Current trends in Endovascular Treatment for acute strokes:
An overview with Preoperative, Intraoperative, and Postoperative nursing considerations

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Disclosure

Conflict of Interest

1. I do not have any conflicts of interest associated with the content presented including:
   a) Financial interest
      i. Salaries
      ii. Honoraria
      iii. Consulting fees
   b) Commercial interest
      i. Familiar relationships
      ii. Membership
      iii. Speaking or teaching

2. Many of the interventions presented in the procedure are not FDA approved (off label)
   a) Interventions include the use of humanitarian devices
   b) Infusion of medications via the intra-arterial route
Objectives

1. Discuss the pre-procedure preparation and patient/family teaching for the endovascular stroke patient.
2. Explanation of endovascular procedures of the brain.
3. Discussion of post-procedure care that includes monitoring and anticipated complications.
4. Discussion of process improvement initiatives for optimal throughput for endovascular revascularation therapy (ERT).
Cerebrovascular Anatomy
Cerebrovascular Anatomy

Arterial Circulation of the Brain, Including Carotid Arteries

- Anterior Cerebral Artery
- Left Middle Cerebral Artery
- Right Middle Cerebral Artery
- Anterior Communicating Artery
- Basilar Artery
- Posterior Cerebral Artery
- Posterior Communicating Artery
- External Carotid Arteries
- Vertebral Arteries
- Common Carotid Arteries
- Internal Carotid Arteries
Rotational Angiogram
(University of Texas Southwestern Medical Center, 2010)
AP (front) View

(University of Texas Southwestern Medical Center, 2010).

Right Internal Carotid Artery
Lateral (side) View
(University of Texas Southwestern Medical Center, 2010).

Right Internal Carotid Artery
Differential Diagnosis

Hemorrhagic?
1. Causes
   a. Aneurysm
   b. Arteriovenous Malformation (AVM)
   c. Fistula, tumor, trauma
2. Treatment-Surgical
   a. Craniotomy
   b. Clipping
   c. Wrapping
   d. Bypass
3. Endovascular Repair
   a. Coiling
   b. Flow diversion (stenting)
   c. Combination
4. Monitoring

Embolic?
1. Causes
   a. Thrombosis (clot)
   b. Mechanical (clip placement)
2. Treatment
   a. Intravenous tPA infusion
   b. Monitoring
   c. Surgery
   d. ERT
      i. Mechanical Retrieval
         a. Trevo™
         b. Penumbra™
         c. Merci™
         d. Solitaire™
      ii. Intra-arterial thrombolytic infusions
          a. tPA
          b. Aggrastat
Definition: Aneurysm

- Fox & Choi (2009) define a cerebral aneurysm as “a weakness or thin section of an artery in the brain which bulges and grows due to pressure of blood entering” the anomaly.
- Subarachnoid hemorrhage (SAH)
- Cerebrovascular accident (CVA)
- Vasospasm
- Brain damage or death
  - (Fox & Choi, 2009)
Classification

• Three (+ one) basic classifications of cerebral aneurysms based on configuration of the aneurysm itself:
  – Saccular
  – Lateral
  – Fusiform
  – Giant

• (Fox & Choi, 2009)
Illustrations Aneurysm Types
(Aneurysm Types [Image], 2010)
Lateral Wall Aneurysm

(Lateral Wall Aneurysm, 2010)
Basilar Tip Aneurysm
(Basilar Tip Aneurysm, 2010)
Statistics

- An estimated 10-15 million people have cerebral aneurysms in the United States.
- Each year approximately 30,000 Americans suffer a SAH.
- Mortality rate for a ruptured aneurysm is 60%.
- 50% of people who suffer a ruptured aneurysm will die within one month.
- 25% of people who suffer a ruptured aneurysm and survive will suffer permanent neurological damage.

