Objectives

- Review the impact of stroke, recognize signs and symptoms
- Define risk factors
- Learn Pathophysiology of stroke
- Learn Pre-hospital recommendations for Dispatch and EMS and define the 10 steps for EMS responders
- Review medical management and treatment options for stroke
- Review national guidelines and recommendations for stroke

Overview

- Key Points
- The Impact of Stroke
- Time is Brain!
- What is our goal?
- Signs and Symptoms of Stroke
- Public Awareness
- Stroke: What is it?
- The Problem with TIA's
- Risk Factors
- Stroke Classification
- Pathophysiology of Stroke
- Cerebral circulation
- ACLS Guidelines
- Emergency Dispatch
- 10 steps for EMS responders
- Stroke Scales
- NINDS Recommendations
- Hospital Care and Treatment Options
- Medical Management
- EMS Role in Research
- ACLS Foundation Facts

Key Points

- EMS play a critical role in the Emergency care of acute stroke patients.
- Over 400,000 acute stroke patients are being transported annually by EMS providers.
- Just over half of all stroke patients use EMS, but those who do comprise the majority of patients presenting within the 3 hour window for acute treatment.
- EMS use decreases time to hospital arrival, physician exam, CT imaging, neurologic evaluation, and ability to implement acute stroke intervention.
The Impact of Stroke

- There are more than 750,000 strokes per year.
- 163,000 die from stroke every year in America.
- Stroke is the third leading cause of death.
- Stroke is the leading cause of disability in adults.
- 4.4 million survivors; only 50-75% of stroke survivors regain functional independence.
- Estimated direct/indirect costs for 2007: $62.7 billion.
- 14% of persons who survive a first stroke or TIA will have another within one year.

Time is Brain!

- Every second 32,000 neurons die.
- Every minute 1.9 million neurons die.
- Every hour 120 million neurons die.
- Completed stroke: Loss of 1.2 billion neurons.
- Blockage of one blood vessel will cause ischemia within 5 minutes.

What is our goal?

- Reduce stroke mortality.
- Improve quality of life for stroke survivors and their families.

Focus:
- Increasing public awareness.
- Timely initiation of 911 system.
- Deployment of informed EMS personnel.
- Delivery to a stroke center.

Signs and Symptoms of Stroke

- Sudden numbness/weakness of the face, arm, or leg, especially on one side of the body.
- Slurred speech/difficulty speaking/understanding.
- Sudden change in vision (blurred or decreased vision) in one or both eyes.
- Dizziness, loss of balance or coordination.
- Acute onset severe headache.
- Nausea or vomiting with any of the above symptoms.
- Confusion or disorientation with above symptoms.
Additional stroke symptoms

- Decrease level of consciousness
- Difficulty with swallowing and secretions
- Respiratory distress
- Pupil changes
- Convulsions
- Loss of bowel or bladder control

Public Awareness

2001 National Stroke Association survey showed:
- 21%-Unaware stroke can be prevented
- 30%-Concerned about suffering a stroke
- 37%-Did not know stroke occurs in the brain
- 40%- Knew someone who had a stroke
- 87%-Would call 911 if experiencing one-sided weakness

What is really happening in your community?

- The average time from symptom onset to the ED is 17-22 hours.
- What percentage of people over 50 who do not recognize s/s of stroke? 42%
- What percentage of people over 50 can’t name a single stroke symptom? 17%
- Only 38% call 9-1-1
- Only 20-25% arrive within 3 hours

F – A – S – T

- Face – smile
- Arm raise
- Say a phrase
- Time – call 9-1-1
**Stroke: What is it?**

- An acute interruption of blood supply to the brain
- Deprivation of oxygen and glucose to nerve cells
- Ischemia within 1 hour
- Cytotoxic and vasogenic edema
- Cellular dysfunction and death

