Management of patient with increased Intracranial Pressure

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CONTENTS OF SKULL

- **SKULL IS RIGID CLOSED STRUCTURE CONTAINS**

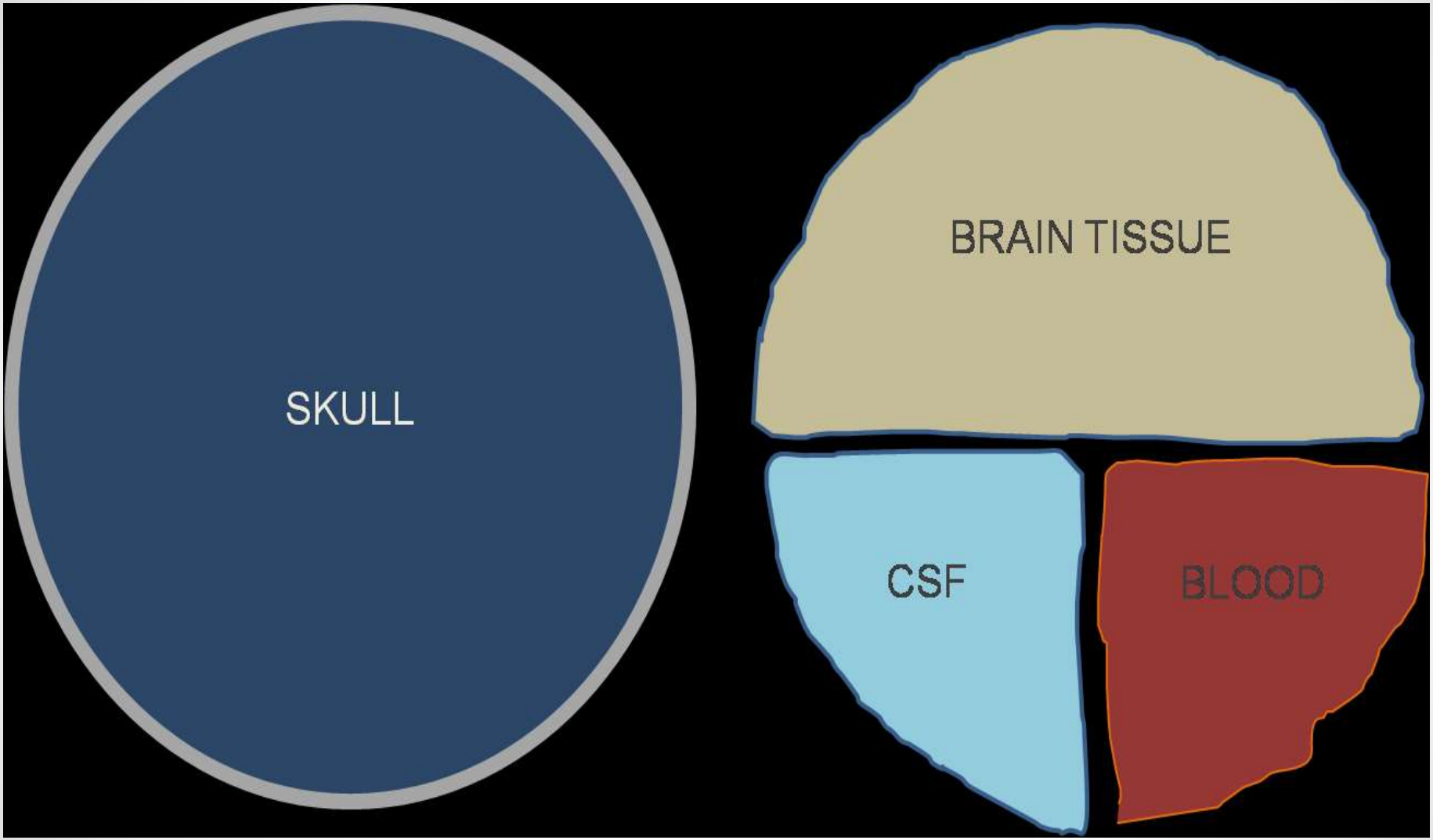
1- the brain and interstitial fluid- 78%;

