first few days after surgery. Potential complications of this procedure include stroke, restenosis of the carotid artery, and temporary facial or tongue numbness, though these are not common. The risk of complications is increased for those who smoke (AANS, 2024).

Carotid angioplasty and stenting (CAS) is a newer procedure that is beneficial for patients who may not be candidates for surgery due to high risk. During this procedure, a tiny metal-mesh tube is inserted into the carotid artery to increase blood flow. Stent placement most often follows angioplasty, in which a balloon-tipped catheter is guided into the blocked artery. The balloon is inflated and

flattens the plaque, reopening the artery. The newly placed stent serves as scaffolding to prevent arterial collapse or re-occlusion. The most serious risk of this procedure is an embolism that can occur when a particle of plaque breaks free from the vessel and travels in the circulatory system to the brain, possibly causing a stroke. Small filters are often used in conjunction with angioplasty and stenting to prevent this complication. The benefits of this procedure include a short vessel occlusion time of 10 seconds, a shorter anesthesia time, and a small leg incision rather than a neck incision (AANS, 2024).

When blood flow is rapidly restored through a previously blocked artery and into the arteries of the brain, a hemorrhagic stroke can occur. Other potential complications for both CEA and CAS include restenosis and reduced blood pressure and heart rate (AANS, 2024).

A healthy diet is an effective way to reduce the risk of stroke. Recommendations include eating plenty of fresh fruits and vegetables. Foods that are low in saturated fats, trans fat, and cholesterol, and high in fiber can help prevent high cholesterol. Salt intake should be limited to optimize blood pressure (CDC, 2024c).

Maintaining a healthy weight is a strategy to prevent stroke, as weight that is considered overweight or obese is a risk factor for stroke. Body mass index is a tool that uses a patient's height and weight to determine whether their weight is within an appropriate range for their height. Sometimes, waist and hip measurements may be used to determine the presence of excess body fat (CDC, 2024c).

Physical activity can help prevent stroke by maintaining a healthy weight and lowering cholesterol and blood pressure. It is recommended that adults have 2.5 hours of moderate-intensity aerobic physical activity each week. Children and adolescents should have at least one hour of physical activity daily (CDC, 2024c). The reduced incidence of stroke depends on the type, frequency, and intensity of

physical activity, with regular physical activity the most important protective factor (Ghozy et al., 2022).

Limiting or eliminating substance use can prevent a stroke. Individuals who do not smoke should be advised not to start, and those who do smoke should be advised to quit. Excessive alcohol consumption should be discouraged. To prevent an increased risk for stroke, men should have no more than two drinks per day, and women should have no more than one drink per day (CDC, 2024c).

By controlling comorbid health conditions that increase risk for stroke, such as heart disease, high cholesterol, hypertension, and diabetes, stroke can be prevented. Cholesterol levels should be checked at least every 5 years (CDC, 2024c).

Stroke prevention can also be improved through community interventions. Public education programs should be in place, even in communities with limited resources, to educate individuals on the signs of stroke and when to seek emergency care (Mead et al., 2023).

The 2024 Guideline for the Primary Prevention of Stroke from the American Heart Association and the American Stroke Association provides specific recommendations for stroke prevention. The guideline outlines 10 of the most important prevention recommendations. The first recommendation is that all people, from birth through older adulthood, should have access to health care and regular visits with a primary care provider to identify and pursue opportunities to promote brain health. The second recommendation is to address the social determinants of health to prevent stroke. Screening for social determinants of health in settings where at-risk stroke patients receive care is recommended. The third recommendation is that adults with no prior cardiovascular disease and those with high or intermediate risk adhere to a Mediterranean diet. This diet has been shown to reduce the risk of stroke,

