

## **MISSION STATEMENT**

1. To assess the needs for comprehensive care of victims of stroke throughout the state.
2. To educate the public on the various aspects of stroke, including risk factors, prevention, and available treatment, with particular attention to high risk populations and geographic areas.
3. To maintain awareness among the general public and all health care providers of the most effective strategies for the prevention and treatment of stroke.
4. To provide guidelines from which the care of potential or actual stroke victims may have a common standard.
5. To advise the state department concerning grant opportunities for providers of emergency medical services and for hospitals to improve care of stroke patients.
6. To issue recommendations on other topics relevant to stroke care and prevention as they may arise.

## INTRODUCTION

Stroke has a major impact on life and economy in the United States, and more specifically, in Indiana. It is the third leading cause of death, and the leading cause of disability in our country. Indiana had the 7<sup>th</sup> highest stroke rate in the country in 2000, and ranked 18<sup>th</sup> in mortality from stroke in 2002. Ten people die from stroke everyday in Indiana. Currently, more than 2% of the population of Indiana are living with the sequelae of stroke. The costs for the medical care of patients suffering a stroke in Indiana was \$300 million in 2001. The indirect costs related to lost productivity of these patients in the Indiana economy was much more.

The Indiana Stroke Prevention Task Force was created by IC 16-41-41, in an attempt to stem the tide of the trends described above. One of the charges to the Task Force is to develop guidelines for the management of stroke. There are many facets to this topic. Management of stroke does not include only the treatment of those individuals who have suffered such an event; management also involves an effort to prevent the event from occurring in the first place. In addition, patients may experience a near stroke (transient ischemic attack) which is a warning that a stroke could soon occur if intervention is not undertaken. Because of this very complicated and involved nature of managing stroke, the task force decided to develop more categorized guidelines. What is to follow, then, are guidelines separated into three topics: risk factors for stroke, transient ischemic attack, and ischemic stroke.

These guidelines were developed from currently available published information and experience as well as from guidelines and recommendations developed by other organizations, including The Brain Attack Coalition, American Stroke Association, American Heart Association, and Mayo Clinic, among others. The published recommendations that were used, were themselves developed with standard evidence-based medicine assessment criteria. In these guidelines, information derived from the aforementioned sources is provided as a background for the subsequent recommendations related to the various aspects of management.

The purpose of these guidelines is to provide a basis from which the management of stroke may proceed. These guidelines are intended to be the minimum standard for such management and a benchmark for all health care providers in Indiana who care for patients with stroke. Some diagnostic and therapeutic procedures are more substantially proven than others. Some of these procedures are more effective when utilized by more experienced or specifically trained operators. An attempt to address these issues in these guidelines has been made in consideration of the recommendations or regulations of other organizations or authorities. In addition, advances in the practice of medicine, which occur continuously, could render portions of the guidelines obsolete or inappropriate. The Task Force will make every effort to provide addenda to these guidelines should such situations arise.

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# GUIDELINES FOR RECOGNITION AND INTERVENTION OF RISK FACTORS FOR STROKE

**Purpose:** To provide a basis for the medical community to more effectively identify those individuals with risk factors for stroke. To provide a minimum standard from which the treatment of these risk factors should be initiated by all health care providers for all affected individuals in the state of Indiana.

## I. Introduction

### A. Types of risk factors

#### 1. Unmodifiable

##### a) Advancing age

1) Risk of stroke doubles for each successive decade after

55 years of age

##### b) Male gender

##### c) African – American and Hispanic ethnicity

##### d) Hereditary predisposition

1) Specific stroke types

2) Risk factors

##### e) Low birth weight

1) <2500 gm vs > or equal to 4000 gm

#### 2. Definite and modifiable

##### a) Asymptomatic carotid artery stenosis

##### b) Hypertension

##### c) Coronary artery disease

##### d) Atrial fibrillation

##### e) Cigarette smoking

##### f) Sickle cell disease

##### g) Transient ischemic attack/previous stroke

##### h) Cholesterol and lipids

#### 3. Definite and potentially modifiable

##### a) Diabetes

##### b) Hyperhomocysteinemia

#### 4. Less well documented

##### a) Other cardiac disease (e.g. cardiomyopathy, Patent Foramen Ovale)

##### b) Obesity

##### c) Physical inactivity

##### d) Oral contraceptives/hormone replacement therapy

##### e) Alcohol/illicit drugs

##### f) Hypercoagulability/inflammation

##### g) Sleep apnea syndrome

### B. General intervention

1. Recognize unmodifiable risks in each individual.

2. Realize that modifiable factors add risk on top of the unmodifiable factors.
3. All patients should be assessed for the presence of risk factors for stroke; especially those with unmodifiable factors.
4. Risk factors should be documented in patient's medical record.
5. Inform the patient of the implication of risk factors on the occurrence of stroke.
6. Educate the patient on the consequences of stroke that relate to the patient's life.
7. Individually address each risk factor present.

## II. Risk Factors

### A. Asymptomatic carotid stenosis

#### 1. Background

##### a) Risk

- 1) Carotid stenosis of greater than 50% is associated with an increased risk of myocardial infarction and nonstroke vascular death
- 2) May result in either thrombotic or embolic stroke if untreated with stenosis greater than 60% at a rate of 2.5% to 3% per year
- 3) If treated medically, risk of ipsilateral (same side) stroke is 2% per year
- 4) If treated surgically, risk of ipsilateral stroke is 1% per year

##### b) Currently available medical treatment

- 1) Antiplatelet medications
- 2) Anticoagulant medications (Coumadin)
  - (a) All data to date do not indicate greater protections with anticoagulant but definite greater risk of complication with anticoagulant
- 2) Risk of treatment
  - (a) GI bleeding
  - (b) Intracranial bleeding
  - (c) Easy bruisability

##### c) Currently available surgical treatment

- 1) Carotid endarterectomy
  - (a) 3 of 5 studies did not show significant benefit over medical treatment
  - (b) Both studies which revealed benefit, indicated a 50% reduction

- in stroke risk compared to medical treatment
- (c) The complication rate in both studies was very low (1.9%) and surgical benefit was negated with complication rates greater than 3%
- (d) Limited data has often revealed higher complication rates where this procedure is performed less frequently

## 2) Carotid angioplasty and stenting

- (a) No specific studies evaluating effectiveness in asymptomatic carotid stenosis although it is being done at some centers
- (b) Preliminary studies and patient registries including both symptomatic and asymptomatic carotid stenosis are revealing comparable efficacy of stenting with endarterectomy and stenting is trending toward fewer complications

## 2. Recommendation

### a) Diagnosis

- 1) Physical exam
  - (a) Carotid bruit
- 2) History
  - (a) Coronary artery disease
  - (b) Diabetes
  - (c) Hypertension
  - (d) Tobacco use
  - (e) Family history stroke
- 3) Consider carotid stenosis in patient with history as above even without bruit
- 4) Imaging
  - (a) Initially carotid doppler
  - (b) If greater than 60% carotid stenosis on Doppler, then second imaging procedure with MR or CT angiography to verify

### b) Treatment

- 1) In patients with stenosis greater than 50%
  - (a) Antiplatelet medication
  - (b) Referral to cardiologist for evaluation of coronary artery disease

- 2) Consider carotid endarterectomy in asymptomatic patients with greater than 70% stenosis
  - (a) Complication rate should be less than 3% for facility
  - (b) Ideally, surgeon should have documented fellowship training in this procedure
  - (c) Surgeon should be performing at least 25 cases per year
  - (d) Agreement that surgery is best option between neurologist, surgeon, and patients primary care physician
  
- 3) Consider angioplasty with stenting in asymptomatic patients with greater than 70% stenosis, and postendarterectomy restenosis, poor cardiac status, prior neck irradiation, or stenosis close to skull base or deep in chest
  - (a) Should be undertaken at facility accredited as part of research protocols or are designated comprehensive stroke centers
  - (b) Should be undertaken at facility and by practitioner with experience of 25 cases per year
  - (c) Ideally, practitioner should have fellowship training in this procedure
  - (d) Agreement that stenting is best option between neurologist, surgeon, interventionalists, and patient's primary care physician

## B. Hypertension

### 1. Background

#### a) Risk

- increase in systolic
- 1) Risk for stroke increases 1.6 times for every 10mm Hg blood pressure
  - 2) Nearly 50% of strokes may be prevented by controlling blood pressure
  - 3) Antihypertensive therapy is associated with a 35 to 40% reduction in stroke incidence

#### b) Currently available treatment

- 1) Diuretics
- 2) Angiotensin-converting enzyme (ACE) inhibitors
- 3) Beta-blockers
- 4) Calcium channel blockers
- 5) Alpha-blockers

6) Angiotension receptor blockers (ARB)

2. Recommendations

a) Blood pressure should be checked in all patients regardless of age, gender, race, or heredity.

b) Individuals with "Prehypertension" should be monitored every 6 months:

prehypertension is systolic blood pressure between 120 mm Hg and 139 mm Hg or

diastolic blood pressure between 80 mm Hg and 90 mm Hg.

1) Initiate lifestyle changes: diet, exercise, weight loss.

c) Treat systolic blood pressure greater than 140 mm Hg in patients 19 years of age and older

1) May require more than one medication

2) Uncomplicated hypertension: consider diuretic or beta-blocker

3) Type I diabetes, myocardial infarctions with systolic dysfunction and some

heart failure patients: consider angiotensin-converting enzyme (ACE)

inhibitor

4) Diabetes: consider ACE inhibitors, alpha-blockers, calcium antagonists, low dose diuretics

d) In diabetics or patients with kidney disease, blood pressure goal should be 130/80 mm Hg

C. Coronary Artery Disease (CAD)

1. Background

a) Risk

1) Risk of stroke after MI is 1% to 2% per year

2) Greatest risk of stroke is in first month after MI (31%)

3) Overall risk of stroke in patients with CAD is increased by 2.0 to 2.2 times

b) Currently available treatment

1) Antiplatelet agents – reduce risk of stroke by 15-20%

2) Statin agents – reduce risk of stroke by 25%

3) ACE inhibitors – reduce risk of stroke by 30%

2. Recommendations

a) Assess patients for risk factors for CAD

b) EEG at age 40 and every 5 years if normal

c) If individual has documented CAD:

1) Aspirin: 81 to 325 mg. daily

2) Clopidrogel (Plavix): 75 mg daily

3) Statin agents: especially if LDL is greater than 70 mg/dl

4) Consider ACE inhibitor

D. Atrial Fibrillation

1. Background

a) Risk

- 1) Average risk for stroke is 5% per year without treatment
- 2) Risk increases with advancing age and/or presence of other risk factors

b) Currently available treatment

- 1) Coumadin – reduces risk of stroke by 70% (brand

name Coumadin is

Recommended due to potential variability of multiple

available generic

Products)

