# Sub-arachnoid haemorrhage

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# *Sub-arachnoid haemorrhage (SAH)* … introduction

- overview of SAH

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- aneurysmal SAH

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- overview of SAH
- aneurysmal SAH
- complications and their treatment
- occlusion of aneurysm
- implications for the anaesthetist

## *Sub-arachnoid haemorrhage…*

- prognosis poor
- early treatment may improve outcome
- prompt diagnosis
- appropriate treatment essential

# *Sub-arachnoid haemorrhage*…presentation

- ‘worst ever headache’ / ‘hit at back of head’
- nausea/vomiting/photophobia
- loss of consciousness (transient/prolonged)
- seizures (10%)
- neurological deficit

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

- physical examination
  - ABC
  - GCS
  - BP/ temperature
  - intraocular haemorrhage
  - neurological deficit

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

- full blood count
- coagulation screen
- urea/electrolytes
- blood glucose
- chest radiography
- 12 lead ECG

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

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- *early* non-contrast computerised tomography (CT)

  < 12 h miss 2%

  > 12h < 24 h miss 7 %

  > 10 days – no blood seen

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

- -ve CT scan →
- lumbar puncture (LP) >12h
  - haemoglobin → oxyhaemoglobin + bilirubin
  - spectrophotometry
  - distinguishes SAH from traumatic LP
  - + ve for bilirubin >2 weeks

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

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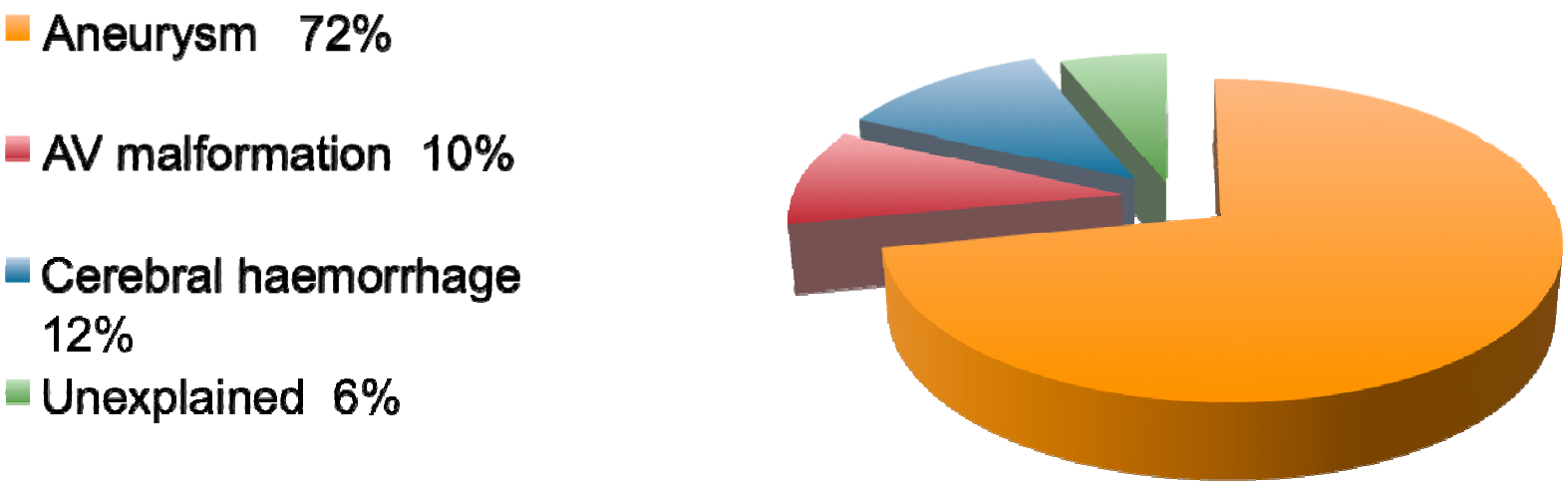
- + ve diagnosis - refer to specialist centre

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

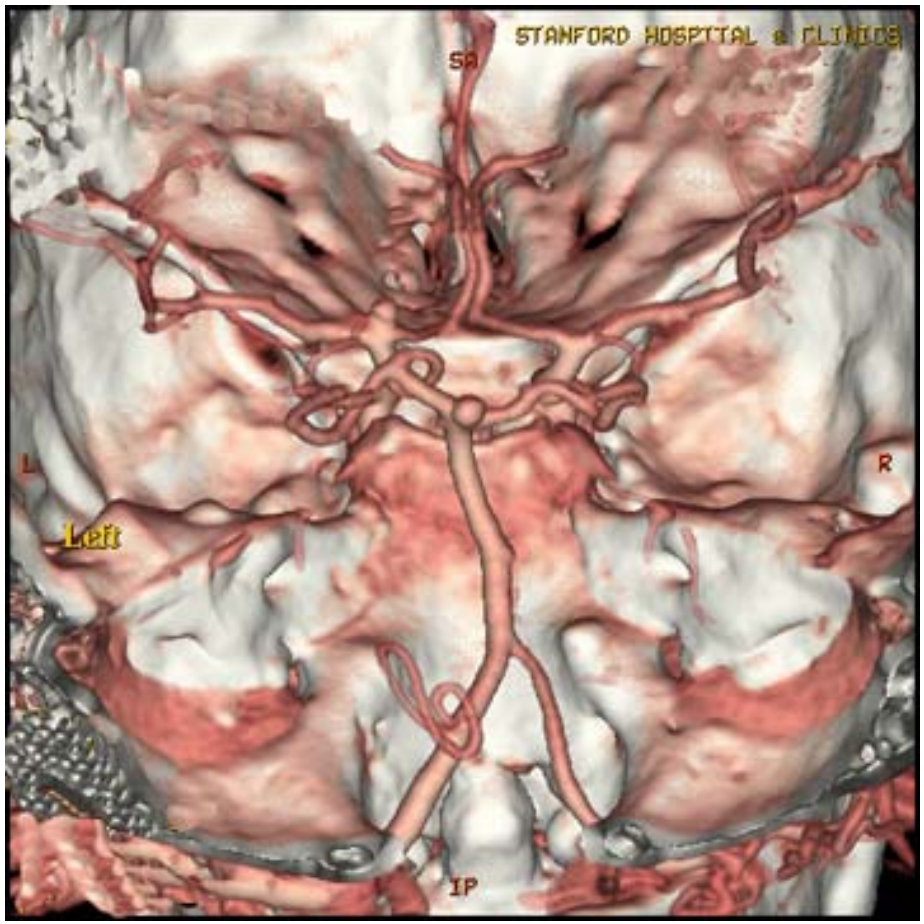
- CTA
- cerebral angiography

# *Sub-arachnoid haemorrhage…* causes

- traumatic (most common)
- spontaneous



*Sub-arachnoid haemorrhage…*
aneurysmal SAH



## *Aneurysmal sub-arachnoid haemorrhage…* prognosis

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- devastating condition – 50% mortality by 30 days
- only 50% survivors return to independent living
- early diagnosis essential to optimize outcome

## *Aneurysmal sub-arachnoid haemorrhage…* epidemiology & aetiology

- 7/100 000 population
- F:M – 3:2
- mean age (55–60y)
- family history, coarctation of aorta, polycystic disease, connective tissue disorder
- smoking

