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# The Pathophysiology Of Acute Ischemic Stroke

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## Introduction

There are two types of stroke : hemorrhagic and ischemic stroke (Davis, & Lockhart, 2016). For this poster, the student will focus on the Pathophysiology of Acute Ischemic Stroke (AIS). AIS is characterized by the impact of an obstruction within a blood vessel supplying blood to the brain. Stroke is one of the leading causes of death and disability worldwide (Sacco et al., p. 2065, 2013).

This student worked as a nurse at interventional radiology; observing patients with AIS undergoing clot retrieval procedure or receiving tissue plasminogen activator (tPA) and thrombolysis treatment.

Consequently, the student picked up this topic to further understand AIS, in depth, and its relations with pathophysiology.

Suwanwela stated that (as cited by Paspalj et al., 2015), epidemiological data have shown that stroke is the leading cause of adult disability and the second or third leading cause of death in the most of developed countries (Paspalj et al., 2015).

The urgency to treat acute ischemic stroke is apparently comparable with acute myocardial infraction (MI) in hospitals. Both require rapid and timely management which are necessary to restore normal blood flow to the brain or heart and to reduce permanent tissue damage. Pathophysiology is significant in relation to cellular level brain tissue.

Understanding the early signs and symptoms of AIS and the timely treatment will reduce the devastating effects. Mozaffarian explained that (as cited by Alfieri et al., 2016), AIS has a heterogeneous etiology caused by modifiable risk factors including hypertension, diabetes mellitus (DM), high level blood cholesterol, sedentary lifestyle, smoking, as well as, unmodifiable risk factors, such as genetic, age, and sex (Alfieri et al., 2016).

This poster discusses the pathophysiology of AIS and the importance of timely intervention to minimize irreversible tissue damage.

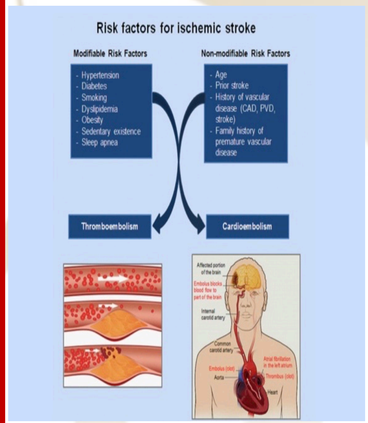


Figure 1. The above information is retrieved from http://www.educatehealth.ca/physician/quick-reviews-(qr)/cerebrovascular/risk-factors-for-ischemic-stroke.aspx.

Ischemic stroke: abrupt onset of neurological deficits resulting from reduced cerebral blood flow most often a thrombo-embolic vaso-oclusion event.

## Pathophysiological Process

### Signs and Symptoms

Recognizing the signs and symptoms of acute ischemic stroke in timely fashion is very important because the treatment window to receive tPA is 3 –4.5 from the onset of the symptom (Anderson, J., 2014).

Some of the sign and symptoms of AIS include, but not limited to:

- Slurred speech & facial droop
- Blurred vision or double vision
- Sudden onset of headache and vertigo
- Unsteady gait and isolated weakness of the arm or leg ( Anderson, p. 24, 2014).

➢ Currently , American Heart Association (AHA) and National Institute of Neurological Disorders and Stroke (NINDS) recommend healthcare facilities displaying posters and educational material for the public (Davis &Lockhart, 2016).

As the adage goes: "time is brain". Beware of the warning signs of stroke to your own life or the life of loved ones.

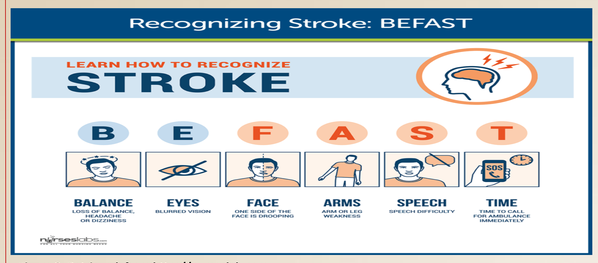


**Figure 2. Retrieved from https//nurseslab.com**

### Underlying Pathophysiology

As a grave neurological problem, stroke, is considered one of the most prevalent diseases that human beings have faced. The pathophysiology of stroke is so complicated. The pathophysiological process comprises of different inflammatory pathways, mechanisms, oxidative damages and imbalances. The end-result of ischemic stroke is the severe damage of neuronal functions leading to neuronal death and disability (Xing et al., 2012).

In the area of the brain with reduced blood supply or blockage, adenosine triphosphate (ATP) use continues in spite of reduced synthesis, affecting the total ATP level to reduce and initiate lactate acidosis, leading loss of ionic homeostasis, and neuronal injury (Xing et al, 2012).

At the cellular level, the sudden interruption or blockage of blood flow to the brain due to blood clot (thrombus) or a plaque (fatty deposits) deprives the brain tissue, from the necessary nutrients and oxygen which leads to irreversible brain tissue damage. Ischemic stroke causes mitochondrial cell death.

Hypoxia is caused by ischemic changes. Hypoxia induces inflammation and inflamed lesions.
Inflammation and Inflammatory markers are very big part of AIS pathophysiology especially in reference to reperfusion.
Clotting cascade: inflammation causes coagulation or clotting. Cascade of cerebral ischemia begins with arterial occlusion and ends with cell death.