- 2) Antiplatelet medication – reduces risk of stroke by 20%

c) CHADS2 stratification scheme

- 1) Considers additional independent risk factors for stroke

- (a) Congestive heart failure
- (b) Hypertension
- (c) Age equal to or greater than 75 years
- (d) Diabetes mellitus
- (e) Prior Stroke or TIA

- 2) Each factor receives one point except prior stroke/TIA which receives two points

- 3) Overall score is directly related to stroke risk except those patients with atrial fibrillation and with stroke/TIA as their only other risk. In this case the risk of stroke (with ASA treatment) was 6 to 10%

2. Recommendations

a) Diagnosis

- 1) Electrocardiogram

b) Treatment

1) CHADS2 score

- (a) 0: antiplatelet agent
- (b) 1-2: antiplatelet or Coumadin
- (c) Greater than or equal to 3: Coumadin

2) Coumadin

- (a) Target INR: 2.0 to 3.0
- (b) Use also dependent on
  - Patient preference
  - Bleeding risk
  - Access to high quality INR monitoring

E. Cigarette Smoking

1. Background

a) Risk

- 1) Risk of stroke is doubled
- 2) Most of this risk is eliminated by 18 months after smoking cessation

b) Currently available treatments

- 1) Support groups/programs

- 2) Nicotine replacement therapy
- 3) Medication (e.g. bupropion)

2. Recommendations

- a) Diagnosis
  - 1) Inquire about patients habits
- b) Treatment
  - 1) Counsel patient on risks of smoking
  - 2) With tobacco users willing to quit, utilize the 5 "A's":

Ask, Advise,

Assess, Assist, and Arrange

- 3) With tobacco users unwilling to quit use the 5 "R's":  
Relevance

Risks, Rewards, Roadblocks, and Repetition

- 5) Develop a plan to quit with the patient
  - (a) Set a quit date
  - (b) Discuss methods for overcoming cravings
  - (c) Identify potential support system (e.g. family, friends)
  - (d) Provide informational resources

F. Sickle cell anemia (SSA)

1. Background

a) Risk

- 1) 15 to 25% of patients with SSA will have TIA or stroke
- 2) Hemorrhage stroke is more common in children with a

risk of 1% per

year

- 3) Ischemic stroke is more common in children with a risk of 1% per year

(a) Patients with transcranial doppler evidence of high cerebral blood flow velocity have stroke rates of 10% per year

b) Currently available treatment

- 1) Transfusion therapy
- 2) Hydroxyurea and bone marrow transplant are currently under investigation in high risk patients requiring long term intervention

2. Recommendations

a) Diagnosis

- 1) Children with sickle cell disease over 2 years of age should be screened with transcranial Doppler at 6 month intervals
- 2) Transcranial Doppler in patients with symptoms suggestive of TIA or stroke, or in patients with evidence of vaso-occlusive disease in other organs

b) Treatment

- 1) Exchange transfusion
  - (a) Patients with 2 abnormal transcranial Doppler studies
    - (mean velocity of > 200 cm/sec)
    - (b) Patients with evidence of TIA or stroke clinically or radiologically
  - 2) Life-style changes in at-risk patients
    - (a) Avoid excess unaccustomed exertion
    - (b) Avoid hypoxia (e.g. altitudes)
    - (c) Avoid exposure to excessive heat
    - (d) Avoid exposure of infection

G. History of transient ischemic attack or stroke

1. Background

a) Risk

- 1) Up to 10% of patients with a cerebral ischemic event will have a stroke within one month if untreated
- 2) Up to 15% of patients with a cerebral ischemic event will have a stroke within one year if untreated
- 3) Up to 40% of patients with a cerebral ischemic event will have a stroke Within 5 years if untreated

b) Currently available treatment (excluding atrial fibrillation)

- 1) Aspirin
- 2) Clopidrogel (Plavix)
- 3) Aspirin/dipyridamole (Aggrenox)
- 4) Ticlopidine (Ticlid)
- 5) Carotid endarterectomy or stenting (see Guidelines for

TIA)

2. Recommendations

a) Diagnosis

- 1) History
- 2) Physical Exam
- 3) Imaging
  - (a) Carotid doppler
  - (b) Echocardiography
  - (c) MRI brain with diffusion weighted imaging

b) Treatment

- 1) If no prophylaxis, 75 to 325 mg aspirin once daily
- 2) If evidence of cardiovascular or peripheral vascular disease with or 75mg clopidrogel (Plavix) for aspirin/dipyridamole without prior prophylaxis, or with allergy to aspirin, (Plavix) once daily (unless you need ASA + clopidrogel cardiac reasons)
- 3) If prior prophylaxis with aspirin or clopidrogel (Plavix); (Aggrenox) twice daily

- 4) If prior prophylaxis with aspirin/dipyridamole (Aggrenox), 250mg ticlopidine (Ticlid) twice daily (follow CBC and SGOT every other week for first 3 months)
- 5) If prior prophylaxis with ticlopidine (Ticlid), consider Coumadin if otherwise not contraindicated

## H. Diabetes mellitus

### 1. Background

#### a) Risk

decreases the risk of

the risk of stroke in

- 1) Increase risk of stroke by 1.4 to 1.7 times
- 2) No data has indicated that tight control of diabetes stroke
- 3) Tight control of hypertension (<130/80mmHg) reduces diabetics by 25 to 33%

#### b) Currently available treatment

- 1) Diet
- 2) Insulin
- 3) Oral hypoglycemic

### 2. Recommendations

history every 3 years

frequent screening on a

- a) Check fasting blood sugar in individuals with or without family starting at 45 years of age
- b) If other risk factors for diabetes, may need earlier or more case by case basis
- c) Maintain fasting blood sugar less than 120 mg/dl
- d) Maintain glycosylated hemoglobin less than 7%
- e) Monitor lipids annually
- f) Use statin agent in those diabetics with additional risk factors
- g) Initiate life-style changes: diet, exercise, weight loss
- h) Tightly control blood pressure with an ACE inhibitor or ARB

## I. Hyperhomocysteinemia

### 1. Background

#### a) Risk

associated with an

existing vascular

clear in otherwise

- 1) A 5 micromol/liter increase in serum homocysteine is increase risk of stroke by 1.5 times
- 2) This risk may increase to 3 times in patients with pre-disease (i.e. cardiac, peripheral, or cerebral)
- 3) Association between homocysteine and stroke is less healthy individuals

#### b) Currently available treatment

- 1) Vitamin therapy (i.e. folate, pyridoxine, and cobalamin)

actually lowers risk (a) Clearly reduces homocysteine levels in serum  
(b) Less consistent evidence that this decrease  
of stroke

## 2. Recommendations

### a) Diagnosis

1) Serum homocysteine levels in patients with documented vascular disease (e.g. MI, Claudication, TIA/stroke) at least once

### b) Treatment

1) The combination of  
(a) Folic acid: 2-5 mg per day  
(b) Pyridoxine: 25-50 mg per day  
(c) Cobalamin: 0.4 to 4 mg per day  
2) Clinician must consider potential problems for patient (e.g. financial) when using such treatment with controversial impact

## J. Cholesterol and lipids

### 1. Background

a) Early studies did not indicate a relationship between cholesterol and stroke

1) It appears that the relationship between cholesterol and stroke may be dependent on the etiology of the stroke and the characteristics of patient (i.e. gender, race)

b) More recent data is beginning to describe possible relationships, but it is very complicated

1) Variability with respect to gender and age  
2) Variability with respect to type of lipid (e.g. total cholesterol, HDL, LDL, triglycerides)

### 2. Recommendations

a) Check lipid profile as routine wellness care on all patients

#### b) Intervene

1) Total cholesterol: probably not factor  
2) Triglycerides: greater than 150 mg/dl  
3) HDL: less than 40 mg/dl  
4) LDL: greater than 100 mg/dl

#### c) Intervention

1) Diet  
2) Medication  
3) Physical activity

## III. Less well documented risk factors

### A. Other cardiac disease

- specific to  
these situations
1. Background
    - a) Multiple cardiac abnormalities have been implicated in the increased risk for stroke, including: cardiomyopathy, patent foramen ovale, mitral annular calcifications, aortic stenosis, nonbacterial endocarditis, segmental wall motion abnormalities, atrial septal aneurysm
    - b) Suggestive data is predominantly retrospective, and some is certain populations
    - c) Very little data is available regarding prophylactic treatment in
  2. Recommendations
    - a) If any suspicion of cardiac disease, consult a cardiologist
    - b) When any of these situations are present in a patient, preventative treatment should be tailored to each patient considering the patient's overall condition and possible presence of other risk factors

## B. Obesity

1. Background
  - a) Increases all-cause mortality and morbidity from many other medical problems
  - b) Obesity increases risk of developing other risk factors for stroke including hypertension, diabetes mellitus and hyperlipidemia
  - c) Some prospective population studies have demonstrated obesity as an independent risk factor for stroke, (especially abdominal obesity)
  - d) No studies have yet shown a reduction of stroke risk with demonstrated weight loss
2. Recommendations
  - a) Body mass index should be below 30 kg/m<sup>2</sup> (ideally 21 to 25 kg/m<sup>2</sup>)
  - b) Do not ignore obesity as a medical problem
  - c) Dietary restriction and increased physical activity should be recommended
  - d) Behavioral therapy should be used to manage other issues contributing to obesity (e.g. stress management, problem solving, self-monitoring and social support)
  - e) Pharmacotherapy and surgery may be considered in the more severe cases as medically indicated

## C. Physical Inactivity

### 1. Background

- a) Several prospective population studies have indicated an inverse relationship between the level of physical activity and occurrence of stroke.
- b) The benefit of physical activity is most likely related to its direct effect on other risk factors, including hypertension, diabetes mellitus, lipid levels, and coagulation
- c) Moderate activity is as effective as heavy activity perhaps with less risk

### 2. Recommendations

- a) 30 minutes of moderate activity (e.g. brisk walking) per day at least 5 days per week
- b) Walk 10,000 steps per day most days of the week
- c) Consider cardiac stress testing in at risk patients before implementing an exercise program
- d) Tailor exercise to limitations of patients overall condition

## D. Oral contraceptives/hormone replacement therapy

### 1. Background

- a) Earlier contraceptive formulations (i.e. estrogen content greater than 50 mcg) were strongly associated with risk of stroke
- b) Low-dose contraceptives have not been shown to increase the risk of stroke
- c) Hypertension and tobacco use further increase the risk of stroke in patients using contraceptives
- d) Evidence suggests that hormone replacement therapy in post-menopausal women may result in a slight increase in the risk of stroke

### 2. Recommendations

- a) Use contraceptive formulations with less than 50 mcg of estrogen
- b) Avoid use of contraceptives in patients with hypertension or who use tobacco
- c) Hormone replacement therapy should not be used to decrease the risk of stroke in post-menopausal women