## *Aneurysmal sub-arachnoid haemorrhage…* epidemiology & aetiology

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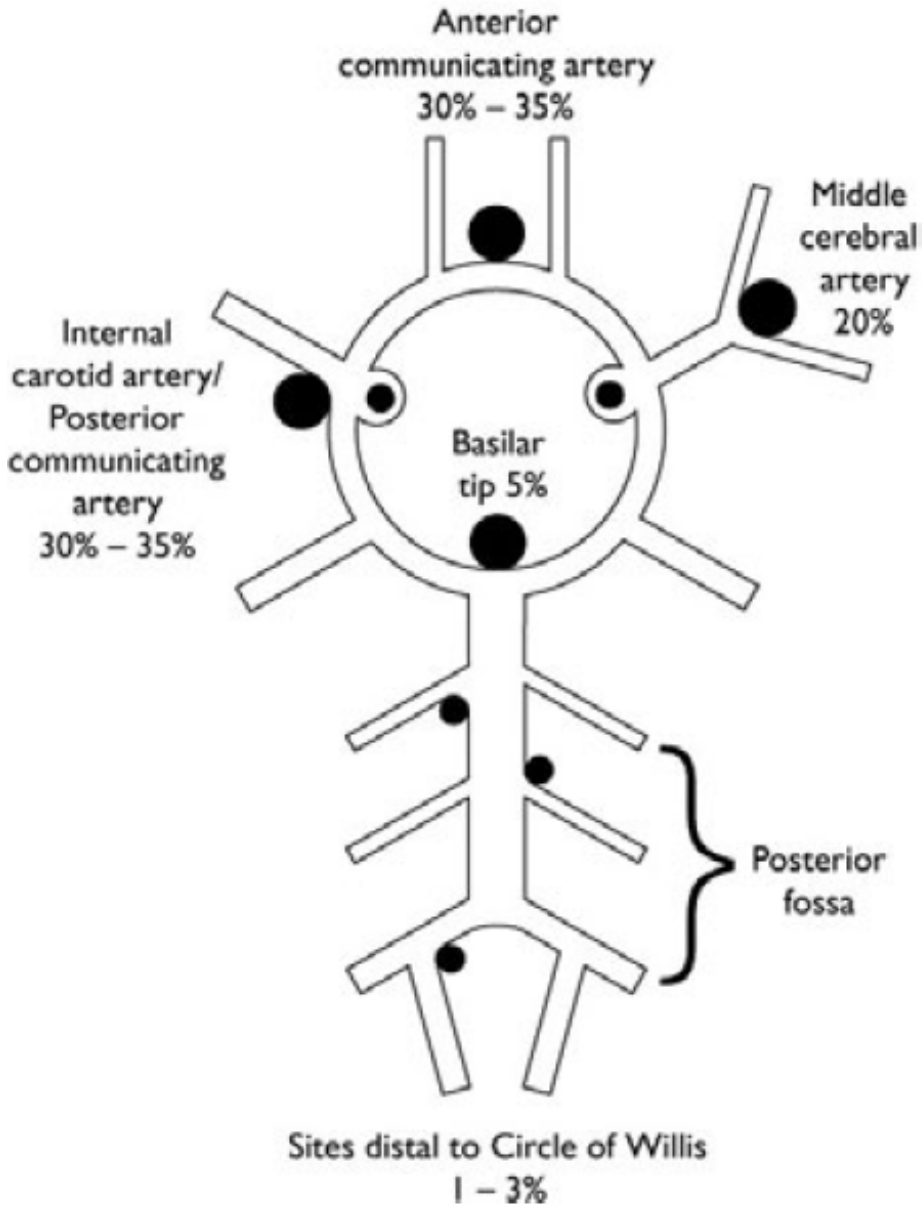
- degenerative changes in tunica media of artery
- mostly at bifurcation
- anterior circulation - 80-90%
- posterior circulation -10-20%


Anterior
communicating artery
30% – 35%
Middle
cerebral
artery
20%
Internal
carotid artery/
Posterior
communicating
artery
30% – 35%
Basilar
tip 5%
Posterior
fossa
Sites distal to Circle of Willis
1 – 3%

## *Aneurysmal sub-arachnoid haemorrhage…*

- early mortality/ morbidity may be from;
  - intracranial and/or
  - extracranial complications

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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- rebleed
- hydrocephalus
- vasospasm
- seizures

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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- rebleed
  - serious risk of death (40%)
  - highest risk is first 24 hours (10%)
  - 25% risk rebleed in first 2 weeks
  - 3% risk per year thereafter

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

- rebleed
- hydrocephalus
- vasospasm
- seizures

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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- hydrocephalus
  - early (1st 24 h) → external ventricular drain
  - late (10%) → ventriculo-peritoneal shunt

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

- rebleed
- hydrocephalus
- vasospasm
- seizures

# *Aneurysmal sub-arachnoid haemorrhage…*
transcranial doppler

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- seizures

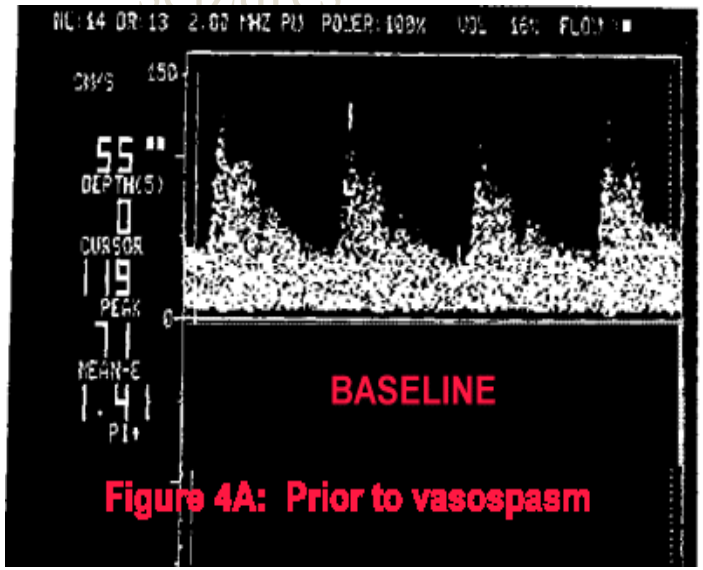

Figure 4A: Prior to vasospasm

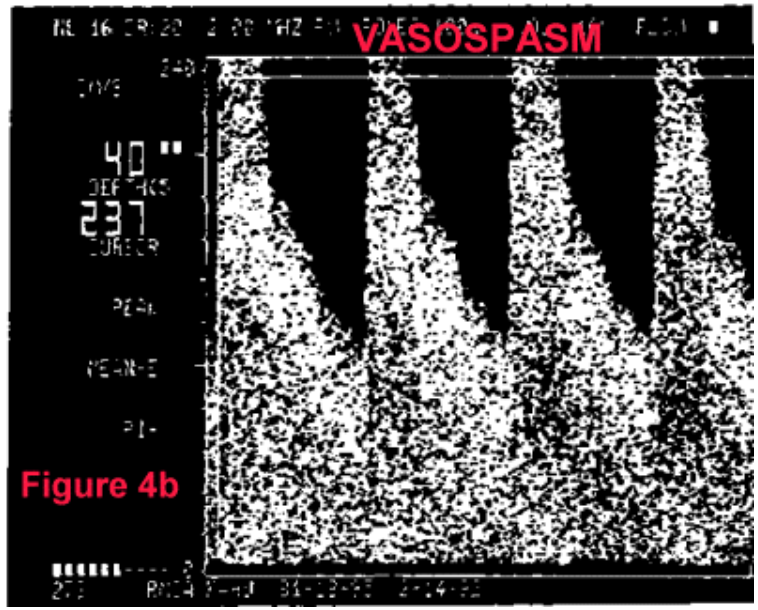

Figure 4b

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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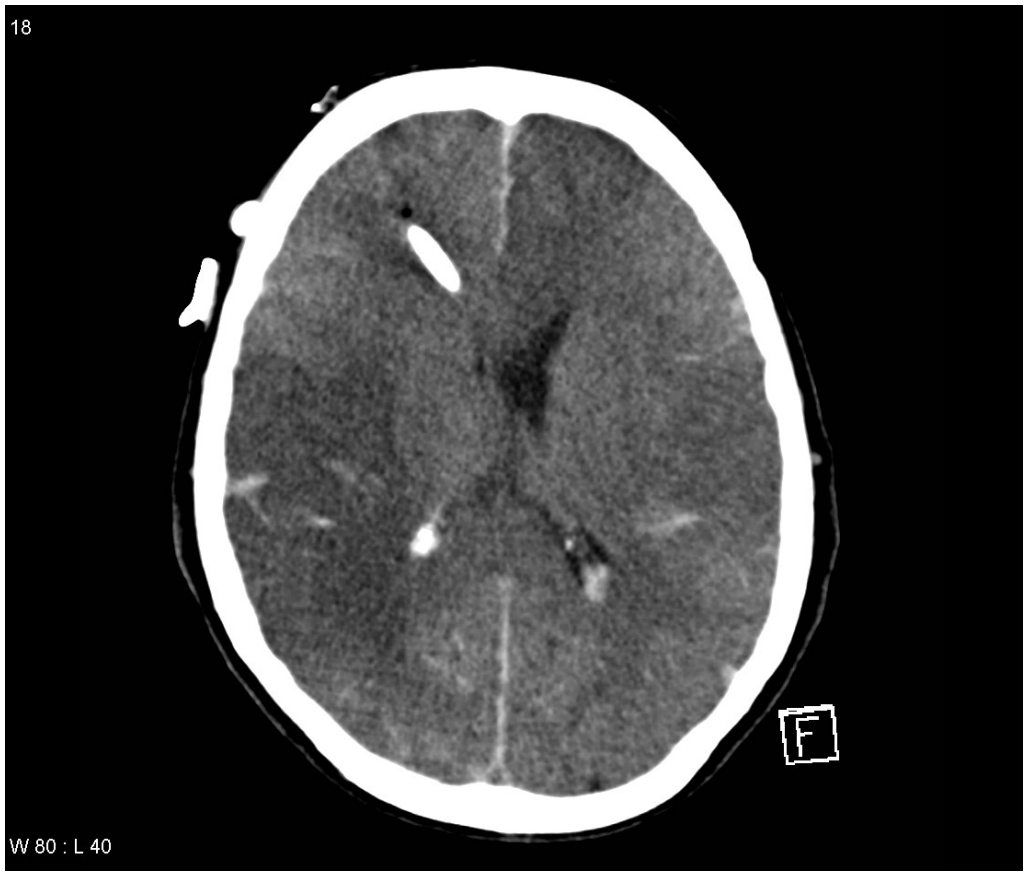
- vasospasm
  - risk day 4 -16
  - 66% angiographic vasospasm
  - 33% symptomatic (↓GCS/neurological deficit)
  - 20% patients with vasospasm → permanent neurological deficit/death