especially when supplemented with nuts and olive oil. The fourth recommendation is to engage in physical activity and cardiovascular health. Research has found that prolonged sedentary behavior during waking hours is associated with an increased risk of stroke. It is recommended that patients be screened for sedentary behavior and educated on the importance of engaging in regular moderate-to-vigorous physical activity. The fifth recommendation is to use glucagon-like protein-1 receptor agonists for patients with diabetes and high cardiovascular risk or established cardiovascular disease. Associated weight loss with these medications can reduce the risk of cardiovascular disease and stroke. The sixth recommendation is blood pressure management. Research has found that most patients require 2-3 different antihypertensive medications to treat hypertension adequately. The seventh recommendation is that antiplatelet therapy be administered to patients with antiphospholipid syndrome or systemic lupus erythematosus without a history of stroke or unprovoked venous thromboembolism to prevent stroke. Some of these patients may benefit from vitamin K antagonist therapy, with a target INR of 2-3. This may be more effective than direct oral anticoagulants for this population. The eighth recommendation addresses the prevention of pregnancy-related stroke. The primary method to reduce risk in this population is to manage hypertension. Systolic blood pressure of 160 mmHg or greater or a diastolic blood pressure of 110 mmHg or greater during pregnancy and within six weeks postpartum should be treated to reduce the risk of maternal intracerebral hemorrhage. The ninth recommendation relates to women with endometriosis, premature ovarian failure, and early-onset menopause, as these conditions increase risk for stroke. Screening for these conditions and management of vascular risk factors can help reduce stroke. The tenth recommendation is that understanding transgender health is essential for an inclusive clinical practice. Studies suggest that transgender women who take estrogen for gender affirmation have an increased risk of stroke. This population

should be evaluated for risk factors and lifestyle modifications recommended that can reduce risk (Bushnell et al., 2024).

The risk of stroke can be reduced by addressing social determinants of health. Nurses and other members of the healthcare team must advocate for patients, provide patient teaching at appropriate educational levels and in a language the patient understands, and build trust with patients so they can re-educate patients whose health beliefs are based on misinformation. The healthcare team can promote stroke prevention by choosing the most efficacious and cost-effective medications, connecting patients to resources that can help with health-related social needs such as food and housing insecurity, referring patients to programs that can support lifestyle changes, and connecting patients with social programs that can help with healthcare costs (Bushnell et al., 2024).

Section 7 Personal Reflection

Why is prevention considered the most effective stroke treatment? What lifestyle changes can individuals make to decrease their risk of stroke? How can community interventions help reduce stroke prevalence? Why is it necessary to address social determinants of health when addressing stroke prevention?

Case Study

It is time for hospital discharge.

When providing discharge education to Mr. Green and Kim, what is important for the nurse to include in their discharge teaching? Select all that apply.

a. Kim should be able to verbalize the signs and symptoms of a stroke

b. Mr. Green does not need to attend physical therapy

c. Lifestyle changes that could prevent another stroke in the future

d. The importance of adhering to all discharge medications, therapies, and follow-up care

e. Mr. Green should be moved to a home closer to the hospital

In Mr. Green's case, assuming he regains some functional ability, what are some ways he can prevent the recurrence of a stroke? Select all that apply.

a. Live independently

b. Focus on a healthy diet

c. Participate in regular physical activity

d. Go back to work

e. Adhere to antiplatelet medications prescribed by the physician

Section 8: Nursing Considerations

Nurses are integral to the healthcare team in stroke-related care. Nurses are responsible for assessing mental status and level of consciousness. They must observe for neurological deficits using frequent neurological assessments, including measuring and monitoring pupil size, observing for mood changes, and monitoring for seizures. Nurses must assess breathing, monitor vital signs, and assess higher brain functions, such as speech, memory, and cognition. Nurses can help promote a therapeutic environment by keeping the area quiet. Nurses can implement interventions to reduce ICP, including elevating the head of the bed and administering stool softeners to prevent constipation and straining. Nurses must also implement interventions to reduce the risk of DVT (Tadi et al., 2023).

Patients who have experienced a stroke are at high risk of experiencing a fall. To prevent falls, nurses should implement interventions to reduce risk. The bed railings should be raised. The nurse call light should be placed within the patient's reach. The nurse should be aware of any functional deficits and support the patient in compensating for impairments (Tadi et al., 2023).

