Acknowledgments

RN.com acknowledges the valuable contributions of...
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Off-Label Usage

Due to the results of the (European Collaborative Acute Stroke Study) ECASS-III study, the AHA/ASA recommends that t-PA can be used from 3-4.5 hours after patient was LSN and the CT scan was negative for a hemorrhagic bleed. This recommendation requires more exclusion criteria if t-PA was administered 3-4.5 hours after LSN. However, this use of t-PA is off-label and NOT approved by the Food and Drug Administration (Jauch et al., 2011).

Another off-label use for t-PA is intra-arterial t-PA administration (IA-tPA). It is not approved by the FDA. It is considered for patients who are outside of the three hour window for IV t-PA. Even though it is found to beneficial for some patients it is still considered “experimental.” A neuro-radiologist must perform the procedure before six hours since the patient was LSN. Lower doses of t-PA are infused directly into the suspected artery (AANN Clinical Guideline Practice Series, 2009).

Purpose

The purpose of the “Acute Ischemic Stroke Management” course is to provide evidence-based literature to help prepare nurses for the challenges the acute ischemic stroke patient may present during their emergency department and hospital stays. This course will assist nurses in the early recognition of acute ischemic stroke, and in reviewing cerebral artery anatomy, stroke scales, laboratory values, radiology testing, medications and nursing interventions which are associated with the treatment of this type of patient.
Learning Objectives

After successful completion of this course, you will be able to:
1. Explain the global impact of strokes.
2. Differentiate between a(n) transient ischemic attack, acute ischemic stroke, and hemorrhagic stroke.
3. Identify modifiable and non-modifiable risk factors.
4. Distinguish between the different cerebral arteries.
5. Describe the importance of the head CT scan in diagnosing an acute ischemic stroke.
6. Describe the evidence-based care for the care of the ischemic stroke patient throughout the hospital stay.
7. Identify the risks and benefits of using t-PA.
9. Discuss the future considerations for the management of acute ischemic stroke.

Introduction

Due to the debilitating effects of an ischemic stroke, many personal and financial resources are used. The American Stroke Association (ASA) estimated the direct and indirect cost of stroke care in 2010 was 3.7 billion dollars. It may take weeks to several months to get someone to their best functional level. Even then, they may still need assistance. Therefore, it is important for nurses to have a complete understanding of strokes including risk factors, types of stroke, medical interventions, nursing interventions, monitoring, and long-term care.

www.strokeassociation.org, n.d.
Glossary of Terms

**Aphasia**: Lack of language abilities.

**Atrial Fibrillation**: Irregular rhythm in which the atriums depolarize many times a minute, but do not fully contract.

**Cardiac Output**: Amount of blood the heart pumps out of the left ventricle in one minute.

**Diplopia**: Double vision (Taber, 2009).

**Dysphagia**: Difficulty or inability to swallow (Taber, 2009).

**Dysarthria**: Difficulty in speaking, but able to swallow (Taber, 2009).

**Dysphonia**: Difficulty in speaking, hoarseness (Taber, 2009).

**Last Seen Normal (LSN)**: Is the time when the patient was last seen normal, without neurological deficits.

**Ptosis**: Drooping of the upper eyelid (Taber, 2009).

**Tinnitus**: Ringing, buzzing sound in the ear (Taber, 2009).

**Vasculitis**: Inflammation of the blood vessels (Taber, 2009).

**Vertigo**: Dizziness or lightheadedness (Taber, 2009).

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**Incidence of First & Recurrent Stroke**

The results of having a stroke are financially and physically debilitating. Strokes are the 3rd leading cause of death in the United States. Each year approximately 795,000 people experience a stroke; approximately 610,000 are first strokes and 185,000 are recurrent strokes.

Roger et al., 2011
Incidence: Race & Age

The incidence of first-time strokes in African-Americans is two times that of Caucasians. And approximately 15,000 people will have their first cerebral infarction before the age of 45.

Roger et al., 2011

Incidence: Types of Stroke

There are different types of strokes. Of all the strokes combined 87% are ischemic while the other 13% are hemorrhagic.

Roger et al., 2011

The Brain

The brain is as fragile as it is complex. It requires at least 20% of cardiac output to function properly (Lewis et al., 2011). An interruption to the blood flow will cause a neurological event. The greater amount of time the brain is without appropriate blood flow, the worse the outcome.

Time is Brain

The medical team needs to use their astute assessment skills to find the cause of the neurological deficit and treat it appropriately, because time is brain.

Now, let us take a look at the different types of strokes which affect patients.
Stroke: Types

There are primarily three different types of strokes. They are:

1. Hemorrhagic Stroke, also known as Spontaneous Intracerebral Hemorrhage (SIH)
2. Transient Ischemic Attack (TIA)
3. Acute Ischemic Stroke (AIS)

Note to reader:
Transient Ischemic Attacks and Spontaneous Intracerebral Hemorrhage will be briefly discussed; however this presentation will focus on the acute care of an Acute Ischemic Stroke.
Stroke: Pathophysiology

When the blood supply to brain is interrupted, the occluded vessel results in ischemia and edema in the surrounding tissue. This may cause a worsening of their symptoms.

During a stroke the brain cells and tissues in the center of the infarction die immediately. The cells which surround the center can be saved if perfusion to that part of the brain is restored in a timely manner.

However, as the result of brain cells and tissue dying, the ischemic event causes even more damage and edema. This will continue unless the blood flow can be restored.

