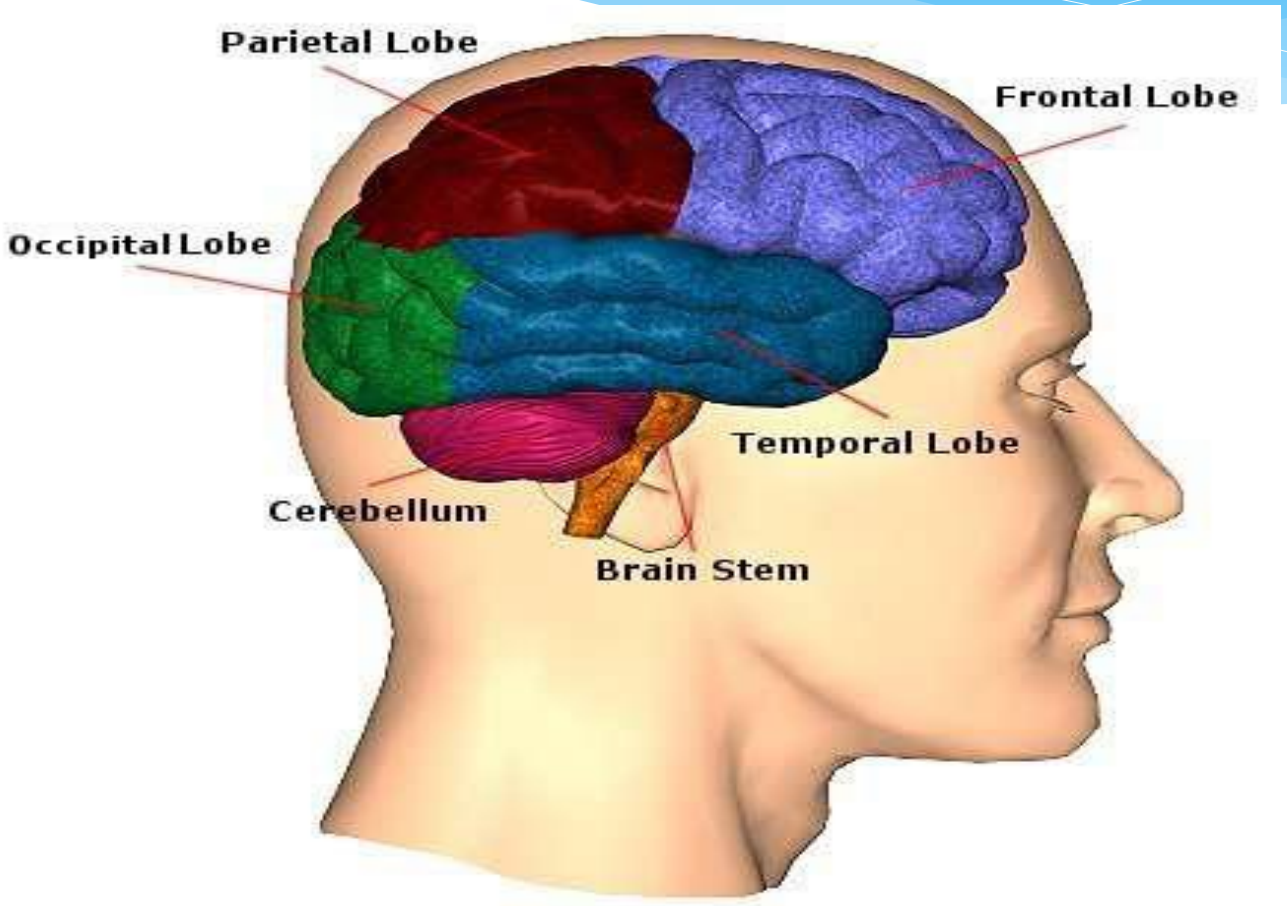
Brain anatomy, physiology, Stroke & Neurological Assessment

Stephanie Drysdale


Parietal Lobe
Frontal Lobe
Occipital Lobe
Temporal Lobe
Cerebellum
Brain Stem

Functions of the Brain

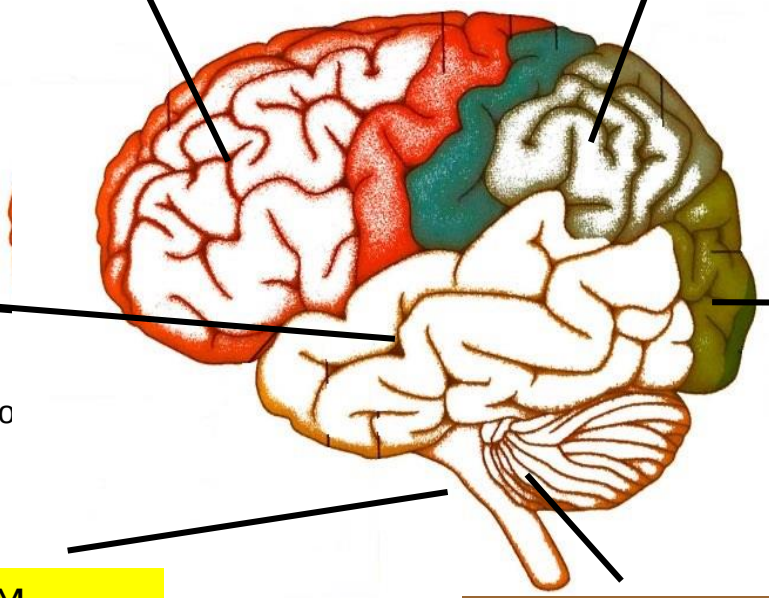
FRONTAL

- Personality/Behaviour
- Planning
- Decision making
- Concentration
- Voluntary motor functions
- Primary motor cortex (precentral gyrus)

Precentral gyrus
Primary Motor Cortex

PARIETAL

Comprehension and language
Sensory functions (pain, heat and other sensations)
rimary somatosensory cortex (postcentral gyrus)



TEMPORAL

- Understanding speech
- Interpretation and storage of audito olfactory sensations

