

Neuro Labs and Best Practices in Stroke Programs

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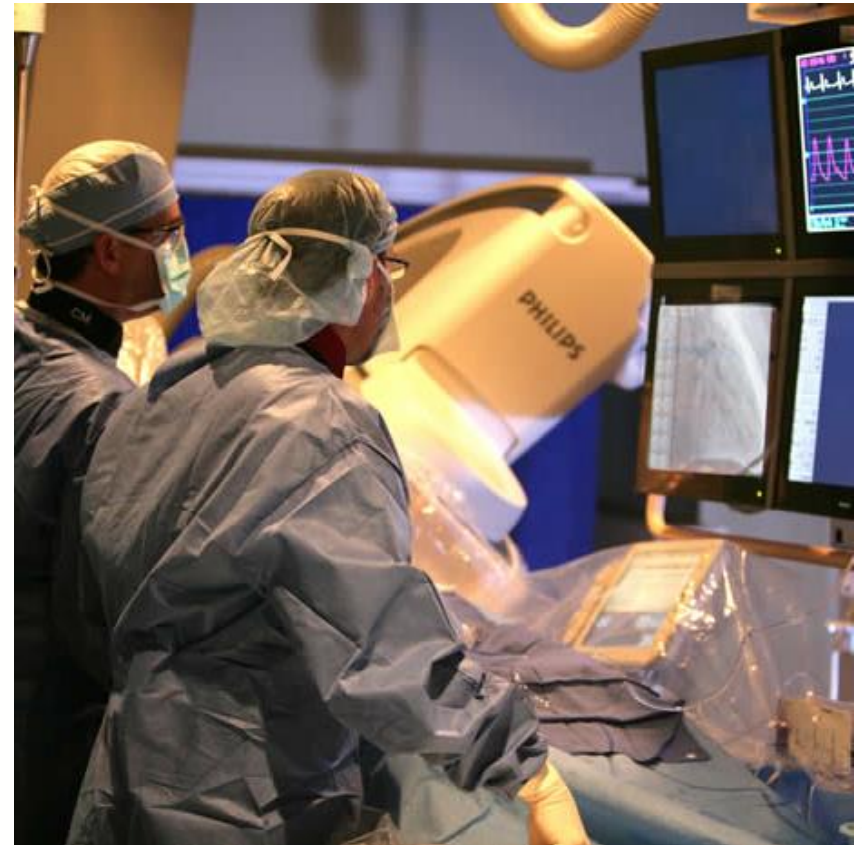
- Discuss the evolving best practices for neuro lab practice in published literature and clinical practice
- Review areas of significant practice variation between endovascular labs across the country and discuss opportunities for improved process and care

- Medline search
 - Neuroradiology = 17138
 - Neuroradiology AND nursing = 22
 - Neuroradiology AND tech(nologist) = 3
 - Neurointervention(al) = 539
 - Neurointervention(al) AND nursing = 5
 - Neurointerventional AND Tech(nologist) = 1
 - Neuroendovascular = 446
 - Neuroendovascular AND nursing = 3
 - Neuroendovascular AND tech(nologist) = 0
 - Similar findings for other search terms including team, room standards, etc.



- Neuro lab interdisciplinary team, roles and responsibilities
- Preparing for the worst case scenario
- Patient monitoring, sedation, and management
- Case documentation
- The perioperative experience: before and after the lab
- Patient handoff

- Current practice
 - Room nurse
 - 1-2 technologists
 - Scrub
 - Technology and data-focused
 - Anesthesia
 - Proceduralist
 - Fellow/trainee
 - Blended lab with cardiac cath versus separate departments



- Opportunities
 - Clarity of roles and responsibilities
 - Understaffing of neuro labs
 - Management of technology and data
 - When separate department from cardiac cath lab, clear communication and evaluation of intra-procedural best practices
 - Mechanical endovascular reperfusion
 - Carotid stenting



Neuroimaging

The neurointerventional procedure room of the future: predicting likely innovations in design and function