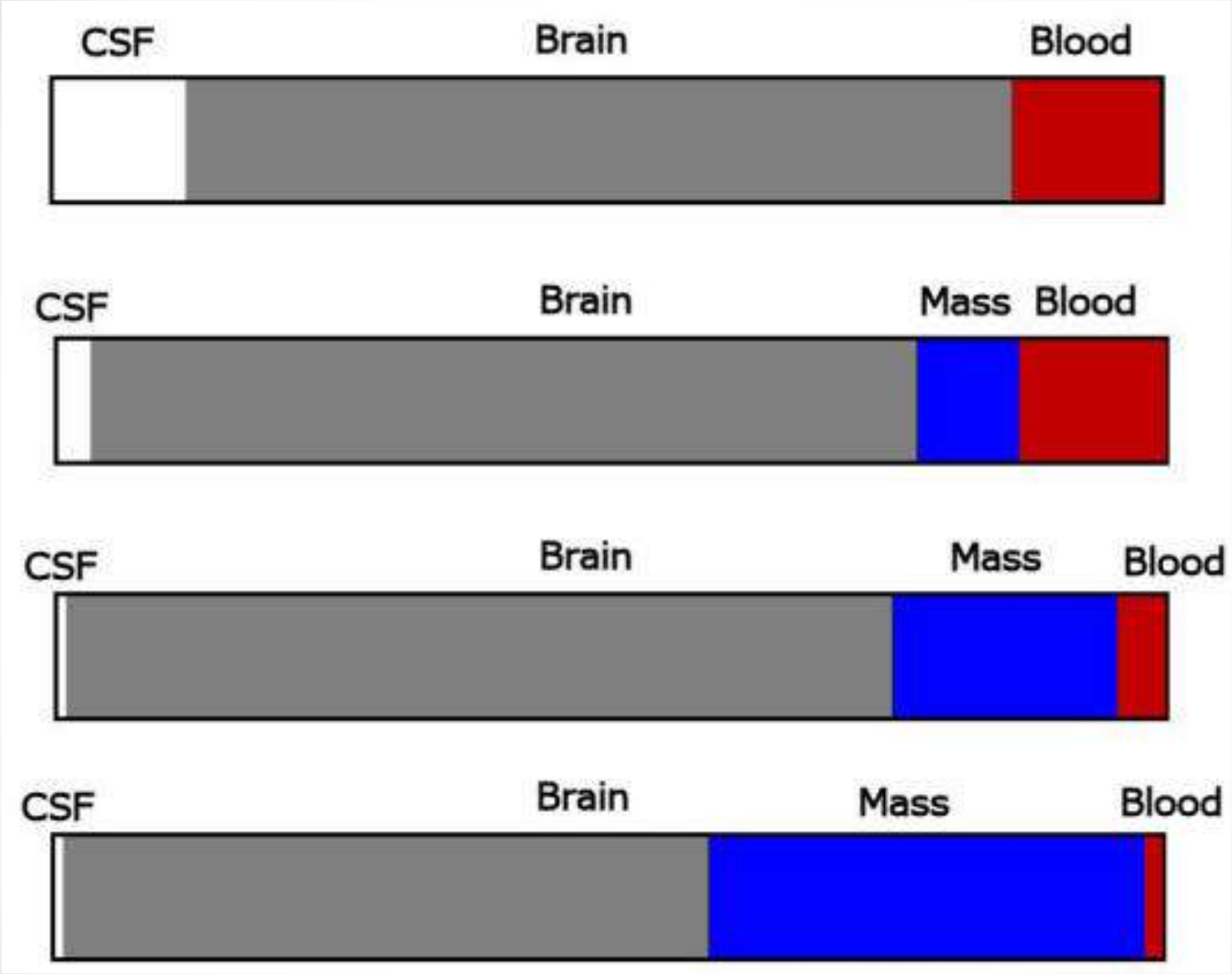
2- intravascular blood-12%

3- the CSF -10%

INTRACRANIAL PESSURE

- ICP IS THE TOTAL PRESSURE EXERTED BY THE THREE COMPONENTS WITHIN THE SKULL
- IT IS THE HYDROSTATIC FORCE MEASURED IN THE BRAIN CSF COMPARTMENT
- MONRO-KELLIE HYPOTHSIS STATES THAT SKULL IS A RIGID STRUCTURE IF THE VOLUME OF THE ANY THREE COMPONENTS INCREAESES THE VOLUME FROM ANOTHER COMPONENT IS DISPLACED , THE TOTAL INTRACRANIAL VOLUME WILL NOT CHANGE


SKULL
BRAIN TISSUE
CSF
BLOOD


CSF
Brain
Blood
CSF
Brain
Mass
Blood
CSF
Brain
Mass
Blood
CSF
Brain
Mass
Blood

Normal compensatory mechanisms

- ALTERATION CSF VOLUME– INCRESED ABSORPTION

  DECREASED PRODUCTION

  DISPLACEMENT TO SUBARACHNOID SPACE

ALTERATION IN BLOOOD VOLUME– VASOCONSTRICTION

VASODILATION

TISSUE BRAIN VOLUME– DISTENTION OF DURAL SPACE

- **These compensatory mechanisms are to maintain a relatively constant amount of cerebral blood flow to meet the metabolic needs of the brain tissue**

- **Cerebral blood flow is the amount of blood in millimeters passing through 100g of brain tissue in 1minute**

- **Under normal conditions, the cerebral blood flow ranges between 50 and 60mL per 100g brain per minute**

- **It makes approximately 700 to 850mL blood per minute for the whole brain and accounts for about 20% of the total cardiac output.**

- **The brain uses 20% of the body's oxygen and 25% of the glucose**

Increased intracranial pressure

- Increased ICP is a life threatening situation that results from an increase in any or all of three components within the skull

  (brain, CSF , blood)

