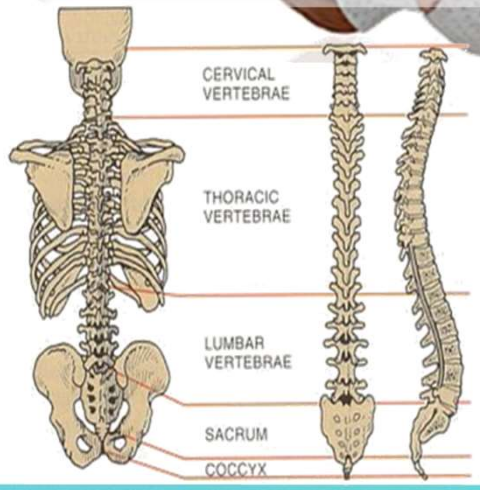
Management of Traumatic Brain Injury & Spinal Cord Injury

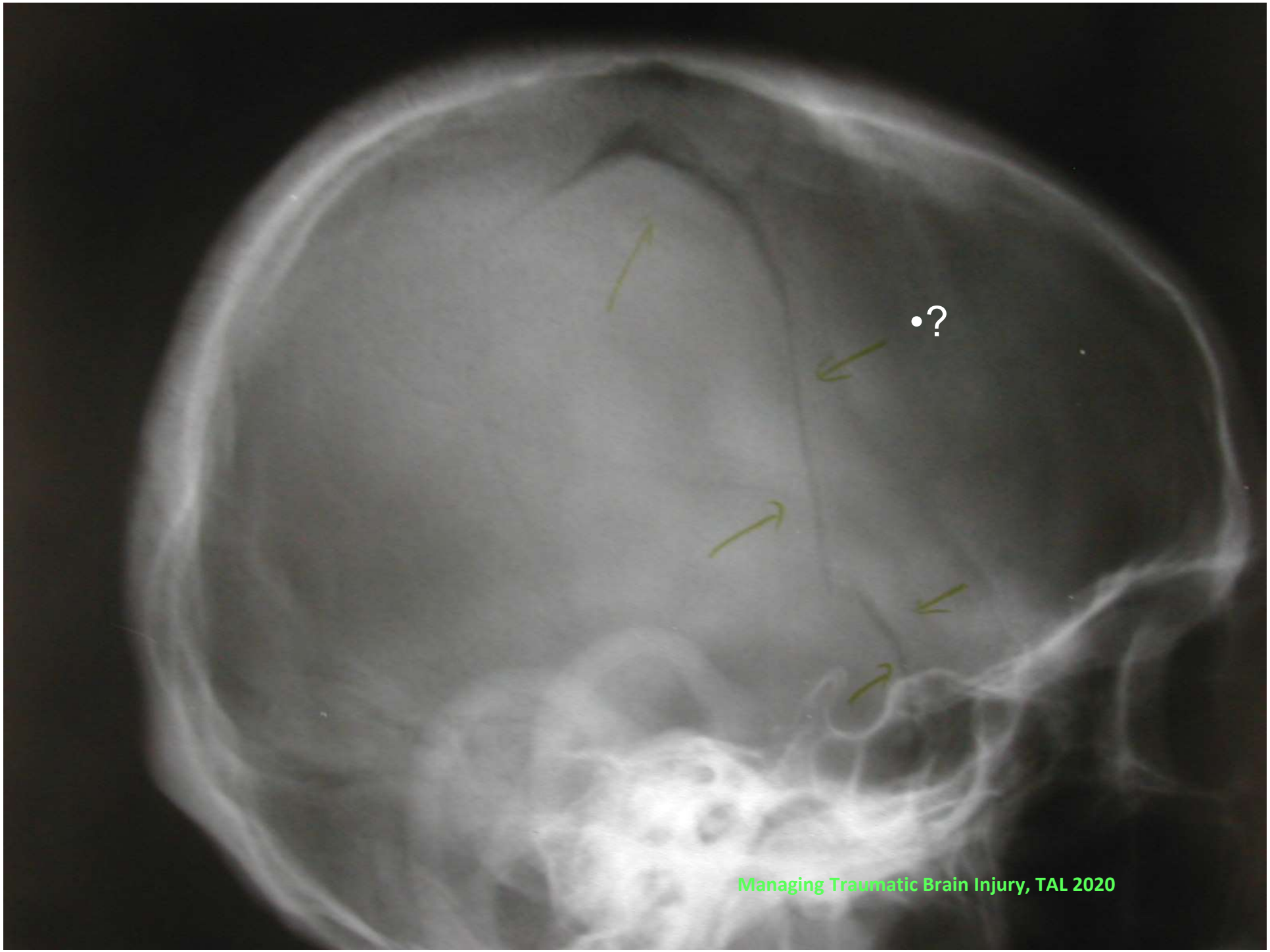


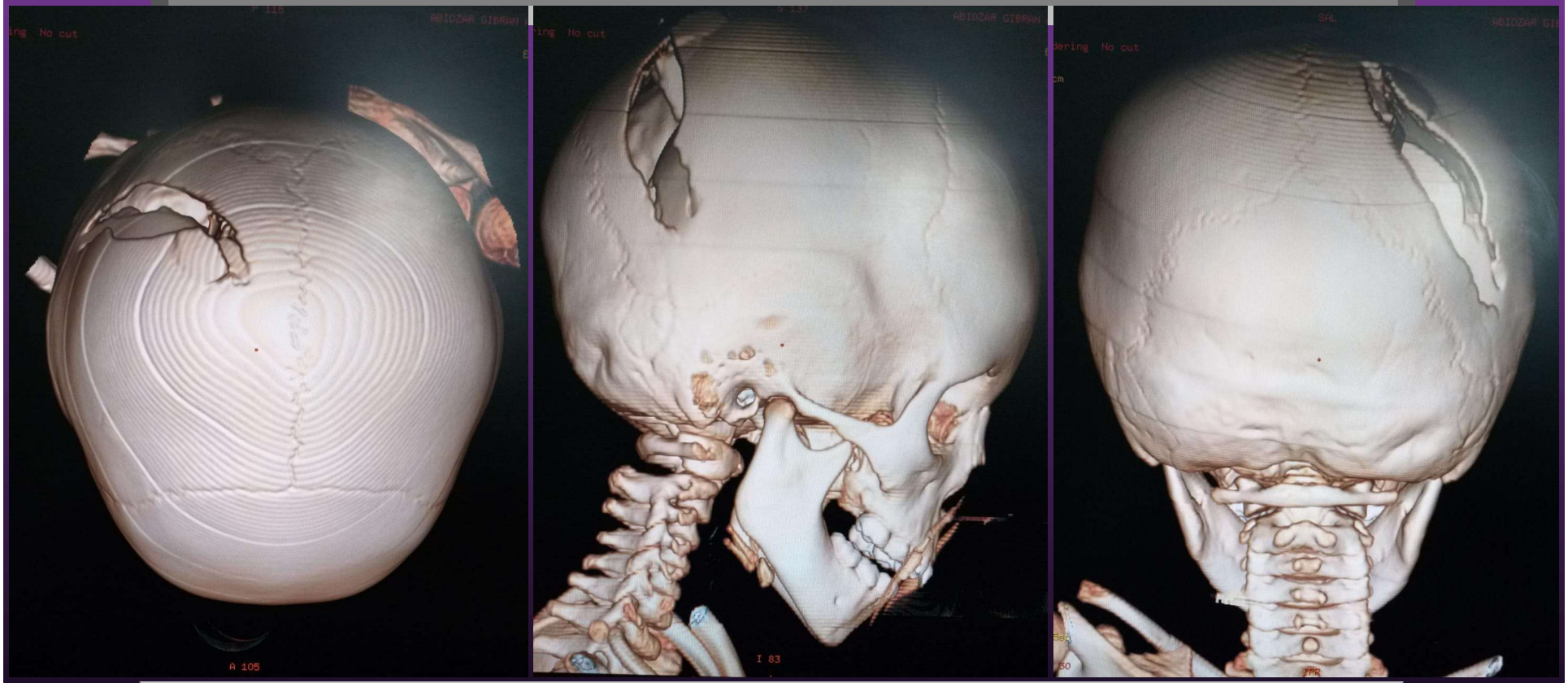
Tommy A Nazwar

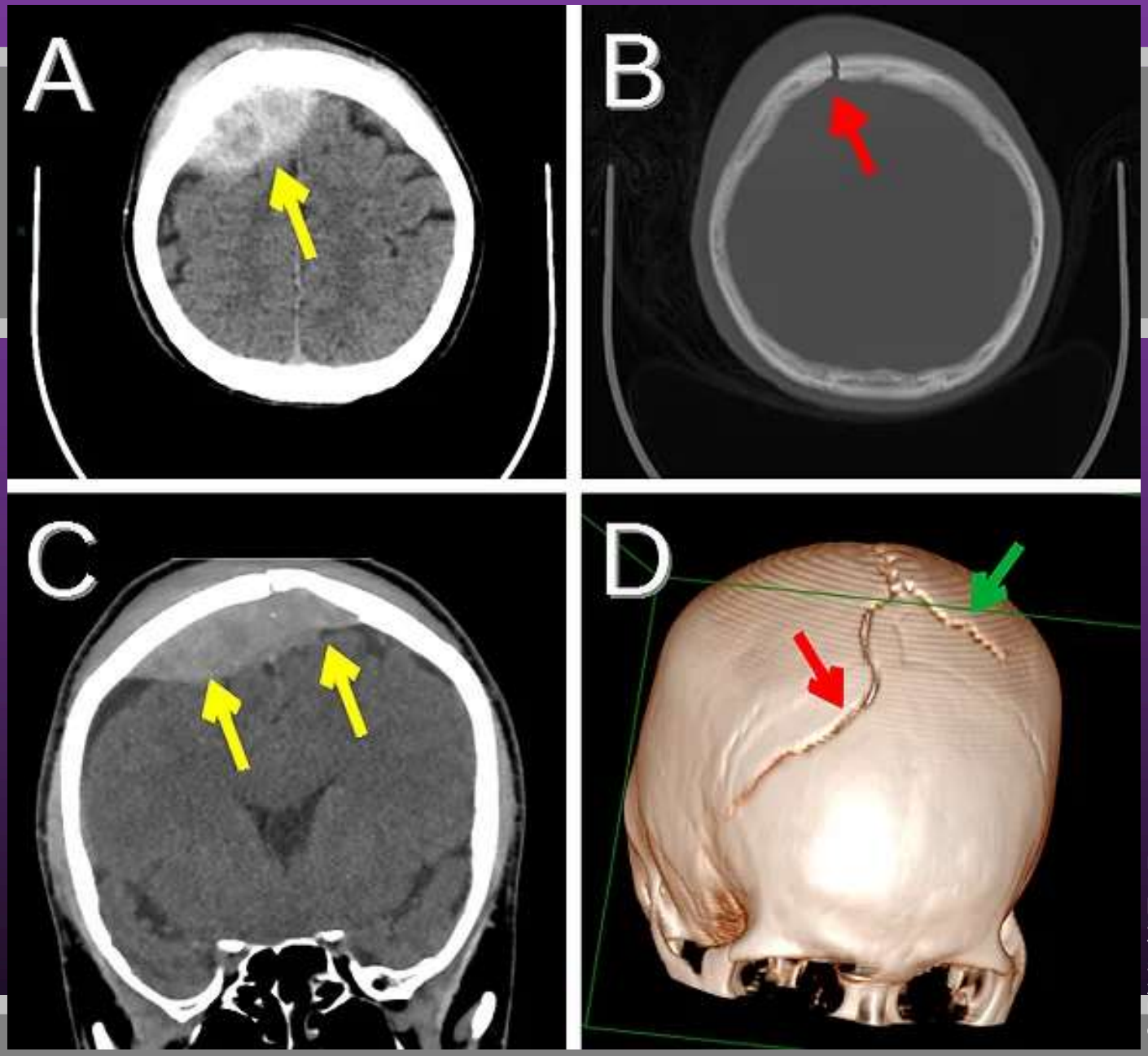
Spine sub-Division - Neurosurgery Division – Surgery Department
Medical Faculty, Brawijaya University - Dr Saiful Anwar General Hospital Malang


Management of
Traumatic Brain Injury

Traumatic Brain Injury


•?
Managing Traumatic Brain Injury, TAL 2020


No cut
A 105
No cut
I 83
No cut



Khairat A, Waseem M. Epidural Hematoma. [Updated 2020 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK518982/

Definisi

Traumatic brain injury (TBI) is defined as:

"an insult to the brain, not of a degenerative or congenital nature but caused by an **external physical force**, that may **produce a diminished or altered state of consciousness**, which results in an **impairment of cognitive abilities and/or physical functioning**. It can also result in the disturbance of behavioral or emotional functioning."

Advanced Trauma Life Support. 2018.
American College of Surgeons, Committee on Trauma

Definisi

Traumatic brain injury (TBI) is defined as:

"**a disruption in the normal function of the brain** that can be **caused by a blow, bump or jolt to the head**, the head suddenly and violently hitting an object or when an object pierces the skull and enters brain tissue."

Definisi

- *Head Injury* (Cedera kepala)
  - Physical injuries to the skull, facial fractures or soft tissue damage to the face or head "without" neurological consequences

- *Traumatic Brain Injury* (Cedera otak)
  - Physical injuries to the face or head or others with "neurological" consequences

Epidemiologi Cedera Otak

- Terbanyak usia produktif (15–44 tahun) & didominasi laki-laki 58 %
- Penyebab cedera Otak terbanyak : KLL
- Polrestabes Surabaya (2011) : dari 872 data KLL median usia yang mengalami cedera otak pada usia 30 tahun.
- POLRI (2011) : data korban KLL sebesar 67% berada pada usia produktif .

