

Cerebral Aneurysm

台北慈濟醫院 神經外科

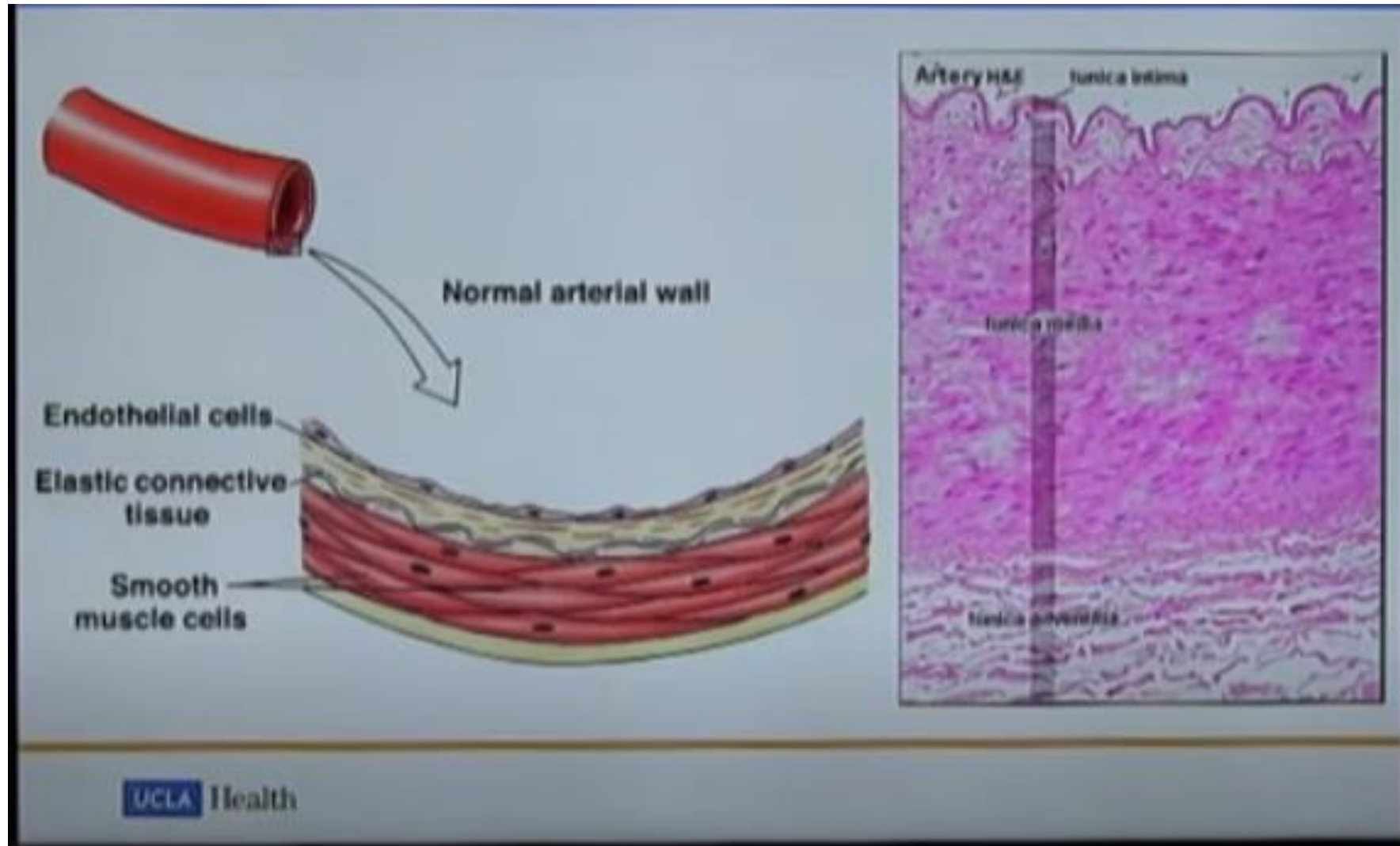
徐賢達 醫師

What Is an Aneurysm ?

- An abnormal localized bulge or widening of a blood vessel caused by a weakness in the wall of the vessel



Blood Vessels Are Tubes Made of Layers



Main Types of Aneurysms

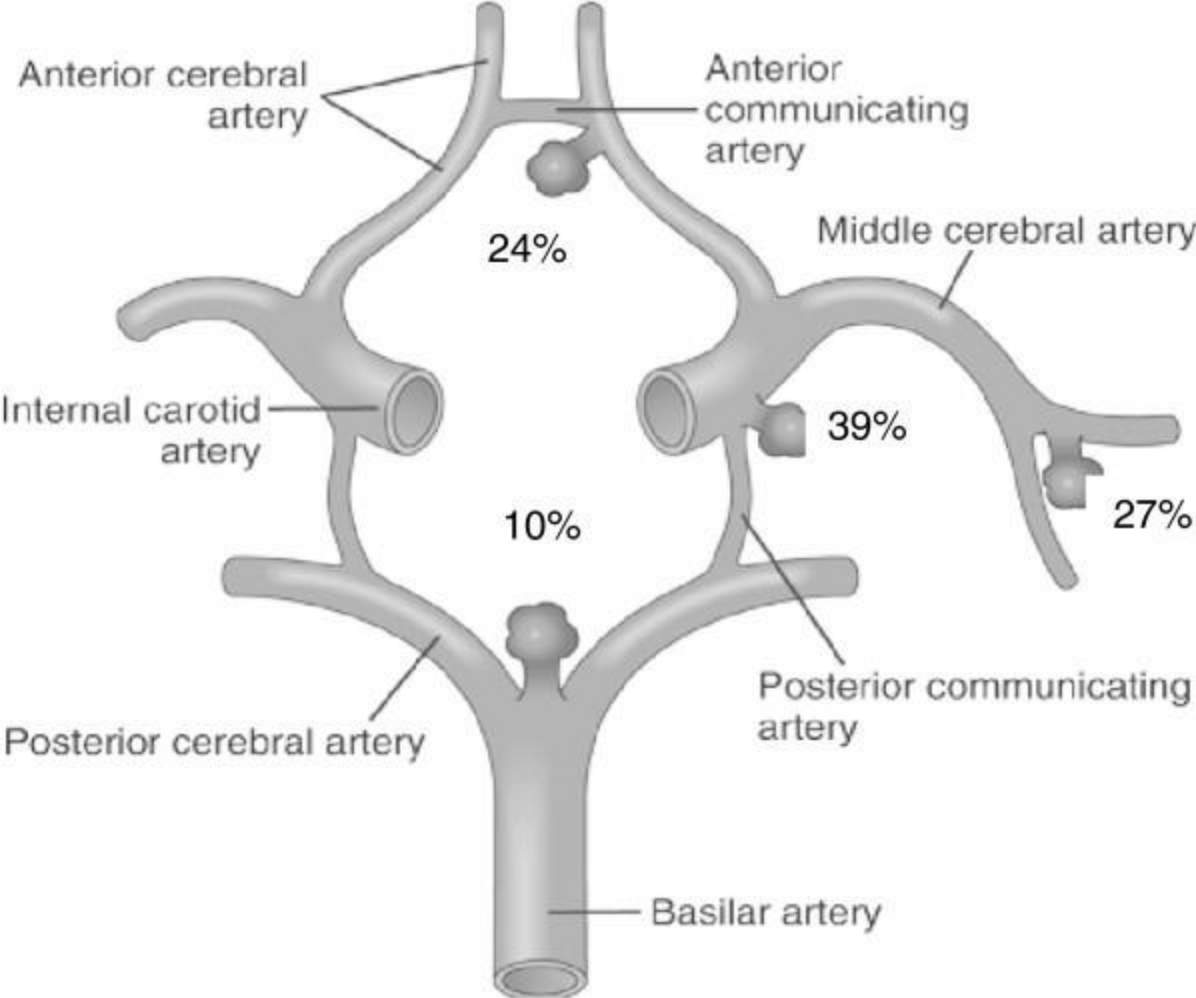
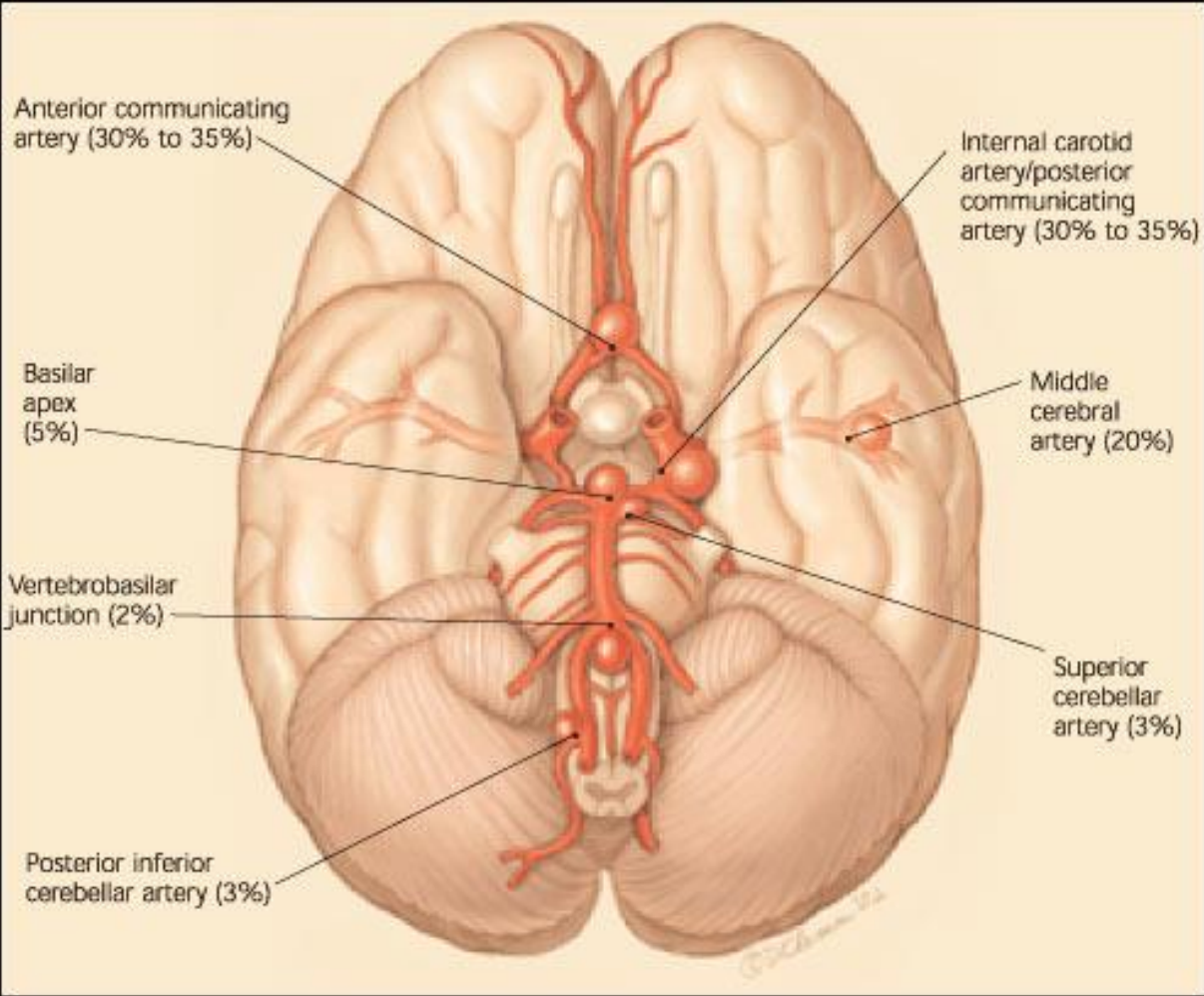


Saccular

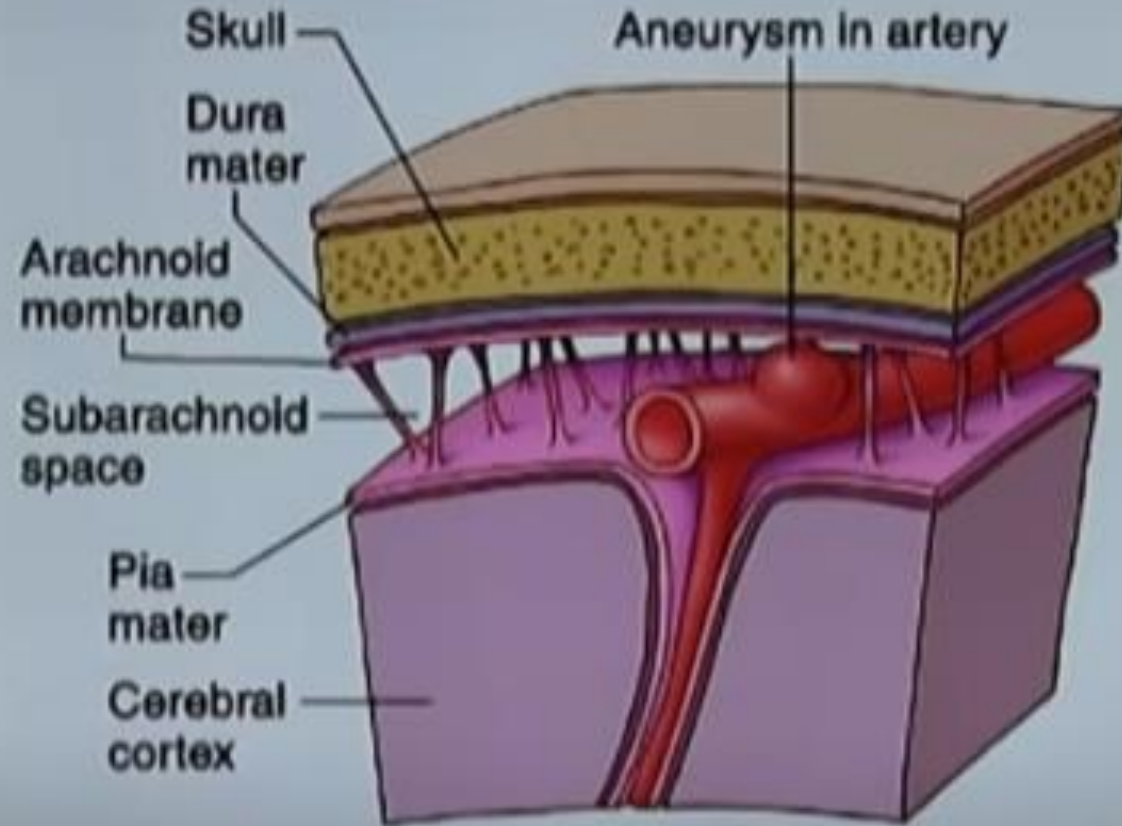
Fusiform

Dissecting

Many Aneurysms Arise at the Circle of Willis



Major Blood Vessels Exist in the Subarachnoid Space



Subarachnoid hemorrhage (SAH)



