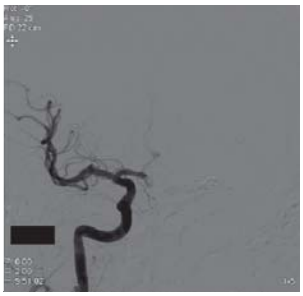
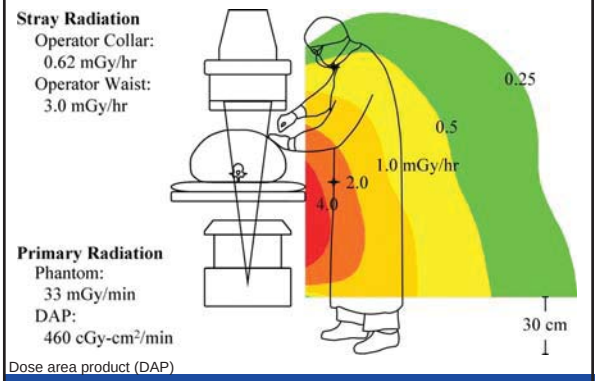
# Neuroanesthesia in the Endovascular Suite
# We Are Doing What In IR??
# Are We Really A Stroke Center?

**Paul Mongan MD**

## Neuro IR Issues

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






Dose area product (DAP)

## Health Phys. 2012 Jul;103(1):80-99.

**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

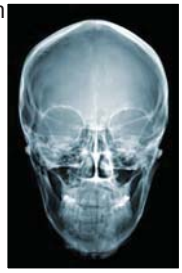
- Diagnostic
- Aneurysm Therapy
  - Coiling
  - Intracranial stent placement
  - Vasospasm management
- Carotid artery stenting
- Stroke Therapy
  - Clot-dissolution
  - Clot removal
- Embolization
  - arteriovenous malformation (AVM)
  - tumor

## 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

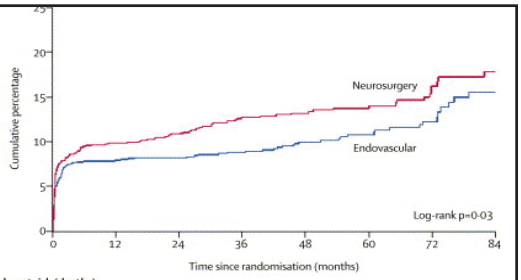
- 1987-1989: Dr Guido Guglielmi (University of Rome) visits Dr Viñuela (IR Neuroradiologist) at UCLA and researches coiling
- 1989: Dr Guglielmi comes permanently to UCLA
- 1989-1990: Bench and animal research
- March 6, 1990: First clinical use of Guglielmi Detachable Coil
- FDA approval in 1995

MAYO CLINIC

## International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomized trial

The Lancet

*Vol 360, October 26, 2002*




**Annual number at risk (deaths):**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Endovascular | 1073 (85) | 974 (3) | 887 (5) | 717 (8) | 541 (4) | 373 (5) | 215 (6) | 103 |
| Neurosurgery | 1070 (105) | 944 (10) | 842 (16) | 663 (3) | 503 (3) | 340 (7) | 192 (3) | 98 |

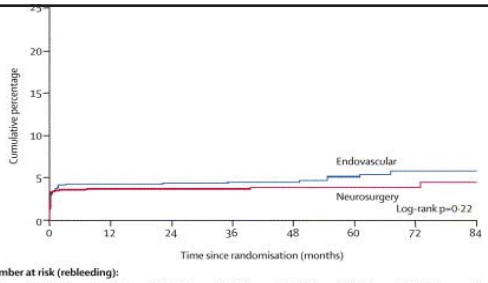
Figure 2 Kaplan Meier cumulative mortality to 7 years

Andrew J Molyneux , Richard SC Kerr , Ly-Mee Yu , Mike Clarke , Mary Sneade , Julia A Yarnold , Peter Sandercock

**International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion**

The Lancet Volume 366, Issue 9488 2005 809 - 817

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




**Annual number at risk (rebleeding):**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Endovascular | 1073 (45) | 953 (1) | 865 (1) | 698 (0) | 524 (3) | 360 (2) | 201 (0) | 98 |
| Neurosurgery | 1070 (39) | 926 (0) | 821 (0) | 652 (1) | 495 (0) | 332 (0) | 188 (1) | 95 |

Figure 3 Cumulative rebleeding risk from target aneurysm

Andrew J Molyneux , Richard SC Kerr , Ly-Mee Yu , Mike Clarke , Mary Sneade , Julia A Yarnold , Peter Sandercock

**International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion**

The Lancet Volume 366, Issue 9488 2005 809 - 817

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.

## Neuroendovascular Concerns

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

## 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

## 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

Rosenberg N, Lazzaro MA, Lopes DK, Prabhakaran S. High-dose intra-arterial nicardipine results in hypotension following vasospasm treatment in subarachnoid hemorrhage. Neurocrit Care. 2011 Dec;15(3):400-4. doi: 10.1007/s12028-011-9537-4. PubMed PMID: 21468780.

