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Acute Ischemic Stroke: Current Management and Role of the Nurse Practitioner

Kang, Ji-Yeon, PhD, ACNP, RN[1]; Patricia Coleman, PhD, RN, APRN, BC[2];
Kim, Keum-Soon, PhD, RN[3]; Yi, Young-Hee, PhD, RN[4]; Choi, Eun-Jung PhD, RN[1]

[1]Department of Nursing, Dong-A University, Busan, Korea
[2]School of Nursing, University of Rochester, NY, USA
[3]College of Nursing, Seoul National University, Seoul, Korea
[4]Graduate School of Clinical Nursing Science, Sungkyunkwan University, Seoul, Korea

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Purpose: This paper reviews current diagnostic evaluation, treatment, nursing considerations, and the nurse practitioner's (NP) role in acute ischemic stroke care. **Methods:** National guidelines and extensive literature on acute stroke care were reviewed and a relevant clinical case was introduced. **Results:** Computerized tomography (CT) of the head without contrast is the initial brain imaging procedure for patients with an acute stroke. Magnetic resonance imaging (MRI) can be an alternative test. Restoration of cerebral perfusion to the affected area is a key therapeutic strategy for ischemic stroke. A number of treatment strategies such as thrombolysis, anticoagulation, antiplatelet, and surgical treatment can be selected to improve blood flow to the ischemic region. The NP on the stroke team is involved with immediate stroke management including neurological assessment, ensuring adequate oxygenation, blood pressure management, activity, and diet. Discharge planning with the patient, family teaching and coordination of follow up care should also be implemented early in the hospitalization. **Conclusion:** The nurse practitioner is one of the cardinal members on the stroke team, and must be updated with current treatment and management guidelines.

Keywords: Stroke, Nurse practitioner, Role

I. Introduction

Stroke is the third major cause of death behind disease of the heart and cancer and a leading cause of severe, long-term disability in the United States. According to the American Heart Association (AHA), approximately

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Address reprint requests to : Kang, Ji-yeon, PhD, ACNP, RN
Department of Nursing, Dong-A University,
1 Dongdaeshin-Dong 3-Ga, Seo-Gu, Busan, Korea
Tel: 82-10-6301-3690, 82-51-240-2871 Fax: 81-51-240-2947 E-mail: jykang@dau.ac.kr
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780,000 people suffer from a stroke annually in the United States including 180,000 cases of recurrent attacks (Heart disease and stroke statistics-2008 update, 2008).

A patient with acute stroke onset experiences multiple critical events beginning with emergency care to post-stroke rehabilitation. A multidisciplinary approach to care that include a neurologist, nurse practitioner (NP), nurse, social worker, physical therapist, occupational therapist, and speech therapist is essential for high quality patient care. The NP is a vital member of the stroke team that deals with various problems that may include coordination of patient care, interaction with family members, consultation, discharge planning and risk reduction such as blood pressure control, smoking cessation, maintaining target lipid levels, diabetes control, diet and exercise modification and monitoring carotid artery disease (Glancy, Roddy, & Bernardini, 2004; Hinkle & Guanci, 2007). The NP collaborates on direct patient care with physicians and acts as a bridge between the patients and other team members. To accomplish all of these activities, the NP needs to be well versed on new guidelines for stroke care, nursing considerations, ethical issues around patient care as well as institutional policies.

This paper summarizes current evidence-based diagnostic evaluations and treatment options for acute ischemic stroke that accounts for 70-80% of total stroke events. It also highlights the role of nursing in stroke care.

