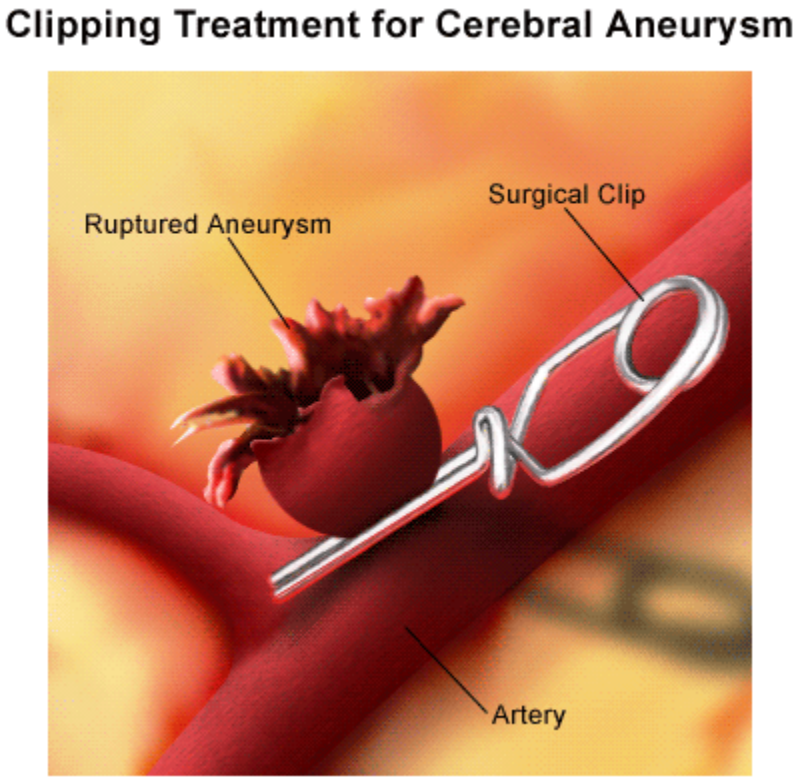
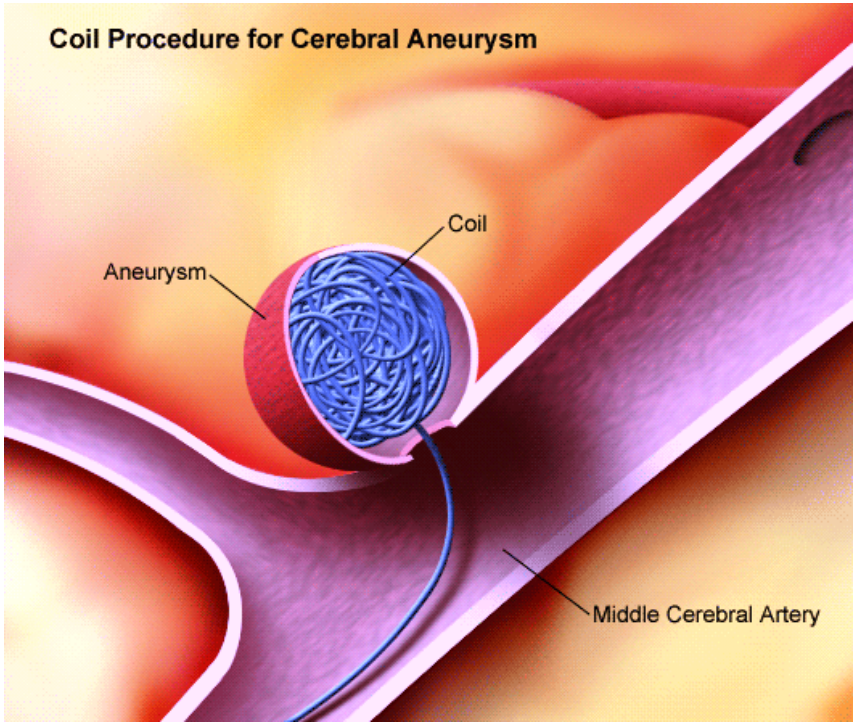
INTRACRANIAL ANEURYSMS : CURRENT ROLE OF CLIPPING AND COILING

CLIPPING



COILING



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INTRODUCTION

- Cerebral aneurysms : a formidable challenge for neurosurgeons and interventional neuroradiologists.
- Presentation

  1) mass effect --> cranial nerve palsies

  2) Rupture -- > hemorrhage

Introduction

- Treatment: a challenging clinical paradigm for both patients and practitioners encompassing the potential for catastrophe, cure, or chronic follow-up.
- Successful management entails a combination of thoughtful surgical and/or medical intervention.