- Brain edema is the common cause for elevated intracranial pressure

Causes of brain edema

Space-Occupying Lesions

Intracerebral hemorrhage
Epidural hemorrhage
Subdural hemorrhage
Tumor
Abscess

CEREBRAL INFECTIONS

- MENINGITIS
- ENCEPHALITIS

BRAIN SURGERY

VASCULAR INSULT

- Anoxic and ischemic episodes
- Cerebral infarction (thrombotic and embolic)

TOXIC or METABOLIC ENCEPHALOPATHIES

- Lead or arsenic poisoning
- Hepatic encephalopathy
- Uremic encephalopathy

HYDROCEPHALUS

CEREBRAL EDEMA

- VASOGENIC CEREBRAL EDEMA
- CYTOTOXIC CEREBRAL EDEMA
- INTERSTITIAL CEREBRAL EDEMA

VASOGENIC CERBRAL EDEMA

- **IT IS CAUSED BY CHANGES IN ENDOTHELIAL LINING OF CEREBRAL CAPILLARIES**
- **THESE CHANGES ALLLOW LEAKAGE OF MACROMOLECULES FROM THE CAPILLARIES INTO SURROUNDING EXTRAVASCULAR SPACE**
- **BRAIN TUMOURS, ABSCESSES AND INGESTED TOXINS COMMON CAUSES**

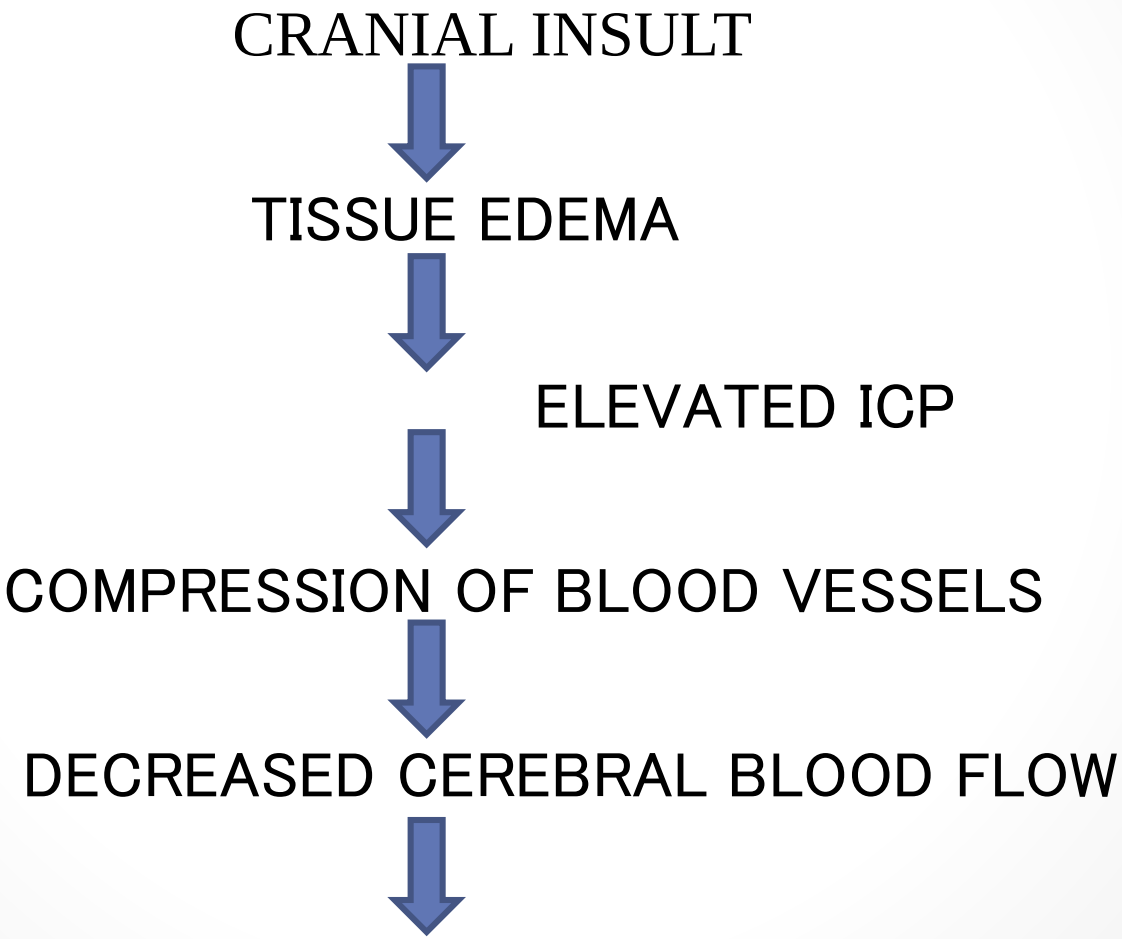
CYTOTOXIC CEREBRAL EDEMA

- IT RESULTS FROM LOCAL DISRUPTION OF THE FUNCTIONAL OR MORPHOLOGICAL INTEGRITYOF CELL MEMBRANE
- IT DEVELOPS FROM DESTRUCTIVE LESIONS OR TRAUMA TO BRAIN TISSUE RESULTING IN CEREBRAL HYPOXIA
- MOST OFTEN IN GREY MATTER OF BRAIN