II. Current Management of acute ischemic stroke

1. Definition and manifestation of ischemic stroke

Stroke is a type of cardiovascular disease that affects blood flow to the vessels of the brain. Presenting signs and symptoms are dependent on the focal area affected. There are two types of stroke, hemorrhagic and ischemic. A hemorrhagic stroke causes bleeding into the brain. Common causes of hemorrhagic stroke include ruptured cerebral aneurysm, arteriovenous malformation (AVM), high blood pressure (BP), direct brain injury, and illicit drug use. Ischemic stroke accounts for 70-80% of stroke occurrences, and is caused by an embolism or thrombosis. Thrombi in the cerebral arteries clog blood vessels and block the supply of oxygen and other nutrients to brain tissue. Emboli from the heart, aorta, carotid, or vertebral vessels lodge in the vessels of the brain and obliterate blood flow to the distal portion of the vessel (Heart disease and stroke statistics-2008 update, 2008).

The clinical manifestations of stroke vary with the location and size of infarction or bleeding. Hemorrhagic stroke usually causes sudden headache, vomiting, seizures, or coma. Ischemic stroke is associated with motor and/or sensory defects involving one side of the body, language and visual deficits as well as other problems including mental status change and even death. However, clinical symptoms are not useful in differentiating the type of stroke (Heart disease and stroke statistics-2008 update, 2008; Sacco, 2005).

2. Diagnosis of acute ischemic stroke

1) Computed tomography (CT)

A CT scan of the brain should be done before implementing any treatment or therapy to rule out possible intracranial hemorrhage and to make decisions on emergency management (Adams et al., 2007). Although early (less than 48-72 hours from onset) cerebral ischemic infarcts are not generally visible on CT scan, immediate CT scanning for all possible stroke patients is considered the most cost-effective and time-saving

strategy in acute stroke diagnosis (Culebras et al., 1997; Xavier, Qureshi, Kirmani, Yahia, & Bakshi, 2003; Wardlaw et al., 2004).

2) Magnetic Resonance Imaging (MRI)

MRI provides biochemical and structural information (e.g., location of the infarct, large vessel versus small vessel disease, and/or the presence of intracranial stenosis) which may affect long-term treatment modalities. Diffusion-Weighted Imaging (DWI) is a newer MRI technique that demonstrates the ischemic region more quickly (within minutes to two hours after stroke onset) than standard MRI or CT. Thus, DWI may improve initial diagnostic accuracy and potentially provide a method for evaluating the impact of treatment interventions on the ischemic region. Fluiid-Attenuated Inversion Recovery (FLAIR) MR image is used to confirm old infarcts. Perfusion-Weighted Imaging (PWI) provides the relative measures of ischemic penumbra (A non-invasive test, Magnetic resonance angiography (MRA) permits visualization of blood flow in vessels without the need for catheterization or contrast, and provides information on collateral blood flow (Karonen et al., 2001; Xavier et al., 2003).

3) Other tests

Other tests that search for underlying causes of the stroke may include cerebral angiography, transcranial doppler (TCD), positron emission tomography (PET) scan, and echocardiogram. Cerebral angiography is an invasive test and may be utilized in selected patients to evaluate AVM, aneurysm, dissection, vasculitis, and stenosis. Ultrasonographic examination of the cranial arteries (TCD) is noninvasive and useful in detecting the site and extent of occlusions (Xavier et al., 2003). PET scan has become more popular because it provides extensive information about the functional and structural characteristics of the brain. Since the introduction of the PET scan, information on post-stroke brain metabolism has rapidly progressed.

Patients who are suspected of having cardiogenic embolism should undergo transthoracic echocardiography (TTE) or transesophageal echocardiography (TEE). TEE is more sensitive than TTE for detecting cardioembolic sources, particularly when searching for sources from the left atrium, atrial septal defects and aortic arch plaque (Adams et al., 2007; Yahia, Kirmani, Xavier, Manalio, & Qureshi, 2004).

In general, CT of the head without contrast is recommended as the immediate diagnostic procedure for patients presenting with acute stroke symptoms. Brain MRI is an alternative choice. Other tests include MR Angiography, cerebral angiography, TCD, PET and echocardiogram which should be selected according to the patients' clinical situation but should not delay acute stroke treatment.