OCCIPITAL

Primary visual cortex
Processing visual information
- Storing visual memories

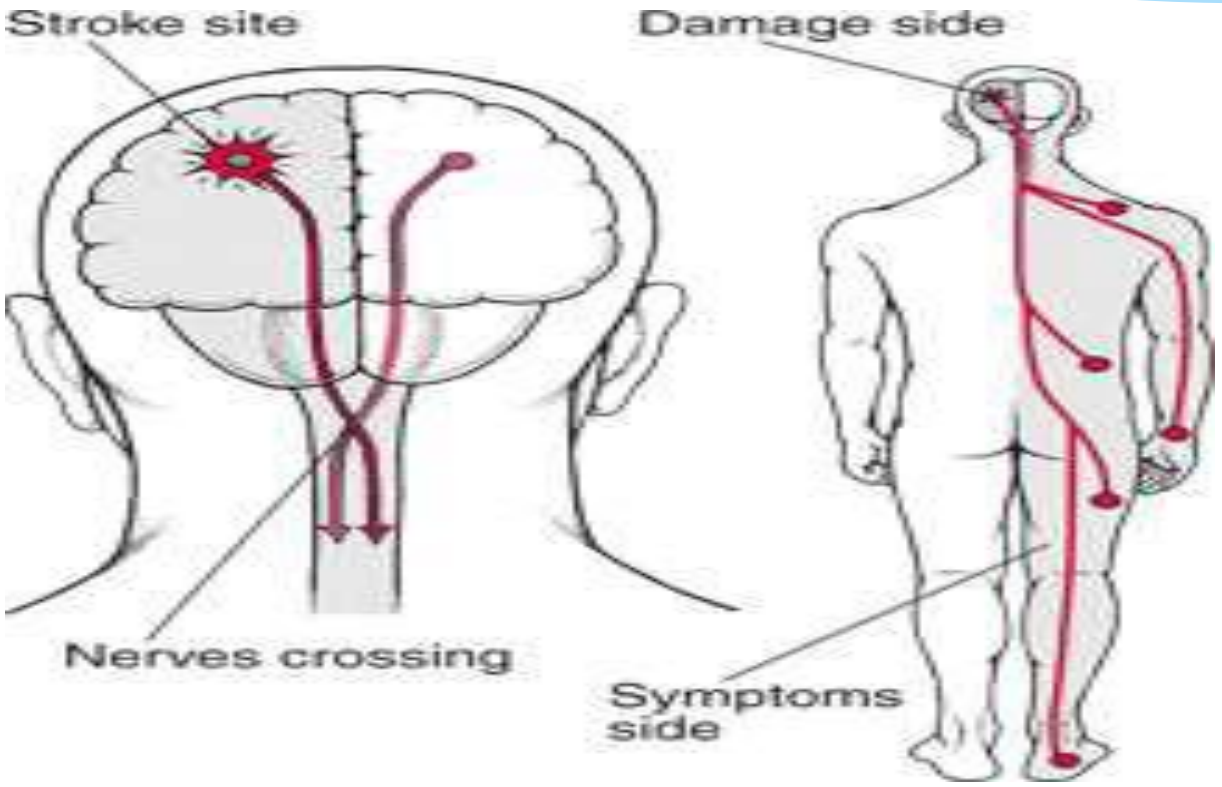
BRAINSTEM
(Midbrain, Pons, Medulla oblongata)

- Breathing
- Swallowing
- Heart rate
- Arousal and wakefulness

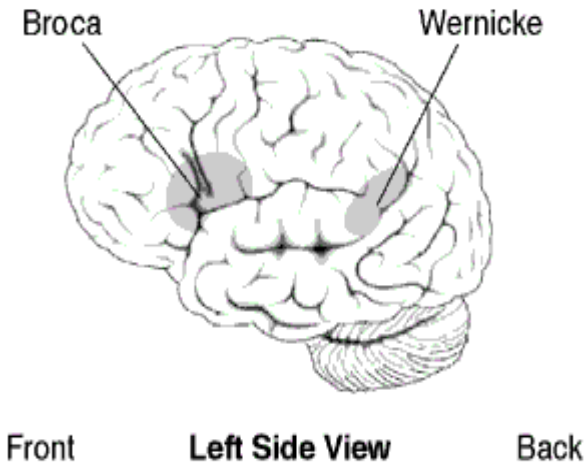
CEREBELLUM

- Coordination
- Balance
- Stores memories of previously learned movement patterns