Penelitian Karya Akhir Cedera Kepala di Kotamadya Surabaya 2011

Epidemiologi Cedera Otak

- According to the CDC (Centers for Disease Control and Prevention), approximately 2.87 million cases of TBI occurred in the U.S. in 2014 with over 837,000 cases occurring amongst children.
- An estimated 13.5 million individuals live with a disability due to traumatic brain injury in the U.S. alone.

Cedera otak dipandang dari segi ekonomi

- Beban finansial (USA) tiap tahun
  - → $. 76.500.000.000,-
  - → Rp. 1.127.170.125.000.000,-

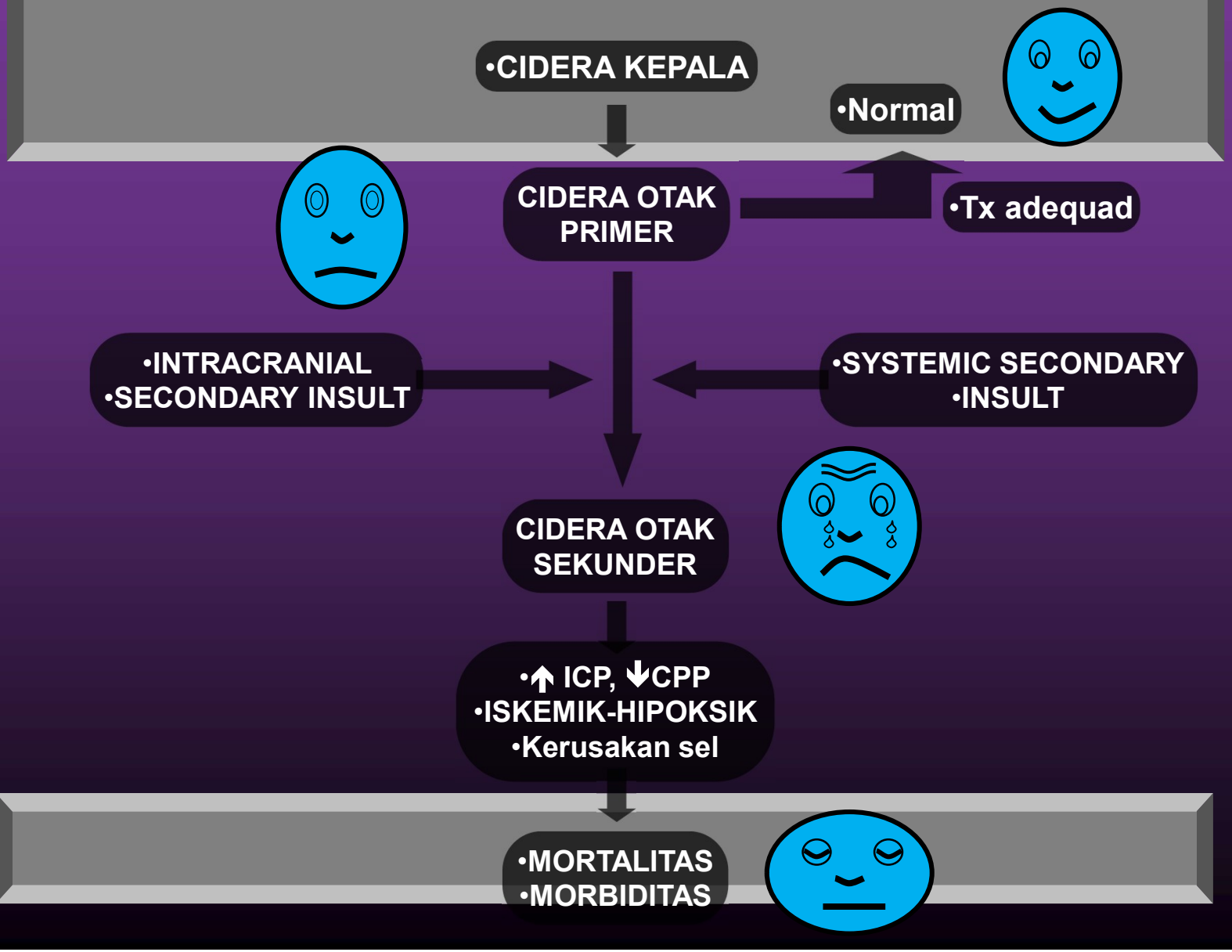
- Beban lebih tinggi lagi → biaya keluarga yg menunggu

Head Injury, Cooper & Paul R, 2000

Epidemiologi Cedera Otak

1) Problem cidera otak :
   - ✓ Mortalitas-morbiditas tinggi
   - ✓ Mortality rate 14-30/100.000 per tahun
   - ✓ 70% accidental deaths
   - ✓ 10-40% more common persisting disability than spinal cord injury
2) Pada usia produktif (usia 15-25 th)
3) Resusitasi awal tak adequad
4) Memerlukan diagnosa - terapi cepat tepat
5) Proses rehabilitasi lama
6) Biaya mahal

Patofisiologi Cidera Otak



Systemic Secondary Insult

- ✓ Hypoxemia
- ✓ Hypotension
- ✓ Hypercapnea
- ✓ Hypocapnea
- ✓ Hyperthermia
- ✓ Hyperglycemia
- ✓ Hypoglycemia
- ✓ Hyponatremia

Intracranial Secondary Insult

- ✓ ICP ↑
  - ❑ Brain herniation
  - ❑ Mass lesion : EDH, SDH, ICH
  - ❑ Edema
  - ❑ Hydrocephalus
- ✓ Vasospasme
- ✓ Seizures
- ✓ Infection
- ✓ Hypoxic – Ischemic

Clinical Signs

- Loss of or decreased consciousness
- Loss of memory for events before or after the event (amnesia)
- Focal neurological deficits such as muscle weakness, loss of vision, change in speech
- Alteration in mental state such as disorientation, slow thinking or difficulty concentrating

Symptoms of a TBI

- mild, moderate, or severe
- depending on the extent of damage to the brain.
- mild cases may result in a brief change in mental state or consciousness.
- severe cases may result in extended periods of unconsciousness, coma, or even death.