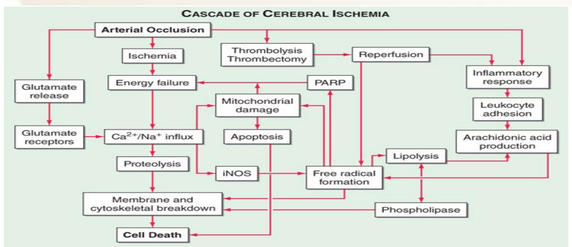


Figure 3. The above information is retrieved from www. accessmedicine.mhmedicca l. com

Eventually, these multimodal cascades will result in neuronal death. To fully grasp the pathophysiology process, understanding the significance of pathophysiology is crucial.

## Significance Of Pathophysiology

- In the United States, the significance of AIS is its devastating effects on hundreds of thousands of patients on their day to day activities. For instance, 795 000 people experience strokes every year here in the United States (Babkair, 2017).
- The blockage of blood flow to the brain inevitably causes acute ischemic stroke (Xing et al, 2012). Once the tissue oxygenation starts, depending on the time elapsed, the situation of the patient changes. The lesser the time the better the prognosis.
- For AIS treatment, tPA is the gold standard and also associated with improved clinical patient outcome ( Xing et al., 2012). The sooner the IV tPA is administered after the onset of stroke symptoms, the better the outcome ( Anderson, 2014).
- According to the National Institute of Neurological Disorders and Stroke (NINDS), patients who are candidates for tPA should receive 0.9mg/kg tPA and for severe ischemic deficits with NIHSS score ≤ 10 or occlusion of larger arteries shown in CT angiogram; endovascular treatment recommended (Payabvash et al., 2015).
- For patients who are not candidates for IV t-PA and presented to the hospital within 8 hours of the symptom, currently, a variety of other treatments such as low dose IA thrombolytic, mechanical thrombectomy, angioplasty, and stent placements (Payabvash et al., 2015).

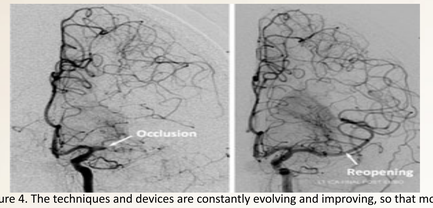


Figure 4. The techniques and devices are constantly evolving and improving, so that more and more arteries can be opened safely and effectively, as seen in the following case, where an occluded (closed) artery was reopened. Retrieved from https://med.nyu.edu/radiology/about-us/subspecialties/neuro-interventional/our-services/acute-ischemic-stroke

➢ Once the treatment protocol initiated with tPA or endovascular treatment, interventional nurse, the neuro ICU nurses, and ED nurses and APNs need a close assessment and required to do neuro checks frequently for any neurological deterioration or changes.

➢ Although the main goal of the treatment is to restore or improve cerebral blood flow, the reperfusion itself can also cause cascades of secondary injury (Xing et al., 2014).

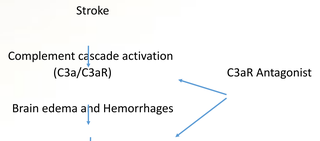


Figure 5. The above information retrieved from ( Zhao et al., 2017)

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## Implication for Nursing Care

➢ It is important for this nurse in her current job and in the future, advanced practice nurse career, to understand the pathophysiology of acute ischemic stroke and the implications of implementing timely intervention. Most importantly, the advance practice nurse needs to understand the new guidelines for acute ischemic stroke management.

➢ Currently, the APNs are used alongside with physicians, more and more, in emergency departments and outside the hospital, as well as, in hospital management. Early identification of stroke patients is crucial for saving the lives of many patients, preventing disability, in addition to, reducing financial burdens.

➢ The implications of nursing intervention and the nurse's role in AIS includes, proper triage, early identifications, ordering non-contrast CT, calling stroke alert, calling pharmacy with patient weight for tPA, finger stick for blood glucose and starting two large bore IV's and blood works.

➢ The American Heart Association guidelines recommend a noninvasive non-contrast study such as computed tomography(CT) for the initial imaging followed by CT angiogram or perfusion studies (Qureshi et al., 2015).
➢ The nurse should work with the physician to gather a thorough past medical history and current medication lists for the physician to complete inclusion/exclusion checklist before administering tPA.
➢ The stroke alert will initiate the team to begin the diagnostic test process; but it is very important to provide the necessary information to the multidisciplinary team through a report or debriefing so that everyone is in the same page.
➢ National Institute of health Stroke Scale (NIHSS) is used to best assess and confirm the presence of stroke and to quantify the degree of neurological deficits ( Anderson, 2014).

The institute of Neurological Disorders and Stroke (NINDS) golden hour workup for AIS time targets:

✓ 10 min initial assessment of patient
✓ 15 min patient seen by stroke team
✓ 25 min non-contrast CT scan performed
✓ 45 min CT scan results available
✓ 60 min initiation of fibrinolytic therapy (Anderson, 2014).

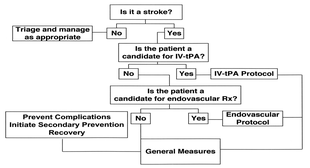


Figure 6. Algorithm for the management of patients with acute ischemic stroke. IV-tPA indicates intravenous tissue plasminogen activator; RX, treatment. The above information is retrieved from www.circ.ahajournals.org/content/116/13/1504

### Conclusion

Ischemic stroke is characterized by the impact of an obstruction within a blood vessel supplying blood to the brain. The underlying pathophysiology process of acute ischemic stroke is caused by the blockage of blood flow to the brain due to blood clot (thrombus) or a plaque (fatty deposits) which deprive the brain tissue, from the necessary nutrients and oxygen. Advance practice nurses, like this student, should equip themselves with the current protocols and timely interventions to save patients from devastating AIS disability and financial burden. At this juncture, many advance practice nurses are working in front line on identifying stroke symptoms and providing the crucial care that patients need.

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