Nurses participate in discharge planning. Patient education is an important aspect of patient care when preparing patients and caregivers for discharge. They should be educated regarding the causes of stroke, modifiable risk factors, blood pressure and glucose management, adhering to a healthy diet, and the use of assistive devices, if indicated. The nurse must emphasize medication adherence and follow-up. The nurse should ensure that the patient and caregivers can verbalize the signs and symptoms of a stroke, so they are prepared to recognize a recurrent stroke quickly. They must also be educated regarding potential complications of stroke treatment, especially bleeding, if they are prescribed an anticoagulant medication at discharge (Tadi et al., 2023).

Individuals who have experienced a stroke may experience total or partial paralysis. They may have difficulty talking or swallowing. They may have cognitive deficits, including memory loss and difficulty with thinking, reasoning, making judgments, and understanding concepts. They may have difficulty controlling emotions or may develop depression. Individuals who have had a stroke can experience pain, numbness, or other sensations in the areas of their body that are affected by the stroke. There may be changes in behavior or their ability to care for themselves. These individuals may become withdrawn. They may also require assistance with grooming and activities of daily living (Mayo Clinic Staff, 2024a).

The outcome of a stroke depends on the location and severity of the stroke. When a stroke occurs on the right side of the brain, the patient may experience paralysis on the left side of the body, vision problems, purposeless behavior, and memory

loss. When someone experiences a stroke on the left side of their brain, they may experience paralysis on the right side of the body, speech and language difficulties, cautious behavior, or memory loss (AANS, 2024).

Nurses have been particularly instrumental in reducing the risk of morbidity and mortality in rural-dwelling populations who experience significant disparities in stroke prevalence, access to care, and outcomes. Limited infrastructure and higher prevalence of hypertension, diabetes, and obesity increase the risk in this population. These individuals may live long distances from medical facilities, which can hinder prompt stroke care. Nurses in rural settings are vital for stroke prevention, stroke management, and poststroke rehabilitation. Through community-based education, assessment, stabilization, and rehabilitation, nurses can promote favorable outcomes (Bushnell et al., 2024).

Workforce challenges, especially in rural areas, affect stroke prevalence and outcomes. Healthcare professionals living in rural areas frequently report burnout due to limited support and resources while caring for heavy workloads. This affects the quality of stroke care. Nursing shortages further exacerbate these problems. Due to limited staff, nurses in rural areas often are burdened with a range of responsibilities. Epidemiological modeling may help predict staffing needs and determine whether to allocate specialized advanced care nurses, such as stroke coordinators or neurovascular nurse practitioners, in high-demand areas. Nursing recruitment and education should focus on neurovascular stroke care to meet the specific needs of these rural communities. Nurses may be responsible for conducting needs assessments in rural areas to improve healthcare access in those communities (Bushnell et al., 2024).

Section 8 Personal Reflection

What is the role of nurses in stroke-related care? How are nurses involved in discharge planning? How do nurses impact stroke care in rural communities? How do workforce challenges affect nurses caring for people who have experienced a stroke? What are some ways to decrease stroke risk in areas affected by workforce challenges?

Section 9: Conclusion

The prevention, identification, and treatment of stroke are complex concepts that require increased knowledge from nurses so that they can respond appropriately to the signs and symptoms of stroke. Ischemic and hemorrhagic strokes have different causes and treatments but often share many of the same symptoms and post-stroke care interventions. Nurses must understand how different types of strokes are similar and how they differ, so that the individual patient's healthcare needs are met and optimal outcomes are achieved. Research continues to identify new and improved treatment methods to improve stroke care. Nurses must remain aware of new treatments and changes in best practices to ensure they are providing excellent care. By understanding the different types of strokes, risk factors, signs and symptoms, evidence-based treatments, preventative measures, and the nurse's role in stroke care, health outcomes can be positively affected through excellent nursing care.

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