(Wright, 2007)
Occurrence

• Approximately 2-6% of the population has a cerebral aneurysm
• More common in women
• Familial
Additional Risk Factors

- Polycystic Kidney Disease
- Connective tissue disorders
- Moya Moya
- Aortic coarctation
- Takayasu’s Arteritis
- Neurofibromatosis
- Fibromuscular Dysplasia (FMD)
- Older patients
- Smoking
- Hypertension
- Traumatic, infections, and neoplastic are rare

- (Bagley, 2009)
Candidates for Endovascular Treatment

• 1. Location of the lesion
• 2. Narrow neck aneurysm
• 3. Contraindications for aspirin and Plavix™ therapy
• 4. Poor surgical candidates
Risks: Endovascular Treatment--Aneurysm

- Morbidity and mortality rates are estimated at 4-10%
- Intracranial or subarachnoid hemorrhage
- Thrombo-embolic formation
- Coil compaction, migration, and revascularization

(Bookley, 2009)
Mechanical ERT: Trevo

• “Trevo utilizes Stentriever technology for thrombus removal by maximizing clot integration”

• Indications
  – Removing clot
  – Restoring blood flow
  – Within 8 hours onset
  – Ineligible for or failed tPA therapy
Pre ERT Treatment

Left
Middle
Cerebral
Artery
Post ERT Treatment

Left Middle Cerebral Artery
Embolic Stroke Imaging

Pre-ERT

Post-ERT

Right Middle Cerebral Artery
Mechanical ERT: Solitaire

- “Overlapping stent based design (technology) to restore flow via clot retrieval, and revive neurological tissue”

- FDA labeling:
  1. Restore Blood Flow
  2. Remove Thrombus
     a) Large Intracranial Vessel
     b) Onset of symptoms within 8 hours of ischemic stroke
  3. Patients that are ineligible or failed IV tPA

Covidien, 2012
Embolic Stroke Imaging

Pre-ERT

Post-ERT

Left Middle Cerebral Artery
<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Neurologic Deficit</td>
</tr>
<tr>
<td>– Medium Vessel Occlusion</td>
</tr>
<tr>
<td>– Large Vessel Occlusion</td>
</tr>
<tr>
<td>• IA thrombolysis initiated w/in 6 hours</td>
</tr>
<tr>
<td>• Mechanical Thrombectomy</td>
</tr>
<tr>
<td>– Anterior Circulation</td>
</tr>
<tr>
<td>• 8 hours from last known well (LKW)</td>
</tr>
<tr>
<td>– Posterior Circulation</td>
</tr>
<tr>
<td>• 12 hours from LKW</td>
</tr>
<tr>
<td>• Advanced Imaging</td>
</tr>
<tr>
<td>• NIHSS greater than 8</td>
</tr>
<tr>
<td>• Deterioration after IV tPA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Arterial Stenosis hinders “safe access”</td>
</tr>
<tr>
<td>• Aortic Dissection</td>
</tr>
<tr>
<td>• Uncontrolled hypertension</td>
</tr>
<tr>
<td>• Platelet count less than 30,000</td>
</tr>
<tr>
<td>• Coumadin</td>
</tr>
<tr>
<td>– INR greater than 3</td>
</tr>
<tr>
<td>• Known bleeding</td>
</tr>
<tr>
<td>• Glucose less than 50 mg/dl</td>
</tr>
<tr>
<td>• Seizure onset</td>
</tr>
<tr>
<td>• Image findings</td>
</tr>
</tbody>
</table>

(Lazzaro et. al., 2012)
Relative Contraindications for ERT

• Hx within the last 3 months
  – Intracranial Surgery
  – Spinal Surgery
  – Head Trauma
  – Stroke
• Intracranial Hemorrhage
• Terminal Illness
• Known pregnancy
• Subacute Endocarditis
• Known glucose greater than 400 mg/dl
  – ↑ ICH
• Hemo or peritoneal dialysis
Preoperative Nursing Considerations
Preoperative Nursing Considerations

• Comprehensive Assessment
  – Preoperative Neuro Exam
    • Alert & Orientated times four
    • Assess cranial nerves II-XII
      – Extra ocular movements intact (EOMs)
    • Visual changes or disturbances
    • Changes in hearing or complaints of dizziness (vertigo)
    • Presence of pronator drift
    • Strength of upper and lower extremities
    • Presence of numbness or tingling
    • (Cox, 2008)
Think FAST!
Everyone’s role in assessment

**F**
Facial Drooping: One side of the face droops or is it numb? Ask the person to smile. Is the smile symmetrical?

**A**
Arm Weakness: Is one arm weaker or numb? Ask the person to raise both arms. Does one arm drift downward?

**S**
Speech Difficulty: Is speech slurred? Is the person unable to speak or hard to understand? Ask the patient to repeat a simple sentence—”The sky is blue.” Is the sentence correct?