PRIMARY SURVEY

Airway

Cek patensi airway, head tilt, chin lift, mayo

Breathing

O2 masker, cek gerakan dada (simetris, flail chest, jejas, frekuensi napas)

Circulation

Nadi, Tekanan darah , Akral, Capillary Refil Time

Classification of TBI

SEVERITY

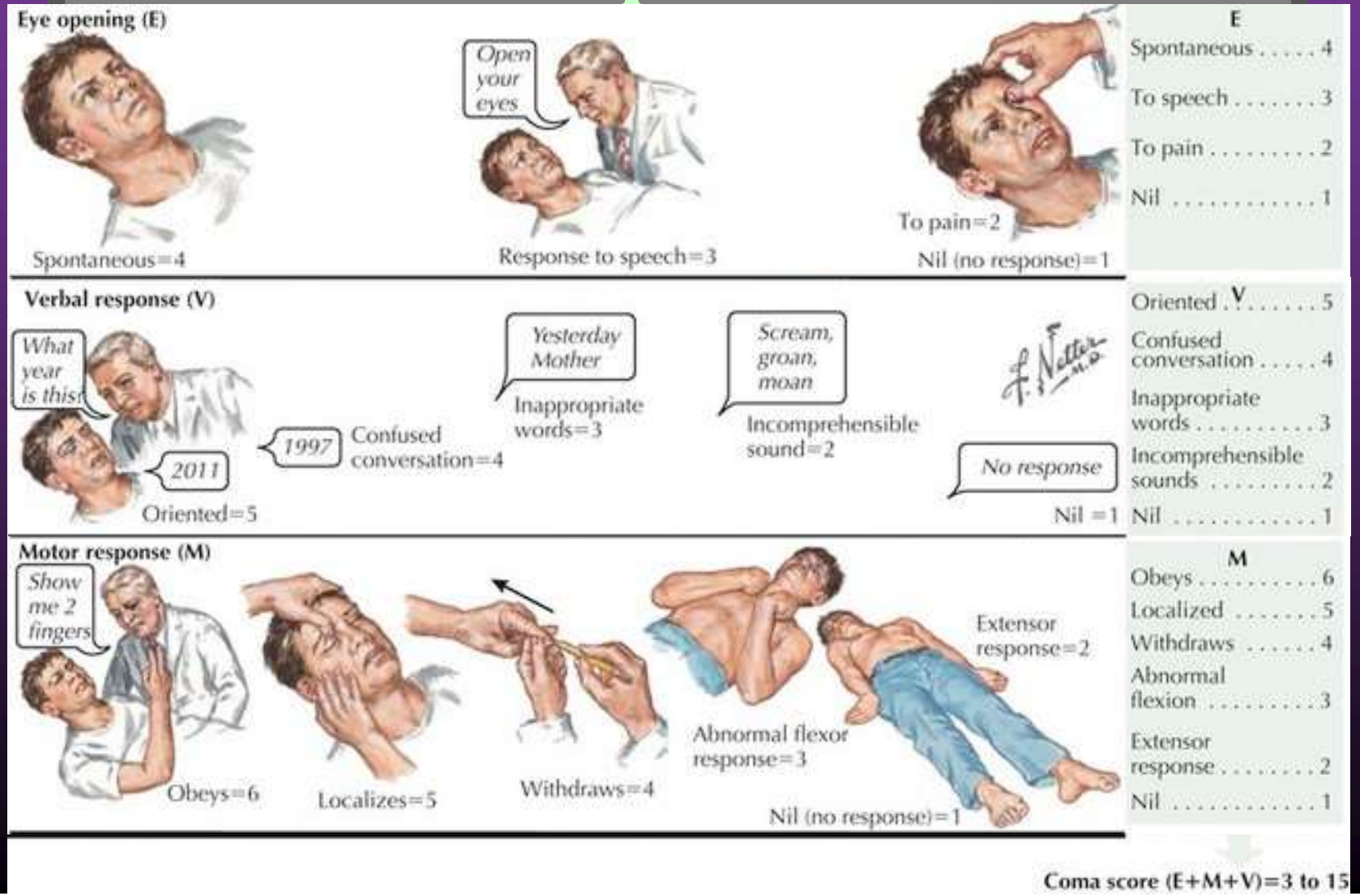
MILD	MODERATE	SEVERE
GCS 13-15	GCS 9-12	GCS 3-8

Glasgow Coma Scale (GCS) Components

Component		Points Assigned
Eye opening (E)		
	Spontaneous	4
	To voice	3
	To pain	2
	Does not open	1
Verbal response (V)		
	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1
Motor response (M)		
	Follows commands	6
	Localizes to painful stimulus	5
	Withdrawal from painful stimulus	4
	Abnormal flexion (decorticate)	3
	Extension (decerebrate)	2
	None	1
GCS sum score: (E + M +V); best possible score = 15; worst possible score = 3		

ATLS - Advanced trauma life support. 2018. Chicago, Ill.: American College of Surgeons, Committee on Trauma.
Bales, James W., Bonow, Robert H., Ellenbogen, Richard G. 2018. Closed Head Injury. In Principles of Neurological Surgery (Fourth Edition). Editor(s): Richard G. Ellenbogen, Laligam N. Sekhar, Neil D. Kitchen, Harley Brito da Silva. Elsevier: Pages 366-389.e4,

Glasgow Coma Scale (GCS) Components



Menilai Kesadaran

Eye opening

> 1 Year	< 1 Year	Score
✓ Spontaneous	✓ Spontaneous	**4**
✓ To speech	✓ To shout	**3**
✓ To pain	✓ To pain	**2**
✓ No response	✓ No response	**1**

Menilai Kesadaran

Verbal Response

> 5 years	2-5 years	0-23 mos	Score
✓ Oriented	✓ Appropriate words	✓ Smiles, coos	5
✓ Disoriented	✓ Inappropriate words	✓ Cries, consolable	4
✓ Inappropriate words	✓ Persistent cries	✓ Persistent inappropriate cries	3
✓ Incomprehensible sounds	✓ Grunts	✓ Grunts, agitated, restless	2
✓ No response	✓ No response	✓ No response	1

Menilai Kesadaran

Motor Response

>1 Year	< 1 Year	Score
✓ Obeys command	✓ Spontaneous	6
✓ Localizes pain	✓ Localizes pain	5
✓ Flexion withdrawal	✓ Flexion withdrawal	4
✓ Decorticate	✓ Decorticate	3
✓ Decerebrate	✓ Decerebrate	2
✓ No response	✓ No response	1

Symptoms of a TBI

- Vomiting
- Lethargy
- Headache
- Confusion
- Paralysis
- Coma
- Loss of consciousness
- Dilated pupils
- Vision changes (blurred vision or seeing double, unable to tolerate bright light, loss of eye movement, blindness)
- Cerebrospinal fluid (CSF) (clear or blood-tinged) appear from the ears or nose

Symptoms of a TBI

- Dizziness and balance concerns
- Breathing problems
- Slow pulse
- Slow breathing rate with an increase in blood pressure
- Ringing in the ears or changes in hearing
- Cognitive difficulties
- Inappropriate emotional responses
- Speech difficulties (slurred speech, inability to understand and/or articulate words)
- Difficulty swallowing

Symptoms of a TBI

- Body numbness or tingling
- Droopy eyelid or facial weakness
- Loss of bowel control or bladder control

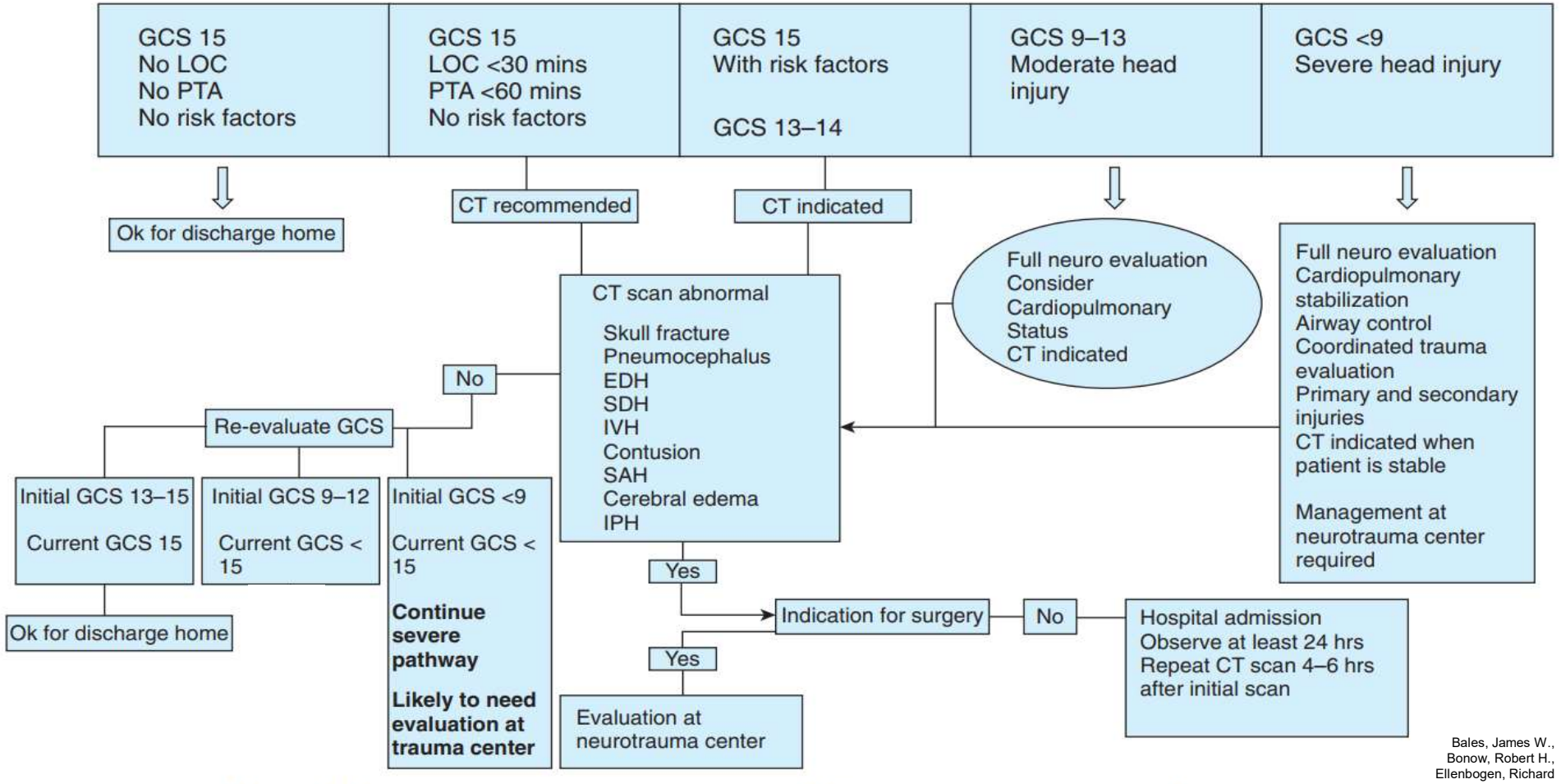
Langkah-langkah Tatalaksana Cedera Otak di Ruang Gawat Darurat