# CT scan - extensive SAH

# CT scan - multiple cerebral infarcts after SAH



## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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- vasospasm
  - prophylaxis
    nimodipine 60mg (4 hourly) x 3 weeks
    well hydrated
    normotension
    avoid hyponatraemia

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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- vasospasm
  - treatment for symptomatic patients
    = triple-H therapy
    **h**ypertension (* care with unprotected aneurysm)
    **h**ypervolaemia
    **h**aemodilution 0.3 - 0.35

## *Aneurysmal sub-arachnoid* ***haemorrhage…***
## intracranial complications

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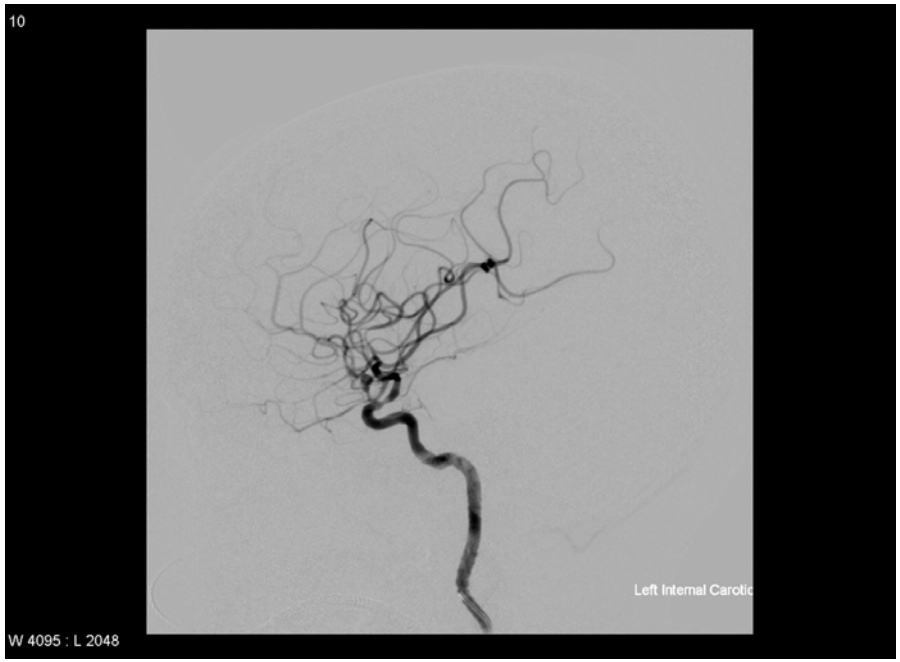
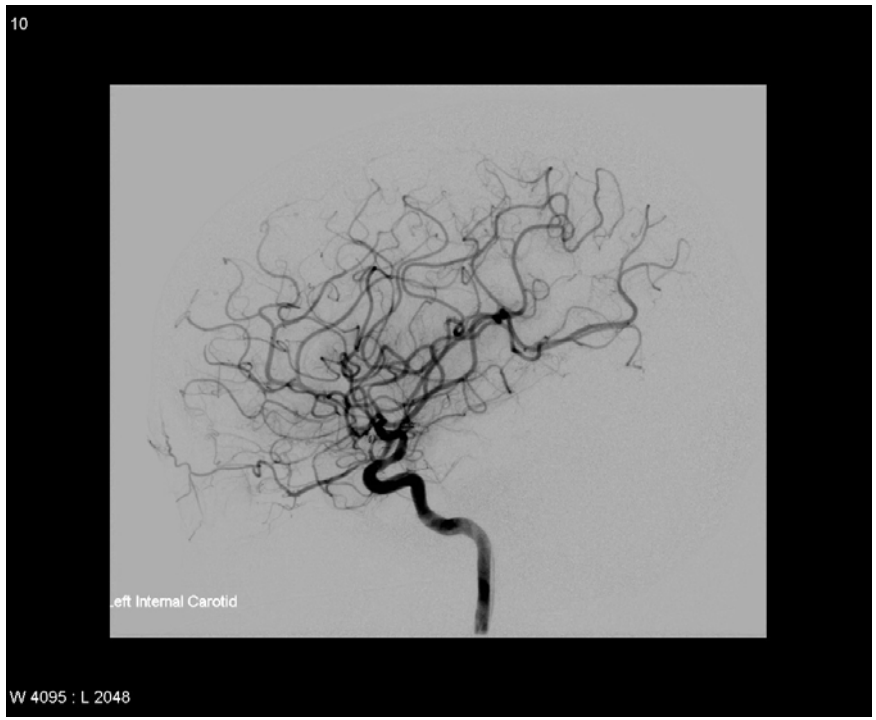
- vasospasm
  - treatment for symptomatic patients
    no improvement after one hour triple-H therapy?
    → CT (to exclude infarct)
    → angiography
    balloon angioplasty (segmental spasm)
    intra-arterial nimodipine (global spasm)

# *Aneurysmal sub-arachnoid haemorrhage* … vasopasm




Pre-nimodipine




Post-nimodipine

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

- rebleed
- hydrocephalus
- vasospasm
- seizures

## *Aneurysmal sub-arachnoid haemorrhage…* intracranial complications

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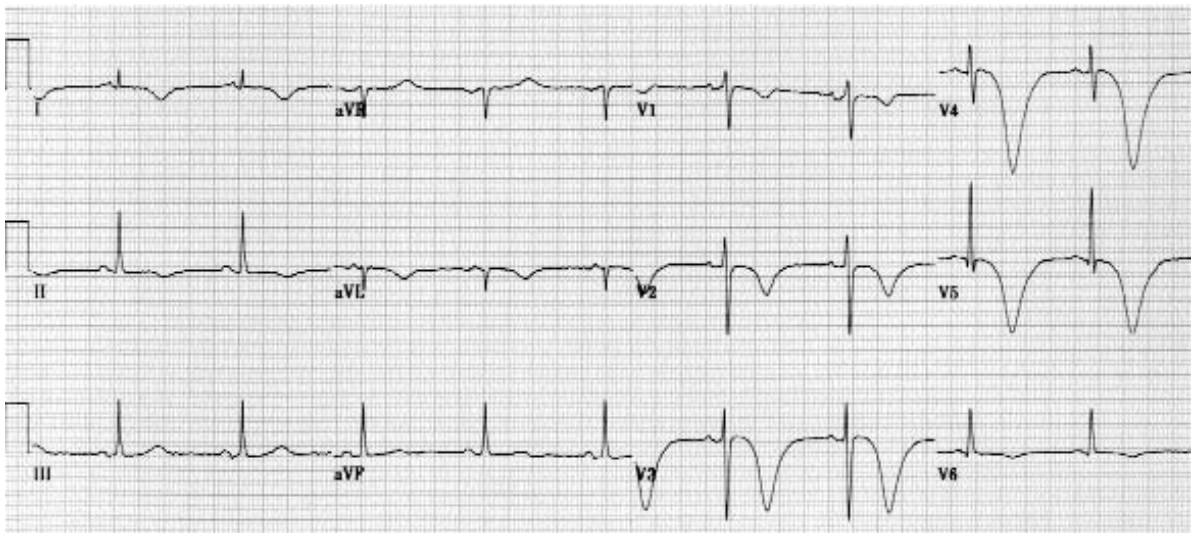
- seizures
  - low incidence (10%)
  - no anticonvulsant unless 2nd witnessed fit

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- cardiac dysrhythmias
- myocardial injury/dysfunction
- pulmonary complications
- electrolyte disturbance