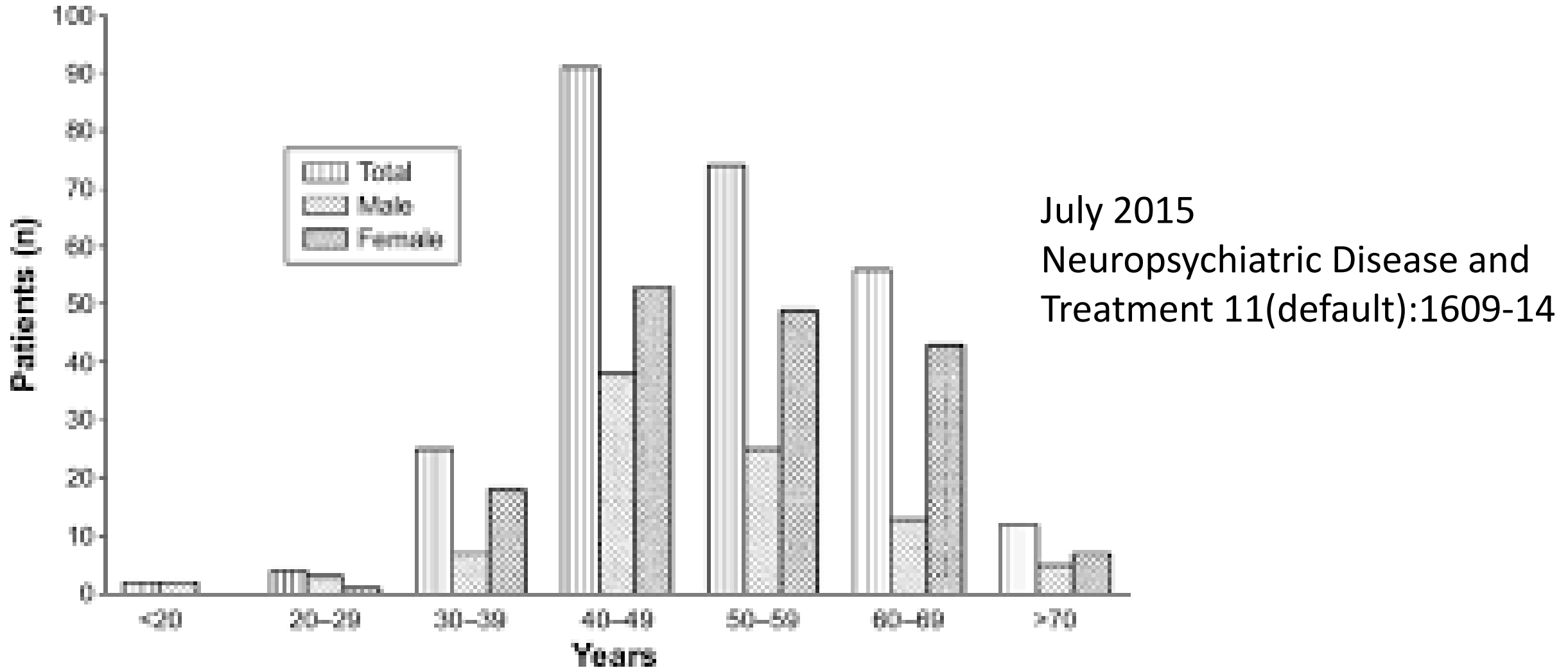
Aneurysms and Aneurysmal Subarachnoid Hemorrhage (aSAH)

- Approximately 1 in 50 in the USA have a brain aneurysm
- Approximately 8 in 10 people per 100, 000 suffer from a ruptured brain aneurysm
- 20 % of patients die due to ruptured brain aneurysms before hospital admission

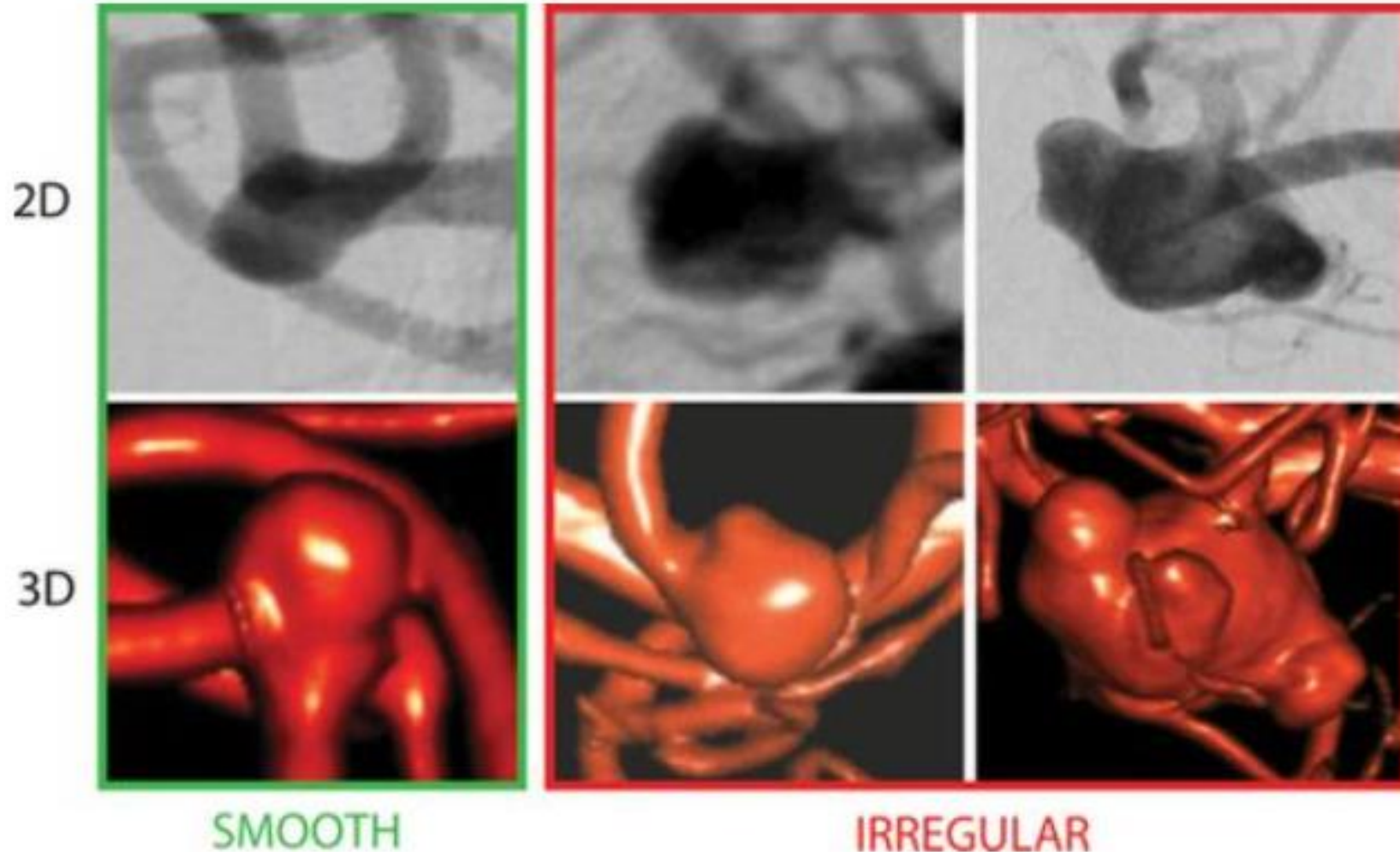
aSAH Risk Factors

- **Modifiable (Behavioral)**
 - Hypertension
 - Smoking
 - Alcohol abuse
 - Sympathomimetic drugs (eg. Cocaine)
- **Nonmodifiable**
 - Female sex
 - History of previous aSAH
 - Family history of aSAH (at least 1 first degree relative)
 - Genetic syndromes(eg. Polycystic kidney disease)

Epidemiological Investigation of 264 Sporadic Cases of Ruptured Cerebral Aneurysm at a Single Institution in Southwest China



Irregular Shape of Intracranial Aneurysm Indicates Rupture Risk Irrespective of Size in a Population-Based Cohort



Stroke. 2016 May;
47(5):1219-26

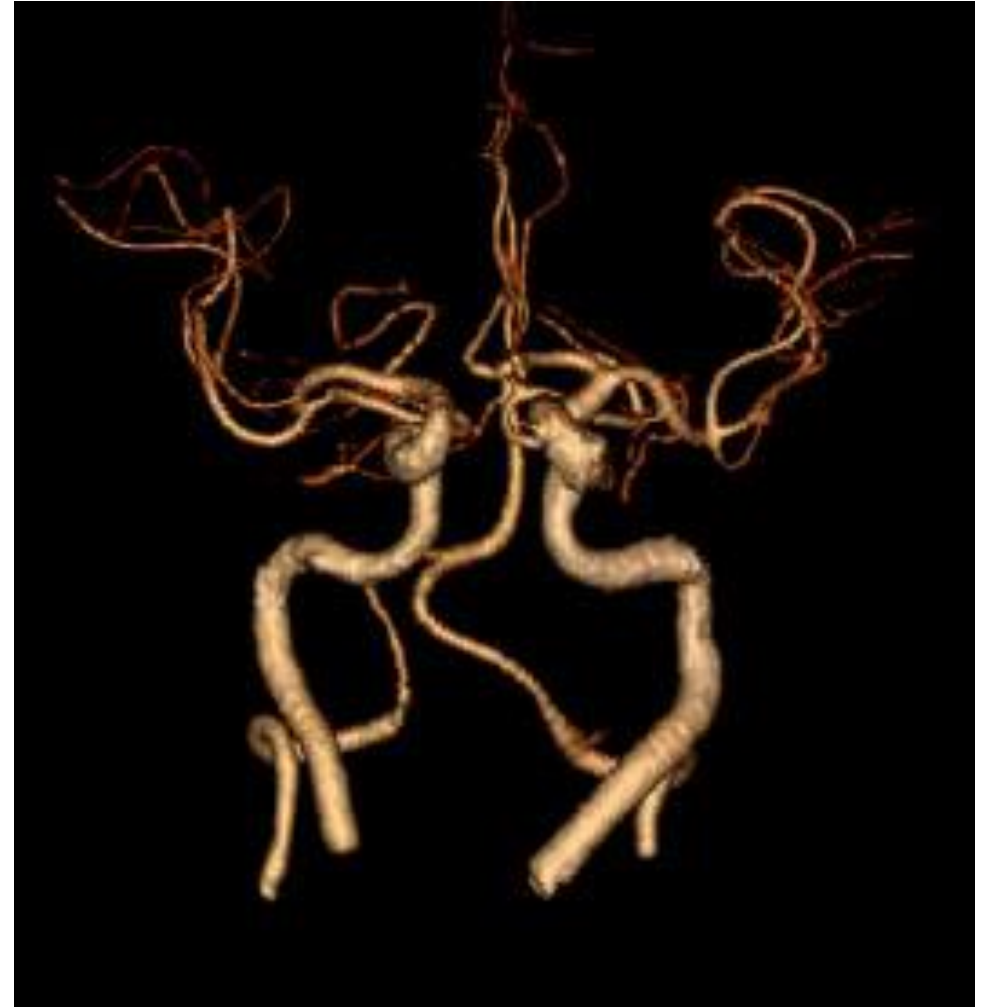
Symptoms of a Ruptured Brain Aneurysm

- Sudden, severe headache
 - “worst headache of your life”
- Nausea or vomiting
- Loss of consciousness
- Stiff neck
- Sudden change in vision: blurry or double
- Dilated pupil or drooping eyelid
- Photophobia
- Sudden change in mental status, dizziness, trouble walking
- Seizure

Imaging: Diagnosis and Initial Screening



computed tomography angiography (CTA)