Introduction

- Since 1981 several important studies have added significant but controversial data to the intellectual resources used in the decision paradigm for the management of intracranial aneurysms.
- Practitioners today are faced with a complex decision tree of whether or not to clip, coil, or wait and watch.

Epidemiology

- Few aneurysms rupture but when they do , outcomes are harsh
- The incidence of aneurysmal rupture is between 6 and 12 per 100,000, yielding 15,000 to 30,000 new SAH annually.

van Gijn J, Rinkel GJ. Subarachnoid hemorrhage: diagnosis, causes and management. Brain 2001;124(Pt 2):249–78.

Epidemiology

- Overall mortality at 6 months: 40% - 50%
- 15% of patients expire before reaching the hospital
- 25% within 24 hours.
- Only one third of those who survive have functional independent lives.

Hop JW, Rinkel GJ, Algra A, et al. Case-fatality rates and functional outcome after subarachnoid hemorrhage: a systematic review. Stroke 1997;28: 660–4.

Epidemiology

- Rebleed has a catastrophic morbidity : 48% to 78%.
- Treatment of a ruptured aneurysm: imperative.

Jane JA, Winn HR, Richardson AE. The natural history of intracranial aneurysms: rebleeding rates during the acute and long term period and implication for surgical management. Clin Neurosurg 1977; 24:176–84.

Treatment options

- Two treatment modalities: to exclude the aneurysm from the circulation:

  microsurgical clipping

  endovascular coiling.
- Microsurgical treatment : more invasive, requires craniotomy, open dissection of the aneurysm followed by clipping.
- Endovascular coiling : a groin puncture, negates the need for craniotomy, the aneurysm is excluded from within using microcoils.

What to choose ?

- This decision needs to be made with knowledge of:

  --- the safety and efficacy data

  ---the patient's expected longevity

  ---aneurysm factors – size

  -- configuration

  -- location

  ---the operator's experience.

What to choose ?

- Equally important to consider whether the aneurysm
  ---unruptured
  ---ruptured

  This complex decision requires entertaining all the variables, ensuring that patients receive the most appropriate care .

Clip vs coil: Safety

- The superiority of either of the treatment options has not been defined, but data are now available with regard to the safety and efficacy of each modality and can be used to decide what is best for individual patients.

Clip vs coil: Safety

- Clipping

  the mortality rate 1% -3.8%

  the morbidity rate 4% - 12%.

  King JT Jr, Berlin JA, et al. Morbidity and mortality from elective surgery for asymptomatic, unruptured, intracranial aneurysms: a meta-analysis. J Neurosurg 1994;81(6):837–42.

- Coiling

  the mortality rate 0.5% - 2%

  the morbidity rate is 4% to 5%.

  Johnston SC, Dudley RA, et al. Surgical and endovascular treatment of unruptured cerebral aneurysms at university hospitals. Neurology 1999;52(9): 1799–805.

Clip vs coil: Safety

- The most comprehensive study looking at the risks of surgical treatment was the International Study of Unruptured Intracranial Aneurysms(ISUIA) .
- Prospective study of 961 patients
  - no history of SAH
  - mortality rate of 2.3% at 30 days and 3.8% at 1 year
  - morbidity rate of 12% at 1 year.

Clip vs coil: Safety

- The safety of endovascular coiling compared with clipping was further augmented by the results of the International Subarachnoid Aneurysm Trial (ISAT).
- Prospective, randomized, controlled trial
- neurosurgical clipping versus endovascular coiling
- 2143 patients with ruptured intracranial aneurysms
- an absolute risk reduction of 8.7% at 1 year.

Clip vs coil : Efficacy

- In the residual clipped aneurysm, the walls are closely apposed and the remaining aneurysm is completely excluded from the circulation.
- Endovascular techniques: the coils keep the remnant's walls apart and the free luminal surface is covered by endothelium, but this endothelization is not observed in coiled aneurysms obtained at autopsy or surgery. Mizoi K, Yoshimoto T, et al. A pitfall in the surgery of a recurrent aneurysm after coil embolization and its histological observation: technical case report. Neurosurgery 1996;39(1):165–8 [discussion: 168–9].

Efficacy: Clip vs coil

- ‘‘Efficacy’’ : an important factor in favor of microsurgical clipping, because clipping seems to be superior to coiling in achieving those goals over the short and long term.
- Most series report a 92% to 96% exclusion rate of the aneurysm from the circulation with microsurgical clipping.

David CA, Vishteh AG, et al. Late angiographic follow-up review of surgically treated aneurysms. J Neurosurg 1999;91(3):396–401.