## E. Alcohol/Illicit Drugs

### 1. Background

- a) Data suggest one to two alcoholic drinks per day may protect against stroke
- b) More than 4 to 5 drinks per day may increase risk of stroke

c) Drugs such as heroine, cocaine, amphetamines, phencyclidine can lead to stroke via vasculitis, vasospasm, vasculopathy, arrhythmias, hypercoagulability, hypertensive crisis

2. Recommendations

- a) No more than 2 alcoholic beverages per day for men and no more than one per day for women
- b) Educate patients on risks of stroke associated with drug use
- c) Alcohol and drug treatment program of those patients unable to control abuse

F. Hypercoagulability/Inflammation

1. Background

- a) Hypercoagulable states have been associated with increased risk of stroke, including lupus anticoagulant, anticardiolipin antibodies, and deficiencies of protein C, protein S and antithrombin III
- b) Inflammatory conditions which affect blood vessels have also been associated with increased risk of stroke, including lupus, isolated CNS angiitis, temporal arteritis, Takayasu arteritis
- c) Treatment is directed toward the primary disorder
- d) Many of these disorders are inherited as well as acquired

2. Recommendations

- a) When positive family history, test patient for presence of disorder even if no - recurrent symptoms are apparent yet
  - 1) Check for family history of other thrombotic events (e.g. miscarriages, DVT)
- b) Hematology consult for coagulopathies
- c) Rheumatology consult for inflammatory diseases

G. Obstructive sleep apnea syndrome (OSA)

1. Background

- a) Prevalence of sleep apnea has been shown to be between 10% and 30% of the population over the age of 20 years
- b) Has been shown to adversely affect other known risk factors for stroke, including: hypertension, cardiac dysrhythmias, other cardiac dysfunction
- c) Has been shown to have a markedly increased prevalence in patients with TIA and stroke independent of other know risk factors
- d) The actual direction of cause-and-effect (although implied by several studies)

has not yet been conclusively supported by controlled prospective studies

- e) Suggested mechanisms for increasing risk of stroke
  - 1) Increased sympathetic activity ( e.g. hypertension, dysrhythmia)
  - 2) Abnormal cerebral hemodynamics (e.g. increased intracranial pressure, altered vascular response to blood gases)
  - 3) Endothelial dysfunction (e.g. atherosclerosis)
  - 4) Increased coagulability (e.g. platelets, fibrinogen)

2. Recommendations

complain

- a) Ask patients about symptoms of OSA even if they do not
  - 1) Snoring
  - 2) Excessive daytime sleepiness
  - 3) Apnea witnessed by sleep partner
- b) Especially consider patients with risk factors
  - 1) Obesity
  - 2) Male gender
  - 3) Increasing age
  - 4) African-American heritage
  - 5) Post-menopausal female
- c) Order overnight polysomnography
  - 1) When any of above mentioned symptoms are present
  - 2) Treatment – resistant hypertension
- d) If OSA documented with testing, consult a board certified sleep

specialist

These guidelines are intended to be a basis from which patient care may be individualized for each patient's situation. Diagnostic and therapeutic procedures and medical treatments are continuously being evaluated and improved. Experience varies with different procedures. Therefore, some procedures require more stringent limitations to their utilization than others based on experience and application. The practice of medicine is continuously changing. These guidelines are particularly pertinent for the point in time during which they have been published. Advancement in medical techniques will necessarily update the propriety of these recommendations.

Suggested reading:

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## **GUIDELINES FOR THE DIAGNOSIS AND TREATMENT OF TRANSIENT ISCHEMIC ATTACK (TIA)**

**Purpose:** To provide a basis from which the medical community in the state of Indiana may more reliably recognize that a patient may have had a transient ischemic attack. To outline an appropriate course for evaluation of such a patient in order to differentiate from other possible diagnoses and determine the cause of an identified transient ischemic attack. To provide a minimum standard from which the treatment of a patient with a transient ischemic attack may proceed in order to prevent recurrence or the progression to stroke.

### I. Introduction

#### A. Definition

1. Transient neurologic deficit classically defined as less than 24 hours in duration
2. In most cases, the deficit lasts less than an hour
3. The advent of MRI diffusion weighted imaging allows us to determine if a stroke has occurred (i.e. permanent brain injury)
  - a) Some patients with a stroke may have only transient symptoms
4. A TIA occurs when blood flow in the brain does not fall below a critically low threshold before normal flow is restored

#### B. Etiologies

1. Cardiac: emboli to smaller blood vessels (20-30%)
2. Large vessel, extracranial: Generally emboli to smaller vessels, but may also be transient occlusion such as dissection or emboli from heart in combination with local atherosclerosis (15-20%)
3. Large vessel, intracranial: same as large vessel, extracranial (5-8%)
4. Small vessel, intracerebral: atherosclerosis; emboli from larger vessels or heart (up to 20%)
5. Blood: coagulopathies (1-5%)

#### C. Symptoms

1. Unilateral sensory or motor impairment
2. Gait disturbance
3. Trouble with speech or language
4. Dizziness
5. Visual changes
6. Confusion

#### D. Risk factors

1. Hypertension
2. Diabetes mellitus

3. Coronary artery disease
4. Atrial fibrillation
5. Carotid artery stenosis
6. Tobacco use
7. Cholesterol
8. Others (see Guidelines for Risk Factors for Stroke)

E. Differential Diagnosis

1. Seizure
2. Migraine equivalent
3. Metabolic disturbance (e.g. hypoglycemia)
4. Vestibulopathy
5. Cerebral vessel aneurysm
6. Ocular disorders
7. Hyperventilation

II. Diagnosis

A. History

1. Time course
  - a) Onset
    - 1) Immediate maximal deficit suggests emboli
    - 2) Stuttering course of progressive deficit suggests small vessel atherosclerosis
    - 3) Symptoms occur simultaneously in all affected areas
  - b) Duration
    - 1) Less than one hour
2. Symptoms
  - a) Negative phenomena (i.e. loss of function)
3. Associated factors
  - a) Provocation
    - 1) Generally none for TIA which may occur under any set of circumstances
  - b) Other symptoms
    - 1) If present, typically indicate diagnosis other than TIA
      - (a) Syncope - cardiac problem, hypotension
      - (b) Incontinence - seizure
      - (c) Headache – migraine, cerebral aneurysm

B. Physical examination

1. Comprehensive neurological examination
  - a) May be normal
  - b) If neurologic deficit still detectable, patient may have had a stroke
  - c) Findings on examination can help localize affected vascular territory
2. General examination
  - a) Vital signs
    - 1) Blood pressure
    - 2) Heart rate
    - 3) Respiratory rate
    - 4) Temperature

- 5) Oxygen saturation
- 3. Cardiac examination
  - a) Irregular rhythm
  - b) Murmurs
- 4. Neck
  - a) Carotid bruits

### C. Testing

- 1. Laboratory
  - a) Hematologic
    - 1) CBC
  - b) Metabolic
    - 1) Electrolytes, BUN, creatinine, and glucose
    - 2) Lipid profile
    - 3) Serum homocysteine level
  - c) Inflammatory
    - 1) Sedimentation rate
    - 2) Syphilis serology
    - 3) Serum protein electrophoresis
  - d) Immunologic
    - 1) Anticardiolipin antibody
    - 2) Lupus anticoagulant
    - 3) Antiphospholipid antibodies
  - e) Coagulation
    - 1) Protime, PTT
    - 2) Protein C & S
    - 3) Antithrombin III
    - 4) Leiden factor V
  - f) ECG
- 2. Imaging options
  - a) Brain
    - 1) MRI
    - 2) CT
  - b) Cerebral vasculature
    - 1) Carotid doppler
    - 2) Magnetic resonance angiography
    - 3) CT angiography
    - 4) Conventional angiography
  - c) Heart
    - 1) Echocardiography
    - 2) Transesophageal echocardiography

### III. Treatment

- A. This means the prevention of recurrent cerebral ischemic events
- B. Medical
  - 1. Antiplatelet medication
    - a) Aspirin
    - b) Clopidogrel (Plavix)
    - c) Ticlopidine (Ticlid)
    - d) Aspirin/extended release dipyridamole (Aggrenox)

2. Anticoagulation
  - a) Heparin
  - b) Coumadin
3. Metabolic
  - a) Folic acid, vitamins B12 and B6
- C. Surgical
  1. Carotid endarterectomy
  2. Carotid angioplasty/stenting

#### IV. Recommendations

##### A. Pre-hospital

##### 1. Patient education

- a) What patients need to know
  - 1) Risk factors for stroke
  - 2) Symptoms of stroke
  - 3) Actions to take in event of suspected stroke
    - (a) Seek medical attention immediately
    - (b) Call 911
- b) How to educate patients
  - 1) Primary physician
    - (a) Learn patients' habits and risks
    - (b) Communicate these to patient
  - 2) Hospitals
    - (a) Educational programs
    - (b) Stroke support groups
    - (c) Screening sessions for risk factors
  - 3) Special interest groups (i.e. American Stroke Association and National Stroke Association)
    - (a) Educational programs
    - (b) Screening sessions
    - (c) Literature

##### 2. Emergency Medical System

- a) Recognition
  - 1) Dispatch
    - (a) Should be able to recognize suspicious complaints as possible stroke symptoms
      - Confusion
      - Weakness
      - Falling
      - Dizziness
    - (b) Should communicate possibility of stroke to emergency personnel in field
  - 2) On-site
    - (a) Cincinnati prehospital stroke scale

- Language
- Facial weakness
- Arm weakness (drift)
- (b) Awareness of other conditions similar to stroke
  - Seizure
  - Hypoglycemia
  - Hyperventilation

b) Management

1) On-site

- (a) Check vital signs
- (b) Intervene with any life threatening conditions
- (c) Consider oxygen administration if oxygen saturation is less than 93%
- (d) Obtain History
  - Time of onset
  - Type of onset: gradual vs. abrupt
  - Onset while awake or asleep
  - Duration of symptoms
  - Nature of symptoms

2) Transport

- (a) As soon as possible
- (b) Start intravenous access
- (c) Nothing by mouth
- (d) Contact ER destination and notify nature of problem and estimated time of arrival
- (e) Check blood sugar by finger stick
- (f) Place patient on cardiac monitor

3) Transfer to ER care

- (a) Provide clinical information
  - Time of symptom onset
  - Symptoms
  - Findings of examination
- (b) Provide medication list

B. In primary care physician's office or urgent care center

1. Patient presents with report of a transient neurologic deficit more than one week earlier
  - a) If patient not previously taking aspirin and it is not otherwise contraindicated, start 325 mg aspirin daily
  - b) Obtain routine neurology consult
2. Patient presents with report of a single transient neurologic deficit within prior one week
  - a) If patient not previously taking aspirin and it is not otherwise contraindicated, start 325 mg aspirin daily
  - b) Order CT of brain within 24 hours
  - c) Electrocardiogram within 24 hours to rule out atrial fibrillation