3. Treatment of acute ischemic stroke

Expert consensus on optimal therapy for acute ischemic stroke is not available. There is agreement by experts however, that restoration or improvement of perfusion to the affected area is a key therapeutic strategy. A number of treatment modalities have been introduced to improve blood flow to the ischemic region, including thrombolyis, anti-coagulation therapy and anti-platelet therapy.

1) Thrombolysis

Intravenous administration of recombinant tissue plasminogen activator (rtPA) is now generally accepted as a treatment modality for acute ischemic stroke (Adams et al., 2007). rtPA is a thrombolytic drug that breaks down

the thrombus that has formed by stimulating the plasmin system. Approval of rtPA by the FDA in 1996 was based on the results of the National Institute of Neurological Disorders and Stroke (NINDS) rtPA Stroke Study group (1995), in which 624 patients with ischemic stroke were treated with placebo or rtPA (0.9 mg/kg IV, maximum 90 mg) within 3 hours of stroke onset. Study results showed favorable responses at 3 months, 12% absolute improvement compared to placebo on Barthel index, modified Rankin scale, Glasgow coma scale and NIHSS to treatment with rtPA. The 7th American College of Chest Physicians Consensus Panel on Antithrombotic Therapy (ACCP) recommends administration of IV rtPA for ischemic stroke patients within 3 hours of clearly defined symptom onset, based on strict eligibility criteria (Albers, Amarenco, Easton, Sacco, & Teal, 2004).

Eligibility for rtPA therapy is associated with fatal intracranial hemorrhage, a head CT scan must be obtained prior to instituting rtPA to rule out intracranial hemorrhage. In addition to risk for intracranial hemorrhage, other potential adverse effects include systemic bleeding, myocardial rupture if the drug is given within a few days of acute myocardial infarction, and allergic reactions including anaphylaxis. To avoid complications, close observation and monitoring of the patient and early management of arterial hypertension are critical. The use of anticoagulants and antiplatelet agents should be avoided within 24 hours of thrombolytic treatment (Adams et al., 2007).

2) Anticoagulation therapy

Anticoagulants interfere with the normal coagulation process to slow or prevent clot formation. No trial has adequately evaluated full-dose anti-coagulants in early (<12 hour) ischemic stroke. Findings from trials of intravenous (IV) heparin for stroke are inconsistent, and trials of subcutaneous (SQ) heparin and low molecular weight heparin (LMWH) or heparinoids have demonstrated increased risk of serious bleeding complications without clear benefits. The 7th ACCP does not recommend full dose anti-coagulants with IV or subcutaneous heparins or heparinoids for treatment of unselected patients with ischemic stroke (Albers et al., 2004).

However, providers may consider early anticoagulation for treatment of acute cardioembolic and large artery strokes and for progressing stroke when the suspected mechanism is ongoing thromboembolism. For cardioembolic strokes, early anticoagulation is most likely to be beneficial for patients who are at high risk for early recurrent embolism (e.g., mechanical valve, intracardiac thrombus, atrial fibrillation, or severe congestive heart failure). The starting dose of IV heparin is 12-15 units/kg/hr with a goal PT of 50-70 seconds. Warfarin can be started at 5mg by mouth daily with a goal INR of 2-3. Monitoring of the level of anticoagulation and adjustment of the dosage/treatment regimen is important for the safe use of these agents. Again, parenteral anticoagulants should not be prescribed until a brain imaging study has ruled out the possibility of an intracranial hemorrhage (Adams et al., 2007; Albers et al., 2004).

3) Anti-platelet therapy

Anti-platelet agents inhibit platelet adhesion and aggregation by blocking the receptor site on the platelet membrane, preventing platelet-platelet interaction or the interaction of platelets with other clotting factors. The 7th ACCP recommends early aspirin (160-325mg) for patients with ischemic stroke who will not be receiving rtPA or heparin. Aspirin (initial dose is 325mg) should be administered orally within 24 to 48 hours of stroke onset in most patients, however oral administration of Aspirin should not be a substitute for other early treatments such

as IV rtPA (Adams et al., 2007: Albers et al., 2004).