**Cytotoxic Edema**

- Cytotoxic: Cells lose ability to balance sodium and calcium
- Sodium and water cause cell swelling
- Calcium causes more swelling
- Occurs in seconds; takes 2-3 hours
- Swelling disrupts cellular function

**Vasogenic Edema**

- Blood vessels become “leaky”
- Allows proteins into cells, causing swelling
- Swelling compresses brain tissue
- If swelling large enough, brain can herniate
- Takes several hours to days
- Irreversible!! (Prevention is key)

**Ischemic Penumbra**

- The ischemic penumbra is the viable but threatened brain tissue between the normal tissue and the tissue of the infarct
- Acute stroke therapies focus on reversing or preventing ischemic damage. “Penumbral Salvage”
Ischemic vs. Hemorrhagic

- Large Ischemic with midline shift

Ischemic vs. Atherosclerotic

- Circle of Willis with severe atherosclerosis & vertebral artery aneurysm

The Problem With TIA’s (Transient Ischemic Attack)

- Classic Definition: “A TIA is a neurological deficit lasting less than 24 hours due to focal ischemia
- Proposed Definition: “A TIA is a brief episode of neurological dysfunction caused by focal brain ischemia with clinical symptoms typically lasting less than 1 hour without acute evidence of infarction”
- A “TIA” has sudden onset and rapid resolution
- Rule of Thumb: The event should last 2-20 minutes
- If the event lasts more than 1 hour it is probably a minor stroke
- The risk of serious stroke within 90 days is 10%-15% following a TIA
- The likelihood of stroke is greatest in the first few days after the event, especially during the first 48 hours.
- More than 1/3 of all persons who experience TIA’s will go on to have a stroke

The problem with TIAs

- TIAs should not be ignored
- Patients need to seek immediate medical attention in order to prevent a possible full blown stroke
Modifiable Risk Factors

- Hypertension
- Elevated cholesterol (statins reduce risk by 30%)
- Diabetes mellitus-independent risk factor
- Coronary Artery disease
- Heart disease-Valve disease/replacement, any factor that decreases ventricular contraction
- Atrial Fibrillation (3-4x risk)
- Previous stroke
- Obesity and Increased abdominal fat
- Excessive alcohol (5+/day)
- Smoking (2x risk ischemic; 4x risk hemorrhagic)
- Oral Contraceptives/HRT

Non-Modifiable Risk Factors

- Age-Risk doubles per decade over 55
- Gender-Men have greater risk, women live longer. Risk differential gets larger with age
- More women die from stroke (60% of stroke deaths)
- Race-African-American, Asian and Hispanic have greater risk, possibly due to hypertension
- Diabetes Mellitus- Exacerbated by hypertension or poor glucose control. Even diabetics with good control are at increased risk.
- Family history of stroke or TIA

Non-Modifiable Risk Factors

If there is a prior history of stroke or TIA:

- Men-42% chance of recurrent stroke within 5 years
- Women-24% chance of recurrent stroke within 5 years

Reducing Risk

Lifestyle Modification
- Low fat diet/Controlling weight/Exercise
- Treating Atrial Fibrillation
- Monitoring Alcohol consumption
- Quit smoking

Medical Management
- Antihypertensive Medication-For blood pressure greater than 140/90, (Tighter control for diabetics)
- Cholesterol reducing medication for cholesterol more than 200 mg/dl (statins)
- Clot prevention medication(Anticoagulants) Warfarin
- Antiplatelet drugs-Aspirin, Aggrenox, Plavix,Ticlid
Three main questions

- Where is the clot?
- Where did the clot come from?
- What can we do about it?