INTERSTITIAL CEREBRAL EDEMA

- It is the result of periventricular diffusion of ventricular CSF in a patient with uncontrolled hydrocephalus

Mechanism of elevated ICP



DECREASED O2 WITH DEATH OF BRAIN CELLS

FURTHER INCREASE IN EDEMA AROUND NECROTIC TISSUE

FURTHER ELEVATION IN ICP WITH COMPRESSION OF BRAIN STEM AND RESPIRATORY CENTER

ACCUMULATION OF CO2

VASODIALATION

INCREASED ICP RESULTING FROM INCREASED BLOOD FLOW

DEATH

CLINICAL MANIFESTATION

CHANGE IN LEVEL OF CONSCIOUSNESS

- SENSITIVE AND RELIABLE INDICATOR OF NEUROLOGIC STATUS
- IT RESULTS FROM IMPAIRED CERBRAL PERFUSION AFFFECTING CEREBRAL CORTEX AND RAS

CHANGE IN VITAL SIGNS

- INDICATE INCREASED PRESURE ON THE THALAMUS, HYPOTHALAMUS, PONS AND MEDULLA

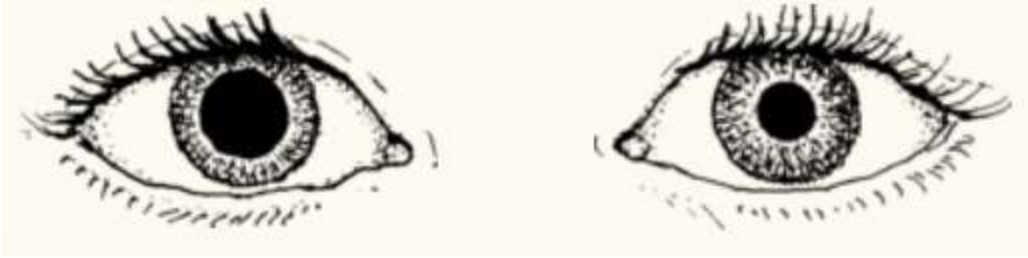
- MANIFESTED AS CUSHINGS TRIAD
  - ELEVATED SYSTOLIC BP
  - BRADYCARDIA
  - WIDENING OF PULSE PRESSURE

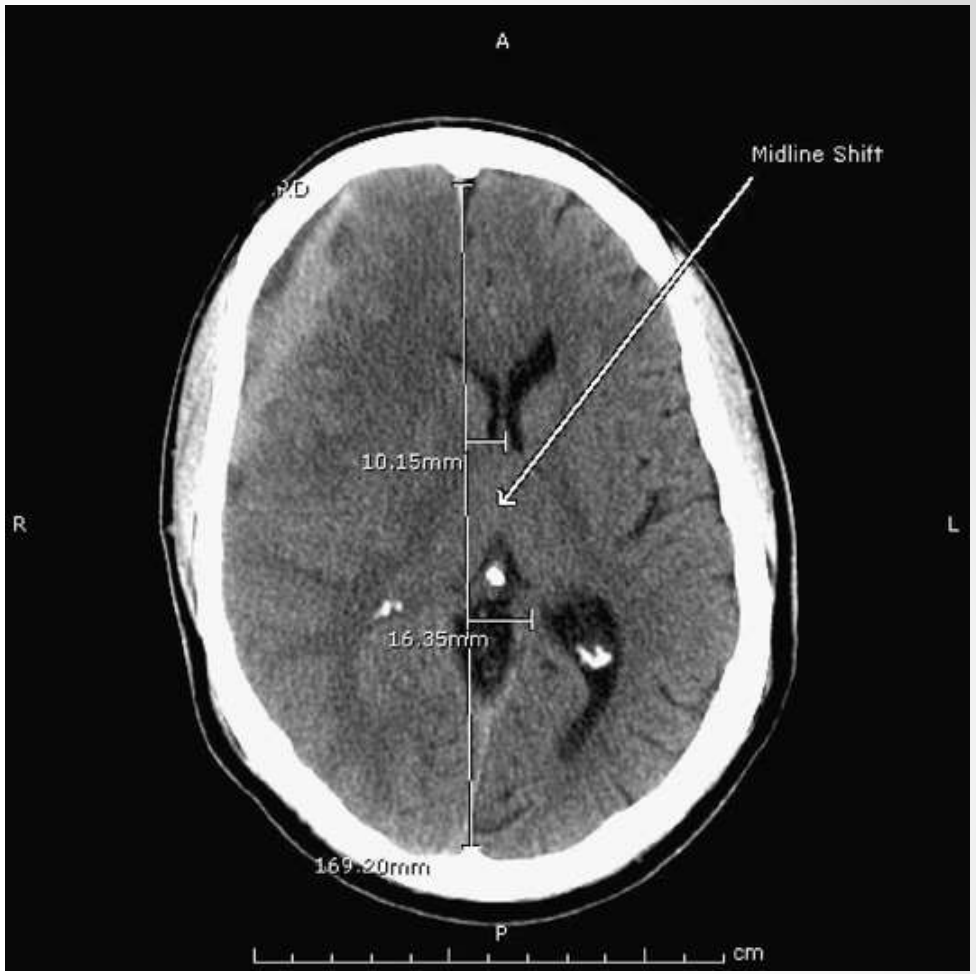
- CHANGE IN BODY TEMPERATURE HYPOTHALAMUS AFFECTED