Accuracy of CTA in the Diagnosis of Intracranial Aneurysms

Table 10. Results Summary

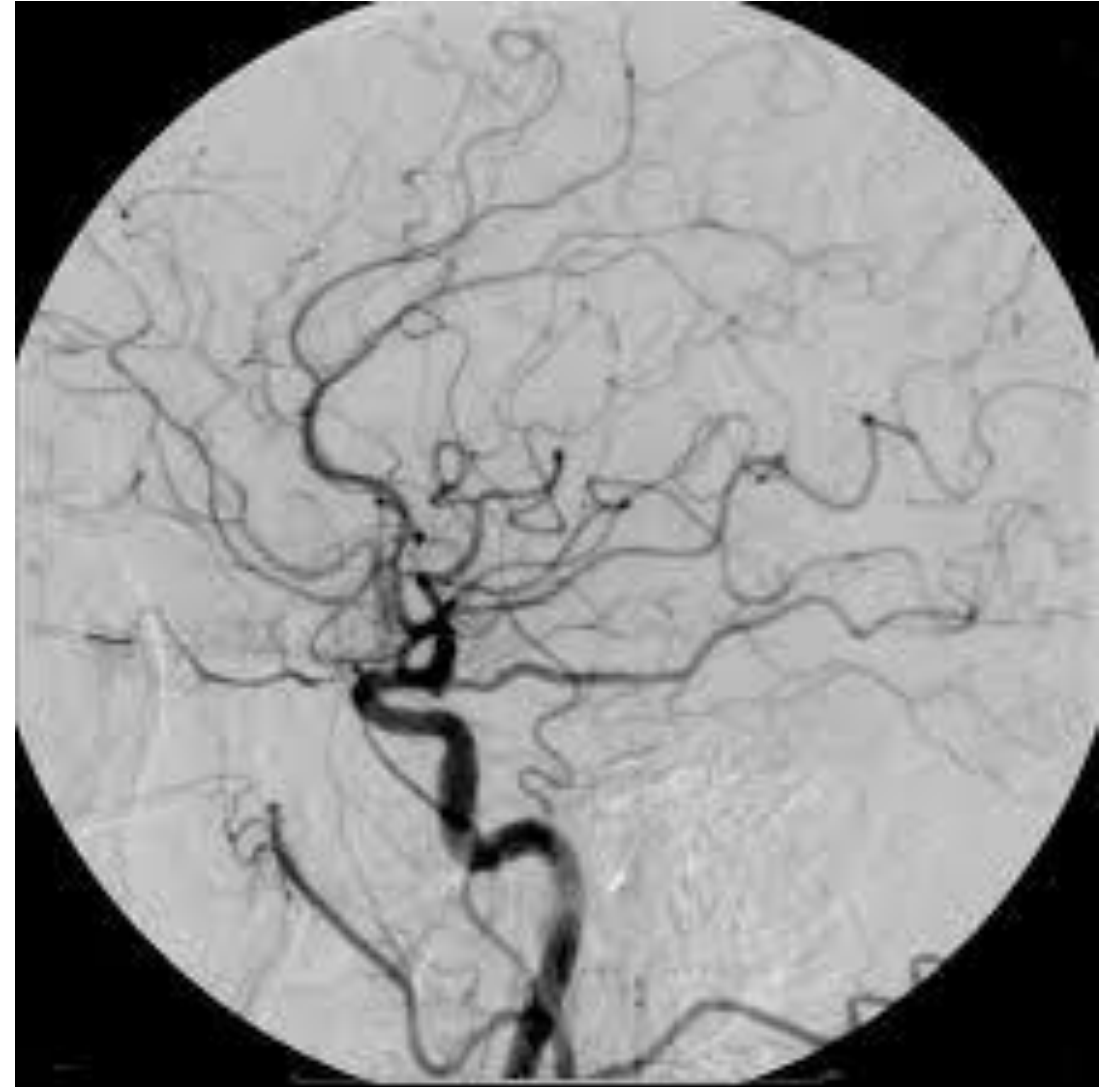
False CTA positives: Aneurysms found on CTA but ruled out by DSA	27 cases of total 132 (20.5% of cases)
False CTA negatives: Aneurysms missed by CTA but confirmed by DSA	29 cases of total 134 (21.6% of cases)

CTA, computed tomography angiography; DSA, digital subtraction angiography.

Table 7. Size of Aneurysms Missed By Computed Tomography Angiography (CTA) but Found on Digital Subtraction Angiography (False CTA Negatives)

Size	Total Aneurysms
Very small (0–5 mm)	28 (96.6%)
Small (6–10 mm)	1 (3.4%)
Medium (11–15 mm)	0
Large (16–24 mm)	0

Catheter Cerebral Angiography



Hunt Hess Grading Scale

Hunt Hess Grading Scale for Subarachnoid Hemorrhage

www.openmed.co.in

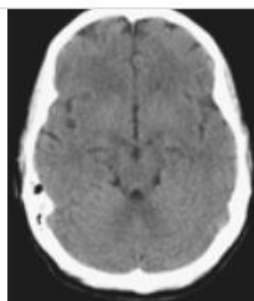
Grade	Clinical Presentation	Survival Rate (%)
I	Mild headache, normal mental status, no neurological deficits, Minimal/slightly nuchal rigidity.	70
II	Severe headache, normal mental status, may have cranial nerve deficit	60
III	Somnolent, confused, may have cranial nerve or mild motor nerve deficit	50
IV	Stupor, moderate to severe motor deficit, may have intermittent reflex posturing	20
V	Coma, decerebrate posturing or flaccid	10

Fisher Grade

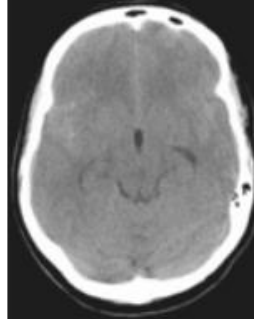
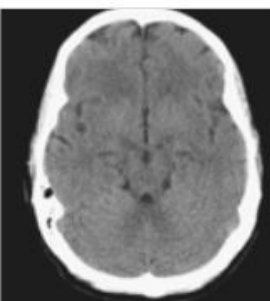
Fisher CT Grading Scale

Fisher Group	Blood Pattern on Nonenhanced CT
1	No subarachnoid blood detected
2	Diffuse or vertical layers <1 mm thick*
3	Localized clot or vertical layers ≥ 1 mm thick
4	Intracerebral or IV clot with diffuse or no SAH

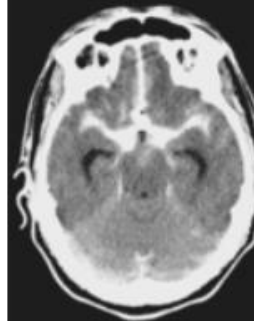
*“Vertical” cisterns: interhemispheric, insular, and ambient.



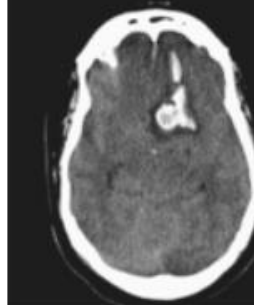
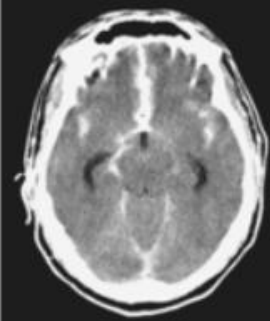
Fisher grade 1
No SAH visualized
Low risk for vasospasm



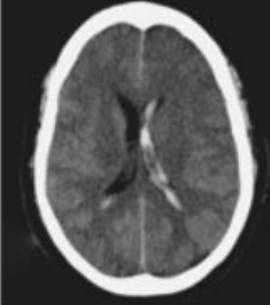
Fisher grade 2
Diffuse SAH without clots
or vertical layers of
blood 1mm or more thick
Low risk for vasospasm



Fisher grade 3
Localized blood clots in the
subarachnoid space or blood clot
more than 1mm thick in the vertical plane
(interhemispheric fissure,
insular cistern, or ambient cistern)
High risk for vasospasm



Fisher grade 4
Intracerebral or intraventricular blood with
only diffuse blood or without blood in the
basal cisterns
Low risk for vasospasm



過五關

腦血管動脈瘤的死亡率相當高，因此醫學界有病患需

“過五關”

第一關是病患出血後，有**20%**左右到院前已過世

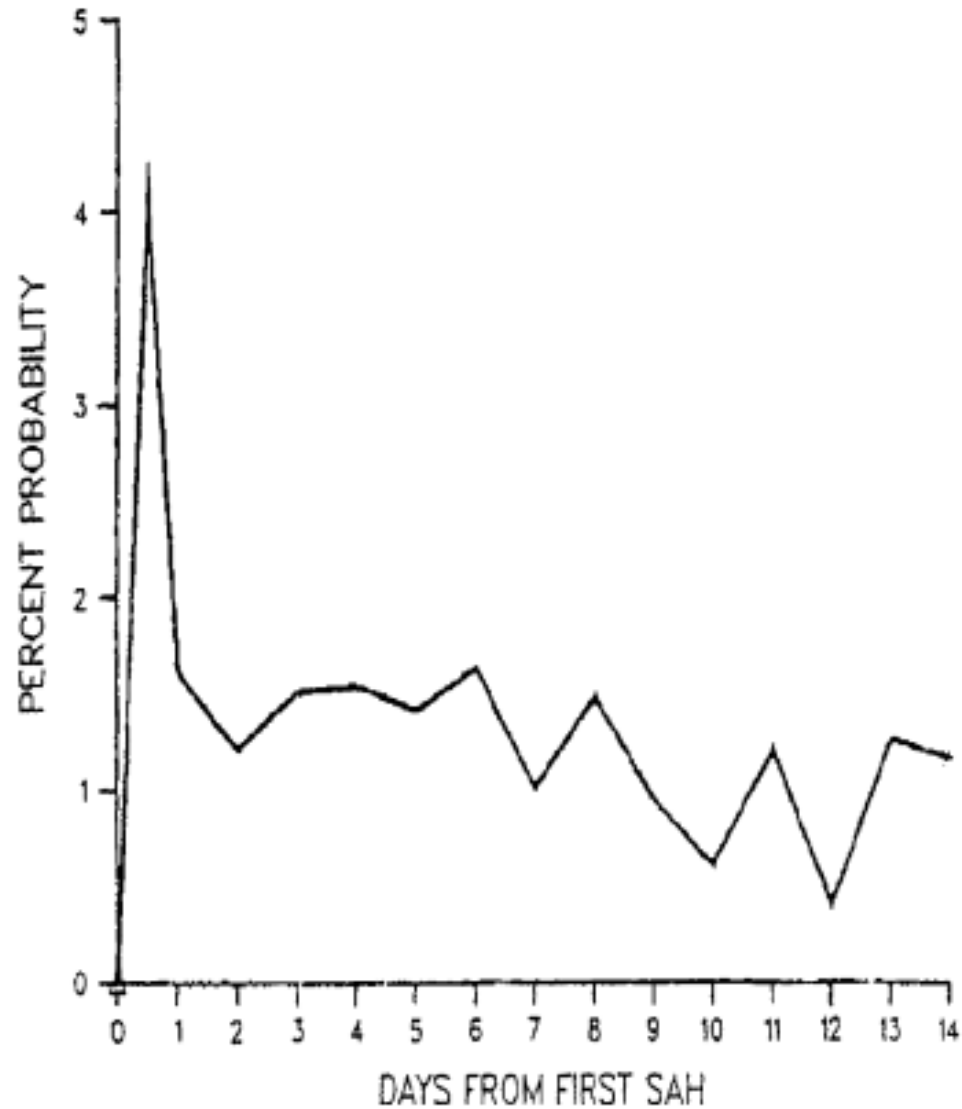
第二關是送到醫院後，病人一旦逐漸清醒，卻可能因疼痛造成血壓飆高，**動脈瘤再度破裂**，增加死亡的風險

第三關是**血管痙攣**一旦發生，藥物治療後有相當高比例無效

第四關是病人若有**水腦**，後續需做腦室腹腔引流術

第五關在住院期間或是情緒不穩定時誘發**癲癇**，病人容易再度摔倒或受傷、甚而死亡

Rebleeding



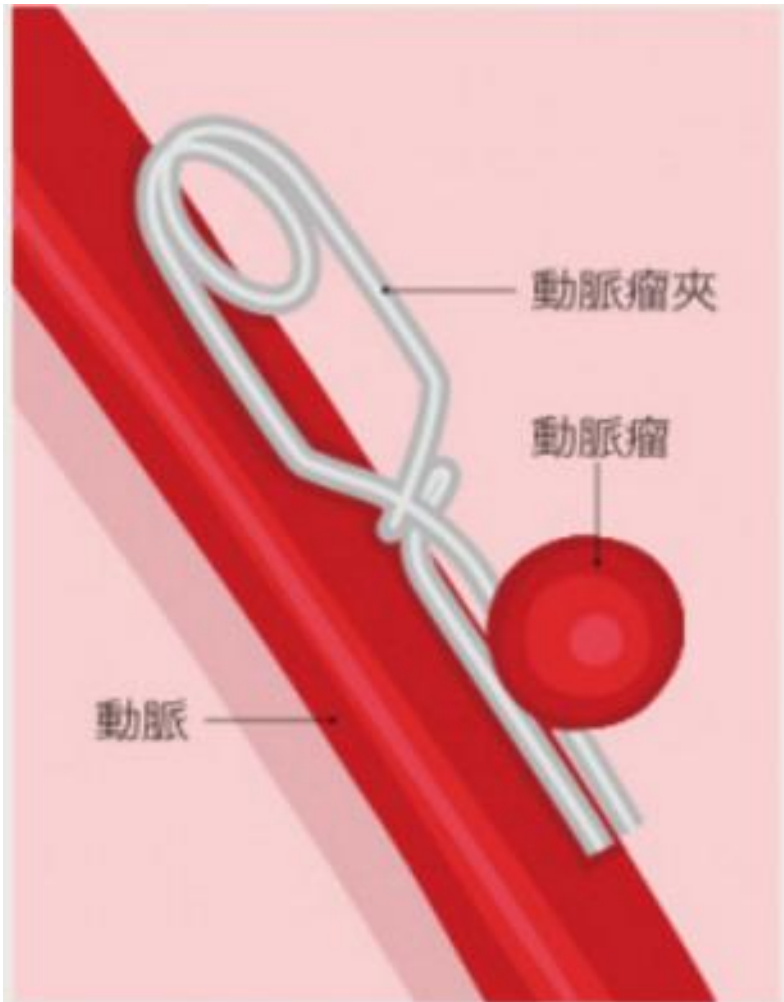
Neurosurgery. 1983;13:479-81.