1. *General precaution*
2. Stabilisasi *Airway, Breathing, Circulation*
3. Survey sekunder (pemeriksaan status general terdiri dari anamnesa dan pemeriksaan fisik seluruh sistem organ)
4. Pemeriksaan neurologis
5. Menentukan diagnosis klinis dan pemeriksaan tambahan
6. Menentukan tahapan tatalaksana selanjutnya sesuai buku Pedoman

Anamnesa

- ✓ *Identitas penderita : Nama, Umur, Sex, Suku, Agama, Pekerjaan, Alamat*
- ✓ *Mekanisma trauma*
- ✓ *Waktu trauma*
- ✓ *Pernah pingsan atau sadar setelah trauma*
- ✓ *Amnesia retrograde atau antegrade*
- ✓ *Keluhan : Nyeri kepala seberapa berat, kejang, vertigo*
- ✓ *Riwayat mabuk, alkohol, narkotika*
- ✓ *Penyakit penyerta : epilepsi, jantung, asma, pernah trepanasi*

Management of TBI



• **Figure 25.6** Flowchart for evaluation of head injury following a traumatic event. *Risk factors include age > 40, headache, vomiting, high-risk mechanism (eg, motor vehicle collision), and anticoagulant use. CT, head compute tomography image; EDH, epidural hematoma; GCS, Glasgow Coma Scale; IPH, intraparenchymal hemorrhage; IVH, intraventricular hemorrhage; LOC, loss of consciousness; PTA, post-traumatic amnesia; SAH, subarachnoid hemorrhage; SDH, subdural hematoma.

Bales, James W., Bonow, Robert H., Ellenbogen, Richard G. 2018. Closed Head Injury. In Principles of Neurological Surgery (Fourth Edition). Editor(s): Richard G. Ellenbogen, Laligam N. Sekhar, Neil D. Kitchen, Harley Brito da Silva. Elsevier: Pages 366-389.e4,

Pemeriksaan Penunjang

- ✓ *CT Scan, bila :*
  - ❑ *Nyeri kepala, muntah menetap dengan obat-obatan*
  - ❑ *Kejang*
  - ❑ *Luka tusuk atau tembak, korpus alienum*
  - ❑ *GCS < 15*
  - ❑ *Penurunan GCS > 1 point*
  - ❑ *Lateralisasi (anisokor, hemiparese)*
  - ❑ *Bradikardia dengan gejala lain diatas*
  - ❑ *Cidera kepala GCS < 15 disertai cidera multiple organ*
  - ❑ *Indikasi sosial*

Managing Traumatic Brain Injury, TAL 2020

Tujuan Penanganan

1. Penanganan Cidera Otak Primer
2. Mencegah terjadinya Cidera Otak Sekunder
3. Optimalisasi Metabolisme Otak
4. Rehabilitasi

Tahapan Penanganan

1. Fase Akut (Gawat Darurat)

2. Fase Perawatan

3. Fase Rehabilitasi

Obersvasi di IRD

- ✓ minimal 4-6jam
- ✓ di-re-evaluasi setiap 15mnt
  - ❑ Keluhan adanya tanda peningkatan TIK
  - ❑ Vital Sign (TD, N, RR, TempAx)
  - ❑ St Neurologis (GCS, Pupil, RC, Motorik, Sensorik)
  - ❑ Fungsi B1-B6
  - ❑ Efikasi & Efisiensi Terapi

Managing Traumatic Brain Injury, TAL 2020

Kriteria MRS

- ✓ Pernah tidak sadar
- ✓ GCS < 15
- ✓ Terdapat gejala neurologis fokal (lateralisasi, kejang)
- ✓ GCS < 15 progresif neurologis menurun
- ✓ Keluhan menetap setelah diberi obat-obatan
- ✓ Fraktur basis kranii
- ✓ Tak ada yang mengawasi di rumah
- ✓ Tempat tinggal diluar kota
- ✓ Mabuk, epilepsi, pernah operasi kepala
- ✓ Disertai penyakit lain yang berat
- ✓ Umur > 50 tahun
- ✓ Atas permintaan keluarga

Kriteria Boleh Pulang

- ✓ Sadar dan orientasi baik, tidak pernah pingsan
- ✓ Tidak ada gejala neurologis fokal
- ✓ Keluhan berkurang, muntah atau nyeri kepala hilang
- ✓ Tak ada fraktur kepala atau basis kranii
- ✓ Ada yang mengawasi di rumah
- ✓ Tempat tinggal dalam kota

Kriteria Boleh Pulang

Peringatan untuk pendamping di rumah, segera dibawah ke IRD bila

- ✓ Muntah makin sering
- ✓ Nyeri kepala atau vertigo memberat
- ✓ Gelisah atau kesadaran menurun
- ✓ Kejang

Outcome

depend on

- ✓ *Quality of early management*
- ✓ *Severity of primary brain injury*
- ✓ *Adequate referral policy*
- ✓ *Prompt diagnosis and treatment*
- ✓ *Adequate prevent and treatment of complication*
- ✓ *Proper Rehabilitation*

Masalah pada Cedera Otak (*Common Problems*)

Jennet and Carlin :

- Mass Lession
- Hypoxia
- Hypotension
- ICP

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Skull Fractures

Linear skull fractures or simple breaks or “cracks” in the skull may accompany TBIs.

Possible forces, strong enough to cause a skull fracture may damage the underlying brain. Skull fractures may be alarming, if found on a patient evaluation. Fractures at the base of the skull are problematic since they can cause injury to nerves, arteries, or other structures. If the fracture extends into the sinuses, a leakage of cerebrospinal fluid (CSF) from the nose or ears may occur. Depressed skull fractures, in which part of the bone presses on or into the brain, can also occur.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Contusion

A cerebral contusion is bruising of brain tissue. When examined under a microscope, cerebral contusions are comparable to bruises in other parts of the body. They consist of areas of injured or swollen brain mixed with blood that has leaked from arteries, veins, or capillaries. Most commonly, contusions are at the base of the front parts of the brain, but may occur anywhere.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Ischemia

Another type of diffuse injury is ischemia or insufficient blood supply to certain parts of the brain. A decrease in blood supply to very low levels may occur commonly in a significant number of TBI patients. This is crucial since a brain that has just undergone a traumatic injury is especially sensitive to slight reductions in blood flow. Changes in blood pressure during the first few days after head injury can also have an adverse effect.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Hematoma

A hematoma is a blood clot within the brain or on its surface. Hematomas may occur anywhere within the brain. An epidural hematoma is a collection of blood between the dura mater (the protective covering of the brain) and the inside of the skull. A subdural hematoma is a collection of blood between the dura mater and the arachnoid layer, which sits directly on the surface of the brain.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Hemorrhage

Intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), and intraventrikel hemorrhage (IVH) are describes bleeding within the brain, may be related to other brain injuries, especially contusions. The size and location of the hemorrhage helps determine whether it can be removed surgically. Hydrocephalus may result from severe traumatic SAH.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Diffuse Injuries

TBIs can produce microscopic changes that do not appear on CT scans and are scattered throughout the brain. This category of injuries, called diffuse brain injury, may occur with or without an associated mass lesion.

Type of Injuries

- ✓ Skull Fractures
- ✓ Contusion
- ✓ Ischemia
- ✓ Hematoma
- ✓ Hemorrhage
- ✓ Diffuse Injuries
- ✓ Diffuse Axonal Injury

✓ Diffuse Axonal Injury

Axonal injury refers to impaired function and gradual loss of axons.These long extensions of nerve cells enable them to communicate with each other. If enough axons are harmed in this way, the ability of nerve cells to communicate with each other and to integrate their function may be lost or greatly impaired, possibly leaving a patient with severe disabilities.

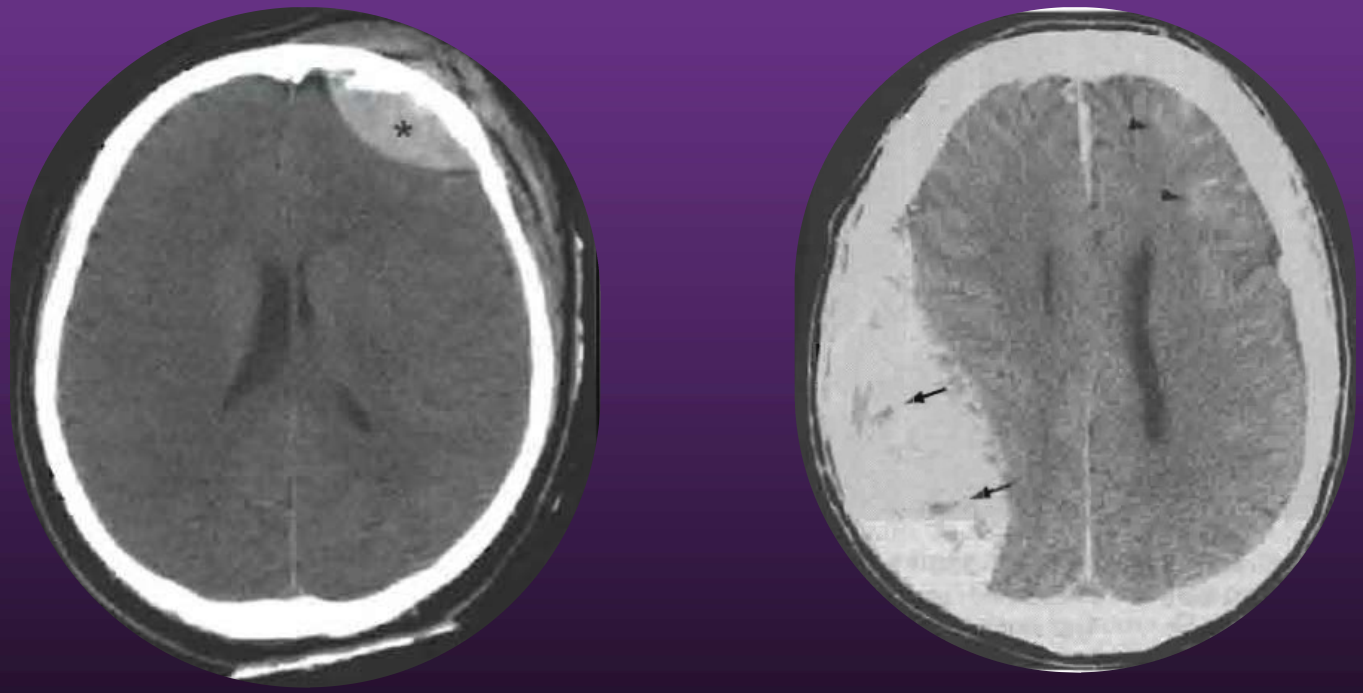
Mass Lession by Hemorrhage

Jenis Perdarahan yang menyebabkan efek massa :

