

Acute stroke treatments

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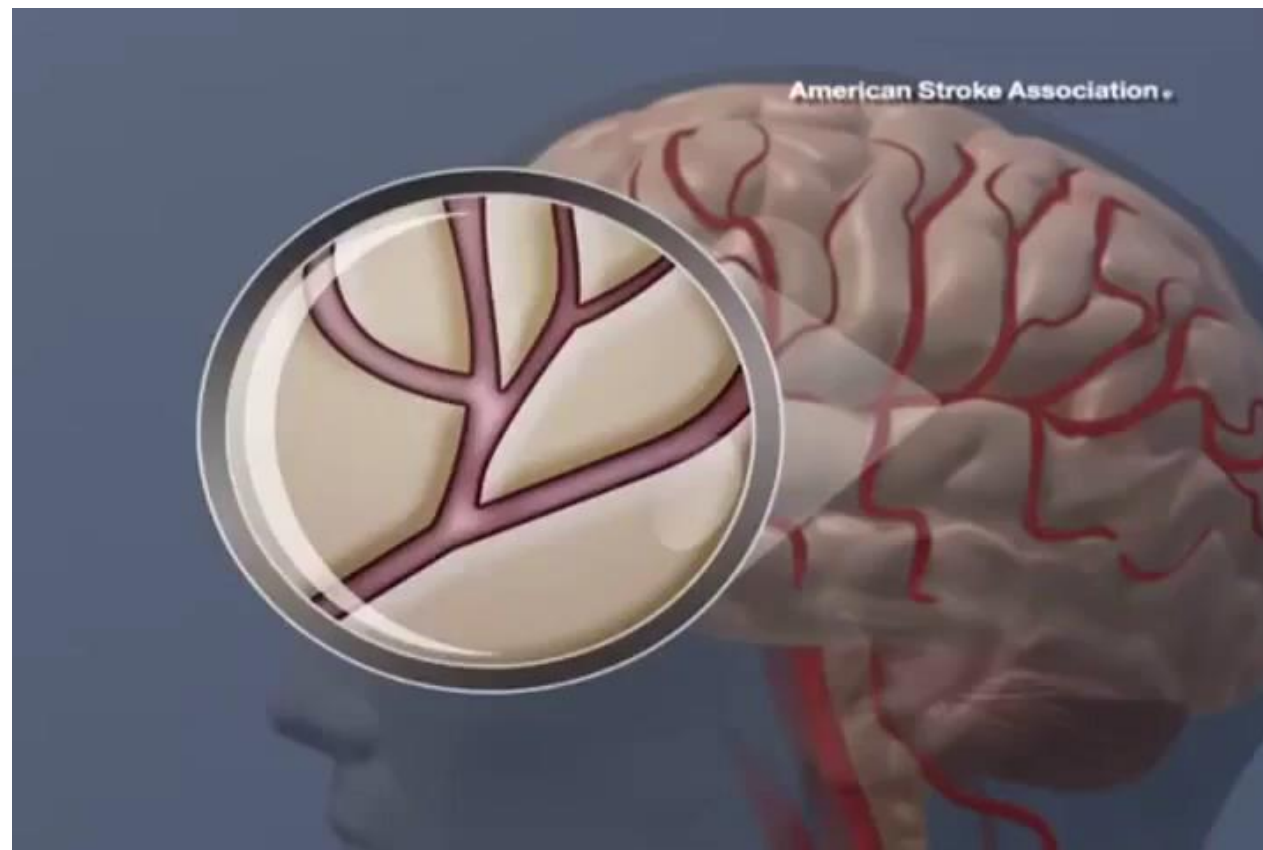
- ▶ Management of acute ischaemic strokes
 - ▶ Thrombolysis in acute ischaemic stroke
 - ▶ Carotid Endarterectomy
- ▶ Management of Primary intracerebral haemorrhages)
 - ▶ Hypertension
 - ▶ Secondary to Oral anticoagulants
- ▶ Intracranial cavity and ICP
- ▶ Decompressive hemicraniectomy
- ▶ Suboccipital decompression craniectomy

Learning objectives:

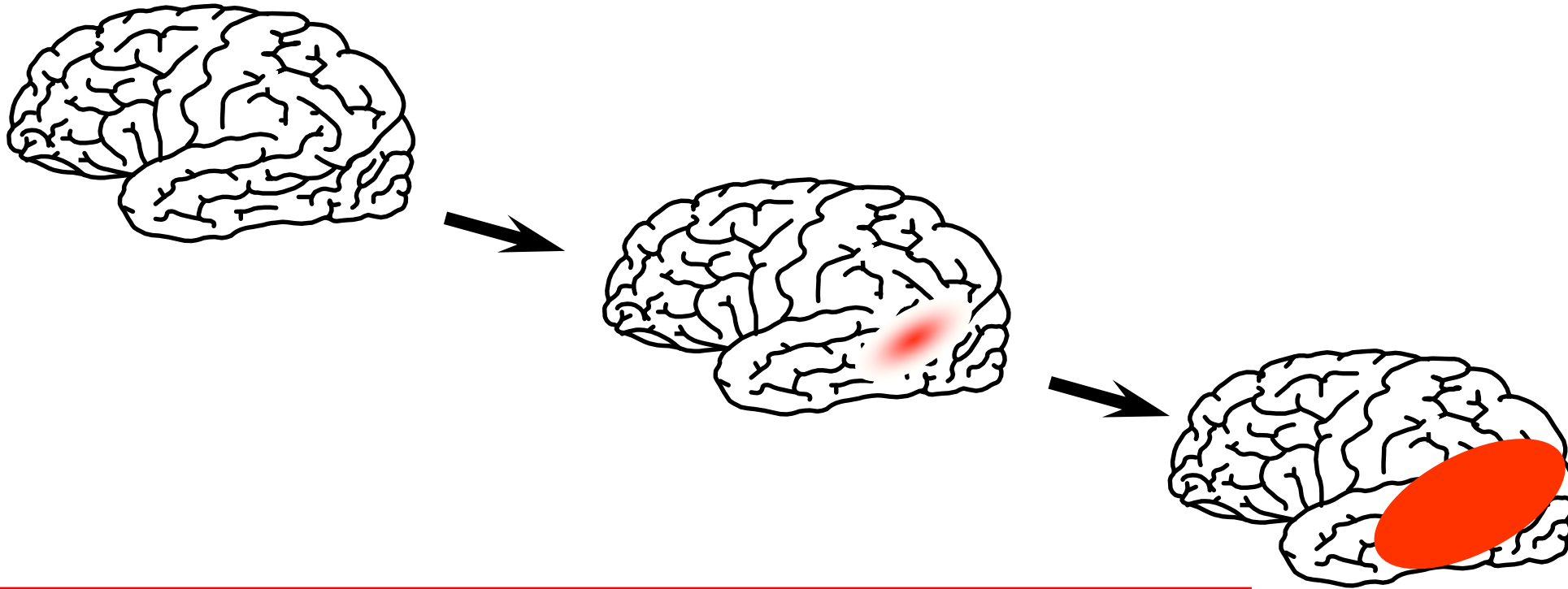
- ▶ Identify acute treatments for ischaemic and haemorrhagic strokes
- ▶ List stroke thrombolysis inclusion and exclusion criteria
- ▶ Have the knowledge to rapid access patients for potential thrombolysis
- ▶ Describe how rtPA therapy works, its side-effects and complications
- ▶ Devise appropriate nursing care for patients after thrombolysis
- ▶ Understand the need for vascular imaging and carotid endarterectomy
- ▶ List the aetiology for primary intracerebral haemorrhages
- ▶ Devise appropriate nursing care for patients with haemorrhagic strokes
- ▶ Understand Intracranial pressure, most common herniations and recognise its signs and symptoms
- ▶ Devise appropriate nursing care for patients post-decompressive craniectomy
- ▶ Be aware of current research and ongoing trials

Map your skills: <http://www.stroke-education.org.uk/> and London Stroke Nurse competencies

Ischaemic stroke



Acute reperfusion therapy



The objective is to avoid lesion enlargement

Thrombolysis in acute ischaemic stroke

- ▶ Thrombo = Clot (fibrin)
- ▶ Lysis = Dissolve

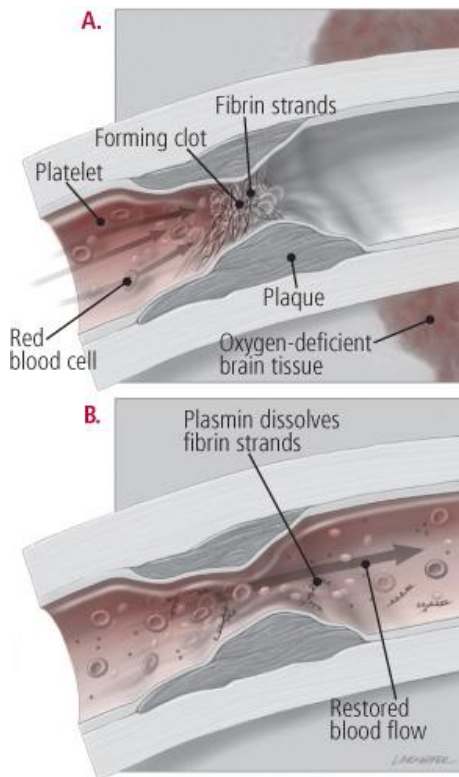
Thrombolysis in acute ischaemic stroke

Alteplase

- ▶ Recombinant tissue plasminogen activator (r-tPA) – a protein
- ▶ Thrombolytic agent