Pugh, Mathiesen, Meighan, Summers & Zrelak, 2009
**Hemorrhagic Stroke**

As mentioned earlier, 13% of all strokes are hemorrhagic. It is important for the healthcare provider to be able to recognize the signs and symptoms for this kind of stroke.

**Hemorrhagic Stroke: Incidence**

A hemorrhagic stroke is defined as a bleed which occurs directly into the brain. The mortality of this type of stroke is higher than an ischemic stroke. It carries with it a 30-day mortality rate of 32-52% with half of these deaths dying within two days (Rordorf & McDonald, 2011).

*Image provided with permission by Robin Smithuis*


**Hemorrhagic Stroke: Causes**

Causes of hemorrhagic stroke include, but are not limited to, uncontrolled hypertension, vascular malformation, and aneurysms (Arbour, 2010).
Hemorrhagic Stroke: Symptoms

The signs and symptoms of a hemorrhagic stroke include a very painful and intense headache, nausea, and vomiting.

Transient Ischemic Attack (TIA)

TIAs are precursors or a warning sign to an acute ischemic stroke.

Definition:
TIAs are transient episodes of neurological deficits, usually lasting less than 24 hours, which are caused by a specific part of the brain and do not cause permanent damage (Furie et al., 2011).

Transient Ischemic Attack: Causes

A TIA can be caused by circulating microemboli which temporarily block blood flow to a part of the brain. Or it can be caused by a temporary blockage of the carotid arteries causing the neurological deficits (Lewis, Dirksen, Heitkemper, Bucher & Camera, 2011).

Transient Ischemic Attack: Diagnostic Tools

TIAs do not show up on a Computed Tomography Scan (CT scan) or a Magnetic Resonance Imaging (MRI) (Lewis et al., 2011).
Significance of Transient Ischemic Attack

A patient with a TIA needs to acknowledge the importance of their diagnosis and know the warning signs of a stroke, because 15% of TIAs lead to AIS within three months (Easton et al., 2009). The greatest risk for AIS occurs within the first week following a TIA (Furie et al., 2011).

Ischemic Stroke

Ischemic stroke is caused from a lack of blood flow to a part of the brain due to inadequate perfusion caused by a partial or complete block of the artery (Lewis et al., 2011).

Image provided with permission by Robin Smithuis
**Acute Ischemic Stroke: Risk Factors**

Risk factors are divided into two categories:
1. Non-Modifiable Risk Factors
2. Modifiable Risk Factors

From health screenings to discharge instructions it is imperative for patients to acknowledge the difference between modifiable and non-modifiable risk factors.

**Non-Modifiable Risk Factors**

- **Age**: Two-thirds of all strokes occur in patients greater than 65 years of age (Lewis et al., 2011).
- **Sex**: Strokes are more common in men (Lewis et al., 2011).
- **Race**: African Americans have a higher stroke rate than Caucasians (Roger et al., 2011).
- **Hereditary**: A family history of stroke increases the risk of a stroke (Lewis et al., 2011).
Modifiable Risk Factors

**Hypertension**: Patients with a blood pressure <120/80 cut their stroke risk by half compared with those with hypertension (Roger et al., 2011).

**Diabetes**: Patients with diabetes have a three-fold risk increase for a stroke (Roger et al., 2011).

**Dyslipidemia**: Lipid lowering medications should be used to assist in lowering total cholesterol as well as low-density lipoproteins (LDL) and high-density lipoproteins (HDL) (Furie et al., 2011).

**Obesity**: Abdominal obesity increases risk of stroke (Lewis et al., 2011).

**Physical Inactivity**: Many studies have shown a consistent relationship between physical activity and a reduction in their risk for a stroke (Roger et al., 2011).
Risk Factor: Atrial Fibrillation

It is not clear if atrial fibrillation (AF) can be prevented; however, it is a major contributor to acute ischemic strokes.

Definition of Atrial Fibrillation

AF is comprised of many disorganized arterial impulses which originate in the atria (the top chambers of the heart). The atrium rate can be upwards to 350-600 beats per minute (Lewis et al., 2011).

If the atriums do not fully contract, it will lead to blood being stagnant and a high potential of clots forming.

Atrial Fibrillation as a Risk Factor

AF is responsible for up to 20% of all strokes (Lewis et al., 2011). AF can be asymptomatic and patients do not realize deadly clots are forming in their heart (Roger, et al., 2011).

Did You Know

Evidence is starting to surface stating that exposure to second-hand &/or environmental smoke increases the risk for cardiovascular disease which includes stroke (Furie et al., 2011).
Classification of Acute Ischemic Stroke

Ischemic stroke is further divided into two types of strokes:

1. Thrombotic
2. Embolic

Thrombotic Stroke: Causes

The buildup of plaque and cholesterol which stick to the vessels are viewed by the body as an injury. As a result the body forms clots at the “injured” site. The combination of the plaque and the clots reduces the diameter of the cerebral vessel. Therefore, there is a significant decrease of blood flow to a part of the brain.


Thrombotic Stroke: Risk Factors

Risk factors specifically associated with thrombotic strokes are:

- Atherosclerosis
- Blood clotting disorders
- Increased number of circulating platelets
- Vasculitis

Berhheisel, Schlaudecker & Leopold, 2011
Embolic Stroke: Causes

Embolic strokes are caused by the formation of a clot circulating in the vasculature. The clot wedges into a narrowing of an artery due to atherosclerotic plaque or the clot diameter is larger than the artery.