# *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- cardiac dysrhythmias – very common 80-90 %
  - prolonged QT interval
  - non-specific ST segment changes



## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

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- ECG changes mostly neurogenic origin
- proportional to severity of neuronal damage
- ↑ troponin reflects myocardial injury and is associated with poor outcome

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- cardiac dysrhythmias
- myocardial injury/dysfunction
- pulmonary complications
- electrolyte disturbance

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

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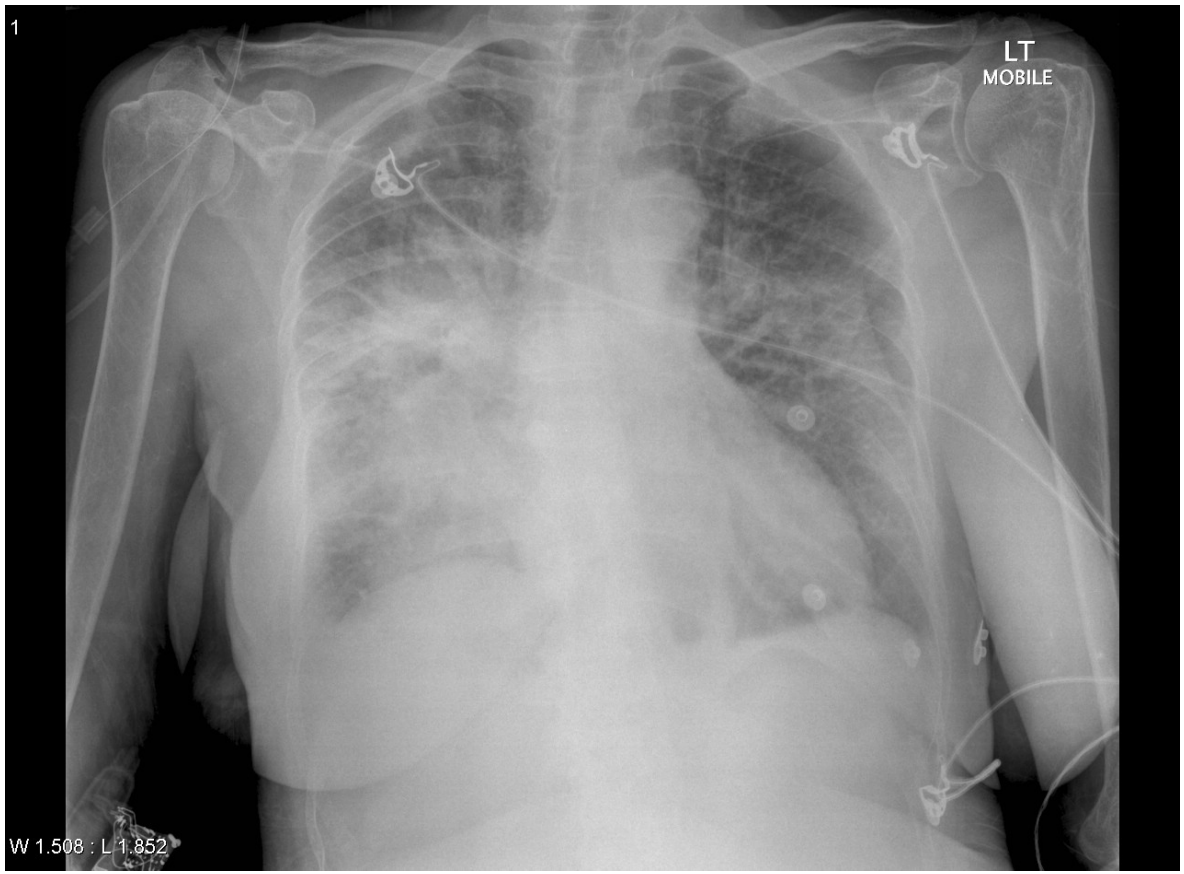
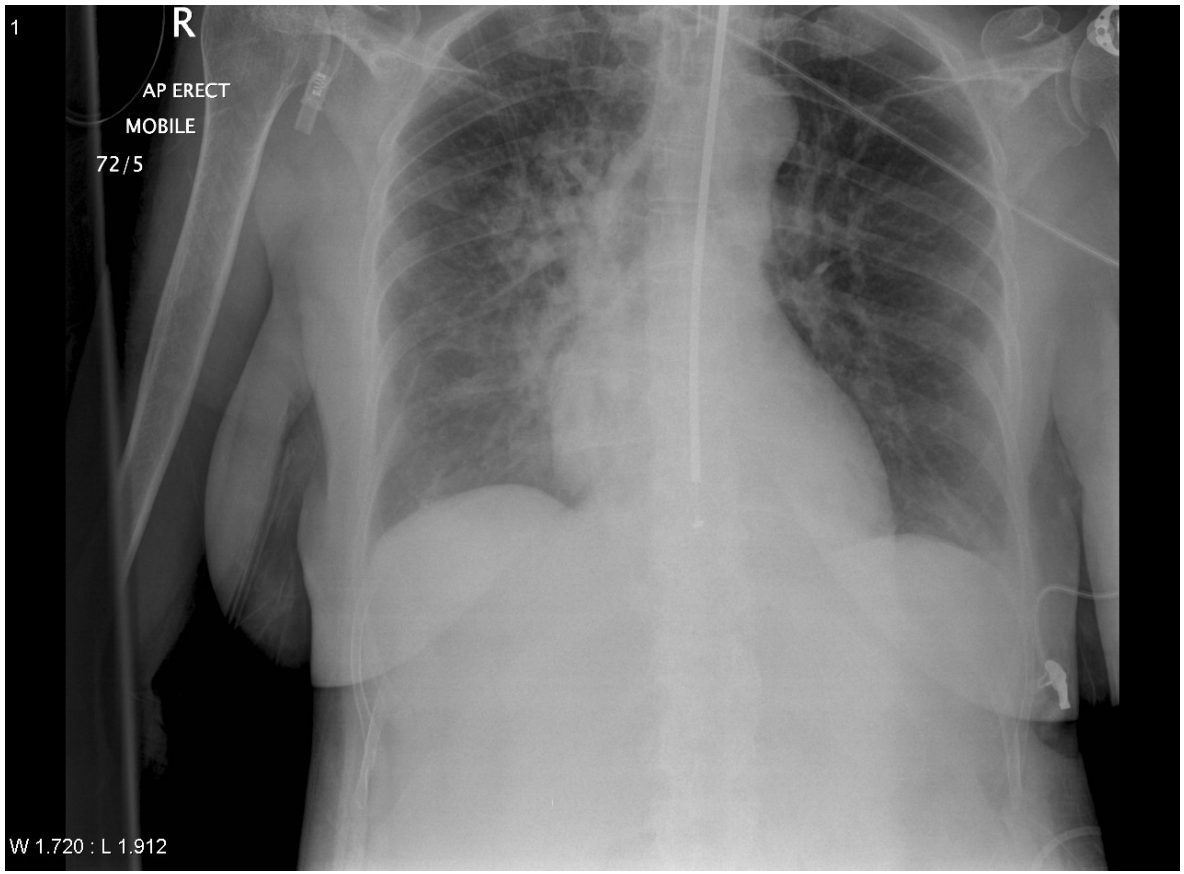
- myocardial injury/dysfunction
  - approx 10-30%
  - neurogenic-stunned myocardium is most severe

  (*reversible* LV dysfunction + pulmonary oedema)

# Cardiogenic pulmonary oedema



# Resolving cardiogenic pulmonary oedema
(oesophageal doppler in position)



## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- cardiac dysrhythmias
- myocardial injury/dysfunction
- pulmonary complications
- electrolyte disturbance

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- aspiration pneumonia
- cardiogenic pulmonary oedema
- neurogenic pulmonary oedema

  - hydrostatic pressure injury to pulmonary capillaries at time of bleed

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

- cardiac dysrhythmias
- myocardial injury/dysfunction
- pulmonary complications
- electrolyte disturbance

## *Aneurysmal sub-arachnoid haemorrhage…* extracranial complications

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- electrolyte disturbance common

  $\downarrow Na^{+}$ (30-40%) – SIADH or CSWS

  $\downarrow Mg^{2+}$ (50%) – ? $\uparrow$ vasospasm

  $\downarrow K^{+}$

# *Sub-arachnoid haemorrhage…*

- overview of sub-arachnoid haemorrhage (SAH)
- aneurysmal sub-arachnoid haemorrhage
- complications and their treatment
- occlusion of aneurysm
- implications for the anaesthetist

## *Aneurysmal sub-arachnoid haemorrhage…*
## occlusion of aneurysm

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- surgical ‘clipping’
- endovascular ‘coiling’