**T**
Time to call for help (911): If someone demonstrates the symptoms, even if transient, call 9-1-1, and get the patient to the hospital immediately. Please take note of the time of onset

(AHA/ASA, 2013)
NIH Stroke Scale

Endorsed by the National Institute of Neurological Disorders and Stroke

• A valid & reliable tool
• 11 components
• Answers should be recorded quickly by the examiner without coaching the patient.

National Institute of Neurological Disorders and Stroke (2012)
NIHSS

**Level of Consciousness**
1a. Alertness (0-4)
   i. Keenly alert
   ii. Not alert (minor stimulation)
   iii. Not alert (repeated stimulation)
   iv. Reflex motor, flaccid, unresponsive
1b. Questions (0-2)
   i. What is the month?
   ii. How old are you?
1c. Commands (0-2)
   i. Opens and closes eyes
   ii. Opens and closes hands

**Best Gaze (0-2)**
1. Horizontal eye movements only
2. Establish eye contact and then move from side to side

**Visual (0-3)**
1. Upper and lower quadrants
2. How many fingers (1, 2, 3, or 0)
3. Patient gets a 3 if blind regardless of cause.

National Institute of Neurological Disorders and Stroke (2012)
NIHSS

Facial Palsy (0-3)
1. Smile, show teeth, raise eyebrows
2. Poor responsive patients? Score the symmetry of grimace with noxious stimulation

Motor Arm (0-4)
1. Hold left arm for 10 seconds
2. Hold right arm for 10 seconds
3. Scored UN for amputation

Motor Leg (0-4)
1. Hold left leg for 5 seconds
2. Hold right leg for 5 seconds
3. Scored UN for amputation

National Institute of Neurological Disorders and Stroke (2012)
NIHSS

Limb Ataxia (0-2)
1. Nose to finger
2. Heel to shin
3. Scored UN for amputation

Sensory (0-2)
1. Pinprick-"Sharp or dull?"
2. Include: Arms (not hands), legs, trunk, face

National Institute of Neurological Disorders and Stroke (2012)
NIHSS
Best Language (0-3)
1. Describe what is happening in picture 1.
2. Name items in picture 2.

You know how.
Down to earth.
I got home from work.
Near the table in the dining room.
They heard him speak on the radio last night.
**NIHSS**

**Dysarthria (0-2)**
1. Slurring of words
2. UN is scored when patient is intubated

<table>
<thead>
<tr>
<th>You know how.</th>
<th>MAMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down to earth.</td>
<td>TIP-TOP</td>
</tr>
<tr>
<td>I got home from work.</td>
<td>FIFTY-FIFTY</td>
</tr>
<tr>
<td>Near the table in the dining room.</td>
<td>THANKS</td>
</tr>
<tr>
<td>They heard him speak on the radio last night.</td>
<td>HUCKLEBERRY</td>
</tr>
<tr>
<td></td>
<td>BASEBALL PLAYER</td>
</tr>
</tbody>
</table>

*National Institute of Neurological Disorders and Stroke (2012)*
NIHSS

Extinction or Inattention (Neglect)
1. Scored 0-2

Summary
1. Cumulative score of zero (0) indicates no neuro deficits
2. Higher the score, the poorer the neuro exam.