Alexander Norbash,¹ Lloyd W Klein,² James Goldstein,³ David Haines,³
Stephen Balter,⁴ Lynne Fairobent,⁵ Donald L Miller,⁶ on behalf of the members of the
Multispecialty Occupational Health Group

Concepts highlighted: Merging Innovation & Technology

- ✓ Multiple transparent control areas
- ✓ Apronless worker protection
- ✓ Integrative monitors & robotic intermediaries
- ✓ Differentiation between datastream and scrub technologist
- ✓ Integration and coordination of multiple datastreams
- ✓ Improved quality and reporting monitoring, measuring, and exporting

- Current practice
 - Variability in the field regarding planning for the worst case scenario
- Managing intra-procedural complications
 - Best practices
 - Clearly outlined roles and responsibilities for complications including
 - Vessel dissection/rupture
 - Intracranial hemorrhage
 - Air emboli
 - Coil prolapse
 - Thromboembolic complications
- Best practices
 - Mobilizing neurosurgery for placement of external ventricular drain
 - Converting to an open procedure
 - Use of checklists and other tools to anticipate needs and roles

- Thromboembolic events
 - Incidence reported 2-61%
 - Higher with carotid artery stenting
 - Prevention
 - Antiplatelet medication
 - Rescue therapies
 - Lack uniform guidelines
 - Intra-procedure administration of glycoprotein IIb-IIIa inhibitors
- Air embolism
 - Formal reconfirmation of all flush systems as a part of safety checklist prior to procedure
- Intraoperative rupture
 - Reports range from 1-9%
 - Associated with increased morbidity and mortality
 - Higher risk with small aneurysm, recent rupture, presence of daughter sac
 - Periprocedural rescue
 - Attempt to repair leakage according to procedure (eg. Complete coil placement, inject embolization material)
 - Placement of EVD
 - Management of acute elevated ICP intra-op
- Best practice
 - Preparing for the event
 - Checklist including roles and responsibilities

- Mayo Clinic Checklist in the event of vessel perforation during coil embolization of aneurysm

<p><u>IDENTIFICATION OF PERFORATION</u></p> <ul style="list-style-type: none"><input type="radio"/> wire/coil beyond aneurysm edge<input type="radio"/> Alert Anesthesia about perforation<input type="radio"/> Do not retract wire/catheter/coil<input type="radio"/> Perform angiography to look for extravasation<input type="radio"/> Look at transit time<input type="radio"/> Consider CT now/after <p><u>CLINICAL EXAM</u></p> <ul style="list-style-type: none"><input type="radio"/> Pupil status<input type="radio"/> Glasgow Coma Scale<input type="radio"/> Blood Pressure Change<input type="radio"/> Focal neurologic deficit<input type="radio"/> Agitation	<p><u>MEDICAL MANAGEMENT</u></p> <ul style="list-style-type: none"><input type="radio"/> Blood pressure modulation<input type="radio"/> Administer protamin if patient on anticoagulation<input type="radio"/> Consider Mannitol<input type="radio"/> Consider Pentobarbital <p><u>ENDOVASCULAR MANAGEMENT</u></p> <ul style="list-style-type: none"><input type="radio"/> Consider second microcatheter<input type="radio"/> Consider balloon inflation<input type="radio"/> Continue with packing of aneurysm	<p><u>CLOSING UP</u></p> <ul style="list-style-type: none"><input type="radio"/> Inform ICU<input type="radio"/> Inform Neurosurgery<input type="radio"/> Consider EVD/Craniotomy
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Fig 1. Checklist for aneurysm perforation during coiling. ICU indicates intensive care unit; EVD, external ventricular drain.

