NEUROLOGY Hx

History of presenting complaint

Headache, [SOCRATES] → type/severity

- **Time course** (esp. SAH vs IIH)
  a. **Acute (secs)** = SAH, stroke, focal/generalised seizure
  b. **Subacute (hrs-days)** = infection, inflammatory disorder (Guillain–Barré syndrome)
  c. **Insidious (wks – mths)** = IIH, tumour, neurodegenerative
- **Triggers?** → auras, hormone changes?
- **Assoc**. (**photo/phono-phobia, cold, mental clouding, rhinorrhoea, flushed head**)

Fits, faints or funny turns [Seizures/Strokes]

- **Pre-event [LAD]**
  a. **LOC**
  b. **auras**
  c. **DIZZY (vertigo, lightheaded),**
  d. **vision issue, speech,**
  e. **trauma** ➔ extra-dural, sub-dural heam.
- **During event (what happened? , duration – hrs, days?)**
- **After event [WILD]** (*weakness incontinence, Lateral Tongue biting, drowsiness)*
- **Previous episodes / scans (MRI, CT)**
- **Underlying CV cause (i.e.** palpitation, SOB)

- **Disturbed gait, sensation and weakness**
  a. Dysesthesia (unpleasant feel)
  b. Paraesthesia (pins & needles) & numb
- **Disturbances of vision, hearing, smell, speech & swallowing**

Consider pattern of symptoms:

- **Unilateral** vs **bilateral**
- Sensory vs motor vs sensori-motor
- **Distal vs proximal weakness**
  - Cranial vs Long tract (UL vs LL)
- **PNS vs ANS** (bladder, ED, irregular BP)
- Dermatomal/myotomal **distribution** or not

Past MHx

Current Conditions

- **Risk of Cerebrovascular disease**: epilepsy/convulsions | HT | DM | Dyslipidaemia
  - **Previous stokes / STEMIs**
  - **Previous accidents (e.g.** head/spinal injuries) or **Infection (**meningitis, STIs)

Medications

- Anticonvulsants, anti-Parkinsonian drugs, **COCP [↑ stroke risk]**
- Steroids, stains & Opiates

Surgeries/ Treatments

- Chemotherapy for malignancy (**leukaemia, myeloma or lymphoma**)
- **Splenectomy (thrombocytopenia or lymphoma)**

Tests

Results of CT or MRI brain scan

Other

Allergies? + **Vaccinations** *[strep. Pneumoniae, FluVax]*

Risk stratification for TIA with ABCD2 score

ABCD²	Criteria	Points
Age	≧ 60 years	1
Blood pressure	≧140/80	1
Clinical features	Unilateral weakness	2
	Speech impairment without weakness	1
Duration of Sx	>60minutes	2
	10-59 minutes	1
Diabetes	Yes	1

Score	2day-risk for stroke	Recurrence within 90days
0-3	Low	1.0%
4-5	Moderate	4.1%
6-7	High	8.1%

JAMA 2000;284:2901-2906

ABCD2-I	Points
ABCD2 +	7
I = (image) MRI : acute infarction on DWI CT : acute or old infarction	3

Stroke 2010;41:1907-13

Social Hx

Occupation	exposure to toxins (e.g. heavy metals)
Smoking	cerebrovascular disease **[↑ vascular risk]**
Alcohol	blackouts, alcoholic dementia, myopathy
Drugs	Marijuana + cocaine induced headache

Family Hx

- **Family Hx of** migraine, stroke, Alzheimer's, epilepsy
- **X-LINKED:** Colour blindness, DMD | **Autosomal dominant (neurodegenerative disease)**: Huntington's chorea, MS

SR

- **CVS** – CAD SPIFE, **RESP** – SCSC FAWIF, **GIT** – BLIND CRAP, **GU** – FUNDWISE | PORN HAWC | **Menstrual Cycle**
  General: Fever | weight loss/gain | Speech | Smell | Hearing | Sight

Red flags on history

- Fever, photophobia or neck stiffness (**meningitis or encephalitis)**
- New neurological symptoms (haem**orrhage, malignancy or stroke)**
- Dizziness (**stroke**)
- Visual disturbance (**temporal arteritis or glaucoma**)
- Sudden onset occipital headache (**subarachnoid haemorrhage**)
- Worse on coughing or straining (**raised intracranial pressure**)
- Postural, worse on standing, lying or bending over or Pemberton's sign (**raised intracranial pressure**)
- Severe enough to wake the patient from sleep
- Vomiting (**raised intracranial pressure or carbon monoxide poisoning**)
- History of trauma (**intracranial haemorrhage**)
- Pregnancy (**pre-eclampsia**)
- *Recent hed trauma within 3/12 = ?SDH*
- Headaches **with use of medications/illicit drugs** *(e.g. anticoagulants, sympathomimetic agents)*

Red flags on Examination

- Abnormal vitals
- Neurological abnormalities
- Decreased LOC ➔ other cause [**CV, metabolic, psychogenic**]:
  - ***Arrhythmias*** = assoc. with palpitations
  - ***Aortic stenosis*** = ***LOC*** *with heavy exercise*
  - ***Transient ischaemic attacks*** = 'drop attacks' means the patient falls but **NO** LOC.
  - ***Vasovagal syncope*** = ***LOC*** due to abrupt drop in HR, BP (due to stress)
  - ***Micturition syncope*** = ***LOC*** *due to urination*
  - ***Hypoglycaemia*** *(diabetics on insulin)* = sweating, weakness and confusion **BEFORE** LOC.
  - ***Psychogenic non-epileptic seizures (PNES)*** → **LOC** [no response to anticonvulsants] → need psychotherapy to Rx anxiety and depression
- Meningismus (similar to meningitis without inflammation of meninges → i.e. stiff neck, photophobia)
- Papilledema ➔ Idiopathic intracranial hypertension (IIH), Raised ICP

Examination	Indication	Purpose
Mental state examination (MSE)	Mental health disorder	• *"A routine assessment to check your brain function that I do on all my patients of similar age"* • provides snapshot of a patient's emotions, thoughts, and behaviour at the time of observation • helps identify the presence and severity of a variety of **mental** health conditions and the risk a patient poses to him- or herself, or to others
Mini-Mental State Exam (MMSE)	Elderly	• tests cognitive function among the **elderly ➔** • measures of orientation, registration (immediate memory), short-term memory (but not long-term memory) as well as language functioning • **Orientation ➔ registration ➔ registration ➔ attention + calc ➔ recall ➔ language** • Score out of 30 (> 25 - normal, 21-24 = mild cognitive impairment, <20 = dementia)

Cranial Nerve Examination (upper CN – I, II, III, IV, VI)

GI

- ***Today I have been asked to check your cranial nerves. These are the nerves that supply your face and neck***
- ***Responsiveness + Orientated*** *["tell me how you got here today?"]*
- **Ptosis (drooping one/both eyelids** = old age, 7th nerve palsy, Horner's (ptosis + anhidrosis, myosis, anophthalmos)
- **Proptosis / strabismus** (misalignment/deviation of one/both eye)
- **Facial asymmetry &** facial drooping (salivation)
- Obvious **muscle wasting** (Temporal)

CN I

- **Alcohol wipe smell (test each** nostril separately
  - "Close eyes + cover one nose" "Describe to me what you smell"
  - **DDx (anosmia):** Kallman URTI, smoking, ethmoid tumours, basal skull/frontal fracture, post pituitary surgery, congenital (eg. Kallmans syndrome), meningioma of olfactory groove, infectious (meningitis)

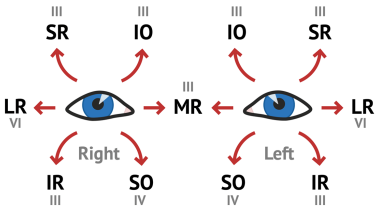
CN 2 AFRO CAP

Acuity [snellan chart]

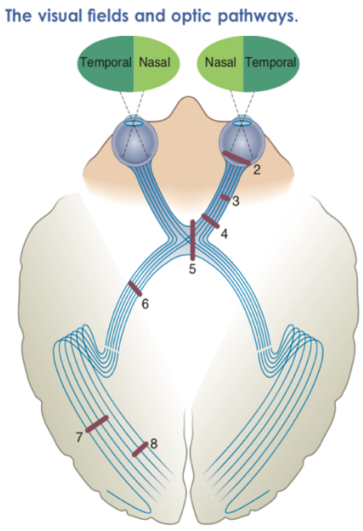
- **ENSURE YOU POSITION PATIENT AT EYE LEVEL!!**
- Cover one eye and read the smallest line you can
  - If unable: → "**How many fingers**" [CF] → **Hand movement** [HM] → **Perception of Light** [PL] → **NPL**

Visual Fields

- **"Cover your own eye with one hand and then the other!"**
- Cover your **left eye with your left hand** → "look into my eye and say 'yes' when you see **my finger moving"**
- Repeat with **coloured object** (NARROWER visual field – cones located centrally in macula, rods peripheral)
- Repeat for other eye



Visual field testing: 'Tell me when you first see the red pin come into view'



1. TUNNEL VISION
   Concentric diminution, e.g. glaucoma, papilloedema, syphilis
2. ENLARGED BLIND SPOT
   Optic nerve head enlargement
3. CENTRAL SCOTOMATA
   Optic nerve head to chiasmal lesion, e.g. demyelination, toxic, vascular, nutritional
4. UNILATERAL FIELD LOSS
   Optic nerve lesion, e.g. vascular, tumour
5. BITEMPORAL HEMIANOPIA
   Optic chiasm lesion, e.g. pituitary tumour, sella meningioma
6. HOMONYMOUS HEMIANOPIA
   Optic tract to occipital cortex, e.g. vascular, tumour (NB: incomplete lesion results in macular (central) vision sparing)
7. UPPER QUADRANT HOMONYMOUS HEMIANOPIA
   Temporal lobe lesion, e.g. vascular, tumour
8. LOWER QUADRANT HOMONYMOUS HEMIANOPIA
   Parietal lobe lesion

Reflexes [Take glasses off]

Colour vision

Ishihara Plates:
- **optic neuritis** (loss of red),
- Colour blindness: vit A **deficiency / X-linked chromosome loss**

Accommodation

- "Stare at point on the wall behind me → now look at the red ball"
  - Should see convergence of eyes

Pupil light reflex (PEARL) [*Check size, shape of pupil*]

"Stare at a point behind me" → Pen light from side and into eye slowly
- Check pupil size
- Repeat x2 (see constriction in blinded eye (direct) and then the other (consensual))

Swing torch test
- If light shone on damaged eye (NO consensual response)
- If light shone on bad eye → good eye → bad eye (appears to dilate)
- *Bad eye* = **Marcus Gunn pupil** is a **relative** afferent **pupillary** defect indicating a decreased **pupillary response** to light in the affected eye

Pathology

- **Failure of accommodation ONLY ➔** midbrain lesion or with cortical blindness.
- **Absent light reflex ONLY ➔** midbrain lesion (e.g. Argyll Robertson pupil of syphilis – accomodates but does not react), a ciliary ganglion lesion (e.g. Adie's pupil)
- **Amsler grid ➔** AMD

Optic Disc (Fundoscopy) *'Say would do*

	Definition	Distribution	vision	Light reflex
Papilloedema	Optic disc swelling due to raised ICP	Bilateral	Huge blind spot	None DDx: retinoblastoma,
Optic neuritis	Inflammed or infarcted optic nerve head	Unilateral	Scotoma → blindness	Reduced

CN 3 / CN 4 / CN 6

Eye movements [Draw large H]

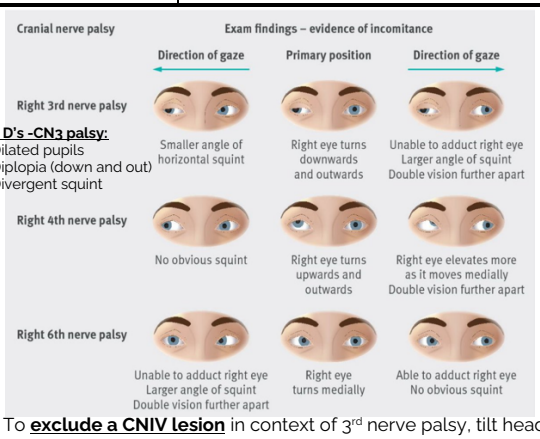
Reflex types:
1) pursuit
2) saccades
3) convergence
4)VOR

LR6 = abduction
SO4 = depressor in eye adduction (head tilt away from lesion

- Do you have any **double vision (diplopia) ?**
- **Pursuit Movements** (tracking) → smooth conjugate movement
- **Saccades** "Look left then right" "up and down"
  - ***hypometric*** *OR* ***hypermetric/overshoot*** **saccades**
- **Horizontal Nystagmus** (MS or vascular lesion)
  - **Vestibular lesion = nystagmus** *away from side of lesion*
  - **Cerebellar lesion = nystagmus** *to side of lesion*
- **Vertical Nystagmus**
  - Midbrain lesion, floor of 4th ventricle
  - EtOH, phenytoin

Conjugate Gaze Palsy

- **PSP = Loss of vertical → then horizontal gaze** → bilateral fixed unequal eyes but reflex eye movements intact
- ***Parinaud's syndrome*** = Involuntary upward dev of the eyes + **loss of vertical agaze** = *pinealoma, MS, vascular*
- ***One and a half syndrome*** = horizontal gaze palsy + impaired adduction



To **exclude a CNIV lesion** in context of 3rd nerve palsy, tilt head to **same side** as the lesion ➔ the affected eye will **intort** if CNIV **intact**)

Cranial Nerve Examination (Lower CN – 5, 7-12)

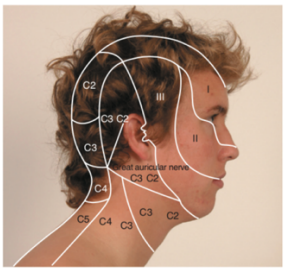
CN 5

Sensory division of trigeminal
V1 = ophthalmic (sup. orbital)
V2 = mandibular (foramen rotundum)

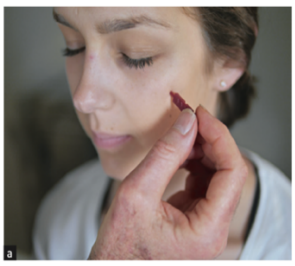
Examine facial sensation [close patients' eyes]

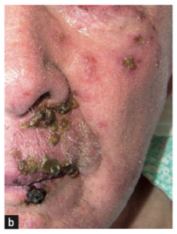
"This is what the cotton wool/pin feels like" [Both sides of Head → cheek → jaw]

- Is **it cold/hot** or **sharp/dull** AND
- **did it feel the same on both sides of the face**?



Dermatomes of the head and neck


Facial sensation V, test all three divisions on each side


Herpes zoster distribution of the maxillary nerve

***Corneal reflex [Not done]**

Lightly touch cornea (*not* the conjunctiva) with cottonwool brought to the eye from side

- *No sensation* = corneal ulceration / ACOUSTIC NERUOMA (**NO CN7 TO BLINK**)

Motor division of trigeminal
V2 = maxillary (foramen ovale)

Muscles of mastication

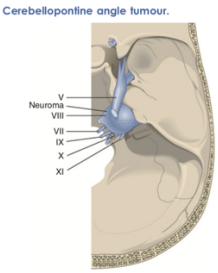
- (**clench your teeth for me + relax**): Feel for **temporalis** and **masseter** muscle wasting?
- (*ask patient to **bite down on wooden tongue depressor with molars***): *muscle strength*
- (open your mouth – don't let me close it): **pterygoid muscle**
  - **Jaw deviates to affected side**

Jaw Jerk* Or *Masseter Reflex

- "Relax your jaw down slightly for me → just going to tap tip of your chin/jaw lightly"
  - ➔ exaggerated jaw jerk = **UMN lesion above pons** [pseudobulbar palsy]


Cranial nerve V (motor): 'Clench your jaw'—feel the masseter muscles


Cranial nerve V: the jaw jerk



NB: schwannoma from CNVIII can compress adjacent CNV and CNVII nerves, brainstem and cerebellum

CN 7

Facial movements

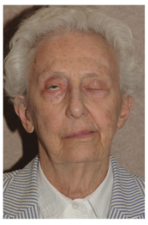
- **Frontalis (temporal)** = **"Raise your eyebrows and don't me push them down "**➔ NO wrinkle (**UMN lesion – FOREHEAD SPARING**)
- **OBICULARIS OCULI (ZYGOMATIC) "Close eyes TIGHTLY as you can and don't let me open them"** ➔ **Bell's LMN palsy**: upward movement of the eyeball and incomplete closure of the eyelid
- **BUCCINATOR (BUCCAL) "Puff cheeks and don't let me push them in"** ➔ asymmetry (**LMN lesion**)
- **ZYGOMATIC MUSCLE (ZYG + BUCCAL) "Smile and show me your teeth"** ➔ facial paralysis (**cortical lesion)**
- **CERVICAL Platysma + occipitalis**

Q "Any change in taste"

- **CNVII (chorda tympani) has** sensory fibres for **taste** from anterior 2/3 of tongue → fibres reach brain via CNV
- **Unilateral loss of taste**: *middle-ear lesions involving the chorda tympani (CN7) or lingual nerve (CNV)*

Q "Any change in hearing"

- **Stapedius** supplied by VII ➔ controls stapes ➔ hyperacusis when damaged


Bell's palsy on the right side


Cranial nerve VII: 'Puff out your cheeks' (normal)


Cranial nerve VII: 'Look up to wrinkle your forehead' (normal)


Cranial nerve VII: 'Shut your eyes tight and stop me opening them' (normal)

Table 1. Distinguishing peripheral vs central vertigo using the HINTS examination

	Peripheral	Central
Head impulse test	Abnormal	Normal
Nystagmus	None or unidirectional	Bidirectional or vertical
Test of skew	No vertical skew	Vertical skew

Central causes (pons, medulla, upper cervical cord) = **FOREHEAD SPARING**

- vascular lesion,
- tumour,
- syringobulbia.

Peripheral causes

- aneurysm, tumour,
- chronic meningitis.
- Trigeminal ganglion causes include trigeminal neuroma, meningioma fracture

CN 8 (512Hz)

Inspect	• Hearing aids • Herpes zoster lesions (external acoustic meatus)
"whisper" test	• **"Close your eyes and tell me if you hear a sound** → Scrunch fingers to test ear" o **Mask** opposite **ear** rubbing the tragus while testing other ear
Vestibular Function	• **Stand up → march on spot [pathological = patient turns to side of lesion]**




Cranial nerve VIII, Rinné's test: 'Where does it sound louder?'

Cranial nerve VIII, Weber's test: 'Is the buzzing louder on one side?'