NIHSS Website (free certification):
http://nihss-english.trainingcampus.net/uas/modules/trees/windex.aspx
Free CNE
Preoperative Nursing Considerations

• Peripheral Vascular Assessment
  – Note bilateral dorsalis pedis pulses
  – Note bilateral posterior tibial pulses
  – Note skin temperature and color
  – Note presence of edema
  – Look for symptoms of vascular insufficiency
  – (Shoulders-Odom, 2008).
Preoperative Nursing Considerations

• Comprehensive Preoperative Pain Assessment
  – Presence of pain
  – Rate pain on a universal scale
    • Numeric Scale
    • Wong-Baker Faces Scale
  – Location and characteristics of pain
  – Duration of pain
  – Home remedies that relieve pain
Preoperative Nursing Considerations

• Accurate weight
• Laboratory results
  – Platelet Aggregation Study
  – Pregnancy Screening
  – Type and Screen
  – Creatinine
    • Consider risk factors for contrast-induced nephropathy (CIN)
Platelet Aggregation Study

• Measures the effectiveness of aspirin and Plavix™
  – “Therapeutic aspirin”
  – “Therapeutic Plavix”
Stent-Coiling of Aneurysm

(Stent-Coiling [Image], 2010)
Pregnancy Testing

• Test or no test?
• No national guideline or standard exists
• AORN recommends pregnancy testing the day of procedure (Allen, 2008).
• International Commission on Radiological Protection recommends all women of childbearing age be asked (Applegate, 2007).
• Exclusions—hysterectomy and/or BSO
Contrast Allergy

- Shellfish allergy **does not** equate contrast allergy!
- Symptoms of intravenous contrast allergy
  - Mild and self limiting
    - Itching and / or hives
  - Severe and life threatening
    - Anaphylactic or cardiopulmonary collapse
- Consider a premedication regimen
  - Bickham & Golembiewski (2010)
Premedication Regimens
Iodinated Contrast Allergy

• **Oral**
  – Prednisone 50 mgs by mouth 13, 7, & 1 hour prior to injection of contrast *OR*
  – Methylprednisolone 32 mgs by mouth 12 hours and 2 hours prior to injection of contrast
  – *AND* Diphenhydramine 50 mgs by mouth one hour prior to procedure

• **Intravenous**
  – Hydrocortisone 200 mgs IV 13, 7, & 1 hour prior to injection
  – *AND* Diphenhydramine 50 mgs IV or IM 1 hour prior
  – Bickham & Golembiewski (2010)
Contrast-Induced Nephropathy (CIN)

Definition: “An increase in serum creatinine of 25% or greater than 0.5mg/dl within 48-72 hours after contrast administration” (Bickham & Golembiewski, 2010).

“CIN is the third leading cause of acute renal failure of hospitalized patients” (Bickham & Golembiewski, 2010).

A baseline creatinine is crucial for post operative comparison.
Risk Factors for CIN

- Decreased kidney function *(serum creatinine greater than 1.5)*
- Diabetes
- Age greater than 75 years
- Heart failure
- Cirrhosis or nephrosis
- Hypertension
- Paraproteinemias (multiple myeloma)
- Poor hydration status
- High volume contrast and/or contrast within previous 48 hours
- Currently taking NSAIDs, diuretics, amphotericin, aminoglycosides, cyclosporine, tacromlimus, chemotherapy agents
- Hypotension or use of intra-aortic balloon pump during percutaneous coronary interventions
- (Bickham & Golembiewski, 2010)
Management and Prevention of CIN

- Hydration, hydration, hydration
  - 0.9% normal saline IV: Infuse at a rate of 1 ml/kg for 12 hours before and after procedure.

- Sodium bicarbonate infusion

- Low or iso-osmolar contrast

- Hold NSAIDs and diuretics 24 hours pre and post procedure

- Acetylcysteine 600-1200 mg orally or IV every 12 hours for 4 doses (2 doses preoperatively and 2 doses postoperatively)
  - (Bickham & Golembiewski, 2010)
Sodium Bicarbonate Infusion

• Dedicated IV

• Sodium bicarbonate drip
  – 150mEq of sodium bicarbonate in D5w 1000 ml or sterile water 1000 ml
  – UTSW’s standard is sterile water

• Infusion
  – 3 mls/kg for one hour THEN DECREASE
  – 1 ml/kg continuously until six hours after procedure
  – (Bickham & Golembiewski, 2010)
# tPA and Stroke