Thrombolysis in acute ischaemic stroke



Conversion of plasminogen to plasmin



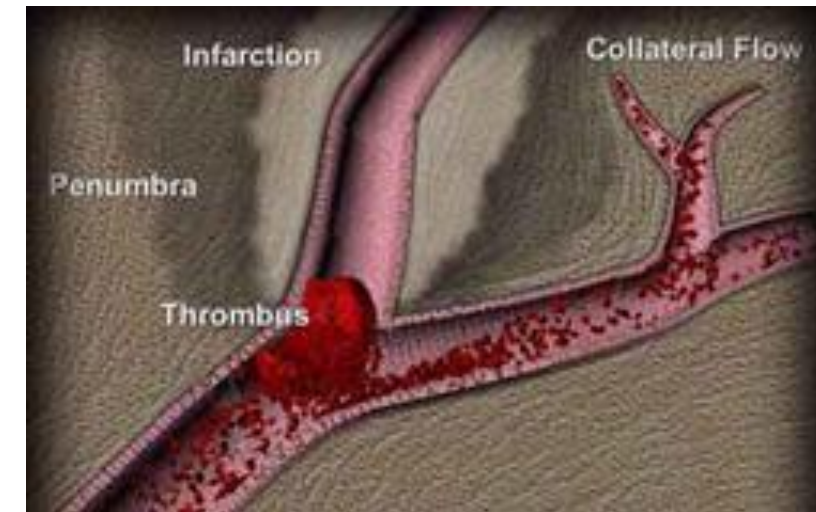
Plasmin breaks down fibrin in clot



Breaks up thrombus



Blood flow through blocked vessel



Thrombolysis in acute ischaemic stroke

- ▶ NINDS trials (1995), ECASS I (1995), ECASS II (1998), ATLANTIS A (1999) and ATLANTIS B (1999): confirmed benefit **within 3 hours of onset**
- ▶ ECASS III (2008): benefit in giving **up to 4.5 hours of onset**
- ▶ IST-3 (2012): confirmed benefits of prior trials for **up to 4.5 hours of onset**; advised thrombolysis **aged over 80 years old**

(WAKE-UP and EXTEND (2019): 4.5 to 9hrs after symptom onset or wake-up positive results)

Thrombolysis in acute ischaemic stroke

Modified Rankin Score

	Modified Rankin score 0-1 at 90 days,* n/N (%)		Odds ratio (95% CI)	p value	Estimated number needed to treat† for modified Rankin score 0-1	Composite endpoint at 90 days; odds ratio (95% CI)‡	p value
	Alteplase	Placebo					
0-90 min	67/161 (41.6%)	44/151 (29.1%)	2.55 (1.44-4.52)	0.0013	4.5	2.84 (1.75-4.60)§	<0.0001
91-180 min	127/303 (41.9%)	91/315 (28.9%)	1.64 (1.12-2.40)	0.0116	9.0	1.52 (1.10-2.11)§	0.0119
181-270 min	361/809 (44.6%)	306/811 (37.7%)	1.34 (1.06-1.68)	0.0135	14.1	1.32 (1.09-1.61)	0.0054
181-270 min (excluding EPITHET† data)	358/795 (45.0%)	303/794 (38.2%)	1.32 (1.04-1.66)	0.0202	14.9	1.31 (1.08-1.60)	0.0074
271-360 min	215/575 (37.4%)	193/542 (35.6%)	1.22 (0.92-1.61)	0.1628	21.4	1.22 (0.96-1.54)	0.1057
271-360 min (excluding EPITHET† data)	200/539 (37.1%)	184/512 (35.9%)	1.16 (0.87-1.54)	0.3063	28.7	1.16 (0.91-1.48)	0.2394
0-360 min	770/1849 (41.6%)	634/1820 (34.8%)	1.40 (1.20-1.63)	<0.0001	12.6	1.36 (1.22-1.58)	<0.0001
0-360 min (excluding EPITHET† data)	752/1798 (41.8%)	622/1772 (35.1%)	1.38 (1.18-1.60)	<0.0001	13.1	1.36 (1.20-1.56)	<0.0001

For 1 patient to have an excellent outcome (mRS 0-1):

- 5 patients NTT within 1.5hrs
- 9 patients NTT between 1.5 – 3hrs
- 15 patients NTT between 3 – 4.5rs

Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials

Kennedy R Lees, Erich Bluhmki, Rüdiger von Kummer, Thomas G Brodt, Danilo Toni, James C Grotta, Gregory W Albers, Markku Kaste, John R Marler, Scott A Hamilton, Barbara C Tilley, Stephen M Davis, Geoffrey A Donnan, Werner Hacke, for the ECASS, ATLANTIS, NINDS, and EPITHET rt-PA Study Group Investigators*

Thrombolysis in acute ischaemic stroke

Inclusion criteria

- ▶ Clinical presentation of a stroke
- ▶ Neurological deficit not improving
- ▶ Onset of symptoms less than 4.5 hrs (BAO \leq 12 hours)
- ▶ Age \geq 18
- ▶ No haemorrhage or early ischaemic changes on CT head
- ▶ No contraindications

- Up to 20% of stroke patients are eligible for thrombolysis
- Only 12% receive treatment

Thrombolysis in acute ischaemic stroke

Exclusion criteria

- ▶ **BP persistently > 185/110**
- ▶ Any evidence of active bleeding
- ▶ Severe sudden onset headache at onset of symptoms (suggestive of SAH)
- ▶ Previous stroke, serious head injury, GI or urinary tract haemorrhage, surgery or significant trauma in the last 3 months
- ▶ Neoplasm with increased bleeding risk
- ▶ Previous history of spontaneous ICH, pancreatitis, oesophageal varices, active hepatitis, portal hypertension or liver cirrhosis
- ▶ AVM or aortic aneurysm
- ▶ LP within the last 10 days
- ▶ External cardiac massage or obstetric delivery within the last 10 days
- ▶ Vitamin K antagonist (eg **Warfarin**) and **INR > 1.7**; **DOACs**
- ▶ Unfractionated heparin within the last 24 hours and APTT abnormal
- ▶ **Treatment dose LMWH within the last 48 hours**
- ▶ Known (or strongly suspected) iron deficient anaemia, thrombocytopenia or platelet defect

Thrombolysis in acute ischaemic stroke

Rapid Assessment

- ▶ History of symptoms and onset time – “*is this a stroke?*”
- ▶ Past medical history
- ▶ ABCD assessment – treat if necessary
- ▶ NIHSS score
- ▶ Baseline neurological observations: Vital signs, Glasgow Coma Scale, Glucose
- ▶ Bloods (FBC, U&E, Lipids, LFTs, Coagulation, Group & Save)
- ▶ Bedside INR (if on Warfarin)
- ▶ 2 x large bore Peripheral cannulas
- ▶ CT head



Thrombolysis in acute ischaemic stroke

Treatment

- ▶ Re-check neurological observations
- ▶ Severe Hypertension
 - ▶ Labetalol 10-20mg IV bolus every 10 min (max 300mg)
 - ▶ Labetalol infusion 2-8 mg/min
 - ▶ GTN infusion 50mg in 50mls, 1 to 10 ml/hr

Thrombolysis in acute ischaemic stroke

Treatment

- ▶ Consent
- ▶ Establish patient weight and calculate dose → 0.9mg/Kg (max 90mg)
- ▶ Prepare and Administer medication (do not shake via. Swirl only)
 - ▶ 10% bolus (over 1 -2min)
 - ▶ 90% infusion (over 1 hr) via an infusion pump



Eg. 70 kg
0.9 mg ----- 1 Kg
X ----- 70Kg $x = 0.9 \times 70 = 63 \text{ mg (ml)}$

10% of 63 = 6.3 or 6 mg (ml)
90% of 63 = 57mg (ml)

Thrombolysis in acute ischaemic stroke

Treatment



Question 1

Thrombolysis is an acute treatment option for which type of stroke?

A – Ischaemic stroke

B – Haemorrhagic stroke

Case study 1

46 year old female, right handed

HPC: Last seen well at 11:00 by her partner. At 12:00 while having lunch, sudden onset of left sided weakness.