Results from randomized clinical trials (CAPRIE steering committee, 1996; Culebras et al., 2004; ESPIRIT group, 2000) have found Clopidogrel, or dipyridamole to be more effective than aspirin for prevention of stroke. The use of these drugs for treating acute ischemic stroke has not been tested yet. The AHA guideline (Adams et al., 2007) does not recommend the administration of clopidogrel alone or in combination with aspirin for the treatment of acute ischemic stroke.

4. Nursing care for acute ischemic stroke patients and role of nurse practitioner

Patients presenting to the emergency department (ED) with stroke syndromes will undergo emergency brain CT scan to rule out intracranial hemorrhage. For patients without contraindications to thrombolytic therapy, IV rtPA is initiated per institutional protocol as soon as possible, with monitoring in an intensive care unit (ICU) for at least 24 hours. For patients ineligible for thrombolytic therapy, anticoagulation and/or antiplatelet agent is started according to each individual clinical situation, with subsequent transfer and monitoring in inpatient stroke units or ICUs. The NP on a stroke team manages immediate stroke care concerns, particularly oxygenation, blood pressure control, and initiating transfers and consultations. Once the patient is stabilized, the NP manages activity and dietary prescriptions, discusses care with patient's family members, and initiates discharge planning. These activities are evidence of the integrative nature of the NP role in acute stroke care. Box 1 shows the NP's role in the care of acute ischemic stroke patient.

1) Oxygenation

It is essential to maintain the airway to promote adequate tissue oxygenation to prevent further neurological injury during periods of acute cerebral ischemia. Patients with large brain stem infarctions or sustained seizure activity are at great risk for airway compromise because of decreased level of consciousness and decreased muscle tone (Fulgham et al., 2004). If patients with large infarcts and/or increased intracranial pressure develop hyperventilation, mechanical ventilation is required.

Continuous monitoring of respiratory status is vital in acute stroke care. Patients' oxygen saturation should be maintained at greater than 92%. Patients need to be oxygenated if blood gas analysis or pulse oximetry shows desaturation or if there are other specific indicators of desaturation like tachypnea or seizure (Adams et al., 2007). The NP must be alert to possible causes for failure to oxygenate (e.g., aspiration pneumonia, alterations in the respiratory center, sleep apnea or weakness of the respiratory muscles) and monitor the oxygen saturation levels to make decisions about need for oxygen therapy or mechanical ventilation.

Pulmonary toileting and position changes promote oxygenation. Both interventions should be provided at least every 2 hours to prevent atelectasis and pneumonia for stroke patients who have impaired mobility. Patients with dysphagia require strict aspiration precautions.

2) Blood pressure management

Maintaining optimal blood pressure in the acute stages of ischemic stroke can be a difficult clinical problem. After an ischemic attack, blood pressure tends to be elevated to maintain cerebral perfusion through ischemic, edematous brain tissue. High blood pressure should be lowered to prevent cerebral edema, hemorrhagic transformation of the infarction, further vascular damage, and recurrent stroke. However, aggressive treatment of elevated blood pressure could inhibit reperfusion of the ischemic area and thus increase the size of the infarction (Oliveira-Filho

& Koroshetz, 2005; Sacco, 2005).

Current guidelines recommend that for patients not on thrombolytic treatment and with the mean arterial blood pressure (MAP) less than 130 mmHg, systolic pressure (SBP) less than 220 mmHg, and diastolic pressure (DBP) less than 120 mmHg do not need to be treated. However, Patients who are eligible for thrombolytic treatments may be given antihypertensive medicines to keep their blood pressure less than 185/110mmHg (Adams et. Al., 2007; Fulgham et al., 2004; Oliveira-Filho & Koroshetz, 2005). Small doses of intravenous labetalol hydrochloride, sodium nitroprusside or intravenous nitroglycerin can be used with proper titration to treat persistent elevated BP. For patients who are alert and do not have any swallowing difficulties, oral agents like captopril or nicardipine may be prescribed. Sublingual nifedepine should not be the first choice for the acute ischemic stroke patient because of the rapid and dramatic effect on BP after administration. If patients have a history of hypertension, and are to be continued on antihypertensive medication, it would be safe to initiate therapy with decreased doses to prevent hypotensive ischemic injury(ISH writing group, 2003; Sare, Gray, & Bath, 2008).