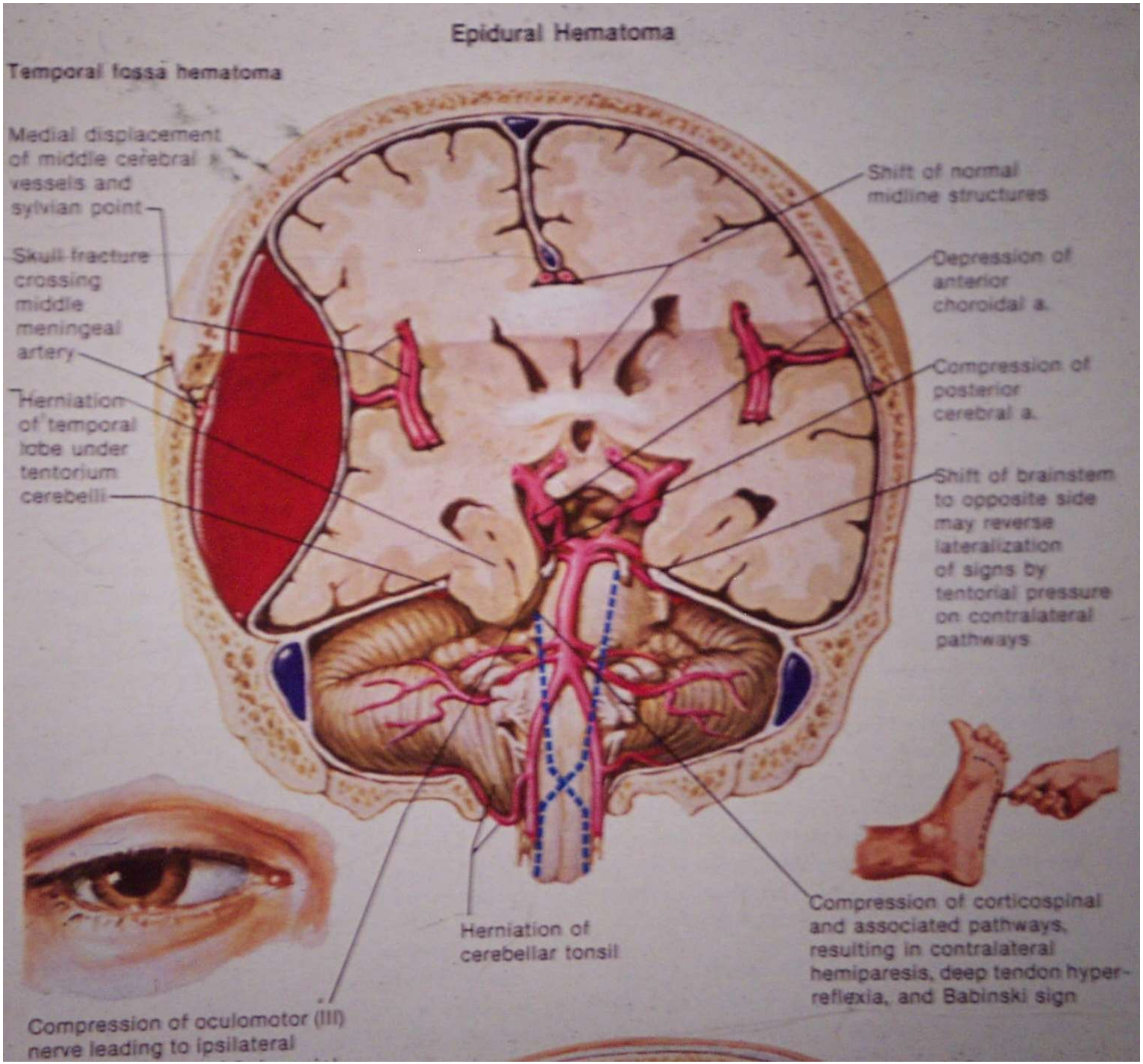
1. EDH (Epidural hematoma)
2. SDH (Subdural hematoma)
3. ICH (Intracerebral hemorrhage)
4. SAH (Subarachnoid hemorrhage)
5. IVH (Intraventrikel hemorrhage)

Epidural hematoma

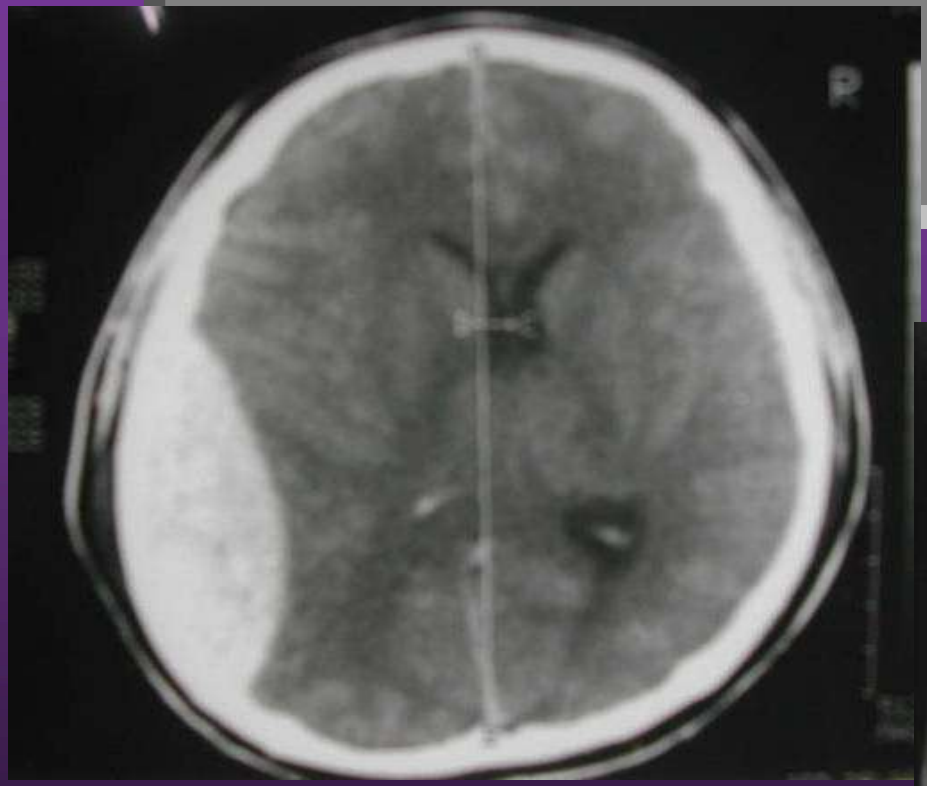
Youmans, Neurological surgery, 2011

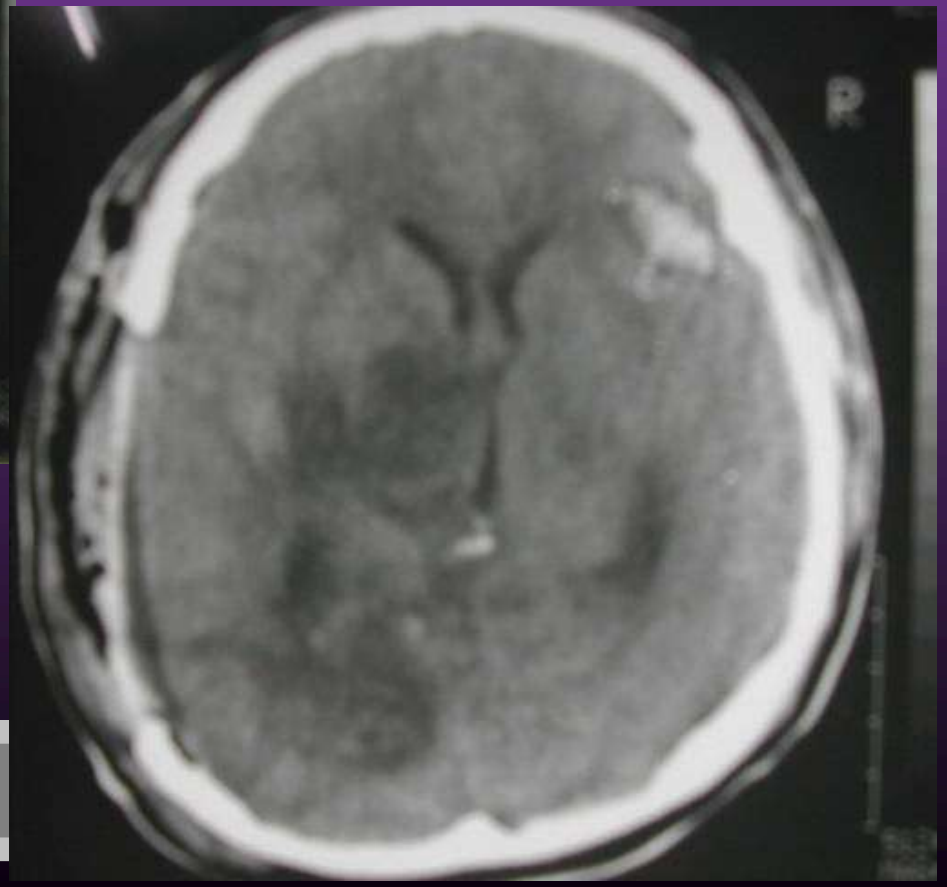


Tommy A Nazwar 2019


Epidural Hematoma
Temporal fossa hematoma
Medial displacement of middle cerebral vessels and sylvian point
Skull fracture crossing middle meningeal artery
Herniation of temporal lobe under tentorium cerebelli
Shift of normal midline structures
Depression of anterior choroidal a.
Compression of posterior cerebral a.
Shift of brainstem to opposite side may reverse lateralization of signs by tentorial pressure on contralateral pathways
Herniation of cerebellar tonsil
Compression of corticospinal and associated pathways, resulting in contralateral hemiparesis, deep tendon hyperreflexia, and Babinski sign
Compression of oculomotor (III) nerve leading to ipsilateral