Special Tests (512Hz)	Normal	Sensorineural hearing deafness	Conductive deafness
Rinne test **[place on mastoid process**, behind the ear]	**Air conduction** > Bone conduction	**Air conduction** > Bone conduction [both conduction reduced equally)	**Bone conduction** > Air conduction
Weber's test [test lateralisation]	Sound heard equally in both ears [no lateralisation]	Sound louder on side of **intact/unaffected ear**	Sound heard louder on side of **affected ear**
DDx	-	**Unilateral** = schwannoma, trauma (# of petrous part of temporal bone) , internal auditory artery rupture **Bilateral** = Infection (TORCH), Ménière's disease, Ab (aminoglycosides), diuretics	Wax, otitis media Paget's

CN 9 "clean spatula"

Inspect	symmetry of soft palate
Voice	• **Say "ahhhh"** → Uvula should be raised upright • **Pathology** = Uvula displaces **away** from side of lesion (**loss of innervation of levator palatini**)
Test cough (bovine)	"**Cough for me**" 1. hoarseness OR bovine cough ➔ **unilateral RLN lesion or vagal palsy**
Swallow test	"Sip this glass of water when I tell you" 2. Dysphagia of dry foods ➔ **CN9 nerve lesion** 3. Dysphagia of solids and liquids + hoarseness ➔ **Unilateral CNX paralysis**
Distribution	***Discuss how IX carries sensory fibres for taste from the posterior one-third of the tongue*** 4. 9th nerve ➔ sensory fibres to **oropharynx** , the middle and inner ear and from the posterior 1/3 of the tongue (including taste fibres) o secretory fibres to the parotid gland (PSNS) 5. 10th nerve ➔ sensory fibres to **laryngopharynx** o Motor innervation to muscles of the pharynx, the larynx and the palate

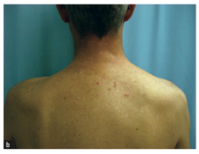
CN 10 "wanderer"

- ***Gag reflex*** (CN IX = sensory on soft palate and X = motor/vomiting component) ➔ touch pharynx with spatula and observe reflex contraction of the soft palate

CN 11

- **Trapezius**: "shrug your shoulders" ➔ don't let me push them down
- **SCM**: "turn your head left and push against my hand → and the other side (right SCM turns head left) ➔ feel for SCM bulk

(Check for winged scapula – serratus anterior)



(a) Cranial nerve XI: 'Shrug your shoulders—push up hard'. (b) Wasting of the left trapezius muscle


CN 12

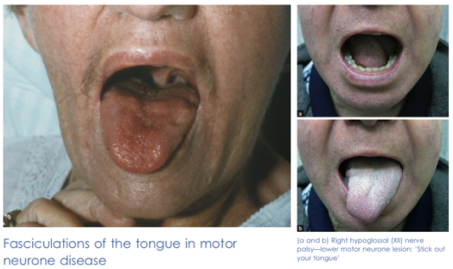
"Stick your tongue out AND wiggle it around":

- *Protrusion = genioglossus muscle*
- **Deviation** to **affected side** ➔ **unilateral LMN lesion**
- *cannot keep tongue protruded* ➔ **Huntington's chorea**
- coarse tremor of the tongue ➔ **Parkinson's disease**

"Press tongue into my fingers (on one side and the other)"

- immobile tongue ➔ **UMN lesion of CN XII**

Innervates ALL intrinsic muscles of tongue EXCEPT palatoglossus


Fasciculations of the tongue in motor neurone disease
(a and b) Right hypoglossal (XII) nerve palsy—lower motor neurone lesion: 'Stick out your tongue'

Feature	Pseudobulbar (bilateral UMN lesions of IX, X and XII)	Bulbar (bilateral LMN lesions of IX, X, and XII)
Gag	Increased or normal	Absent
Tongue	Spastic	Wasted, fasciculations
Jaw jerk	Increased	Absent or normal
Speech	Spastic dysarthria	Nasal
Other	Bilateral UMN (long tract) signs Labile emotions	Signs of underlying disease – eg. Limb fasciculations, normal emotions
Causes	Multiple sclerosis MND Brain trauma Raised ICP T2DM Vascular	MND GBS Poliomyelitis Brainstem infarction Myasthenia Gravis

Practise point:

The tongue and jaw never lie → always point to side of lesion!

UPPER LIMB NEURO EXAM

Today I examined Mr Smith, a 32-year-old male. On **general inspection**, the patient appeared comfortable at rest, with normal speech and no other stigmata of neurological disease. There were no objects or medical equipment around the bed of relevance."

- "**Assessment of the upper limbs** revealed normal tone, power, reflexes, sensation and coordination."
- "In **summary**, these findings are consistent with a normal upper limb neurological examination."
- "Further assessment of the neck and cranial nerves as well as gait examination"

DDx: small hand muscle wasting
- **SC lesion** = syringomyelia, tumour, trauma, cervical spondylosis
- **Ant horn cell** = MND, polio, SMA, C8 compression
- **Median / ulnar nerve palsy**
- **Lower branchial trunk lesion**
  - Thoracic outlet syndrome
  - Tumour, RT, infect
  - MS
- **Muscle** = DMD

General [SWIFT]

Sit patient on bed

- **S**cars/skin changes/Symmetry (herpes zoster, shingles with segmental distribution, NFT)
- **W**asting
- **I**nvolunty **movements** (i.e. *jerks, dystonia, myoclonus, chorea*)ßΣ
- **F**asciculations [*MND, , thyrotoxicosis, primary neuropathy*]
- **T**remors (*low freq = PD, high freq = thyrotoxicosis)*

Tone

Relax your arms → just going to check the tone:

- **Hold onto elbow** (at epicondyles) + shake hands → pronate → supinate → flex/extend elbow (repeat faster movements)
- **Cock patient's wrist repeatedly** → check for repetitive movement (clonus)

- **Paratonia** = increased tone = involuntary resistance against passive movement
  - Assoc. Dementia
- **Hypotonia** = **Slow Opening of fist or wrist drop**
- **Hypertonia #1: Spasticity** (unidirectional & velocity dependent) ➔ **stroke (UMN lesion)**
  - Spastic/fast movement in one direction ONLY [**catch it!]**
- **Hypertonia #2: cog-wheel Rigidity** (bidirectional & velocity **INdependent**)➔ *Parkinson's disease*
  - Stiffness in BOTH directions
  - **Clonus** (>5 abnormal repeated

Power

	Movement	Muscles	Nerve	Talk
Shoulder	**Abduction**	Trapezius	CNXI	Shrug your shoulders for me
		Deltoid	Axillary (C5,C6)	Make a chicken wing for me and don't let me push down
		Supraspinatus	Suprascapular	bring your arms up
	Adduction	Pec. major & latissimus dorsi	Thoracodorsal (C6,8)	Brings elbows close to side and flap it like a wing
Elbow	**Flexion**	Biceps brachii	MSC (C5,6)	Brings arms up like a boxer → don't let me pull you arm away from you [**hold shoulder on same side]**
	Extension	Triceps brachii	Radial (C7, 8)	Brings arms up like a boxer → don't let me pull your arm towards you [**hold shoulder on opp. side]**
Wrist	**Flexion**	Flexor carpi ulnaris & radialis	Ulnar (ulnar half) Median (radial half)	*"cock your wrists downwards + don't let me pull them up"*
	Extension	Extensor carpi group [EDC]	Radial (C7, C8)	*"cock your wrists upwards + don't let me pull them down"*
Finger	**Flexion**	FDP, FCU, FCR	Radial (C7, C8)	*Bend your fingers 90° straight down and don't let me bring them up"*
	Extension	Extensor digitorum	Radial (C7, C8)	*Hold your fingers out straight and don't let me push them down"*
	Abduction	Dorsal interossei	Ulnar (C8, T1)	*"Splay your fingers outwards and don't let me push them together"*
	Adduction	Palmar interossei	Ulnar (C8, T1)	*"Use tissue paper"*
Thumb	**Abduction**	Abductor pollicis brevis [APB]	Median nerve (T1)	*"Point your thumbs to the ceiling and don't let me push them down"*
	Extension	Extensor pollicis longus [EPL]	Radial	Stretch thumb

MRC MUSCLE POWER SCALE

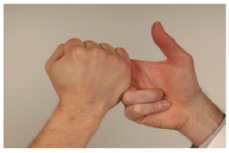
Score	Description
0	No contraction
1	Flicker contraction
2	Active movement (while lying down)
3	Active movement (defy gravity)
4	Active movement (against resistance)
5	Normal

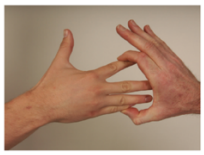


Testing power—shoulder (test each arm separately)


Testing power—elbow flexion: 'Stop me straightening your elbow' (test each arm separately)


Testing power—wrist extension: 'Stop me bending your wrist'

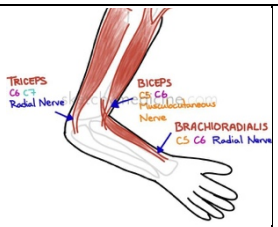

Testing power—finger flexion: 'Squeeze my fingers hard' (don't offer more than two fingers)


Testing power—finger abduction: 'Stop me pushing your fingers together'

Reflexes

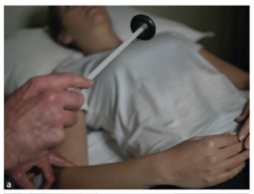
Lie patient on bed

"I'm now going to test your reflexes with a light tap using this hammer. Just relax for me as much as possible"

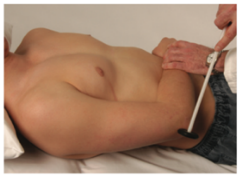


1. **Biceps (C5, C6)**
2. **Brachioradialis/Supinator jerk (C6)**
3. **Finger jerk (C8)** = hold weight of hand
4. **Triceps (C7)**
5. **Hoffman's reflex** = *hold middle finger at DIP → flick nail of middle finger [+ve sign = index/thumb movement]*

If reflex is not found ➔ **clench teeth "Jendrissek"**



The biceps jerk examination

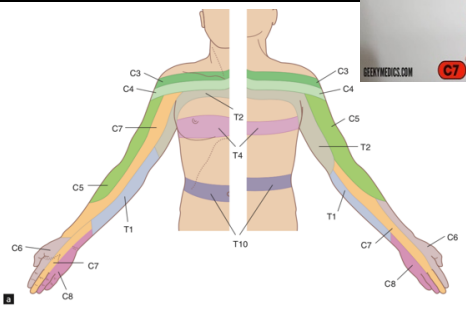

The triceps jerk examination


The finger jerk examination

Coordination	**1. Finger nose test "dysmetria"**	• **Large H (touch my finger /your nose)**	*intention tremor, past pointing = posterior lobe cerebellar disease*
	2. Dysdiadochokinesis [fast repetitive movement]	• **Tap hand on knee as fast as possible [Both sides] ➔**	*slow clumsy movement = ipsilateral cerebellar disease*
	3. Rebound	• **Hold hands out palm facing up → and Lift arm up rapidly to my eye** • Push up and down each arm → should return to normal position	hypotonia (delay in stopping arms) = *cerebellar disease*
	4. Pronator drift [*contralateral pyramidal tract lesion*]	• **"Close your eyes" → observe any DRIFT** • Mild upper limb weakness and spasticity	• *CST + internal capsule* • UMN weakness (from stroke) = spasticity • Ipsilateral cerebellar disease

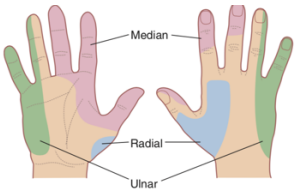
Finger-nose test: 'Touch your nose with your forefinger and then reach out and touch my finger'

Testing for dysdiadochokinesis in the upper limbs: 'Turn your hand over, backwards and forwards on the other one, as quickly and smoothly as you can'

Sensation ***[Close eyes!]*** *Correlate with dermatome]*	• C5 = shoulder tip & outer part of upper arm • C6 = lateral aspect of forearm and thumb • C7 = middle finger • C8= little finger • T1 = medial aspect of upper arm and elbow	
Spinothalamic pathway	• **Pain** (pinprick) → C7 = middle finger • **Cold** (tuning fork) ➔ distal → peripheral (compare both sides)	

Dorsal column pathway	• **Vibration** (128 Hz tuning fork) ➔ bony points (thumb → wrist → elbow)
	  ○ Tell me when the vibration stops (control with finger on fork)
	• **Proprioception** (play a game – this is down/up – close eyes → is this "up or down")
	  ○ Hold thumb on either side + close eyes → move thumb side-to-side	

Mixed	• **Light touch** (does NOT discern between spinothalamic and dorsal column loss)	

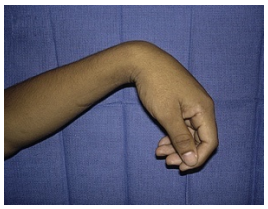


TYPES OF MOTOR NEURONE LESIONS

	Signs of UMN [Hyper – CENTRAL]	Signs of LMN lesions [Hypo - PERIPHERAL]
DDx:	• **Brain**: MS, Amyloidosis/Infiltrative, Trauma • **SC**: Transverse myelitis, Cauda Equina syndrome • **After 6 weeks post**-surgery	• **Anterior horn**: MND, Poliomyositis • **Peripheral nerves**: Peripheral Nerve Injury, GBS • **NMJ**: Myasthenia Gravis • **Muscles**: DMD
Inspection	• Absent fasciculations • Quadriplegia, hemiplegia (contralateral), paraplegia	• **Fasciculations** [esp. tongue, triceps, calf, 1st dorsal interossei] • Denervation ➔ loss of contraction➔ **muscle wasting**
Pronator Drift	**Present Pronator Drift**	Some drift if weak or de-afferented but not pronator
Muscle Tone	**Hypertonia+ clonus** (i.e. clasp-knife reflex +repetitive)	**Hypotonia**
Contraction	**Spasticity**	**Flaccidity**
Reflexes	Exaggerated or brisk (**hyper-reflexia**) Hoffman reflex	Absent (or hyporeflexia)
Power	**"pyramidal" pattern of weakness** **(i.e.** upper limb extensors **weaker** than flexors and lower limb flexors **weaker** than extensors**)** • **Leg** affected: L1 or above • **Arm** affected: C3 or above • **Face** affected: pons or above • **Diplopia**: midbrain or above	**Variable weakness** • proximal weakness in muscle disease • distal weakness in peripheral neuropathy • *Focal pattern of weakness* = damaged nerves = correspond to weakness in innervated muscles
Plantar reflexes	+ve Babinski response [toes point up]	-ve Babinski response [toes point DOWN - plantar]
EMG	NORMAL nerve conduction → decreased interference pattern and firing rate	Abnormal nerve conduction → large motor units → fasciculations

TYPES OF UPPER LIMB NERVE LESIONS

Radial Nerve (C5-C8)	**Median Nerve Lesion** (C6-T1)	**Ulnar lesion** (C8-T1)
• Triceps, • Brachioradialis, • Extensor Muscles Of Hand • **Lesion** = Wrist Drop [cannot straighten finger]	• Ant. forearm muscles + LOAF exc. FCU and ulnar ½ of FDP • **Lesion at wrist ➔ pen-touching test** for APB • **Lesion at cubital fossa ➔** ochsner's clasping test (loss of flexor digitorum) • **Cannot oppose thumb or grab objects**	• Supplies all muscles of small hand except **LOAF** • **Froment's signs ➔** Loss of **thumb adductor** → thumb flexes when holding card • **Clawing** = MCP hyperextension + IP flexion ➔ ***Diff dx*** = *brachial plexus lesion (C8-T1), RA, or neurological disease (e.g. polio, syringomyelia)*



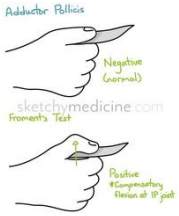
Brachial plexus cords, nerves and their supplied muscles

Cords	Nerves formed	Muscles supplied
Lateral	Musculocutaneous, median	Biceps, pronator teres, flexor carpi radialis
Medial	Median and ulnar	Hand muscles
Posterior	Axillary and radial	Deltoid, triceps and forearm extensors

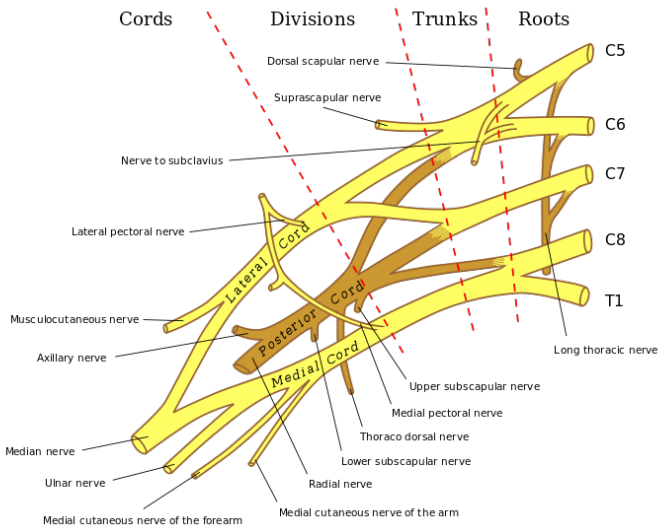
Nerve roots and brachial plexus trunks

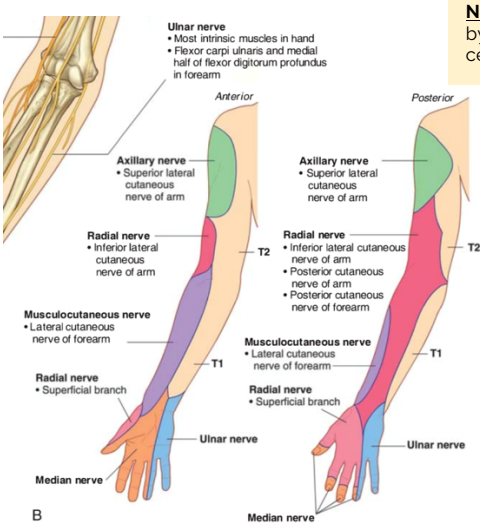
Nerve roots	Trunks	Muscles supplied
C5 and 6	Upper	Shoulder (especially biceps and deltoid)
C7	Middle	Triceps and some forearm muscles
C8 and T1	Lower	Hand and some forearm muscles

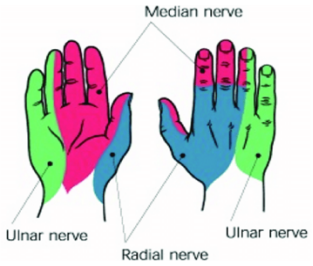
Pen-touching test for loss of abductor pollicis brevis: 'Lift your thumb straight up to touch my pen'



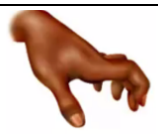
BRACHIAL PLEXUS



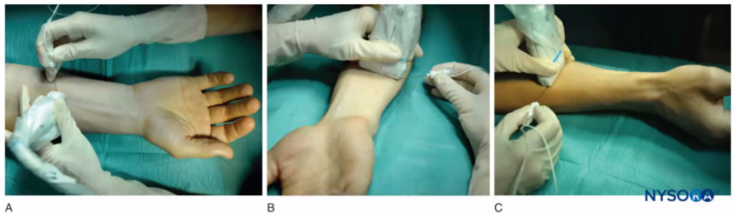




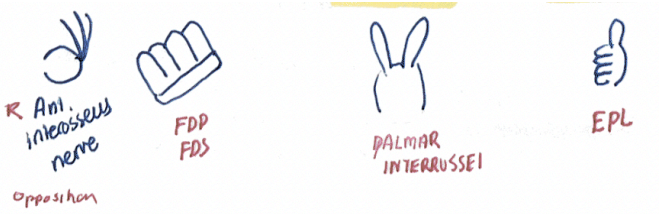
NB: C3/C4 dermatomes provide by supraclavicular nerve of cervical plexus (ansa cervicalis)

Nerves	Root	Location	Innervates	Damage Occurs	Pathology	
Axillary	**C5-C6**	**Posterior cord** *Quandrangular space*	• Deltoid • Teres minor	Surgical neck of humerus fracture or dislocated shoulder "**sergeant's patch**"	**Erb's Palsy" =IR, extended arm + arm length discrepancy** • Loss of Flex/ext | Abd • Loss of External rotation of arm • Sensation loss = C5 dermatome (sup. lateral cutaneous nerve of arm)	
Musculo-cutaneous	**C5-C7**	• **Terminal branch of lateral cord** → from inferior pec. minor • Pierces coracobrachialis	• **Biceps brachii** • Coracobrachialis • Brachialis	**Rare (**as between brachialis & biceps muscles → possible compartment syndrome**)**	**Forearm flexion and supination** • BUT can still flex elbow via brachioradialis with assistance from pronator teres	
Radial *Runs with profunda brachii artery*	**C5- T1**	• **Posterior cord** • Triangular space • **Along radial groove** → Between brachioradialis (medial) & brachialis (lateral)	Posterior compartment • **Supinator** • **Brachioradialis** (flexion ONLY) • **Triceps** (long and lateral)	**Spiral fracture of humerus**	**"Saturday Night Palsy" = compressed nerve while asleep** • **Forearm extension loss** • **finger extension loss (PIN)**	
				Radial groove injury "extension injury"	**Entire triceps** is NOT paralysed since innervated BEFORE radial groove → can still extend forearm • **Wrist drop = reduced extension**	
Median	**C5- T1**	• **Medial & lateral cord** • Middle of cubital fossa • Medial to brachial artery • **Anterior interosseus nerve** = thumb opposition	**Anterior compartment** • **Anterior forearm muscles esp. FCR** (*exc. FCU and ½ FDS)* • **Pronator teres** & **pronator quadratus** (pronation) • **LOAF**	*Injury at **elbow** = proximal nerve entrapment* ➢ *Most common supracondylar syndrome*	**Hand of benediction/waiter's tip** • **Loss of PIP flexion (1-5)** • **Loss of DIP flexion (2-3) ONLY** • **FDP (medial part) innervated by ulnar nerve → allows DIP flexion of (4-5)**	 *'Waiter's tip when asked to form a fist*
				Carpal tunnel syndrome = *distal nerve entrapment*	**Loss of LOAF → CANNOT** • *flex at CMC of 1st – 3rd digits* • *oppose thumb* **BUT** can still **flex at thumb at CMC** due to FPL innervation	
Ulnar	**C8, T1**	• **Medial & lateral cord** (under FCU)	**Intrinsic hand muscles** (exc. LOAF) • **FCU and ½ FDS**	• Elbow fracture • medial epicondyle of humerus • flexion-type / post-op supracondylar #	• Claw hand → loss of intrinsic hand muscles (FDP loss) • **Ulnar paradox = more proximal = less clawing**	