The heart is the primary source where clots develop and travel to the brain (Bader, 2009).

Embolic Stroke: Risk Factors

Risk factors that are specifically associated with embolic strokes are:
- Dysrhythmias
- Bacterial endocarditis
- Enlarged heart
- Heart failure with ejection fraction less than 30%,
- Myocardial infarction within 30 days
- Rheumatic mitral and/or aortic valve disease

Berhheisel et al., 2011

Timely Management of Acute Ischemic Stroke

During the discussion of the AIS, it is important to remember there are thrombotic and embolic strokes. The treatment for strokes is time dependent; therefore, the treatment algorithm in the acute phase of an ischemic stroke will be the same.
**Acute Ischemic Stroke: Signs & Symptoms**

Signs and symptoms of AIS are unique, but can be subtle at times. The patient may feel a sudden weakness or numbness in the face, arm or leg, especially on one side of the body.

Your patient may develop sudden confusion and difficulty speaking or understanding what is being spoken. They may become frustrated easily and may become tearful or emotional.

Other signs that may be noticed are difficulty in walking or even falling and an inability to get back up. Finally, a severe headache or sudden trouble seeing in one eye or both eyes should prompt the patient to seek emergent medical attention.

Jauch et al., 2010

**Acute Ischemic Stroke: Mimics**

In assessing the patient, it is important to rule out other pathophysiology which may mimic AIS. Some of the differential diagnoses that the healthcare provider may rule out are migraines, seizures (postictal stage), hypoglycemia, syncope and psychogenic disorders.

Anderson et al., 2010

**Cerebral Arteries**

The four cerebral arteries which will be discussed are:

1. Middle Cerebral Artery
2. Anterior Cerebral Artery
3. Posterior Cerebral Artery
4. Vertebral-Basilar Artery

The carotid arteries which are found in the neck will also be discussed.
Cerebral Arteries: Middle Cerebral Artery

The middle cerebral artery (MCA) supplies blood to a large portion of the brain.

The MCA, which branches off the carotid artery, is the most common site of an occlusion which causes an acute ischemic stroke (Tocco, 2011).

A patient with an MCA stroke may exhibit the neurological deficits such as facial asymmetry. For example, when the patient smiles, only one side of their mouth will go up. Also, the patient will exhibit unilateral arm and hand weakness. The patient may have difficulty speaking and their words may be garbled (Tocco, 2011).

Patients with strokes which were caused by an occluded middle cerebral artery (MCA) are at a higher risk for intracranial pressure. Intracranial pressure (ICP) peaks about four days after the stroke (Pugh et al., 2009).

Did You Know

Recent studies have shown that patients who have had a stroke affecting the MCA may have greater blood flow to their brain if their head is laid flat. Though before doing this, physicians need to weigh the potential neurological benefits to the flat positioning against the risk of the patient aspirating (Pugh et al., 2009).
Cerebral Arteries: Middle Cerebral Artery (cont.)

On the left is a scan of an MCA ischemic stroke. On the right, the color yellow represents the parts of the brain to which the MCA supplies blood.

The Anterior Cerebral Artery (ACA) supplies the color of the brain which is designated in red. The Posterior Cerebral Artery (PCA) supplies the color of the brain which is designated in green.

Image provided with permission by Robin Smithuis

Cerebral Arteries: Anterior Cerebral Artery

The ACA supplies the anterior and medial portion of the frontal and parietal lobes.

The ACA rarely is the primary site for strokes.

If a stroke is located here, look for signs and symptoms of sensory loss, lower extremity weakness, behavioral abnormalities, and incontinence (Tocco, 2011).
Cerebral Arteries: Posterior Cerebral Artery

The Posterior Cerebral Artery (PCA) supplies the medial occipital lobe, inferior, and medial temporal lobes.

Signs and symptoms of a PCA stroke are visual disturbances or complete loss of vision (Tocco, 2011).

Image provided with permission by Robin Smithuis
Cerebral Arteries: Vertebral-Basilar

AI that affects the vertebral-basilar circulation influences the cerebellum, brain stem, or both.

Signs and symptoms of cerebellar strokes include deficits in balance and coordination. Other symptoms may include dizziness, nausea, vomiting, headache, and slurred speech (Tocco, 2011).

Brain stem strokes are rare and the mortality rate is high. Some of the signs and symptoms correlated with this location of ischemia are hemiparesis, quadriplegia, double vision, and abnormal respirations.

These patients will typically be in critical condition requiring an intensive care unit for mechanical ventilation support.

Cerebral Arteries: Carotid Artery

The carotid arteries found in the neck also may contribute to an acute ischemic stroke.
**Cerebral Arteries: Carotid Artery Disease**

Carotid artery disease is present when there is a buildup of cholesterol, called atherosclerosis or plaque, in one or both of the carotid arteries. The artery lumen narrows and may occlude blood flow.

Additionally, a piece of atherosclerotic plaque may break off and migrate into the cerebral circulation causing a stroke.

**Stroke Scales**

Stroke scales assist the nurse and physician to differentiate between the different types of strokes, the severity level, and provide guidance for appropriate treatment.

Stroke scales that will be discussed are the National Institute of Health Stroke Scale (NIHSS), the modified National Institute of Health Stroke Scale (mNIHSS), and the Glasgow Coma Scale.