## 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

## CEA vs. Best Medical Therapy

| Trial | Ipsilateral stroke, periop stroke, death | |
|---|---|---|
| | CEA | BMT |
| Nascet 70-99% (1991) | 9% | 26% |
| ECST 70-99% (1991) | 9.5% | 13.6% |

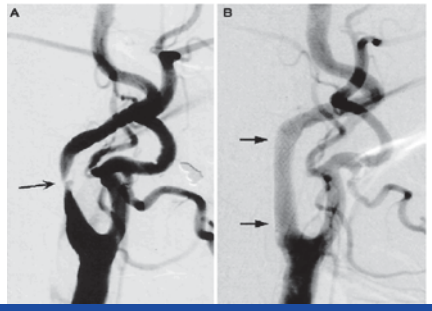
## CEA vs. Best Medical Therapy

| Trial | Ipsilateral stroke, periop stroke, death | |
|---|---|---|
| | CEA | BMT |
| Nascet 50-69% (1998) | 1.9% | 7.0% |
| ECST 0-29% (1998) | 11.3% | 5.6% |

## 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 stoke (5 year projected rate)
    - CEA + BMT 5.1%
    - BMT 11%

## CEA vs CAS




## Anesthesia for CAS

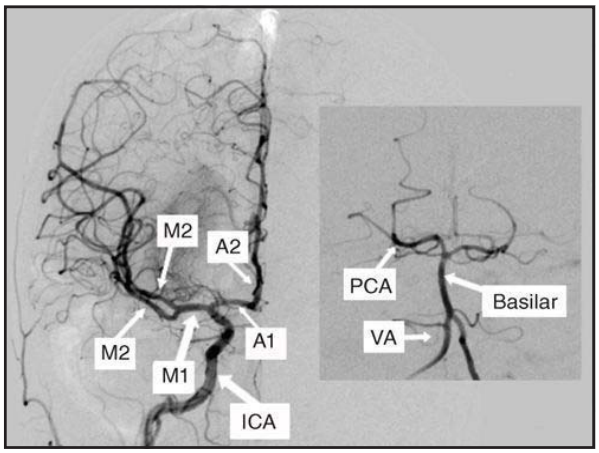
- Minimal to moderate sedation
  - Awake (very minimal sedation)
  - Propofol infusion
  - Dexmedetomidine infusion
- ACT monitoring
- Balloon dilation
  - Neck pain, cough
  - Bradycardia (25%)
  - Labile BP (20-50%)

## Specialties Performing Carotid Stenting

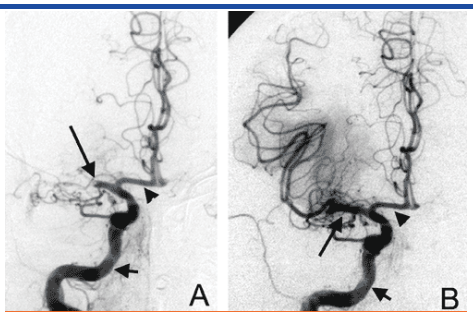
| specialty | percent |
|---|---|
| Interventional Cardiologist | 60 |
| Interventional Radiologist | 15 |
| Interventional Neuroradiologist | 10 |
| Interventional Neurosurgery | 5 |
| Interventional Vascular Surgery | 5 |
| Interventional Neurology | 2 |
| Interventional Medicine | 3 |

## 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)




## Ischemic Stroke

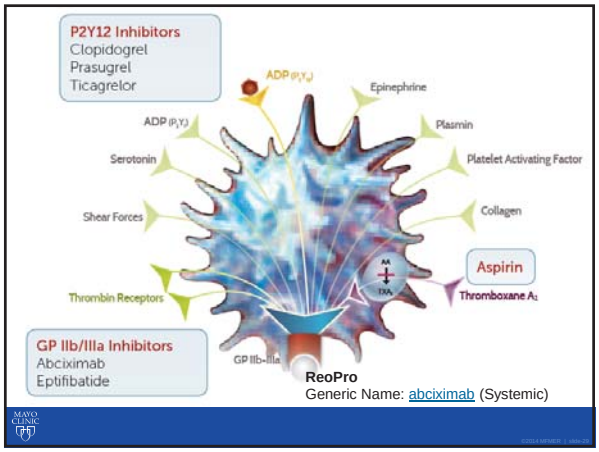



## Thrombolysis

- 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




**ReoPro**
Generic Name: abciximab (Systemic)

## 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

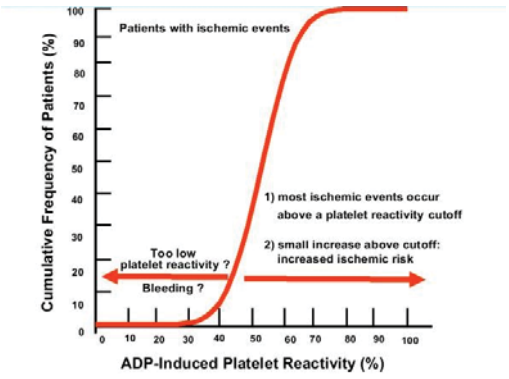
## New Oral Antiplatelet Drugs
## Adenosine Diphosphate-Receptor Antagonists

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

## P2Y12 Platelet Inhibition Test

| % Inhibition Threshold | PRU Threshold |
|---|---|
| 10% | 259 |
| 20% | 237 |
| 30% | 214 |
| 40% | 187 |
| 50% | 159 |
| 60% | 131 |

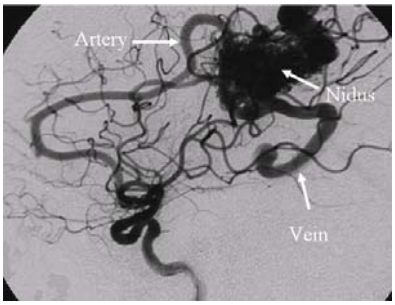
A PRU of **208 or less** is recommended for patients receiving P2Y12 anti-platelet therapy.



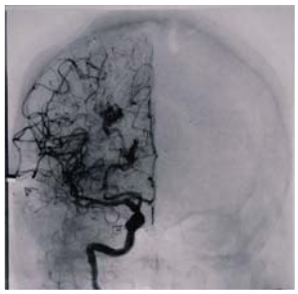

## Abciximab - ReoPro

- 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

## Neuroendovascular Procedures

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

## Disasters

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

## Questions