Contra-lateral Control



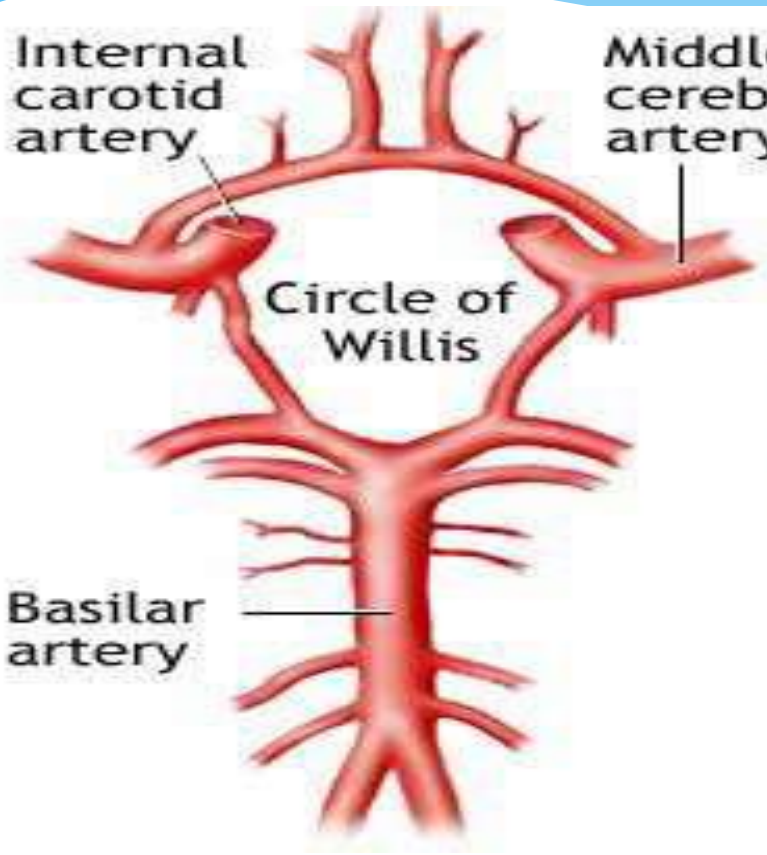
Speech centres

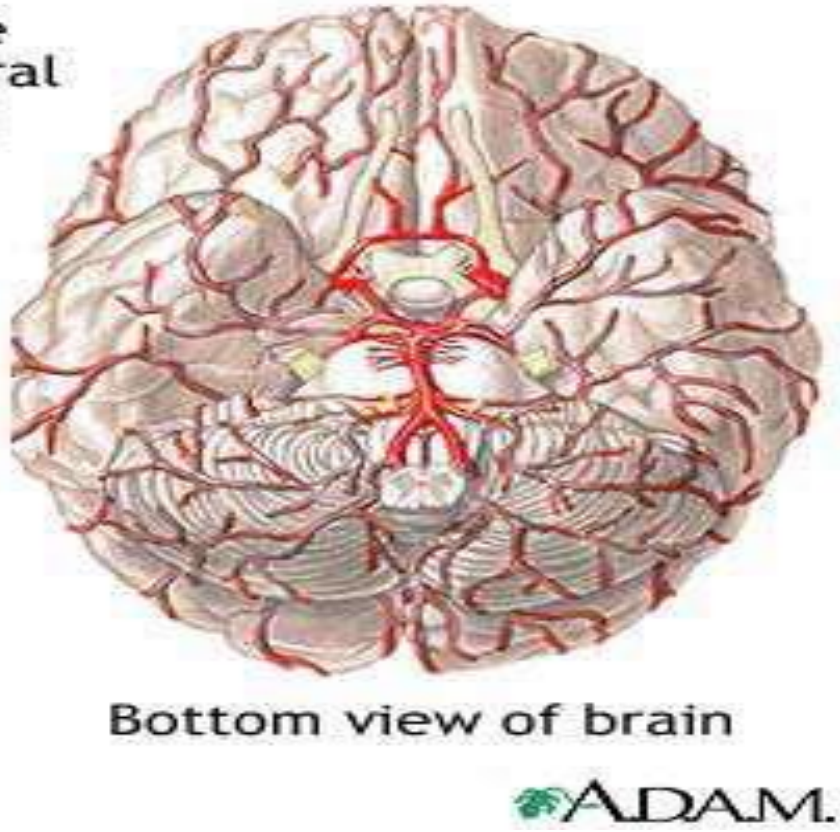


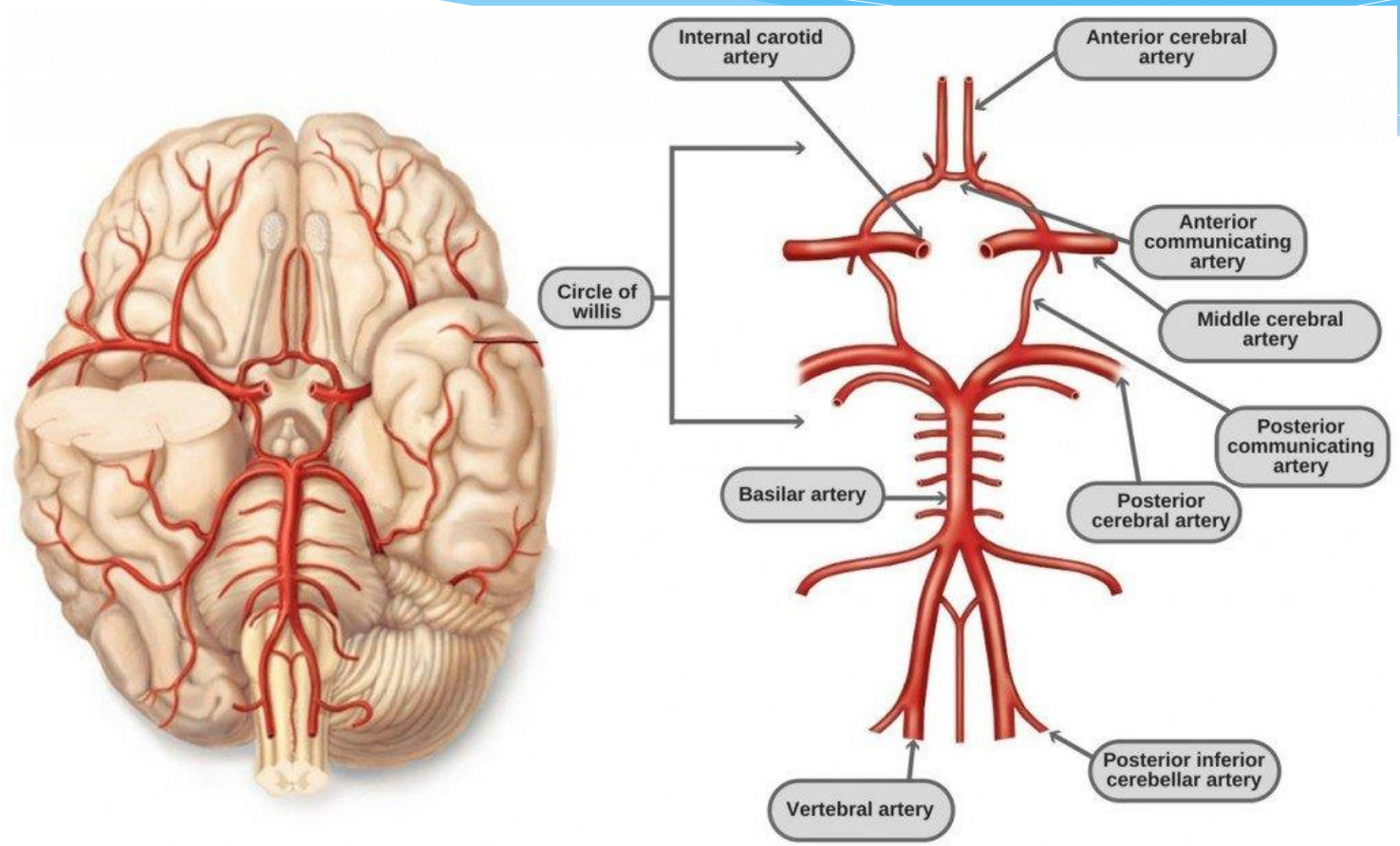
- **Broca;** control the muscles of the larynx, pharynx and mouth that enable us to speak

- **Wernicke's area,** injury here may result in receptive dysphasia. Controls our understanding of language.

Blood Supply to the Brain







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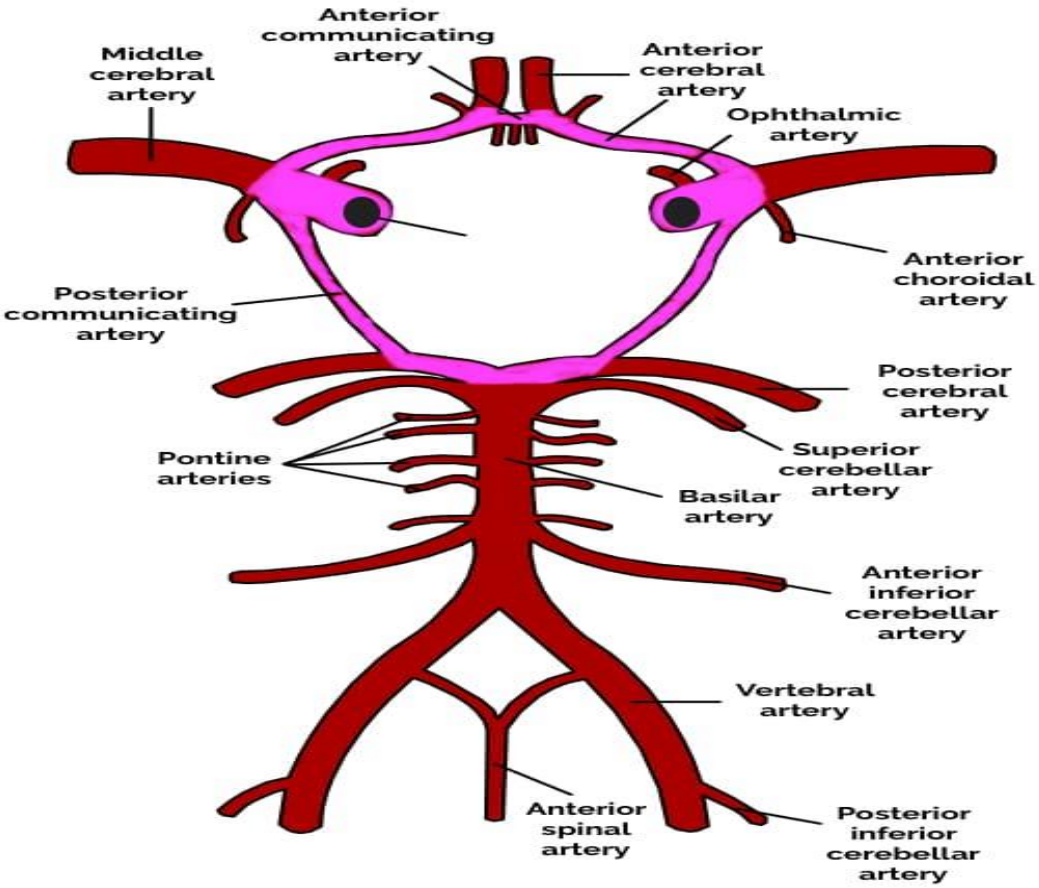
Circle of Willis