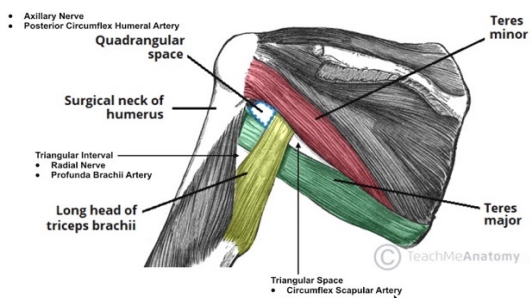
'compartment syndrome (pain = most sensitive symptom)= ↑↑pressure within fascia →ischeamia & necrosis & 5 P's



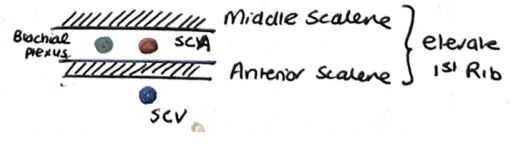
A) median nerve B) ulnar nerve C) radial nerve



The Quadrangular and Triangular Spaces; The Triangular Interval



Nb: Posterior scalene elevated 2nd rib AND all scalene muscles involved in lateral neck flexion



LOWER LIMB NEURO EXAM

Today I performed a lower limb neurological examination on Mr Smith, a 32-year-old male. On general inspection, the patient appeared comfortable at rest, with a normal **gait** and no abnormal **posturing**, **muscle wasting** or **fasciculations**. **Tone** was normal throughout and **power** was 5/5 in all muscle groups bilaterally. **Reflexes** were normal and present at the knees, ankles and plantars bilaterally. **Coordination** was intact with **normal sensations** felt. This was a normal lower limb neurological examination. To complete the examination, I would like to examine the lumbar spine and review any available CT/MRI scans".

Introduction

1. "Do you mind if we examine your lower limbs. It's going to involve me moving your legs, watching you walk a bit"
2. For this examination, I'll need you to **roll up your pants, remove socks and shoes**
3. Are you in any pain at all?

Gait

Test proximal leg weakness:

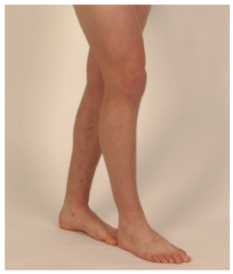
- Arms crossing chest
- Stand up from chair without using hands

Romberg's test [assess proprioception – ataxia = loss of balance?]

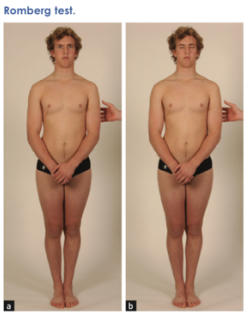
- "Stand with your eyes closed"

Conduct Gait

- **Observe normal cadence**: posture, speed, symmetry, balance and arm swing, stride length, abnormal movements (e.g. writhing)
  - ***?POOR TO command***
  - ***on heels (dorsiflex – L5)***
  - ***on tip-toes (plantarflex -S1)***
  - ***heel-to-toe walk on tightrope (tandem gait)*** = cerebellum, PD
  - ***Squat (L4)***
- **High-stepping unsmooth gait** = foot drop



Cerebellar testing—heel–toe walking

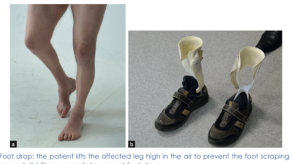


(a) 'Stand with your feet together.' (b) 'Now shut your eyes. I won't let you fall.'

General [SWIFT]

Look from end of the bed: (raise bed to waist level)

- **Scars/skin lesions [hair from interdigits to arm = SNS intact] /Symmetry** (shingles (zoster) with segmental distribution, NFT)
- **Wasting [**vastus medialis, symmetry**]**
- **Involuntary movements** (i.e. *jerks, dystonia/rigidity, myoclonus, chorea*)
- **Fasciculations/twitching** [UMN lesions, *MND, , thyrotoxicosis, primary neuropathy*] | **Feet [arched of flat]**
- **Tremors** (*low freq = PD, high freq = thyrotoxicosis)*
- **Check Vitals: what is the BP, pulse, RR, Temp, O2**
  - **AF** = stroke (embolic)
  - **Febrile** = Guillan Barre syndrome



(a) Foot drop: the patient lifts the affected leg high in the air to prevent the foot scraping on the ground. (b) Shoe supports to prevent foot drop

Differential Dx of Foot Drop

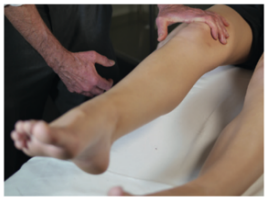
- Common peroneal nerve palsy
- Sciatic nerve palsy
- Lumbosacral plexus lesion
- L4, L5 root lesion
- MND
- Stroke (ACA or lacunar syndrome)

Tone

- **Palpate for tenderness**
- **Leg roll –** on knee cap ➔ feel for looseness
- **Leg lift –** under popliteal fossa (lift up at sufficient height and drop)
  - **Any tense/rigid leg = ?UMN lesion**
- **Ankle clonus with knee bent** [lift ankle and hold base of foot ➔ single quick movement ➔ >5 abnormal]

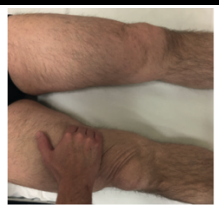
Power (MRC grade)

	Movement	Muscles	Nerve	Nerve	Talk
Hip	**Flexion**	Psoas & iliacus	**L2/L3**	Femoral	Lift leg up and stop me from pushing it down
	Extension	Gluteus Maximus	**L5-S2**	Inferirou gluteal	Push against the bed for me
	Adduction	Adductor longus, brevis and magnus	**L2-4**	Obturator	Push your legs apart [hold both **lateral** thighs]
	Abduction	Gluteus medius & minimus, sartorius and tensor fascia lata	**L4-S1**	Superior gluteal	Push legs together for me [hold both **medial** thighs]
Knee	**Extension**	Quadricep femoris (3x stronger)	**L3, 4**	Femoral	Kick out against me and straighten your leg [hold under knee to bend it and ask to straighten]
	Flexion	Hamstring (biceps, semimembranosus , semitendinosus)	**L5, S1**	Tibial part of sciatic	Bend your knee & stop me from straightening your leg
Ankle	**Dorsiflexion**	Tibialis anterior, extensor digitorum longus/brevis	**L4/5**	Common fibular	Bring your toes up towards your face and stop me from them down [**Hold down ankle**]
	Plantarflexion	Gastrocnemius, soleus, plantaris	**S1/S2**	Tibila	Push down against my hand [**palm on feet]**
Tarsal Joint	**Inversion**	Peroneus longus & brevis & extensor digitorum longus	**L5, S1**	*Tibial*	*Push your foot IN against my hand*
	Eversion	Tibialis posterior, gastrocnemius, hallucis longus	**L5, S1**	*Superficial fibular*	*Push your foot out against my hand*

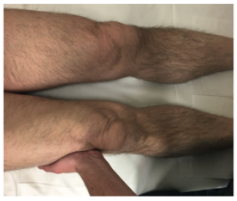


Testing power—hip flexion: 'Lift your leg up and don't let me push it down'

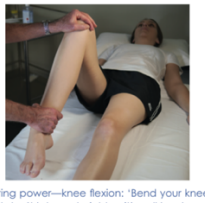
Testing power—hip extension: 'Push your heel down and don't let me pull it up'



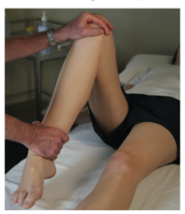
Testing power—hip adduction: 'Don't let me push your hip out'; pull hard



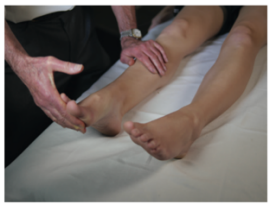
Testing power—hip abduction: 'Don't let me push your hip in'



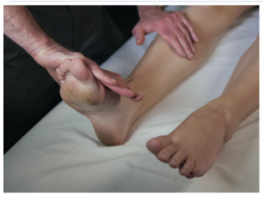
Testing power—knee flexion: 'Bend your knee and don't let me straighten it'; pull hard



Testing power—knee extension: 'Straighten your knee and don't let me bend it'; push hard

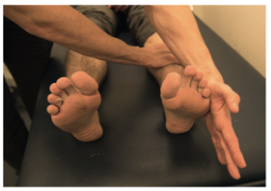


Testing power—ankle, plantar flexion: 'Don't let me push your foot up'



Testing power—ankle, dorsiflexion: 'Don't let me push your foot down'

Testing power—ankle (tarsal joint) inversion: 'Stop me turning your foot outwards'



Testing power—ankle (tarsal joint) eversion: 'Stop me turning your foot inwards'

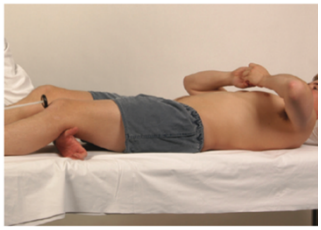
TEST POWER - Provide resistance in middle thigh / leg / foot = avoid any mechanical advantage

Reflexes

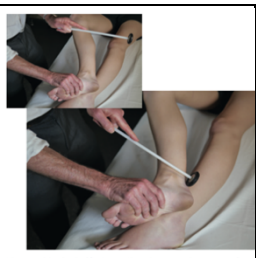
"I'm going to test your reflexes on with a tendon hammer. Let your legs go floppy for me"

- **knee jerk** (L3/4 – Femoral) → you have to flex knee with left hand (hold underneath)
- **ankle jerk** (L5/S1 – sciatic) – bend your knee and bring it to the side
- **plantar reflex** - Babinski (S1) –→ use fingernail or tip of tendon hammer → upgoing toes = ? UMN lesion

'***Jendrassik maneuver*** = *clench teeth to reinforce reflex*



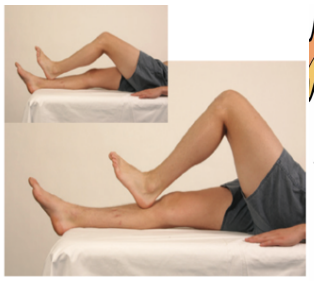
The knee jerk with reinforcement: 'Grip your fingers and pull your hands apart'



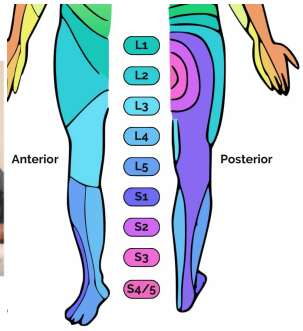
The ankle jerk (first method, see also p 456): the examiner dorsiflexes the foot slightly to stretch the tendon

Coordination

1. **Heel-shin test**
   - Put your ankle on the opposite knee
   - Lift it off and go back to your knee and keep going in a circle
   - Repeat on other leg
   - **heel wobbles (cerebellar disease) or lower limb weakness**
2. **Toe-finger test** ➔ intention tremor (when foot lifted)
3. **Foot-tapping test [each side separately]**
   - Tap your feet against my hand as quickly as possible
   - loss of rhythmicity (when tapping foot on your hand



The heel–shin test: 'Run your heel down your shin smoothly and quickly'



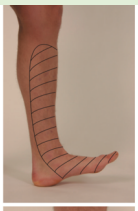
Above knee = L2, **Knee** = L3, **Great toe** = L4,
Lateral foot = L5, **Heel** S1, **Up calf** = S2

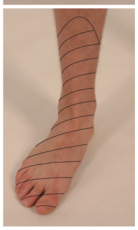
Sensation [Close eyes!] Correlate with dermatome]

Close your eyes [distal → proximal] ➔ Complete both sides

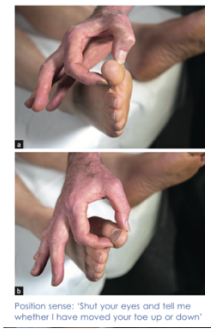
Spinothalamic	**1.** **Pin prick (show pin 1st) = check symmetry and from distal to proximal** ***a.*** TELL me when it becomes normal/sharp **2.** ***Temp*** **= *check symmetry* from distal to proximal [***small gradient normal since distal areas colder – smaller temp. diff]*** ➔ *3-4 locations*
Dorsal columns	**3.** **Vibration (128Hz)** → 1st on wrist/sternum → bony prominence on **big toe** → **patella** → **ASIS** **4.** **Proprioception (joint sensation)** → "Play a game" ➔ hold distal phalanx by its side "tell me if your toe is moving or down"

5. ***Why not do fine touch?*** *Light touch activates the 2 sensory pathways and hence does not allow me to discriminate which pathway could be the problem*

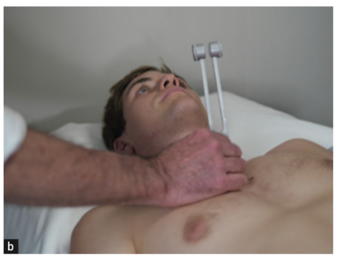


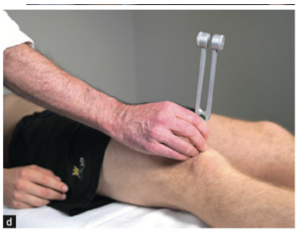


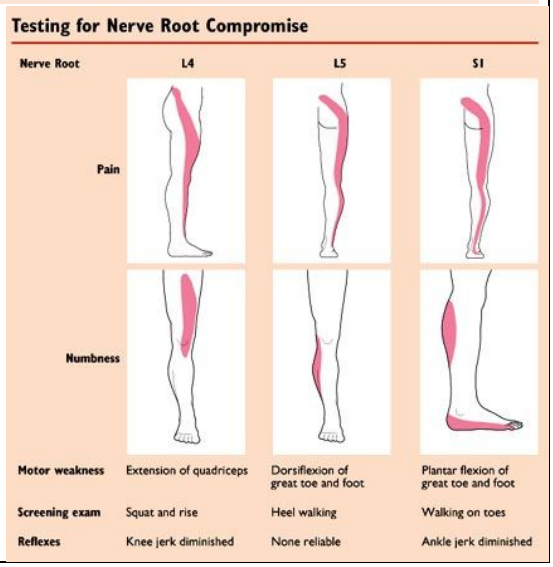
Sensory distribution of the common peroneal nerve (compression at the fibular neck)

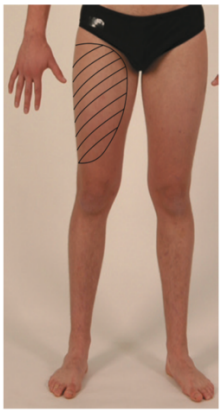


Position sense: 'Shut your eyes and tell me whether I have moved your toe up or down'

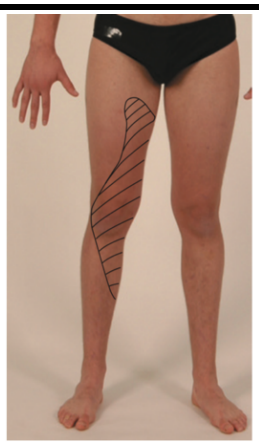




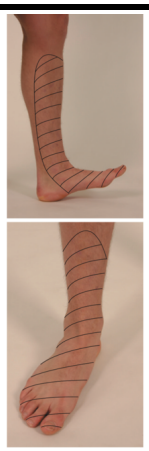




Distribution of the lateral cutaneous nerve of the thigh



Sensory distribution of the femoral nerve



Sensory distribution of the common peroneal nerve (compression at the fibular neck)

Sensory distribution of the sciatic nerve

Lateral cutaneous nerve (L2, L3)	**Femoral nerve (L2, L3, L4)**	**Common peroneal (L4-S1)**	**Sciatic nerve (L4,-S2)**
likely entrapment between inguinal ligament and ASIS ➔ ***meralgia paraesthetica*** ➢ ***Anterior thigh*** ➢ Assoc. w/ long periods of sitting, obese, tight belts ➢ Assoc. w/ DM, pregnancy, trauma	**Weakness**: • knee extension **Reflexes**: • absent knee jerk reflex	**weakness of:** • ankle dorsiflexion • ankle eversion • toe extension **Reflexes:** ➢ present	• **Loss of power below knee** • **Weak knee flexion** ➔ foot drop (plantar-flexed foot) • **Absent ankle jerk** and plantar response (but knee jerk intact)

Contrast peroneal nerve lesion vs. L5 radiculopathy

	Common peroneal nerve (L4, L5, S1)	L5 radiculopathy
Location of weakness	weakness of: • ankle dorsiflexion • ankle eversion • toe extension	weakness of: • ankle dorsiflexion • ankle eversion • toe extension
Sensory loss	Lateral aspect of dorsum of foot	L5 distribution
Reflexes	Yes	Lost
Key differential		• **weakness of ankle inversion** • **weakness of knee flexion** [since tibialis posterior – ankle inverter supplied by tibial nerve - supplied by L5]

DIFFERENT TYPES OF DIZZINESS (NB: Vertigo is a subtype of dizziness)

	Vertigo	Presyncope	Disequilibrium	Light-headed
System affected	Vestibular	Cardiovascular	Neurological	Psychological
Sensation type	Spinning or motion sensation Head spinning → worse on turning head	Near fainting	Unsteady/ imbalance in lower limbs	Non-specific → woozy disconnected from environment
Assoc.	• No LOC + headache • N + V • pallor, sweating	Tunnel vision Still standing	Unsteady gait	**postural hypertension**
Timing	**Episode** / continuous	**Episodic** (few secs) → relief on lying down	Continuous	
DDx	**Intermittent vertigo** / **Constant vertigo** **Hearing normal**: BPPV = (Lying in bed) / Vestibular neuronitis (> 30 y.o.) **Hearing loss**: Ménière's disease (>50 y.o.) + tinnitus / Acute labyrinthitis **DDx:** • **Stroke (> 70 y.o.)** • **Vestibular migraine**	• Dehydration • Anaemia • Arrythmia • Hypoglycemia	• Peripheral neuropathy • Vision loss	• Anti-hypertensives • Anxiety • Hyperventilation

Medical terms for Involuntary Movements:

Akathisia	Motor restlessness; constant semipurposeful movements of the arms and legs ➔ **INNER RESTLESSNESS (?CLUSTER HEADACHE)**
Asterixis	Sudden loss of muscle tone in tonic contraction of an outstretched limb → CO_2 retention, hepatic disease
Athetosis	Writhing, slow sinuous movements, especially of the hands and wrists
Chorea	Jerky small rapid movements → transformed into voluntary movement to scratch head [ABNORMAL POSTURE] ➔ **HUNTINGTONS**
Dyskinesia	Purposeless / continuous movements, ➔ face and mouth (due to Rx with major tranquillisers for psychotic illness)
Dystonia	Sustained contractions of agonist /antagonist muscles ➔ **bizarre postures**
Hemiballismus	Exaggerated form of chorea → unilateral →: wild flinging movements that can injure patient (or bystanders) ➔ **LESION TO SUBTHALAMIC NUCLEUS**
Myoclonic jerk	Involuntary/purposeless jerking → affects **ALL LIMBS → encephalitis, dementia, tumours**
Myokymia	repeated contraction of a small muscle group; often involves the orbicularis oculi muscles
Tic	repetitive irresistible movement that is **purposeful or semipurposeful [preceded by action to do specific task]**
Tremor (Essential)	rhythmical alternating movement at **REST**

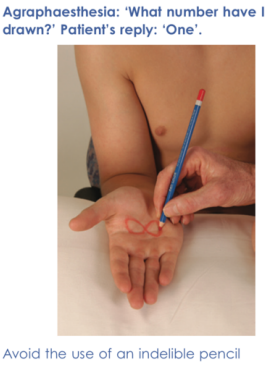
Visual disturbances and deafness	• Cataracts	• Polyopia (many images)
	• **Amaurosis Fugax (TIA in eye)**	• **Curtain closing down vision loss –** painless temporary vision loss due to obstructed BV
	• Migraine, Vascular Lesions	• **Double vision (**diplopia), blurred vision (amblyopia), • light intolerance (photophobia) and visual loss
Disturbances of gait	• **Spastic (Scissoring)**	• UMN disorder (stroke, MS)
	• **High Stepping (Foot Drop)**	• L4-L5 deep fibular nerve compression (**MND, sciatic nerve palsy, CP palsy)**
	• **Slapping Gait**	• B12 deficiency → ***subacute degeneration of spinal cord***
	• **Shuffling**	• Parkinson's disease → **more prefrontal lobe "glued to floor" ➔ TRAPS**
	• **Waddling**	• Myopathic → **DMD, proximal myopathy**
	• **Wide-Based Ataxic**	• Anterior cerebellar lobe lesion (**fall to side of lesion**)
Disturbed sensation or weakness in the limbs	• Paraesthesia In Hands Or Feet	• nerve entrapment or a peripheral neuropathy (e.g. carpal tunnel syndrome) → nocturnal parasthesia
	• UMN (Pyramidal) Weakness	• LESION at level above anterior horn cell ➔ NO muscle wasting
	• LMN Weakness	• lesion at reflex arc between the anterior horn + and muscle ➔ reduced tone + reflexes + fasciculation ➔ **MUSCLE WASTING**
	• Muscle Disease (E.G. DMD)	• wasting and decreased tone and absent reflexes (proximal weakness)
	• Disease At NMJ	• myasthenia gravis [general weakness BUT normal reflexes/tone]
	• Non-Organic Weakness	• Hysteria with normal tone and power
Tremor and involuntary movements **[become worse with fatigue, active SNS,** beta-agonist drugs or caffeine]	• **Resting** Tremors [**3-5 Hz**]	• Parkinson's disease = when muscles relaxed
	• **Benign Essential** Tremor [**4-7Hz**]	Autosomal dominant = postural tremor disappears when muscles at rest (**esp. upper limb)**
	• **Physiological** Tremor [**8-13 Hz**]	Thyrotoxicosis = fine tremor assoc. with maintaining posture or performing a movement slowly
	• **Postural** Tremors	When limbs active (e.g. writing)
	• **Action** ('Intention') Tremors	Cerebellar disease = voluntary actions (tremor worse at end of action)
	• **Shivering**	• type of tremor caused by cold

Higher Centres & Mental State:

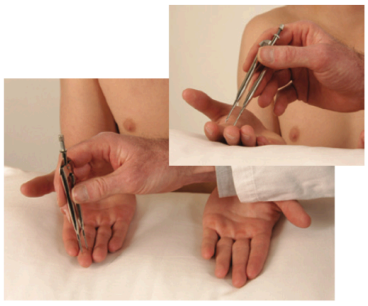
Cerebral hemisphere	Dysfunction	Testing
Frontal lobe defect [*frontal lobe dementia or space occupying lesion*]	• Disinhibition + Impaired cognition, judgement • Volatile and unkept appearance • "**jacksonian march** = progressive jerks peripheral to central (distal to proximal)	• **P**rimitive reflexes – grasp, palmomental, *pout and snout (normal in children/elderly, abnormal in adults)* • **I**nterpret a proverb • **G**ait apraxia • **S**mell (anosmia - CNI)

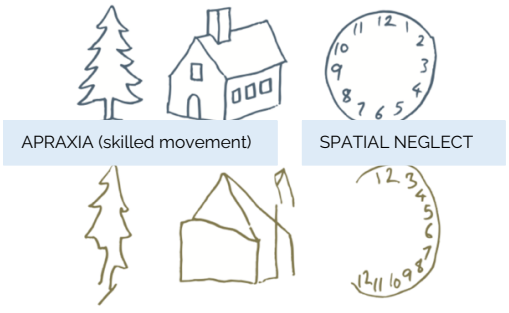
Temporal lobe defect	• **Korsakoff's psychosis** (confabulation, short term memory)
	• **TBI / concussion** (Retrograde amnesia)
		• **Memory loss**
		  ○ **Short term** - name 5 items, ask patient to repeat this 5 minutes later
		  ○ **Medium – who is married to your son?**
		  ○ **Long term** – when did WW2 end?
		• **Hearing loss and inability to lateralise** (Weber's test)
		• **H**allucinations
		• **E**pigastric rising
		• **A**utomatisms
		• **D**éjà vu feeling

Dominant Parietal lobe defect	• **Gerstmann's syndrome** [impaired in dementia] • **NB: contralateral defects (make sure to ask about dominant hand!)**	• **A**calculia (7 + 7 + 7 + 7 = series of 7's) • **A**graphia (Cannot Write) • **L**/R disorientation → place tissue paper with left hand and put it on right foot • **F**inger agnosia (Cannot Name fingers)
non-dominant Parietal lobe defect	• Issues with cortical sensation	• **Agraphaesthesia** ➔ Draw numbers/letters in skin and ask patient to tell you what number/letter was drawn • **Sensory/visual inattention** • **Two point discrimination** → use a compass pin to measure distance between two points • **Spatial neglect** ➔ draw a clockface with the time • **Dressing/constructional apraxia** ➔ cannot dress properly • **Tactile agnosia** • **Visual field defects** ➔ check visual fields • ***Dysprosody*** = loss of the normal ups and downs in speech, without a change in the content from a non-dominant hemisphere lesion [not dysphasia]
Occipital lobe	• Visual mainly	• **Vision loss** • **Floaters and flashes**



Avoid the use of an indelible pencil


Two-point discrimination: 'Can you feel one point or two?'



Lower figures show (a and b) constructional apraxia and (c) spatial neglect

Speech / Language Issues

Always examine speech in a post-stroke stetting ➔ all paraphrasic errors

	Brain area affected	Name object [speech]	Comprehend	Impaired Repetition	Reading	Writing
Receptive (sensory) dysphasia	Wernicke's area	Fluent, good grammar but meaningless	Poor [*auditory dysphasia*]	*Yes*	dyslexia	
Expressive (motor) dysphasia	Broca's area]	**Slow, non-fluent** poor grammar ➔ often frustrated	Good	Ok [With effort]		dysgraphia
Conduction dysphasia	Lesion to arcuate fasciculus	Poor naming Fluent, good grammar	Good	*Yes*	dyslexia	dysgraphia
Nominal dysphasia	Lesion to dominant posterior temporoparietal area	**Cannot name** objects [Fluent Speech and use of long sentences]	Good	Good		

What is dysarthria? = difficulty articulating

Dysarthria "slurred, slow speech" =when speech muscles become weak or lost control of them.

- Causes include**: bell's palsy (CNVII lesion), cerebellar lesion, drunkenness, opiate usage**

Dysphonia (or hoarseness/abnormal sounds)

- Causes include **vocal cord injury ➔ RLN damage/mass compression OR CNX lesion**

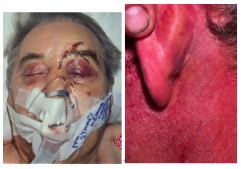
DDx causes of aphasia:

1) Infection
2) Brain tumour (temporal lobe)
3) Stroke (CNX)
4) Psychogenic
5) Vagal nerve paralysis
6) Vocal cord damage

RAISED ICP & BRAIN ISCHAEMIA

ICP causes & Pathophysiology

- Trauma → Bleeding
  - Contusion? Shear injury?
  - ***Raccoon Eyes*** [anterior skull bone fracture] → risk of meningitis = **open fracture in paranasal sinuses**
  - ***Battle sign*** [petrous temporal bone fracture] – otorrhea (CSF leakage) = **basal skull Fracture**
- Tumour
- Infection (Abscess, mastoiditis)
- Metabolic failure (causing lipolysis, proteolysis etc.
- Late cause: hydrocephalus, epilepsy



Monro-Kelline Doctrine: [$V_{CSF} + V_{Blood} + V_{Brain} + V_{Intracranial\ Space} + V_{Other} = K$]

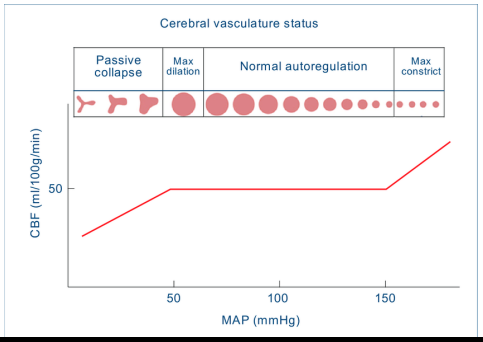
- incompressible rigid skull (≈ 1600mL)
- ICP ≈ 7-15mmHg (supine) affected by cardiac and resp. cycles
  - Pressure-volume index (PVI) = vol. added to intracranial vol. to increased ICP by factor of 10
- **Changes in vol. up to 100-120mL can be compensated if CSF shunted down SC**
  - CSF = shunted down spinal cord
  - Increased venous blood in dural venous sinuses
- **Loss of autoregulation:** ➔ Non-compliant brain = **lower PVI** = small vol. changes causes greater changes in Pressure

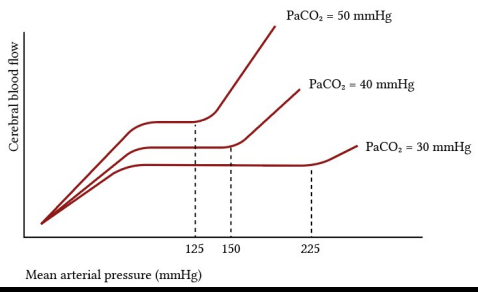
Clinical Px

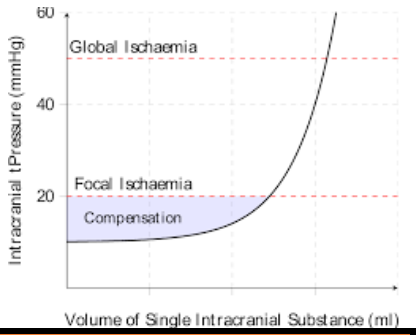
- Headache [Herniation & midline shift]
- Vomiting
- Stupor/Coma
- Bulging fontanelles (infants)
- **Cushing's triad (irregular RR, widened PP, and bradycardia)**
- Cheyn stokes breathing (shallow rapid breaths)
- *Mass effect*:
  - **CN3 palsy**
  - **CN6 palsy** (most likely affected by raised ICP due to long course)
  - **FND**
- **Extensor posutre**

Rx

- Head of bed elevation
- Mannitol
- **Decompressive craniectomy** (remove fontanelle)
- **Burr-hole washout** (subdural)
- **Clot evacuation + ligate bleed** (epidural)
- **Intubate + hyperventilate** (raise CPP and prevent herniation e.g. CNV3 – Foramen ovale)







Cerebral perfusion pressure

CPP = MAP – ICP

MAP = [1/3 (SP-DP)] + DP

- CPP maintained via **autoregulation** over MAP range (60-150mmHg)
- **CPP < 70mmHg** OR **ICP > 50 mmHg**
  - **ischeamic brain damage**
  - Hypereamic response
- Chemo-regulation (**mainly CO_2**, also O_2 , pH, calcium, NO)
  - **hypercapnia** = vasodilatation = ↑ **CBF**
  - **hypocapnia** = vasoconstriction = ↓ **CBF**

Cerebral blood flow

$$\textbf{CBF} = \frac{CPP}{CVR} = \frac{\Delta P}{\frac{8\mu L}{\pi r^4}} = \frac{\Delta P \pi r^4}{8\mu L}$$

CVR = *cerebrovascular resistance*

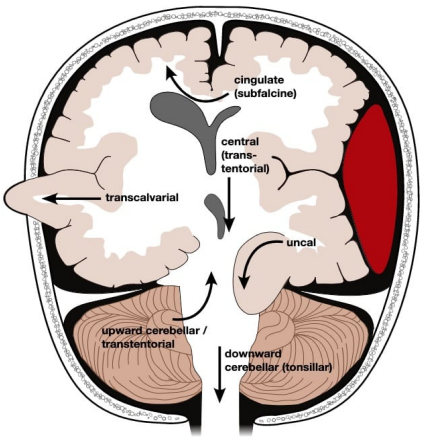
- ≈ 50% of total CVR arises from **small piar arteries (150-200µm in diameter) and arteries of circle of Willis**
  - **R** = vessel radius
  - **L = vessel length**
  - **µ** = coefficient of fluid viscosity

Oedema

Type	Description
Cytotoxic	cellular swelling 2° to cell injury (hypoxia, reduced substrate)
Vasogenic	vascular leakage via disrupted BBB = ↑↑ fluid ➔ cancer, TBI, inflamed
Interstitial	transependymal flow of CSF → ***normal pressure hydrocephalus*** (dementia, gait disturbed, incontinence)
Osmotic	Normally hyperosmolar brain → ↑ osmosis from blood plasma into brain via gradient (intact BBB)

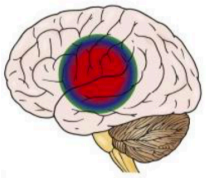
Herniation Types

	Symptoms
Subfalcine	• Midline shift of septum pellucidum • Infarction ACA → contralateral hemiparesis (legs > arms) • cognitive/emotional impairment
Central / transtentorial	• **Cushing triad** (HTN, bradycardia, irregular RR) • decorticate → decerebrate posture *if involvement of rubrospinal and the vestibulospinal tract* • Vegetative state OR death
Uncal / Temporal transtentorial	CN3 Palsy (ipsilateral mydriasis, anisocoria) • **contralateral hemiplegia** (motor weakness) • **Kernohan notch phenomenon** → ipsilateral weakness due to excess midline shift causing compression of opposite cerebral peduncle containing CST fibres
Cerebellar tonsillar	• Medulla compression → respiratory dysfunction → death • May lead to **chiari malformation** [i.e. tonsils compress SC]



Discuss the metabolic requirements of neurons.

Ischaemic core:
- Perfusion below a threshold needed to maintain certain biochemical functions
- Neurons – terminal loss of membrane potential (permanent depolarisation) – cannot be revived - infarction



TIME COURSE
- 10–20 min: few scattered dead neurons in core.
- 60 min: infarct observed in core.
- 6-24h: infarct encompasses core & penumbra.

Penumbra:
- Surrounding region of intermediate perfusion (may be collateral supply)
- Neurons depolarise intermittently
- Potentially salvageable if re-perfused (blood flow restored)

GLUCOSE
- Enters cells via GLUTs
- Conversion to G6P
- 3 potential pathways (cytoplasm)

Glycogenesis Neurons – no Astrocytes - yes → Glycogen

Glycolysis Neurons – low Astrocytes - high → Pyruvate + 2 ATP → Aerobic glycolysis in astrocytes – produce and excrete **lactate**

PPP **Neurons – high** Astrocytes - low → NADPH → GSH ⇄ GSSH → ROS

OTHER SUBSTRATES

TCA cycle/oxidative phosphorylation

Neurons – high (lactate-pyruvate pathway) Astrocytes - low → >30 ATP

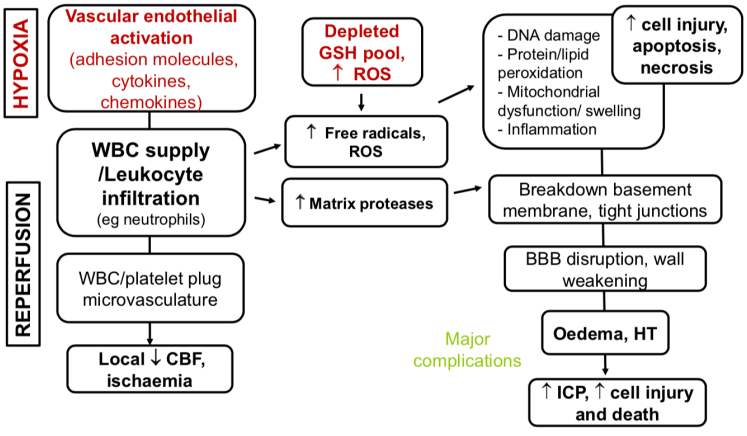
Energy maintenance in neurons

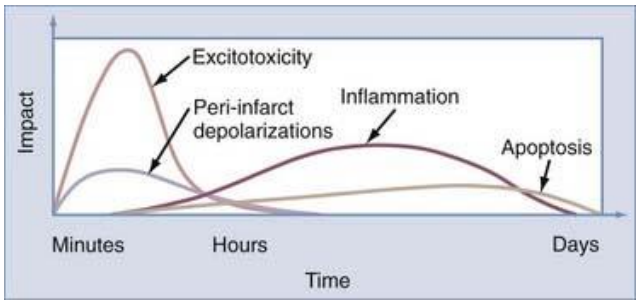
Coupled/ finely balanced

Neuroprotection

Key points:

- Neurons have high ATP/energy needs and rely on oxygen and glucose for oxidative phosphorylation (TCA cycle)
  - ATP powers **Na+/K+ ATPase and transporters to generate APs and release neurotransmitters, respectively.** *Excess glutamate at pre-synaptic terminal is toxic, hence needs to be removed*
  - **However, pathway requires substrate (i.e. lactate) + oxygen** availability → **Ischaemia (no O_2) stops this process or no glucose will cause neuronal death**
  - Neurons *CANNOT* store glucose as glycogen
- **Astrocyte-neuron coupling** plays an important role in metabolism and antioxidant defence.
  - **Astrocytes use aerobic glycolysis → produce lactate** (even in presence of O_2) → lactate released via MCT→ received by neurons via monocarboxylase transporters (MCTs) → converted into pyruvate → enters mitochondria and TCA cycle
  - *NB: primary source of pyruvate for neurons comes from lactate NOT glucose*
- Mature neurons ***down-regulate*** glycolysis = switch off glycogenesis → divert glucose into PPP (to generate GSH antioxidant and replenish reserves) – to stop neurotoxicity caused by ROS/oxidative species.
  - GSH = antioxidant that needs to be constantly replenished to ***prevent*** endogenous stress (from ROS) + neuronal death
  - **Astrocyte-neuron coupling** ➔ couple glucose metabolism to antioxidant defence





- ***Ishaemia***
  - *no ATP= inactivated Na+/K+ ATPase → influx and accumulation of Na in cell = cellular oedema*
  - reduced GSH (antioxidant) production
- **Loss of neuronal selective membrane permeability and ion gradient** = anoxic depolarisation
- Over-stimulated post-synaptic glutamate receptors → Excess influx Ca^{2+} → **Glutamate excitotoxicity & free radical production (proteases, lipases etc.)**
- **Neuronal nitric oxide synthase (NOS) → increase free radicals (NO)** → stimulate cell damage and inflammation – leukocyte infiltration, microglial activation

Reperfusion
– restoration of microcirculation

Recanalisation
(unblocking of artery)

No-reflow phenomena
- Capillary obstruction (intraluminal entrapment of erythrocytes, leukocytes, platelets)
- Luminal narrowing (continuous pericyte contraction, external compression from swollen astrocyte end-feet)

Increase infarcted area (cell death)

Oedema + Haemorrhagic transformation (HT) → ↑ICP etc

Major repercussions in brain

What happens if we reperfuse?