## *Aneurysmal sub-arachnoid haemorrhage…*
## occlusion of aneurysm

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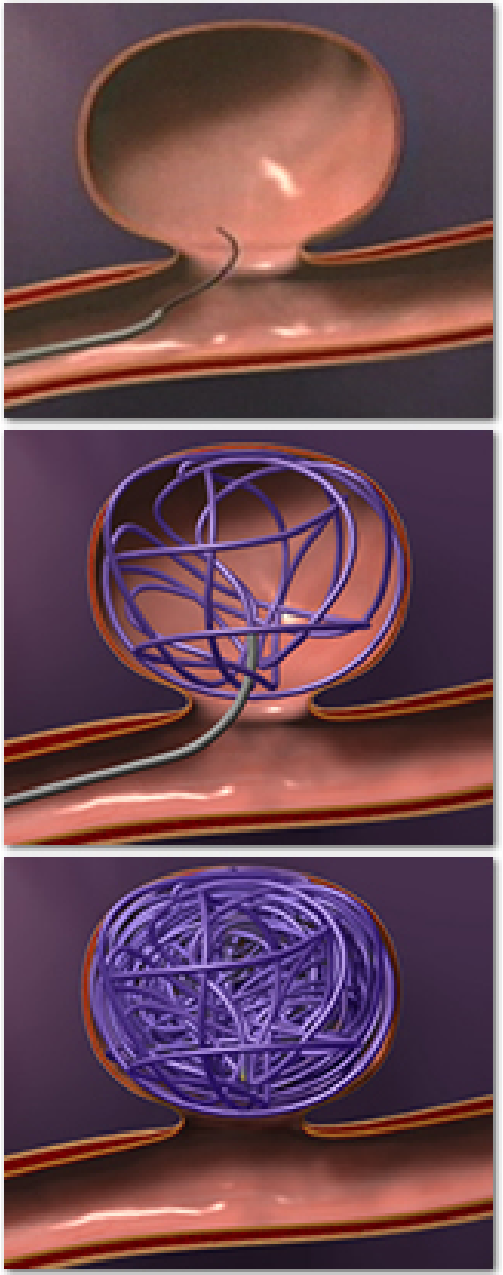
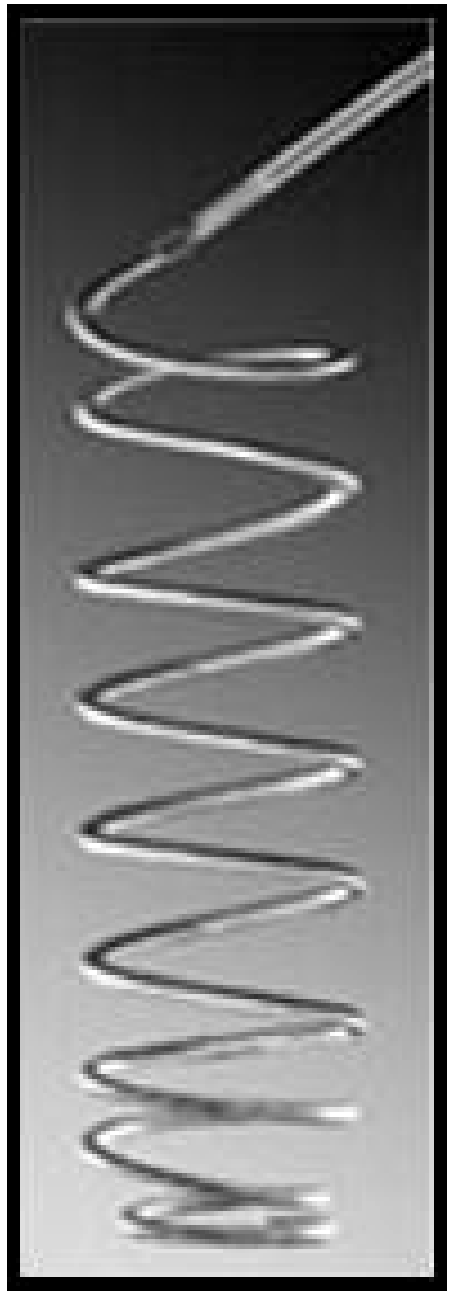
- International Subarachnoid Aneurysm Trial (ISAT) published 2002
- neurosurgical clipping v endovascular coiling
- many caveats but …
- outcome significantly better with endovascular coiling

ISAT Collaborative Group *The Lancet* 2002; **360**:1267-1274





## *Aneurysmal sub-arachnoid haemorrhage…*
## occlusion of aneurysm

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- at our hospital multidisciplinary approach
- most aneurysms → coiling (120 in 2008)
- middle cerebral artery aneurysm (mca) → clipping
- rapid learning curve with coiling
- treating more and more complicated aneurysms
- consultant–led service

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’

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- implications for the anaesthetist …

## *Aneurysmal sub-arachnoid* ***haemorrhage…***
## ‘coiling’- implications for the anaesthetist

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- consideration of associated medical problems
  - ECG abnormalities, ↑ BP, pulmonary problems
- wherever possible proceed; secured aneurysm may allow optimization of other conditions
- coiling probably less challenging if cardiac impairment

## *Aneurysmal sub-arachnoid haemorrhage…*
## ‘coiling’- implications for the anaesthetist

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- geographically remote (theatres/ITU)
- cramped conditions
- moving equipment
- poor light
- flat table (problem if ↑ ICP )
- radiation hazard

# Angiography suite

# Angiography suite

# Angiography suite

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

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general principles of anaesthesia are the same for ‘clipping’ & ‘coiling’;

- prevention of rupture
- CVS stability - maintain CPP
  - avoid hypertension
- maintain optimal ICP
- prevent movement to stimulus

# *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

Induction/maintenance anaesthesia

- avoid volatile agents if ↑ ICP
- avoid $N_20$ (micro air emboli)
- aim for $PaCO_2$ 4.5-5.0 KPa
- prevent hyperthermia

## *Aneurysmal sub-arachnoid haemorrhage…*
## ‘coiling’- implications for the anaesthetist

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- nasogastric tube post-induction (aspirin)
- tracheal intubation
- i.v. access
- arterial line
- no CVP line
- urinary catheter
- nasopharyngeal temperature

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

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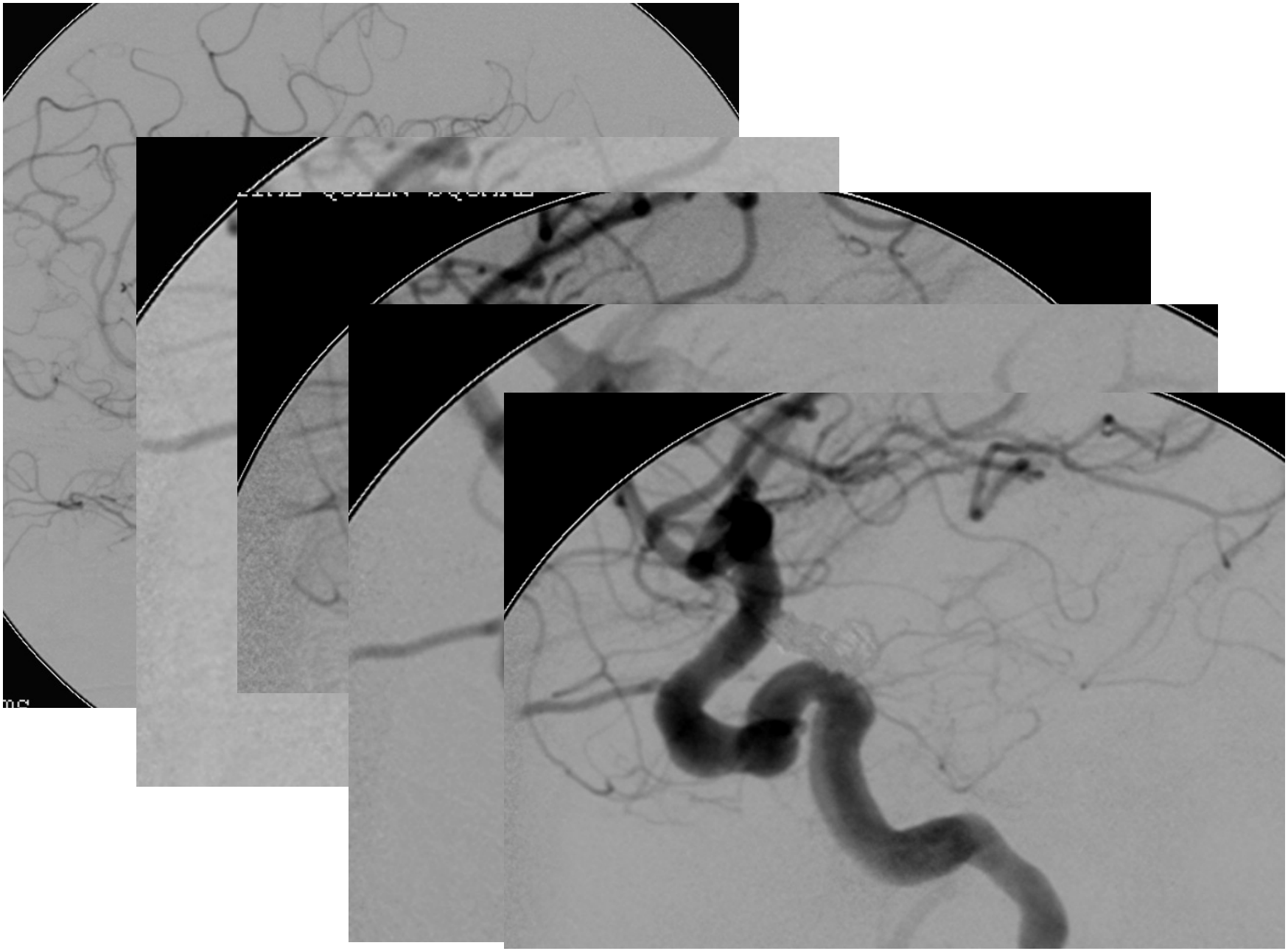
- specific problems during procedure;
  - vasospasm (nimodipine)
  - aneurysm rupture
  - thrombosis – rapid action