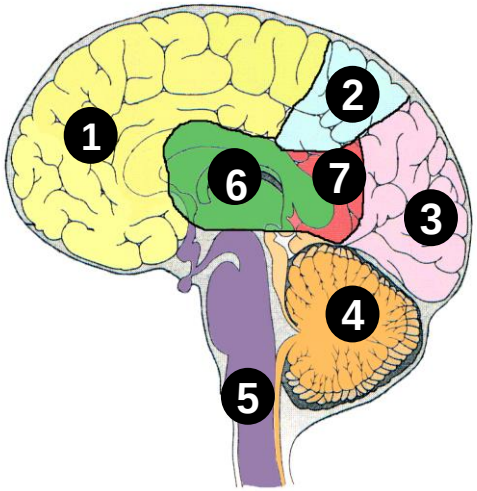
1. Frontal Lobe
Controls:
- Behaviour
- Emotions
- Organisation
- Personality
- Planning
- Problem solving

Arteries: ACA, MCA

2. Parietal Lobe
Controls:
- Judgement of shape,size,texture, and weight
- The sensation of pressure and touch
- Understanding of spoken/written language **Arteries: ACA, MCA**

3. Occipital Lobe
Controls:
- Colour recognition
- Shape recognition

Arteries: PCA



4. Cerebellum
Controls:
- Balance
- Muscle co-ordination
- Posture maintenance

Arteries: Basilar PICA, AICA, SCA

ACA = Anterior Cerebral Artery
MCA = Middle Cerebral Artery
PCA = Posterior Cerebral Artery
PICA = Posterior Inferior Cerebellar Artery
AICA = Anterior Inferior Cerebellar Artery
SCA = Superior Cerebellar Artery

5. Brainstem
Controls:
- Alertness
- Blood pressu
- Digestion
- Breathing
- Heart rate

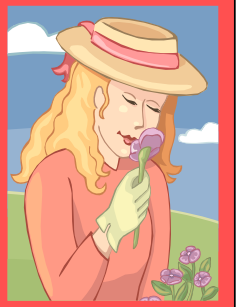
Arteries: Vertebral Basilar

6. Hippocampus
Controls:
- Object recogni
- Stores meanin words or place

Arteries: PCA

7. Temporal lobe
Controls:
- Smell Identification
- Sound Identification
- Short-term Memory
- Hearing

Arteries: MCA, PCA



What is a Stroke?

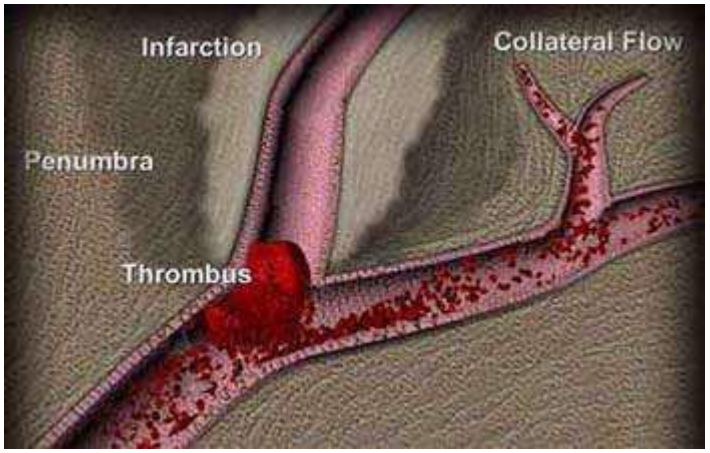
* Interruption of blood supply to the brain, caused by a blocked or burst blood vessel… Cuts of the supply of oxygen and nutrients, causing damage to brain tissue.

(World Health Organisation 2010)

Ischaemic Stroke

- It an obstruction within the Blood Vessels.
- 84% Strokes are Ischaemic.

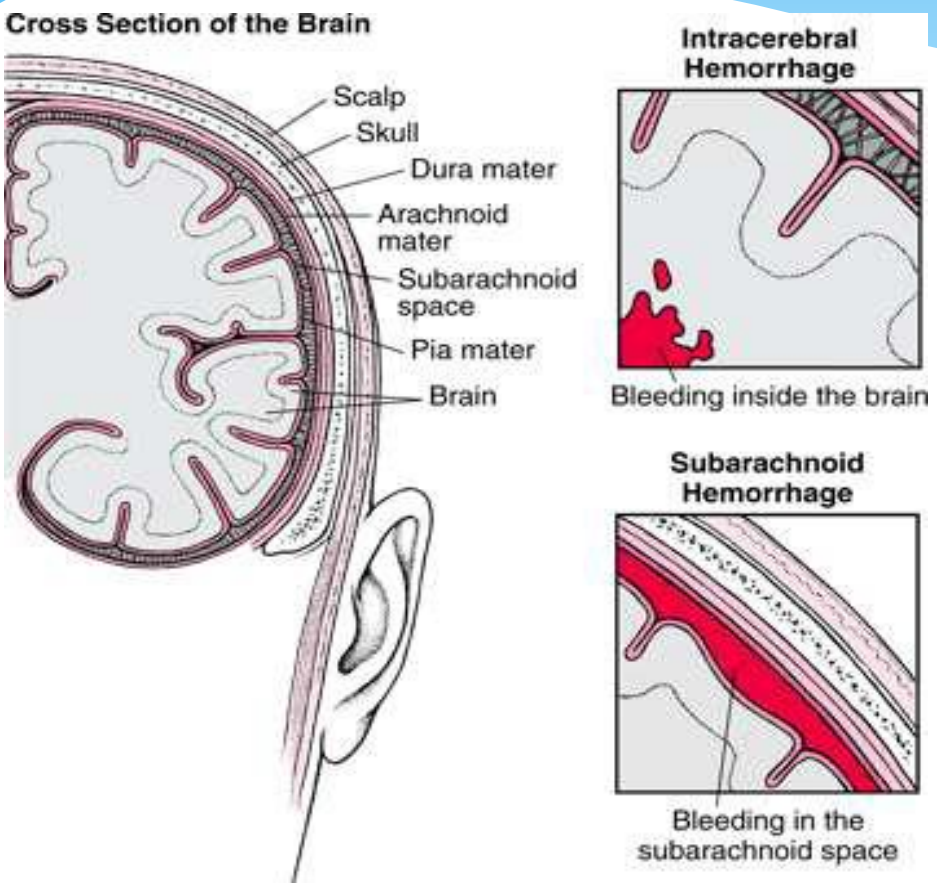
Ischemic stroke (Thrombo/embolic stroke)



- hypercholesterolemia
- hypertension
- Atrial fibrillation
- Ischaemic heart
* disease/angina
* • Peripheral vascular
* disease
- Diabetes

- Previous stroke/TIA
- Smoking
- Increased alcohol intake
- Poor diet/obesity
- Increased ageatherosclerosis
- Oral Contraceptive Pill
- Drug misuse

Haemorrhagic Stroke



- Chronic high blood pressure.
- Amphetamine.
- Amyloid angiopathy
- Arterial Venous malformation (AVM),
- inflammation of blood vessels (vasculitis),
- bleeding disorders,
- anticoagulants,

Intracerebral and subarachnoid haemorrhage

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Subdural Haematoma

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* A **subdural hematoma** (American spelling) or **subdural haematoma** (British spelling), also known as a **subdural haemorrhage** (SDH), is a type of haematoma, usually associated with traumatic brain injury. Blood gathers between the dura mater, and the brain.
* Usually resulting from tears in bridging veins which cross the subdural space, subdural hemorrhages may cause an increase in intracranial pressure (ICP), which can cause compression of and damage to delicate brain tissue.
* Subdural hematomas are often life-threatening when acute. Chronic subdural hematomas, however, have a better prognosis if properly managed.