3) Activity

Patients with acute stroke syndrome are usually on bed rest for the first 24 hours after admission. While on bed rest, the head of the bed (HOB) can be elevated approximately 30 degrees to prevent increased intracranial pressure or to prevent aspiration (Guide to the care of patient with ischemic stroke, 2004; Hinkle & Guanci, 2007). However, elevating HOB may inhibit residual blood flow in the affected area. A repeated-measures quasi-experimental research (Wojner-Alexander, Garami, Chernysher, & Alexandrove, 2005) was conducted to examine the effect of head positioning on intracranial blood flow velocities in 20 acute ischemic stroke patients. Using TCD sonography, they measured mean flow velocities of middle cerebral arteries (MCAs) when the HOB was positioned at 0, 15, and 30 degrees. The researchers reported mean flow velocity in the MCAs increased by an average of 20% when the HOB decreased to 0 from 30 degrees, suggesting that patients with acute ischemic stroke may benefit from the lower HOB position, particularly flat positioning, to promote blood flow into the ischemic area, and ultimately reducing brain infarct volume.

After the acute period, early mobilization is encouraged. NPs should request consults for physical therapy and occupational therapy to promote the patient's early and safe mobility and return to the highest level of pre-morbid functioning. Early mobilization minimizes pneumonia risk, deep vein thrombosis, pulmonary embolism, and pressure sores. Current guidelines (Adams et al., 2007; Albers et al., 2004) recommend prophylactic low-dose subcutaneous heparin or low molecular weight heparins for acute ischemic stroke patients with restricted mobility. For patients who have contraindications (e.g., acute intracerebral hemorrhage) to anticoagulants, use of intermittent pneumatic compression devices or elastic stockings is recommended. Passive and full-range-of-motion exercises for paralyzed limbs can be started within the first 24 hours. Frequent position change, use of alternating pressure mattresses, and close surveillance of the skin help prevent pressure sores. Fall prevention measures are an important part of mobilization. Once the NP has identified patients who can follow commands and can maintain their own energy for exercise, patients can be referred to acute in-patient physical rehabilitation as soon as possible.

4) Diet

Most patients are not allowed to eat until a speech and

swallowing evaluation confirms their safe swallowing ability. Patients with infarctions of the brain stem, multiple strokes, large hemispheric lesions, or altered mentation are at the greatest risk for aspiration. Swallowing impairments can cause aspiration pneumonia and are associated with increased mortality. When necessary, a nasogastric or nasoduodenal tube can be placed to provide nutrition, hydration and medications. Percutaneous placement of an endogastric tube can be selected if a prolonged need for tube feeding is anticipated (Guide to the care of patient with ischemic stroke, 2004; Hinkle & Guanci, 2005).

Wojner and Alexandrov (2002) reported that tube feeding-dependent stroke patients were on average older, had more severe neurologic impairment, longer hospital stays, and cost significantly more to manage during acute care. They identified four independent risk factors for tube feeding: wet voice after swallowing water, hypoglossal nerve dysfunction, high NIHSS score, and incomplete oral labial closure.

Knowledge of these risk factors for swallowing difficulties should inform the NP to order appropriate swallowing studies, which include a pharyngogram and fibroptic endoscopic evaluation of swallowing. If patients are not able to swallow safely and fail swallowing test, NPs have to recommend artificial nutrition such as nasogastric tube or percutaneous endoscopic gastrostomy tube placement.