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

- specific problems;
  - vasospasm (nimodipine)
  - aneurysm rupture
  - thrombosis – rapid action



## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

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- aneurysm rupture
  - closed cranium
  - massive ↑ ICP and ↓ CBF
  - patient often anti-coagulated (heparin)
  - do <u>not</u> reverse heparin
  - control BP (propofol)
  - rapidly continue coiling
  - urgent CT scan ? transfer to theatre

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

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- specific problems;
  - vasospasm (nimodipine)
  - aneurysm rupture
  - thrombosis

## *Aneurysmal sub-arachnoid haemorrhage…* ‘coiling’- implications for the anaesthetist

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- thrombosis
  - requires rapid action … seconds count
  - usually with last coil (aneurysm secure)
  - elevate blood pressure
  - abciximab (glycoprotein IIb/IIIa receptor antagonist)

## *Aneurysmal sub-arachnoid haemorrhage…*
## 'coiling'- implications for the anaesthetist

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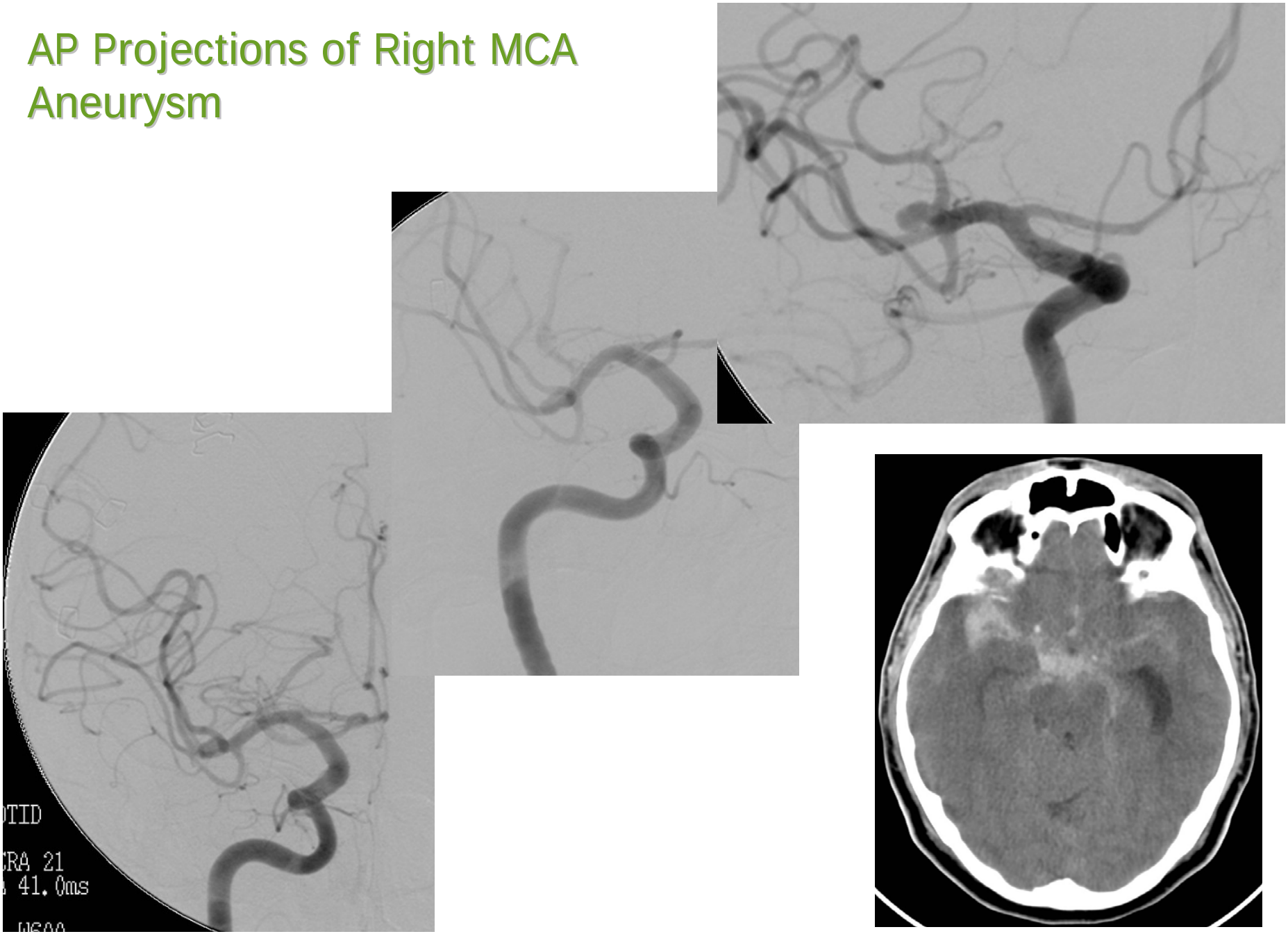
- emergency situations
  - successful outcome requires urgent management by experienced team
  - 'coiling' procedures therefore within normal working hours

## *Sub-arachnoid haemorrhage…*
## aneurysmal SAH – conclusions

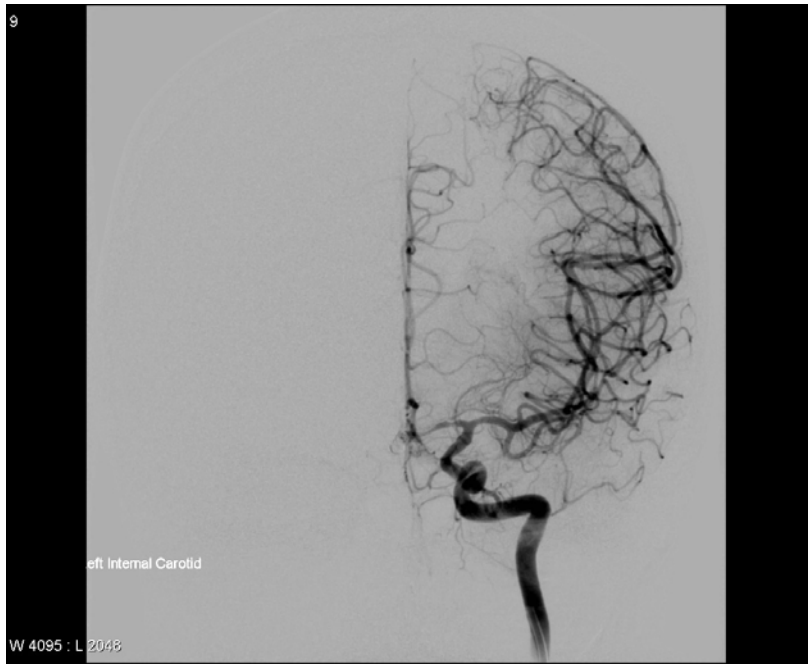
- aneurysmal SAH has a poor prognosis
- anaesthetists involved at many stages of a patient's illness
- early treatment (occlusion) and supportive neurocritical care may improve outcome

