Neuroanesthesia in the Endovascular Suite

We Are Doing What In IR??
Are We Really A Stroke Center?

Paul Mongan MD

Neuro IR Issues

- System
- IR Suite size
- Organization
- Radiation Safety
- Procedures
- Coagulation

Dose area product (DAP)


Occupational radiation doses to operators performing fluoroscopically-guided procedures.
Kim KP, et al.

The estimated effective dose per case ranged from
0.1-101 μSv for vertebroplasty,
2.5-88 μSv for orthopedic extremity nailing,
2.0-46 μSv for biliary tract procedures,
2.5-74 μSv for TIPS,
1.8-53 μSv for head/neck endovascular therapeutic procedures,
0.2-49 μSv for ERCP.

Mean operator radiation dose per case measured over personal protective devices at different anatomic sites on the head and body ranged from
19-800 (median = 113) μSv at eye level,
6-1,180 (median = 75) μSv at the neck,
2-1,600 (median = 302) μSv at the trunk.

average annual U.S. radiation dose of 6.2 mSv.

Neuroendovascular Procedures

- Diagnostic
- Aneurysm Therapy
  - Coiling
  - Intracranial stent placement
  - Vasospasm management
- Carotid artery stenting
- Stroke Therapy
  - Clot-dissolution
  - Clot removal
- Embolization
  - arteriovenous malformation (AVM)
  - tumor

Subarachnoid Hemorrhage

- 57 yo female with SAH 4 hours ago
  - GCS 15
  - Headache with BP 140/76
  - No focal signs (mass effect)
  - No cranial nerve injury (jet effect)
- 6mm ACA aneurysm
- Clip or coil???
IR Suite vs. OR

- Location / anatomy of the aneurysm
- Age and grade of the patient
- Skill of the facility
- Skill of the proceduralist
- Luck of the draw???

Aneurysm Therapy

- **Surgical clipping** (approximately 60-65% in the United States)
- **Endovascular coiling** (approximately 30-35% in the United States)
- In certain countries such as Finland, Great Britain and France, close to 90% of aneurysms are treated with endovascular coiling
- After the release of the ISAT results, the percentage of aneurysm patients treated with coiling in England went from 40% to 90%

History of Coiling

- 1987-1989: Dr Guido Guglielmi (University of Rome) visits Dr Viruela (IR Neuroradiologist) at UCLA and researches coiling
- 1989: Dr Guglielmi comes permanently to UCLA
- 1989-1990: Bench and animal research
- March 6, 1990: First clinical use of Guglielmi Detachable Coil
- FDA approval in 1995

International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomized comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion

The Lancet

Vol 366, October 26, 2005

http://dx.doi.org/10.1016/S0140-6736(05)67214-5
**ISAT Trial**

- In patients with a ruptured intracranial aneurysm, for which endovascular coiling and neurosurgical clipping are therapeutic options, the outcome in terms of survival free of disability at 1 year is significantly better with endovascular coiling.
- The data available to date suggest that the long-term risks of further bleeding from the treated aneurysm are low with either therapy, although somewhat more frequent with endovascular coiling.

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**Neuroendovascular Concerns**

- Maintain Physiological Stability
- Manage Anticoagulation
- Manipulate Systemic or Regional Blood Pressures
- Treat Unexpected Complications
- Rapid Recovery (neuro evaluation)

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**Anesthesia for Aneurysm Coiling**

- GA with ETT (possible LMA) vs sedation
- Patient must NOT move
- Normocapnia and stable VS
- Arterial line
  - Radial
  - Side port on femoral
- Complications
  - Hemorrhage
  - ICP elevation
  - Ischemia

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**Emergent Angiography For Vasospasm**

- Devastating complication of SAH
- Based on clinical criteria, transcranial doppler, ultrasound
- Irreversible damage can occur
- Time is critical, perfusion is critical
- Angioplasty
- Intra-arterial verapamil, nicardipine or papaverine can cause systemic effects


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**CEA vs. Best Medical Therapy**

<table>
<thead>
<tr>
<th>Trial</th>
<th>Ipsilateral stroke, periop stroke, death</th>
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<tbody>
<tr>
<td>CEA</td>
<td>BMT</td>
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<tr>
<td>Nascet 70-99%</td>
<td>9%</td>
</tr>
<tr>
<td>(1991)</td>
<td>26%</td>
</tr>
<tr>
<td>ECST 70-99%</td>
<td>9.5%</td>
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<tr>
<td>(1991)</td>
<td>13.6%</td>
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CEA vs. Best Medical Therapy

