Endovascular Aneurysm Treatment

Current Status and Emerging Technologies

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History Quiz:

• Who was Antonio Egaz Moniz?
Moniz was a Portuguese Neurologist who developed cerebral angiography in 1927 and helped develop the first contrast Thorotrast. Nominated for Nobel Prize twice for angiography.

Better known for development of the surgical procedure leucotomy, known today as lobotomy. Received a Nobel Prize in 1949 for it. Procedure was abandoned in the 60s.
History Quiz;

- Who was Fedor Serbinenko?
Serbinenko was a Neurosurgeon from Moscow’s Burdenko Neurosurgery Institute.

Regarded as founder of Endovascular Neurosurgery

Developed balloon for endovascular brain aneurysm embolization and vessel occlusion in late 1960s
History Quiz:

- Who are these dudes?

**Figure 6.** Guido Guglielmi (left), autumn 1991, at UCLA in Los Angeles, CA, USA, doing one of the first coiling procedures in patients (right: Fernando Viñuela).
Old good days .....
History of Coiling

- **1987-1989**: Dr Guido Guglielmi (University of Rome) visits Dr Viñuela (Interventional Neuroradiologist) at UCLA and research work on coiling concept starts.
- **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**.

Advocate Health Care
Brain Aneurysms

• unruptured intracranial aneurysms overall prevalence is 3.2% from recent systematic review and meta-analysis.

• the prevalence is higher in patients with polycystic kidney disease or a positive family history of SAH with aneurysm

• most common locations: Pcom 42%, MCA 35% and Acom in 18%

• fatality of IA rupture is high from 27% to 44% but has decreased over the past few decades because of introductions of improved management strategies, including neurocritical care!

• The International Study of Unruptured Aneurysms (ISUIA) showed increased rupture risk with aneurysm size and for posterior fossa aneurysms

• the randomized International Subarachnoid Aneurysm Trial (ISAT) has clearly demonstrated the superiority of endovascular treatment (EVT) of ruptured aneurysm using coil technology over surgery.

• Unruptured aneurysm direct comparison between EVT and surgery is not available but EVT is widely used in that subgroup as well.
Coiling

• Large series conformed feasibility of aneurysm coiling 96.9% in ruptured aneurysms and 94% in unruptured with acceptable procedure mortality of 1.4% in ruptured and 1.7 in unruptured aneurysms and morbidity of 8.6% in ruptured and 7.7% in unruptured

• large series showed recanalization in 20.8% with retreatment rate of 10.3%

• in effort to reduce recanalization rate, surface-modified coils were developed: Hydrocoils(Microvention), PGLA covered coils

• because recanalization can occur, anatomic follow up with digital angiography and MRA is mandatory. (all coils are MRI compatible!)

• two most frequent complications are thromboembolic and intraoperative rupture with rates of 7.2% and 2% respectively in large series.

• in ruptured aneurysm perioperative thromboembolic rate of 13.3% vs unruptured of 3.7% (more blood thinners and use of ASA and Plavix)
basilar tip aneurysm

Aneurysm before repair with coils

Aneurysm after repair with coils
Balloon-Assited Coiling, BAC

• Moret initially described the BAC, (aka remodeling technique) for expansion of EVT to wide neck IAs

• a nondetachable balloon is temporally inflated in front of the neck of aneurysm during each coil placement.

• several options are available with use of hyper-compliant balloon, double lumen ballon, use of two etc.

• associated with higher rates of thromboembolic and rupture adverse in early series however more recent comparisons more similar with only 3.2% rupture with BAC vs 2.2 coiling alone and comparable thromboembolic complications

• long term anatomic result is still unclear

• some studies observing better total occlusion

• without doubt more wide neck aneurysm are for

• endovascular treatment, especially in SAH group
balloon-assist
Branch from aneurysm - Overinflation technique
Balloon remodeling, small aneurysm for PICA protection
Stent-Assisted Coiling

• introduced in early 2000s to overcome some limitations of standard coiling and to help for the treatment of some complex, wide neck, large giant and fusiform aneurysms
• also used as a rescue approach in case of coil herniation
• several low profile stents has been developed; Neuroform, Enterprise, LVIS, Bolt...
• Preoperative and postoperative use of ASA and Plavix is mandatory
• Antiplatelets initialy limited SAC to unruptured aneurysns but during the past years, stenting has been used in ruptured aneurysms.
• stenting was considered to prevent aneurysm recanalization however only few series compare the safety and efficacy of SAC to standard coiling (or BAC)
• Most of those show higher morbidity rates but with higher rate of permanent occlusion was seen in the stented goup
• **SAC has enabled the treatment of more complex aneurysms with lower rate of recanalization and retreatment**
STENTS FOR BRAIN ANEURYSM
ICA “T” aneurysm, Stent Assisted Coiling
SAH with a wide neck blister aneurysm, stent/ coil Tx
New stent like design, testing in Europe; Pulserider
Flow diverters, FDs: tubular stent like implants....
Flow diverters have 2 main work mechanisms:

- Flow redirection; bridge like action with reduction of flow into the aneurysm sac because of increased impedance created by the mesh of the implant, yet providing flow through adjacent perforators and side branches.

- Tissue overgrowth; as it provides a scaffold for neoendothelialization across the aneurysm neck
Flow diverters:

- US: Pipeline Embolization Device by Medtronic (only device approved)
- Silk by Balt; outside US
- Surpass by Stryker in clinical trials
- FRED by Microvention; outside US, waiting for FDA
Flow Diverters:

- complex, large giant and fusiform aneurysms with initial trials...
- delayed ruptures issues; from Retrospective Analysis of Delayed Aneurysm Ruptures (RADAR) it occurred in 1% patients with most in the first 3 months from 2 to 48 days, (10/13)
- it is observed mostly in large and giant symptomatic aneurysms; worsening mass effect...
- Mechanism not well understood: hemodynamic change, thrombus induced inflammatory reaction on the wall, nonorganized red thrombus that is not stable with high content of proteolityc enzymes.... use of antiplatelets preventing platelets aggregation may also play a role..
- For large and giants aneurysm use of few coil has been suggested as well as use of steroids.
- another issue is delayed parenchymal hemorrhage observed in 8.5% in initial series of large and giant aneurysms.
- with increased experience smaller nonruptured aneurysm treated
- Blister aneurysms with SAH in several case reports.
- ASA, Plavix mandatory, 6months till first angio f/u
Pipeline FD, Large Pcom aneurysm
Pipeline FD, large Petrous Aneurysm
Intrasaccular flow disruption devices.....

- similar to intraluminal FD technology; however the mesh of the flow disruptor is placed within the aneurysm pouch and creates blood flow stasis with subsequent thrombosis.
- Early trials large wide neck bifurcation aneurysm, but smaller aneurysm already treated.
- WEB; Woven Endobridge Device, in clinical trials in US
WEB Device, MCA aneurysm
WEB Device, MCA aneurysm
WEB Device, MCA aneurysm
WEB Device, Acom aneurysm
Intrasaccular flow disruption, not available in US

- WEB Device
- LUNA Device
THANK YOU