epidural hematoma satu hari

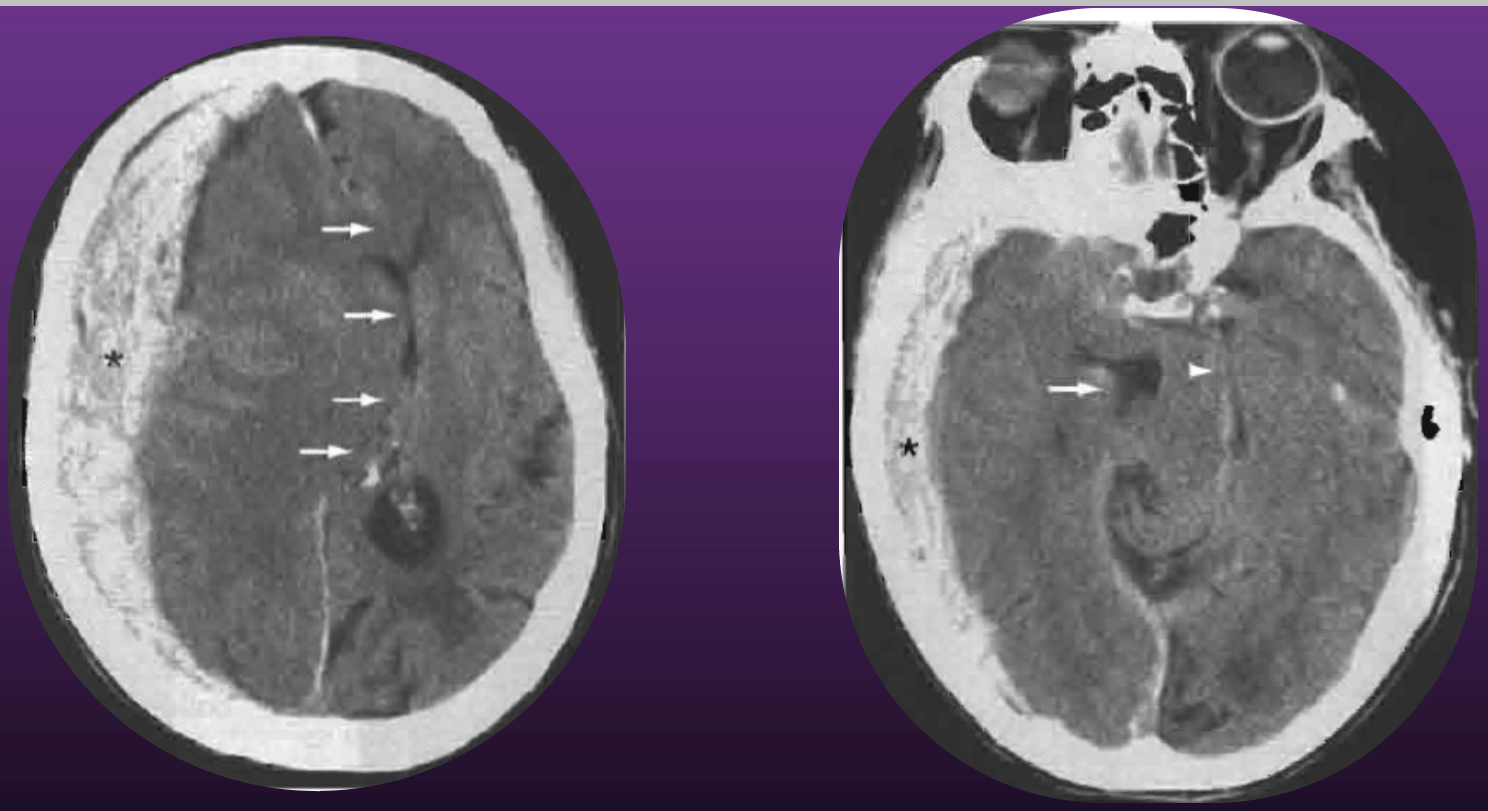




infark basal ganglia

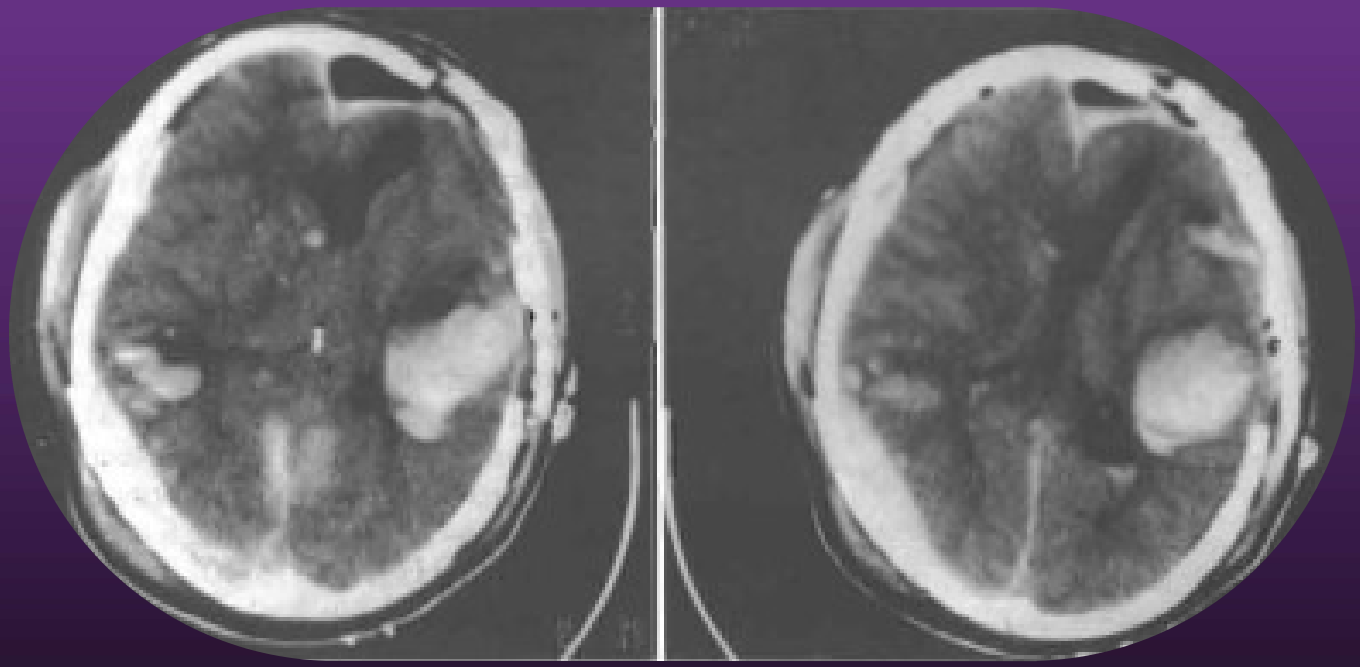
Subdural hematoma

Youmans, Neurological surgery, 2011

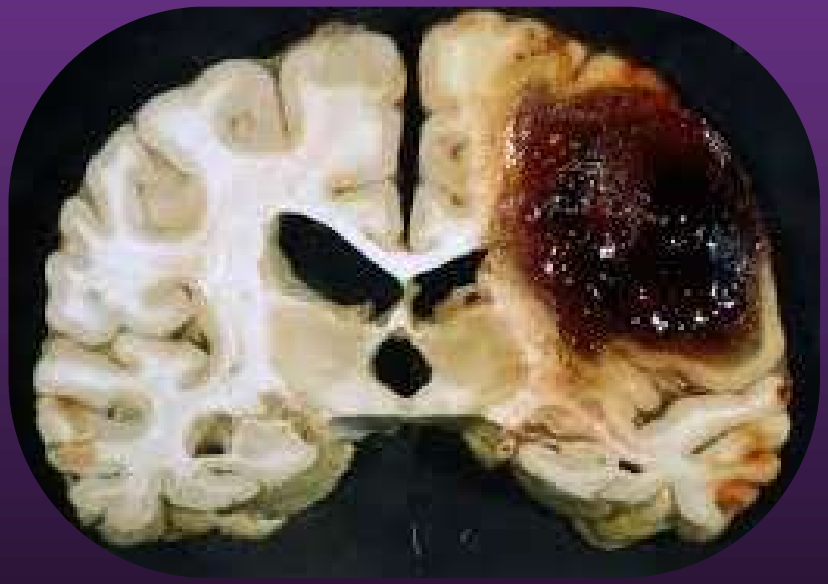


Intracerebral hemorrhage

Youmans, Neurological surgery, 2011

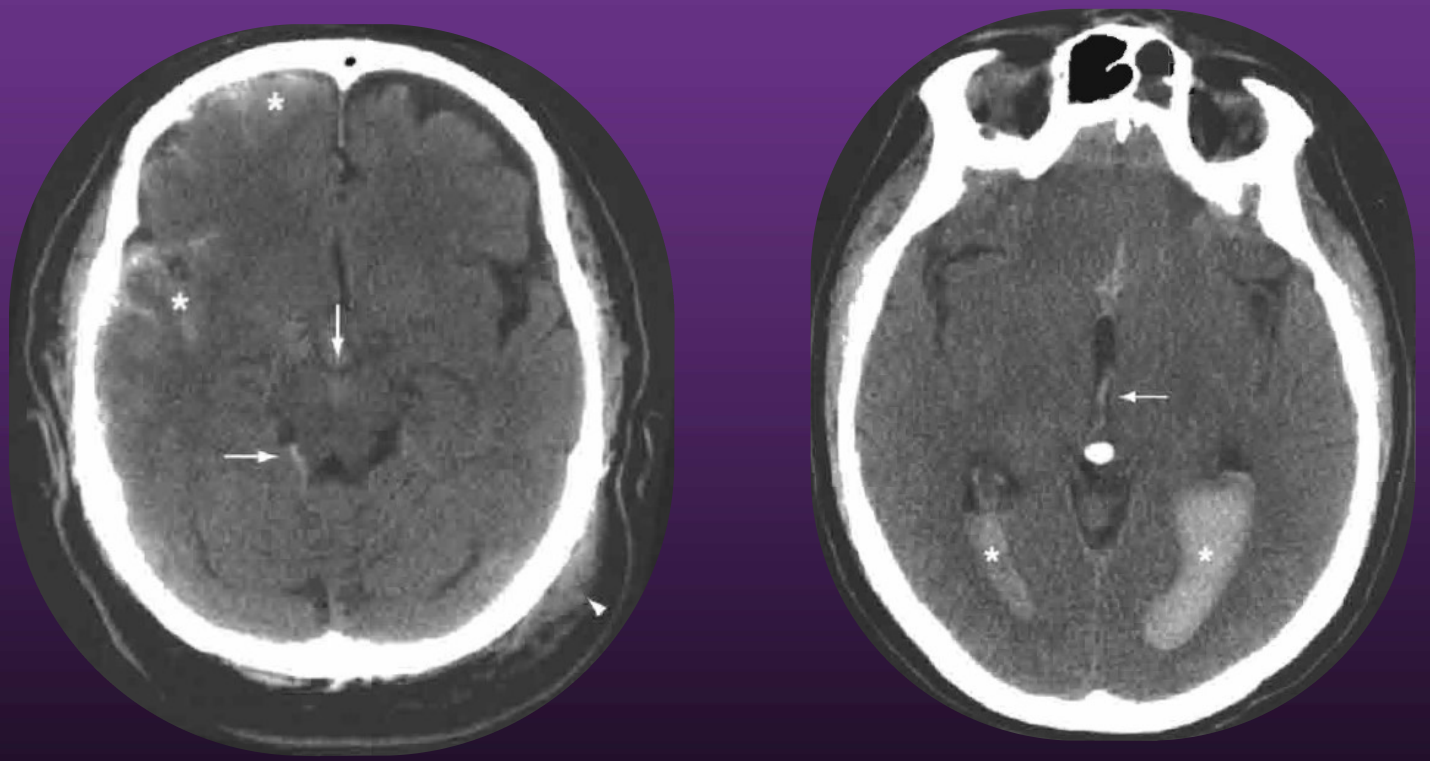