Clip vs coil : Efficacy

- With respect to endovascular coiling, most series report

  40% to 55% complete exclusion,

  35.4% to 52% near-complete exclusion

  3.5% to 8% incomplete exclusion of the aneurysms from the circulation.

Murayama Y, Nien YL, et al. Guglielmi detachable coil embolization of cerebral aneurysms: 11 years' experience. J Neurosurg 2003;98(5):959–66.

Clip vs coil : Efficacy

- Tsutsumi and coworkers reported a 0.09% per year hemorrhage risk in a cohort of 114 patients who had completely clipped UIAs.

  Tsutsumi K, Ueki K, et al. Risk of subarachnoid hemorrhage after surgical treatment of unruptured cerebral aneurysms. Stroke 1999;30 (6):1181–4.

- Murayama and colleagues ‘s report on an 11-year experience in 818 patients with 916 aneurysms demonstrated a hemorrhage rate of 1.6% that decreased to 0.5% in the last 5 years.

  Murayama Y, Nien YL, et al. Guglielmi detachable coil embolization of cerebral aneurysms: 11 years’ experience. J Neurosurg 2003;98(5):959–66.

Patient factors : Age

- Morbidity and mortality rate in those patients undergoing surgical clipping.

  6.5% for patients less than 45 years old,

  14.4% for patients 45 to 65 years old,

  32% for patients greater than 64 years old

  Investigators I. Unruptured intracranial aneurysms :risk of rupture and risks of surgical intervention. N Engl J Med 1998;339:1725–33.

- Similar finding have been reported with endovascular coiling, but the effects seem to be less significant with endovascular coiling in older patients.

  Barker FG II, Amin-Hanjani S, et al. Age-dependent differences in short-term outcome after surgical or endovascular treatment of unruptured intracranial aneurysms in the United States, 1996–2000. Neurosurgery 2004;54(1):18–28 [discussion: 28–30].

Life expectancy

- The patient's life expectancy is related to
  age,
  associated comorbidities,
  history of illnesses .

- Long life expectancy: longer than 16 years,
- Intermediate life expectancy: 5 to 15 years,
- Short life expectancy : less than 5 years.

Life expectancy

- The patient's estimated life expectancy is particularly important when dealing with unruptured aneurysms,

  because the estimated length of life translates into the patient's length of risk from the aneurysm in an untreated (natural history) or treated (no current aneurysm treatment is 100% effective) form.

Neurological grade

- In patients with ruptured aneurysms, the patient's neurologic condition after the initial hemorrhage is directly associated with survival, and therefore longevity.
- WFNS I grade: excellent recovery
- WFNS II and III grade: good recovery
- WFNS IV and V grade: unfavorable outcome is expected in greater than 50% of the patients.

Rosen DS, Macdonald RL. Grading of subarachnoid hemorrhage: modification of the world World Federation of Neurosurgical Societies scale on the basis of data for a large series of patients. Neurosurgery 2004;54(3):566–75 [discussion: 575–6].

Aneurysm factors : size

- Increased size : increased risk with microsurgical treatment.
- Wirth and colleagues have demonstrated a linear relation with regard to size and outcome, with a complication rate
- 3% for aneurysms less than 5 mm
- 7% for 6- to 15-mm aneurysms
- 14% for aneurysms of 16 to 24 mm.

Wirth FP, Laws ER Jr, et al. Surgical treatment of incidental intracranial aneurysms. Neurosurgery 1983;12(5):507–11.

Aneurysm factors : size

- Safety of endovascular treatment : also affected by size with extremely large and extremely small aneurysms having increased complications.
- Extremely small aneurysms : risk of intraprocedural rupture .
- Giant aneurysms: less favorable d/n ratio, often associated with a higher incidence of a branch vessel origin of the aneurysm neck, and often have intra-aneurysmal thrombus.

Aneurysm factors : size

- Surgical clipping is less affected than coiling by increasing size of the aneurysm.
- Increased aneurysm size is associated with residua
- Large calcified aneurysms may be treated with parent vessel occlusion with an associated cerebral bypass in select cases with effective results.

Aneurysm factors : size

- Endovascular coiling is associated with significant aneurysm recanalizing and rebleeding with increasing size of the aneurysm with rates of postprocedural hemorrhage of 3.5% per year in UIAs larger than 10 mm in size .

Lanterna LA, Tredici G, et al. Treatment of unruptured cerebral aneurysms by embolization with Guglielmi detachable coils: case-fatality, morbidity, and effectiveness in preventing bleeding, a systematic review of the literature. Neurosurgery 2004; 55(4):767–75 [discussion: 775–8].