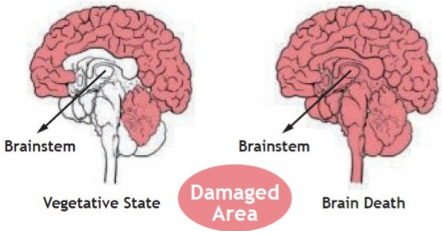
Rapid Reperfusion injury can **worsen outcomes** after ischaemic episode
- Enlarge infarcted area and increase neurological damage
- Cerebral oedema and/or haemorrhagic transformation ➔ increasing ICP ➔ FND or global effects

Solution:
- ***Pre-conditioning*** (expose/adapt to short periods of hypoxia)
- ***Post-conditioning*** - transient reperfusion/re-occlusion cycles to ***induce protective*** mechanisms → reduce ROS
- ***Therapeutic Hypothermia*** (reduces enzymatic activity and cellular damage) – during or after ischaemia

Define Brain Death

An individual is dead if they sustain either:

1. Irreversible cessation of circulatory and resp. functions
2. Irreversible cessation of all BRAIN functions **PLUS** brain stem



	GCS	PTA	LOC
Mild	13–15	<1 day	0–30 minutes
Moderate	9–12	>1 to <7 days	>30 min to <24 hours
Severe	3–8	>7 days	>24 hours

Longer the amnesia OR lower the GCS
⇧ risk of death/ disability

Vital signs for brain death

- **Core temp. >35°C [**anything below = hypothermia = stunned state]
- **SBP>100mmHg** [anything below = hypoperfusion = shock]
- **No drugs** simulating brain death (e.g. baclofen, anti-cholinergic, barbiturates)
- **Blood alcohol content** <0.08%
- **Absent brainstem reflex (corneal, VOR, RAPR)**
- **No response to deep central pain (***cerebration/decortication are not compatible with brain death***!) ➔ trap squeeze, press supratrochlear**
- **Failed apnoea challenge (***no resp. with pCO2>60 mmHg)*
- **Brain death in children** ➔ 2 exams inc. *apnoea testing* separated by an *observation period*
  - 12-24 hrs according to age, with cut off of 30 days of age for term newborns (i.e. 37 wks gestational age)
- No guidelines for infants < 37 weeks gestational age

Most common etiologies of brain death

1. TBI
2. SAH (most common = 2° to TBI, other = aneurysm
3. ICH (2° to TBI)
4. Stroke with cerebral edema & herniation (↑ ICP)
5. Hypoxic-ischemic encephalopathy
6. Fulminant hepatic necrosis + cerebral edema + ↑ ICP

DDX:

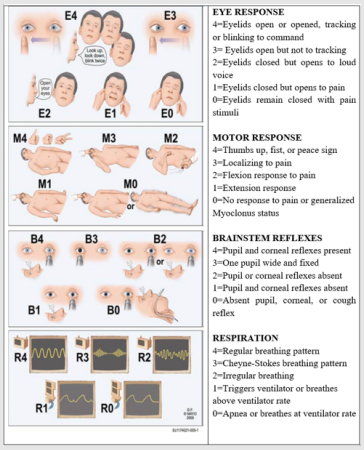
- Locked-in syndrome
- Guillain-Barre' syndrome [antibodies to ganliosides - SC]
- Severe hypothermia (<28 C)
- Anaesthetic or sedative medications

TABLE 38-2
Glasgow Coma Scale

BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	*Best response*	15
	Comatose client	8 or less
	Totally unresponsive	3

Limitations:

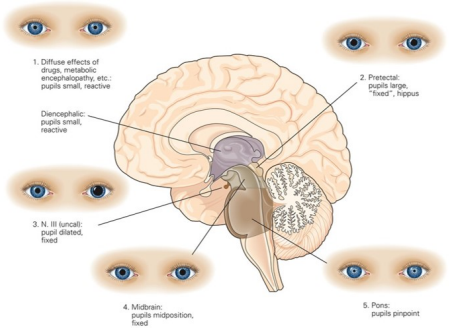
- **Everything will score 3** (even the kitchen table!)
- Requires a **verbal response** – can't be used on patients that are intubated, mutes, paraplegics?
- Does **NOT** assess brainstem reflexes.
- **Biased** towards a motor response

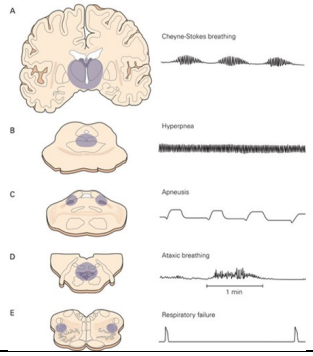


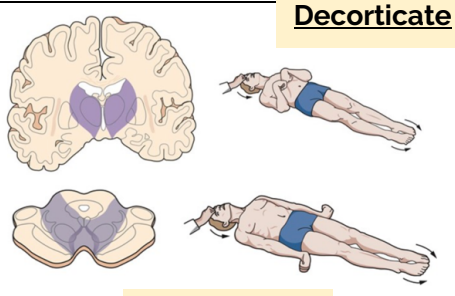
Benefits of FOUR score:

- Can be used on *intubated patients*
- Can *detect early changes in consciousness* (particularly useful for metabolic disturbances etc).
- **NO bias**

(3) LOCALISING SIGNS to assess UNCONSICOUS PATIENT







Decorticate

Decerebrate

#1: Eye Movements

The **reticular activating system** is anatomically close to the midbrain structures that control pupillary function and breathing.

- **upper brainstem lesion** = Enlarged pupils + loss of light reaction and vertical and adduction movement of the eye
- **intact brainstem [Vegetative state]** = normal pupillary light reactivity and eye movement [likely widespread structural lesions or metabolic suppression of cerebral hemispheres causing LOC]

#2: Breathing changes

A. **Bilateral cortical or diencephalic dysfunction** → **Cheyne-Stokes breathing** (waxing and waning breathing pattern interspersed with apnoea)

B. **Hyperpnea or hyperventilation** ➔ **brainstem tumour**.

C. **Lesions of the parabrachial region of the rostral pons** causes **apneusis** (pattern of deep, prolonged inspiration)

D. **Lesions of the pontomedullary junction** ➔ **ataxic breathing** (irregular frequency, duration and depth of breathing). →LEADS to respiratory failure

E. **Lesions at level of the rostral ventrolateral medulla** ➔ **respiratory failure**. Occasional gasps interspersed with long apnoea may occur.

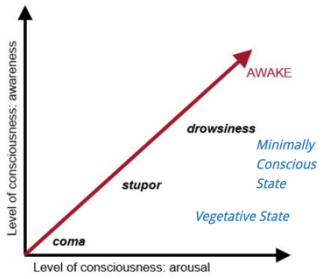
#3: Changes in posturing

Decorticate Posturing (M3)	**Bilateral damage to diencephalon**	Upper limb flex Lower limb extend
Decerebrate Posturing (M2)	**Severe midbrain damage**	All limbs extend

*NB: Progression from decorticate → decerebrate posturing indicates **rostrocaudal deterioration of brainstem** (→ respiratory arrest if medulla affected)

Collapse Consciousness

Term	Definition
Awareness	content of consciousness (i.e. you know what is happening)
Arousal	level of consciousness (e.g. asleep vs. awake)
Coma	most severe state of reduced alertness (cannot be aroused) • ONLY result from **BILATERAL** cortical damage OR damage to ***reticular activating pathwa***
Stupor	higher degree of arousability than a coma (aroused with vigorous stimuli)
Drowsiness	simulates light sleep (easy arousal & alertness for brief periods)
Vegetative State "awake coma"	• awake but unresponsive state (i.e. eyes open, CV regulation maintained but not responsive to environ. cues) • ***widespread cortical damage***, ➔ BUT reticular activating is intact because they have a sleep-wake cycle • *Due to head injury or cardiac arrest*
Minimally conscious state	• Less severe vegetative state → shows some awareness of self and surroundings • *Due to head injury or cardiac arrest*
Akinetic Mutism	• virtually immobile and mute BUT can think and form impressions
Catatonia	• hypomobile and mute syndrome + few voluntary or responsive movements
Locked-In Syndrome	• Patient is awake and can move eyes BUT cannot speak [**PONTINE ARTERY STROKE**]



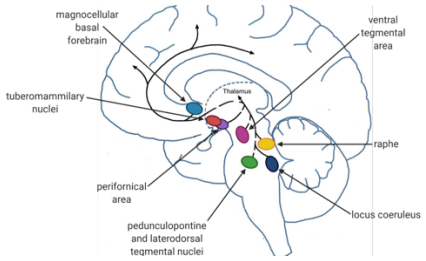
Explain the role of the reticular activating system in consciousness – how is consciousness processed in the NS?

Trigger/stimuli		2 pathways	Origin of pathway	Structures involved
• *Somatic* • *Visual* • *vestibular*	**ASCENDING RETICULAR ACTIVATING SYSTEM**	AWARENESS	Thalamus [Dorsal]	cortex
		AROUSAL	reticular formation [ventral]	hypothalamus, thalamus, basal forebrain projections and cortex

*Without arousal = there is NO awareness

Identify drug classes affecting reduced LOC & Describe how to reverse this

	Pathway	Function
Reticular structures	**monoaminergic pathways** from locus ceruleus and raphe =	regulate sleep and wakefulness
	glutamatergic projections from the rostral pons and caudal medulla	regulate sleep and wakefulness
Non-reticular structures	**lateral hypothalamus** (orexin and melanin concentrating hormone containing neurons)	regulate sleep and wakefulness
	cholinergic and GABAergic neurons in the basal forebrain	arousal



Both reticular and non-reticular structures contribute to arousal

	MoA	Overdose	Examples
Sedatives-Hypnotic Agents	facilitating actions of GABA • Sedatives portion provide calming anxiolytic • hypnotics produce sleep-inducing	No reversal agent – supportive care only	• **short acting GABA agonists** (e.g. triazolam), • **benzodiazepines** (e.g. temazepam, diazepam), • **barbiturates** (e.g. thiopental, pentobarbital),
Opioids	Widespread reduced neuronal activity → Resp depression	reversed with μ-opioid receptor antagonists **e.g. naloxone**	heroin, morphine, oxycodone.

Others: antihistamines, centrally acting sympatholytic antihypertensives (clonidine), antidepressants, antiemetics (metoclopramide)

Occlusion of which blood vessel would result in ipsilateral CN VII palsy, decreased consciousness, hemiparesis and hemiataxia, oculomotor defects and arm posturing?

- ✔ Mid Basilar Artery
- Extracranial Vertebral Artery
- Intracranial Vertebral Artery
- Distal Basilar Artery

1/1

Which of the following **would not** result in a loss of consciousness?

- Increasing intracranial pressure.
- ✔ Increasing blood supply to the brain.
- Disrupting the activity of the sodium potassium pump.
- Decreasing the neuronal membrane potential.

1/1

Which type of herniation occurs when there is symmetrical downward movement of the diencephalon through the opening of the tentorium cerebelli?

- Foraminal herniation.
- Uncal herniation.
- ✔ Central herniation.
- Subfalcine herniation.

Which brain region would antihistamines affect to produce drowsiness?

- ✔ Tuberomammilary Nucleus.
- Perifornical Area
- Ventral Tegmental Area
- Raphe.

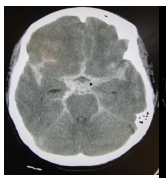
STROKE: TYPES

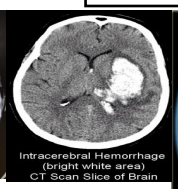
Box 5. The recognition of stroke in the emergency room (ROSIER) score

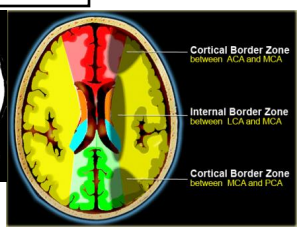
	Score Yes	No
Has there been loss of consciousness or syncope?	-1	0
Has there been seizure activity?	-1	0
Has there been new acute onset (including on wakening from sleep) of:		
Asymmetric facial weakness	+1	0
Asymmetric arm weakness	+1	0
Asymmetric leg weakness	+1	0
Speech disturbance	+1	0
Visual field deficit	+1	0

FAST Symptoms
(Face/arm Weakness, speech/dysphasia, or vision)

- **Stroke** (ROSIER score >1)
  - **Haemorrhagic** (15%)
    - **Risk factors:** advanced age, anti-coagulation, EtOH, HTN, stress, smoking
    - **3 H's of stroke**
      1) Higher cortical function (speech, apraxia, neglect, gaze deviation)
      2) Hemianopia
      3) Hemi-loss (motor/sensory)
    - **SAH**
      - Cause: aneurysm, TBI,AVM
      - Xanthrochromasia (in CSF) Hydrocephalus Vasospasm (released blood products)
    - **ICH**
      - Cause: HTN, infection, tumour, TBI, AVM, amyloid deposits
      - Raised ICP = MASS effect (haematoma) Bleeding = releases hamolysis products causing toxicity --> LOC
  - **Ischaemic** (85%)
    - **Mod. Risk factors:** smoking, HTN, DM, Obesity, HC, FHx, COCP
    - **Non-mod. Risk factors:** Previous, AF, FHx,, vasculitis, thrombophilia
    - **Global Ischaemia (LARGE VESSEL)**
      - Assoc. atherosclerosis and embolism
      - Total stroke (3/3 H's)
      - Partial stroke (2/3 H's)
    - **Lacunar "silent" infract (SMALL VESSEL)**
      - Small infarct < 20mm Assoc. HC, HTN, T2DM
      - Lacunar stroke (1/3 H's) NO cortical signs NO preference (arm = leg =face)
      - **Types include**: 1) pure motor (50%) 2) pure sensory 3) mixed 4) dysartrhia 5) Ataxic hemiparesis
    - **Thromboembolic**
      - **Thrombotic (50%)**
        - **Local clot** **Slow** onset
      - **Embolic (30%**
        - **Distal** clot **rapid** onset large vessel
        - Fat embolic, AF, infection, tumour
- **TIA** (rapid recovery < 24hrs) ***ischaemia* without *infarction***
  - Low flow TIA (mins) (classic FND)
  - Embolic TIA (hrs) (localsied to territory)
  - Lacunar TIA (capsular warning syndrome)







STROKE: Work up

Stroke (time-based)

↓

Non-contrast CT head (exc. intracranial bleed)
can also use DWI and CTA +/- pefusion scan after

↓

Thrombolysis (alteplase) if ≤ 4.5 hours
Or if not
Aspirin 300mg PO/PR for 2 weeks
Clopidogrel 300mg PO STAT then 75mg OD

↓

Consider endovascular clot retrieval (if within 6 hours **AND pt has large vessel occlusion with minimal brain damage)**
Transfer to acute stroke unit (ASU)

↓

MDT management:
1) Speech pathologist, ophthalmologist, psychologist
2) neurologist + neurosurgeon
3) stroke rehabilitation nurse coordinator
4) dietician = **nutritional optimisation**
5) social worker = coordinate stroke rehab

↓

EARLY immobilisation (physio)
TREAT INFECTIONS early + Protect pressure areas
Acute: Give Anti-HTN + Warfarin 24 hrs after clot removal
Long-term drugs (Anti-HTN, 75mg PO Clopdiogrel, statins - wait 24 hrs after stroke)
Consider carotid endarterectomy (carotid USS doppler)

Stroke in young
Functional fake → "drop hand over face"
- dissociative disorder (stress),
- factitious

Organic;
- APS, homocystienuria
- Fabry's
- AVM
- 'berry' aneurysm / cardiac embolism

CI for thrombolysis
- Concurrent warfarin
- SAH or previous ICH
- Aneurysm or AVM
- Brain cancer
- Acute pericarditis
- Recent surgery /LP
- Active GI or UT bleed
- Uncontrolled HTN (>185/110)

DRIVING CONSIDERATIONS
- **If normal** = wait 2 weeks
- **If recovering** = NO DRIVING for ≥ 4 weeks (Service NSW report if Heavy vehicle driver)
- **If seizure** = cannot drive for 6/12

TIA (SUSPECTED)
(not time-based)

↓

Higher risk of developing lacunar stroke within 24 hrs
Aspirin 300mg PO/PR for 2 weeks
Clopidogrel 300mg PO STAT then 75mg OD

↓

Specialist review within 24 hours
(and CTA +/- pefusion scan)

↓

Consider carotid endarterectomy if:
1) ipsilateral carotid stenosis > 50% OR
2) ipsilateral carotid stenosis > 70% (ECST)

Long-term drugs = secondary prevention
(Anti-HTN, 75mg PO Clopdiogrel, statins)

F/U investigations include:
ECG, 24-hr ECG tape, ECHO, vasculitis and thrombophilia screen, carotid doppler USS

STROKE: LOCATION

Lenticulo-striate artery

Supplies anterior limb of IC, basal ganglia

3 H's – hemiparesis, hemiplegia, hemianopia

Sensori-motor (tremor, spasms, rigidity)

MCA/Branch occlusion (most common)

Supplies lateral frontal, parietal and superior temporal lobe

- Contra **LOWER** facial hemiplegia
- Contra hemiplegia (**arm/face > leg)**
- Contra sensory loss (**arm/face > leg)**
- Contra homonymous hemianopia

Dominant hemisphere

- Dysphasia

Non-dominant hemisphere

- Contra neglect (spatial)

Triad of:

- Facial / upper limb weakness
- Vision
- Speech

PCA Occlusion

Supplies occipital lobe, thalamus, inferior temporal lobe, splenium of CC

- Contra homonymous hemianopia
- Contra sensory loss
- Involuntary movements = Parkinson's

Special features

- "alexia without graphia" "disconnection syndrome"

Triad of:

- Vision loss
- Nausea
- Vertigo

Thalamic (*branch of PCA*)

Supplies PINEAL GLAND

Post. Choroidal artery (*branch of PCA*)

Supplies thalamus → sensory loss

Pontine Arteries ("locked in syndrome")

- Eye movements preserved
- Whole body paralysis

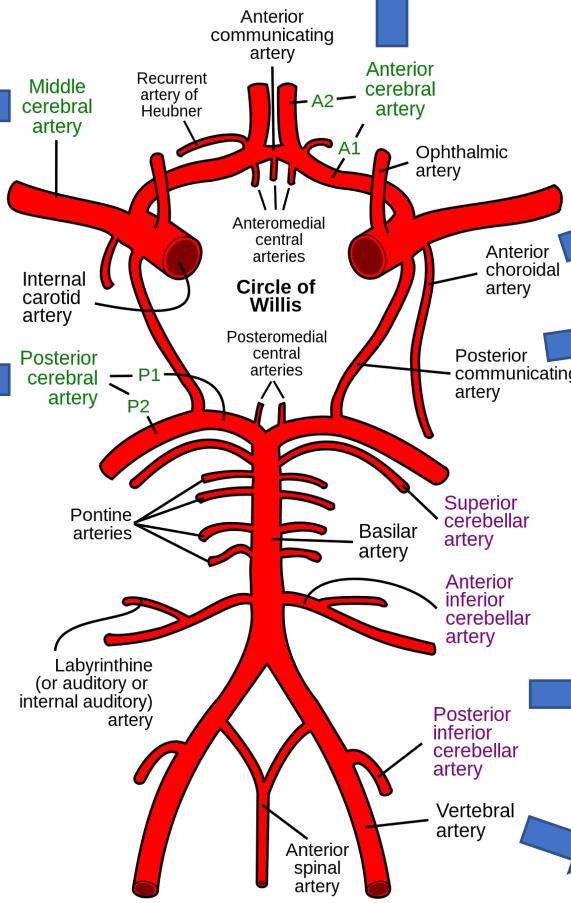
ACA Occlusion

Supplies medial frontal lobe (leg part of homunculus), superior-medial parietal lobe