OCCULAR SIGNS

- COMPRESSION OF CRANIAL NERVE (111)– PUPILLARY DILATION
- FIXED UNILATERAL DILATED PUPIL – HERNIATION OF THE BRAIN

- OPTIC– BLURRED VISION, DIPLOPIA
- TROCHLEAR, ABDUCENS – EYE MOVEMENTS

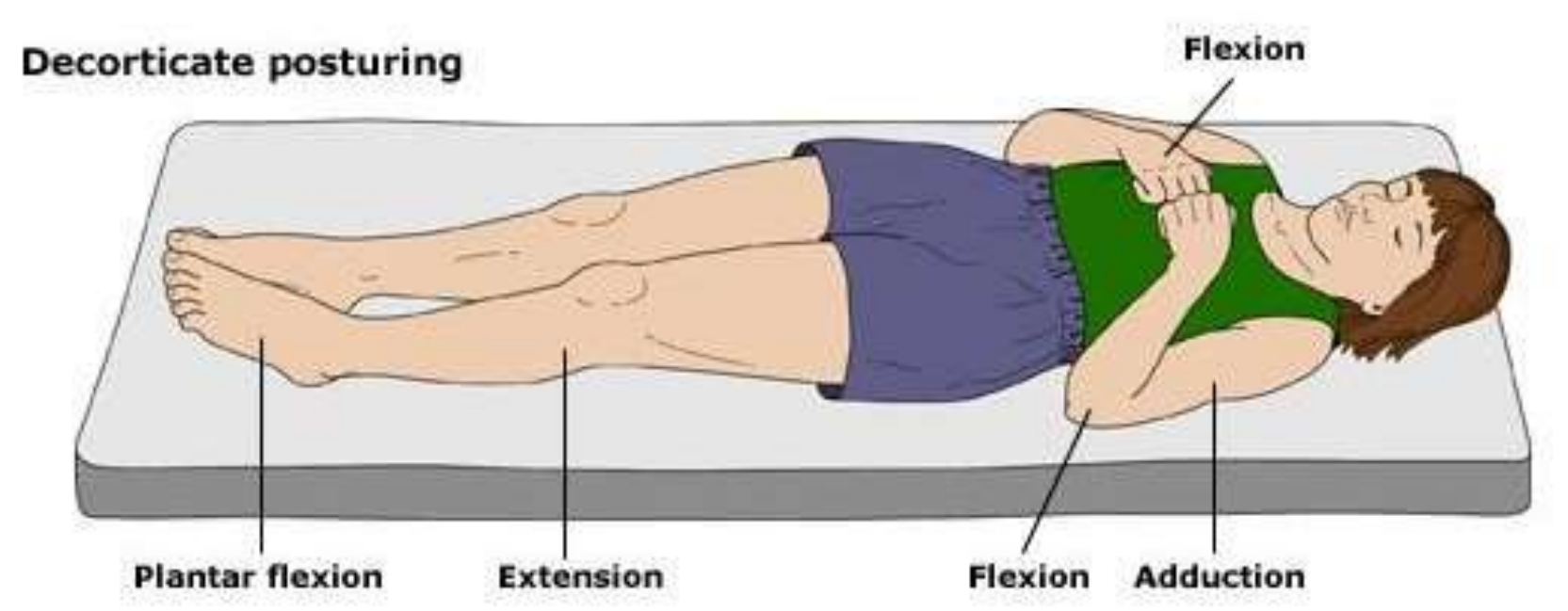




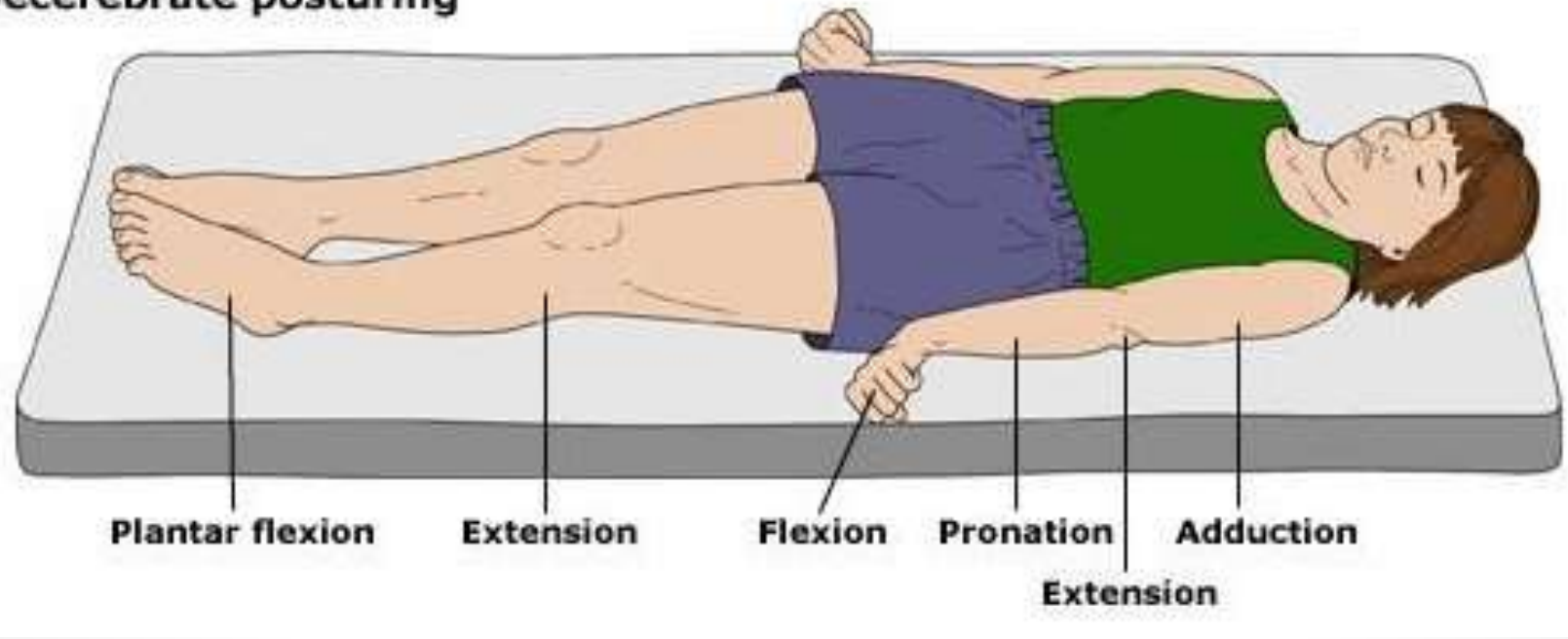
MIDLINE SHIFT OF BRAIN

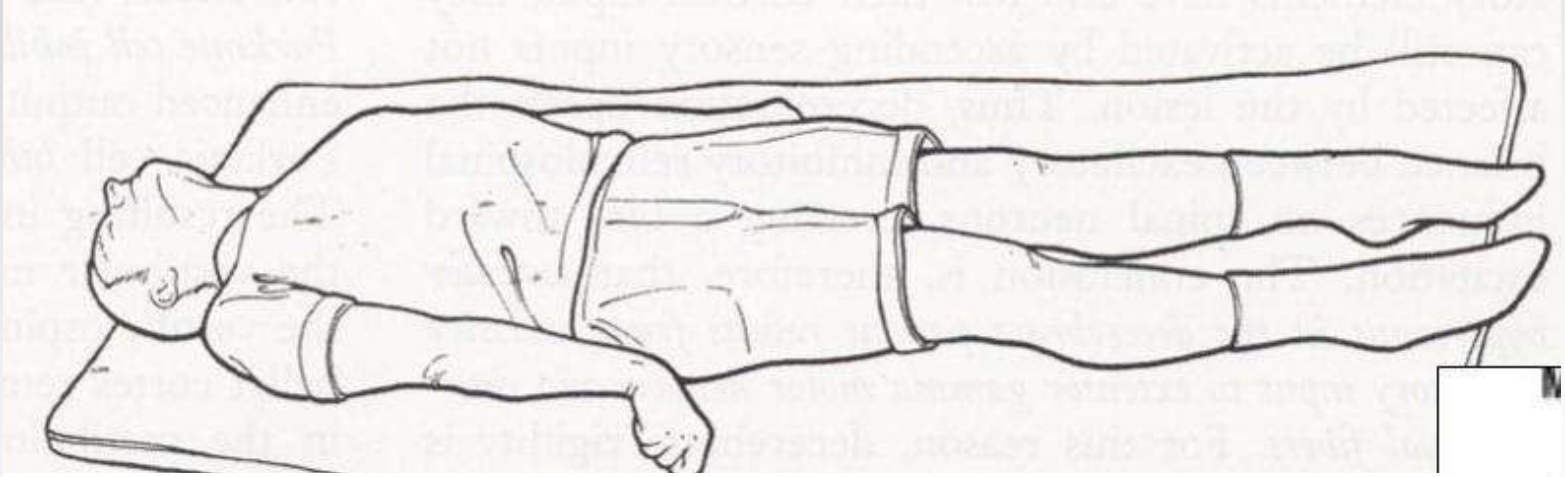
DECREASE IN MOTOR FUNCTION

- CONTROLATERAL HEMIPARESIS OR HEMIPLEGIA
- DECORTICATION– INTERRUPTION OF VOLUNTARY MOTOR CORTEX
- DECEREBRATION– DISRUPTION OF MOTOR FIBERS IN THE MIDBRAIN AND BRAIN STEM


Decorticate posturing
Flexion
Plantar flexion
Extension
Flexion
Adduction

Decerebrate posturing





- **IT is a state of severe hyperextension and spasticity in which an individual's head, neck and spinal column enter into a complete "bridging" or "arching" position**