Aneurysm configuration

- In patients with wide-necked aneurysms and/ or having the aneurysm involving the major neighboring artery(ies), the surgical complexity is increased and experience is required to ensure complete exclusion of the aneurysm with preservation of the parent vessel and its associated branches.

Aneurysm configuration

- The most important factor relating to aneurysm configuration is the d/n ratio, divided into three groups:

  large, intermediate, and small d/n ratios describing the most favorable to least favorable configuration.

Aneurysm configuration

- Dense packing of the coils within the aneurysmal sac can be achieved with less risk of migration of the coil into the parent artery when the treated aneurysm has a small dome size, a small neck, and a large d/n ratio, which are conditions that enhance the complete occlusion of the aneurysm with fewer complications

Aneurysm location

- Location is of prime importance
- Posterior circulation aneurysms: higher complication rate with microsurgical treatment when compared with anterior circulation aneurysms of similar size .

Raaymakers TW, Rinkel GJ, et al. Mortality and morbidity of surgery for unruptured intracranial aneurysms: a meta-analysis. Stroke 1998;29(8): 1531–8.

Aneurysm location

- Complications seem to occur significantly less frequently with coiling.
- Evidence : endovascular treatment of posterior circulation aneurysms is safer than clipping, and most patients with posterior circulation aneurysms undergo endovascular therapy.

Aneurysm location

- Despite major technical advances in imaging and endovascular treatment of cerebral aneurysms, surgical clipping is still the most safe and efficient treatment for most middle cerebral artery aneurysms.

  Regli L, Uske A, et al. Endovascular coil placement compared with surgical clipping for the treatment of unruptured middle cerebral artery aneurysms: a consecutive series. J Neurosurg 1999;90(6):1025–30.

Aneurysm location

- MCA aneurysms: often originate from one or both of the branching vessels and often have an associated unfavorable d/n ratio.
- This configuration : renders aneurysms unable to be coiled or
- may allow for migration of the coil into the parent vessel or a branch, resulting in a stroke.

Aneurysm location

- Acom aneurysms: often require dissection around hypothalamic perforators;

  risk of cognitive dysfunction with surgical treatment
- In a recent study, Chan and colleagues reported impaired verbal memory and executive function with clipping compared with coiling.

Aneurysm location

- Paraclinoid aneurysms: microsurgical clipping often requires decompression of the optic nerve to expose the proximal neck: blindness is a concern.
- In contrast to popular belief, however, no difference in complications has been documented in paraclinoid aneurysms, with regard to visual loss with coiling versus clipping.

Hoh BL, Carter BS, et al. Results after surgical and endovascular treatment of paraclinoid aneurysms by a combined neurovascular team. Neurosurgery 2001;48 (1):78–89 [discussion: 89–90].

Management: UA

- In treating UIAs, the risk of hemorrhage can be divided into

  Low risk: 0.05% per year or less,

  Moderate risk: 0.06% to 2% per year,

  High risk: greater than 2% per year.

Management: UA

- Single UIA less than 5 mm in size, most surgeons do not treat the aneurysm, low-risk category and observe for growth of the aneurysm.
- Exceptions : patients with multiple aneurysms,
  : posterior circulation aneurysms,
  : a history of a prior SAH,
  : a strong family history

  may have an increased risk of hemorrhage, and the surgeon may consider treating an aneurysm of 4 to 5 mm in size in those situations.

Management: UA

- Aneurysms 6 - 24 mm in size : moderate risk of hemorrhage category.
- Aneurysms that are larger in size, such as giant aneurysms (*25 mm):*high-risk hemorrhage category

  -- *grave* prognosis with a rupture rate of 6% in the 1st year and 45% within 7.5 years .

Management: UA

- Next consideration : aneurysm configuration, particularly the d/n ratio
- Grouping into those with a large, intermediate, and small d/n ratio describing the most favorable to least favorable configuration, respectively.
- All this information is taken into consideration after evaluating the patient's estimated life expectancy.

Management: UA

- The advantage of clipping:

  Relatively safe procedure

  Effective in changing the natural history of UIA in the short and long term.

- The disadvantage of clipping:

  Risk of treatment is higher than that of coiling.

Management: UA

- The advantage of coiling:
  less invasive and safer than clipping,
- The major limitation: lack of durability in changing the natural history compared with clipping.

Management: UA

- Anterior circulation aneurysms with a large d/n ratio, endovascular coiling should always be considered as the first line of treatment in those patients with long, intermediate, and short estimated life expectancies, because this treatment provides the patient with relatively effective treatment that is safer than clipping.

Management: UA

- Patients with a long estimated life expectancy or small d/n ratio should undergo clipping, except those patients who have an extremely short life expectancy and in whom coiling is possible based on aneurysm configuration.