Fig. 3 Daily risk of rebleeding in The International Cooperative Study on the Timing of Aneurysm Surgery [5]

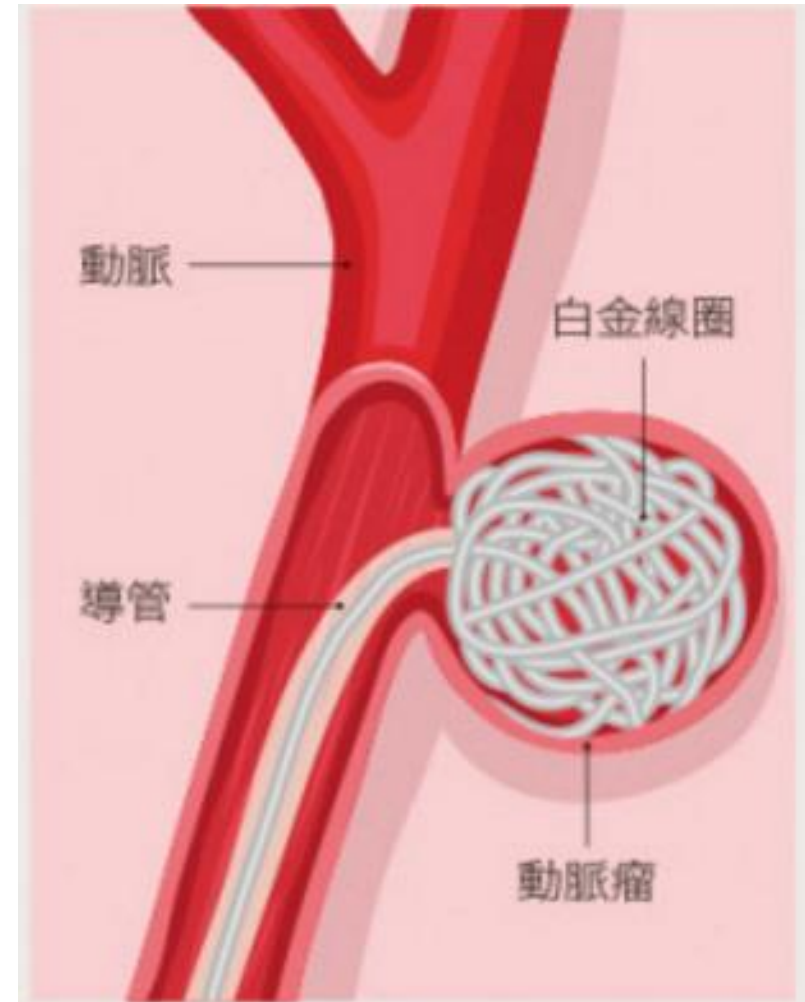
The risk of rebleeding from ruptured intracranial aneurysms

- 5-year period from 1978 to 1983, 1076 patients (Danish Aneurysm Study Group)
- 133 patients suffered at least one rebleed
- Patients had a mortality rate of 80% compared to 41 % for patients without a rebleed ($p < 0.0001$)
- Significantly fewer rebleeds were reported in patients with good clinical grades (Hunt Grades I and II) compared to those with poor clinical grades (Hunt Grades III to V: $p < 0.001$).

Treatment of Ruptured Aneurysm



用夾子夾住動脈瘤，阻斷血液滋養它長大。



將白金線圈經導管塞進動脈瘤，防止它變大、破裂。

Clipping or Coiling

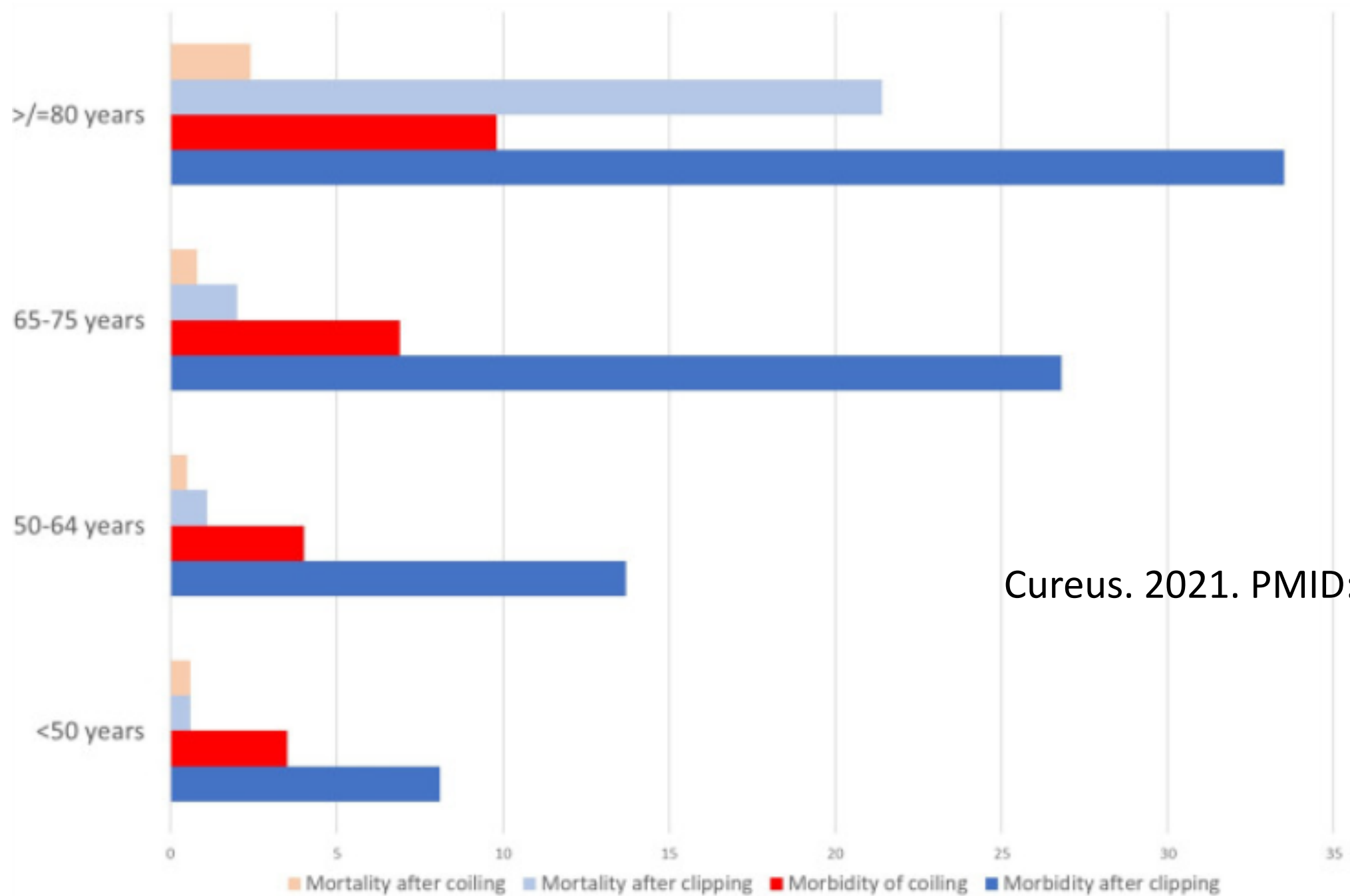
- Treatment decision for observation, surgical clipping, or endovascular coiling largely depends on the **aneurysm's size, location, and neck geometry**.
- The less invasive nature of coiling is likely to be favored in patients who are **older**, are in **poor health**, have **serious medical conditions**, or have aneurysms in **certain locations**.

Clipping or Coiling

- The better long-term protection from bleeding may give patients with **clipped aneurysms** an **advantage in life expectancy**
- **Surgical clipping** is recommended as the principal treatment strategy for **MCA aneurysms**.

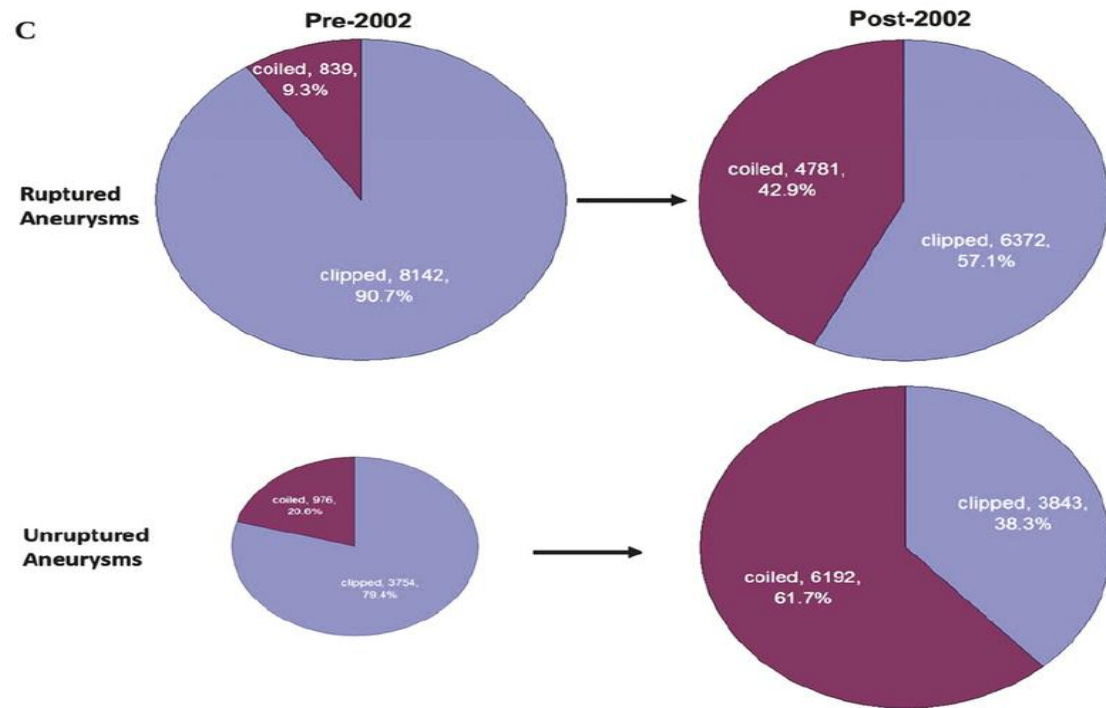
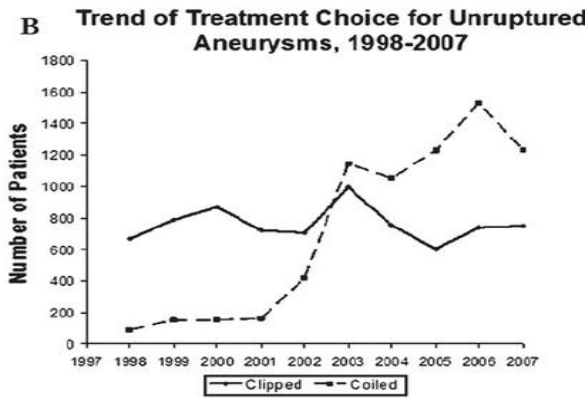
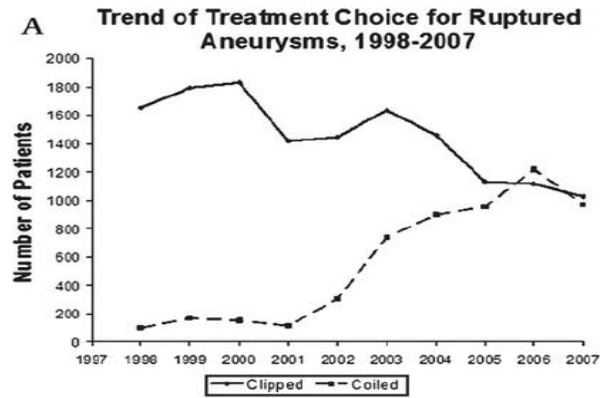
Acta Neurochir (Wien). 2011; 153(11): 2111–2117

- Restricted to specialized regional centers with a high caseload, which are able to provide full-time high-level care by a team of experienced **vascular neurosurgeons** and **interventional neuroradiologists**.