- Cerebral infarction/ischaemic 84%
- Intracerebral haemorrhage 13%
- Subarachnoid haemorrhage 6%
- Risk of recurrence within 5 years 30-40%

(Stroke Association

Neurological assessment

Why perform a neurological assessment?

The reasons to perform a neurological assessment include:

1. Identify the presence of nervous system dysfunction
2. Detect life-threatening situations
3. Establish a neurological baseline for the patient
4. Compare data to previous assessments to determine change, trends and necessary interventions
5. Determine the effects of nervous system dysfunction on activities of daily living and independent function
6. Provide a database upon which nursing interventions will be implemented.

The Glasgow Coma Scale

* It provides a practical method for assessment of impairment of conscious level

The Glasgow Coma Scale

- The GCS evaluates three key categories of behaviour that most closely reflect activity in the higher centres of the brain: **eye opening, verbal response and motor response** (Waterhouse, 2005). These categories enable the MDT to determine whether the patient has cerebral dysfunction

The Glasgow Coma Scale

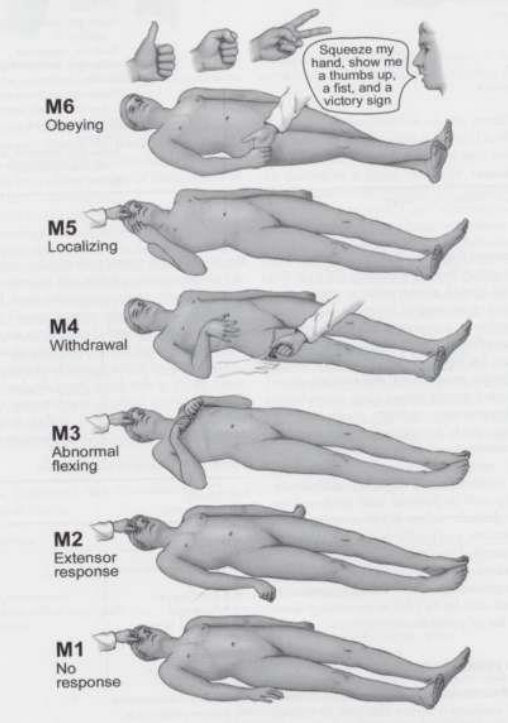
* Within each category, each level of response is attributed a numerical value. The lower the value, the greater the neurological deterioration and resulting brain insult. A Coma Score of 13 or higher correlates with a mild brain injury, 9 to 12 is a moderate injury and 8 or less a severe brain injury. The lowest possible score is 3 which indicates that the patient is completely unresponsive.

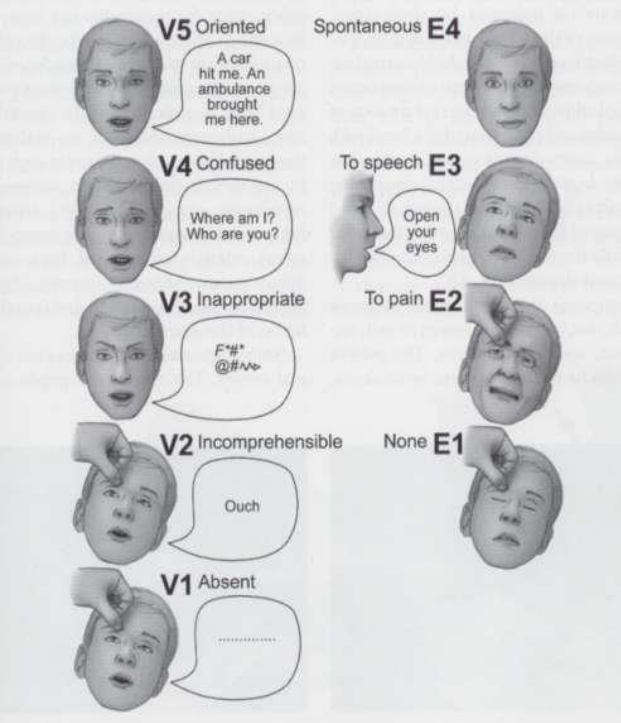
The Glasgow Coma Scale

* The aim of the GCS, is to get a firm baseline for comparison. Without this, you will be unable to recognise deterioration in the patient's neurological condition and will not be able to react appropriately.

- When used correctly, it alerts medics and nurses to a deterioration in a patient's neurological status

Illustration of GCS





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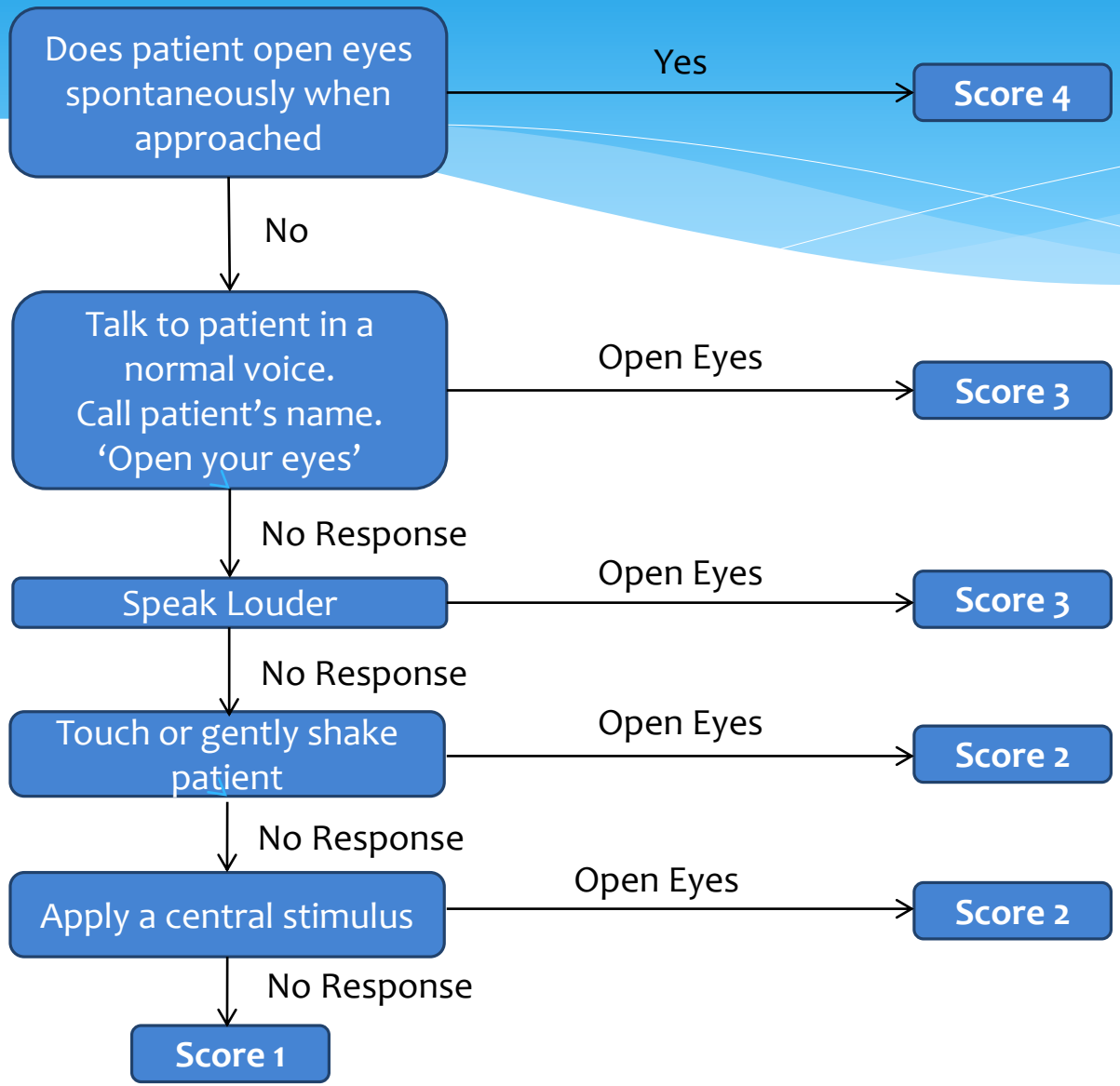
Motor response -Abnormal Flexion (3)