There are different types of scales used to measure stroke deficits. The most commonly used scale is called the National Institute of Health Stroke Scale (NIHSS).

An example of the NIHSS can be found at: [http://www.ninds.nih.gov/doctors/NIH_Stroke_Scale.pdf](http://www.ninds.nih.gov/doctors/NIH_Stroke_Scale.pdf)

**Stroke Scales: NIHSS**

The NIHSS is an assessment of deficits concerning level of consciousness, commands, visual fields, facial and limb weaknesses, aphasia, and dysarthria.

It is scored from 0-42; a score of 0 equals no deficits, while a score of 42 exhibits severe deficits (Pugh et al., 2009).

**Recommendations for Using the NIHSS**

It is recommended to administer the NIHSS upon admission and every 12 hours for the first 24 hours. Then every 24 hours until patient is discharged (Miller & Mink, 2009).
Information & Training on the Use of NIHSS

It is important that the NIHSS is completed the same way each time it is administered. Additional training is necessary for those caring for stroke patients.

For more information and training on the NIHSS visit: http://www.nihstrokeScale.org

Stroke Scales: mNIHSS

The Modified National Institute of Health Stroke Scale (mNIHSS) was derived from the NIHSS. It is recommended the mNIHSS be completed every shift.

Recommendations for Using the mNIHSS

According to Meyer and Lyden (2009), the mNIHSS is an improvement over the NIHSS and leads to great accuracy in treating patients.

According to Meyer and Lyden (2009), weaknesses of the scales are their inability to appropriately assess for posterior circulation deficits.

Stroke Scales: Glasgow Coma Scale

The Glasgow Coma Scale (GSC) assesses eye, motor and verbal responses. The lowest score is a 3, while the highest score is a 15.

The GCS is used concurrently with the NIHSS to evaluate level of conscientious (Mink & Miller, 2011).
Acute Ischemic Stroke: CT Scan

Once the patient has been assessed by the healthcare providers, the next step is to obtain a CT scan to determine if there is a bleed and to see which part of the brain has been affected by the stroke.

A CT scan should be completed within 25 minutes and interpreted within 45 minutes of the patient’s arrival to the Emergency Department (Jauch et al., 2010).

When a patient comes into the Emergency Department with stroke symptoms, healthcare providers should work diligently to diagnose the patient for AIS. One of the most important tests is a CT scan of the head.

A head CT scan takes many images from various angles. Different cerebral arteries each supply particular parts of the brain. It is important to recognize distinct signs and symptoms of a stroke to determine which artery is occluded.

Purpose of the CT Scan

The main purpose of the CT scan is to rule out any type of bleed in the brain. Remember: time is brain. Therefore, once a CT is completed and is negative, the next treatment options must be considered.
The CT Scan as the Gold Standard

Although there are several different types of scans which may provide information on the location of an infarct, the CT scan is considered the gold standard for the initial diagnosis of the patient with signs and symptoms of AIS. The CT scan takes less time than a MRI to complete, and is less expensive.

The information provided by the CT scan will highly influence the physician on what medical interventions will be a part of the patient’s plan of care.

Using the CT Scan to Direct Management

If the CT scan is negative for a hemorrhagic stroke and the patient continues to exhibit signs and symptoms of an acute ischemic stroke, the medical team will evaluate if the patient qualifies for thrombolytic therapy.

CT Scan: Follow-Up

Typically, acute ischemic strokes which have occurred in less than 12-24 hours will not show up on a CT scan (Thompson, 2011). Therefore you would expect to see other higher resolution and angiography scans ordered 24 hours after the CT scan.

Acute Ischemic Stroke: Tissue Plasma Activator (t-PA)

When a hemorrhagic stroke has been ruled out per the CT scan, and the patient continues to exhibit signs and symptoms of AIS, these factors meet the inclusion criteria for thrombolytic therapy with Tissue Plasminogen Activator (t-PA).
**t-PA: Indications**

The indication for t-PA is for the management of AIS. It is the only pharmacological intervention FDA approved for the treatment of AIS.

**t-PA: Inclusion Criteria**

This thrombolytic has a very specific inclusion and exclusion list. Inclusion criteria is as follows:

- The last time the patient was last seen normal (LSN) has to be within three hours.
- The CT scan has to be negative for any bleeding.
- The patient needs to be 18 years of age or older.
- A qualified physician must make a clinical diagnosis of an acute ischemic stroke.
- The patient must continue to have neurological deficit.

Miller & Mink, 2009

**t-PA: Exclusion Criteria**

The exclusion criteria for t-PA includes:

- Any active internal bleeding
- Suspicion OR confirmed bleed in the brain
- If heparin was administered within 48 hours of the onset of the stroke
- Uncontrolled hypertension (185/110) at time of the infusion of t-PA
- A seizure witnessed at the time of the stroke
- Any history of intracranial or intraspinal surgery
- Any history of intracranial bleeding
- Bleeding disorders
- A current use of anticoagulants

Gahart & Narareno, 2011
t-PA: Exclusion Criteria (cont.)

Additionally, t-PA cannot be administered if (Jauch et al., 2010):
- Blood glucose is <50 mg/dl or > 400mg/dl
- There was an arterial puncture at non-compressible site in previous seven days
- The CT Scan show multi-lobular infarction

As part of the exclusion criteria, labs such as a complete blood count, coagulations will be drawn. If there are any acute bleeding tendencies as below, the patient cannot receive t-PA.