Management: UA

- In patients with a medium d/n ratio and a long estimated life expectancy, clipping would be most appropriate to provide a more durable treatment

Management: UA

- In patients with an intermediate lifetime risk, either treatment would be appropriate, and in patients with a short estimated lifetime risk, coiling would be more appropriate

Management: UA

- Posterior circulation aneurysms: patients with large and medium d/n ratios should undergo endovascular coiling regardless of the estimated life expectancy, because endovascular coiling provides a safer treatment that is relatively effective.

Management: UA

- Patients with a small or unfavorable d/n ratio: coiling should still be considered in those individuals with a short or intermediate estimated life expectancy because it is still probably safer than microsurgical clipping

Management: UA

- In some posterior circulation aneurysms with less favorable configurations, where the aneurysm sac involves one of the posterior cerebral branches, clipping may be the only alternative.

Management: UA

- Microsurgical clipping should also be performed in those patients with an unfavorable or small d/n ratio with a long estimated life expectancy by an experienced neurovascular neurosurgeon so as to provide the patient with reasonably safe and effective long-term treatment

Management: RA

- Ruptured aneurysms: the primary cause of death or disability is related to

  -- the effect of the initial hemorrhage

  --subsequent rebleeding

  --associated complications of hemorrhage, vasospasm and hydrocephalus.

Management: RA

- Therefore, in addressing the treatment of a ruptured aneurysm, preventing rebleeding is crucial to prevent further injury to an already compromised brain.

Management: RA

- In ruptured aneurysms, in addition to evaluating the patient's life expectancy based on the premorbid status, the patient's clinical condition after the hemorrhage must be considered because this is directly associated with early survival.

Management: RA

- The author arbitrarily places patients into three groups:

  -- those expected to survive with no or minimal deficits (WFNS I),

  -- those expected to survive with mild to moderate deficits (WFNS II and III),

  -- those possibly not surviving and most likely to have deficits (WFNS IV and V).

Clipping or Coiling of Cerebral Aneurysms , Gavin Wayne Britz, MD, MPH, Department of Neurological Surgery and Radiology, Harborview Medical Center, University of Washington,

Management: RA

- In ruptured aneurysms, the effectiveness of treatment is particularly vital, because rebleeding is associated with a worse prognosis.

Management: RA

- Therefore, in treating a patient with a ruptured aneurysm in the anterior circulation, clipping is advocated in those patients with medium or small d/n ratios, except in those patients with a short life expectancy and/or a poor clinical grade after the initial hemorrhage.

Management: RA

- Endovascular coiling is reserved for those patients with a large d/n ratio in whom complete occlusion can be obtained.

Management: RA

- In posterior circulation aneurysms, coiling is still the first choice; microsurgical treatment is advocated for those patients with an unfavorable d/n ratio, a long life expectancy, and a good clinical grade and is an option in those with a medium d/n ratio.

Special circumstances

- Giant calcified aneurysms
- Large aneurysms with intraluminal thrombus
- Aneurysms in which the vessel is originating from the aneurysm
- Dissecting aneurysms
- Fusiform and
- Mycotic aneurysms

need to be evaluated differently..

Special circumstances

- These aneurysms require clipping with or without bypass or vessel sacrifice surgically or endovascularly if treatment is clinically indicated.

ISUIA

- The 1998 report of the retrospective data from the International Study of Unruptured Intracranial Aneurysms (ISUIA) was very controversial because of the 0.05% yearly rupture rate identified for aneurysms <10 mm in size in patients with no previous history of subarachnoid hemorrhage (SAH). This rate of rupture was considerably lower than the rate in earlier reports and, if true, the risks of treatment would clearly outweigh the natural history risk.

ISUIA: New prospective data

- In a recent study (**Lancet 362:103-110, 2003),** participating centers in the USA, Canada, and Europe report data on patients enrolled prospectively. Investigators recorded the natural history in patients who did not have treatment, and determined the morbidity and mortality associated with endovascular or microsurgical repair of unruptured aneurysms.

ISUIA

- Patients in Group 2 (Patients who have had a ruptured aneurysm at another location that was isolated, trapped, clipped, or treated through endovascular obliteration) with unruptured intracranial aneurysms less than 7 mm had higher rupture rates than did those in Group 1 ($p<0.0001$).