- d) Order carotid Doppler within 48 hours
  - e) Order echocardiogram within 48 hours
  - f) Obtain neurology consult within one week
3. Patient presents with report of multiple recurrent transient neurologic deficits up to the prior 24 hours
    - a) If patient not previously taking aspirin and it is not otherwise contraindicated,
      - give 325 mg aspirin as soon as possible
    - b) Immediate electrocardiogram to rule out atrial fibrillation
    - c) Immediate admission to hospital with neurology consultation
  4. Patient presents with report of a single neurological deficit within prior 48 hours
    - a) If patient not previously taking aspirin and it is otherwise not contraindicated
      - start 325 mg aspirin daily
    - b) Immediate neurology consultation
    - c) Consider immediate hospitalization for observation and evaluation

#### C. Emergency Room

1. Contact with EMS
  - a) Time of symptom onset
  - b) Identify symptoms
  - c) Stability of patient
  - d) Medications
2. Triage
  - a) Recognize symptoms of walk-in patients
  - b) Determine time of onset of symptoms
3. Evaluation
  - a) Examination
  - b) Labs
    - 1) Finger stick blood sugar
    - 2) CBC
    - 3) Electrolytes, BUN, creatinine, and glucose
  - c) Imaging
    - 1) CT brain
  - d) ECG
4. Treatment
  - a) Aspirin (325 mg)
    - 1) If no medical contraindication
    - 2) If no hemorrhage on head CT
    - 3) If patient can safely swallow
  - b) Clopidrogel (Plavix)(75 mg)
    - 1) If contraindication to aspirin

## 5. Disposition

- a) Neurology consultation
- b) Consider admission when
  - 1) Event is within prior 48 hours
  - 2) Crescendo events

## D. Post Emergency Room

### 1. Evaluation

- a) Dependent on clinical localization of event
  - 1) Anterior circulation (i.e. carotid distribution)
    - (a) Carotid Doppler
    - (b) Echocardiogram
    - (c) MRI with diffusion – weighted imaging
  - 2) Posterior circulation (i.e. vertebro-basilar distribution)
    - (a) MRI with diffusion – weighted imaging
    - (b) MR angiography
    - (c) Echocardiogram
  - 3) Subcortical lacunar syndrome
    - (a) MRI with diffusion – weighted imaging
    - (b) Carotid Doppler
- b) Dependent on suspected etiology
  - 1) Cardioembolic
    - (a) Transthoracic echocardiography (TTE)
    - (b) Transesophageal echocardiography (TEE)
      - When workup is otherwise negative (especially if patient is younger than 45 years of age)
      - Suspicious TTE
  - 2) Aortic disease
    - (a) Transesophageal echocardiogram
  - 3) Coagulopathy
    - (a) Protein C & S
    - (b) Antithrombin III
    - (c) Leiden Factor V
  - 4) Inflammation
    - (a) Sedimentation rate
    - (b) Syphilis serology
    - (c) Serum protein electrophoresis
  - 5) Immunologic
    - (a) Anticardiolipin antibody
    - (b) Lupus anticoagulant
    - (c) Antiphospholipid antibodies
  - 6) Metabolic
    - (a) Serum homocysteine level
    - (b) Fasting blood sugar
    - (c) Lipid profile

### 2. Management

- a) Nursing (if patient admitted to hospital)
  - 1) Assess and monitor neurological status for further signs and symptoms of

- neurological dysfunction
- 2) Assess patient and family for baseline knowledge level of risk factors, diagnostic tests, medications, and surgical therapies
  - 3) Facilitate and educate the patient and family according to assessment of knowledge deficit appropriate to the patient's educational level and learning style
    - (a) Blood pressure control
    - (b) Stop smoking
    - (c) Control diabetes
    - (d) Limit alcohol intake
    - (e) Monitor blood lipid levels
    - (f) Regular physical activity
    - (g) Stop illicit drug use
    - (h) Well balanced diet
  - 4) Educational materials may include
    - (a) Printed material on specific medications
    - (b) Videos on medication/procedures
    - (c) Recommended websites
    - (d) Printed material about the warning signs of stroke
  - 5) Consult dietician/diabetes educator
- b) Medical
- 1) Identification of risk factors
    - (a) Obtain additional history
      - Past medical history of conditions that could increase the risk of stroke (e.g. hypertension, diabetes, atrial fibrillation, coronary artery disease and hypercholesterolemia)
      - Identify habits (e.g. tobacco, alcohol/illicit drug, diet, and exercise)
      - Family history of stroke or coagulation disorders
    - (b) Evaluate blood pressure trends
    - (c) Check metabolic status
      - Fasting glucose
      - Fasting lipid profile
      - Serum homocysteine level
    - (d) Evaluate for coexistent heart disease
      - Coronary artery disease
      - Cardiac dysrhythmia
      - Congestive heart disease
      - Valvular disease
  - 2) Treatment of risk factors
    - (a) Hypertension

- Prehypertension: systolic blood pressure 120-139 mm Hg; diastolic blood pressure 80-89 mm Hg;
    - Recommend lifestyle changes
    - Closer monitoring of blood pressure
  - Blood pressure greater than 140/90 mm Hg;
    - Initiate medication with consideration of patient's overall conditions
    - Consider angiotensin converting enzyme inhibitor
    - Wait 7 to 14 days after the event to start treatment
- (b) Diabetes mellitus
- Maintain fasting blood sugar less than 120 mg/dl
  - Maintain glycosylated hemoglobin less than 7%
  - Monitor lipids annually
  - Initiate lifestyle changes: diet, exercise, and weight loss
- (c) Hypercholesterolemia
- Maintain triglycerides less than 150 mg/dl
  - Maintain LDL less than 70 mg/dl (ideally)
  - Intervention may require medication (i.e. statin agent)
- (d) Tobacco
- Smoking cessation program
- (e) Serum homocysteine level
- Folic acid, vitamins B12 and B6
- 3) Treatment of etiology
- (a) Atrial fibrillation
- Start Coumadin since patient now has risk factors for stroke in addition to atrial fibrillation (brand-name Coumadin is recommended due to potential variability with multiple available generic products)
  - Other risks may preclude use of Coumadin (e.g. recurrent GI bleeding, recurrent falls)
  - Target range for INR is 2.0 to 3.0
- (b) Carotid stenosis (symptomatic by definition since patient has had TIA)

- Stenosis less than 50%; antiplatelet agents
- Stenosis greater than 50% in men and 70% in women
  - Consider carotid endarterectomy at institution with surgical risk of stroke and death of less than 3%
  - Consider carotid artery stenting in patients with restenosis after prior carotid endarterectomy, poor cardiac status, prior neck irradiation, difficult surgical access or high anesthetic risk (procedure should be performed at facility designated as a comprehensive stroke center and by interventionalists certified to perform this procedure)

(c) Intracranial vascular disease

- Antiplatelet agents
  - Aspirin: if first event
  - Aspirin/dipyridamole (Aggrenox): if event occurred while patient on aspirin
  - Ticlopidine (Ticlid): if event occurred while patient aspirin/dipyridamole (Aggrenox)
  - Clopidrogel (Plavix): if patient also has documented coronary or peripheral vascular disease, is allergic to aspirin, or has drug-eluting stent
- Angioplasty or stenting may be appropriate in specific research settings

(d) Coagulation disorders

- Coumadin is generally indicated
- Consult Hematologist

(e) Prosthetic heart valve on adequate oral anticoagulation

- Add 81 mg aspirin daily

E. Long Term

1. Follow up care

- a) Managed by primary care physician or neurologist
- b) Reinforce risk leading to individual patients' event
- c) Management of risk factors
  - 1) Medical treatment as outlined above
  - 2) Monitor appropriate parameters
- d) Management of lifestyle
  - 1) Tobacco

- (a) Monitor abstinence
    - (b) Support
  - 2) Physical activity
    - (a) Encourage maintenance program
    - (b) Tailor to patient's physiologic status
  - 3) Diet
    - (a) Consult with nutritionist
- 2. Other monitoring
  - a) Carotid Doppler
    - 1) Yearly if greater than 50% originally
  - b) Labs
    - 1) Serum homocysteine level 3 months after initiation of treatment
    - 2) Blood glucose at frequency dependent on diabetic status
    - 3) Lipids yearly
    - 4) Coagulation parameters if implicated in original event
  - c) Symptoms
    - 1) Report of patient
    - 2) Report of family/care-takers

These guidelines are intended to be a basis from which patient care may be individualized for each patient's situation. Diagnostic and therapeutic procedures and medical treatments are continuously being evaluated and improved. Experience varies with different procedures. Therefore, some procedures require more stringent limitations to their utilization than others based on experience and application. The practice of medicine is continuously changing. These guidelines are particularly pertinent for the point in time during which they have been published. Advancement in medical techniques will necessarily update the propriety of these recommendations.

## Suggested Reading

Albers, G.W. & Easton, J.D. (2002). "Managing TIA: The Current Clinical Strategies." Transient Ischemic Attack. Disease Management Guide. Medical Economics Company. Pg. 101-126.

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## **GUIDELINES FOR THE DIAGNOSIS AND TREATMENT OF ISCHEMIC STROKE**

**Purpose:** To provide a basis from which the medical community in the state of Indiana may more reliably and efficiently recognize that a patient with ongoing neurologic deficit may be in the midst of a stroke. To outline an appropriate course for the evaluation of such a patient in order to differentiate other possible diagnoses as well as to determine the cause of an identified stroke. To provide a minimum standard from which the immediate and long-term management of a patient with a stroke may proceed in order to maximize functional recovery, minimize complications, and prevent recurrence.

### I. Introduction

#### A. Definition

1. Neurologic defect lasting more than 24 hours.
2. The advent of MRI diffusion weighted imaging allows determination of permanent brain injury regardless of the duration of clinical symptoms.
3. A stroke occurs when blood flow in the brain falls below a critical level whether or not normal flow is subsequently restored.

#### B. Epidemiology

1. Stroke is the 3<sup>rd</sup> leading cause of death in the U.S.
2. Stroke is the leading cause of disability and long-term institutionalized care in the U.S.
3. Approximately 600,000 new and recurrent strokes occur in the U.S. per year
4. The direct and indirect costs of stroke exceed \$50 billion per year in the U.S. (\$300 million in hospital charges in Indiana)
5. Indiana has the 7<sup>th</sup> highest rate of stroke in the U.S.