PMH: smoker

Medications: Nil

Allergies: nil

FM: mother MI at 60

SH: lives with husband and 2 children. Works as a cleaner

Paramedics arrived on scene and took patient to the nearest HASU, alerting ED

ED arrival: 13:15

Case study 1

- ▶ LUL, severe weakness (power 1/5)
- ▶ LLL, no response (power 0/5)
- ▶ Left homonymous hemianopia
- ▶ Left facial droop
- ▶ Right gaze preference
- ▶ NIHSS 16

Vital signs:

E4 V4 M6

Blood Pressure 200/110

HR 75 Sinus rhythm

SaO₂ 98% in Air

RR 15

T 36,5°C

BM 6.5 mmol/L

Case study 1

Can we thrombolysed this patient right now?

A – Yes, absolutely. Let's do it!

B – No way

C – I have no idea

Case study 1



NIHSS 16

Vital signs:

E4 V4 M6

Blood Pressure 200/110

HR 75 SR

SaO₂ 98% in Air RR 15

T 36,5°C

BM 6.5 mmol/L

Can we thrombolyse this patient right now?

A – Yes, let's do it!

B – No way

C – I have no idea

Thrombolysis in acute ischaemic stroke

Treatment

- ▶ Monitor side-effects/complications and treat

- ▶ Allergic rash
- ▶ Bronchospasm
- ▶ Severe Hypotension
- ▶ Anaphylactic reaction
- ▶ Bleeding/ICH (including bruises)

- ▶ Stop rtPA if severe hypotension, bronchospasm, anaphylactic shock

- ▶ Management of suspected ICH as per local policy

- ABCD
- Chlorpheniramine 10mg IV
- Hydrocortisone 200mg IV
- Salbutamol 2.5 – 5 mg
- Adrenaline 0.5mg im (0.5 ml of 1:1000)
- Fluid challenge



Transfer to HASU



- ▶ Flush the entire IV line at the end of the infusion
- ▶ Avoid all treatments/procedures with associated risk of bleeding (eg. NG tube, NSAIDs, anticoagulants)
- ▶ Repeat Brain imaging at 24 hours → antiplatelet therapy

Thrombolysis in acute ischaemic stroke

Treatment

- ▶ Repeat brain imaging if ICH is suspected
- ▶ NIHSS at 2, 24, 48 and 72 hours
- ▶ Neurological observations as per local policy (Glasgow Coma Scale, pupil assessment, limb power, NEWS)
 - ▶ 15 min for 2 hours
 - ▶ 30 min for 6 hours
 - ▶ 1 hrly for 16 hours
- ▶ Know the clinical syndrome and monitor for lesion extension
- ▶ Continuous cardiac monitoring
- ▶ Maintain BP < 185/110
- ▶ Monitor for signs/symptoms of raised ICP

Tenecteplase

- ▶ Genetically variant of alteplase
- ▶ Longer half-life
- ▶ Greater binding affinity with fibrin → better thrombolytic effect
- ▶ Administered as bolus only
- ▶ Tenecteplase dose 0.25mg/Kg before thrombectomy associated with higher recanalization and better functional outcomes in comparison with alteplase (Campbell et. al 2018 – phase II trial)
- ▶ Tenecteplase (dose 0.4mg/Kg) not superior than alteplase in patients with mild stroke (Logallo et al. 2017 – phase III trial)
- ▶ Current trials: EXTEND-IA TNK Part 2: dose 0.4 mg/Kg; TASTE; ATTEST-2; TEMPO-2

Case 2

- ▶ 36 y.o male, right handed
- ▶ PMH: Nil
- ▶ SH: mRS 0, lives with wife
- ▶ 6:00-6:45am: collapse, vomiting and headache. Taken to ED @ Northwick Park Hospital

Case 2

- 7:00am: CT head – nil acute infarct. No bleed

CTA – L M1/M2 thrombus with ICA dissection

- NIHSS 21
- 9:00am: Thrombolysed. CXH contacted
- 9:45am: Patient still at NWPH, waiting for ambulance and drop
GCS 9/15 E3 V1 M5. Repeat CT – early L MCA changes

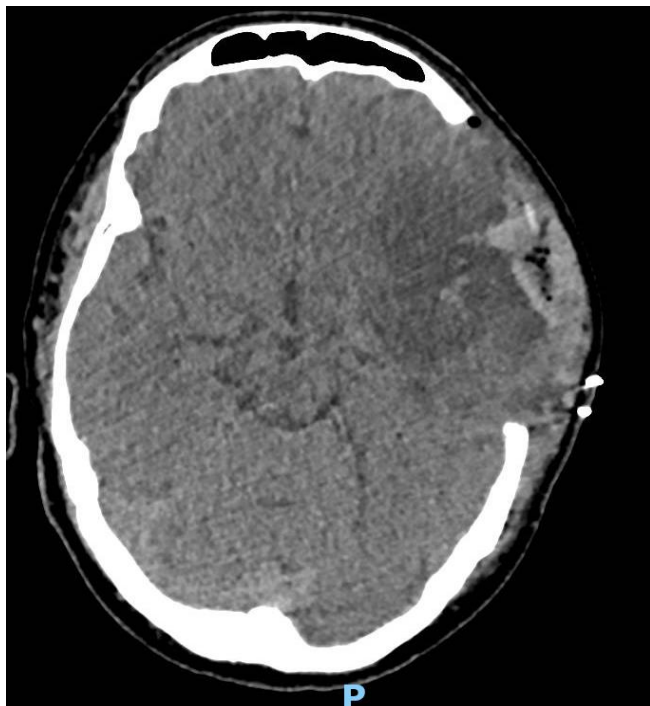


Case 2

- ▶ Transferred to CXH. On arrival NIHSS 19
- ▶ Thrombectomy: recanalization at 12:22.
- ▶ Post-thrombectomy: improved, more alert, obeying commands with visual cues. NIHSS 17
- ▶ 16:00: repeat CT - evolving MCA with early mass effect
- ▶ 20:00: decision made for surgical intervention
- ▶ 21:16: Knife to skin

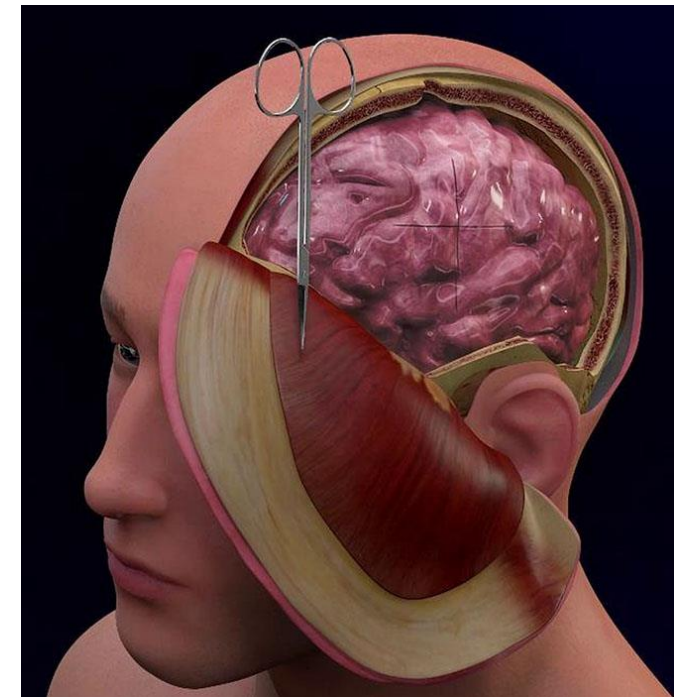


Case 2

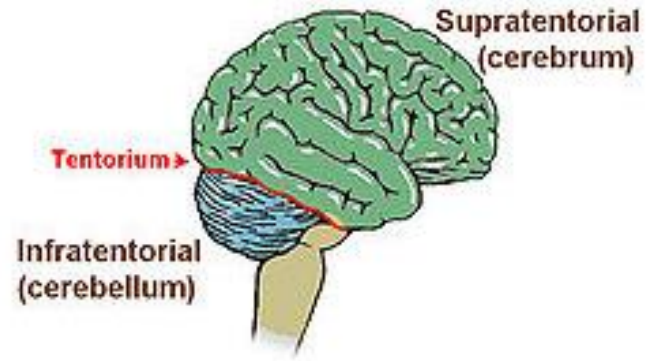
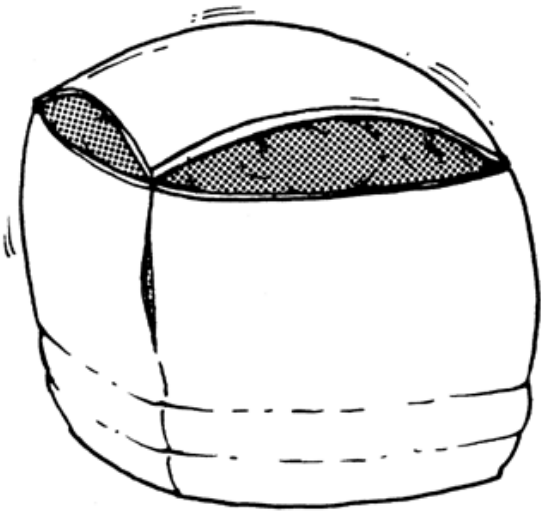