Intracerebral hemorrhage



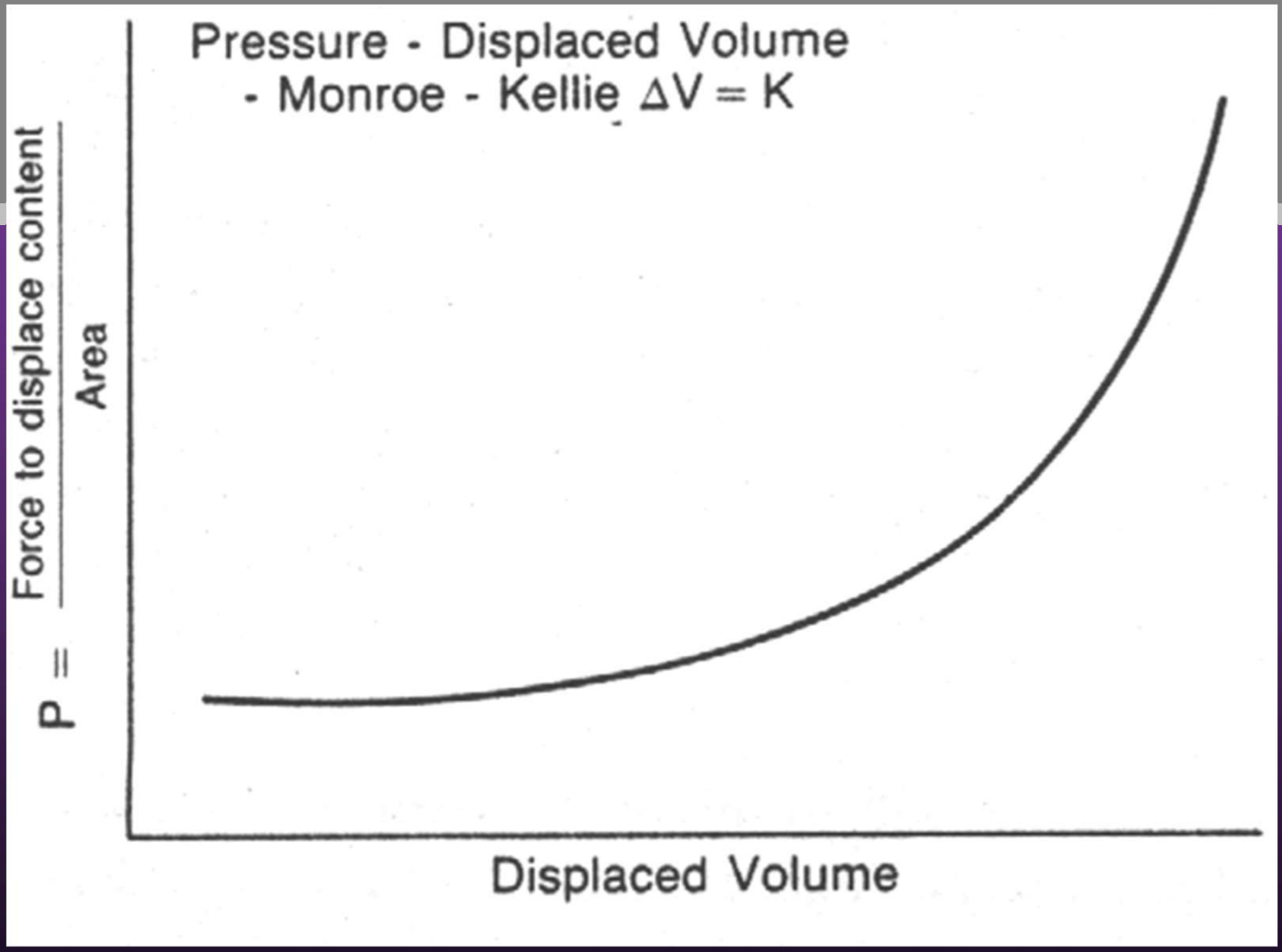
Subarahcnoid hemorrhage & Intraventrikel hemorrhage

Youmans, Neurological surgery, 2011



Brain injury is ongoing process

Monroe – Kellie Doctrine



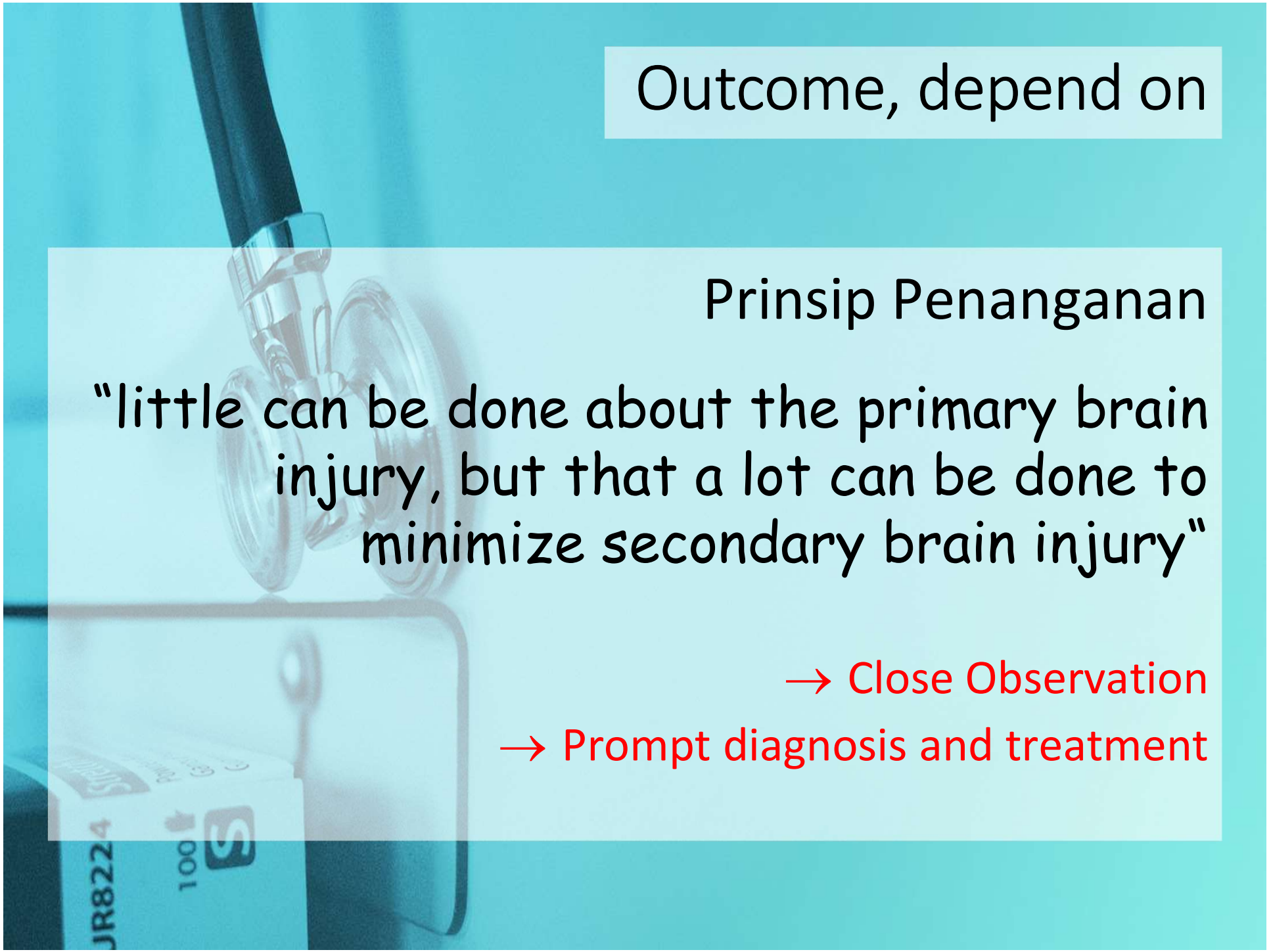
Volume = $V_{blood} + V_{CSF} + V_{parenchyma}$