Acute bleeding tendencies (Miller & Mink, 2009):
- Platelet count <100,000/mm3
- Prothrombin time (PT) >15 seconds
- International normalized ratio (INR) >1.7
- Activated partial thromboplastin time (aPTT) > upper normal limit

t-PA: Dosing

- t-PA is weight based (maximum dose 90mg):
  - 0.9 mg/kg
    - 10% of dose IV bolus over 1-2 minutes
    - 90% of dose IV infusion over 1 hour
- The nurse will bolus the calculated amount followed by an infusion administered via a dedicated IV line.
- If invasive lines are required they should be placed prior to t-PA infusion.
- Once t-PA is initiated blood pressure must be kept under 185/110 to decrease the chance of hemorrhaging.

Pugh et al., 2009
t-PA: Blood Pressure

If the patient receiving t-PA has a blood pressure greater than 185/110, anti-hypertensive IV medications should be administered. Labetalol and nicardipine are recommended for blood pressure control for the acute ischemic stroke patient.

t-PA: Complications

There are risks involved with t-PA which should be discussed with the patient and their family. The risks include bleeding in the brain, internal bleeding (non-brain), and an allergic reaction to t-PA itself (Jauch et al., 2010). Because there is such a high risk of bleeding internally and into the brain, frequent neurologic and invasive line insertion site checks must be completed and documented.

t-PA: Criteria Not Met

If t-PA is not administered due to the patient being out of the window of opportunity or did not meet all the inclusion criteria, then physicians will look to prescribing anti-platelets, such as aspirin, if not contraindicated (Jauch et al., 2010).

If a patient does not receive t-PA, it is appropriate to treat blood pressure 210/120 or greater. It is also recommended to use labetalol or nicardipine for reduction of blood pressure in the non- t-PA patient.
t-PA: Off Label Use

Due to the positive results of the European Collaborative Acute Stroke Study (ECASS-III study), the AHA/ASA recommends that t-PA can be used from 3-4.5 hours after patient was LSN and the CT scan was negative for a hemorrhagic bleed. This recommendation requires more exclusion criteria if t-PA was administered 3-4.5 hours after LSN.

However, this use of t-PA is off-label and NOT approved by the Food and Drug Administration (FDA).

Jauch et al., 2010

Acute Ischemic Stroke: Blood Pressure

As healthcare providers, it is important to note that for the patient who is having an acute ischemic stroke, it is normal for the blood pressure to rise during a stroke. The blood pressure rises due to the opening of the collateral vessels trying to supply blood to the ischemic part of the brain. This is a compensatory mechanism which helps the brain to perfuse the ischemic tissue of the brain called the penumbra.

The blood pressure will naturally fall 24-48 hours later.

Bader, 2009
Penumbra

The penumbra is the area of reduced blood flow which centers around the ischemic area. If blood flow is properly restored within three hours and ischemia stopped, there is decreased chance of neurological damage (Lewis et al., 2011).

Image provided with permission by Robin Smithuis

Interventional Radiology

If a patient is outside of the three-hour window of IV t-PA administration there is another intervention option.

Mechanical embolectomy is a procedure where the clot is mechanically removed from the artery. A neuroradiology interventionalist must be present to perform this intervention.
Interventional Radiology: Mechanical Embolectomy

If a patient is not a candidate for t-PA or arrives out of the window for t-PA administration, the patient may undergo a mechanical embolectomy. The patient has up to eight hours from LSN to receive this treatment.

The Merci Retrieval System was FDA approved in 2004. It is used by a neuro-radiologist to perform a mechanical embolectomy. The FDA approved another mechanical embolectomy device in 2008, called the Penumbra System (Pugh et al., 2009; Mink & Miller, 2011).

Interventional Radiology: Off Label

Another off-label use for t-PA is intra-arterial t-PA administration (IA-tPA), but is not approved by the FDA. It is considered for patients who are outside of the three hour window for IV t-PA. Even though it is found to be beneficial for some patients, it is still considered “experimental.” A neuro-radiologist must perform the procedure before six hours since the patient was LSN. Lower doses of t-PA are infused directly into the suspected artery/clot.

Pugh et al., 2009
Summary of Acute Ischemic Interventions

<table>
<thead>
<tr>
<th>Last Seen Normal (LSN)</th>
<th>Intervention</th>
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<tbody>
<tr>
<td>0-3 hours</td>
<td>IV t-PA</td>
</tr>
<tr>
<td>3-4.5 hours</td>
<td>IV t-PA (off-label)</td>
</tr>
<tr>
<td>0-6 hours</td>
<td>IV t-PA (off-label)</td>
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<tr>
<td>0-8 hours</td>
<td>Mechanical Embolectomy</td>
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<tr>
<td>&gt; than 8 hours</td>
<td>Anticoagulants &amp; Antiplatelets</td>
</tr>
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Swallowing Evaluation & Assessment

After the interventions are completed and the patient is stable, the next thing to do is to evaluate the patient for swallowing.

One of the top complications of a stroke is aspiration (Bader, 2009).

All patients should have a swallowing assessment before oral medications or nutrition is initiated (Berhheisel et al., 2011).
Swallowing Screens: Evidence-Based Practice

A study reviewed thirty-five swallowing screens and protocols. The four best screens reviewed took 2-10 minutes to complete. They assessed oropharyngeal functions such as speech deficits and asymmetry or weakness of the face, tongue, and palate.