Box 1 Aneurysm perforation checklist

Overall goals

1. Hemostasis
2. Manage increased intracranial pressure

Neurointerventionalist

1. Reverse antithrombotics
 - a. Protamine
2. Complete aneurysm embolization
3. Monitor and treat increased intracranial pressure
 - a. Monitor transit time, hemodynamics and need for ventriculostomy
4. Disposition
 - a. DynaCT
 1. Ventricular drain
 2. Operating room for hematoma evacuation

Anesthesiology

1. Page attending
2. ABCs
 - a. Secure airway and ventilate with 100% O₂
3. Antithrombotic reversal at neurointerventionalist direction
 - a. For heparin reversal, protamine bolus 10 mg per 1000 U of heparin
 - b. Monitor for cardiopulmonary reaction
 - c. For aspirin and clopidogrel reversal, 5 single units of platelets and a 0.3 mg/kg intravenous bolus of desmopressin
4. Hemodynamic control
 - a. Blood pressure goal, systolic blood pressure <120, often use intravenous nicardipine
5. ICP monitoring and management
 - a. Use transducer, clinical or radiographic signs
 - b. Control intracranial pressure
 1. Hyperventilate patient
 2. Mannitol 0.5 g/kg, rapid intravenous infusion
 3. Neuroprotection
 4. Passive cooling to 33–34°C

Nursing

1. Monitor and manage increased intracranial pressure
 - a. Observe CSF color change
 - b. Monitor hemodynamic changes for Cushing reflex
 - c. Prepare external ventricular drain
 - d. Page neurosurgery resident if necessary
2. Prepare medications
 - a. Mannitol
 - b. Protamine
 - c. Nicardipine
 - d. Anticonvulsant

Technologist

1. Assist with hemostasis
 - a. Make coils rapidly available
 - b. Prepare to open compliant balloons or n-butyl cyanoacrylate if necessary
2. Imaging
 - a. Prepare for possible DynaCT
 - b. Call CT tech about possible emergent scan

Box 2 Thromboembolic complication checklist

Overall goals

1. Thrombolysis
 - a. Optimize anticoagulation with heparin
 - b. Thrombolysis
2. Optimize distal perfusion
 - a. Blood pressure goals

Neurointerventionalist

1. Determine clinical significance of lesion
 - a. Check for neuromonitoring changes
 - b. Evaluate collateral angiographic flow
2. Check guide catheter for flow limiting vasospasm
3. Complete embolization of ruptured aneurysm
4. Superselective intra-arterial abciximab
 - a. 2 mg boluses up to 10 mg.
5. Prepare to use aspiration devices
6. Endpoint
 - a. Angiographic recanalization
 - b. Maximum abciximab
 - c. Neuromonitoring changes or improved collaterals.

Anesthesiology

1. Hypervolemia, use normal saline
2. Optimize collateral cerebral perfusion

Nurse

1. Anticoagulation
 - a. Give heparin if activated clotting time <250 s
2. Antiplatelets
 - a. Abciximab, intra-arterially, 2 mg boluses up to 10 mg.
3. Vasospasm
 - a. Verapamil or nicardipine

Technologist

1. Thrombolysis
 - a. Prepare stroke aspiration devices
 - b. Record complication onset time
 - c. Observe for angiographic changes



Additional published checklists
for emergencies in the
endovascular suite

- Current practice: variation in monitoring practices for
 - Pre and post procedure neurologic and vascular status
 - Anesthesia and conscious sedation
 - Vital signs throughout at defined intervals
 - Medications administered
 - Who is monitoring neuro devices such as EVD & licox
 - Monitoring and documentation of ICP, drain status, output, interventions
- Best practice: organizing roles, responsibilities and documentation

- Current practice
 - Significant variability regarding intra-procedural documentation of events and post-procedural documentation by MD performing procedure
 - Need for standardization in the field
- Best practice
 - Clear criteria for required intra-procedural documentation at your facility until national guidelines are published

- Current practice
 - Practice variability between centers regarding groin closure practices
 - Opportunities for improved handoff between caregivers during perioperative care
 - Emergency department, stroke, anesthesia, neuroradiologist, ICU team
 - Incomplete medical record due to incomplete or absent procedure reports
- Best practice
 - Groin closure according to evidence based publications
 - Checklists and documentation of significant events and goals of care during handoff
 - Auditing documentation for completeness

- Significant practice variation in neuro labs across the country and lack of solid evidence for improvement
- Opportunity to measure outcomes and publish on a number of best practices
- Periprocedural team communication and clear roles and responsibilities, particularly during emergencies, is a hallmark of superior neuro labs across the nation

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