Cureus. 2021. PMID: 35047297

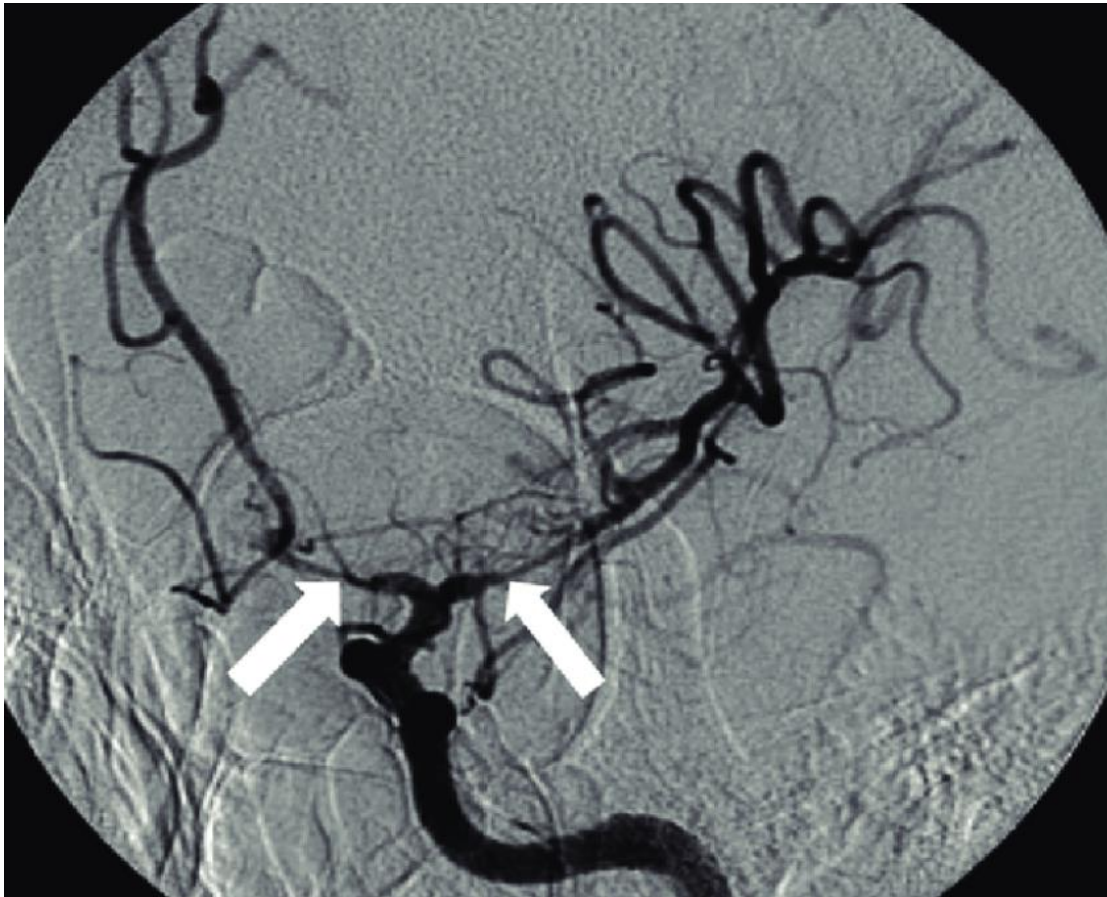
Treatment of Ruptured and Unruptured Cerebral Aneurysms in the USA: a Paradigm Shift



J Neurointerv Surg. 2012
May;4(3):182-9.

Vasospasm

- Defined as focal or diffuse, temporary narrowing of cerebral arterial caliber due to **smooth muscle contraction** within the vascular wall.



Kenneth Byron
Loyola University Chicago |
LUC · Department of Molecular
Pharmacology and Neuroscience

Subarachnoid Blood

- P-Selectin
- Fibrinopeptide A
- Plasminogen Activator Inhibitor 1
- Thromboxane A2
- Serotonin
- ADP

- Microthrombosis
- Erythrocyte-Degradation Products

- Oxygemoglobin
- Bilirubin-Oxidized Products

- Vasospasm**
- ↑ Endothelin 1
- Ionic Imbalance (Ca, K)

- ↑ ROS
- ↓ eNOS
- Lipid Peroxidation
- Neuroinflammation



Therapy for Vasospasm

- 3-H became the mainstay in the prevention and treatment of cerebral vasospasm: **Hypervolemia, Hypertension, Hemodilution**

- The regimen is not without risk

Kosnik AJ, et al. JNS 1976

- Current recommendation

- Normovolemia, Normotension

Dhaval Shukla

[NIMHANS], Bangalore 560029, India

- Intra-arterial Nimodipine (calcium entry blocking agent)

AJNR Am J Neuroradiol.2008 Feb;29(2):291-5.

Hypervolemia

Increase risk of complications

- Pulmonary edema
- Cardiac arrhythmia
- Congestive heart failure
 - Cerebral edema
 - Sepsis

Induced Hypertension

Complications

- Cardiac arrhythmia
- Pulmonary edema
- Hemorrhagic transformation
- Intracranial bleeding

iHT is a labor-intensive treatment

There is still no evidence that iHT improves outcome in patients with DCI

High rate of serious complications associated with iHT

Widespread use of iHT in aSAH patients with DCI and the pertinent guideline recommendations may require reconsideration

Hemodilution [Hematocrit 30]

- 40%–50% of patients with SAH develop anemia during in ICU
- Age, sex, surgery, and blood drawing for investigations
- Anemia has been **associated** with increased **morbidity** because of infarction, disability, and eventually death
- **Low** brain tissue **oxygen** because of anemia, leading to **neuronal injury** in patients with acute brain injury
- Optimal Hb concentration is still a matter of debate
- Target Hb >10 g% is a reasonable option

Hydrocephalus (communicating)

- Various mechanisms implicated as causative factors for the chronic hydrocephalus following aSAH
- Alterations in CSF dynamics, obstruction of the arachnoid granulations by blood products, and adhesions within the ventricular system

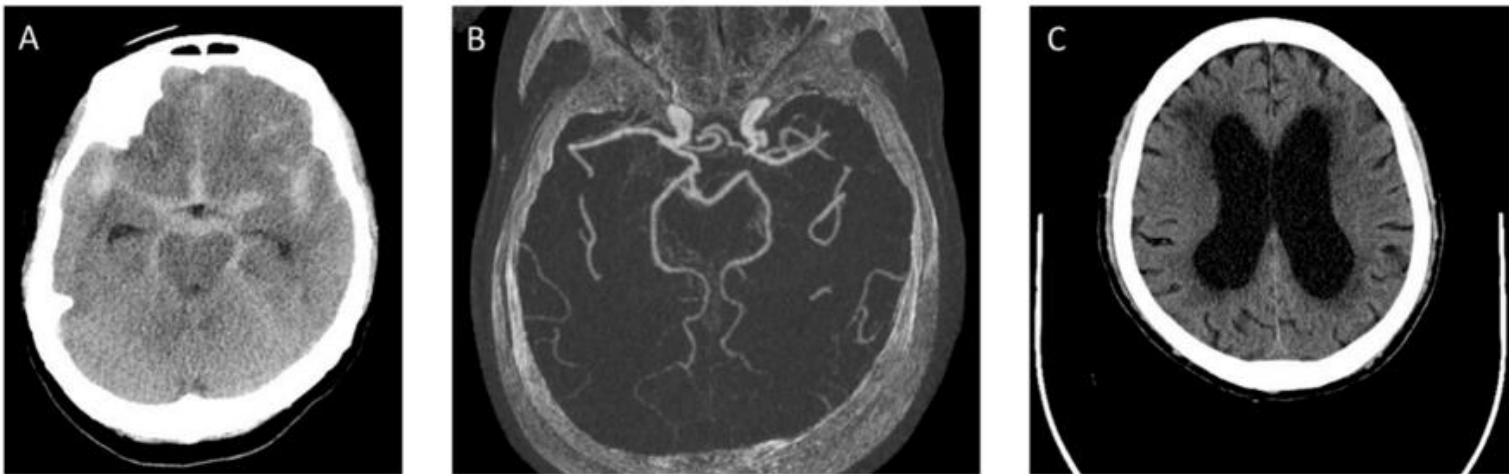


Figure 1. The series of computed tomography (CT) images of a case with aSAH. (A) A 68 years-old female patient presented with SAH at admission. There is no IVH and no acute hydrocephalus; (B) a ruptured left posterior communicating artery aneurysm was identified and coiled; (C) on 12 days after aSAH, CT showed hydrocephalus. She developed progressive ataxia and cognitive dysfunction.

Management of Hydrocephalus

- Medical treatment
 - Not proved to be useful
 - Used as a temporary measure and in conjunction with surgical management
 - Acetazolamide : reduce CSF production
- Surgical treatment: Cerebrospinal fluid shunts
 - Ventriculo-peritoneal (VP) shunt – most common
 - Ventriculo-atrial (VA) shunt
 - Lumbo-peritoneal (LP) shunt
 - External ventricle drainage (EVD) - temporary

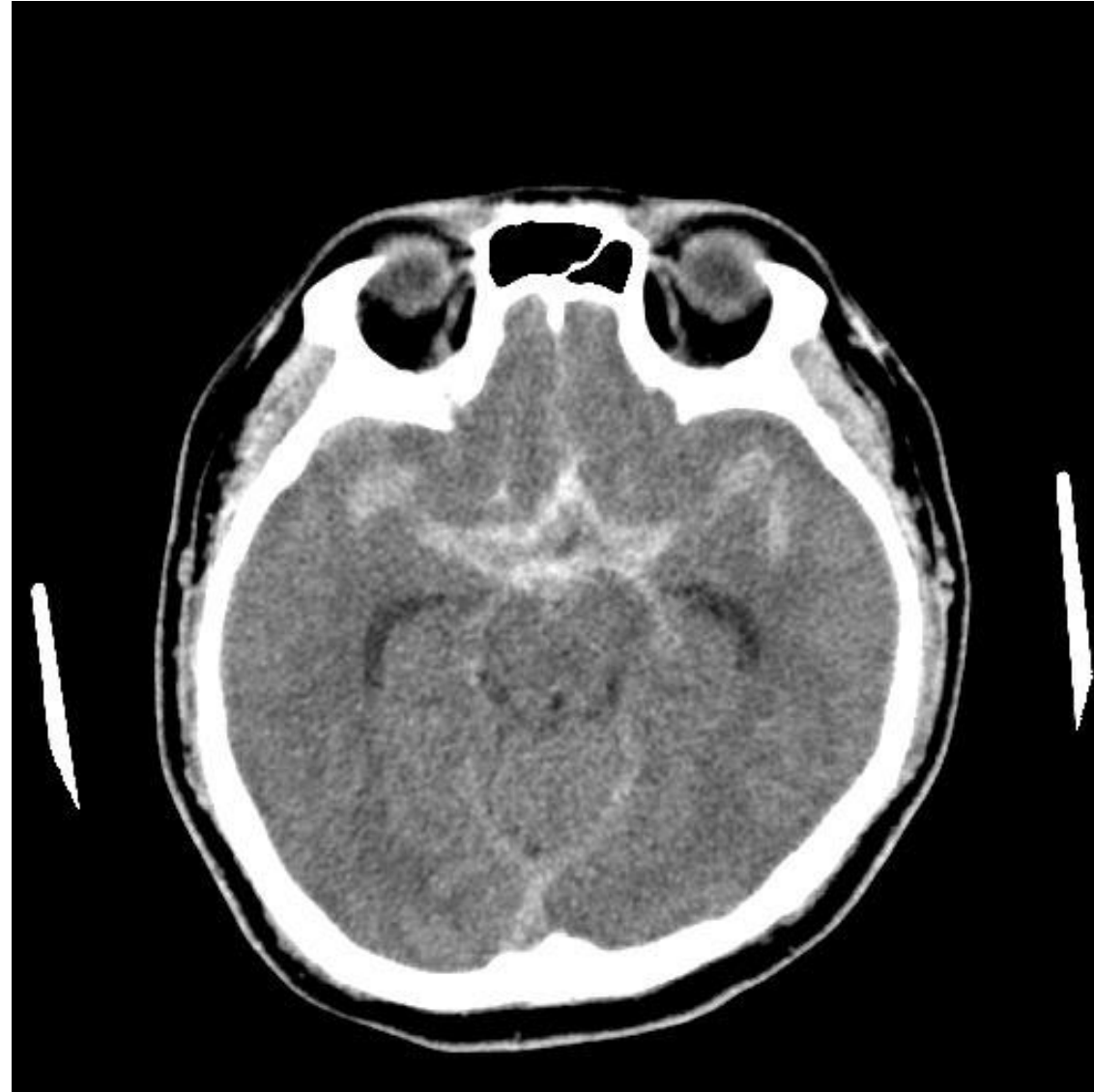
Factors Associated with VP Shunt Placement

- Older age, female sex, a history of hypertension
 - High Fisher grade on the initial computed tomography (CT) scan
 - Low initial Glasgow Coma Scale (GCS) score
 - Higher Hunt and Hess grade at admission
 - Amount of subarachnoid blood
 - Presence of intraventricular hemorrhage (IVH)
 - Prolonged EVD
-
- J. Neurosurg. 2009, 111, 1029–1035
 - J. Neurosurg. 2010, 113, 774–780
 - Neurosurgery 2018, 83, 393–402