Decompressive hemicraniectomy

- ▶ Within 72-92 hours
- ▶ Surgical procedure under GA
- ▶ Aim to relieve increased ICP as result of oedema of cerebral tissue caused by large cerebral hemisphere lesion, or space-occupying lesion
- ▶ Removes part of the skull and opens the dura ➡ Brain herniates outwards



Intracranial Pressure (ICP)



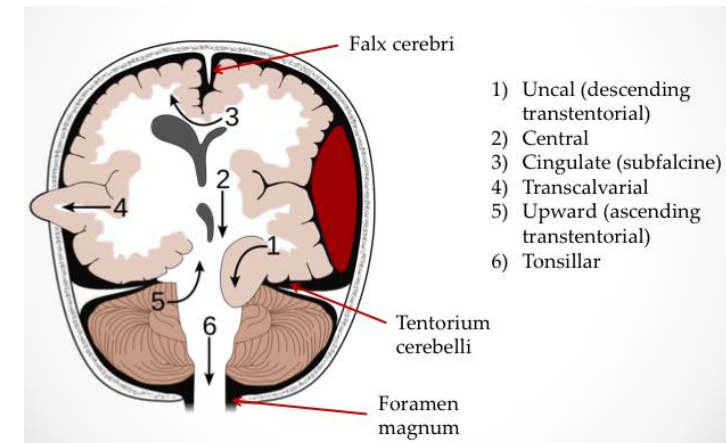
- ▶ 3 compartments
 - ▶ 2 Supratentorial – falx cerebri
 - ▶ 1 Infratentorial

When oedema/mass occurs within a compartment, the brain shifts from a compartment of high pressure to one of a lesser pressure

Subfalcine herniation

► Subfalcine herniation (3)

- Most common herniation
- midline shift
- Headache
- contralateral leg weakness
- possible hydrocephalus



Eg. Malignant MCA infarct/space-occupying lesion (8%) - 80% mortality rate

Signs and symptoms of raised ICP

- ▶ **Restlessness**
- ▶ **Headache**
- ▶ **Nausea and/or vomiting**
- ▶ Photophobia
- ▶ Reduce GCS (or effort)
- ▶ Increase focal neurology
- ▶ Seizure
- ▶ Increased BP with associated Bradycardia (*Cushing 1900*)
- ▶ Meningism (*neck stiffness, headache and photophobia*)
- ▶ Changes in the pupil size and reaction of the pupils to light
- ▶ **Think about the clinical syndrome!**

Decompressive hemicraniectomy

- ▶ **Traditional conservative management:** sedation, hyperventilation, barbiturates and osmotic therapy (no evidence from RCTs)
- ▶ **DHC** (evidence from RCTs) – death and disability (mRS 4 and 5) at 12 months
 - Major disability
 - Death
 - Less 60 years versus older 60 years

Age should not be an exclusion criteria!

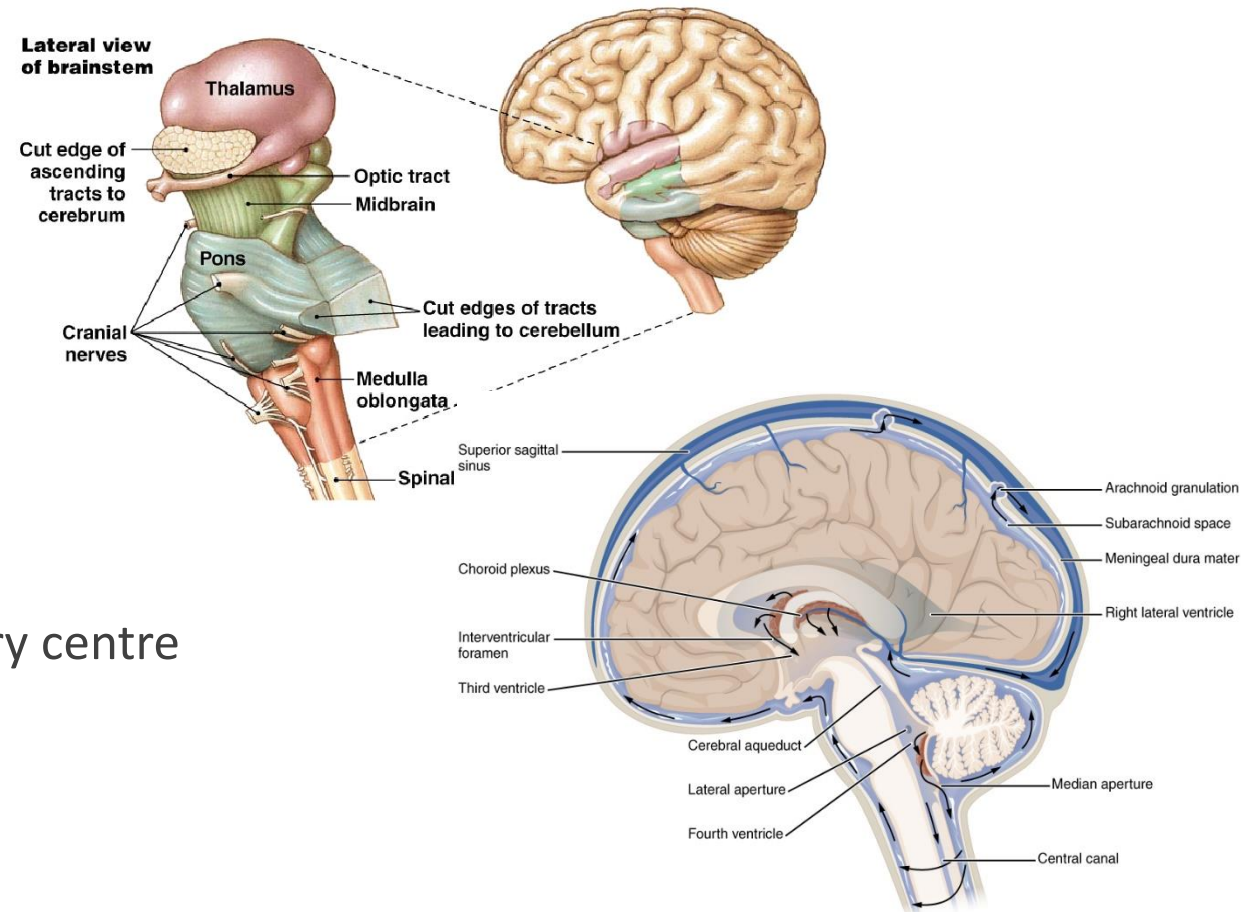
Decompressive hemicraniectomy

Refer to neurosurgery within 24 hours of symptom onset and treat within 48 hours if:

- ▶ Pre-morbid mRS < 2
- ▶ Clinical diagnosis of MCA syndrome
- ▶ NIHSS > 15
- ▶ Decrease in the level of consciousness to a score of 1 or more on NIHSS 1a
- ▶ At least 50% of the MCA territory in brain imaging

Posterior fossa herniation

- Cerebellum, midbrain, pons, medulla
- 3rd to 12th CN impairment
- Cardiac centres in medulla
- Medullary respiratory centre and pontine respiratory centre
- 4th ventricle - CSF obstruction - hydrocephalus



Suboccipital decompressive craniectomy

- ▶ Is effective for cerebellar infarction
- ▶ EVD and Craniectomy
- ▶ EVD increased mortality because of upward herniation

Suboccipital decompressive craniectomy

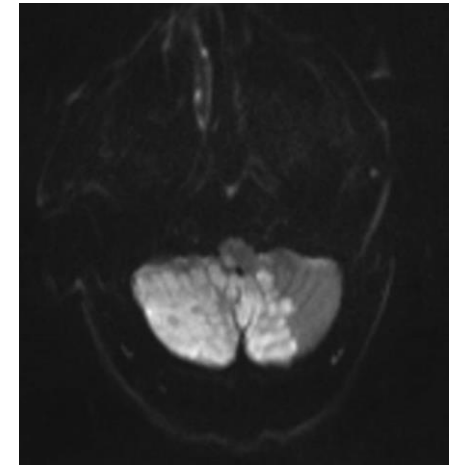
- ▶ 57 y.o male

HPC: 4pm acute onset dizziness + vomiting. Lasted 2 hours then settled.

8pm symptoms returned. Went to bed.