Most of the screens completed an assessment of the patients’ ability to swallow water.

Schepp, Tirshwell, Miller & Longstreth, 2011

Swallowing Screens

If the patient passes the swallowing screen, the patient is allowed to take nutrition and medication by mouth.

If the patient does not pass the swallowing screen, the patient remains NPO. Further consultation to a Speech Language Pathologist is required.

Acute Ischemic Stroke: After the Emergency Department

A patient diagnosed with an acute ischemic stroke who received t-PA will go to a specialized nursing unit or the intensive care unit (ICU). There they will be monitored for worsening signs and symptoms. After they have stabilized, they will be transferred to a regular nursing unit and continue their progress towards discharge.
Acute Ischemic Stroke Management: The First 48 Hours

In the first 48 hours it is important to start addressing other factors that can impact the patient’s recovery. The following conditions and their nursing interventions will be discussed:

- Intracranial pressure
- Vital signs
- Oxygenation
- Blood pressure management
- Hypo-hyperglycemia
- Maintaining normal temperature
- Deep vein thrombosis
- Nutrition
- Constipation
- Risk for infections
- Immobility

The First 48 Hours: Intracranial Pressure

Due to the swelling and edema cause by the ischemia, intracranial pressure (ICP) may rise.

Signs and symptoms of ICP include headache, decreased level of consciousness, confusion, aphasia, changes in vital signs, pupil changes (late sign), and respiratory patterns (late sign) (Mink & Miller, 2011).

Did You Know

The current AHA guidelines do not recommend using corticosteroids in the treatment of acute cerebral edema in stroke patients (Pugh et al., 2009).
The First 48 Hours: Vital Signs & Dysrhythmias

Vital signs should be taken every 1-2 hours for the first 8 hours. Vital signs may need to be taken more frequently if the patient becomes unstable. Follow your hospital’s policies and procedures.

Regular, intermittent neurological checks are an important assessment tool. Neuro checks should be completed every 15 minutes during the administration of t-PA, and are usually decreased to Q30 minutes for two hours after t-PA is completed, and the patient is stable. After two hours, neuro checks are usually decreased to hourly exams. Always check your facility’s Policy and Protocol for guidelines on frequency of neurological assessments.

In addition, the patient’s cardiac rhythm should be monitored for 24 hours to assess for any new dysrhythmias. Patients suffering from an acute ischemic stroke are also at high risk for a heart attack.

Pugh et al., 2009

The First 48 Hours: Oxygenation

Unless otherwise contraindicated, as in conditions such as Chronic Obstructive Pulmonary Disease (COPD), oxygen saturation should be kept greater or equal to 92%. If the patient cannot keep their oxygen saturations above the prescribed amount, then the nurse needs to frequently assess their lung sounds for possible aspiration. The physician may order a chest x-ray or increase their oxygen use.

Another intervention to consider is keeping the patient’s bed elevated 30 degrees or higher if not contraindicated. Other ways to prevent aspiration is to keep the patient on their side and keep their airway clear of secretions.

Pugh et al., 2009
The First 48 Hours: Blood Pressure Management

As mentioned earlier in the course, if the patient has received t-PA, their blood pressure needs to remain under 185/110. If the patient is not a candidate for t-PA then their blood pressure may run as high as 220/120. Blood pressure is managed with intravenous anti-hypertensives such as labetalol and nicardipine.

The First 48 Hours: Hypoglycemia & Hyperglycemia

During the acute phases of an acute ischemic stroke it is important to avoid both hypo- and hyperglycemia.

Recent studies have shown that blood glucose levels greater than 200 mg/dl have contributed to poor outcomes. When caring for your patient, try to keep your patient’s blood glucose level less than 140 mg/dl.

Pugh et al., 2009

The First 48 Hours: Free of Fever

Jauch et al., (2010) states a fever over 99.5 degrees fahrenheit should be treated.

Higher temperatures and increasing tissue damage from the ischemia equates to increased intracranial pressure (Thompson, 2011).

The studies have shown that patients with AIS, who have a fever, have a higher rate of morbidity and mortality (Pugh et al., 2009).
The First 48 Hours: Deep Vein Thrombosis

Deep vein thrombosis (DVT) prophylaxis is important due to the high probability your stroke patient may not be as mobile as they were prior to the stroke.

Expect the physician to order sequential compression devices or heparin products when appropriate (Bernheisel, et al., 2011).

Do not forget to turn and ambulate your patients as tolerated.

The First 48 Hours: Nutrition

A nutrition assessment should be completed as soon as the patient is stable. Due to difficulties in swallowing, other means of receiving nutrition are available. A patient can receive nutrition enterally through tube feedings. Using tube feedings for nutrition uses the normal physiological functions such as digestion and absorption.

However, enteral feedings can cause constipation and/or diarrhea. It is important to have a registered dietician be involved in the patient’s nutritional plan.

Total Parenteral Nutrition

Total Parenteral Nutrition (TPN) or Peripheral Parenteral Nutrition (PPN) is another way to give patients nutrition. TPN and PPN are administered intravenously. Even though the patient is getting nutrition, it carries risks such as infection because it needs to be given through a central or peripheral line. Also, it is more expensive than enteral feedings.

Pugh et al., 2009
The First 48 Hours: Pressure Ulcer Prevention

Due to the potential for poor nutrition and mobility, pressure ulcer prevention is imperative. Your facility should already have prevention measures and protocols in place. It is very important to assess your patient’s skin condition every shift. Document your findings and consult a wound care nurse specialist as needed.