- Elbow bends
- Shoulder adduction - arm moves towards the body
- Wrist flexion
- features clearly predominantly abnormal

Motor response – Extension (2)

- Arm extends at elbow
- Adduction of the shoulder -arm moves towards the body
- Wrist flexion • Arm rotates internally

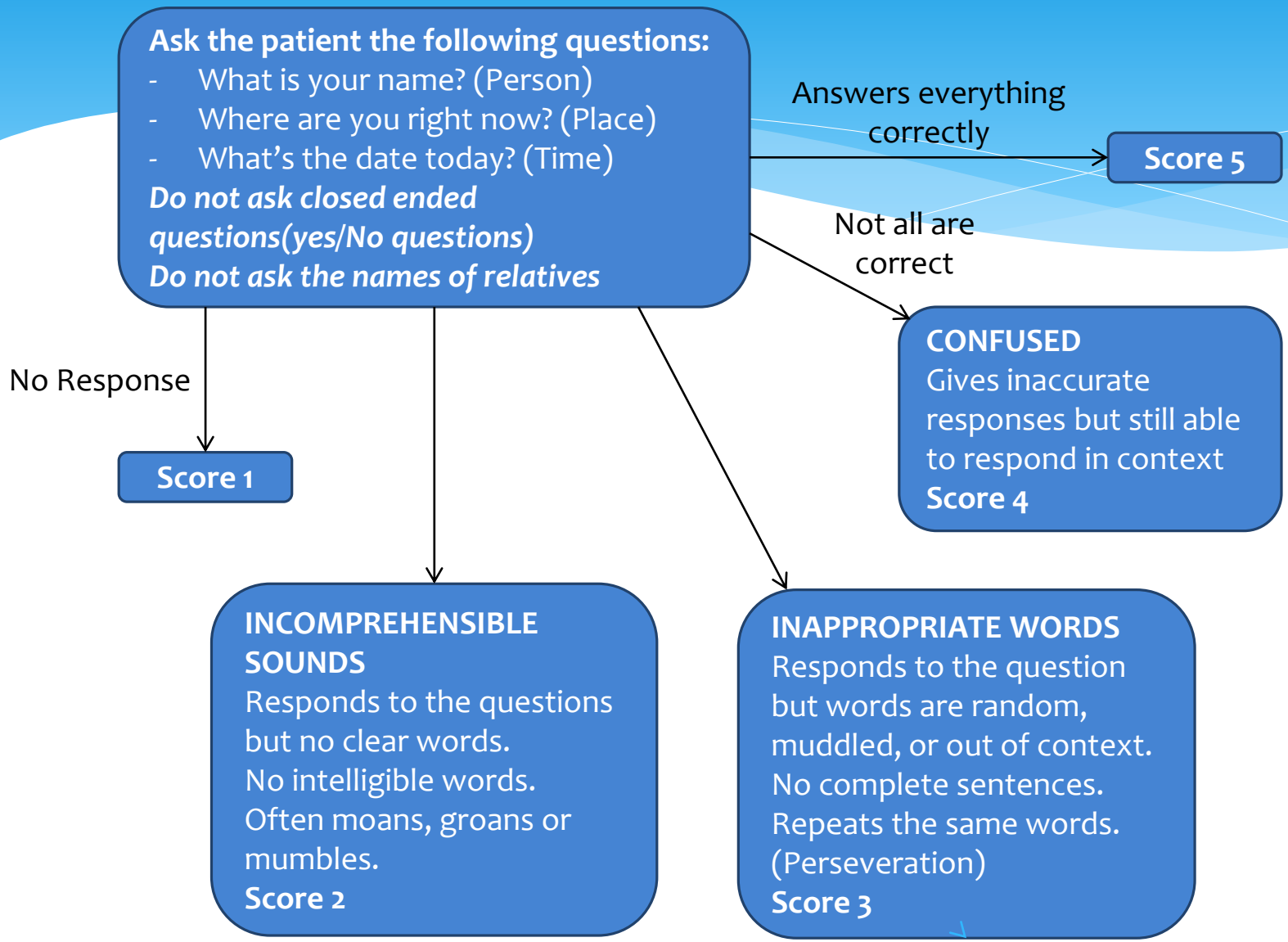
GCS Flow Chart : Eye Opening



Eye Opening

Score	Interpretation
4 Spontaneously	RAS, thalamus and cortex function intact CN3 intact
3 To speech	RAS and cortex function intact Motor cortex intact CN3 intact
2 To pain	Reduced function of RAS and cortex
1 none	Neurological dysfunction in RAS (brainstem)