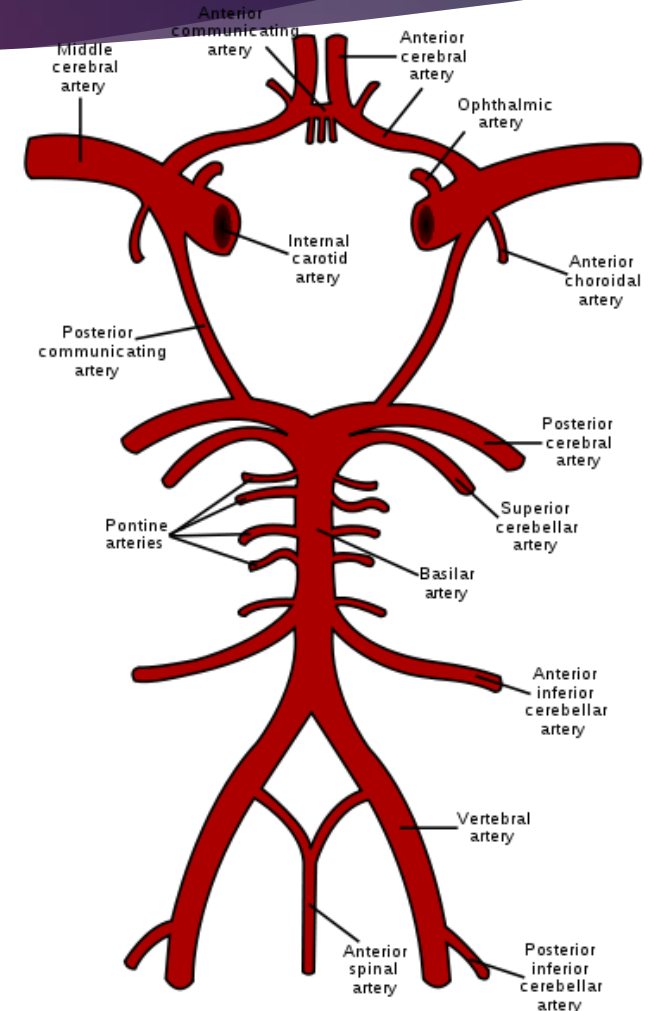
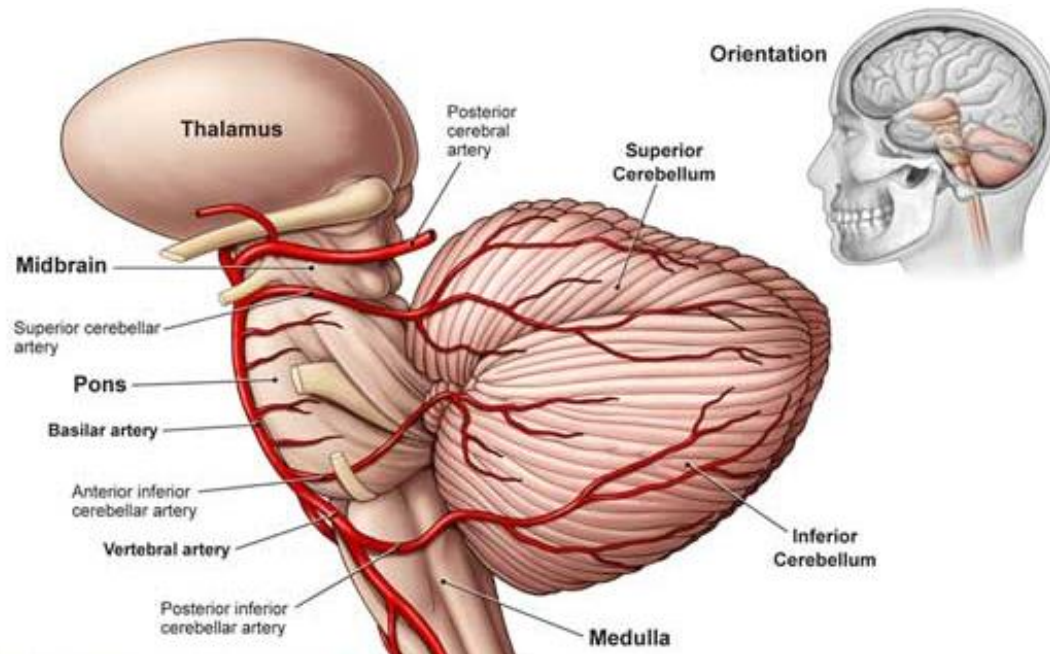
2am woke up, vomiting + room spinning

- ▶ LAS arrival: noted RUL + RLL weakness
- ▶ Examination in ED: nystagmus, R facial droop, RUL, RLL weakness. GCS 15/15
- ▶ CT – old R basal ganglia infarct. Nil acute DWI MRI – bilateral cerebellar infarcts



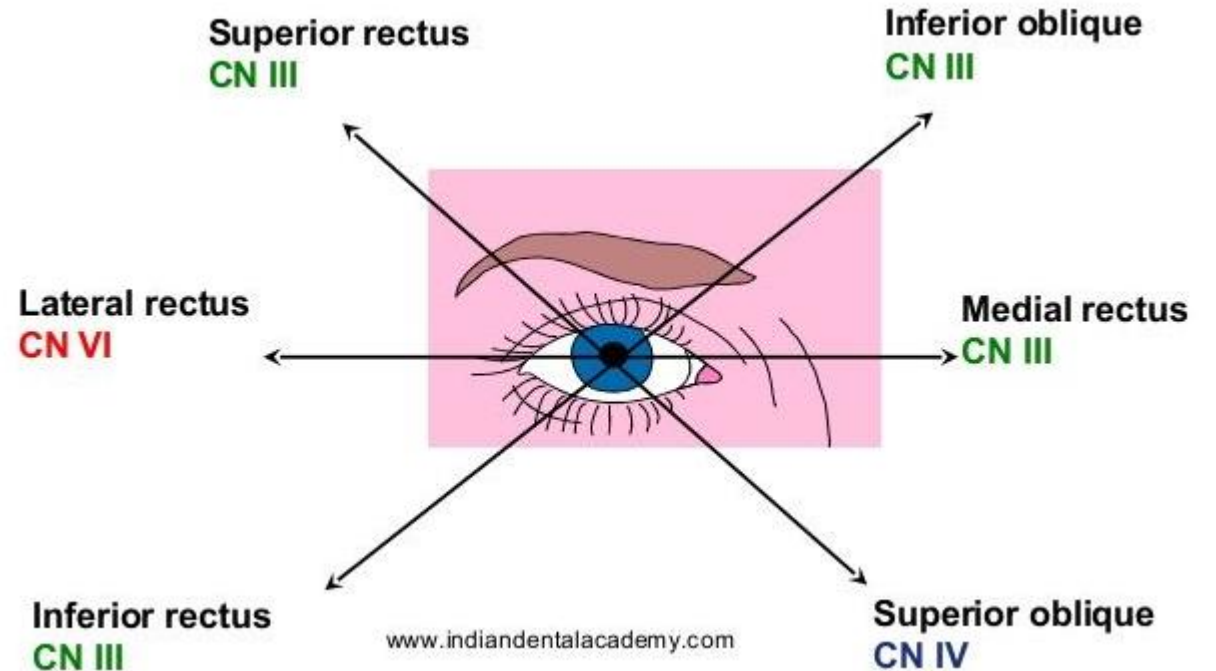
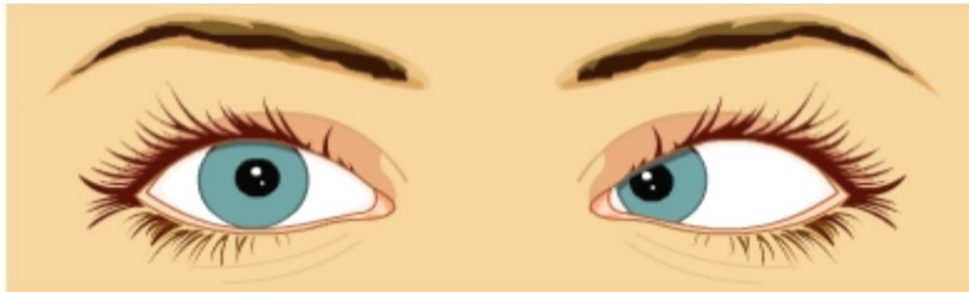
Suboccipital decompressive craniectomy

- CTA – Thrombus in R VA



Suboccipital decompressive craniectomy

- 8:30am: drop GCS (E3 V5 M6), ataxia, worsened dysarthria, R CN VI palsy, upper airway noises, tachypnea



Suboccipital decompressive craniectomy

Impression: Posterior fossa malignant swelling 2nd bilateral cerebellar infarcts and hydrocephalus

- ▶ 11am (just before intubation): Noted L sided weakness
- ▶ **Plan:** 1) R frontal EVD for posterior fossa decompression
2) Posterior fossa decompression

Question 2

Do all stroke patients have carotid dopplers?