- *Opisthotonus position*

HEADACHE

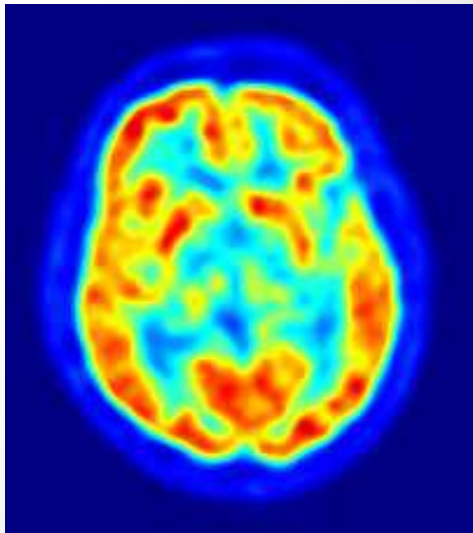
- COMPRESSION OF OTHER INTRACRANIAL STRUCTURES
- CONTINOUS, WORSE IN THE MORNING

VOMITING

- PROJECTILE TYPE
- COMPRESSION TO CTZ(VOMITING CENTER)

DIAGNOSTIC STUDIES

- HISTORY COLLECTION AND PHYSICAL EXAMINATION
- COMPUTED TOMOGRAPHY
- MAGNETIC RESONANCE IMAGING
- ELECTROENCEPHALOGRAM
- POSITRON EMISSION TOMOGRAPHY
- MEASUREMENT OF ICP
- LP?

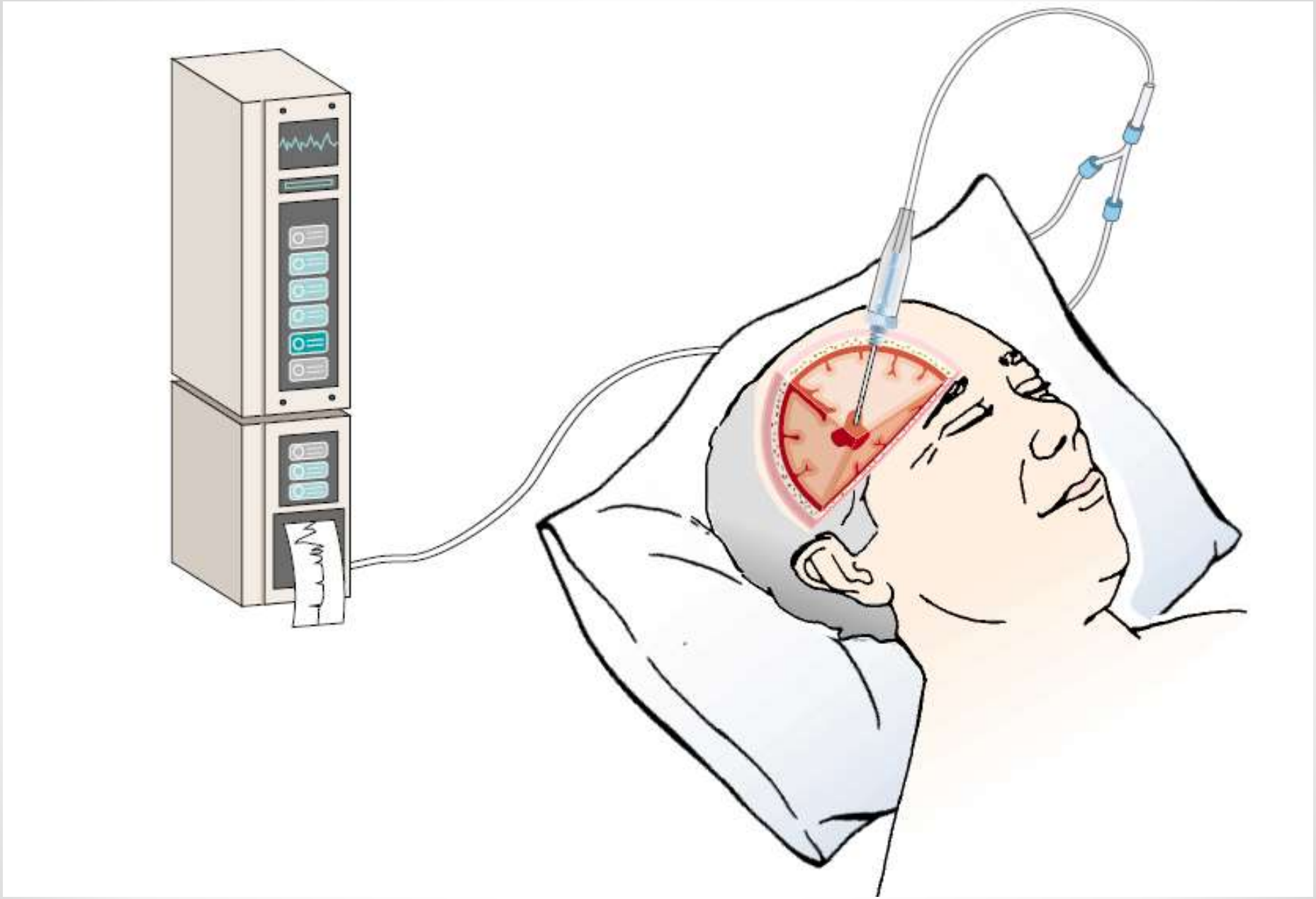


Measurement of ICP

- ICP should be monitored in patients admitted with Glasgow coma scale (GCS) 8or less and an abnormal CT or MRI