#### C. Etiology

1. Cardiac: emboli to smaller vessels (20-30%)
2. Large vessel, extracranial: generally emboli to smaller vessels, but may also be transient occlusion such as dissection or emboli from heart in combination with local atherosclerosis (10-20%)
3. Large vessel, intracranial: same as large vessel, extracranial (5-8%)
4. Small vessel, intracerebral: atherosclerosis, emboli from larger vessels or heart (up to 20%)
5. Blood: coagulopathies (1-5%)
6. Cryptogenic: undetermined etiology (20-35%)

#### D. Signs and Symptoms

1. Unilateral sensory or motor impairment
2. Gait disturbance
3. Trouble with speech or language
4. Dizziness
5. Visual changes
6. Confusion

E. Risk factors

1. Hypertension
2. Diabetes mellitus
3. Coronary artery disease
4. Previous TIA
5. Atrial fibrillation
6. Carotid artery stenosis
7. Tobacco use
8. Elevated cholesterol
9. Others (see Guidelines for Risk Factors of Stroke)

F. Differential diagnosis

1. Seizure
2. Migraine
3. Metabolic disturbance (e.g. hypoglycemia)
4. Subdural hematoma
5. Brain tumor
6. Trauma
7. Intoxication
8. Brain infection (e.g. abscess, encephalitis)

II. Diagnosis

A. History

1. Significance
  - a) Differentiates stroke from other possible diagnoses
  - b) Localizes area of brain affected and involved circulation (e.g. carotid vs. basilar arteries)
  - c) Helps to determine possible cause (e.g. embolus vs. thrombosis)
2. Time course
  - a) Onset
    - 1) Immediate maximal deficit suggests embolus
    - 2) Stuttering course of progressive deficit suggests small vessel atherosclerosis
    - 3) With stroke, symptoms occur simultaneously in all affected areas
  - b) Duration
    - 1) Symptoms lasting longer than one hour
3. Symptoms
  - a) Usually negative phenomena (i.e. loss of function)

4. Associated factors
  - a) Provocation
    - 1) Activity – usually embolic source
    - 2) Sleep – usually thrombotic source
  - b) Other symptoms
    - 1) If present, typically indicate diagnosis other than stroke
      - (a) Syncope – cardiac problem, hypotension
      - (b) Incontinence – seizure
      - (c) Headache – migraine, cerebral aneurysm
    - 2) Symptoms occasionally associated with stroke
      - (a) vomiting – brainstem involvement
      - (b) Seizure – embolic stroke
  
5. Past medical history
  - a) Risk factors for stroke
    - 1) Hypertension
    - 2) Diabetes
    - 3) Coronary artery disease (e.g. MI)
    - 4) Atrial fibrillation
    - 5) Tobacco use
    - 6) Recent illicit drug use
  - b) Mimics of stroke
    - 1) Migraine headaches
    - 2) Seizures
    - 3) Recent head trauma
  - c) Affecting eligibility for thrombolytics
    - 1) Recent surgery (2 weeks)
    - 2) Recent gastrointestinal or genitourinary bleeding (3 weeks)
    - 3) Recent stroke or MI (3 months)
    - 4) Recent arterial puncture (7 days)
    - 5) Use of anticoagulants (2 days)

## B. Physical examination

1. Comprehensive neurologic examination
  - a) Level of consciousness
  - b) Neurologic deficits
    - 1) Cincinnati prehospital stroke scale is easy to perform and has a high degree of reliability in predicting if a patient is actually experiencing a stroke (Appendix 1)
      - (a) Ideal for use by EMS and ER personnel for rapid assessment
    - 2) NIH stroke scale can be helpful in quantitating overall deficit and subsequent progress (Appendix 2)
  - c) Examination findings can help localize affected vascular territory

2. General examination
  - a) Vital signs
  - b) Overall examination to determine comorbid conditions which could lead to impaired recovery
3. Cardiac examination
  - a) Rhythm disturbance
  - b) Murmurs
4. Neck
  - a) Carotid bruits

C. Testing (will depend on circumstances)

1. Laboratory
  - a) Hematologic
    - 1) CBC
  - b) Metabolic
    - 1) Electrolytes, BUN, creatinine, glucose
    - 2) Lipid profile
    - 3) Serum homocysteine level
  - c) Inflammatory
    - 1) Sedimentation rate
    - 2) Syphilis serology
    - 3) Serum protein electrophoresis
  - d) Immunologic
    - 1) Anticardiolipin antibody
    - 2) Lupus anticoagulant
    - 3) Antiphospholipid antibody
  - e) Coagulation
    - 1) Protime (INR), PTT
    - 2) Protein C & S
    - 3) Antithrombin III
    - 4) Leiden factor V
  - f) Markers for cardiac ischemia
  - g) Electrocardiogram
2. Imaging
  - a) Brain
    - 1) MRI
    - 2) CT
  - b) Cerebral vasculature
    - 1) Carotid Doppler
    - 2) MR angiography
    - 3) CT angiography
    - 4) Conventional angiography
  - c) Heart
    - 1) Echocardiography
    - 2) Transesophageal echocardiography

III. Treatment

A. Immediate treatment

1. Intravenous tissue-type plasminogen activator (TPA)

a) Mechanism of action

- 1) Degradation of thrombus in artery
- 2) Conversion of plasminogen to plasmin which cleaves the fibrin matrix of the thrombus

b) Dosing and administration

- 1) 0.9 mg/kg (maximum of 90 mg)
- 2) 10% of dose given as intravenous bolus over one minute
- 3) The remaining 90% of dose is administered intravenously over 60 minutes

c) Inclusion criteria

- 1) Symptom onset less than 3 hours prior to administration of TPA
- 2) No evidence of intracranial hemorrhage on CT scan of brain
- 3) NIH stroke scale score between 4 and 20

d) Exclusion criteria

- 1) Active bleeding
- 2) Systolic blood pressure greater than 185 mm Hg or diastolic blood pressure greater than 110 mm Hg
- 3) Aggressive treatment required to reduce blood pressure to specified limits
  - (a) Sodium nitroprusside
- 4) Rapidly improving or minor symptoms
- 5) Seizure at onset of stroke
- 6) Symptoms of subarachnoid hemorrhage
- 7) Prior intracerebral hemorrhage felt to predispose patients to high risk of recurrence
- 8) Stroke or head trauma in previous 3 months
- 9) Myocardial infarction in previous 3 months
- 10) Major surgery or other serious trauma in previous 2 weeks
- 11) Gastrointestinal or urinary tract hemorrhage in previous 3 weeks
- 12) Arterial puncture at a noncompressible site in previous 7 days
- 13) Use of oral anticoagulants or intravenous heparin in previous 48 hours
- 14) INR greater than 1.5 or elevated PTT
- 15) Platelet count less than 100,000/mm<sup>3</sup>
- 16) Glucose less than 50 mg/dl or greater than 400 mg/dl
- 17) Pregnancy or lactation
- 18) Obtunded or comatose patient
- 19) Evidence of ischemic involvement of more than 1/3 of a cerebral hemisphere

2. Alternative procedures
    - a) Types
      - 1) Intraarterial thrombolytics
      - 2) Intraarterial mechanical thrombectomy
    - b) Have been shown to improve outcome in selected patients
      - 1) Documented arterial occlusion by angiographic procedure
      - 2) More than 3 hours since onset of symptoms
  3. Experimental procedures
    - a) Hypothermia
    - b) Desmoteplase
- B. Prophylactic treatment
1. Antiplatelet medication
    - a) Aspirin
    - b) Clopidogrel (Plavix)
    - c) Ticlopidine (Ticlid)
    - d) Aspirin/extended release dipyridamole (Aggrenox)
  2. Anticoagulation
    - a) Heparin
    - b) Warfarin (Coumadin)
  3. Metabolic
    - a) Folic Acid/B complex
  4. Surgical
    - a) Carotid endarterectomy
    - b) Carotid stenting/angioplasty
  5. Identification and management of risk factors
- C. General supportive care - management will improve recovery
1. Oxygenation and ventilation
  2. Temperature
  3. Cardiac rhythm
  4. Blood sugar
  5. Blood pressure
  6. Complications – occurrence will impair recovery
    - a) Aspiration
    - b) Deep venous thrombosis
    - c) Pressure sores
    - d) Infection
    - e) Depression
    - f) Falls
    - g) Cerebral edema
    - h) Seizures
    - i) Hemorrhagic transformation

#### IV. Rehabilitation (2/3 of persons who have stroke need rehabilitation)

- A. Goals for rehabilitation of stroke patients
  - 1. Training for maximum recovery
  - 2. Prevent and treat comorbid conditions
  - 3. Enhance psychosocial coping
  - 4. Promote reintegration into the community
  - 5. Prevent recurrent strokes and other vascular events
  - 6. Improve quality of life
  
- B. Factors for successful rehabilitation
  - 1. The timing of rehabilitation
  - 2. Extent of brain injury
  - 3. Survivor's attitude
  - 4. Skill of the rehabilitation team
  - 5. Cooperation of family and friends
  
- C. Settings for rehabilitation
  - 1. Acute care hospital for initial care and stabilization 24-48 hours after stroke
  - 2. Acute rehabilitation unit or freestanding hospital provides therapy for a minimum of 3 hours per day 5-6 days per week
  - 3. Long-term acute care hospital for complex medical needs provides no therapy or 1-2 hours per day
  - 4. Subacute rehabilitation unit either hospital based or in a skilled facility provides 1-2 hours therapy per day
  - 5. Home-based nursing care and therapy provides necessary staff for 2-3 visits per week
  - 6. Outpatient therapy services provided 2-3 days per week
  - 7. Day treatment provides 2-3 therapies and groups 4-6 hours/day for 3-5 days/week
  
- D. Medical professionals involved in rehabilitation care
  - 1. Physician: physiatrist or neurologist
    - a) Training and experience in general medicine as well as neurology or physical medicine and rehabilitation with certification
  - 2. Rehabilitation nursing
    - a) Prevention of medical complications, education, and supervision to maximize patient abilities and self-care potential
    - b) Focus on medical conditions, elimination, medication knowledge, skin integrity, safety
  - 3. Physical therapy
    - a) Improvement in strength, coordination and endurance
    - b) Improvement in skills needed for mobility
    - c) Recommend and instruct in use of appropriate bracing and assistive devices

- d) Establish exercise programs
- 4. Occupational therapy
  - a) Evaluate and treat deficits in daily living skills, eye-hand coordination and homemaking
  - b) Improvement in general strength and upper extremity function
  - c) Assess and devise plans to address safety, architectural barriers, and adaptive equipment needs
  - d) Address energy conservation and work simplification
- 5. Recreational therapy
  - a) Reinforcement of socialization skills and improvement of self esteem
  - b) Recommend adaptive equipments and techniques for leisure time activities
  - c) Provide community reintegration programs to allow for practice of skills
- 6. Speech language pathology
  - a) Evaluate and treat speech, language, cognition and swallowing deficits
  - b) Perform swallowing evaluations and recommend compensatory strategies
  - c) Treat problem solving and memory deficits
  - d) Implement alternative means of communication
- 7. Psychology/Neuropsychology
  - a) Provide individual, family and group counseling to aid in adjusting to disability
  - b) Neuropsychology testing to identify cognitive deficits
  - c) Oversight of behavioral modification programs, if necessary
- 8. Social worker/Case manager
  - a) Oversight of the discharge plan
  - b) Identification and referral to needed community resources, financial assistance, and continuing health services