A – Yes

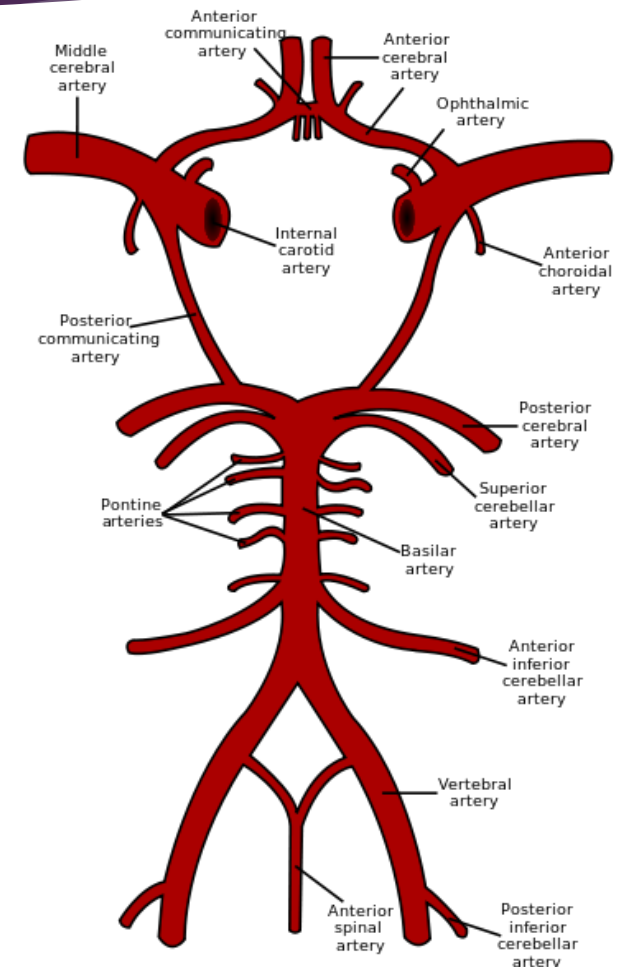
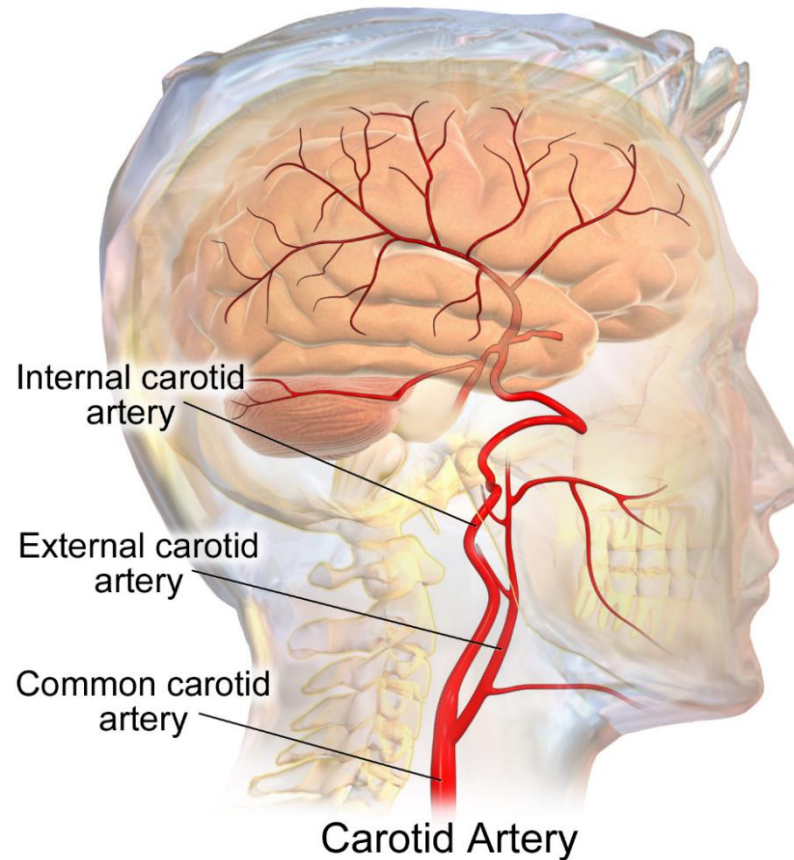
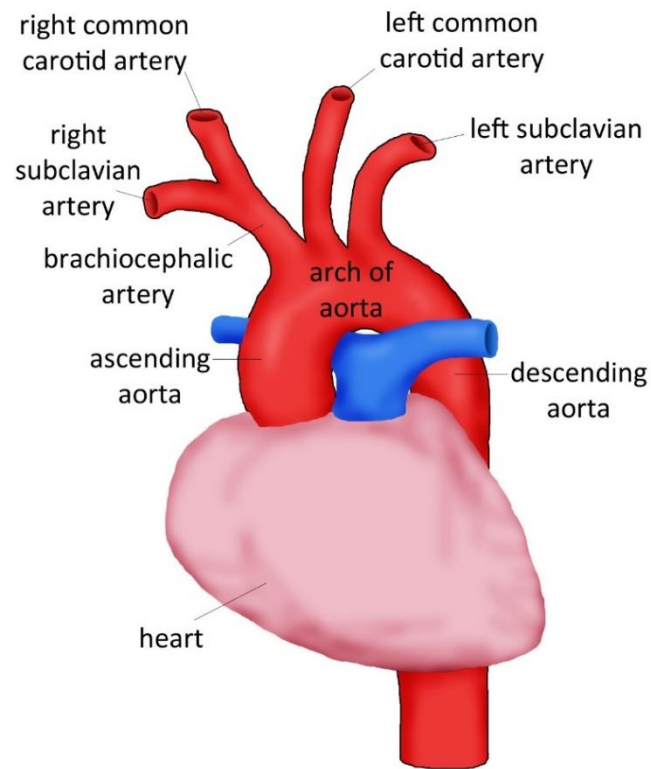
B – No

C – Don't know

Why?

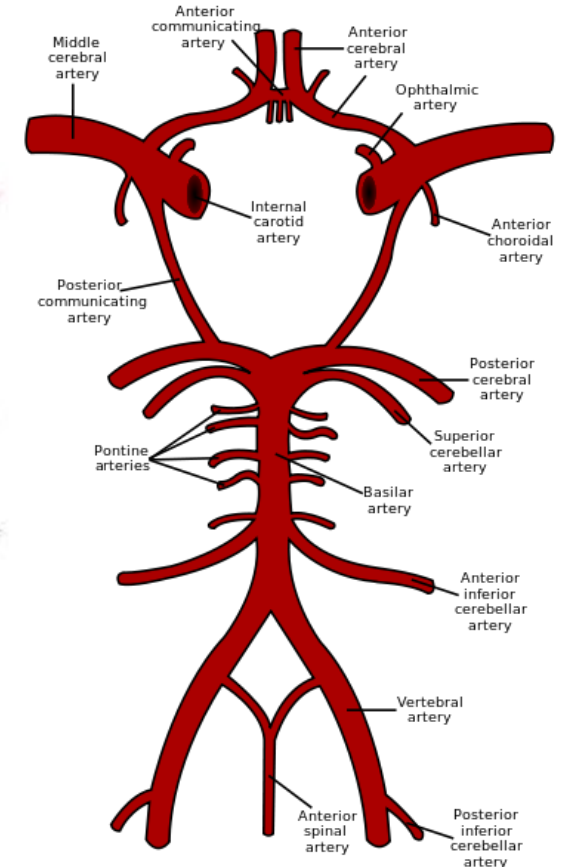
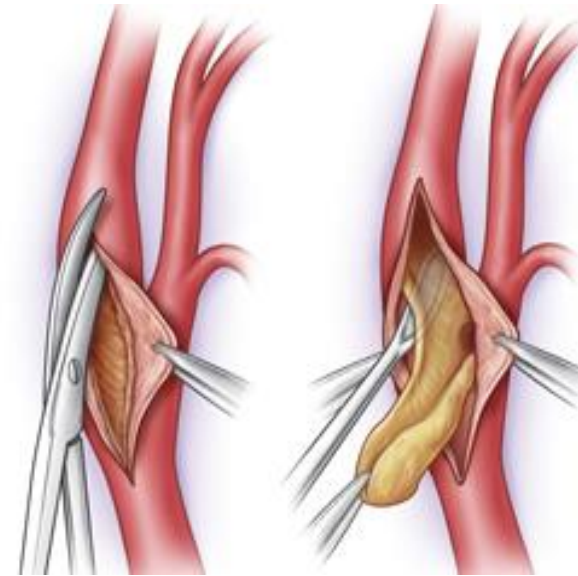
- ▶ Is it an ischaemic stroke?
- ▶ Is it an anterior circulation ischaemic stroke?
- ▶ Will the person be a candidate for carotid endarterectomy?
 - ▶ Pre-morbid mRS
 - ▶ Co-morbidities

Vascular imaging for anterior circulation



Carotid Endarterectomy

- ▶ Surgical procedure under local or general anaesthesia
- ▶ Aims to remove atherosclerotic plaque in the arteries
- ▶ Considered for patients with symptomatic severe carotid artery stenosis (50-99%)
- ▶ Reduces the risk of stroke or death
- ▶ Optimise BP, cholesterol levels, diabetes, lifestyle advice, antiplatelet treatment pre and post CEA



Symptomatic or asymptomatic ICA stenosis?

CEA or no CEA?

78 years old male

HPC: At 2pm sudden onset of RUL weakness and word finding difficulty

PMH: DM2, HTN, Smoker

At 4pm, presented as a thrombolysis call.