ISUIA

- A multivariate analysis was done using proportional hazards methodology. Statistically significant predictors of hemorrhage included aneurysm size & 3 locations.
- <u>Aneurysm size</u>

  7-12 mm diameter, RR of 3.3 p=0.01

  12 mm diameter, RR of 17.0 , p<0.0001

ISUIA

Three locations

- Tip of basilar artery RR of 2.3, p=0.025
- Cavernous ICA RR of 0.15, p=0.01
- Pcom artery RR of 2.1 [1.1-4.2], p=0.02

using internal carotid artery aneurysms as the reference group (i.e. a RR of 1).

ISUIA

- For both Group 1 and Group 2 patients the combined morbidity and mortality at 1 year was about 3% higher in the microsurgical group (12.6% for clipping vs. 9.8% for coiling in Group 1 patients and 10.1% vs. 7.1% in Group 2 patients).

WAIT AND WATCH ??

- Low rupture rates do not mean no rupture. Aneurysms less than 7 mm can and will rupture, and patients bear the morbidity and mortality of aneurysmal SAH.

WAIT AND WATCH ??

- Furthermore, preliminary neuropsychologic studies demonstrate that patients who harbor and know they have untreated intracranial aneurysms have a reduced quality of life.

WAIT AND WATCH ??

(1) How often should patients be restudied?

(2) Which modality is best for follow-up (angiography, magnetic resonance angiography, or CT angiography)?

(3) How much change in an aneurysm should prompt intervention?

WAIT AND WATCH ??

(4) How should patients modify their lifestyle to accommodate an aneurysm?

(5) What are the medicolegal implications of observation?

TO CLIP OR TO COIL

- Once it is determined that an aneurysm should be or will be treated, two options prevail: endovascular embolization and open surgical clipping.
- The goal of either treatment should be complete and lasting exclusion of an aneurysm from cerebral circulation with preservation of parent, branching, and perforating arteries.

TO CLIP OR TO COIL

- The gold standard for aneurysm obliteration is open surgery. The International Subarachnoid Aneurysm Trial (ISAT) and the International Study of Unruptured Intracranial Aneurysms (ISUIA) compared interventional endovascular treatment to open surgical clipping. Both landmark studies challenge conventional wisdom and patient management.

ISAT

- In patients with ruptured intracranial aneurysms for which endovascular coiling and neurosurgical clipping are therapeutic options , the outcome in terms of survival free of disability at 1 year (assessed by modified Rankin scale) is significantly better with endovascular coiling.
- At 1 year, the relative risk of dependence or death was reduced by 22·6%, with an absolute risk reduction of 6·9%.

ISAT

- The data suggest that long-term risks of further bleeding from a treated aneurysm are low with either treatment, although somewhat more frequent with endovascular coiling.

ISAT Follow–up study

- In patients with intracranial aneurysms suitable for both treatments, endovascular coiling is more likely to result in independent survival at 1 year than neurosurgical clipping; the survival benefit continues for at least 7 years. The risk of rebleeding is low but more common after endovascular coiling than after neurosurgical clipping.

ISAT

- Entry criteria to ISAT required subjective agreement that an aneurysm could be treated by either endovascular or open surgery. Many aneurysms failed to meet that criteria.

ISAT

(1) patients who had life-threatening intracerebral or subdural hematomas

(2) incompatible neck-to-dome ratios

(3) parent artery or branch artery incorporation into the dome

(4) fusiform aneurysms

(5) thrombotic aneurysms

ISAT

(6) giants

(7)blisters

(8) pseudo/traumatic aneurysms

(9) those with mass effect

(10) those that had failed repeated endovascular treatment.

ISAT

- In the ISAT study, 9559 patients who had SAH were assessed; 7416 were excluded (671 refused and 6,745 for ‘‘other reasons’’); and 2143 were randomized. The study revealed that the outcome in terms of survival free of disability at 1 year is significantly better with endovascular coiling.

Follow up study

- The follow-up ISAT article validates these findings

  Molyneux AJ, Kerr RS, Yu LM, et al. 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. Lancet 2005;366:809–17.

Comparison

- Patients in both ISAT studies

(1) were 88% grade I-II

(2) had 93% small aneurysms less than 10 mm

(3) had 97% anterior circulation

(4) were 99% European.

Comparison

- Mortality was not significantly different.
- Rebleed rate was approximately 3 times higher in the endovascular group than the surgical group (2.6% versus 0.9%).
- Retreatment was 4 times as prevalent in the endovascular group than with open surgery (136 versus 34).

- The completeness and durability of endovascular treatment should be considered in light of actual data in the surgical literature on partially treated aneurysms where symptomatic rehemorrhage is a late phenomenon reported to occur between 4 and 20 years, with a mean of approximately 10 years and rebleed rates of 71% to 79%.