5) Discharge planning

Glancy et al. (2004) investigated the effectiveness of the NP in a stroke program at an academic medical center, and reported that NP was highly effective in both acute treatment and prevention of stroke, in terms of length of stay and follow-up care. Discharge planning begins at the time of admission. The NP coordinates and facilitates the discharge process. Stroke patients may go home with 24 hour assistance, to acute inpatient rehabilitation, nursing home rehabilitation or to an assisted living facility. Placement is determined consistent with the patients' level of functioning, psychosocial abilities as well as type of medical insurance and their financial status. Discharge planning for cognitively impaired patients may involve issues related to determination of health care proxy, guardianship, power of attorney and living will, as appropriate. NPs should arrange family meetings and provide needed information for families and relatives. NPs also assist with coordinating care and collaborating with the social worker, physical therapist, occupational therapist, neurologist, bedside nurse, and home care nurse to plan for a safe and seamless transition from hospital to home. Daily health team rounds on the unit can be a valuable channel to update every multidisciplinary team member.

III. Conclusion

The diagnosis and management of acute ischemic stroke has evolved rapidly in recent years. Health care professionals need to integrate this expanding research base into their clinical practice to provide evidence-based health care for patients. This paper reviews current guidelines for management of patients with acute ischemic stroke and nursing considerations including the role of a stroke nurse practitioner. Stroke team member including NP should provide the comprehensive care to achieve better outcomes for patients. As a team member, stoke NP is responsible for screening of stroke risk factors on admission, inpatient management, rehabilitation, and discharge planning. Many new trials regarding treatment strategies are underway, thus, NPs and other health care providers should pay careful attention to the latest evidence.

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Case of Mr. S.

Mr. S is a single 46-year-old male who was brought to the ED after being found face-down on his apartment floor, with inability to stand and left-sided weakness. He stated that he had just lost his balance. For the prior 3 weeks he had experienced constant pain in his right neck between shoulder and skull. The pain improved with Geborin® but without complete resolution. He also experienced intermittent blind spots in his vision involving the right eye only. His past medical history included dyslipidemia and headache. He worked as a chef at a university cafeteria. Usual habits included drinking 4-6 cans of beer /night and smoking 1/2 pack a day. He denied illicit drug use. His vital signs were stable. Neurologically he was alert and oriented, but slightly inattentive. He had anosognosia. His speech was slurred although he was able to name, repeat and comprehend. Short- and long-term memory was intact. Left sided visual field cut (neglect) and left facial weakness & decreased sensation were noted. He was positive for pronator drift on left and left sided muscle strength was decreased. He showed sensory extinction on left side and left position sense of fingers and toes was decreased. Left DTRs were hyperactive (3-4). Laboratory studies were remarkable for elevated triglycerides at 516, High-density lipoprotein low at 34 and Low density lipoprotein high at 146. MRI suggested intracranial right MCA dissection.

Based on the neurological exam and MRI results, the team put Mr. S on a Heparin drip per sliding scale with a planned switch to Fragmin SQ and Coumadin PO after acute phase with an INR goal of 2 to 3. A carotid dissection workup that included a 4-vessel angiogram, carotid ultrasound and vascular surgery consult was initiated. Initially the team ordered bed rest with head of bed flat, check NIHSS q 6 hour, NPO until speech & swallowing evaluation completed and Labetolol 20mg IV PRN if MAP >130mmHg. Mr. S was started on Lipitor 10mg qhs and Niacin 50 mg tid for his dyslipidemia, with planned follow-up in 4-6 months to evaluate cholesterol and liver profile. Because Mr. S showed hemineglect and hemiparesis a referral for acute inpatient rehabilitation, including physical and occupational therapy was initiated. Social work was consulted to explore post-discharge home care services. The NP held a family meeting to discuss Mr. S's progress and plan for post-discharge care needs. Prior to discharge, Mr. S agreed to participate in an in-hospital smoking cessation class suggested to him by the stroke NP.