## Inclusion Criteria

1. Age 18 or older
2. Clinical diagnosis of Ischemic Stroke
3. Measurable neurological deficit
4. Last Known Well (onset is within 180 minutes*)
5. Verbal Consent
6. May extend to 270 minutes if no exclusion criteria

## Exclusion Criteria

1. Evidence of ICH on CT scan
2. Minor or rapid improvement of symptoms
3. Active internal bleeding**
4. Systolic BP greater than 185 mmHg
5. Diastolic BP greater than 110 mmHg
6. Any HX of
   1. ICH
   2. Neoplasm
   3. AVM
   4. Aneurysm
7. Recent acute MI
8. Seizure at stroke onset

*(Stroke Care Now, n.d.)*
Active Bleeding?

- Platelet count less than 100,000/mm³
- Heparin within the last 48 hours
  - Elevated PTT
- Oral anticoagulant use
  - Elevated PT
    - PT greater than 15 seconds
    - INR greater than 1.7
- Major surgery or serious trauma
  - 14 days
- Stroke, head trauma, intracranial surgery
  - 3 months
- Recent arterial puncture
  - At a non-compressible site
- Recent lumbar puncture
tPA Dosage

0.9mg/kg

1. Give 10% IV (bolus/push) over 1 minute
2. Give 90% IV over 59 minutes
Pre & Post tPA Infusion

Pre-tPA Infusion
1. Review labs
2. Know CT findings
3. Treat elevated BP
4. Weight
5. Review HX
   a. Inclusion criteria
   b. Exclusion criteria
6. Start 2 IVs
7. Consider placement of urinary catheter
8. Education and Verbal Consent

Post-tPA Infusion
1. **Neuro Checks with Vital Signs***
   a) Hemodynamic (including BP)
   b) Q 15 minutes for 2 hours
   c) Q 30 minutes for 6 hours
   d) Q 1 hour for 16 hours
2. Admit to ICU or ASU
3. Telemetry monitoring for 24 hours
4. Oxygen to keep saturations greater than 92%-94%
5. Maintain BP less than 185/110 mmHg
6. Avoid hypotension
7. Assess for Angioedema
8. General and systemic symptoms of bleeding
9. No needle punctures
10. Treat hyper/hypoglycemia
11. HOB greater than 15 degrees
12. TX hyperthermia
13. CT head
14. No urinary catheters
15. No heparin or anticoagulants
16. Antiplatelets held for 24 hours
17. Keep family updates
18. NPO unless dysphagia screen passed

(UTSW, 2012)
Question and Answers

• The astute nurse can pick up on any of the concepts discussed and alert the physician.

• Failure to do so on the nurse’s part can lead to:
  – canceled or delayed cases
  – dissatisfaction with nursing by patients, physicians, and the organization
  – increased healthcare cost
Intraoperative Nursing Considerations
Welcome to the Angiography Labs
Intraoperative Complications

Be prepared for the worst!

• Radiation dosage

• Embolic event (clot formation)

• Hemorrhagic event (extravasation)

• Vasospasm

• Positioning
Cutaneous Radiation Injury (CRI)

- Defined as “injury to skin and underlying tissues that occurs because of radiation exposure” (Bixby, 2009).
- Injury may not manifest for 6-12 weeks after the exposure (Bixby, 2009).
- Risk factors include
  - Obesity
  - Prolonged procedures
  - Several interventional procedures in a short period of time (UTSW defines within six months)
Monitoring of Fluoroscopy Dosage

• Monitored throughout the procedure
• Benchmarks for reporting to physician
  – 3000 mGys
  – Then every 1000 mGys
  – AND/OR
  – First 30 minutes
  – Then every 15 minutes thereafter
• Documentation of total dosage within medical record
  – Nursing documentation
  – Physician procedure note
  – (Stecker et al, 2009)
Intraoperative Complications

Embolic formation

• “Thrombo-embolic events are often caused by the mechanical force of the catheter being navigated and the coils being deposited within the aneurysm” (Fox & Choi, 2009).