The First 48 Hours: Constipation

Constipation is a common bowel problem with those diagnosed with AIS. There are a lot of factors that contribute to constipation such as:

- Immobility
- Not receiving enough IV or PO fluids
- Low fiber diet
- Stress
- Narcotics received for their pain

Pugh et al., 2009

Constipation: Nursing Interventions

Nursing interventions should include asking the patient what kind of bowel regimen and routine did they have before the stroke. If at all possible, try to replicate the routine in the hospital.

The nurse’s responsibility is to assess for constipation and communicate to the other staff what the patient’s bowel program is, as well as ensuring proper medications for constipation have been ordered.

Pugh et al., 2009
The First 48 Hours: Risk for Infections

Pneumonia and urinary tract infections (UTIs) remain a great risk to those patients who have suffered an acute ischemic stroke. Due to their immobility and difficulty clearing secretions effectively, preventing pneumonia remains a challenge.

Pugh et al., 2009

Risk for Infection: Pneumonia

Up to 35% of patients with a stroke die from pneumonia. Nurses and the healthcare team can assist their patients by encouraging early mobility and aggressive pulmonary care, such as cough, deep breathing and incentive spirometers.

Pugh et al., 2009

Risk for Infection: Urinary Tract Infections

Another infection healthcare providers need to be cautious of is urinary tract infections (UTIs). The prevalence of UTIs vary in stroke patients. They are usually caused by indwelling catheters used when they are in a critical care unit or the stroke may have caused some changes to their urinary sphincter control.

UTI Prevention

An UTI can be prevented by ensuring the catheter was inserted using sterile techniques and completing perineal care as needed.

Another UTI prevention technique is removing the indwelling catheter as soon as the patient is stable and is able to use a bed pan or bedside commode.
The First 48 Hours: Immobility

Immobility can lead to a number of post-stroke complications such as pressure ulcers, pneumonia and contractures. Frequent turning and range of motion exercises can decrease complications related to immobility and should be implemented as the patient is admitted to the intensive care unit or specialized nursing unit. Occupational and physical therapy should be consulted.

Repositioning Hints

Repositioning the patient who has suffered a stroke can be challenging. To prevent any further harm, avoid pulling on the affected arm when repositioning the patient or getting them in and out of bed (Pugh et al., 2009).

Collaborative Care

The patient who is admitted to the hospital with an acute ischemic stroke will need the assistance of almost every service offered by the hospital. Nurses need to be proactive for their patient to ensure specialized therapies such as speech, occupational, and physical therapy are consulted.

Primary Stroke Center Certification

In 2003, The Joint Commission (TJC) with the assistance from the AHA/ASA launched a program called The Joint Commission’s Primary Stroke Center Certification. As of January of 2011 there were over 800 certified primary stroke centers in 49 states (www.jointcommission.org, n.d).
Primary Stroke Centers

The TJC’s goal is to recognize excellence in centers/hospitals where the staff is exceptional in the comprehensive care of stroke patients. The on-site review of a stroke center is conducted every two years and the certification process is based on evaluation of standards, clinical practice guidelines, and performance measurement activities.

www.jointcommission.org, n.d

Case Study: Mr. Y

It is a Sunday afternoon in the Emergency Department (ED) and you are working the 1100-2300 shift. You have had a steady flow of patients so far and at 1300 you tell your charge nurse you are headed to the cafeteria to get some lunch. While browsing the selections of food, you notice some people gathering around one of the tables in the dining area. You investigate the situation of chaos and find an older African-American gentleman who is markedly overweight staring blankly at you with right sided facial droop and drooling. His wife tells you he is a diabetic and thinks he is just experiencing “low blood sugar.”

Case Study: Calling a Code

You also notice a pack of cigarettes in his shirt pocket and a prescription bottle of a cholesterol lowering medication on the table.

From the astute assessment skills of his presentation, and noting the risk factors for a stroke (African American, diabetes, cigarette smoking, and treatment for high cholesterol) you proceed to call a Code Stroke. In your facility, Code Stroke has just as much importance as a Code Blue and within a matter of minutes, Mr. Y is in the care of your dedicated Emergency Department physicians and nurses.
**Case Study: Initial Management**

Mr. Y is laying down with his head of bed (HOB) 30 degrees. You know this is important in decreasing intra-cranial pressure as well as lowering the risk for aspiration.

The ED physician is at the patient’s side and starts to elicit a patient history from the wife. During history taking you are placing him on the EKG monitor, securing the blood pressure cuff and, pulse-oximetry probe.

**Case Study: Patient History & Medications**

<table>
<thead>
<tr>
<th>Patient History</th>
<th>Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-pack/day cigarette smoker</td>
<td>Atenolol</td>
</tr>
<tr>
<td>Type II diabetic</td>
<td>Metformin</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>Simvastatin</td>
</tr>
<tr>
<td>Heart attack one year ago</td>
<td>Baby aspirin</td>
</tr>
</tbody>
</table>

**Case Study: Neurological Assessment**

The patient is alert, his pupils are equal and reactive to light, he cannot perform any task you ask of him, he exhibits moderate sensory loss, has complete right sided facial paralysis, and his right arm and leg do not move.

**Case Study: Physical Assessment Data**

The cardiac monitor shows a regular rhythm. His BP is 170/80, SpO2 on room air is 93% and a bedside glucose reveals to be 185.
Case Study: Labs

Now it is time to get some labs.