Stroke Classification

- Ischemic versus Hemorrhagic
- Anterior circulation versus Posterior circulation
- Right brain versus Left brain

Ischemic stroke subtypes

- **Large-vessel** thrombotic and embolic strokes (20%) result from hypoperfusion, hypertension and arterial emboli from large vessels to smaller distal vessels
- **Small-vessel** strokes (lacunar) – 25% - come from plaque, diabetes, or hypertension
- **Cardioembolic** strokes (20%) come from atrial fibrillation, valve disease, or ventricular thrombi
- **Other types** (5%) – arterial dissection, arteritis, or drug abuse
- For **30%** of ischemic strokes, the cause is unknown

Pathophysiology of Stroke

**Ischemic Stroke- 88%**

- Embolic (24%): Blood clot forms somewhere in the body and travels to the brain
- Thrombotic (61%): Clot forms on blood vessel deposits
Pathophysiology of Stroke

- Hemorrhagic stroke-12%

Hemorrhagic Stroke

- Responsible for 30% of stroke deaths
- Intracerebral Hemorrhage-(ICH) (within the brain tissue) occurs with rupture of a small diameter blood vessel due to hypertension, amyloid or vascular malformation
- Subarachnoid Hemorrhage-(SAH) (around the brain’s surface and under its protective layer - Most commonly from aneurysm rupture
- Risk factors: hypertension, alcohol, drug abuse, anti-clotting medication and blood clotting disorders

Cerebral Circulation

- Anterior Circulation
  - Carotid arteries
  - Anterior cerebral arteries
  - Middle cerebral arteries

- Posterior Circulation
  - Vertebral arteries
  - Basilar artery
  - Posterior cerebral arteries
Right Brain vs. Left Brain

**Right –Hemisphere**
- Movement of the left side of the body affected
- Stroke Survivor:
  - Overestimates abilities, does not understand physical limitations
  - Shows poor judgment of distance, size, speed, and position, relating how parts are connected to the whole
  - Has difficulty with judgment, short-term memory, impulsiveness, processing visual information

**Left-Brain**
- Movement of the right side of the body is affected
- Stroke Survivor:
  - Has difficulties with language and speech
  - Aphasia, slow, cautious behaviors, difficulty with memory, retention span, reading, writing, performing math, understanding what people say, finding and understanding words

Cerebellar and Brain Stem Stroke
- Cerebellar-Balance, coordination, reflexes, dizziness, nausea, vomiting
- Brain Stem-Involutary life-support functions (breathing, heartbeat, blood pressure)
- Eye movement, hearing, speech, swallow, mobility on one or both sides of the body

Cranial Blood Flow
- Carotid Arteries
  - Internal Carotid- Supplies anterior 3/5 of cerebrum’s blood. Disruption usually affects frontal lobe causing numbness, weakness or paralysis on opposite side of body
  - External Carotid-Supply of face and scalp only
Cranial Blood Flow

- **Vertebral Arteries**—Supply posterior 2/5 of cerebrum’s blood
- Cerebellum and Brain Stem
- Occlusion can cause variety of problems, from blindness to paralysis
- **Basilar Artery**
  - Formed by merger of vertebral arteries
  - Occlusion can cause variety of problems, from blindness to paralysis
  - Also referred to as the vertebrobasilar artery
- **Circle of Willis**—Convergence of internal carotid and basilar arteries, forming a circle

ACLS Guidelines

The 7 D’s of Stroke Care

- **Detection**—Recognition of stroke signs and symptoms
- **Dispatch**—Call 911. Priority EMS dispatch
- **Delivery**—Prompt transport and prehospital notification to appropriate hospital (Check for facilities able to administer IV tPA or “drip and ship” protocols)
- **Door**—Immediate ED triage
- **Data**—ED evaluation, prompt laboratory studies, CT scan, CT results, Review of tPA exclusions
- **Decision**—about potential therapies. Review with patient and family
- **Drug Therapy**—Current treatment options within appropriate time frames

ACLS Guidelines

- IV tPA (tissue Plasminogen Activator) improves neurologic outcome in patients with stroke meeting fibrinolytic criteria when administered within 3 hours of onset
- Stroke presenting within *3 hours should be triaged on an emergent basis with urgency similar to acute ST-elevation myocardial infarction
- Patients who may be candidates for fibrinolytic therapy should be transported to hospitals identified as capable of providing acute stroke care, including 24-hour availability of CT scan and interpretation