Thank you for your attention

# AP Projections of Right MCA Aneurysm




9
Internal Carotid
W 4095 : L 2048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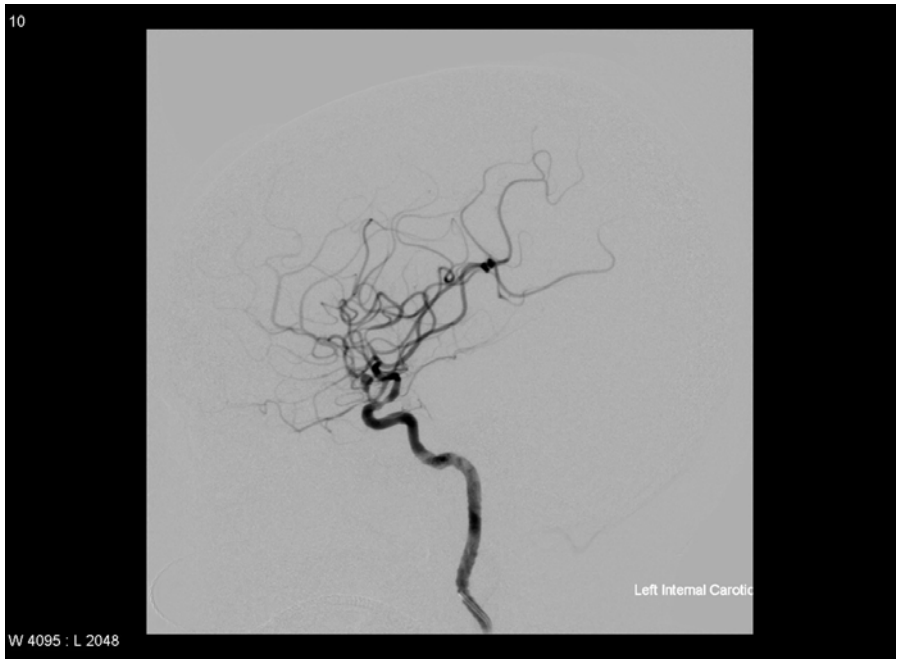
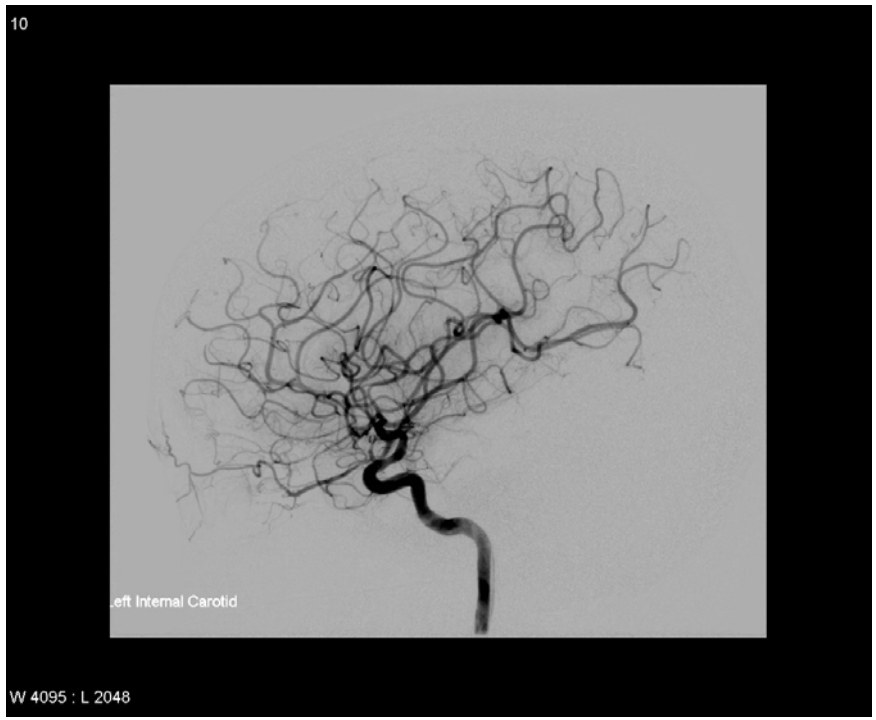