- Contra **LOWER** facial hemiplegia
- Contra hemiplegia (**leg > arm)**
- Contra sensory loss (**leg > arm)**

Triad of:

- Lower limb Apraxia (skilled movement)
- Urinary incontinence
- Abulia (lack of will, motivation)



Carotid Artery Dissection (Ant. Circulation)

Recent neck trauma (hyperextension injury)

- Young patient w/ neck pain
- Dysarthria
- **Paralysis**
- **Sensation loss**

Anterior choroidal artery

Supplies medial temporal lobe, posterior limb of IC, choroid plexus

3 H's – hemiparesis, hemiplegia, hemianopia

PcomA ("oculomotor nerve")

- CN3 palsy → mydriasis, exotropia, complete ptosis, anisocoria
- Must exclude SAH

Lateral Medullary Syndrome (occlusion of vertebral or PICA)

Supplies brainstem, cerebellum

- Ipsilateral cerebellar signs (DANISH)
- Ipsilateral Horner's
- **Pain & temp sensation loss** (ipsilateral face & contralateral body)
- **CNX palsy (nucleus ambiguous)** = hoarseness, dysphagia, absent Gag reflex
- **CNIX palsy (vestibular nuclei)** = N/V, vertigo , nystagmus, truncal ataxia

Vertebral Artery Dissection (Post. Circulation) "vertebrobasilar artery system stroke"

Recent neck trauma (hyperextension injury)

- Young patient w/ neck pain
- Dysarthria
- **Coordination loss**
- **Vision loss**

Anterior spinal artery (medial medullary syndrome)

Supplies CST, medial lemniscus, CN12

- CST = hemiplegia
- Medial lemniscus = proprio + vibration loss
- CN12 = tongue can't move

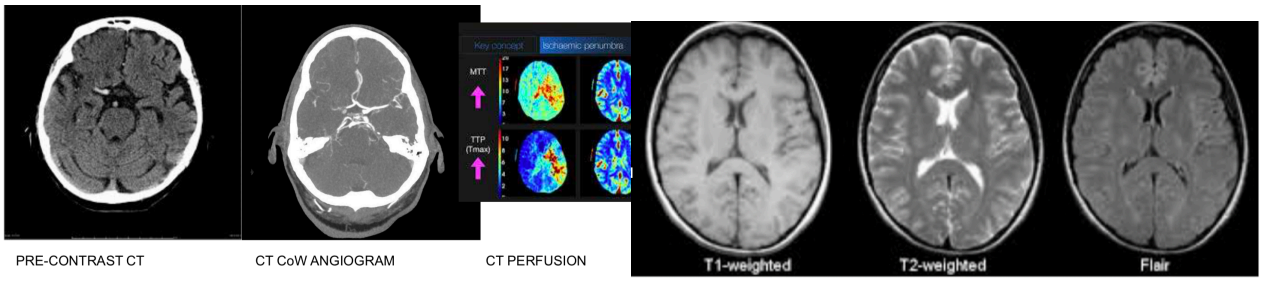
LUMBAR PUNCTURE – MENINGITIS DDx

	LP fluid	Gram stain	Opening Pressure	Glucose (40-75)	Protein (15-45)	Cells on LP	Treatment
Bacterial	Cloudy	+	↑↑	low	High	• PMN (>1000) • Gram +ve = listeria (rods), pneumococci (diplococci) • Gram –ve = HiB (coccobacilli), meningococcal (diplococci)	**RF:** DM, immunocomp, EtOH, pregnant, > 50 • Senior help → ABCD → IVF • **Regardless** = Early IV 2g ceftriaxone + IV 10mg dexamethasone (+/- benzyl if listeria suspected) • **Viral** = IV acyclovir • **Fungal** = IV amphotericin B (check liver and renal function) • Public NSW health notification *Close contacts* • N. meningitis → prophylactic cef, cipro or rifampicin • HiB → cef or rifampicin
Viral (PCR)	Clear	–		normal	Low	• Lymphocytes (>10-500) • HZV = bloody tap + anosmia + confuse	
Fungal	Cloudy	–	↑↑	low	High	• Lymphocytes (20-200)	
TB (acid-fast)	Clear + spiderweb clot	+	↑↑	low	high	• Lymphocytes (mainly) +PMN	
SAH	Yellow xanthochromia		↑↑				

INTRACRANIAL BLEEDS

	EDH	SDH	SAH	ICH	General Mx
Where	Ruptured middle meningeal artery Assoc.	Rupture of bridging emissary veins	Subarachnoid space (in CSF) ➢ Meningeal signs without fever ➢ LP – xanthochromia ➢ CTA or MRA	• Lobar ICH • Deep ICH • IVH • Basal ganglia • Cerebellar	*Assess risk factors:* 4. Head injury 5. Hypertension 6. Aneurysms 7. Ischaemic stroke can progress to haemorrhage 8. Brain tumours 9. Anticoagulants e.g. warfarin *Senior help* 10. GCS score 11. Urgent non-contrast CT head 12. FBC + Coags 13. Admit under ASU OR neurosurgery 14. Consider I+V, and ICU care (if reducing LOC)
Key features (RF)	• temporal bone # • young pt • brief Lucid period then sudden deterioration	• elderly • alcoholic (more brain atrophy)	• Ruptured aneurysm • Cocaine • Sickle cell anaemia • ADPKD, NF, Marfan, Ehler • XS EtOH • **Black females aged 45-70**	Spontaneous secondary to: ➢ Infarct, tumour, aneurysm rupture	
Shape	Bi-convex	Crescent	Continuous w/ ventircles	Central dot sign	
Suture cross	No	Yes	NA	NA	
Midline cross	Yes	No	NA	NA	
Rx	Clot removal	Burr-hole washout	1. **Nimodipine** = prevent vasospasm post-SAH **2. Endovascular coiling OR surgical clipping** 3. **Shunt insertion** (for hydrocephalus) 4. **Anti-epileptics** (if seizrues)		*F/U management once stabilised:* 15. Correct clotting issue, severe HTN (but avoid hypoTN) 16. Consider LP 17. Consider CTA or MRI-angio

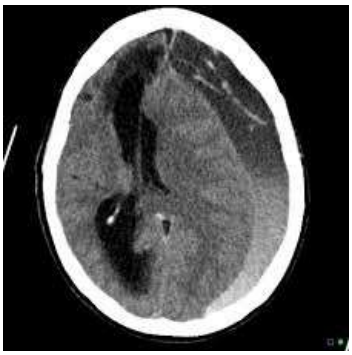
	CT: Computed Tomography	MRI: Magnetic Resonance Imaging
Modality	• **Electron imaging** • Utilizes X-rays – ionizing radiation → cancer risk • ED workhorse	• **Proton imaging (any structure with water lights up = oedema, tumour etc.)** • **Radio waves & high energy magnet**→ non-ionizing radiation [but heat up skin] • **Patient safety questionnaire** (E.g. metal implant, pacemaker, cochlear implant, neurostimulator, braces)
Indication	• **Bone/fractures** [use bone window] • **Acute blood** (bright = hyperattenuating Hb/Fe) • **Established stroke** • **Vessel blockage or aneurysm** (CTA esp. CoW) • **Ventricle size** (hydrocephalus)	• **Acute stroke detection** (DWI) • **Brain & pituitary masses/tumour** • **Epilepsy Foci** • **Spinal cord injury – T2 Flair** • **Ligamentous injury** • **White matter lesions** (e.g. MS) - **– T2 Flair**
Avoid	• **Acute infarct/stroke** (need CT angiogram) • **Masses/tumour** (need iodinated contrast CT) • **Demyelinating disease** • Pregnant women • Young children	• Fractures • **Minimise contrast** (i.e. Gadolinium may cause rare and incurable nephrogenic systemic fibrosis) esp. if eGFR < 30 (CKD stage 4) • **Unsecured metal (e.g. shrapnel, metal fragments in eyes)** NB: pacemakers OK (if allowed to be switched off)
Differences	• Bright skull bone • Fat is dark on CT = dark white matter Metal > contrast > bone > blood > soft tissues > fat > thin fluid > air Hyperattentuating ----------→ Hypoattenuating	• Scalp is white Hyperintense ---→ Isointense (same as cortex/muscle)---→ Hypointense • **T1** = grey matter (grey), white matter (white) ➔ **fat melanin, heavy metals** • **T2** = grey matter (white), white matter (grey),➔ **CSF, SC compression** • **Flair** = T2 without bright CSF ➔ **demyelinating diseases (MS)** • **DWI** = best to detect ***acute strokes or cytotoxic oedema*** o Water molecules restricted within the cells o **Susceptible to artefacts from blood/metal/braces**
Advantages	1. Widely available 2. Less contraindications (metals, implants, claustrophobia) 3. Much faster acquisition or less motion artefacts 4. More sensitive in detecting acute bleed/skull and spineal fractures 5. Routine multiplanar reconstruction 6. CT radiographers more often available	1. **No Radiation** → children, pregnant women, young adults 2. Superior contrast resolution (with gadolinium) 3. Many sequences to assess different pathology 4. No contrast needed to assess vascular structure 5. Image in any plane
Disadvan	1. Radiation 2. Poor to assess infection, tumours, demyelination and SCI 3. Damage to lens, skin, cancer and foetus	1. Safety questionnaire needed → Be careful of pacemakers, metal implants 2. Claustrophobia 3. Not good for anxious/claustrophobic patients → need oral sedation 4. MRI radiographers longer training (less available) 5. Long preparation and acquisition time



PRE-CONTRAST CT | CT CoW ANGIOGRAM | CT PERFUSION

Scenario	Imaging of choice	Reason
Acute head injury brought in by ambulance to ED	**CT brain and cervical spine non-contrast**	Exc. intracranial bleed and skull/C-spine fracture)
50 yo patient with sudden onset left hemiplegia	**CT brain pre-contrast** (exc. haemorrhage) + CT CoW angiogram (aortic arch to vertex), CT perfusion	acute stroke +/- occluded MCA or acute haemorrhage in right cerebrum
30 year old woman with 3 weeks history of numbness in left arm and previous episode of visual deterioration	**MRI**	MS or less likely a tumour
6 year old boy with recurrent seizures	**MRI**	epileptogenic foci, congenital anomalies + exc. tumour

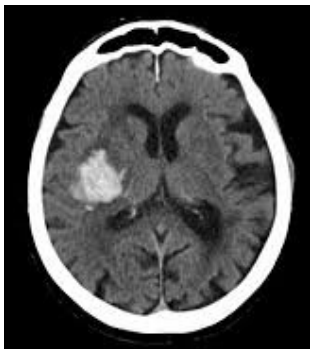
**Not uncommon for patient to get both – initial CT in ED to triage and decide which team coming in under (e.g. neurology vs neurosurgery) overnight, and then MRI next day for detailed assessment*



Px: Progressive Confusion And Right Weakness: Elderly Patient

Dx: Subacute subdural haeamtoma

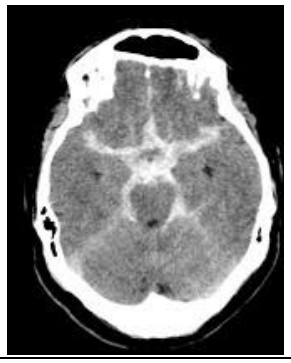
Desc: Non-contrast axial CT brain scan showing significant subdural heamorrhage causing significant midline shift and effacement of left lateral ventricles



Px: Headache And Left Weakness: History Of Hypertension

Dx: intracerebral heamorrhage

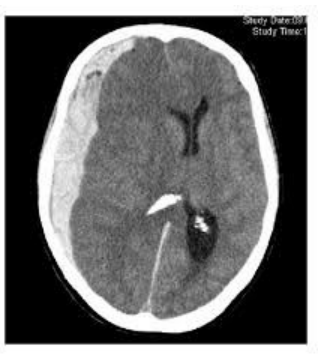
Desc: Non-contrast axial CT brain scan showing right intracerebral heamorrhage of basal ganglia with no midline shift



Px: Sudden Onset Worst Headache Of Life

Dx: Subarachnoid heamorrhage

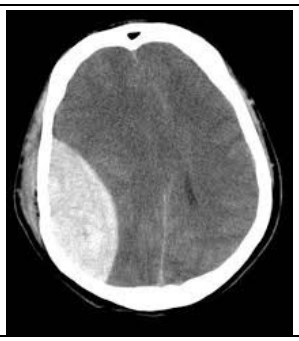
Desc: Post-contrast axial CT brain scan showing subarachnoid hemorrhage with blood in the basal cisterns



Px: MVA – No Seatbelt – Head Through Windscreen

Dx: acute subdural haeamtoma

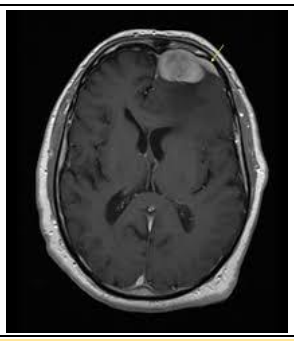
Desc: Post-contrast axial CT brain scan showing right SDH causing sig, midline shift with IVH causing obstructed hydrocephalus in the left occipital horn as well as calcification in the right occipital horn + effaced R lateral ventricles



Px: Fall From Ladder

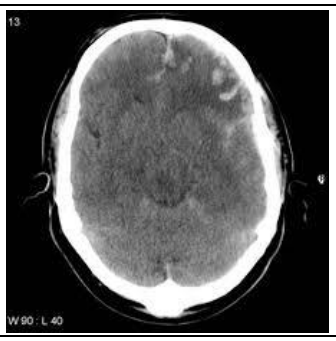
Dx: Extradural heamatoma

Desc: Non-contrast axial CT brain scan showing right parietal extradural heamotoma with overlying scalp swelling and significant midline shift req. neurosurgical referral



Dx: Meningioma

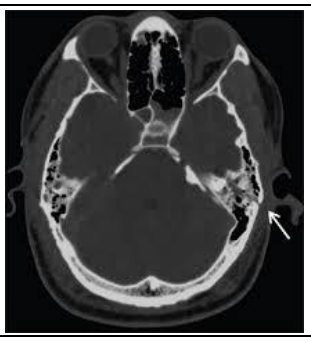
Axial MRI brain scan showing a well-demarcated hyperattenuating lesion in the left frontal lobe that is adhered to the dural wall with a poorly demarcated homogenous hypoattenuating oedematous region



Px: FRIDAY NIGHT ASSAULT

Dx: Cerebral contusion

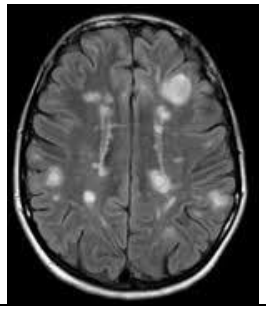
Desc: Non-contrast axial CT brain scan of poor resolution due to patient movement. Evidence of **contre-coup injury**, slight midline shift and SAH in the left frontal lobe and basal cisterns.
(Salt + pepper appearance – hypo/hyper attentuating)
Also effacement of CSF on left midbrain suggestive of L)-sided uncal herniation



Px: Left Hearing Loss After Assault → *localised bruising at back of mastoid*

Dx: Base of skull fracture

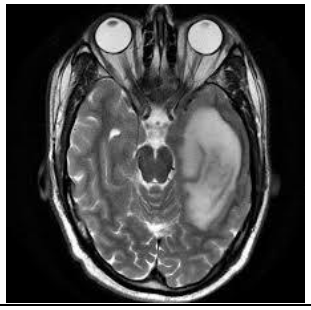
Non-contrast axial CT scan in bone window showing an oblique fracture of the left petrous portion of the temporal bone with Ethmoid air sinus damage



Px: Intermittent Limb Paraesthesia, Fatigue, Visual Loss

***Dx*: Multiple sclerosis**

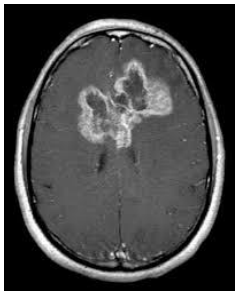
Desc: Non-contrast axial MRI brain depicting multiple areas of hyperintense regions of white matter bilaterally especially at **Juxtacorticol, periventricular and corpus callosum regions**



Px: 4 Months Headache And New Seizures

Dx: Diffuse astrocytoma: WHO II

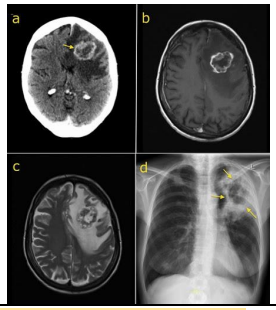
Desc: Non-contrast axial MRI brian scan showing a large left sided hyperintense temporal lobe associated with oedema centred in white matter.
To confirm, use post-gadolinium image and lesion should NOT enhance



Px: Headache For 3 Months, Confusion, Incontinence

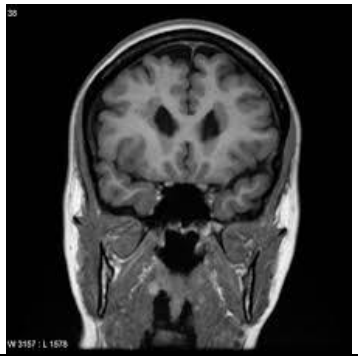
Dx: Glioblastoma: WHO IV

Axial MRI depicting **intra-axial** poorly demarcated ring enhancing lesion/mass across the midline in both frontal lobes. There is a heterogenous hyperintense oedematous region around these lesions.



Dx: Metastatic lung cancer into brain

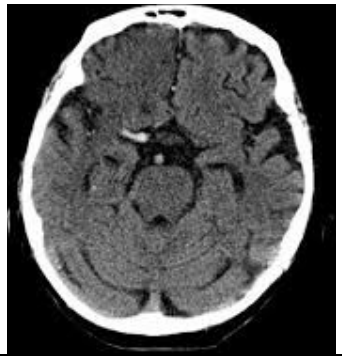
Desc: Contrast axial CT and MRi brain scans depicting ring-enhancing lesion in the left frontal lobe with surrounding homogenous poorly demarcated area of Disproportionate oedematous
***CXR confirmation of apical lung tumour metastasis.**



Px: Intractable Seizures And Developmental Delay

Dx: Migrational anomaly (grey matter heterotopia)

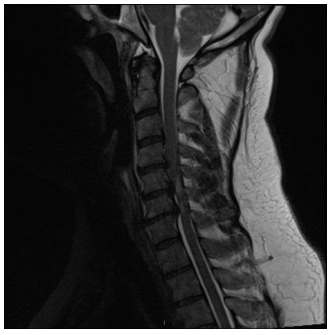
Desc: Coronal brain MRI showing possible migrational anomaly with heterogenous basal ganglia gray matter near the lateral ventricles in abnormal anatomical location.



Px: Sudden Onset Left Weakness

Dx: MCA occlusion

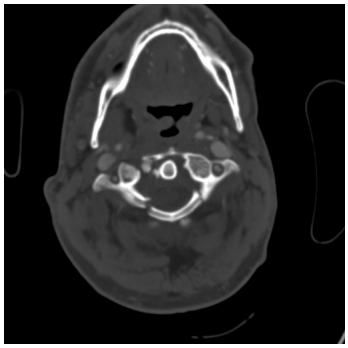
Desc: Non-contrast axial CT scan showing a hyperattenuating lesion suggestive a right MCA occlusion



Px: Neck Pain, Ataxia, Upper Limb Weakness

Dx: Spinal cord compression

Desc: Sagittal MRI of the cervical spine showing effacement of CSF anteriorly and posteriorly from C3-C6 and **spinal cord oedema (needs surgical intervention)**



Px: Hit By Falling Object From Building

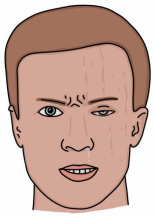
Dx: Multiple Fracture of C1 (Jefferson Fracture)

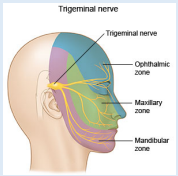
Desc: Axial CT of cervical spine showing multiple fractures of the atlas/C1 along the posterior and anterior arch.