- NORMAL ICP 5-15 mm hg/**10 to 20cm H_2O**

- METHODS
  - EPIDURAL
  - SUBDURAL
  - SUBARACHNOID
  - INTRAPARENCHYMAL
  - VENTRICULAR



- **GOLD STANDARD – VENTRICULOSTOMY**
- **A Specialized catheter is inserted into right lateral ventricle and coupled to an external transducer**

This technique

- **directly measures pressure inside ventricles,**
- **facilitates removal or sampling of CSF**
- **for intraventricular drug administration**

- Direct visualization of the height of the CSF column generated outside the body or through its measurement by an external transducer

- *CSF drainage*

using a closed system, elevations in ICP are controlled by removal of CSF by gravity drainage and by adjusting the height of drip chamber and drainage bag relative to ventricular reference point

- Typically a point 15 cm above ear canal the drainage bag is placed
- Raising the height diminishes the drainage and vice versa
- Normal adult CSF production- 20-30ml/hr
- Total CSF volume- 90-150ml

COMPLICATIONS

- *Tentorial herniation*

mass lesion in the cerebrum forces the brain to herniate downward through the opening created by the brain stem

- *Uncal herniation*

lateral and downward herniation

- *Cingulate herniation*

It occurs when there is lateral displcement of brain tissue beneath the falx cerebrai

MANAGEMENT

GOALS

- Identifying and treating the underlying cause of increased ICP
- Maintaining adequate perfusion and oxygenation to the brain

DRUG THERAPY

Administer **INJ.mannitol 25%**

- It acts in TWO ways
  1. Plasma expansion
  2. Osmotic effect

- It have an immediate plasma expanding effect that reduces the hematocrit and blood viscosity there by increasing CBF and cerbral oxygenation
- It creates a vascular osmotic gradient , that will results to move the fluid from tissues to blood vessels

- *Corticosteriods(dexamethasone, dexona)*

  It will help to improve the neuronal function

  Inhibit the synthesis of prostaglandins thereby preventing formation of inflammatory mediators

- *Barbiturates (Thiopental, pentobarbital)*

  It will decrease in cerebral metaabolism and subsequent decrease in ICP

- *Antiepileptics(phenytoin)*

  As seizure prophylaxis

- *H2 receptor antagonists or proton pump inhibitors*

  Prevent gastric ulcers and bleeding

Hyperventilation therapy

- In the past aggressive hyperventilation was one of the important treatment modality
- It will decrease the C02 level in the blood

  PaCO2 less than 25 mm Hg
- Brief periods of less aggressive hyperventilation therapy is useful

  PaCO2 30–35 mm Hg

REDUCING CSF AND INTRACRANIAL BLOOD VOLUME

- CSF drainage is frequently performed because the removal of CSF with a ventriculostomy drain may dramatically reduce ICP and restore cerebral perfusion pressure.

Nutritional therapy

- All patients must have their nutritional needs met regardless of their state of consciousness or health
- Adequate fluid volume should be maintained

POSITIONING

- Head position: Maintain head in midline position at above 30 degrees to improve cerebral venous drainage; lower cerebral blood volume (CBV) will lower ICP.

Surgical decompression

- Surgical decompression is indicated for clear–cut mass lesions amenable to removal, i.e. tumor, epidural bleed, large contusion. For refractory elevated ICP without a surgical lesion, there may be a role for a decompressive craniectomy. Especially if done early after the initial insult, it may improve functional outcomes of patients.

NURSING MANAGEMENT

- **ASSESSMENT**

  NEUROLOGICAL ASSESSMENT

  GLASGOW COMA SCALE

  MIN SCORE- 3

  MAX SCORE- 15

  GCS below 8- indicative of coma

NURSING DIAGNOSIS

- Ineffective tissue perfusion (cerebral) related to reduction of arterial blood flow and cerebral edema as evidenced by CPP<60 mm hg, GCS score <8, altered mental status, changes in mental status

INTERVENTIONs

- maintain hemodynamic parameters within normal range
- Calculate and monitor CPP
- Monitor neurologic status
- Maintain input and output chart
- Administer medication
- Administer oxygen

- Decreased intracranial adaptive capacity related to decreased cerebral perfusion as evidenced by ICP More than 20 mm of hg, elevated systolic pressure, bradycardia and widened pulse pressure

Interventions

- Monitor vital signs, ICP and neurologic status
- Position the head end of the bed 30 degree or more
- Maintain normothermia
- Give sedatives
- Administer osmotic diuretics
- Decrease stimuli in patients environment