GCS Flow Chart : Best Verbal response



Verbal Response

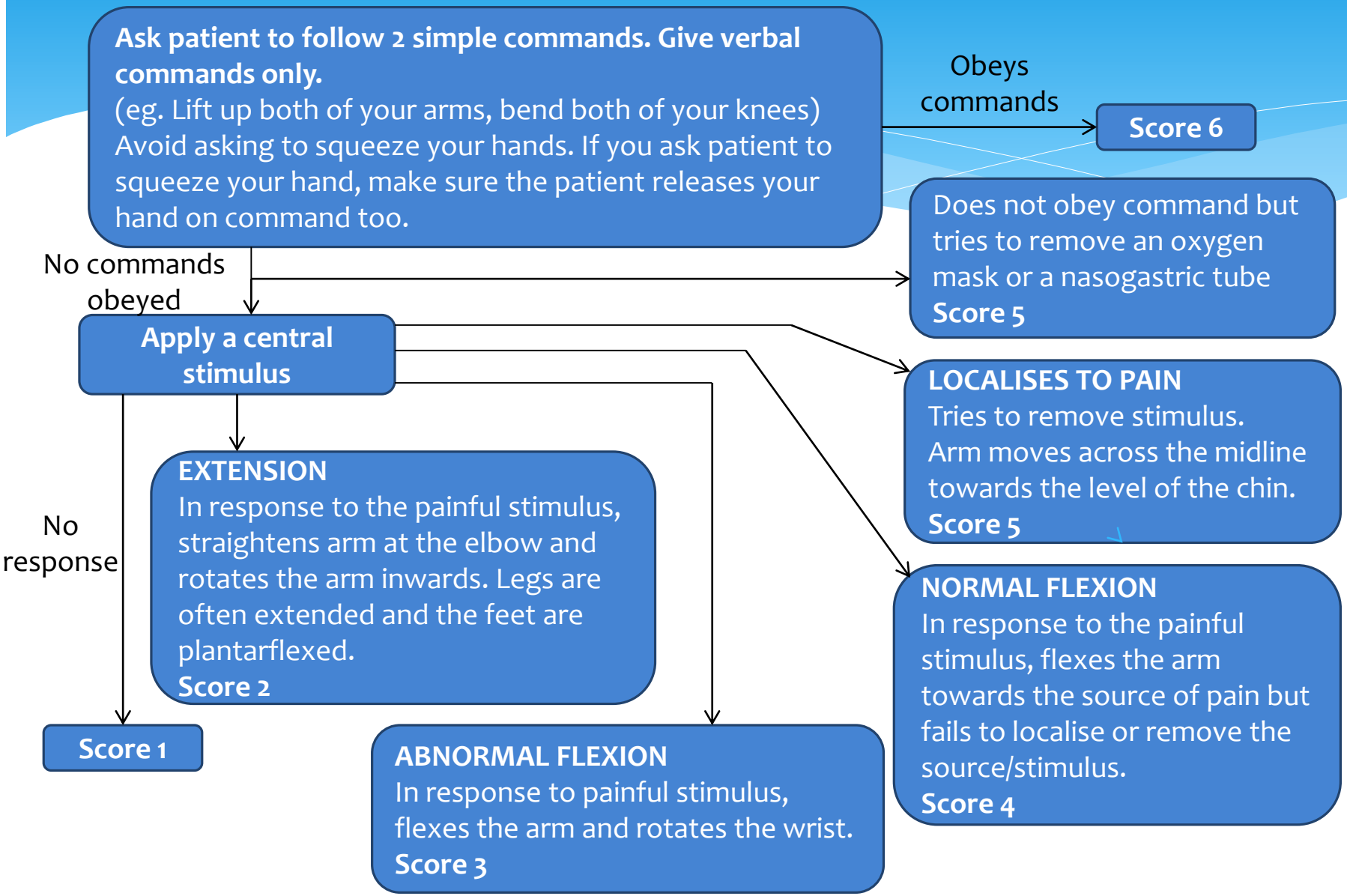
Score	Interpretation
5 Orientated	Temporal/parietal, frontal and prefrontal cortex intact CN 5, 7, 8, 9, 12
4 Confused/ sentences	Temporal/parietal, frontal intact Reduced activity pre-frontal cortex
3 Inappropriate Words	Temporal/parietal, frontal intact
2 Incomprehensible Sounds	Temporal/parietal, frontal intact
1 none	Neurological dysfunction in cerebral cortex

Questions used to assess best verbal response

Ask patient the following questions:

* Tell me your name? (personal details)
* Where are you? Or what is this place? What do you think my job is? (hospital, nurse)
* Tell me the month and year (the current month, year or season)
* **Do not ask closed questions(i.e. those with yes/no answers)**
* **Do not ask the names of relatives**
* **Do not ask who the current prime minister is or other irrelevant questions (these are context specific e.g. if it is a visitor to the UK, they might not be able to answer)**

GCS Flow Chart : Best Motor Response



Motor responses

Score	Interpretation
6 Obeys commands	Neurologically intact
5 Localising pain	Sensory and motor cortex and pathways intact
4 Flexion to pain	Reduced sensory and motor processing
3 Abnormal flexion	Blocked motor pathway between cortex and brainstem
2 Extension	Blocked motor pathway within brainstem
1 none	Gross neurological dysfunction

Physical stimulus

Central Stimulus

* Can be used to assess eye opening response and motor response
* If the patient does not obey commands or is not trying to pull of oxygen facemask or nasogastric tube (if applicable)- central painful stimulus needs to be applied
* Trapezius squeeze

Always explain to the patient and relatives what you are about to do and why

Trapezius Squeeze

* The trapezius squeeze targets the spinal accessory nerve (cranial nerve XI) and is documented as the most suitable method.
* Apply pressure by grasping approximately 3 cm of the muscle between the thumb and forefingers and squeezing with gradually increasing intensity for up to 15 seconds
* Do not squeeze for more than 15 seconds even if the patient does not react
* This method could be difficult on a large or obese patient but can be done.

Pupillary Responses

* Estimate the size in mm using pupil scale and record the size numerically on the chart
* Move the torch from the outer aspect of the eye towards the pupil, the pupil should constrict quickly(direct light response)
* Repeat the previous procedure but observe the reaction of the opposite eye(consensual light response)
* Repeat point 3 and 4 for the opposite eye

Pupillary Responses

feature	action	interpretation
Size Equality • **Normal pupils are round, equal and react briskly and simultaneously to light**	Resting assessment equality	Normal 2-6mm, Pinpoint- opiates Large- atropine Fixed Dilated- sudden CN3 compression, rising ICP
shape	Ovoid Keyhole Irregular/ jagged	Rising ICP Cataract Orbital injuries
Reaction to light	Sluggish None Consensual response	rising intracranial pressure compression of CN3 at brainstem Coordination of CN3, unilateral compression

Assessing the pupils

Acutely widely dilated pupil on one side may be due to a unilateral space occupying lesion

Bilateral abnormally constricted pupils may be due to opiates

Bilaterally dilated pupils could be an intracranial catastrophe or due to sympathetic over activity i.e fear

Limb assessment

* Evaluation of the limbs provides the nurse with detail of the geographical distribution of dysfunction and is important when performing a full neurological assessment of the patient.

* A difference in responsiveness in one limb compared to another indicates focal brain damage. Hemiparesis or hemiplegia usually occurs in the limbs on the opposite side to the lesion (due to the crossing over of nerve fibres in the medulla). However, it may also affect the limbs on the same side as the lesion due to the pressure on the contra lateral hemisphere

How to test limbs

* Each limb should be assessed separately. The patient should be awake, able to co-operate and understand what you are asking them to do.
* Have the patient flex and extend their arm against your hand, squeeze your fingers, lift their leg while you press down on their thigh, hold her leg straight and lift it against gravity, and flex and extend her foot against your hand. A peripheral stimulus needs to be applied to limbs that you have not seen move.
* As part of the motor assessment, also check for arm pronation or drift. Have the patient hold her arms out in front of her with her palms facing the ceiling, eyes closed. If you observe pronation—a turning inward—of the palm or the arm or the arm drifts downward, it means the limb is weak.

Grading of motor function

Grade each extremity using a motor scale like the one below.