Nb: Single fracture of posterior arch may be congenital and physiological

HEADACHES

Immediate	Acute	Subacute	Chronic
SAH Vasospasm ICH Trigeminal Cluster	Migraine Trigeminal ICH SDH Trauma	Migraine Medication Tension Post-trauma Occipital neuralgia	Migraine H.Continua Medication Tension FND/fixation

	Site	Onset/Timing	Assoc.	Treatment
Common Migraine [no aura]	**Unilateral**	Prodrome (3/7 before) Aura (lasts 60 mins) headache(4-72 hrs) resolution Recovery / post-drome	• **P** ulsatile headache • 4–72 h **O** urs duration • **U** nilateral, not bilateral • **N** ausea and / or vomiting & mental clouding • **D** isabling headache	**Acute Mx:** ➢ paracetamol ➢ Triptans → 50mg sumi ➢ NSAIDs ➢ Anti-emetics (maxolon) **Long-term Mx:** ➢ Avoid trigger (stress, lights, smells, dehydration, choc, critic acid, poor sleep) ➢ CBT ➢ Headache diary ➢ Relaxation (massage) ➢ **Vitamin B2 (riboflavin) –** reduce freq. + severity ➢ **Amitriptyline (TCA) but AE** = fatigue, dizzy, depression, insomnia ➢ **Prophylaxis (with Panadol + propranolol]**
Classical Migraine Headache (+aura)	**Unilateral**	Gradual onset <1 hr	• Females (20%) • Preceded by aura -sparks, blurry, lines across vision or loss of visual fields • **Photophobia,** *phonophobia* • Visual scotoma, scintillations, • Disequilibrium	
Hemiplegic migraine	**Unilateral**	Sudden or grdaul	• Hemiplegia (weakness + migraine) • Ataxia • Altered level of consciousness	
Tension-Type Headache	**Bilateral** (bitemporal, bifrontal)	Recurrent/daily with variable duration (30 mins – 7days)	• worse by walking • Tight dull aching pressure headache • Trigger = A+D, alcohol, dehydrated, skip meals, dehydration	• Reassure • Basic analgesia • Relaxation techniques • Hot towels to local area
Cluster Headache **('Alarm Clock')** 	**Unilateral 10/10** (e.g. one eye) (15mins-3hrs) *"trigger = EtOH, strong smell, exercise"*	Wake from sleep **same time each day** 	• 30-50yo Men (+ smoking!) • **A**ttacks of severe orbital/ supraorbital pain (3-4x attacks per day for weeks followed by pain free period lasting 1-2 years) • **ANS** issues (Lacrimation, rhinorrhoea) • **A**gitation • **A**t least 8x/day • **A**lternate sides • **A**kathisia • **A**nxiety • **A**t-risk suicide	• **100% High flow FiO2 [BEST]** • **Triptans** (8mg sumi SC) Prophylaxis: ➢ Verapamil ➢ Lithium ➢ Prednisone for 2-3wks to break cycle
Temporal Arteritis *[Giant cell arteritis - GCA]*	**"Unilateral** over temporal area	Persistent [mild and severe]	• **Polymyalgia rheumatica** (common cause) → features shoulder and hip girdle pain + (RAISED ESR) • **> 50** → tender *temporal artery* • **Vision loss [worst outcome]** • **Locked Jaw stiffness/pain** esp. when eating ➔ weight loss	• Prednisone • Rheumatological review
Subarachnoid Haemorrhage	initially localised then generalised	Sudden onset "thunderclap"	• Worst ever headache 10/10 • neck stiffness	Surgery clipping of ruptured aneurysm
Reversible cerebral vasoconstriction syndrome (RCVS)	sudden constriction (tightening) of the vessels that supply blood to the brain		• hemiparesis • receptive and expressive dysphasia • altered vision	**NONE** ➢ CTA = string and bead appearance
IIH	Bilateral	Insidious onset	• Obese young women of child-bearing age • Papilloedema (fundoscopy)	• LP to relieve pressure if no tumour present
Posterior reversible encephalopathy syndrome	Due to HT, CKD, pre-eclampsia	Insidious rapid onset	• Headache • Seizures • altered consciousness, • visual disturbance	Short-term management of seizures using anti-epileptic drugs
Subdural / epidural heamorrhage	Site of head trauma	Freq. + severity increases over weeks	After head trauma	Surgical evacuation of heamotoma
Acute Sinusitis	**Unilateral/ Bilateral**	Preceding infection	Facial pain + Forehead flush when bending down (better in evening)	NSAIDs, decongestants, nasal sprays, hydration ➢ resolves within 2-3 wks
Meningitis *[like migraines]*	General headache	Gradual + infection	• Photophobia/phonophobia + **fever** + neck stiffness • +/- HIV or cancer	Bacterial = vancomycin Viral = antivirals
Raised ICP	General Pressure headache	AM headache (after exertion)	• **CUSHING'S TRIAD**: widened PP, bradycardia and irregular RR	• Non-contrast CT • MRI

			• drowsiness or vomiting • Papilledema (if severe) • **Basal skull # (Raccoon's eyes and Battle' sign)**	• LP (if no tumour)
Low CSF pressure	Trauma site → CSF leak through tear or cribriform fracture	Worse in evening	• Positional exacerbation (most severe when upright) • Similar to post-dural puncture headache	• Bed rest • Caffeine • Increased fluid intake
Tolosa Hunt syndrome	Unilateral orbital pain **[CNIII, CNIV and CNVI]**		• Paresis/damage to CNIII, CNIV and CNVI → due to granulomatous inflammation of cavernous sinus, SOF or orbit • Reduced and painful eye movement	High-dose glucocorticoid (response in 24-72 hrs)
Trigeminal neuralgia /injury 	**V1, V2, V3 dermatomes** [vascular compression of CNV nerve root → usually **(**supra/infraorbital branch**)**	**Recurrent** (secs and mins) **Sudden onset** (short lasting)	• Pain on brushing teeth, eating • **Excruciating Electric +++ shocks on face** • **Allodynia**, • May be Herpes Zoster Triggers: ➢ Cold weather ➢ Spicy food ➢ Citrus fruits	• 1st line = **carbamazepine** • Surgical nerve decompression • Post-herpes = gabapentin, lyrica, carbamazepine • CaB (verapamil) = prophylaxis
Occipital neuralgia	**Site of nerve injury [greater occipital nerve]**	Subacute	• Aching, pressure, stabbing or throbbing pain • Pain reproduced with digital pressure over greater occipital nerve (rad. Ipsilateral fronto-orbital region)	• **Massage** • **Heat** • **Nerve block**
Concussion	TBI	Sudden (within 1st 24 hrs)	• headache, • FND – speech, weakness, sensation • Head and neck injury **How to investigate**? • Exclude ICH, SDH, SAH = • MRI > CT • F/U within 1 week (as neurophysiological changes may take 30 days to occur)	**Educate** ➢ **Simple analgesia** ➢ **No EtOH, driving** **When to refer?** ➢ Insight loss ➢ Mood + memory change ➢ CTE – chronic traumatic encephalopathy (footballer)
Post-concussion syndrome (PCS) after traumatic brain injury (TBI)	Worse in those with mild head injury compared to severe trauma	**> 2 weeks after concussion [**greatest within 7-10 days**]**	• headache, • dizziness, • neuropsychiatric symptoms, • cognitive impairment	• CBT • Antidepressants?
TMJ injury	Site of trauma		• Jaw claudication • Ipsilateral hemicranial aching	• NSAIDs • TCAs
Cervical spondylosis	Degenerative change in cervical spine		• Neck pain worse on movement	• CT and MRI spine to exclude nerve root lesions
SUNCT	unilateral	short-lasting [+/- triggered by skin contact]	• ***short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing*** • **SUNA** =*if autonomic symptoms (e.g. lacrimation,*	• **Gabapentin**
Psychologically induced headache	Generalised		• Insomnia (daytime somnolence) • OSA • Cannot tolerate noise or large crowds • Assoc. with PTSD, acute stress, panic disorder, depression	• Address streses in life
Dysesthesias (abnormal sensations)	*site of scalp laceration /soft tissue injury*	Persist over months	• Aching, sore, tingling or shooting pain	• **Gabapentin** • **Pregabalin** • **carbamazepine**
Coital Headache	Generalised	Sudden onset during sex [esp. Middle-aged men]	**NOT** SAH [no nausea or neck stiffness]	• indomethacin **BEFORE sex**
Hormonal headache		2 days before and first 3 days of menstrual period OR Around menopause	Non-specific TTH ➢ assoc. with **low estrogen**	• OCP • Mirena
Analgesia Headache	Generalised		Long-term or XS analgesia usage (Analgesic overuse (i.e. Panadol & codeine))	• Psych counsel • Slow wean

EPILEPSY

EPILEPSY

Def

- Umbrella term for condition where there is a tendency to have seizures
- Seizure = transient episodes of abnormal electrical activity in brain

Ix

General Bloods

- **Postural BP**
- **Capillary glucose & Hba1C (***exc. hypoglycaemia)*
- **EUC + VBG** (measure lactate + acidosis + BSL)
  - **?hypoBSL, hypoCa, hyperUrea**
- **CK & Prolactin** (both elevated in generalised tonic-clonic seizure**s**)
- **ACE** (sarcoidosis)
- **Urine MCS & drug screen**
- **B12/Folate** (reduced = encephalopathy)
- **Fe** (haemochromatosis – Fe deposition in brain)
- **ESR/CRP** (septic)
- **Cholesterol** (risk of stroke)
- ***Autoimmune panel, HIV/Viral panel, acanthocytes, porphyrins***

Imaging

- **MRI** → visualise brain structure = SoI, *infarcts*
- **MRA** *[magnetic resonance angiography]* → vasospasms, RCVS
- **MRV** *[magnetic resonance venography]* → venous thromboembolisms (esp. SSS, transverse sinus)
- **CT/CXR** → *check for possible fractures*
- **EEG → DDx:** idiopathic generalized epilepsy from PNES,
  - **NB: low sensitivity/specificity →** abnormal EEG does NOT indicate brain pathology NOR does a normal EEG rule out epilepsy/seizure disorder

Other

- **ECG** (*prolonged QT interval)*
- **LP** (*if meningitis/encephalitis suspected*)
- **Neurology referral if:**
  - **1st seizure →** *most epilepsies treatable with 1st agent*
  - **Refractory epilepsy**
  - **Surgery**

Types

	Description	Duration	1st line med	2nd line med
Focal seizures	**Begin in temporal lobe:** ➢ **Hallucinations, memory flash backs** ➢ **Déjà vu** ➢ **Automatism** = *strange actions on autopilot*	**30-180s**	Lamotrigine Carbamazepine	**Sodium valproate** Levetiracetam
Generalised tonic-clonic "Grand mal"	➢ LOC + tonic-clonic jerks (tonic before clonic) ➢ WILD – post-ictal period	**3-5mins**	**Sodium valproate**	Lamotrigine Carbamazepine
Absence *"petit mal"*	**Typically children** ➢ **Typical** = Blank stare into space ONLY ➢ **Atypical** = plus automatisms	**< 10s**	**Sodium valproate** Ethosuximide	
Atonic *"drop attacks"*	**"drop attacks" = brief lapses in muscle tone** ➢ **Seen in Lennox-Gestaut syndrome**	**< 3mins**	**Sodium valproate**	Lamotrigine
Myoclonic seizures	➢ **Sudden brief muscle contraction like a "sudden jump"** ➢ **Remains conscious** ➢ *Seen in juvenile myoclonic epilepsy* ➢ *DDx: CJD (mad cow disease)*		**Sodium valproate**	Lamotrigine Levetiracetam Topiramate
Infantile spasms (west syndrome)	➢ **Rare (1 in 4000)** ➢ **Infancy → 6/12 old** ➢ **Full body spasms** ➢ **Bad prognosis – 1/3rd die by age 25**		**Prednisone** **Vigabatrin**	
Status epilepticus (medical emergency)	**Defined as any seizure that:** ➢ Lasts longer than 5 mins OR ➢ More than 3 seizures in 1 hour **Stages:** ➢ **stage 1 = acidosis** ➢ **stage 2 = hypoglycaemia**	**>5mins**	**ABCDE** 1. Secure airway 2. High FIO2 3. Assess CV and Resp 4. Check BSL 5. IV lorazepam 4mg or 03.mg/kg buccal or intranasal midazolam (repeat after 5 mins if seizure persists) 6. Switch to IV 20mg/kg phenytoin (if seizure persists at 15 mins) ***Can use buccal midazolam or PR diazepam (in community) → flumazenil (antidote to midazolam)**	
Non-epileptic seizures (PNES)	• Type of conversion disorder • May be caused by Factitious disorder and malingering where patient is purposely deceiving the physician • **NO AUTOMATISM, NO TONGUE BITING AND LASTS OVERLY LONG!**	5-10mins	About 9% to 15% of patients with psychogenic events have coexistent seizure disorders ➢ Psych counselling	

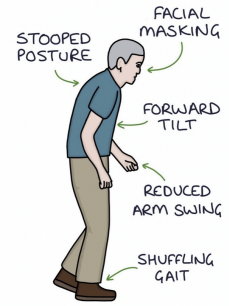
A/E of meds

Sodium valproate	Carbamazepine	Ethosuximide	Lamotrigine	Phenytoin
Increases GABA activity inhibiting GABA transaminase	**Na channel blocker**	**Ca channel blocker**	**Na channel blocker**	**Na channel blocker**
➢ Teratogenic so patients need careful advice about contraception ➢ Liver damage and hepatitis ➢ Hair loss ➢ Tremor	➢ Agranulocytosis ➢ Aplastic anaemia ➢ Induces the P450 system so there are many drug interactions ➢ SJS (if mutant HLA B1502)	➢ Night terrors ➢ Rashes	➢ Stevens-Johnson syndrome or DRESS syndrome. These are life threatening skin rashes. ➢ Leukopenia Nb: hormonal agents reduce effectiveness	➢ Folate and vitamin D deficiency ➢ Megaloblastic anaemia (folate deficiency) ➢ Osteomalacia (vitamin D deficiency) ➢ Affect cerebellar function

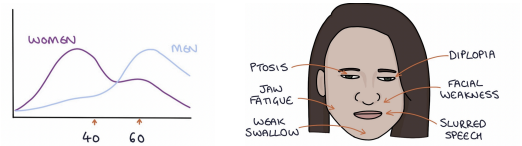
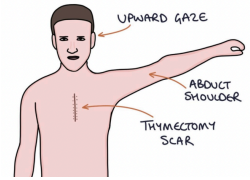
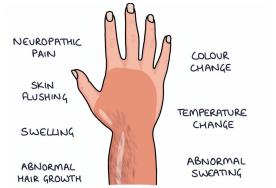
Lifestyle impacts & legal considerations

- **Driving (no driving for 6/12)**
- **No swimming & driving [loss of independence,** limited options for occupation/work**]**
  - **Doctors responsible to encourage patient to self-notify RMS [but can legally notify RMS without consent]**
- **Need for counselling [***explaining that it is a medical condition that was out of anyone's control***]**
  - **Seizure action plan → call OOO → keep attended and away from danger (administer benzo ASAP)**
- **Medical costs** (i.e. consultations and medications) **➔** [aim to wean off AEDs after ≥2 year seizure free period]
  - If frequent → carer requirements
- **Disruptions to social life** → encouraging isolated, anxiety and depressive behaviour [also personality changes]
- **Fear of losing control and hurting one's self during an episode** (esp. falls) with subsequent comp. (e.g. fractures, bruises, hemorrhages if brain trauma)

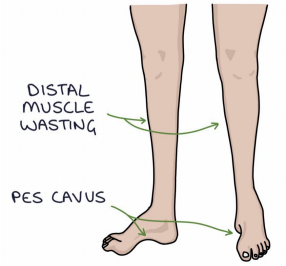
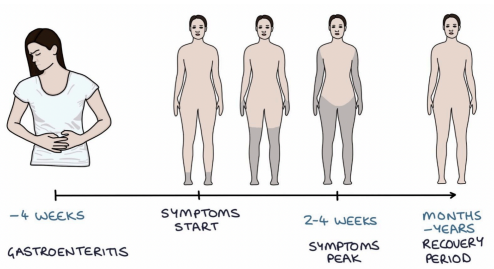
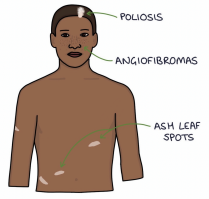
MS, MND, Parkinson's

	MULTIPLE SCLEROSIS	MOTOR NEURON DISEASE	PARKINSON'S DISEASE
Def	➢ Chronic progressive autoimmune demyelination of nerves in CNS by myelin-reactive T cells	**MND = umbrella term that encompasses progressive deterioration of UMN and LMN with NO effect on sensation**	**Degeneration of the dopaminergic neurons in the pars compacta in the substantia nigra and basal ganglia**
Types	*Types:* 1. **Clinically isolated** (not disseminated in time and space) = 1st MS attack **2. Relapse and remitting (most common)** 3. **Secondary progressive** – initially relapse and remitting but now symptoms worsen and more permanent **4. Primary progressive -** worsening Sx from point of diagnosis (no relapse or remitting period)	*Types* • **ALS** (UMN + LMN signs) = most common (Stephen Hawking) • **Progressive bulbar palsy** (CNIX, X, XI, XII) = 2nd most common • **Progressive muscular atrophy** (LMN, anterior horn of medulla) • **Primary lateral sclerosis -rare** (UMN, **BETZ motor neurons** → CST degeneration)	**Types: Parkinson-PLUS syndromes** ➢ **Multiple system atrophy (rare)** – neurons in multiple areas of brain degenerate o **ANS dyfn =** postural HypoTN (falls risk), constipation, unregulated sweating, sexual dysfn o **Cerebellar dysfn (ataxia)** ➢ **Lewy Body dementia** o *Progressive cognitive decline* o *Visual hallucinations* o *REM sleep disorder (e.g. kicking in bed)* o *Fluctuating consciousness* o *Delusions* ➢ **Progressive supranuclear palsy =**
Cause	➢ Multiple GENES ➢ EBV ➢ Low vitamin D ➢ Smoking ➢ Obesity • ***Risks***: Female, <50, obese, northern hemisphere • ***Protective***: pregnancy, early age, breastfeeding	• FHx o Genes = SOD1, ALS2, SETX • Smoking • Heavy metals • Pesticides	• Idiopathic
S+S	Symptoms > 24 hrs (lasting days to weeks before improving) 1. **Optic neuritis** – new onset unilateral vision loss and colour vision + painful eye movements + RAFD 2. **6th CN palsy** = Internuclear opthalmolplegia (MLF lesion) and conjugate lateral gaze palsy 3. **Focal weakness** = Bell's, Horner's, limb paralysis, incontinence 4. **Focal sensory** = *trigeminal neuralgia, numb, parasthesia,* ***Lhermitte's sign*** = *shooting pain down spine on neck flexion* 5. **Sensory ataxia** = loss of proprioception (Romberg's +) **6. Cerebellar ataxia**	*UMN signs:* ➢ Spasticity, rigidity, hyperreflexia *LMN signs* ➢ Muscle wasting, reduce tone, hyporeflexia, fasciculations Key signs: 1. Eyes spared (ALL) 2. sensation spared (ALL) 3. **ALS** - progressive paralysis 4. **progressive bulbar palsy** = *dysphagia and dysphonia* 5. **Progressive muscular atrophy** = clumsy hand movements, fasciculations 6. **Primary lateral sclerosis** = akinesia	**ASSYMETRICAL MOTOR SYMPTOMS** • Unilateral resting Pill-rolling tremor (4-6Hz) – improves on movement • Rigidity "cogwheel" • Akinesia – "**shuffling gait**", hard to start walking, smaller and smaller handwriting, reduced facial expression (**hypomimia**) • Postural instability • "glabellar tap" = Meyerson's sign "eyes shut when tapped lightly between eyebrows" **Non-motor symptoms**: ➢ Depression ➢ Insomnia ➢ Anosmia ➢ Cognitive issues and memory problems 
Ix	**McDonald's criteria** • ≥ 2 attacks + ≥2 lesions w/ objective evidence ***OR*** • 1 lesion + clinical Hx suggesting previous lesion ***OR*** • dissemination in space on MRI **MRI** • T1 = atrophy & axonal death • T2 = Hyperintense fingerprints **CSF** = +ve oligoclonal IgG bands **Autoantibody test** (Serum aquaporin 4) = marker for neuromyelitis optica	Diagnosis based on clinical presentation and exclusion of other causes ➢ Formal diagnosis by neurologist	Diagnosis based on clinical presentation and exclusion of other causes • Formal diagnosis by neurologist
Comp.	➢ **Death**	Death – respiratory failure or pneumonia	
Rx	**MDT approach** *neurologist, specialist nurse, PT, OT* ***Lifestyle:*** ➢ *Stop smoking + vit D supp.* ➢ *Regular exercise* ***DMARDs and biologics*** ➢ *Rituximab* ➢ *Fingolimod* ***Symptom Mx:*** ➢ ***Gabapentin*** *(neuropathic pain)* ➢ ***SSRI*** *(depression)* ➢ ***Ant-chol*** *(urge incontinence)* ➢ ***Baclofen, Gabapentin*** *(spasticity, painful cramps)* ****Avoid giving vaccines during attacks***	No cure ➢ Palliative care o Organise ACD o End-of life care planning ➢ Symptom management ➢ **Experimental drugs to slow progression**: o Riluzole (UK) o EdaravOne (US)	**MDT approach** (NO cure) *neurologist, specialist nurse* | Drugs	Class	MoA	Indication	Adverse Effects | |---|---|---|---|---| | **L-DOPA (Levodopa)**	**Natural dop precursor**	Crosses BBB → **BUT** broken down outside BBB by AADC or COMT	**1st line** [useless after 5 years]	**Dyskinesias (XS motor activity):** ➢ **Dystonia** – abnormal postures ➢ **Chorea** / invol. jerks ➢ **Athetosis** – twisting/ writhing fingers, feet | | ***Carbidopa***	AADC inhibitor	Block L-DOPA breakdown in periphery extend duration [**cannot cross BBB**]	*Combined with L-Dopa = sinamet*	| | ***Entacopone***	COMT inhibitor		*Combined with L-Dopa*	| | ***Selegiline, Rasagiline***	Irreversible MAO inhibitor	Prevent dopamine breakdown	**Used early to delay L-DOPA use OR** *combined with L-DOPA*	**Selegiline** is metabolized to methamphetamine = XS SNS activity | | ***Bromocryptine, pramipexole***	D2/D3 agonists	Directly stimulate dopamine receptors		**Pulm. Fibrosis (long-term use)** • hallucinations • compulsive behaviour