- Drake CG, Vanderlinden RG. The late consequences of incomplete surgical treatment of cerebral aneurysms. J Neurosurg 1967;27: 226–38.
- Sato S, Suzuki J. Prognosis in cases of intracranial aneurysm after incomplete direct operations. Acta Neurochir (Wien) 1971;24:245–52.
- Lin T, Fox AJ, Drake CG. Regrowth of aneurysm sacs from residual neck following aneurysm clipping. J Neurosurg 1989;70:556–60.

ASTRA

- Reinforcing the issue of chronicity of the pathology, the Dutch aneurysm screening after surgical treatment for ruptured aneurysms (ASTRA) Study Group demonstrates a 16% incidence of new aneurysm formation over a 15-year period in 610 patients who underwent surgical clipping of a ruptured aneurysm.
- Werner MJH, van der Schaaf IC, Velthius BK, et al. Follow-up screening after subarachnoid haemorrhage : frequency and determinants of new aneurysms and enlargements of existing aneurysms. Brain 2005;128(Pt10):2421–9 Epub 2005 Jul 6.

Not so fast….

- The fastest growing population of patients who have aneurysms is those who have partially obliterated coiled aneurysms.
- In a review of 48 studies comprising 1383 patients treated with coil embolization, a permanent complication was observed in 3.7%. Occlusions of greater than 90% were achieved in 90%.

Brilstra EH, Rinkel GJ, van der GraafY, et al. Treatment of intracranial aneurysms by embolization with coils: a systematic review. Stroke 1999;30:470–6.

Is endovascular treatment flawless??

- Outcomes such as these have led to several patient management nuances, which data have yet to address. A new vernacular has evolved. Terms, such as (1) greater than 95% occlusion, (2) stable residual neck at 2 years, (3) protected dome, and (4) near complete occlusion, now are part of the medical record.

- Surgical management of recurrent partially coiled aneurysms seems technically more difficult and significantly underdeveloped

- Deinsberger W, Mewes H, Traupe H, et al. Surgical management of previously coiled intracranial aneurysms. Br J Neurosurg 2003;17:149–54.
- Thornton J, Dovey Z, Alazzaz A, et al. Surgery following endovascular coiling of intracranial aneurysms. Surg Neurol 2000;54:352–60.
- Zhang YJ, Barrow DL, Cawley CM, et al. Neurosurgical management of intracranial aneurysms previously treated with endovascular therapy. Neurosurgery 2003;52:283–93 [discussion: 293–5].

Clipping : Indications

- The choice of open surgical intervention is influenced by several factors:

  ---complexity of the aneurysm,

  ----size (too small or too large),

  ----- geometry,

Clipping : Indications

---unfavorable dome-to-neck ratio,

---access (inability to navigate delivery system to aneurysm site),

--- anatomy (parent artery, branch artery, or perforator incorporation into neck).

Surgical technique

- <u>The cornerstone of open surgical management</u>

-- microsurgical dissection of the subarachnoid planes

--proximal and distal vascular control

--direct visualization of clip application

-- puncture verification of total aneurysm obliteration.

Yasargil MG, Fox JL. The microsurgical approach to intracranial aneurysms. Surg Neurol 1975;3:7–14.

Advancements in surgery

- Surgical innovations, such as cranial base approaches, have advantaged these goals.

  Origitano TC, Anderson DE, Tarassoli Y, et al. Skull base approaches to complex cerebral aneurysms. Surg Neurol 1993;40:339–46.

- Intraoperative angiography is a powerful interdiction confirming parent or branch artery patency and aneurysm obliteration.
- Alexander TD, Macdonald RL, Weir B, et al. Intraoperative angiography in cerebral aneurysm surgery: a prospective study of 100 craniotomies. Neurosurgery 1996;39:10–7 [discussion: 17–8].
- Origitano TC, Schwartz K, Anderson D, et al. Optimal clip application and intraoperative angiography for intracranial aneurysms. Surg Neurol 1999;51: 117–24 [discussion: 124–8].

Surgery : Risks

- Open surgical procedures, although advantaging a more durable and complete obliteration, do so at a higher risk related to neurobehavioral outcomes compared with their endovascularly treated counterparts.

- Towgood K, Ogden JA, Mee E. Neurological, neuropsychological, and functional outcome following treatment for unruptured intracranial aneurysms. J Int Neuropsychol Soc 2005;11:522–34.
- Bellebaum C, Schafers L, Schoch B, et al. Clipping versus coiling: neuropsychological follow up after aneurysmal subarachnoid haemorrhage (SAH). J Clin Exp Neuropsychol 2004;26:1081–92.
- Brilstra EH, Rinkel GJ, van der Graaf Y, et al. Quality of life after treatment of unruptured intracranial aneurysms by neurosurgical clipping or by embolisation with coils. A prospective, observational study. Cerebrovasc Dis 2004;17:44–52.