On Examination, NIHSS 0

CT head: Nil acute infarct. No bleed

Clinical impression: L MCA TIA

C. Dopplers: L ICA 65-75%

Analysis						
Right Carotid			Left Carotid			
Com	Int	Ext	Com	Int	Ext	
PSV ICA / EDV CCA						
Velocity cm/s						
67/16	85/25	88/18	92/36	52/19	56/11	

Duplex B-Mode Ultrasound and Doppler

R

Vertebrals	
Right 26/8 cm/s	Left 33/12 cm/s
Antegrade	Antegrade

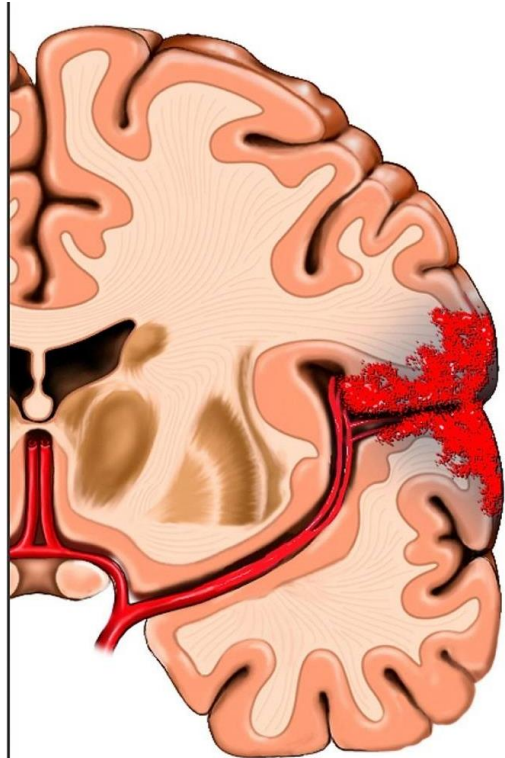
Carotids

	Per cent Stenosis					
	Right			Left		
	com	int	ext	com	int	ext
0-24	2		10			10
25-49	25	145				
50-74						
75-99						
100						

Hand-drawn diagrams of carotid arteries with stenosis indicated by arrows and handwritten notes.

Right			Left	
com	int		com	int
P/T P.		Normal, intimal thickening, plaque	Thick P.	
mix mix		If plaque soft, dense, mixed, calcified	Soft	Soft
S	S	Irregular, smooth	I	S
		Ulceration haemorrhage		

Primary Intracerebral haemorrhages



Acute Primary intracerebral haemorrhage

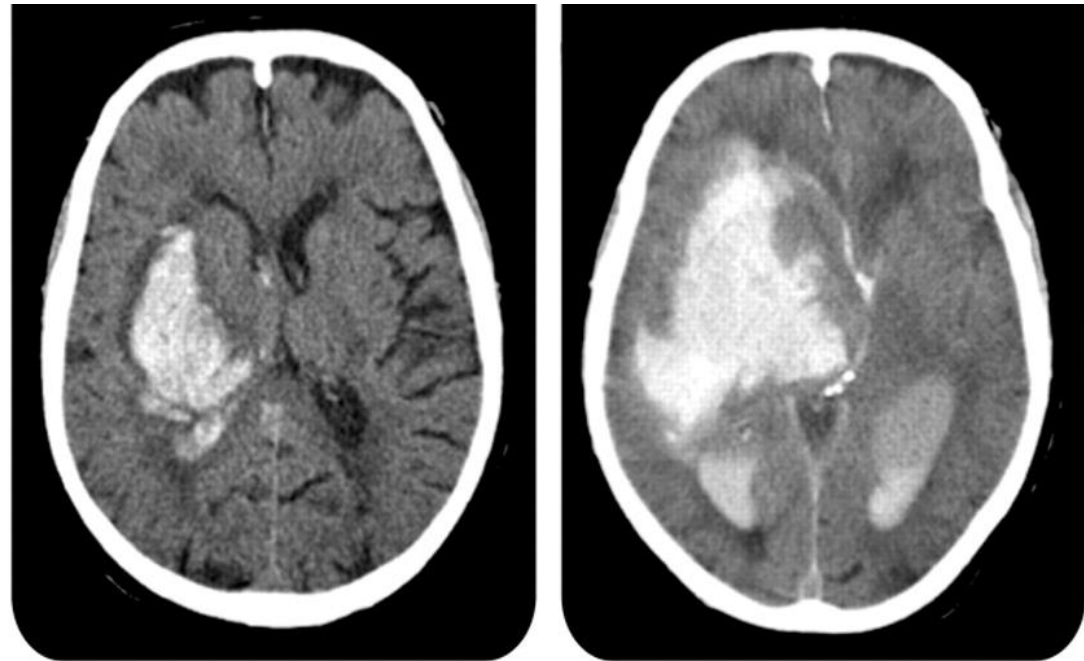
Primary Intracerebral haemorrhage

- ▶ Hypertension
- ▶ AVM or aneurysms
- ▶ Intracerebral tumours
- ▶ Haematological disorders



Acute Primary Intracerebral haemorrhage

- Airway protection
- Management of HTN
- Reversal of coagulopathy
- Surgical intervention



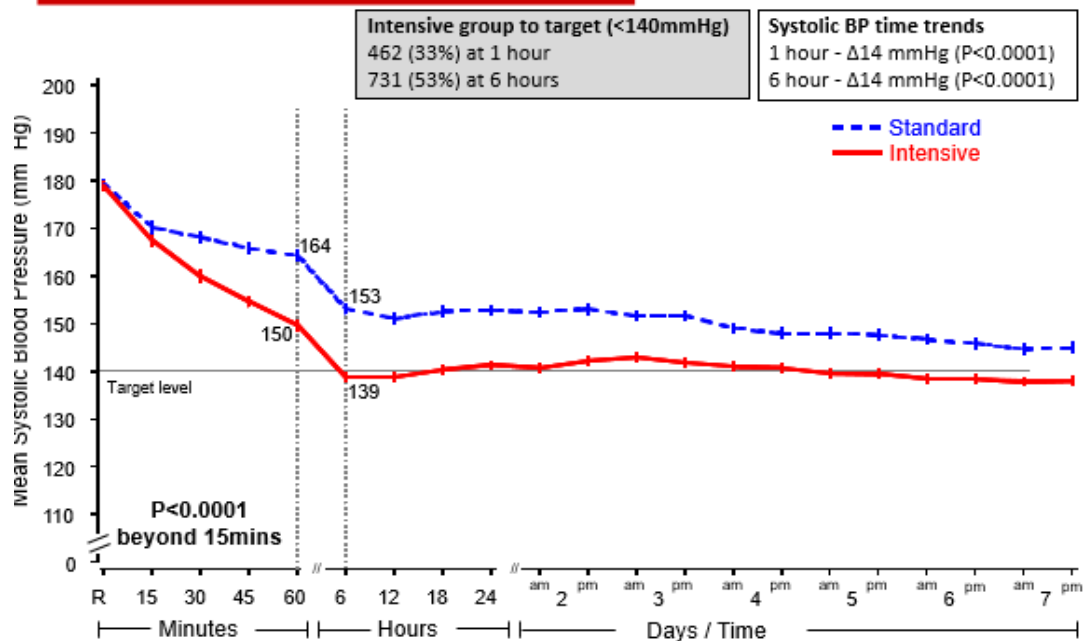
Management of hypertension

INTERACT 2 Trial

- SBP reduction to < 140 mmHg within 1 hour and during 7 days

Systolic BP control

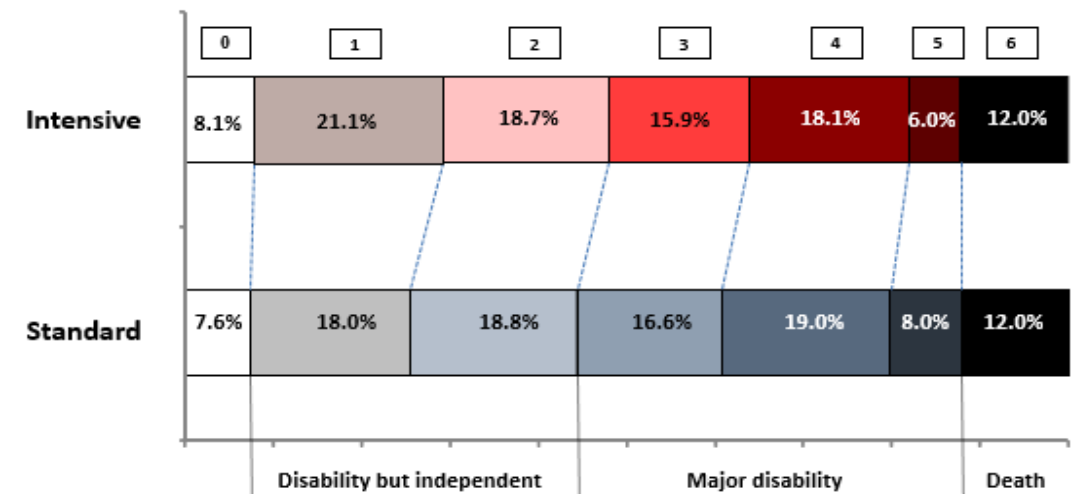
Median (iqr) time to treatment, hr - intensive 4 (3-5), standard 5 (3-7)