You draw the patient’s blood and send it off to the lab.

<table>
<thead>
<tr>
<th>Patient’s Lab Orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC – Complete Blood Count</td>
</tr>
<tr>
<td>CMP – Complete Metabolic Panel</td>
</tr>
<tr>
<td>INR – International Normalized Ratio</td>
</tr>
<tr>
<td>PT/INR – Prothrombin Time</td>
</tr>
<tr>
<td>PTT – Partial Prothrombin Time</td>
</tr>
<tr>
<td>Troponin - I</td>
</tr>
</tbody>
</table>

Case Study: The NIHSS & CT Scan

Next you complete the NIHSS and it reflects significant neurological deficits. Within twenty-five minutes Mr. Y is in the CT suite.

Forty-five minutes later, the radiologist calls the results to the Emergency Department physician as well as the neurologist who was consulted. The results are a negative CT scan of the head, no active bleeding noted, and negative for any ischemic areas.
**Case Study: Reviewing Labs & Providing Support**

Now you know the CT scan is negative and upon reassessment of the patient, he is still experiencing significant neurological symptoms. His last blood pressure was 175/90. Knowing this is a scary time, you give emotional support to Mr. Y and his wife. The labs have just resulted. Next, you go and review them with the physician.

**Pertinent Lab Results for Mr. Y**

<table>
<thead>
<tr>
<th>Lab</th>
<th>Normal</th>
<th>Mr. Y Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>4300 – 10,800 mm3</td>
<td>10,000 mm3</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>13 – 18 g/100ml</td>
<td>15 g/100ml</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>42 – 52%</td>
<td>45%</td>
</tr>
<tr>
<td>PT/INR</td>
<td>11 – 12.5/0.7 – 1.8</td>
<td>11.5/1.0</td>
</tr>
<tr>
<td>PTT</td>
<td>25 – 38 sec</td>
<td>&lt;30 sec</td>
</tr>
<tr>
<td>Platelets</td>
<td>150,000 – 350,000 mm3</td>
<td>230,000 mm3</td>
</tr>
<tr>
<td>BUN</td>
<td>8 – 25 mg/100ml</td>
<td>22 mg/100ml</td>
</tr>
<tr>
<td>Creatinine</td>
<td>0.6 – 1.5 mg/100ml</td>
<td>1.4 mg/100ml</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.5 – 5.0 mEq/L</td>
<td>4.0 mEq/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>135 – 145 mEq/L</td>
<td>140 mEq/L</td>
</tr>
<tr>
<td>Glucose (fasting)</td>
<td>70 – 110 mg/100ml</td>
<td>190 ml/100ml</td>
</tr>
<tr>
<td>Troponin-I</td>
<td>0 – 0.1 ng/ml</td>
<td>&lt;0.1 ng/ml</td>
</tr>
</tbody>
</table>

**Case Study: t-PA**

Since Mr. Y met all the inclusion criteria and his CT scan was negative for a bleed, the neurologist recommended IV t-PA to be ordered.

The physicians discussed their findings and recommendations with Mr. Y and his wife. Mr. and Mrs. Y wanted to proceed with the t-PA infusion. IV t-PA was ordered. A second IV line was placed and a foley catheter was ordered and placed prior to the t-PA administration. A bolus with given followed by an infusion over an hour.
Case Study: Blood Pressure Management
Mr. Y’s blood pressure consistently stayed at 210/100 as the infusion was initiated. Orders were received to give IV labetalol to keep the pressure under 180/110.

Case Study: Swallowing Screen
After his IV t-PA was completed, Mr. Y was transferred to the intensive care unit. There a swallow screen was completed. He did not pass the screen due to coughing when 5mL of water was given to him. An order was placed to the speech language pathologist to further evaluate his swallowing.

Case Study: Acute Rehabilitation
Mr. Y’s neurological status slowly improved and he was able follow commands appropriately. However, he could only move his arm and leg slightly and his facial drooping was still present. By day three, many therapies had been able to work with Mr. Y and he was able to walk with a walker to his hospital room door and back to bed.

Case Study: Long-Term Rehabilitation
Mr. Y was transferred to a rehabilitation facility on day five and continued to make improvements. He was able to be discharged home two weeks later.

Mr. Y’s outcome was good because he was at a hospital when his symptoms started. He was able to receive t-PA in a timely fashion. Dedicated nursing care helped keep Mr. Y from acquiring any infections or pressure ulcers.
Future Treatments: Therapeutic Hypothermia

In the case study, Mr. Y received evidence-based care for an acute ischemic stroke. Still researchers continue to conduct studies to improve upon current treatments.

Researchers are discussing how therapeutic hypothermia (TH) is being considered one of the most promising neuroprotective therapies for an acute ischemic stroke.

The goal of TH is to decrease cell death in the penumbra.

Studies have shown TH would generate positive outcomes for the patient suffering an ischemic stroke.

Many elements need to be further researched such as:
  • Optimal initiation time
  • Cooling and temperature monitoring method
  • Target temperature
  • Duration of cooling and re-warming

Klassman, 2011

Future Treatments: Neuroprotective Agents

Research is ongoing to produce a safe medication that is neuroprotective during an acute ischemic stroke. To date, no medications have been approved by the FDA.
References


References (cont.)


The Joint Commission www.jointcommission.org.
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