

BRAIN DEATH



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- Death is **an irreversible, biological** event that consists of **permanent cessation** of the critical function of the organism as a whole, especially respiration and heart beat.



1- Clinical Death: the cessation of the circulatory and respiratory functions.

2- Brain Death (Biological/or Legal Death): is the irreversible damage and loss of functions of the entire brain (the cerebrum and brain stem) which results in loss of consciousness and termination of vital signals from the brain stem.



Clinical death will eventually progress into brain death, unless we revive the circulatory and respiratory systems by CPR and defibrillation and limit brain damage..

- **Brain damage start as early as 4-10 minutes after clinical death..**
- so basically those 4-10 minutes are our 'survival window'.

DEATH PRONOUNCEMENT

- **Two physicians** must be involved in examining then announcing death..
- Criteria they should meet:
 - 5 years post bachelor`s degree of medicine and surgery
 - Preferably neurologist/neurosurgeon

**they mustn't be previously involved with patient care or with the organ transplant team.



When is the patient pronounced dead??

1- GCS = 3

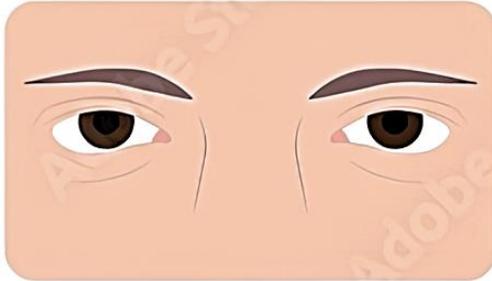
2- loss of Brain stem reflexes

3- absent motor activity

4- positive apnea test (done twice 12 hours apart)

GLASGOW COMA SCALE

EYE OPENING RESPONSE



SCALE

SCORE

EYES OPEN SPONTANEOUSLY	4
EYES OPEN TO VERBAL COMMAND OR SPEECH	3
EYES OPEN TO PAIN	2
NO EYE OPENING	1

VERBAL RESPONSE



SCALE

SCORE

ORIENTATED	5
CONFUSED CONVERSATION BUT ABLE TO ANSWER QUESTIONS	4
INAPPROPRIATE RESPONSES	3
INCOMPREHENSIBLE SOUND OR SPEECH	2
NO VERBAL RESPONSE	1

MOTOR RESPONSE

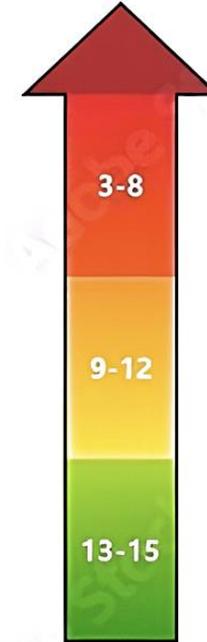


SCALE

SCORE

OBEYS COMMANDS FOR MOVEMENT	6
PURPOSEFUL MOVEMENT TO PAINFUL STIMULUS	5
WITHDRAWS FROM PAIN	4
ABNORMAL FLEXION OR DECORTICATE POSTURE	3
EXTENSOR RESPONSE OR DECEREBRATE POSTURE	2
NO MOTOR RESPONSE	1

GCS SCORE



SEVERITY OF INJURIES

SEVERE BRAIN INJURY

MODERATE BRAIN INJURY

MINOR BRAIN INJURY

GLASGOW COMA SCALE SCORE

EXAMINATION :

- Before the examination, 4 things should be stabilized :

1 - stable vital signs

2- body temp $> 34^{\circ}\text{C}$.

3-normal electrolytes and a free toxicology screen

4-normal pCO₂ level (35-45 mmHg).

BRAIN STEM REFLEXES

Brain death confirmation needs loss of brain stem reflexes , including :

pupillary reflex (light reflex): Pupils should be fixed in mid - size or dilated (4 to 9 mm) and not reactive to light . (bilateral fixed dilated pupils) .

corneal reflex: determined by using a cotton swab or drops of water / normal saline .

vestibulocular reflexes:

A)(Caloric test) : Irrigation of each ear by 50 to 60 ml of ice water won't move the eyes towards the irrigated side within 1 minute of the test performed

B)Oculocephalic manuver: Eye motion is lost in reaction to head movement "**doll's eye**"

This test should not be performed in patients with injuries to the cervical spine, since it may cause further damage

gag reflex : confirmed after stimulation of bilateral posterior pharyngeal membranes .

cough reflex :confirmed after tracheal suctioning .