#### E. Types of disabilities

- 1. Physical
  - a) Paralysis – hemiplegia or hemiparesis
  - b) Problems controlling movement (ataxia)
  - c) Affects range of motion, activities of daily living, transfers, mobility
  - d) Visual/perceptual – hemianopsia or neglect
  - e) Swallowing – Dysphagia
  - f) Incontinence
- 2. Sensory
  - a) Paresthesia
  - b) Pain (thalamic pain syndrome)
  - c) “Frozen” joints
- 3. Language
  - a) Understanding – receptive aphasia
  - b) Expression – expressive aphasia

- c) Global aphasia
- 4. Thinking and memory
  - a) Short term memory loss
  - b) Attention and concentration
  - c) Sequence/planning – apraxia
- 5. Emotional
  - a) Depression
  - b) Lability
  - c) Anger/frustration
  - d) Impulsivity; poor judgement
  - e) Relationships; intimacy
- 6. Vocational/Avocational
  - a) Driving
  - b) Return to work/accommodations
  - c) Community re-entry

- F. Commission on Accreditation of Rehabilitation Facilities (CARF) accredits stroke specialty programs indicating optimal performance in post-acute rehabilitation settings
  - 1. Stroke specialty rehabilitation programs provide services that focus on prevention, on minimizing the participation and quality of life of persons who have sustained a stroke
  - 2. Many organizations use CARF standards, but due to the involved costs, do not pursue its certification

## V. Hospital systems

- A. Within the hospital
  - 1. Stroke protocol/pathways (Appendix 3)
    - a) A standardized set of instructions for the management of a patient with ischemic stroke
      - 1) For evaluation of patient
      - 2) For treatment of stroke
      - 3) For secondary prevention of stroke
        - (a) Identifications and treatment of risk factors
      - 4) For nursing management
    - b) May include standing orders
      - 1) For administration of TPA
      - 2) For management of patient following TPA
      - 3) For subacute management of patient regardless of use of TPA
    - c) Much documentation exists indicating improved patient outcomes when stroke protocols are in use
      - 1) Increase use of select medications and treatments
      - 2) Improved patient assessment
      - 3) Reduction in unnecessary tests
      - 4) Shorter length of stay
  - 2. Stroke teams

- a) Provide evaluation of the patient by designated staff with experience in the diagnosis and management of stroke
- b) Composition (varies depending on the facility)
  - 1) Neurologist
  - 2) Neurosurgeon
  - 3) Emergency physician
  - 4) Radiologist
  - 5) Registered nurse
  - 6) Radiology technician
  - 7) Pharmacist
- c) Members carry pager for rapid activation of the team
  - 1) Members carry pager for rapid activation of the team
  - 2) Once activated, the members of the team are available for communication in their respective departments (e.g. radiology, technician prepared for CT, pharmacist available to rapidly dispense TPA)
  - 3) Members of team may be rotated on predetermined schedule
    - (a) Reduces interference with other duties
    - (b) Enables participation and cooperation among all appropriate medical staff members
  - 4) Response should be within 15 minutes
  - 5) Availability should be 24 hours daily

B. Stroke centers

1. Purpose

- a) To provide a cohesive infrastructure in a health care facility for the optimal management of patients with stroke

2. Primary stroke center

a) Capabilities

- 1) Assess and diagnose patients with stroke
- 2) Stabilize patient
- 3) Provide emergency care including TPA if appropriate

b) Major elements

- 1) Acute stroke team (see above)
- 2) Written care protocols (see above)
- 3) Emergency medical services – close communication

between the stroke

patient, but also

early management of

and stroke team,

diagnosis and treatment

center and EMS, not only with each suspected stroke

In general with information and education regarding

stroke

- 4) Emergency department – close integration with EMS

along with appropriate training and protocols for

- of stroke
- 5) Stroke unit – only for those stroke centers that will be admitting patients for ongoing care
- 6) Neurosurgical services – should be available within 2 hours of recognizing Such a need; this could involve transfer to another facility
- 7) Neuroimaging – CT or MRI brain available within 25 minutes of original order and experienced interpretation within 20 minutes of completion (24 hours daily)
- 8) Laboratory services – blood cell counts, chemistry, coagulation studies, electrocardiogram, and chest x-ray results available with 45 minutes of order (24 hours daily)
- 9) Outcomes/quality improvement or development of database or registry of parameters of ongoing stroke care and benchmarks to which the parameters can be compared to assess progress
- 10) Educational programs – professional staff should have 8 hours of relevant continuing education yearly and there should be 2 annual public education programs
- 11) Support of medical organization – administrative and personnel commitment to the program as well as the presence of a designated medical director

c) Certification

- 1) By JCAHO
  - (a) Eligibility
    - Operational stroke center for at least 3 months
    - Submission of application fee
  - (b) Initial certification is one year with additional year contingent on additional documentation; then two year renewal
- 2) By HFAP
  - (a) Eligibility
    - Level 1: meets standards (Major elements as above), but not minimum patient volume
    - Level 2: meets standards and had 30 patients or more on the stroke center protocol in prior 12 months

(b) Duration

- Level 1: one year
- Level 2: two years

3. Comprehensive stroke centers

a) Capabilities

- 1) Same as primary stroke center
- 2) Ongoing inpatient care
- 3) Specialized testing (e.g. angiography, transcranial doppler)
- 4) Specialized procedures (e.g. carotid stenting; carotid endarterectomy)
- 5) Rehabilitation
- 6) Research

b) Major elements

1) Personnel

- (a) Vascular neurology
- (b) Vascular neurosurgery
- (c) Diagnostic neuroradiology
- (d) Vascular surgery
- (e) Interventional neuroradiology
- (f) Rehabilitation physician
- (g) Rehabilitation therapists
- (h) Staff stroke nurse
- (i) Radiology technologist

2) Diagnostic capabilities

- (a) MRI with diffusion
- (b) MR angiography
- (c) Digital cerebral angiography
- (d) Carotid duplex ultrasound
- (e) Stroke registry

c) Certification

- 1) Not yet available

C. Interaction between hospitals and including other agencies

1. Components of care

- a) Primary prevention
- b) Patient education
- c) Emergency medical services
- d) Acute stroke treatment
- e) Subacute stroke treatment and secondary prevention
- f) Rehabilitation
- g) Quality assurance

2. Advantages

- a) Ensuring the provision of evidence-based care to all patients with stroke
- b) Providing appropriate coverage for those geographic areas that may be otherwise neurologically underserved

3. Linkages

a) Transport

- 1) Hasten delivery of patient to capable facility

- 2) Transfer of patients between facilities as necessary
  - 3) Ability to cross geopolitical boundaries
  - 4) Coordinated emergency response call centers and
- EMS agencies
- b) Interhospital
    - 1) Each facility must recognize its own limitations
    - 2) Predetermined interhospital protocols and transfer agreements should be in place
    - 3) Availability of neurologic consultation in ER at least by telephone with neurologist or tertiary facility with equivalent expertise
    - 2) Availability of rehabilitation assessment by agreement with other specialty Facilities
  - c) Radiology
    - 1) Teleradiology for rapid review of CT scans with qualified radiologists

## VI. Recommendations

### A. Pre-hospital

#### 1. Patient education

- a) What patients need to know
  - 1) Risk factors for stroke
  - 2) Symptoms of stroke
  - 3) Actions to take in the event of a suspected stroke
    - (a) Seek medical attention immediately
    - (b) Call 911
- b) How to educate patients
  - 1) Primary physician
    - (a) Learn patient's habits and risks
    - (b) Communicate these to the patient
    - (c) Provide printed information materials
  - 2) Hospitals
    - (a) Educational/informational programs
    - (b) Stroke support groups
    - (c) Screening sessions for risk factors
  - 3) Special interest groups (i.e. American Stroke Association, National Stroke Association)
    - (a) Educational programs
    - (b) Screening sessions
    - (c) Printed literature
    - (d) Educational grants

#### 2. Emergency Medical System

- a) Recognition
  - 1) Dispatch
    - (a) Should be able to recognize suspicious complaints as possible stroke symptoms
      - Confusion

- Weakness
  - Dizziness
  - Falling
- (a) Should communicate possibility of stroke to emergence personnel in field
- 1) On-site
- (a) Cincinnati prehospital stroke scale
- Language
  - Facial weakness
  - Arm weakness (drift)
- (b) Awareness of other conditions similar to stroke
- Seizure
  - Hypoglycemia
  - Hyperventilation
- b) Management
- 1) On-site
- (a) Check vital signs
- (b) Intervene with any life threatening conditions
- (c) Consider oxygen administration if oxygen saturation is less than 93%
- (d) Perform Cincinnati prehospital stroke scale
- (e) Obtain history
- Type of onset: gradual vs. abrupt
  - Onset while awake or asleep
  - Duration of symptoms
  - Nature of symptoms
  - Comorbid conditions
    - Diabetes mellitus
    - Hypertension
    - Coronary artery disease
    - Prior stroke
- 2) Transport to the closest facility capable of managing stroke
- (a) As soon as possible
- (b) Nothing by mouth
- (c) Place on cardiac monitor
- (d) Check blood sugar by finger stick
- (e) Start intravenous access (any IV fluids should be normal saline)
- (f) Contact ER destination and notify nature of problem and estimated time of arrival
- (g) Do not intervene with hypertension
- 3) Transfer to ER care
- (a) Provide history
- Time of onset
  - Symptoms
  - Findings of examination
- (b) Provide medication list

- c) EMS systems should have stroke protocols in place to be used by their personnel

## B. Emergency Room

### 1. Contact with EMS

- a) Time of symptom onset
- b) Identify symptoms
- c) Stability of patient
- d) Medication

### 2. Triage

- a) Recognize symptoms of walk-in patients
- b) Determine time of onset of symptoms

### 3. Evaluation

#### a) History

- 1) Time of symptom onset
- 2) Type of symptoms
- 3) Circumstances of onset
- 4) Risk factors
- 5) Obtain from family and witnesses as well

#### b) Examination

- 1) Neurologic
  - (a) NIH stroke scale
- 2) Vital signs
- 3) Cardiac
- 4) Neck

#### c) Labs

- 1) Oxygen saturation
- 2) CBC
- 3) Electrolytes, BUN, creatinine, and glucose (BMP)
- 4) Protime and PTT
- 5) Markers for cardiac ischemic