Goals for EMS Response and Acute Intervention

- Rapid Recognition and Reaction to Stroke warning signs
- Rapid EMS Dispatch
- Rapid EMS transport and hospital prenotification
- Rapid diagnosis and treatment
Emergency Dispatch

- Use of 911 system is recommended for symptoms of stroke
- Many callers do not use the word “stroke”
- Dispatchers should recognize the seriousness of stroke and be familiar with stroke symptoms.
- Strokes should be dispatched as a high priority call, send closest unit- similar to acute MI or trauma
- An EMD call-receiving algorithm is recommended to ask appropriate questions to callers

10 Steps for EMS Responders

1. Evaluate and monitor ABCs
2. Perform blood pressure monitoring (DO NOT treat hypertension in suspected stroke patient)
3. Perform glucose fingerstick (Check your State regulations)
4. Perform EKG/Cardiac monitoring
5. Administer 02, per local EMS protocol
6. Perform prehospital stroke scale/screen
7. Obtain medical history, medications and compliance; **determine time patient last seen normal**
8. If local protocol allows, take a family member to the hospital
9. Minimize scene time; procedures can be performed during transport
10. Transport patient to the nearest appropriate hospital per local transport protocols; notify receiving hospital en route

Key Components of Taking Patient History

- Onset of symptoms
- Recent Events-stroke, MI, trauma, surgery, bleeding
- Comorbid diseases-Hypertension, Diabetes (hypoglycemic patients may have symptoms that mimic stroke)
- Use of medications-Anticoagulants, Antithrombotics, Insulin, Antihypertensives, Statin medications
Guidelines for EMS Management of Patients With Suspected Stroke

**Recommended**
- Manage ABCs
- Cardiac monitoring
- Intravenous access (18 gauge preferred)
- Oxygen (as required, O2 saturation <92%)
- Assess for hypoglycemia
- NPO
- Alert receiving ED
- Rapid transport to closest appropriate facility capable of treating acute stroke

**Not Recommended**
- Dextrose-containing fluids in nonhypoglycemic patients
- Hypotension/excessive blood pressure reduction (can decrease cerebral perfusion and worsen stroke)
- Excessive intravenous fluids (can cause increased intracranial pressure)

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**Recommendations from NINDS (National Institute of Neurological Disorder and Stroke)**

1. Take the patient to the nearest hospital if there are no stroke centers nearby
2. Bypass hospitals unable to provide care if there are stroke centers close by. Follow local destination protocols
3. If remote, consider air-evacuation if:
   - The closest center is > 1 hour away, OR
   - The closest center cannot provide stroke care, OR
   - If the patient can reach a center within the “3-hour time window or tPA treatment

**National Stroke Association Recommendations**

“EMS System Medical Directors should have a process to identify and provide transport protocols to authorize EMS to transport stroke patients to the nearest appropriate hospitals, including recognized stroke centers”

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**Stroke Scales**

[Image of Stroke Scales]
Northwest Medstar Response Times

Hospital Care and Treatment Options

Time Benchmarks (AHA recommended time frames)
- Door to Doctor 10 minutes
- Door to CT 25 minutes
- Door to CT interpretation 45 minutes
- Door to IV tPA 60 minutes
- Door to monitored bed 3 hours
- Administration of IV tPA from onset of symptoms 3 hours

Hospital Care and Treatment
- Rapid Triage “Code Stroke”
- Establish time of onset
- Rule out stroke mimics: hypoglycemia, hypertensive encephalopathy, complicated migraine, seizures, conversion disorder
- Patient history
- Physical exam/NIH Stroke Scale
- Labs-CBC, PT/INR, fibrinogen, BMP, blood glucose, cardiac enzymes
- Stat Neuroimaging-CT/CTA, DWI MRI
- EKG/CXR
- Review Exclusion Criteria for tPA. Discuss with patient/family
- Administer thrombolytics/determine if interventional candidate