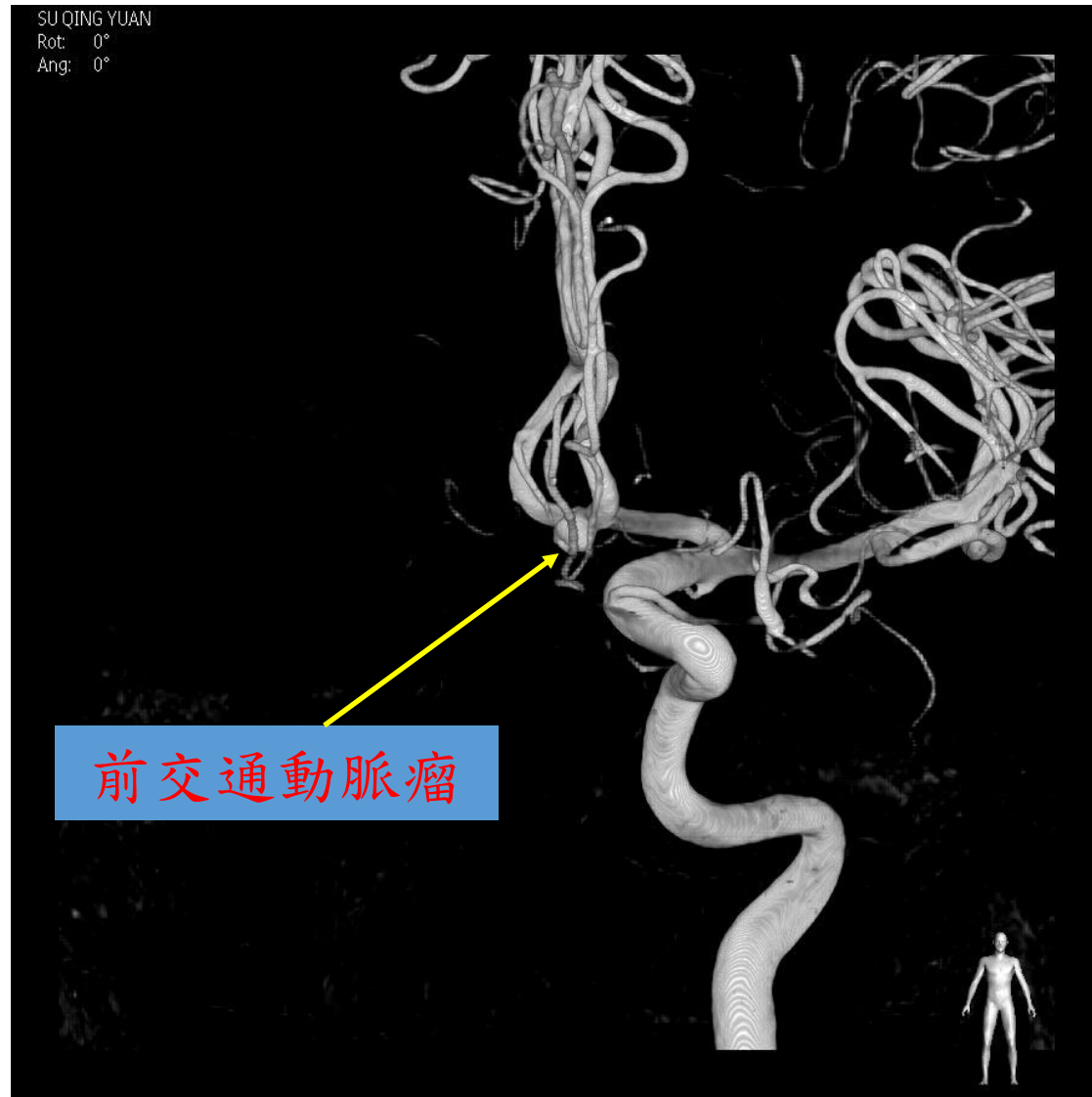
開顱夾閉術 病患(甲)