#### d) Imaging

- 1) CT brain
  - (a) Test complete within 25 minutes of patient arrival

- (b) Interpretation available within additional 20 minutes

#### e) Cardiac

- 1) Electrocardiogram

#### f) Neurology consultation

- 1) In person
- 2) By phone

### 4. Treatment

#### a) Intravenous TPA

- 1) Does patient meet criteria
  - (a) May treat hypertension
    - Oral antihypertensive medication
    - Intravenous labetalol

- 2) Neurologist should concur with treatment
- 3) Patient should have two intravenous access sites
- 4) Full discussion of risks and benefits with patient and family
- b) Aspirin (325 mg)
  - 1) If no TPA
  - 2) If no medical contraindication
    - (a) If aspirin allergy, use clopidogrel (Plavix) 75 mg
  - 3) If no hemorrhage on head CT
  - 4) If patient can safely swallow
    - (a) Consider rectal suppository if patient cannot

swallow

- 5) Within 24 hours of stroke
- c) Alternative therapies
  - 1) Consider when:
    - (a) Symptom onset longer than 3 hours earlier
    - (b) Documented occlusion of large vessel
    - (c) Basilar artery involvement
  - 2) Recommended by neurologist
  - 3) Performance
    - (a) By practitioner with expertise with the

procedure

the procedure and

complications, afterward

cardioembolic source

- (b) At facility with expertise in and capabilities for care of the patient, including potential

- d) Heparin, in any form, is not recommended unless well known

#### 5. Disposition

- a) Admit to intensive care unit
  - 1) Received TPA
  - 2) Recent aspiration
  - 3) Persistent oxygen desaturation
  - 4) Cardiac dysrhythmia
  - 5) Evidence of concurrent MI
  - 6) Need for IV control of hypertension
- b) Admit to general medical or neurologic floor
  - 1) No TPA
  - 2) Otherwise stable

### C. In hospital

#### 1. Evaluation

- a) Dependent on clinical localization of event
  - 1) Anterior circulation (i.e. carotid distribution)
    - (a) Carotid doppler
    - (b) Echocardiogram
    - (c) MRI with diffusion-weighted imaging
  - 2) Posterior circulation (i.e. vertebra-basilar distribution)
    - (a) MR angiography
    - (b) Echocardiogram

- (c) MRI with diffusion-weighted imaging
  - 3) Subcortical lacunar syndrome
    - (a) Carotid doppler
    - (b) MRI with diffusion-weighted imaging
- b) Dependent on suspected etiology
  - 1) Aortic disease
    - (a) Transesophageal echocardiogram
  - 2) Coagulopathy
    - (a) Protein C & S
    - (b) Antithrombin III
    - (c) Leiden factor V
  - 3) Inflammation
    - (a) Sedimentation rate
    - (b) Syphilis serology
    - (c) Serum protein electrophoresis
  - 4) Immunologic
    - (a) Anticardiolipin antibody
    - (b) Lupus anticoagulant
    - (c) Antiphospholipid antibodies
  - 5) Metabolic
    - (a) Serum homocysteine level
    - (b) Fasting blood sugar
    - (c) Lipid profile

## 2. Acute management

- a) Medical
  - 1) Post TPA
    - (a) Neurologic assessment every 15 minutes during infusion, every 30 minutes for the next 6 hours, and every hour until 24 hours after infusion
      - Obtain emergent head CT if change in neurologic status, severe headache, or nausea/vomiting
    - (b) Monitor blood pressure every 15 minutes for the first two hours, every 30 minutes for the next 6 hours, and every hour until 24 hours after infusion (should be less than 180/105 mmHg)
      - If systolic blood pressure is between 180 and 230 mm Hg diastolic blood pressure is between 105 and 120 mm Hg, give labetalol 10 mg over 1-2 minutes and repeat or double the dose every 10 to 20 minutes up to 300 mg, check blood pressure every 15 minutes until stable (two consecutive readings)

- If systolic blood pressure is greater than 230 mm Hg or diastolic blood pressure is between 121 and 140 mm Hg give labetalol as above, or 10 mg IV bolus followed by a continuous infusion at 2-8 mg/min if unsuccessful, start infusion of sodium nitroprusside at 0.5 mcg/kg/min and monitor blood pressure every 15 minutes during treatment
  - If diastolic blood pressure is greater than 140 mm Hg, infuse sodium nitroprusside and monitor blood pressure every 15 minutes during treatment
- d) No anticoagulant or antiplatelet agents for the first 24 hours after TPA administration
- e) For first 24 hours after TPA administration, no:
- Nasogastric tubes
  - Urinary catheters
  - Intraarterial catheters

## 2) General supportive care

### (a) Ventilation

- Oxygen saturation should be greater than 92%
  - Use supplemental oxygen only if necessary to maintain this level
- Intubation
  - Severely obtunded patients
  - Clear inability to manage own secretions
  - Persistent tachypnea despite supplemental oxygen

### (b) Fever

- There is evidence that fever with acute ischemic stroke is associated with poorer neurologic outcomes
- Treat promptly with antipyretics, cooling blanket
- Look for source

### (c) Cardiac rhythm

- Can be a complication of stroke or for stroke
- Cardiac monitoring for at least 48 hours

### (d) Blood glucose

- Evidence that aggressive management of blood sugar

improves outcomes after stroke is still vague

- Hyperglycemia may be a reflection of the severity of a stroke
- Hypoglycemia can mimic symptoms of stroke
- Monitor blood glucose as for any seriously ill patient and with respect to preexisting diabetes
- Treat blood sugars of less than 80 mg/dl or greater than 180 mg/dl

(e) Blood pressure

- Hypertension should be treated when
  - Systolic blood pressure is greater than 220 mm Hg
  - Diastolic blood pressure is greater than 120 mm Hg
  - Hemorrhagic transformation of stroke
  - Hypertensive encephalopathy
  - Arterial dissection
  - Acute renal failure
  - Acute pulmonary edema
- Treatment of hypertension should be cautious and gradual over hours and not minutes
  - Blood pressure may be lowered by approximately 15% in the first 24 hours
  - Blood pressure medications for patients with pre-existing hypertension may be restarted 24 hours after the stroke
- Hypotension should be treated (e.g. mean arterial pressure below 100 mm Hg)
  - IVF with normal saline
  - Patient flat in bed
  - Avoid pressure lowering medications
  - Consider vasopressors in persistent cases

3) Complications

(a) Aspiration

- Prevention
  - Bedside swallow evaluation with sips of water

- Speech therapy for video fluoroscopic swallow evaluation
- Diet appropriate to swallow function
- Proper positioning for meals
- Close monitoring during first two or three meals after stroke
- Bedside suction available
- Treatment
  - Percutaneous gastric tube when evidence of aspiration
  - Close monitoring for fever
  - Speech therapy for rehabilitation of swallow

(b) Deep venous thrombosis

- Prevention
  - Graduated compression stockings on all patients
  - Intermittent pneumatic compression devices especially to paralyzed extremity
  - Subcutaneous heparin or heparinoids in patients that are immobile
  - Passive range of motion 2 to 3 times daily in paralyzed limbs (especially upper extremity)
- Treatment
  - Subcutaneous heparin or heparinoids and Coumadin when deep venous thrombosis is detected
  - Inferior vena cava filter if Coumadin is contraindicated

(b) Pressure sores

- Prevention
  - Especially susceptible if smoker, malnourished or have dry skin
  - Frequent turning
  - Alternating pressure mattresses
  - Dietary consult to establish adequate protein level
- Treatment
  - Skin care consultation

- Surgical consultation
- (c) Infection
  - Urinary tract
    - Avoid indwelling catheters
    - Acidify urine
    - Anticholinergic agents when neurologic dysfunction
  - Pneumonia
    - Aspiration precautions
    - Early mobilization
    - Chest x-ray with any fever
    - Prompt antibiotic therapy
- (d) Depression
  - Prevention
    - 50% of stroke patients will develop depression
    - Talk to patient and family
    - Watch for signs: poor motivation, withdrawal, agitation, anorexia, insomnia
    - Support groups
  - Treatment
    - Antidepressant medication (watch for sedation)
    - Counseling
    - Support groups
- (e) Falls
  - Prevention
    - Identify patient as fall risk for staff
    - Bed alarms
    - Assistance with initial activity
    - Implement falls prevention program
  - Treatment
    - Evaluate patient immediately after fall
    - Radiologic evaluation of involved part of body
- (f) Cerebral edema and increased intracranial pressure
  - Prevention
    - Nothing specifically known
    - Close observation for signs of increased intracranial pressure (e.g. nausea/vomiting, headache, decreased consciousness, increased neurologic deficit)

- Treatment (in order of severity of problem)
  - Avoid hyposmolar fluids
  - Elevate head of bed to 30 degrees
  - Diuretic (e.g. furosemide, mannitol)
  - Hyperventilation to decrease pCO<sub>2</sub> by 5 mmHg
  - Ventriculostoms
  - Decompressive craniectomy (predominately for posterior fossa strokes)
  - Cortiosteroids are not recommended

(g) Seizures

- Prevention
  - Prophylactic use of antiepileptic medicine is not helpful
- Treatment
  - Check EEG
  - Antiepilepsy medicine only if EEG has epileptiform activity or there has been more than one seizure
  - Choice of agent depends on other conditions and medications of the patient

(h) Hemorrhagic transformation

- Prevention
  - Avoidance of unnecessary or inappropriate use of anticoagulant and antiplatelet medications (see above information)
- Treatment
  - Prompt CT evaluation of neurologic decline
  - Restrict anticoagulant and antiplatelet medications temporarily
  - Check coagulation parameters
  - Consider reversal of anticoagulation
  - Consider administration of platelets or cryoprecipitate
  - Consider surgical evacuation

- Decisions will depend on situation and patient's condition

#### 4) Identification of risk factors

##### (a) Obtain additional history

- Past medical history of conditions that could increase the risk of stroke (e.g. hypertension, diabetes, atrial fibrillation, coronary artery disease and hypercholesterolemia)
- Identify habits (e.g. tobacco, alcohol/ illicit drug, diet, and exercise)
- Family history of stroke or coagulation disorders

##### (b) Evaluate blood pressure trends

##### (c) Check metabolic status

- Fasting glucose
- Fasting lipid profile
- Serum homocysteine level

#### 5) Treatment of risk factors

##### (a) Hypertension

- Prehypertension: systolic blood pressure; 120-139 mm Hg diastolic blood pressure 80-89 mm Hg
- Blood pressure greater than 140/90 mm Hg
- Initiate medication with consideration of patient's overall condition

##### (b) Diabetes mellitus

- Maintain fasting blood sugar less than 120 mg/dl
- Maintain glycosylated hemoglobin less than 7%
- Monitor lipids annually
- Initiate lifestyle changes: diet, exercise, and weight loss