Acute Stroke Interventions
- IV tPA (Alteplase)-Within 3 hours of onset of symptoms
- Dosage= 0.9mg/kg, up to a maximal dose of 90mg.
- Deliver 10% of determined dose as an IV bolus
- Deliver remaining 90% over one hour

May cause intracranial bleeding-has not been shown to increase mortality
Contraindications
Acute Myocardial Infarction or Pulmonary Embolism
Activase therapy in patients with acute myocardial infarction or pulmonary embolism is contraindicated in the following situations because of an increased risk of bleeding:
- Active internal bleeding
- History of cerebrovascular accident
- Recent intracranial or intraspinal surgery or trauma (see WARNINGS)
- Known bleeding diathesis
- Severe uncontrolled hypertension

Interventional Radiology
- Intra-Arterial tPA-0-6 hours
- Mechanical Clot Retrieval-0-8 hours, sometimes longer depending on location of clot.
- Carotid Endarterectomy-removal of fatty deposits
- Angioplasty and stenting. Investigational phase. Angioplasty opens up blocked arteries through use of catheters. After the artery is opened, a stent is inserted to prevent further blockage. Stenting can also be done in the vertebral or intracranial arteries.

Merci™-Mechanical Clot Retrieval Device

Medical Management of Stroke
1. Oxygenation-Prevent hypoxia, watch for increases in CO2
2. Blood Pressure Management-Gently lower if patient is a thrombolytic candidate, to <185 systolic, <110 diastolic. Avoid hypotension.
   - Recommended Meds:
     - Labetalol, Nicardipine drip, Nitropaste
     - Avoid Nifedipine
Medical Management

Mean Arterial Pressures:
- \[
    \text{Systolic} + (2 \times \text{Diastolic}) = \text{MAP}
\]

Goal MAP - Per physician order to maximize Cerebral Perfusion Pressure

Blood Pressure management is a case by case decision based on patient history, underlying stroke mechanism, and neurological status

Medical Management

- Fluid Management-Avoid dextrose in the first hours of stroke. Use Normal Saline
- Glucose Management-Aggressive control with IV insulin (insulin drip) or sliding scale. (Hyperglycemia may increase infarct size and may increase risk of hemorrhagic transformation of an ischemic stroke)
- Temperature Management-Temps greater than 99.5 should be promptly treated with antipyretics and cooling measures.

EMS Role in Research

- Identification of an effective neuroprotective therapy may further expand the role of EMS in the treatment of acute stroke.
- Hypothermia-Reduces cytotoxic cascade, Stabilizes blood-brain barrier, Reduces free-radical formation, May prevent neurotoxicity of tPA
- IV Magnesium-(FASTMAG Trial)
  IV Magnesium given in the field. Cytoprotective and vasodilating effects.

Evaluation of Current Systems

- What is your general EMS environment in your state?
- What processes are in place that provide rapid access to EMS for patients with acute stroke?
- What are your EMS dispatch protocols?
- Where are suspected stroke patients transported?
- What communications occur between local hospitals and EMS systems?
ACLS Foundation Facts

- Studies have documented improvement in 1-year survival rate, functional outcomes, and quality of life when patients hospitalized for acute stroke receive care in a dedicated unit with a specialized team
- Each receiving hospital should define its capability for treating patients with acute stroke
- When a stroke unit with a multidisciplinary team experienced in managing stroke is available within a reasonable transport interval, patients with stroke who require hospitalization should be admitted to a stroke unit.

Questions?

References

- American Heart Association/ACLS Provider Manual. 2006
- National Institute of Neurological Disorders and Stroke (NINDS)
- Concentric Medical-Merci Retrieval device
- Genentec-Alteplase
- National Stroke Association-EMS Provider information
- Thanks to Michael Day-Trauma Services Coordinator Sacred Heart Medical Center