* +5 - full ROM, full strength
*
* +4 - full ROM, less than normal strength
* +3 - can raise extremity but not against resistance
* +2 - can move extremity but not lift it
* +1 - slight movement
* 0 - no movement

Vital signs

Temperature

* Regulation may be disrupted due to damage to the hypothalamus
* In the acute phase of brain injury hyperthermia should be treated as it will exacerbate cerebral ischaemia and adversely affect outcome

Heart rate

* ECG changes may occur in the acute stage following cerebral insult as a result of catecholamine release
* These can include peaked P waves, prolonged QT interval, heightened T waves, ST segment elevation or depression
* Bradycardia is present in the later stages of raised ICP (compensatory phase – Cushing's response) or when there is an associated cervical spine injury.
* Tachycardia is present in the terminal stage of raised ICP
* Arrhythmias are seen in posterior fossa lesions or when there is blood in the CSF

Vital signs

Blood pressure

* In a normal brain a fall in blood pressure does not cause a drop in cerebral perfusion pressure since autoregulation results in cerebral vasodilation to protect brain tissue.
* However, following cerebral insult/injury, when autoregulation may be impaired, hypotension may lead to brain ischaemia.
* Hypotension (systolic BP <90mmHg) has been identified as a predominant factor in secondary brain injury and is related to morbidity and mortality.
* Hypotension is associated with a rising ICP and is part of the Cushing's response – rising BP with a widening pulse pressure, bradycardia and decreasing respirations.
* This is a late response and may not appear in some patients and is invariably preceded by a drop in GCS.

Vital signs

Respiration

* Changes in the respiratory pattern are common following cerebral insult and patients often require advanced respiratory support in the acute stage. Initially an acute rise in ICP will cause slowing of the respiratory rate indicating loss of all cerebral and cerebellar control of breathing, with respiratory function at only brain stem level
* As ICP continues to rise the rate becomes rapid indicating that the brain stem is affected too.

A decreased level of consciousness may compromise respiratory function, therefore observe for potential airway problems

* Irregular pattern
* Noisy or snoring respirations
* Use of accessory muscles
* Tacypnoea/dyspnoea/apnoea

Raised Intracranial Pressure

Early Signs

- Agitation
- Vomiting
- Headache
- Dilated pupils

Later Signs

- Increased systolic blood pressure
- Bradicardia
- Abnormal respiratory pattern

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Causes and Treatment

Causes

- Oedema
- Haemorrhage
- Tumour
- Encephalopathy

Treatment

- Steroids
- Manitol
- Hyperventilation
- Hemicraniectomy

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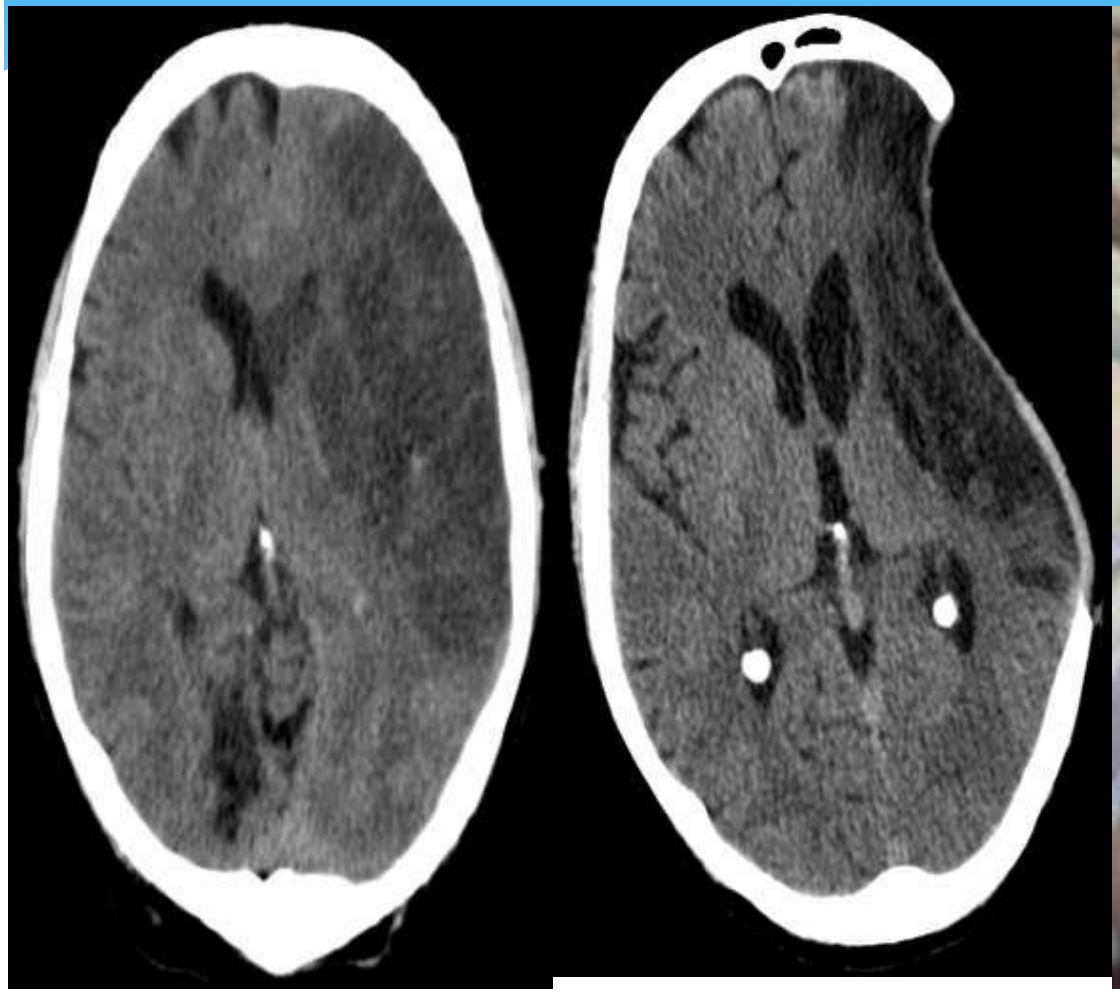
Hemicraniectomy



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GCS .....DONT FORGET

- Score the patient as you see them – no guessing or backdating the results

- If they do not meet one criteria move down the score to the next one

- Always start the assessment with the patient as awake as possible (even at 2am)

GCS .....DONT FORGET

- If patient looks different to the GCS scoring do a set of obs together at hand over
- Consistency with using the neuro. Obs is vital to detecting changes in the patients
- Don't forget to spot other changes like

increasing confusion even if the GCS hasn't yet changed

GCS .....DONT FORGET

* Patterns of change in GCS
- Dropping obviously!
- Fluctuating widely – could it represent seizure (sub-clinically)
- Increasing difficulty in obtaining the same GCS
- Small changes within the category – e.g.

confused but worsening confusion, obeys some commands but not others

http://www.glasgowcomascale.org/

References

* Care of the neurological patient. Caroline Pollington, 2013
* Glasgow coma scale flow chart: a beginner's guide. K. Okamura, 2014
* National Institution for Health and Care Excellence (NICE) (2014) Head injury: Triage, assessment, investigation and early management of head injury in children, young people and adults. http://www.nice.org.uk/guidance/cg176 (accessed 24 October 2014)
* Assessment of altered conscious level in clinical practice (2006) Palmer & Knight