##### (c) Hypercholesterolemia

- Management based on National Cholesterol Education Program (Adult Treatment Panel III)
  - Maintain triglycerides less than 150 mg/dl
  - Maintain LDL less than 70 mg/dl (ideally)
  - Intervention may require medication

- Statin agents are recommended
- (d) Tobacco
  - Smoking cessation program
- (e) Serum homocysteinemia level
  - Folic acid, vitamins B12 and B6
- (f) See also: Guidelines for Risk Factors of Stroke

## 6) Treatment of etiology

- Cardiac
  - Atrial fibrillation
    - Start Coumadin since patient now has risk factors for stroke in addition to atrial fibrillation (brand-name Coumadin should be used due to potential variability with multiple available generic products)
      - INR of 2.5
    - Aspirin 325 mgs daily when other risks preclude use of Coumadin (e.g. recurrent GI bleeding, recurrent falls)
  - Acute MI with left ventricular thrombus
    - Coumadin in INR of 2.5 for 3 to 12 months
    - Aspirin 162 mgs daily for coronary artery disease
  - Prosthetic heart valves or rheumatic mitral valve disease
    - Coumadin to INR 2.5 to 3.0
    - CVA while on Coumadin, add aspirin 81 mgs daily
- Carotid stenosis (symptomatic by definition since patient has had TIA)
  - Stenosis less than 50%: antiplatelet agents
  - Stenosis greater than 50% in men and 70% in women
  - Consider carotid endarterectomy at institution with surgical risk of stroke and death of less than 3%, performed within 2 weeks of event
    - Consider carotid artery stenting in patients with restenosis after prior carotid endarterectomy, poor cardiac

status, prior neck irradiation, difficult surgical access or high anesthetic risk (procedure should be performed at facility designated as a comprehensive stroke center and by interventionalists certified to perform this procedure, with complication rates less than 6%)

- Intracranial vascular disease
  - Antiplatelet agents
    - Aspirin: if first event
    - Aspirin/dipyridamole: if event occurred while patient on aspirin
    - Ticlopidine: if event occurred while patient on aspirin/dipyridamole
    - Clopidrogel: if patient also has documented coronary or peripheral vascular disease, a vascular stent, or is allergic to aspirin
    - Angioplasty or stenting may be appropriate in specific research settings
  - Coagulation disorders
    - Coumadin is generally indicated
    - Consult Hematologist

b) Nursing

1) Patient care

(a) Check vital signs and neurologic status for deviations from

baseline

- Immediately inform physician of any negative deviations
- Closer monitoring of blood pressure as patient's mobility increases
- Check orthostatic blood pressure and heart rate when patient is initially able to get out of bed
- Evaluate blood pressure medications in order to maintain requested limits on vital signs
- Monitor oxygen saturation for at least first 24 hours after event

(b) Assess patient's swallow

- Initially sips of water, then progressively more solid foods
  - If swallow impaired, nothing by mouth and consult speech therapy for more detailed evaluation
  - If swallow functional, assure diet appropriate for patient overall needs (e.g. low sodium) and consult dietician as necessary
- (c) Administer medication
- Maintain IV including fluids as ordered
  - Anticoagulation: obtain and monitor coagulation levels to maintain within prescribed parameters
- (d) Post-TPA care
- Monitor for bleeding at puncture sites
  - Increased frequency of vital signs and neurologic assessments per protocol
  - Ensure avoidance of anticoagulants and antiplatelet agents during the first 24 hours after infusion
  - No invasive tubes or catheters
  - Monitor patient for complications
    - Aspiration - upright during meals, supervision as needed
    - Deep venous thrombosis – compression stockings, sequential compression devices
    - Pressure sores – move patient frequently, daily check of skin
    - Urinary tract infection – avoid catheters
    - Depression
    - Falls – bed alarms

### 3) Education

- (a) Assess patient and family for baseline knowledge
- Risk factors
  - Diagnostic tests
  - Medications
  - Surgical therapies
- (b) Facilitate and educate the patient and family according to assessment of knowledge deficit

appropriate to their educational level and learning style

- TPA
- Risk factors
- Diagnostic tests
- Medications

(c) Educational materials may include:

- Printed materials
- Video recordings
- Web-sites
- Support groups (e.g. national organizations and local groups)

#### D. Rehabilitation

1. Transfer from acute care hospital to rehabilitation facility
  - a) Overall medical condition should be stable
  - b) All acute medical evaluation should be complete (e.g. CT, MRI, vascular imaging, etc.)
  - f) Evaluation of patient's rehabilitation potential for appropriate rehabilitation service transfer
2. Acute care hospital
  - a) Initiate therapy evaluation and treatment within 24-48 hours or after medical stabilization in all patients with stroke
  - b) Begin evaluation of self-care ability – referral to Occupational Therapy
  - c) Bedside swallowing evaluation – referral to Speech Therapy
  - d) Maintain joint mobility/promote independent movement – referral to Physical Therapy
  - e) Cognitive changes – referral to Neuropsychology
  - f) Prevent further medical/neurologic complication through appropriate medication and fluid administration; adequate positioning and safety precautions; monitoring of skin condition, elimination and nutrition
3. Acute rehabilitation unit in a hospital or free-standing rehabilitation hospital
  - a) Medically stable
  - b) Need 24 hour rehabilitation nursing supervision and physician care
  - c) Physical disability or cognitive impairment – able to do 25-50% of the work
  - d) Requires more than one therapy and can tolerate therapy for minimum of 3 hours per day 5-6 days per week
  - e) Potential for functional improvements and return to community

4. Long term acute care hospital
  - a) Complex medical needs
  - b) Need 24 hour nursing supervision and physician care
  - c) Physical disability or cognitive impairment – dependent
  - d) Unable to participate in therapy or very low endurance – 1-2 hours per day
  - e) Expected length of stay 25 days
  
5. Subacute rehabilitation unit either hospital based or in a skilled facility
  - a) Medically stable
  - b) Need 24 hour nursing supervision
  - c) Physical disability or cognitive impairment – dependent or able to do less than or equal to 25% of the work
  - g) Low endurance for therapy – 1 to 2 hours per day
  
6. Outpatient therapy
  - a) Medically stable
  - b) Not needing 24 hour nursing supervision or physician care
  - c) Needs 1-2 therapies 2-3 days per week
  - d) Day treatment – requires groups for socialization and cognition in addition to 2-3 therapies for 3-5 days/week to address physical or cognitive impairments
  - h) Physical disability or cognitive impairment – able to do 75% of the task or requires supervision
  - i) Excellent family/social support
  
7. Home-based nursing care and therapy
  - a) Medically stable
  - b) Not needing 24 hour nursing supervision or physician care
  - c) Home-bound
  - d) Adequate social support or be able to be alone in home environment
  - e) Physical disability or cognitive impairment – able to 50-75% of the work
  
8. Parameters dependent on patient's deficits and needs
  - a) Length of stay in rehabilitation unit
  - b) Daily duration and schedule of therapies
  - c) Type of therapies
  
9. CARF
  - a) Not necessarily practical for every rehabilitation setting
  - b) Rehabilitation settings with stroke as one of their top diagnosis should strongly consider CARF accreditation as a Stroke Specialty Program

#### E. Hospital Systems

1. Within the hospital

- a) Emergency room
    - 1) All personnel should be trained in recognition of stroke
      - (a) Risk factors
      - (b) Symptoms
      - (c) Signs (at least Cincinnati prehospital stroke scale)
    - 2) Protocol in place for management of stroke patient
      - (a) Acute management
        - TPA protocols, including CT and laboratory availability
        - Stroke standing orders
        - Stroke teams
      - (b) Protocol in place for transfer to another facility
  - b) Subacute treatment
    - 1) Stroke protocols (Appendix 3)
      - (a) Post-TPA management
      - (b) Standing orders for continued evaluation and treatment
    - 2) Stroke unit
      - (a) Inpatient neurologic consultation available
      - (b) Nursing with experience in potential stroke complications
      - (c) Availability of technical monitoring such as telemetry, pulse oximetry, continuous blood pressure
    - 4) Secondary prevention
      - (a) Protocols for investigation of possible risk factors
      - (b) Protocols for intervention of discovered risk factors
        - Lipids
        - Hypertension
        - Antithrombotics
    - 5) Rehabilitation
      - (a) Evaluation of needs
      - (b) Initiation of therapy
  - c) Primary stroke center certification
    - 1) Not necessarily practical for every hospital
      - (a) Hospitals that treat 100 to 200 patients with stroke yearly should ensure that their programs meet stroke care guidelines as outlined
      - (b) Hospitals with stroke as one of their top 10 DRG's should strongly consider primary stroke center certification
    - 2) Protocols should be reviewed and updated annually
2. Between hospitals and other agencies
    - a) Emergency medical systems

- 1) All personnel should be trained in recognition of symptoms and signs of Stroke
  - (a) Dispatcher
  - (b) Emergency medical services personnel
  - (c) Paramedics
  - (d) Stroke centers should be active in the education process
- 2) Transport
  - (a) To primary stroke center or equivalent facility if time from onset of symptoms to arrival at facility will be less than 2 hours
  - (b) To nearest hospital for evaluation and possible transfer to primary stroke center if
    - The patient is in cardiac arrest
    - The patient has an unmanageable airway
    - The patient has other medical conditions that warrant transport to the closest appropriate hospital ER as per protocols
    - The total pre-hospital time is greater than 2 hours
    - An on-line physician directs
  - (c) Hospital or corporate affiliations as well as local and state boundaries should not interfere with safe and efficient transport
- b) Hospitals
  - 1) Develop network to facilitate transfer of patients for:
    - (a) TPA administration
    - (b) Inpatient management (e.g. ICU, neurosurgery, special testing)
    - (c) Advanced procedures (e.g. stenting, mechanical thrombectomy)
    - (d) Rehabilitation
  - 2) May involve multiple referral patterns, but specific agreements preferred for:
    - (a) Standardized protocols
      - Treatment
      - Transfer
    - (b) Consistent communication pathways
    - (c) Facilitation of educational processes for staff
    - (d) Hastening transfers
- c) Specialty organizations (e.g. American Stroke Association, Association)
  - 1) Should be involved with any hospital treating stroke
  - 2) Should participate with:

National Stroke

- (a) Assisting in stroke center certification
- (b) Providing access to quality improvement tools
- (c) Assisting with educational efforts (i.e. patients and staff)
- (d) Increase public awareness
- (e) Advocacy

These guidelines are intended to be a basis from which patient care may be individualized for each patient's situation. Diagnostic and therapeutic procedures and medical treatments are continuously being evaluated and improved. Experience varies with different procedures. Therefore, some procedures require more stringent limitations to their utilization than others based on experience and application. The practice of medicine is continuously changing. These guidelines are particularly pertinent for the point in time during which they have been published. Advancement in medical techniques will necessarily update the propriety of these recommendations.

Suggested reading:

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