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<tr>
<th>Trial</th>
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<tbody>
<tr>
<td>Nascet 50-69% (1998)</td>
<td>1.9%</td>
<td>7.0%</td>
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<tr>
<td>ECST 0-29% (1998)</td>
<td>11.3%</td>
<td>5.6%</td>
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Asymptomatic Carotid Atherosclerosis Study

- 1662 patients, 60-99% stenosis
- 1993-2002 with 10 year follow-up
- BMT vs BMT + CEA
- Study stopped after 2.7 years of follow-up
  - Ipsilateral stroke (5 year projected rate)
    - CEA + BMT: 5.1%
    - BMT: 11%

CEA vs CAS

Anesthesia for CAS

- Minimal to moderate sedation
  - Awake (very minimal sedation)
  - Propofol infusion
  - Dexmedetomidine infusion
- ACT monitoring
- Balloon dilation
  - Neck pain, cough
  - Bradycardia (25%)
  - Labile BP (20-50%)

Specialties Performing Carotid Stenting

<table>
<thead>
<tr>
<th>specialty</th>
<th>percent</th>
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<tbody>
<tr>
<td>Interventional Cardiologist</td>
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<tr>
<td>Interventional Radiologist</td>
<td>15</td>
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<tr>
<td>Interventional Neuroradiologist</td>
<td>10</td>
</tr>
<tr>
<td>Interventional Neurosurgery</td>
<td>5</td>
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<td>Interventional Vascular Surgery</td>
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<tr>
<td>Interventional Medicine</td>
<td>3</td>
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</table>

Stroke Therapy

- Intravenous Thrombolysis
- Combined Intravenous and Intraarterial Thrombolysis
- Endovascular Thrombectomy (the Merci Retriever)
- Endovascular Thromboaspiration (the Penumbra System)
- Angioplasty and/or Stent Placement (Covidien Solitaire™ FR Revascularization Device)
Thrombolysis

- Therapy cannot be initiated within three hours
- tPA during the first three hours is not sufficient
- Interventional neuroradiologists can provide intra-arterial thrombolysis treatment
- When given locally this way, the tPA can be administered up to six hours after the onset of stroke symptoms

Anticoagulation

- Heparin
  - ACT monitoring
- P2Y12 inhibitors
- GIIb/IIIa inhibitors

Clopidogrel

- Onset: 4-6 hours (after loading dose with 8 x maintenance dose)
- Offset: 5-7 days
- Variable response: 25-30% of patients achieve less than 25% inhibition of platelet activity
- 2 step metabolism (CYP3A4 mediated) to active agent
- Binds irreversibly to P2Y12 receptor
  - P2Y12 Reaction Unit (PRU) monitoring
VerifyNow P2Y12 test

- literature advises waiting 5 to 7 days after stopping clopidogrel before surgery
- tested patient as soon as 3 days
  - percent inhibition less than 20%
  - P2Y12 Reaction Units (PRUs) greater than 235
- Blue top tube, 3.2% sodium citrate

New Oral Antiplatelet Drugs
Adenosine Diphosphate-Receptor Antagonists

- Prasugrel
  - (Effient)
  - Thienopyridine
  - More rapid onset of action than clopidogrel
  - Irreversible inhibitor of the P2Y12 receptor
- Ticagrelor
  - (Brilinta)
  - Cyclo-pentyl-triazopyrimidine (CPTP)
  - More rapid onset of action than clopidogrel
  - Reversible inhibitor of the P2Y12 receptor

P2Y12 Platelet Inhibition Test

<table>
<thead>
<tr>
<th>% Inhibition Threshold</th>
<th>PRU Threshold</th>
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<tbody>
<tr>
<td>10%</td>
<td>259</td>
</tr>
<tr>
<td>20%</td>
<td>237</td>
</tr>
<tr>
<td>30%</td>
<td>214</td>
</tr>
<tr>
<td>40%</td>
<td>187</td>
</tr>
<tr>
<td>50%</td>
<td>159</td>
</tr>
<tr>
<td>60%</td>
<td>131</td>
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A PRU of 208 or less is recommended for patients receiving P2Y12 anti-platelet therapy.

Abciximab - ReoPro

- glycoprotein IIb/IIIa receptor antagonist
- platelet aggregation inhibitor
- short plasma half-life
- strong affinity for receptor on the platelets
  - may occupy some receptors for weeks
  - platelet aggregation gradually returns to normal about 96 to 120 hours after administration

AVM Embolization

- AVM Embolization
AVM Embolization

- 3-5% serious complications
- distal migration of cement/beads/coils
  - can shut-down the AVM
  - acute ICP elevation
  - bleed
- Ischemic complications

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Disasters

- Vessel rupture and hemorrhage
- Vasospasm
- Occlusion
- Dissection
- Thromboembolism
- Stent misplacement
- Access site hematoma
- Arrhythmia
- Death

Questions