- 59歲 男性
- 2022年4月16日突發頭痛，嘔吐
- 至台北慈濟醫院求診(昏迷指數15分)
- 電腦斷層顯示蜘蛛膜下腔出血

電腦斷層



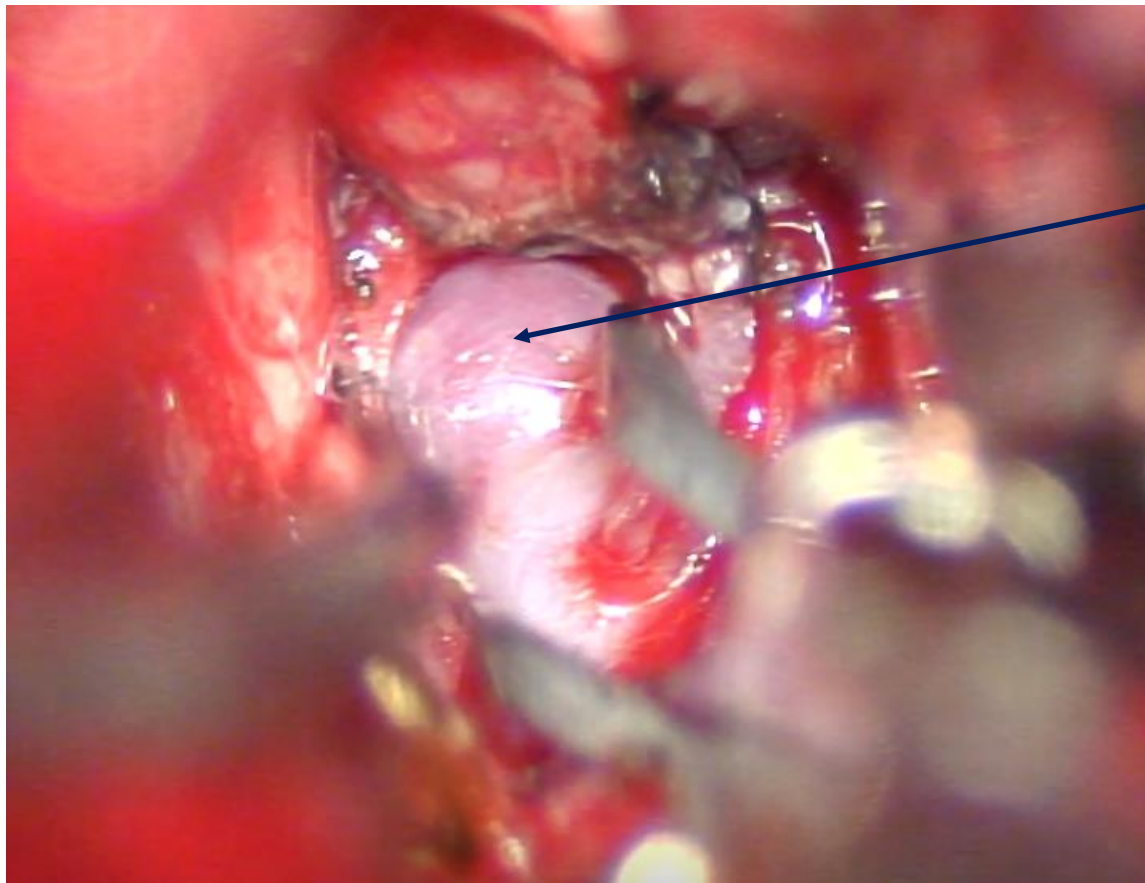
腦血管攝影



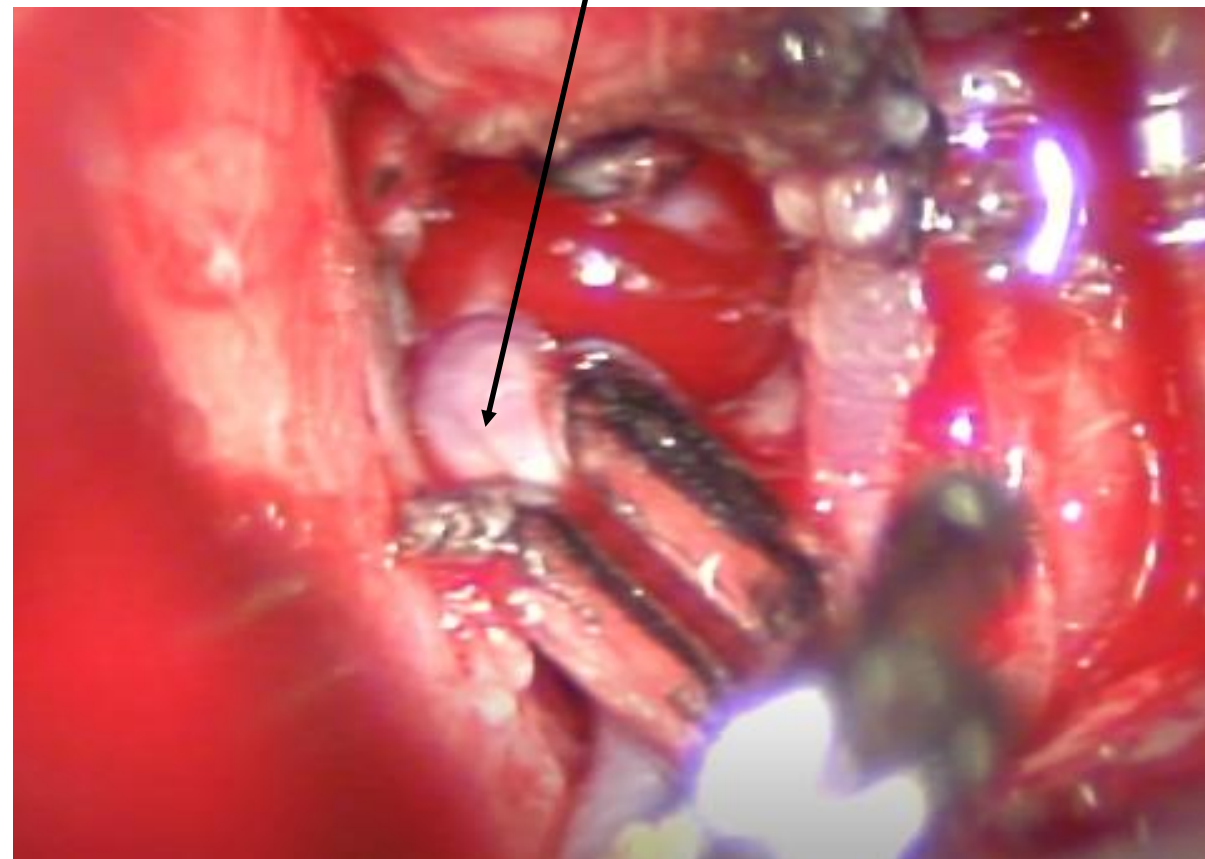
複合式開刀房手術



開顱夾閉術



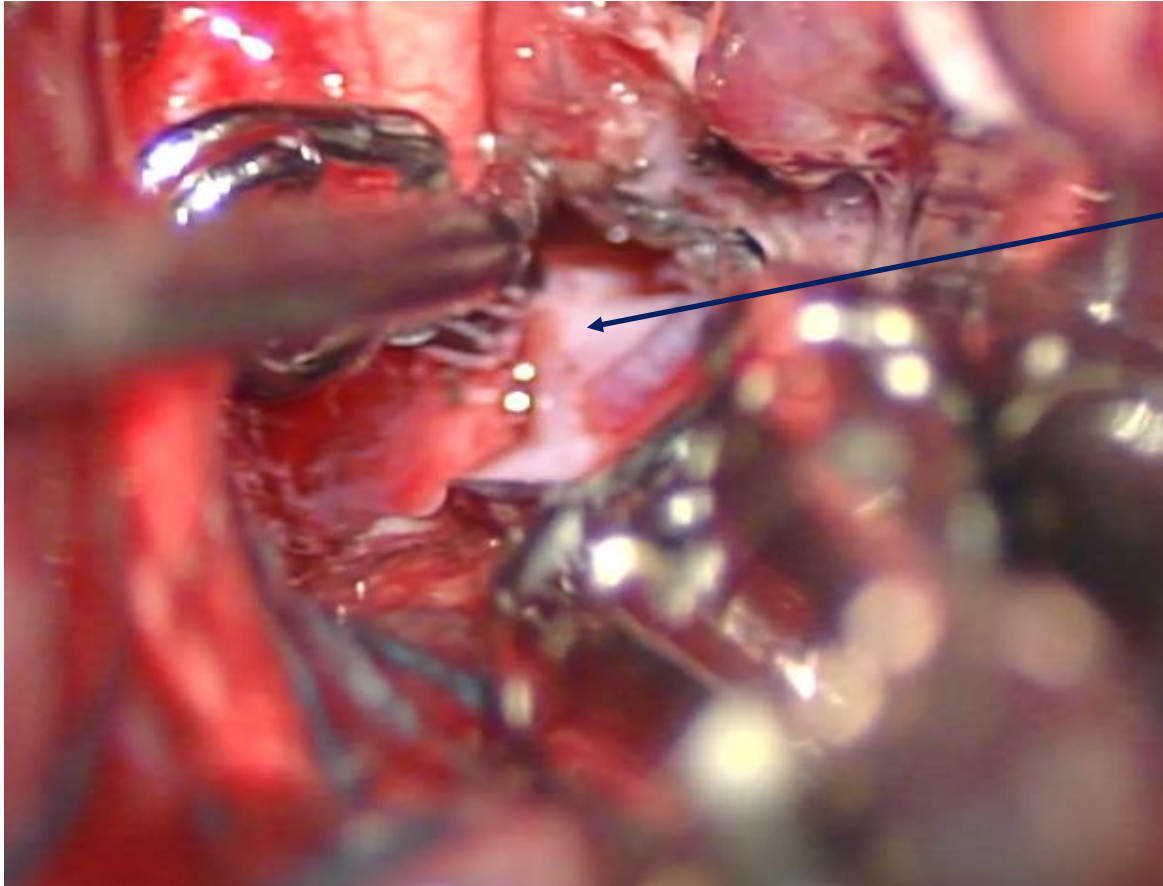
動脈瘤



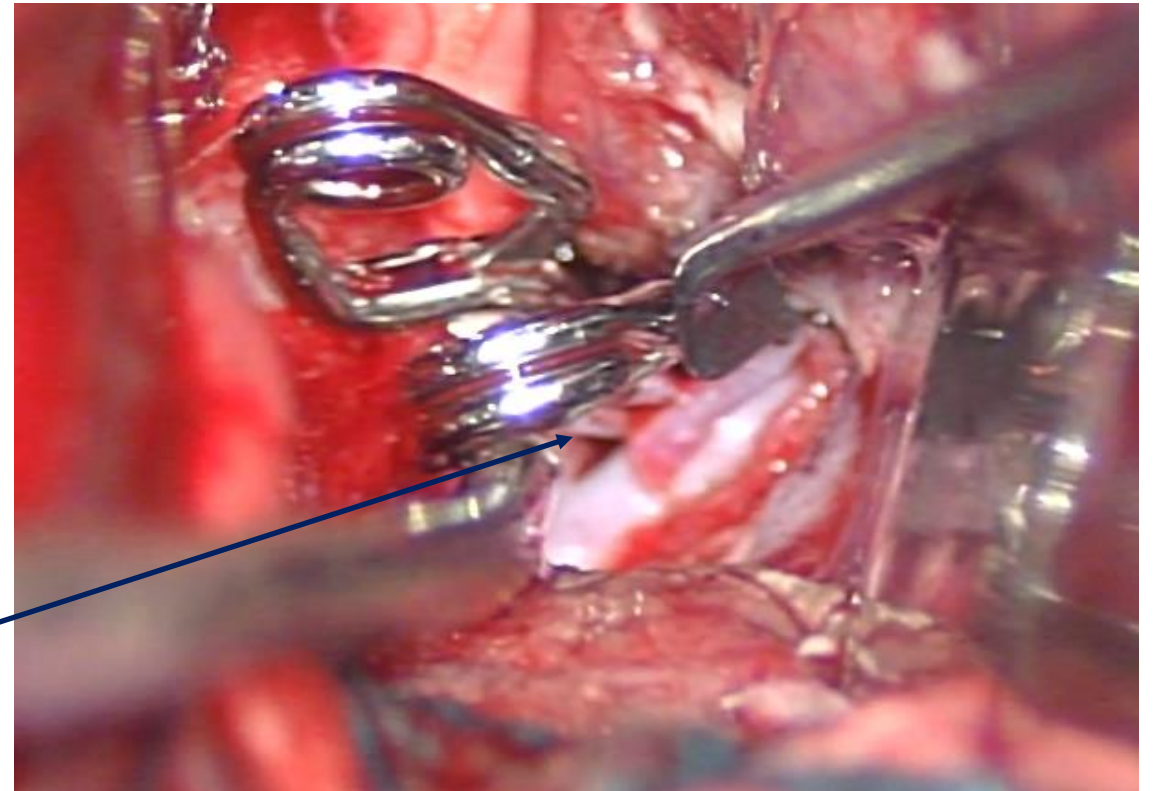
術中腦血管攝影



開顱夾閉術



殘餘動脈瘤



動脈瘤夾閉

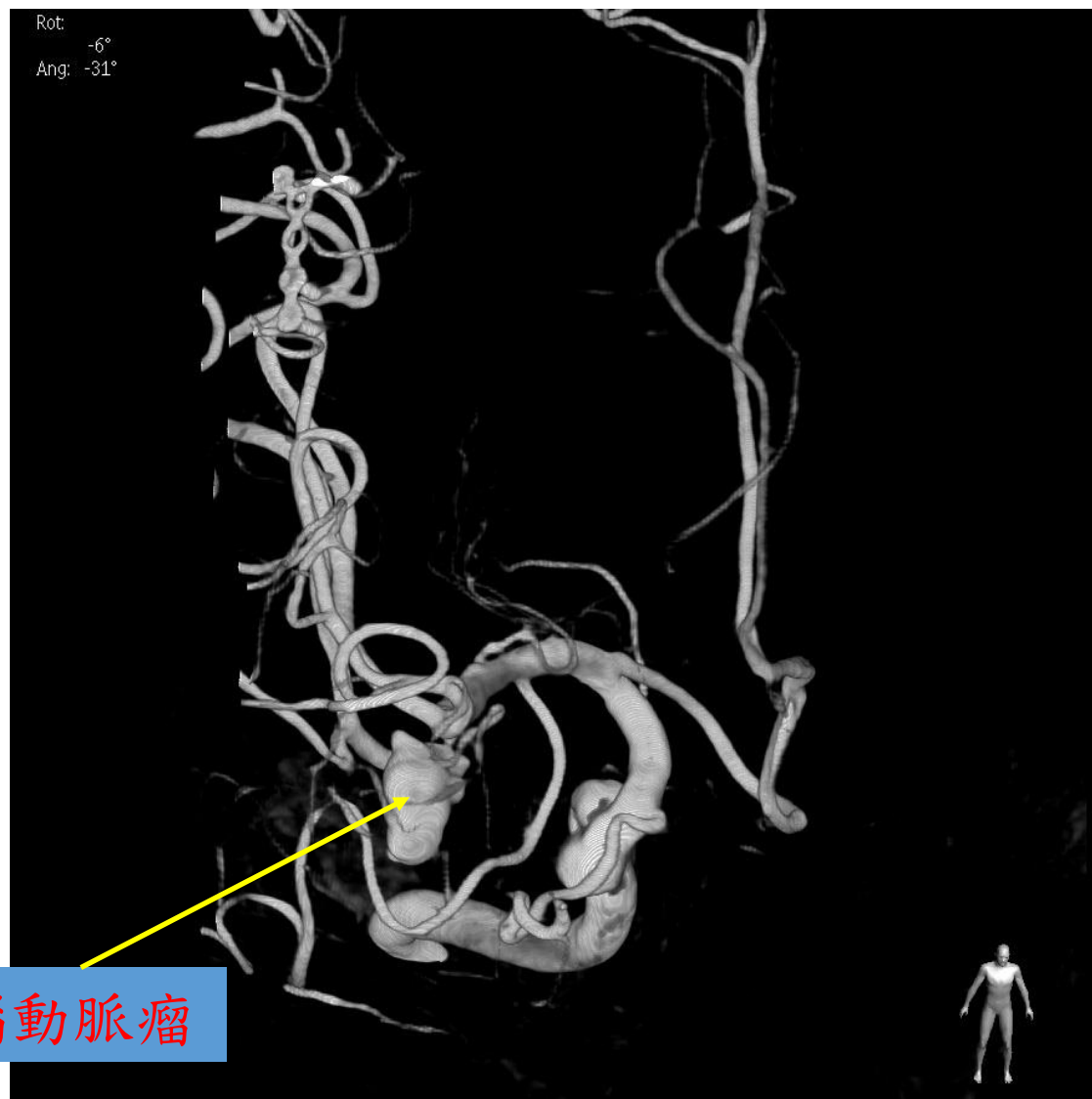
病患(乙)