Key secondary outcome

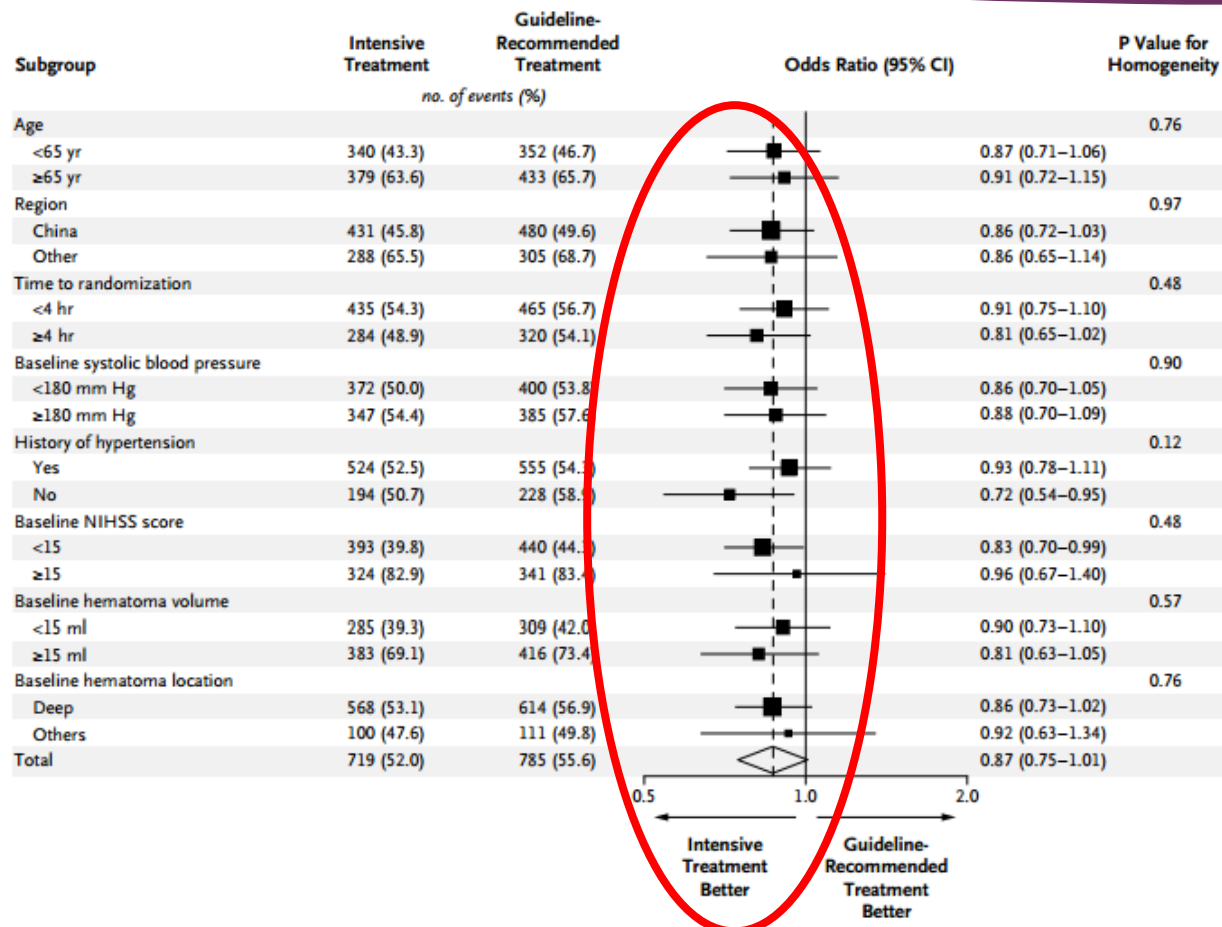
Ordinal shift in mRS scores (0-6)

Odds ratio 0.87 (95%CI 0.77 to 1.00); $P = 0.04$



Management of hypertension


INTERACT 2 Trial



- Early BP control
- Target SBP < 140 mmHg
- Sustained BP control

Reversal of coagulopathy

► If on Warfarin:

- 1) Reverse anticoagulation with Vitamin K and prothrombin complex concentrate (PCC) - Octaplex
- 2) Initiate Octaplex 1ml/min for 5 minutes  2-3 mls/min after
- 3) Check INR 30 min post-treatment

► If on Dabigatran: Reverse anticoagulation with Idarucizumab 5g

► If Apixaban, Edoxaban, Rivaroxaban: reverse with PCC

Surgical intervention

- ▶ Patients with PICH who develop hydrocephalus should be considered for surgical intervention or insertion of an EVD

Case study 3

74 years old lady

HPC: 6am seen well. At 8.40am tonic clonic seizure and left sided weakness

PMH: Right lumpectomy for breast cancer, depression, anxiety, cognitive impairment

SH: ex-smoker, heavy alcohol consumption (4 bottles wine/day). Lives with husband but currently in residential home for respite care, mRS 3

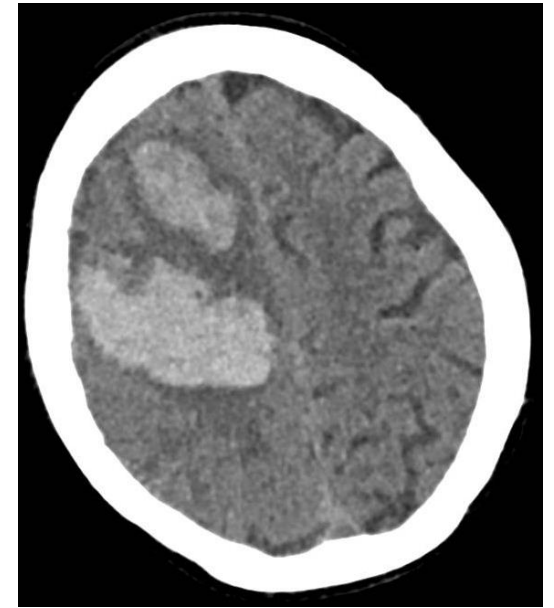
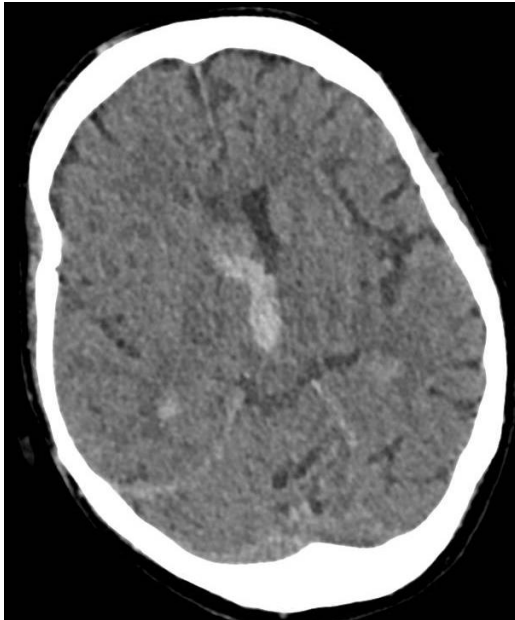
On Examination in ED at 9.30am:

NIHSS 19

BP 220/110 HR 140 sinus tachycardia SaO2 95% in air BM 8.3

GCS 14/15 (E4 V4 M6) LUL 0/5 LLL 0/5

Case study 2



Are you going to thrombolyse this patient?

A – Yes

B – No

C – Maybe

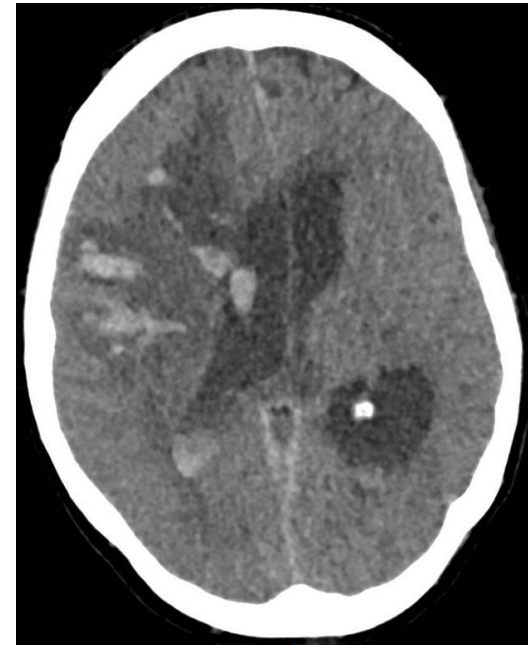
D – I don't know

Case study 2

► Day 2 of admission, 6:40am:

GCS E2 V1 M4. NIHSS 36

EVD @ 10am.





Thank you!

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