Facts

- Either clipped or coiled, management of intracranial aneurysms is advantaged in centers where both modalities are available and a volume of SAHs are treated routinely.
- Mortality rates in hospital centers managing fewer than 10 SAH per year were 40% higher than those in high volume centers managing more than 35 SAH per year.

Cross DT 3rd, Tirschwell DL, Clark MA, et al. Mortality rates after subarachnoid hemorrhage: variations according to hospital case volume in 18 states. J Neurosurg 2003;99:810–7.

Facts

- The ability to perform intracranial angioplasty had a 16% risk reduction for death.

Johnston SC. Effect of endovascular services and hospital volume on cerebral aneurysm treatment outcomes. Stroke 2000;31:111–7.

Size (of case load) does matter.

- The California SAH study of 21,540 patients who had SAH and were admitted revealed 40% lower odds of mortality when 21 or more cases per year were managed.

  Bardach NS, Zhao S, Gress DR, et al. Association between subarachnoid hemorrhage outcomes and number of cases treated at California hospitals. Stroke 2002;33(7):1851–6.

- These results were similar to a New York study, where a 43% reduction in mortality was seen for craniotomies for aneurysm in centers that performed 30 or more cases per year.

  Solomon RA, Mayer SA, Tarmey JJ. Relationship between the volume of craniotomies for cerebral aneurysm performed at New York state hospitals and in-hospital mortality. Stroke 1996;27:13–7.

TREATMENT CONSIDERATIONS

1) Patients who have intracranial aneurysms should be referred to centers that have interventional and surgical capacities.

TREATMENT CONSIDERATIONS

These centers should contain dedicated ICUs and technologies, such as intraoperative angiography, biplane angiography with 3-D capabilities and transcranial Doppler, and capabilities to do cerebral blood flow studies. Having this, the full capacity to manage the interventional and medical aspects of SAH is advantaged.

TREATMENT CONSIDERATIONS

2) Interventionalists and open surgeons should act as partners, not competitors. All patients should be assessed clinically and radiologically by both practitioners before a decision for treatment is decided.

TREATMENT CONSIDERATIONS

3) The goal of aneurysm management is complete, durable obliteration without neurologic consequence.

Experienced teams understand their own capacities, limitations, and patient ability to tolerate each intervention.

Surgical clipping surely is a more invasive procedure but also more durable.

TREATMENT CONSIDERATIONS

4) Initial evaluation by both practitioners advantages consideration for placement of an external ventricular drain in poor grade patients or in patients whose ventricles are increasing in size before systemic heparinization associated with endovascular intervention.

TREATMENT CONSIDERATIONS

5) The initial angiography is done best by interventionalists with an open surgeon present.

This allows for real-time decision making. Angiographic runs, which demonstrate collateral circulation, are obtained to facilitate surgical intervention should temporary occlusion be necessary.

TREATMENT CONSIDERATIONS

- The 3-D reconstruction is invaluable to assess more accurately dome-to-neck ratio and parent artery or branch orientation to neck and enhances surgical view for clip placement and vessel reconstruction

TREATMENT CONSIDERATIONS

6) The right of first attempt goes to an interventionalist unless aneurysms are clearly noncoilable, including those with a wide neck, blebs, those that are geometrically complex with incorporation of branch artery, those with inability to navigate delivery system, those that are partially thrombosed, fusiform, giants, and those in patients who prefer open surgery.

TREATMENT CONSIDERATIONS

7) The goal is complete angiographic obliteration.

8) If the framing coil does not seat or does so with significant asymmetry, leaving a portion of the neck uncovered, the likelihood of complete obliteration declines.

TREATMENT CONSIDERATIONS

9) Certainly balloon- or stent-assisted coiling is an option. Each adds risk.

Stent-assisted coiling requires use of antiplatelet agents, a risk consideration at least in patients who have ruptured aneurysm. Stent-assisted and balloon-assisted interventions are not part of the ISAT or ISUIA data.

TREATMENT CONSIDERATIONS

10) A classical aneurysm for residual neck after coiling is the ‘‘simple’’ posterior communicating artery aneurysm. It often has an oblong neck, lending itself to residual dog ear and potential for regrowth.

TAKE HOME MESSAGE

Treatment of intracranial aneurysms involves many factors:

--patient preference and demographics;

--aneurysm size, site, geometry, access,

--practitioner experience and availability;

--facility; technology; and ancillaries.

---Volume counts.

---Teamwork enhances.

---Management should be individualized.

THANK YOU !!