- 60歲 男性
- 2021年12月14日突發頭痛
- 至台北慈濟醫院求診(昏迷指數15分)
- 電腦斷層顯示蜘蛛膜下腔出血

電腦斷層

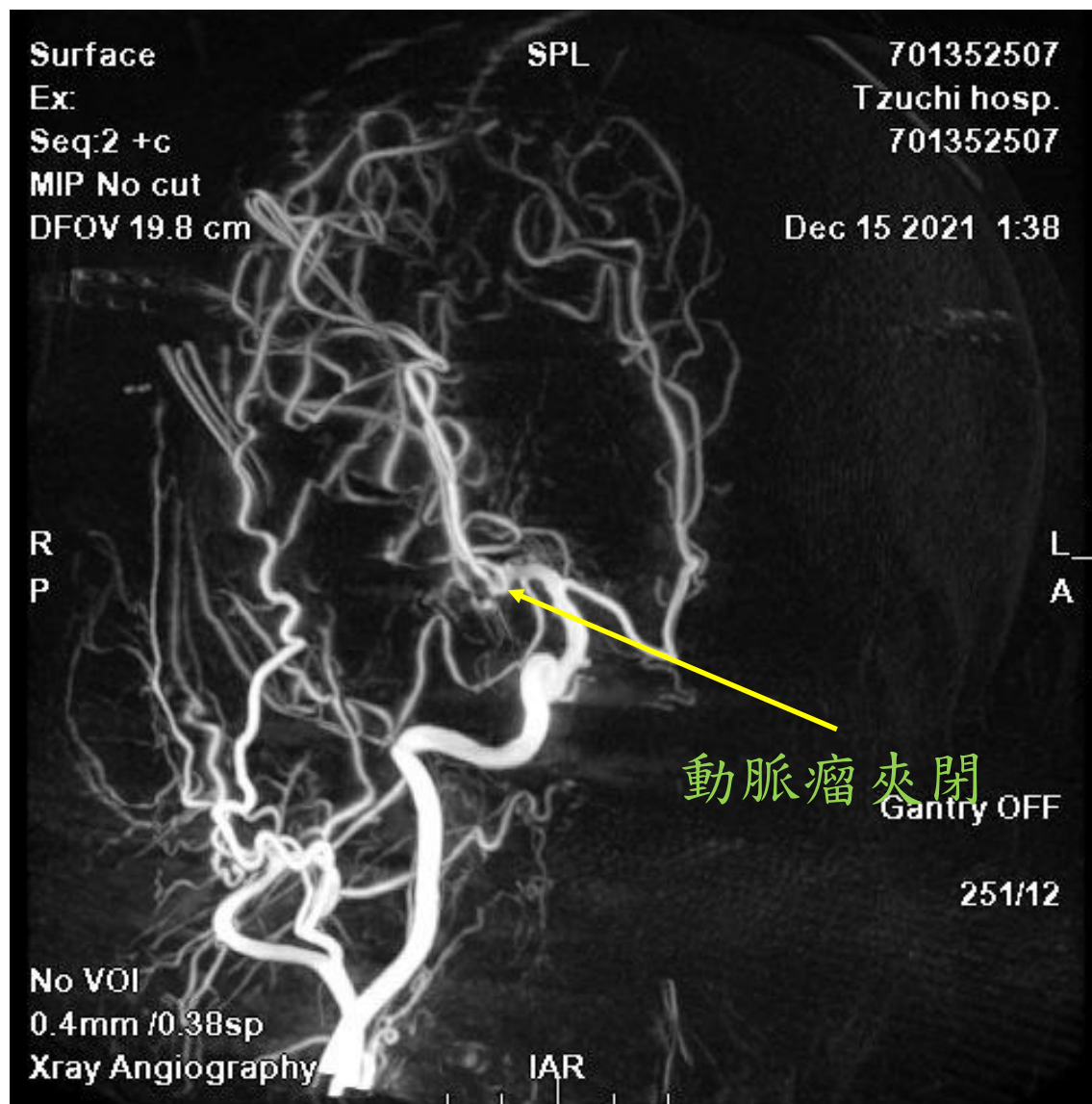


腦血管攝影



中大腦動脈瘤

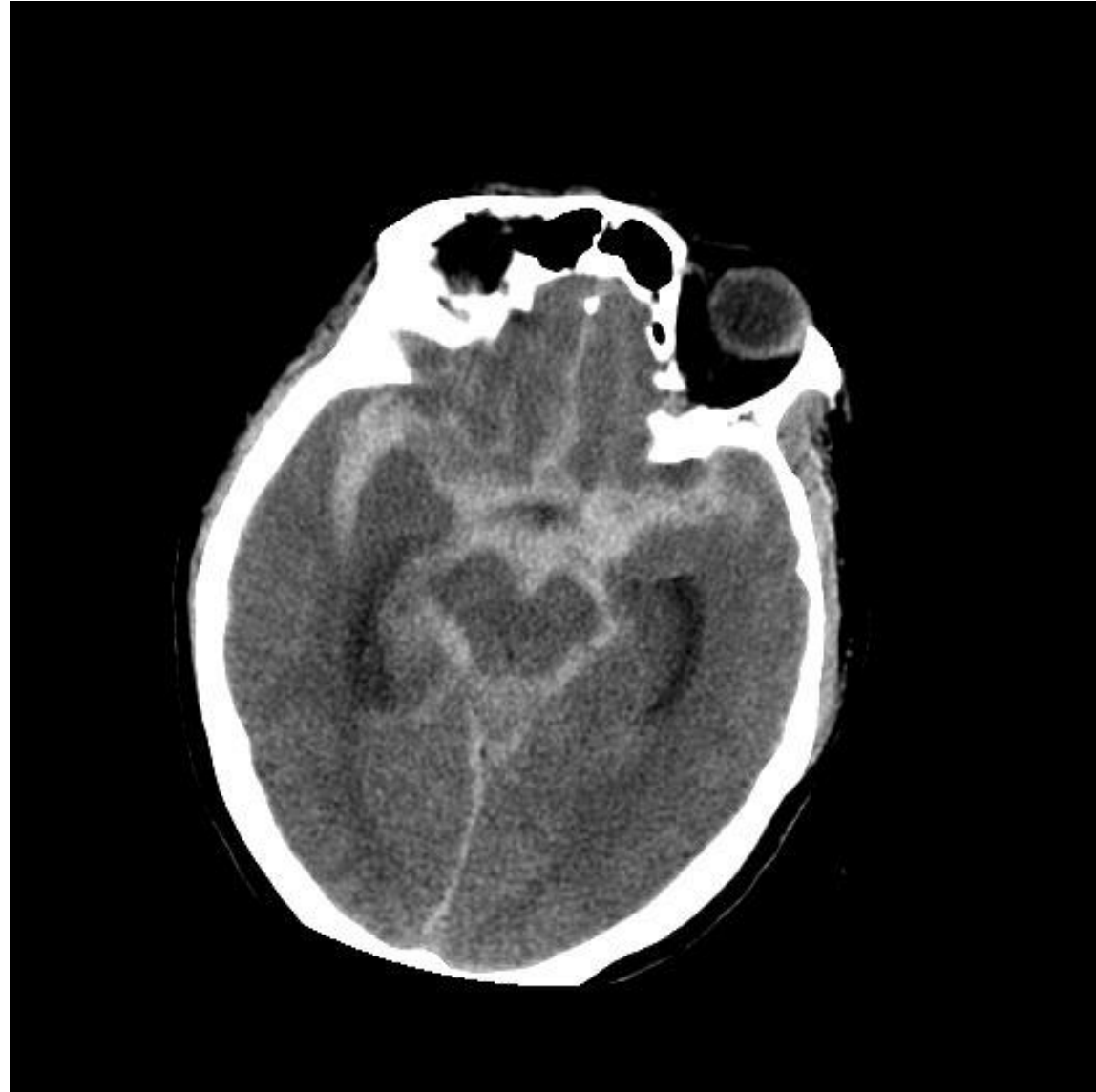
術中腦血管攝影



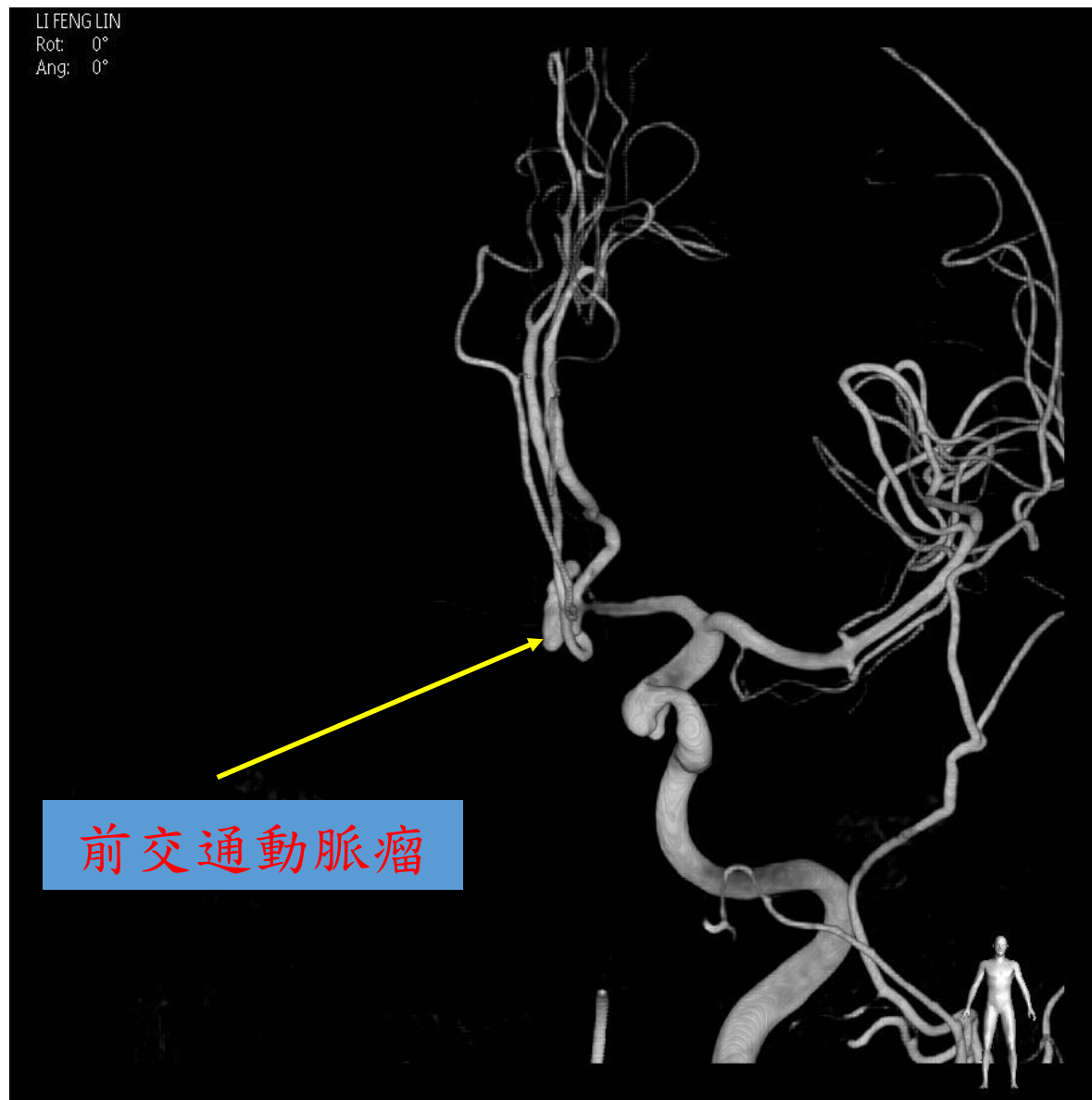
病患(丙)

- 69歲 女性
- 2021年12月14日突發意識喪失
- 至台北慈濟醫院求診(昏迷指數5分)
- 電腦斷層顯示蜘蛛膜下腔出血

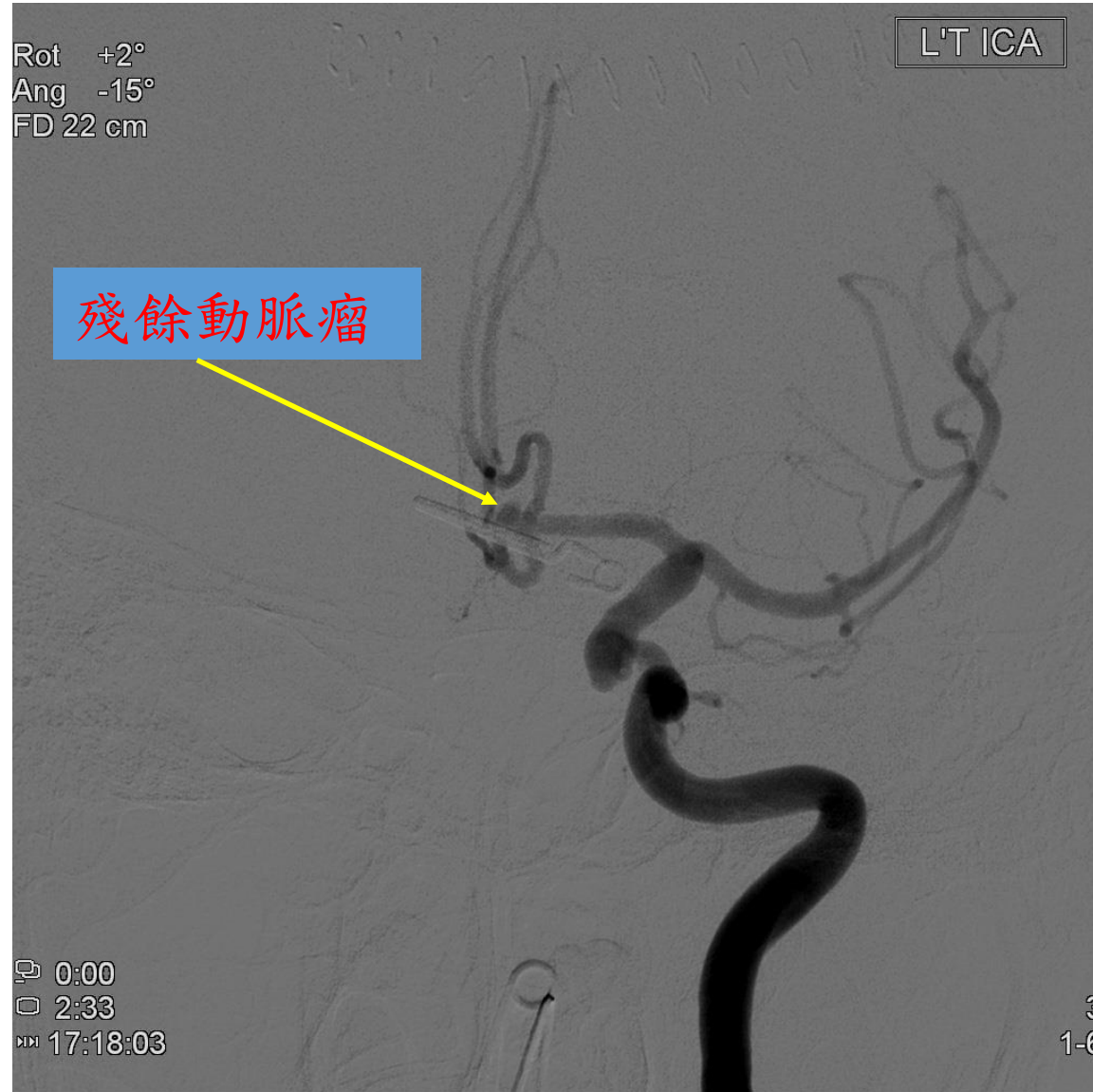
電腦斷層



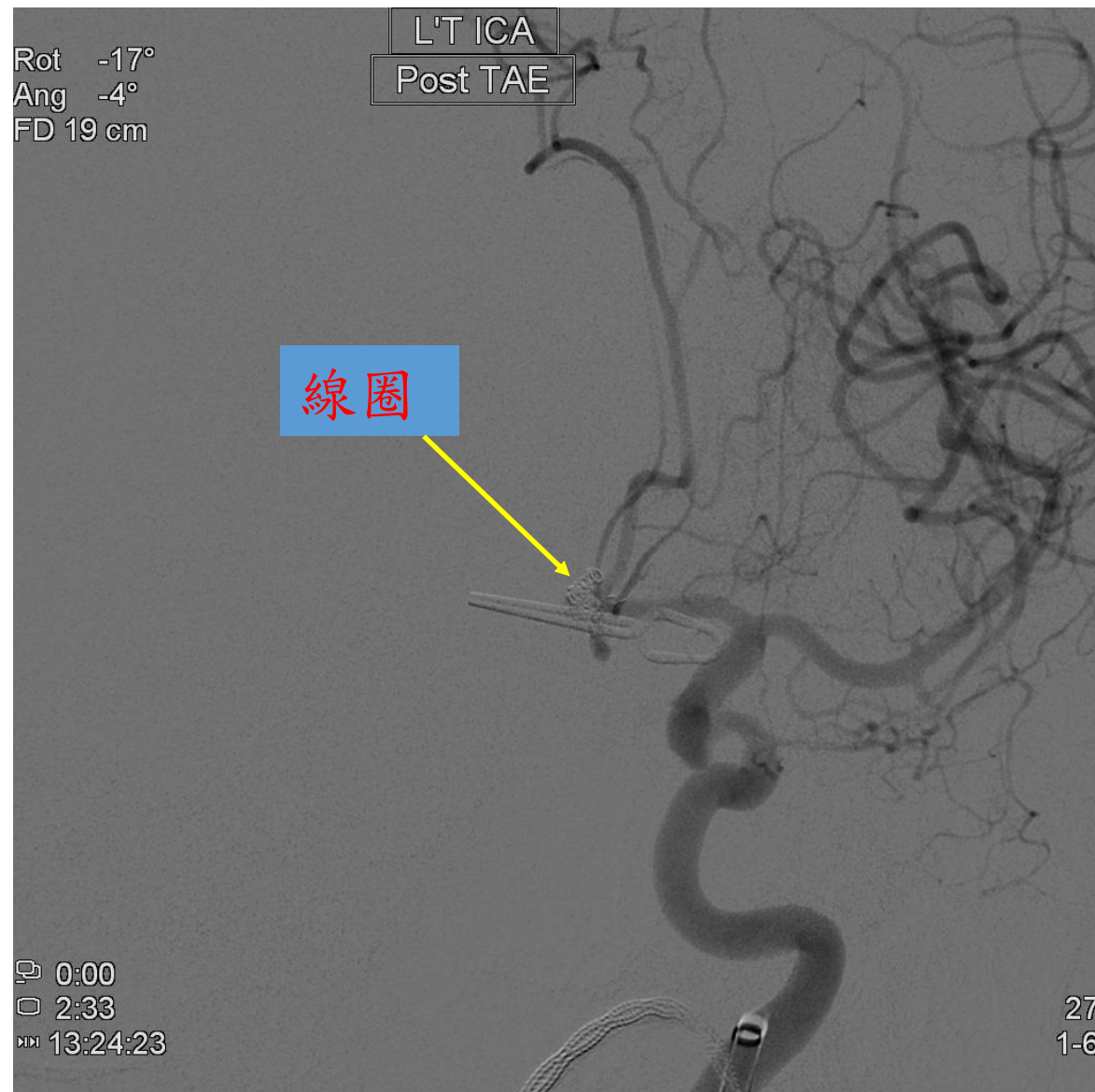
腦血管攝影



術後腦血管攝影



動脈瘤栓塞術



Thanks for Attention