• Treatment includes:
  – Preoperative aspirin and Plavix®
  – Intra-arterial tPA infusion
  – Combined intra-arterial and IV Aggrastat™ infusion
Aggrastat™ (tirofiban) Infusion

• Dosage
  – IV infusion at
    • 0.4 mcg/kg/min for 30 minutes
    • For pumps with volume to be infused (VTBI) half the hourly rate
  – THEN decrease to
    • 0.1 mcg/kg/min

• (Mehta & Johnson, 2006)
Aggrastat™ (tirofiban) Infusion

- Intra-arterial infusion advantages
  - “Direct angiographic identification of the vessel occlusion—confirming diagnosis.”
  - “High local concentration of (drug) with a lower systemic dose—minimizing the risk of systemic complications.”
  - Success or failure of clot “dissolution” through direct visualization by the surgeon which allows for quick determination of mechanical clot retrieval.
  - (Mehta & Johnson, 2006)
Intra-arterial Nicardipine

- Vasospasm window is usually days 4-14
- “Serial clinical assessments and transcranial doppler” are used to monitor for symptoms of vasospasm
- Angiography is done within days 7-10
- Diagnosis is confirmed with direct visualization via angiography

(Curran et al, 2006)
Intra-arterial nicardipine

• Diagnostic angiography

• Vasospasm confirmed

• Microcatheter parked in general region of vasospasm

• Infusion of nicardipine by physician

• Dosage 0.5-6 mgs (Curran et al, 2006)
Post-operative Nursing Considerations
Postoperative Nursing Considerations

- Admission to PACU and/or ICU
- Comprehensive Neurological Assessment
- Comprehensive Peripheral Vascular Assessment
  - Assess the femoral puncture site/dressing for bleeding, hematoma, and discomfort
  - Ongoing assessment of pedal pulses with vital sign documentation
- Comprehensive Pain Assessment
  - Remember patient complaints of headache are common and expected postoperatively
  - Note intensity, characteristics, and location and compare to preoperative findings
  - Notify physician if headache is not relieved with pain medication
Manual Pressure

• Activated Clotting Time (ACT) should be less than 180-200 seconds

• Sheath is removed and pressure applied for 20-30 minutes

• Careful assessment at and around insertion site, abdomen, and inner thigh

• If sheath is left in place, it should be sutured in place and a sterile dressing placed
  • (Bixby, 2009).
Closure devices

- Closure devices are utilized to seal or plug the arteriotomy
- Three main types
  - Collagen
  - Sutures
  - Clips
Closure Devices
Advantages and Disadvantages

• Advantages
  – Early ambulation
  – Early discharge
  – Improved patient comfort

• Disadvantages
  – Upsizing of sheath
  – Failure to deploy
  – Infection
  – Thrombosis
  – (Bixby, 2009)
Complications:
Closure devices or manual pressure

- Bleeding from arterial site
- Thrombus formation at the site inhibiting perfusion of distal extremity
- Hematoma formation
- Assessment is the key for complications associated with closure devices or manual pressure
Patient Teaching

• **Procedure**
  – Discuss with patient what to expect pre, intra, and post procedure

• **Medications**
  – Review medications, indications, regimen, contraindications, and adverse reactions

• **Activity/Activities of Daily Living (ADLs)**
  – When to resume a regular diet
  – When to shower—avoid community water
  – When to lift, exercise, return to work

• **Radiation**
  – Changes in skin color or pain
  – Loss of hair
AVM: AP View

Distal Posterior Cerebral Artery (PCA)
AVM: Lateral View

Distal Posterior Cerebral Artery (PCA)
AVM: Rotational View

Distal Posterior Cerebral Artery (PCA)
Stroke Throughput Task Force

Using Lean/Six Sigma

√ Add value
√ Eliminate waste

Goal:

√ Door to groin puncture site is 60 minutes
Timeline
MR # DOS 05-23-2013

1513
• Patient Admission Activation

1540
• RN onsite

1619
• Patient in Angiography

1623
• Procedure Start (Groin Puncture)

1927
• Procedure End

66 Minutes

*Here indicates that the nurse was on campus.
**The patient went to the stroke unit and then CT prior to IR.
Questions

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References


References


References