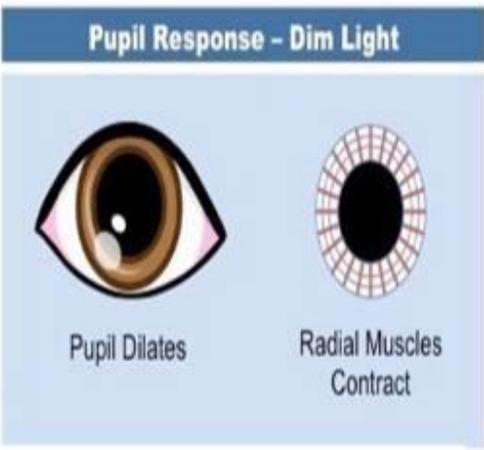
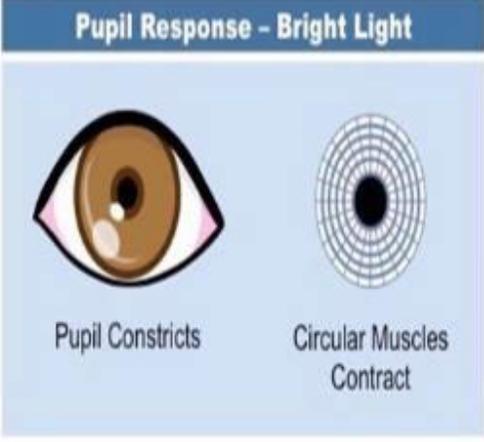
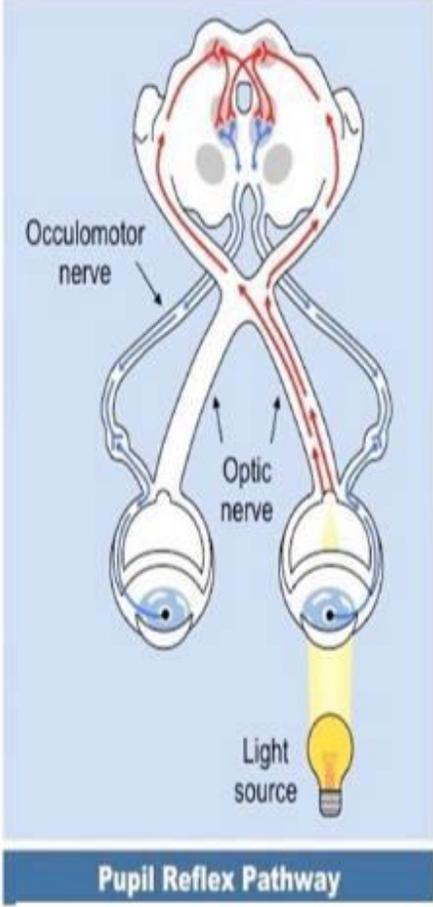
Brain stem reflexes		
	Afferent	Efferent
Corneal reflex	ophthalmic	facial
Papillary reflex	optic	oculomotor
Gag reflex	glossopharyngeal	vagus
Tracheal reflex	vagus	vagus

Important note :

vestibulo-ocular/oculocephalic reflex; the most clinically important reflex to diagnose brain death



CN V – Trigeminal



Gag and Cough reflex



- Area tested – CN IX and X , medulla.
- Brain death – absence of both cough and gag reflex.



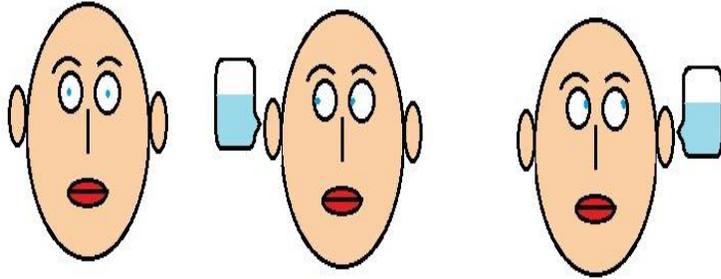
The corneal reflex tests the afferent (sensory) arc of CN V, and the efferent (motor) arc of CN VII.

- **Corneal Reflex Test**
 - Usually not done if light touch is intact
 - Instruct the patient to look up and away from you.
 - Approaching the patient laterally, out of his line of vision, and avoiding the eyelashes, touch the cornea lightly with a fine wisp of cotton.
 - Look for blinking of the eyes, the normal reaction to this stimulus.
 - Be aware that use of contact lenses frequently diminishes, or may even eliminate, the corneal reflex response.

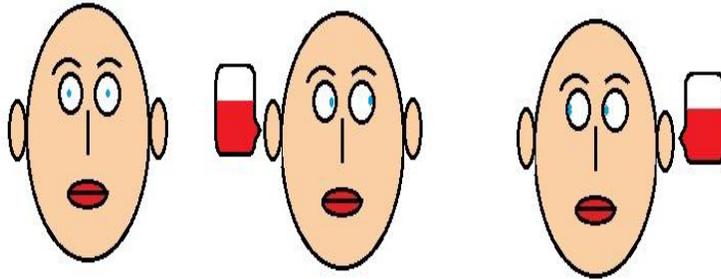
Cold caloric

Vestibulo-ocular Reflex

Cold water:

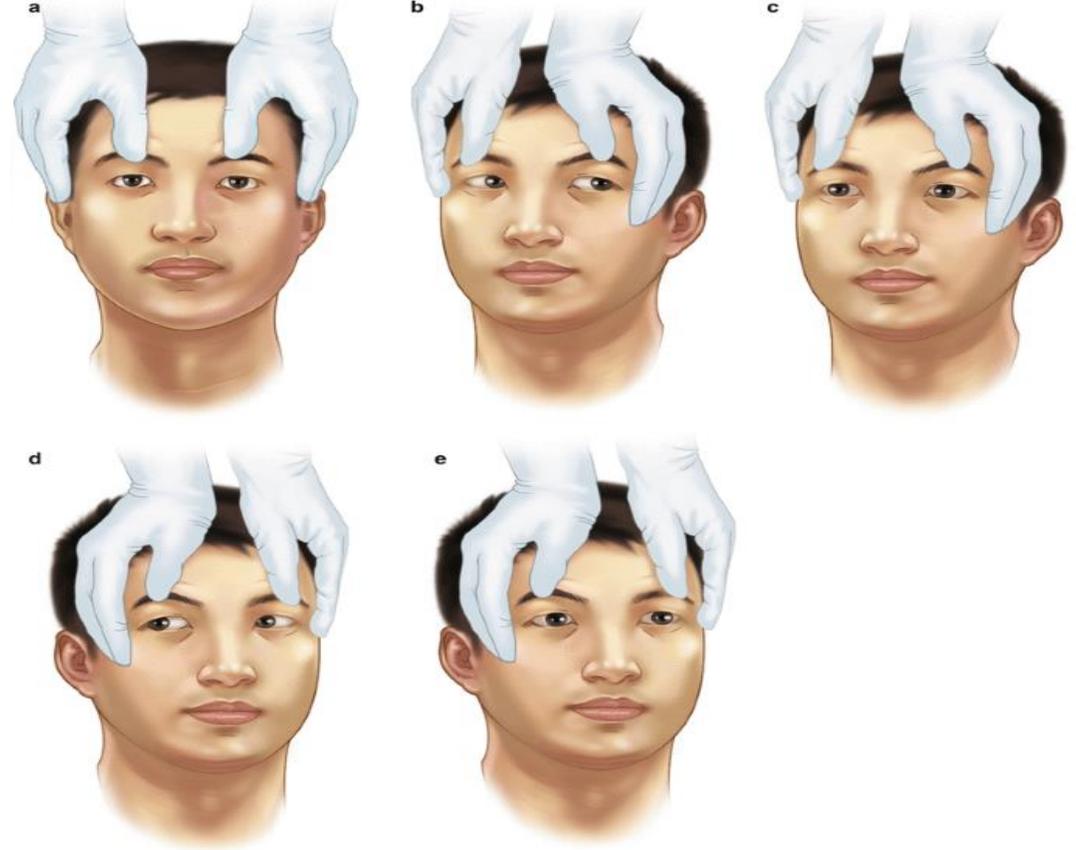


Warm water:



<https://youtu.be/6F1sSfGnTXk>

Doll's eyes



<https://youtu.be/5dvqpxUGfcg>

APNEA TEST :

- We test for the respiratory centers in the medulla oblongata by sensitizing them with increasing PaCO₂ up to 60mmHg (we anticipate visible signs of respiratory musculature contraction if the brain stem isn't severely damaged beyond repair).



A common method of apnea testing involves

disconnection of mechanical ventilation from the patient,

followed by the insertion of a catheter or cannula into the endotracheal tube, down to the level of the carina, through which oxygen is delivered.



before we start ,

we hyperventilate the patient with 100% O₂

- CPAP into tube with 6L of O₂/min

- ABG after 8-10 min



- we make sure that systolic blood pressure doesn't fall below 90mmHG during the entire test and the oxygen saturation level below 85%
or else we stop and end the test and repeat it else time.

Positive Or Negative

brain death	indeterminate result
respiratory movements are absent	respiratory movements are detected
arterial PCO ₂ is 60 mm Hg (option: 20 mm Hg increase in PCO ₂ over a baseline normal PCO ₂)	If the PCO ₂ is < 60 mm Hg or PCO ₂ increase is < 20 mm Hg over baseline normal PCO ₂
the apnea test is positive	the result is indeterminate and an additional confirmatory test can be considered

AFTER CONFIRMATION OF BRAINSTEM DEATH

- If the patient meets all criteria for brain death on both examinations, this should be noted in the medical record at the time of the second exam.
- This time becomes the time of legal death declaration.
- If organ donation is considered, the situation is discussed with the family, primarily to ascertain the patient's wishes about donation (if known).
- If donation is possible, intensive care of the body must be continued



Factors that falsely suggest cerebral function

Spontaneous or reflexive complex motor activity (e.g., repetitive leg movements) Motor activity that does not depend on cerebral function may be seen in brain-dead patients, thereby falsely suggesting cerebral function.

False triggering of ventilator detection system for spontaneous breathing drive Ventilators may misinterpret slight changes in airway pressure as the patients breathing drive, thereby falsely suggesting brainstem function.



Ancillary brain death tests

Only to be performed if clinical examination and/or apnea testing are inconclusive, or if patient is < 1 year

One ancillary test is sufficient; suitable ancillary brain death tests are:

- Electroencephalography (EEG)
- Cerebral angiography
- Transcranial Doppler ultrasonography
- Cerebral scintigraphy



THANK YOU