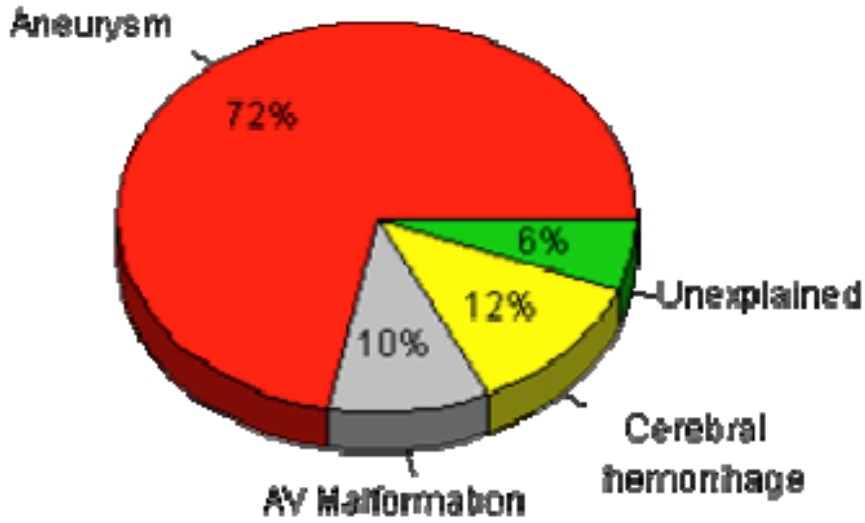

Pre-nimodipine




Post-nimodipine

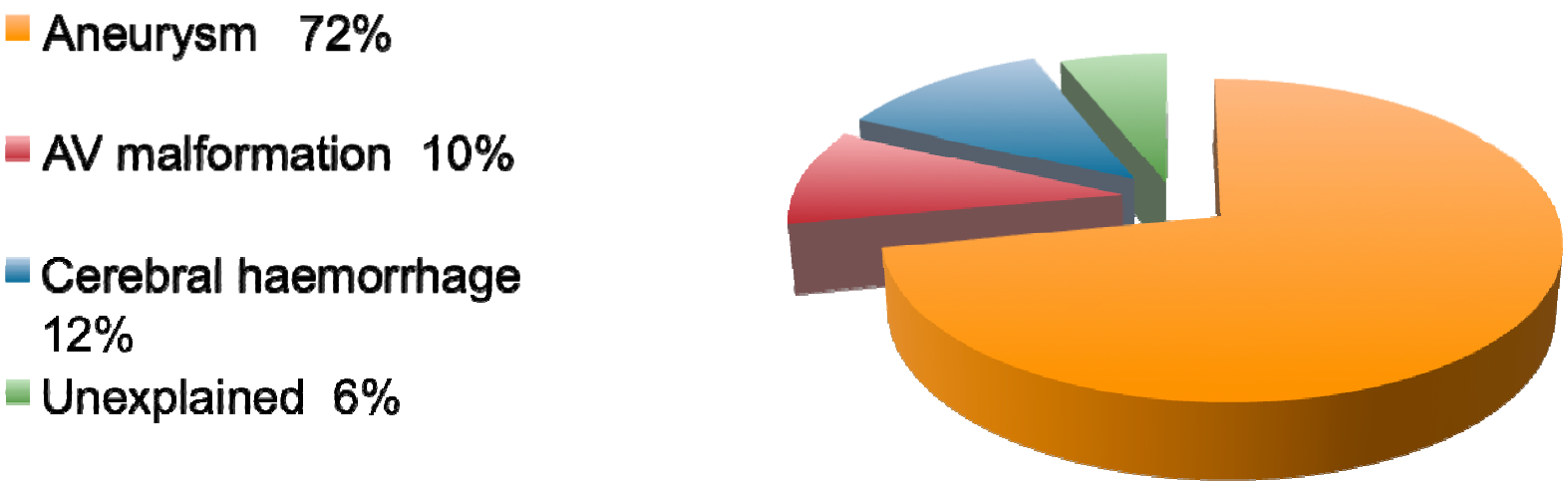
# Subarachnoid Hemorrhage

Non-traumatic



# *Sub-arachnoid haemorrhage…* causes

- traumatic (most common)
- spontaneous



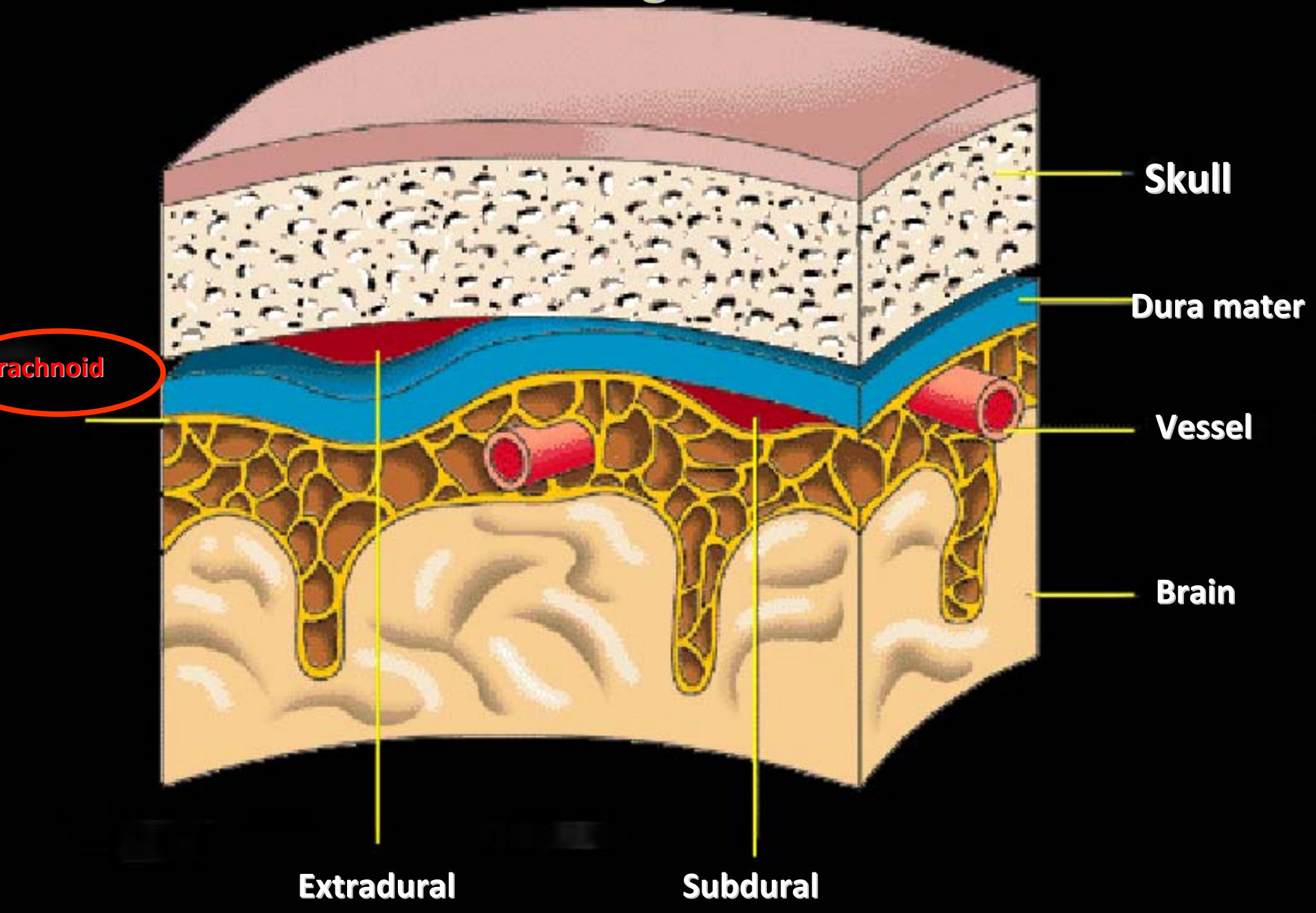
# Angiography suite

## *Sub-arachnoid haemorrhage…* diagnosis/investigations

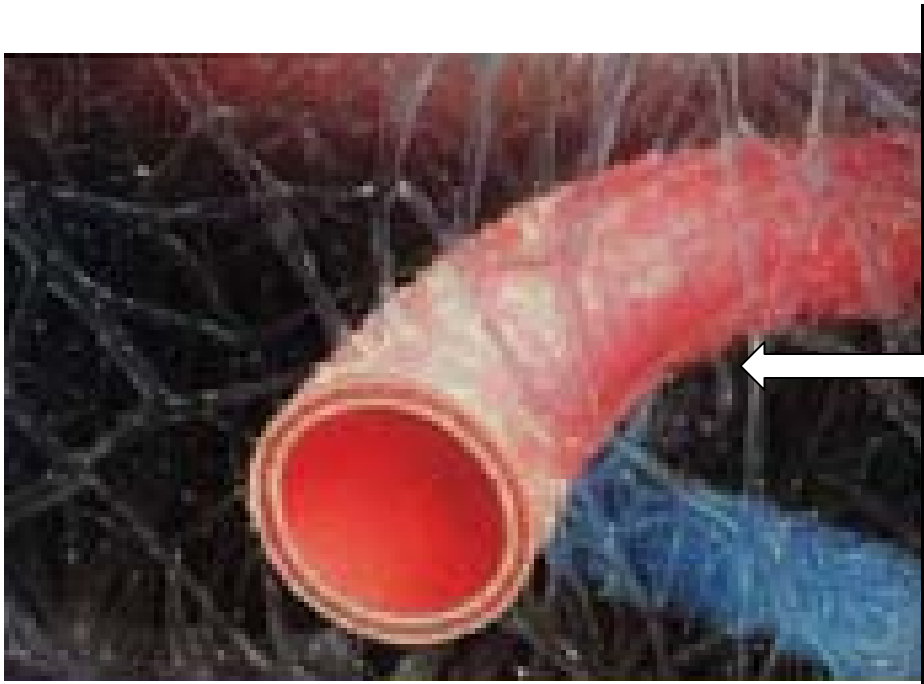
- aneurysm 72%
- -ve angiography 10% (perimesencephalic)
- AVM, tumours, vasculitis etc

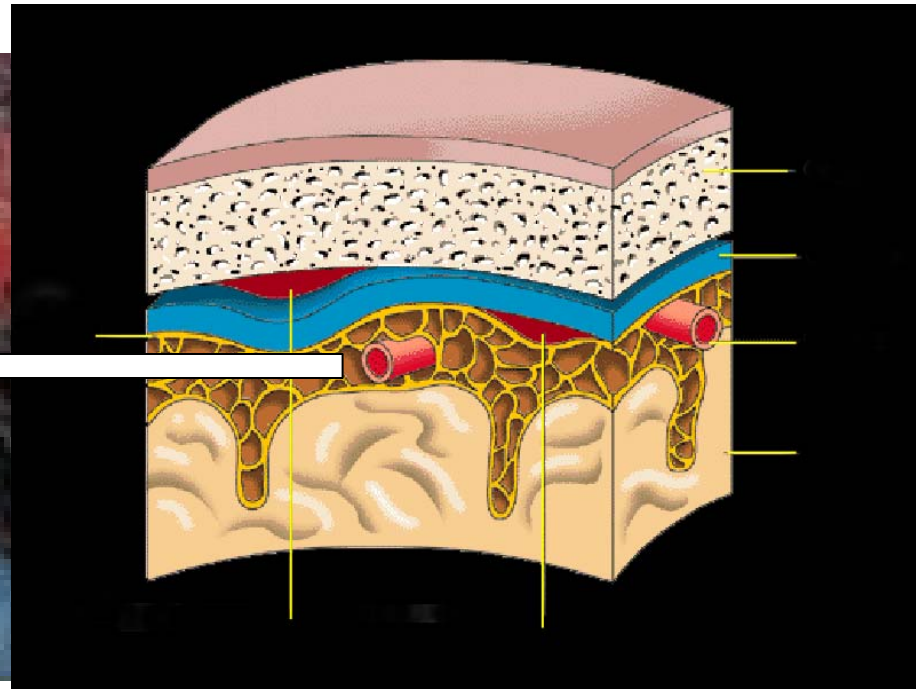
# Angiography suite

# Meninges


Skull
Dura mater
rachnoid
Vessel
Brain
Extradural
Subdural

# Sub-arachnoid space





# *Aneurysmal sub-arachnoid haemorrhage…* prognosis

- grading
  - aids research / prognosis / guides treatment
  - most common;
    WFNS (World Federation of Neurological Surgeons)
    Hunt and Hess

# *Aneurysmal sub-arachnoid haemorrhage…*

## WFNS (World Federation of Neurological Surgeons)

| Grade | GCS | Motor deficit |
|---|---|---|
| I | 15 | absent |
| II | 13-14 | absent |
| III | 13-14 | present |
| IV | 7-12 | absent/ present |
| V | 3-6 | absent/ present |