RARE NEUROLOGICAL DISEASES

	Huntington's chorea	Myasthenia Gravis	Lambert Eaton Myasthenic syndrome	Facial Nerve Palsy	Neuropathic Pain
Cause	Genetic – autosomal dominant ➢ **Trinucleotide repeat disorder (**HTT gene) – 'CAG' ➢ **Anticipation** = successive generations have more repeats in gene ➔ earlier age of onset and increased disease severity	• Type 2 Autoimmune attack on ACh receptors in NMJ • Progressive muscle weakness across day that improves with rest • Affects women at an earlier age than men 	• Progressive muscle weakness due to antibodies targeting voltage Ca channels on pre-synaptic terminals of LMN	Dysfunctional facial nerve ➢ **Motor** = muscles of facial expression, stapedius, post. Digastric stylohyoid, platysma ➢ **Sensory** = taste anterior 2/3rd ➢ **PSNS** = submadinbular, sublingual and lacrimal gland *Pathway of facial nerve:* ➢ Exit cerebellopontine angle ➢ Passes temporal bone ➢ Passes parotid gland	**Abnormal functioning of sensory nerves causes delivery of painful and abnormal signals to the brain** **Causes:** ➢ Post-herpetic neuralgia (HZV – shingles) ➢ **Post-op nerve damage** ➢ **MS** ➢ **Trigeminal neuralgia** ➢ **Complex regional pain syndrome (CRPS)**
S+S	Asymptomatic until symptoms begin around aged 30-50 ➢ Chorea (involuntary, abnormal movements) ➢ Eye movement disorders ➢ Dysarthria ➢ Dysphagia	Symptoms **affect proximal muscles** and small muscles of head and neck: ➢ Extraocular weakness = diplopia ➢ Eyelid weakness = ptosis ➢ Facial weakness ➢ Dysphagia ➢ Slurred speech ➢ Jaw fatigue *TEST FATIGABILITY BY ASKING PATIENT TO: > GAZE UPWARDS OR abduct shoulder and hold it 	Paraneoplastic syndrome ➢ SCLC ➢ RCC Symptoms **affect proximal muscles** and small muscles of head and neck: ➢ Extraocular weakness = diplopia ➢ Eyelid weakness (levator muscle) = ptosis ➢ ANS dysfn = dry mouth, blurred vision, ED, dizzy ➢ **Reduced tendon reflex** ➢ **Post-tetanic potentiation →** after contracting muscles, reflexes tested after are actually normal	• **Unilateral** facial weakness • **Ptosis** • **Loss of nasolabial fold** **UMN lesion (forehead sparing)** ➢ Unilateral = CVA, tumour ➢ Bilateral = MND, pseudobulbar palsy **LMN lesion** ➢ **Bell's palsy** (HZV) = idiopathic ➢ **Ramsey Hunt** (VZV) = painful vesicular rash ➢ **Infection** (AOM, HIV, lyme, malignant otitis externa) ➢ **Systemic** (Sarcoid, MS, GBS, DM) ➢ **Tumour** (acoustic neuroma, cholesteatoma, parotid tumour) ➢ **Trauma** (post-op, base of skull or temporal bone #)	**General Symptoms**: • Burning • Tingling • Parasthesia (pins and needles) • Electric shocks • Loss of touch sensation to affected area **Complex regional pain syndrome** ➢ Allodynia ➢ Skin flushed ➢ Temperature change ➢ Swelling ➢ Abnormal sweating ➢ Abnormal hair growth
Ix	➢ **Genetic testing**	➢ Lung function test = forced vital capacity (FVC) ➢ ACH-R antibodies (85% patients) ➢ Muscle-specific kinase (MuSK) antibodies (10% patients) ➢ CT/ MRI thymus '**EDROPHONIUM** test helpful if diagnosis unsure - Patient given IV dose of neostigmine (edrophonium Cl) to briefly and temporarily relieve the weakness	Investigate cause ➢ CXR ➢ HRCT	**CLINICAL diagnosis** ➢ **Brain MRI**	**Clinical diagnosis** 
Comp.	➢ Suicide (leading cause of death) ➢ Death due to respiratory disease (pneumonia)	1. Strong link to **thymomas (20-40%) and converse is true (i.e. those with thymomas are more likely to develop MG)** 2. **Myasthenic crisis (life- threatening)** ➢ Triggered by acute illness (e.g. URTI) ➢ Leads to respiratory failure due to respiratory fatigue ➢ May need PEEP or I+V ➢ **Rx: IVIg and plasma exchange**		➢ HSV → meningitis, encephalitis ➢ **Ramsey Hunt** (VZV) = painful vesicular rash may extend to ear canal, pinna and around ipsilateral ear	➢ Reduces QoL ➢ Suicide
Rx	➢ **No treatment** - life expectancy 15-20 years after onset of symptoms ***MDT approach*** ➢ OT, PT and psychologist ➢ Speech therapies ➢ Genetic counselling (relatives, pregnancy, children) ➢ Advanced care planning ➢ End of life care planning ***Symptomatic treatment***: ➢ Anti-psychotics (olanzapine) ➢ Benzos (diazepam) ➢ Dopamine -depleting agents (e.g. tetrabenazine) ➢ Antidepressants	*Medical treatment:* 1. **Neostigmine** (reversible ACHE inhibitors) 2. **Immunosuppression** (e.g. prednisone) – suppress antibody production 3. **Thymectomy** – may improve symptoms even in patients without thymoma *Alternatives (MABs)* ➢ **Rituximab** – (anti-CD20) – inhibit B cell antibody production ➢ **Exculizumab** (anti-C5) = prevent complement activation and stop ACHR destruction	*Medical treatment:* 1. **Amifampridine** (block voltage gated K channels in pre-synaptic terminals) → prolongs depolarization of cell membrane 2. **IVIg** 3. **Plasma exchange** 4. **Immunosuppression** (e.g. prednisone) – suppress antibody production	*For UMN:* ➢ Surgical resection if tumour *For LMN:* ➢ **Bell's palsy** = start **50mg prednisolone PO for 10 day** within 72 hours then **5 days high does 60 mg** before weaning for next 5 days [**NO acyclovir**] o *Lubricating eye drops to prevent exposure keratopathy* o *May take 12 months recovery with some residual weakness* ➢ **Ramsey Hunt** = start **prednisolone and acyclovir** within 72 hours	***1) Referral to pain specialist:*** ***2) medical therapy*** ➢ **Antidepressants (*amitriptyline, SNRI*)** ➢ ***Anti-convulsant (****gabapentin, pregabalin*) ➢ ***Carbamazepine (if*** *trigeminal neuralgia*)

RARE NEUROLOGICAL DISEASES

	Charcot Marie-Tooth Disease	Gullian-Barre Syndrome	Neurofibromatosis	Tuberous Sclerosis	ESSENTIAL TREMORS
Cause	➢ Inherited – autosomal dominant ➢ 1 in 2500 people ➢ Affects **peripheral motor and sensory nerves (dysfunctional myeline)** ➢	➢ Acute paralytic polyneuropathy that affects PN ➢ Triggered by infection (esp. C. jejuni, CMV, EBV) ➢ Cause: **MOLECULAR MIMICRY** ➔ B cells create antibodies against antigens on pathogen from preceding infection. Same antibodies target myeline sheath of LMN	• Inherited – autosomal dominant • NF1 – chr 17 (neurofibromin -TSP) • NF2 – chr 22 (merlin - TSP	➢ Inherited – autosomal dominant ➢ TSC1 = Chr 9 (hamartin) ➢ TSC2 = Chr 16 (tuberin) Abnormal development of hamartomas (benign neoplastic growth of tissue they originate from → skin, brain, lung, heart, kidneys and eyes)	➢ **VERY COMMON** condition assoc. with older age ➢ **Fine tremor** affecting ALL **voluntary muscles** (e.g. hand, jaw and vocal tremor)
S+S	<u>Symptoms develop before 10yo but can be delayed up to 40yo</u> ➢ Pes cavus (high foot arch) ➢ Inverted champagne bottle leg (distal muscle wasting) ➢ Weak lower leg (loss of ankle DF) ➢ Weakness in hands ➢ Reduced tendon reflexes ➢ Reduced muscle tone ➢ Peripheral sensory loss 	Symptoms develop 4 weeks after infection ➢ Acute symmetrical **ascending weakness** + sensory symptoms o Begins in feet then moves up body ➢ Reduced reflexes ➢ Peripheral loss of sensation or neuropathic pain ➢ May progress to cranial nerves causing facial weakness 	<u>*NF1 criteria (at least 2 out of 7)*</u> • **C** – ***Café-au-lait spots*** (≥ 6) measuring ≥ 5mm in children or ≥ 15mm in adults • **R** – **R**elative with NF1 • **A** – **A**xillary or inguinal freckles • **BB** – **B**ony dysplasia such as **B**owing of a long bone or sphenoid wing dysplasia • **I** – ***Iris hamartomas*** (≥2x ***Lisch nodules***) = yellow brown spots on the iris • **N** – **N**eurofibromas (2 or more) **or** 1 plexiform neurofibroma • **G** – **G**lioma of optic nerve <u>*NF2 classic signs (acoustic neuroma)*</u> ➢ Hearing loss ➢ Tinnitus ➢ Balance problems	➢ ***Ash leaf spots*** = depigmented areas of skin shaped like an ash leaf ➢ ***Shagreen patches*** = thickened, dimpled, pigmented patches of skin ➢ ***Angiofibromas*** = small skin coloured or pigmented papules on nose and cheeks ➢ ***Subungual fibromata*** =circular painless fibromas growing from the nail bed. ➢ ***Cafe-au-lait spots*** = light brown "***coffee & milk***" coloured flat pigmented lesions on skin ➢ ***Poliosis*** = isolated patch of white hair on the head, eyebrows, eyelashes or beard 	Autosomal dominant inheritance ➢ Fine symmetrical tremor ➢ Worse on movement ➢ Worse when tired, stressed ➢ Improved with alcohol ➢ Absent during sleep
Ix	**Exclude other causes of peripheral neuropathy:** A) Alcohol B) B12 deficiency C) Cancer or CKD D) Diabetes and drugs (e.g. isoniazid, amiodarone, cisplatin) **E)** Every vasculitis	**<u>Brighton criteria for GBS</u>** ➢ Bilateral and flaccid limb weakness ➢ Loss of deep tendon reflexes ➢ CSF cell count (normal) and CSF protein (high) ➢ Nerve conduction study consistent with GBS **<u>Supporting Ix:</u>** ➢ Nerve conduction studies (reduced signal through nerves) ➢ LP in CSF (**elevated proteins** with normal FBC and BSL)	***<u>Clinical diagnosis:</u>*** ➢ Genetic testing ➢ XR – to investigate bone pain ➢ CT and MRI → check for lesions / masses in brain, SC	***<u>Clinical diagnosis:</u>*** ➢ Genetic testing	**DDx:** ➢ **Parkinson's** ➢ **MS** ➢ **Huntington's** ➢ **Hyperthyroidism** ➢ **Wilson (< 30 yo)** ➢ **Fever** ➢ **Meds (e.g. anti-psychotics)**
Comp.	➢ Reduced QoL	➢ 80% fully recover ➢ 15% with some neurological deficit ➢ 5% die (usually secondnary to PE)	Mainly for NF1 ➢ Migraines ➢ Epilepsy ➢ Renal artery stenosis (HTN) ➢ ADHD ➢ Malignant PNS sheath tumours ➢ GIST (sarcoma) ➢ ++cancers (brain, breast, leukemia, spinal cord)	➢ Epilepsy ➢ Learning disability ➢ Developmental delay Extra-organ manifestations: ➢ Rhabdomyomas in heart ➢ Gliomas (tumours in brain and spinal cord) ➢ Polycystic kidneys ➢ Retinal hamartomas ➢ Lymphangioleiomyomatosis (SMC growth in lungs)	➢ Disrupted QoL
Rx	**MDT approach (NO cure)** ➢ **Neurologist and geneticist** (make dx) ➢ **PT** – maintain muscle strength and ROM ➢ **OT** – assist ADLs ➢ **Podiatrist** – orthoses to improve Sx ➢ **Orthopaedic surgeons** – correct disabling joint deformities	➢ IVIg ➢ Plasma exchange ➢ Supportive care ➢ VTE prophylaxis (PE is a leading cause of death)	No CURE NF1: ➢ Control Sx /complications NF2- Schwannomas: ➢ Surgical resection (risk of permanent damage)	No CURE ➢ SUPPORTIVE MANAGEMENT ➢ Prevent and treat complications (esp. epilepsy)	➢ *No definitive treatment* <u>*Symptomatic improvement*</u>: ➢ *Propranolol (non-selective BB)* ➢ *Primidone (barbiturate anti-epileptic)*

BRAIN TUMOURS

Cause

Abnormal growths in brain that can be benign or malignant

- Benign = meningioma, pilocystic astrocytoma
- Malignant = glioblastoma, medulloblastoma
- Secondary METs = lung, breast, RCC, melanoma

S+S

Asymptomatic (especially when they are small)

- **FND**
- **Raised ICP** – AM headache, altered mental state, CN palsies (III and VI)
- **Visual disturbances** – diplopia
- **Personality change** → frontal lobe tumour
- **Headache**:
  - constant,
  - nocturnal,
  - new
  - worse on coughing or straining
  - AM headache
- **Seizures** (usu. low grade gliomas)

DDx:

- Psychological stress
- Migraines, cluster
- Raised ICP - DDx: tumour, ICH, IIH, abscess, infection, hydrocephalus
- Infection
- Stroke
- Temporal arteritis
- Autoimmune (MS)
- Drugs (nitrates)

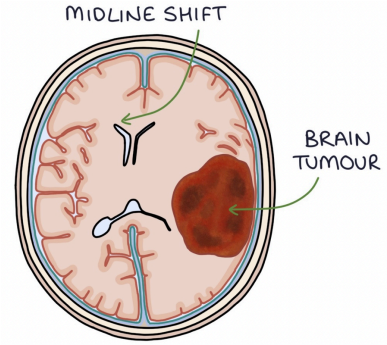
Ix`

Bloods:

- FBC (WCC = infection, low plts = haemorrhage)
- EUC (SIADH)
- CRP (inflammation)
- INR -coagulation

Imaging:

- **Non-contrast head CT**
- **MRI Brain (better delineation)**
- **PET-CT (mets? - →***conduct breast, resp and abdo exam***)**
- **Fundoscopy –** *papilloedema* **(optic disc swelling) -** ***When looking for elevation of the optic disc, look at the way the retinal vessels flow across the disc. Vessels are able to flow straight across a flat surface, whereas they will curve over a raised disc.***



Invasive:

- **Brain biopsy**
- **Frozen section + biopsy (confirm on the spot)**
  - DDx: is it glioblastoma (resection) or CNS lymphoma (chemo)? (as management is different)
- **Genetic profiling = p53, MDMT methylation and IDH status**
  - **IDH testing →** ***IDH WT = highly aggressive and malignant glioblastoma***

Gliomas	Meningioma	Pituitary tumours	Acoustic neuroma	Other
➢ **Pilocystic Astrocytoma** most common benign child ➢ **Glioblastoma** multiforme (grade IV astrocytoma) – most common malignant adult "ring-enhancing lesions" "pseudopallisaded necrosis + atypical nuclei and + mitoses" ➢ **Oligodendroglioma –** well-demarcated with **psammatous** calcification *"chicken wire vasculature or honeycomb fried egg* **, peri-nuclear clearing (halos)"** ➢ **Ependymoma -** perivascular fibrillay in **pseudorosette** pattern ➢ **Medulloblastoma (embryonal cell tumour)** most common malignant childhood brain tumour	Most common benign adult tumour ➢ **More common in women** ➢ **Slow growing headaches and seizures** ➢ Mass effect – raised ICP and FND ➢ "whirling architecture" ➢ Dural based well circumscribed lesion ➢ Good prognosis	*Bitemporal hemianopia* ➢ *Acromegaly* ➢ *hyperPrL* ➢ *Cushing's disease* ➢ *Thyrotoxicosis* ➢ *Hypopituitarism* ***DDx: craniopharyngiomas*** ➢ *Rare benign growth of embryonic tissue around pituitary gland* ➢ *Growth slowly disrupts pituitary function* ➢ *Can become cystic or solid*	Cerebellopontine angle tumours **(vestibular schwannomas)** ➢ *assoc. with NF2* ➢ *Tinnitus,* ➢ *imbalance,* ➢ *sensorineural hearing loss* ➢ *"verocay bodies"* ***DDx: neurofibromas*** ➢ *assoc. with NF1* ➢ *affects PNS*	**Germ cell tumours:** ➢ Linked to Klinefelter syndrome ➢ Raised tumour makers (BHCG, AFP) **Primary CNS lymphoma** ➢ 6% of primary brain tumours ➢ *Angiocentric infiltration* (atypical lymphocytes, B or T cell, around vessels

Comp.

- Death

Rx

MDT approach for any brain tumour

- **C**hemo
- Radiotherapy w/ temozolomide (akylating agent) → for Glioblastoma
- Surgical resection (neurosurgery)→ risk of irreversible brain damage depending on llcation
  - Corticosteroids → reduce inflammation
  - Stop taking aspirin prior to surgery
- Palliative care

Specific approach for PITUITARY tumour

- Trans-sphenoidal Surgical resection
- Radiotherapy
- Medications:
  - **Bromocriptine** to block Prolactin-secreting adenomas
  - **Somatostatin analogues (octreotide)** to block GH-secreting adenomas