Tabel 2: Gejala dan Tanda-tanda Herniasi Otak[6]

STADIUM KLINIS	DIENSEFALON	MESENSEFALON	PONS	MEDULA OBLONGATA
Derajat Kesadaran	Somnolen Stupor Semi koma	Koma	Koma	Koma
Pola Pernafasan	Cheyne Stoke	CNH: Central Neurogenik Hiperventilasi	CNH Ataxic Apneustik	Apneu
Tensi	Normal	Tidak Stabil	Hipertensi	Hipotensi
Nadi	Normal	Mulai Bradikardi	Bradikardi	Bradikardi
Suhu Badan	Normal	Mulai Naik	Hipertermia	Hipertermia
Kedudukan Bola Mata	Bergerak kian kemari konyugat	Strabismus divergen ipsilateral	Diam ditengah	Diam ditengah
Pupil **R. Cahaya**	Isokor Miosis +/+	Anisokor ipsilateral Midriasis ipsilateral +/-	Pin point pupil -/-	Midriasis ODS -/-
R. Bulu Mata	+/+	+/+	-/-	-/-
R. Cornea	+/+	+/+	-/-	-/-
R. Doll Eye	+/+	+/- ipsilateral	+/- ipsilateral	-/-
Test Kalorik	+/+	+/- ipsilateral	+/- ipsilateral	-/-
R. Muntah	+/+	+/+	+/-	-/-
Posturing	Decorticate rigid	Decorticate rigid	Decerebrade rigid	Flacid

Gejala Klinis Peningkatan TIK

Subyektif :	Obyektif:
1. Cefalgia 2. Muntah 3. Kejang 4. Penurunan visus 5. Penurunan kesadaran	1. Cushing respon • Tekanan darah meningkat • Bradikardia • Pernapasan tidak teratur 2. Mata : Papil edema 3. Kelumpuhan N.cranialis 4. ICP Monitoring



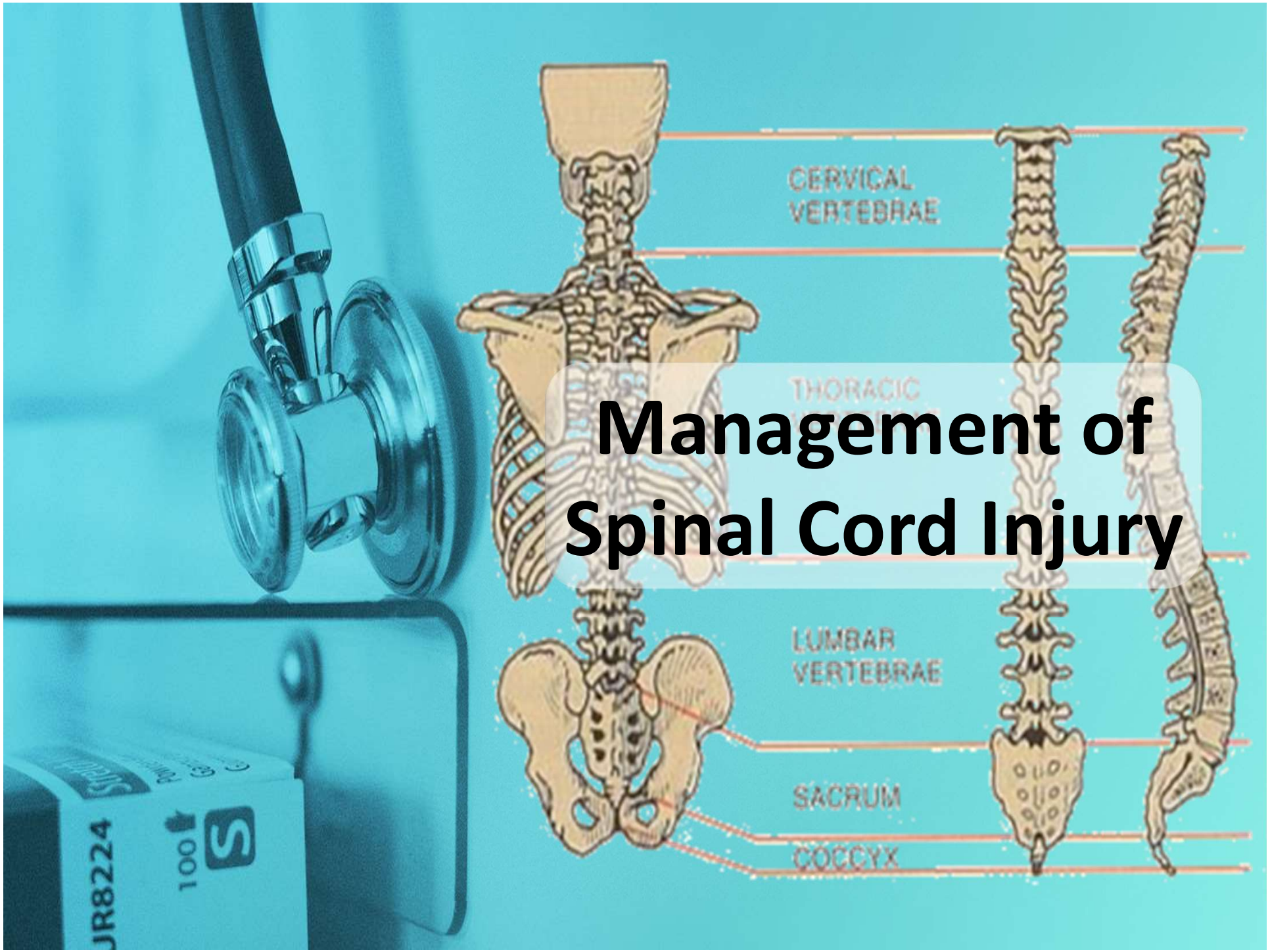
Outcome, depend on

Prinsip Penanganan

"little can be done about the primary brain injury, but that a lot can be done to minimize secondary brain injury"

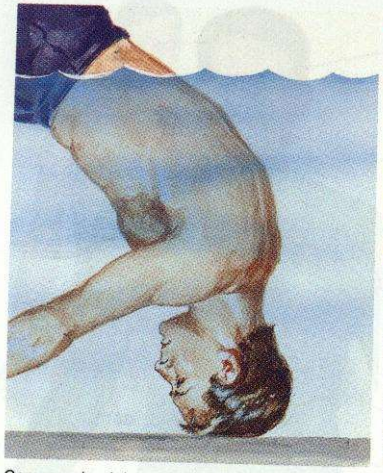
→ Close Observation

→ Prompt diagnosis and treatment

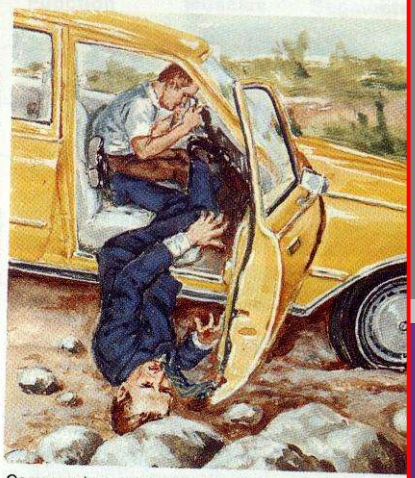


Management of Spinal Cord Injury

Common Causes of Cervical Spine Injury

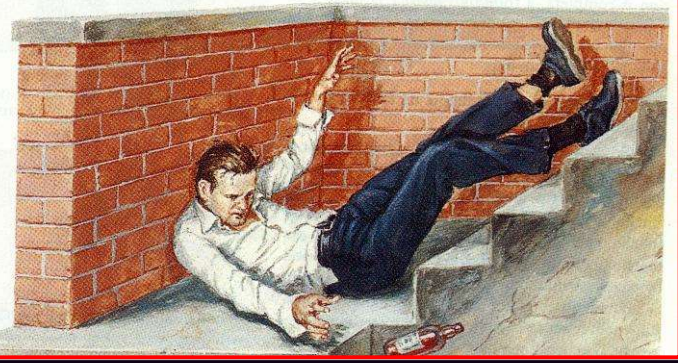


Compression injury of cervical spine may result from blow on top of head, as in diving accident



Compression–rotation injury may occur when person is thrown from car or upended in football or other sports accident

Head–on collision with stationary object or oncoming vehicle may, if seat belts not used, drive forehead against windshield. This sharply hyperextends neck, resulting in dislocation with or without fracture of cervical vertebrae

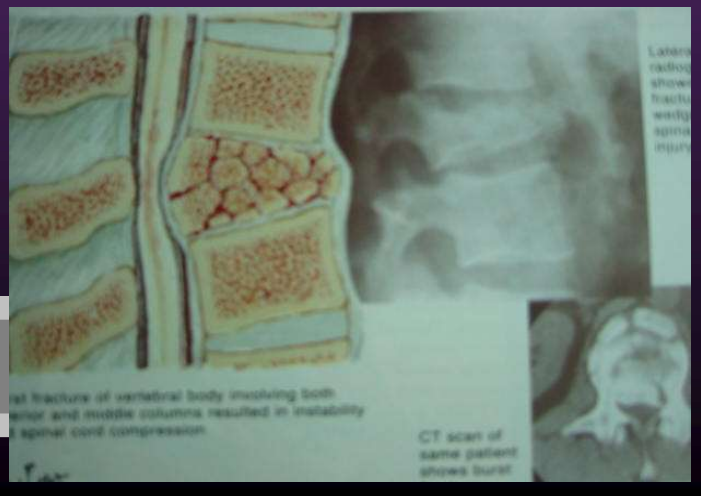


Flexion injury commonly results from blow on back of head, as in fall when intoxicated

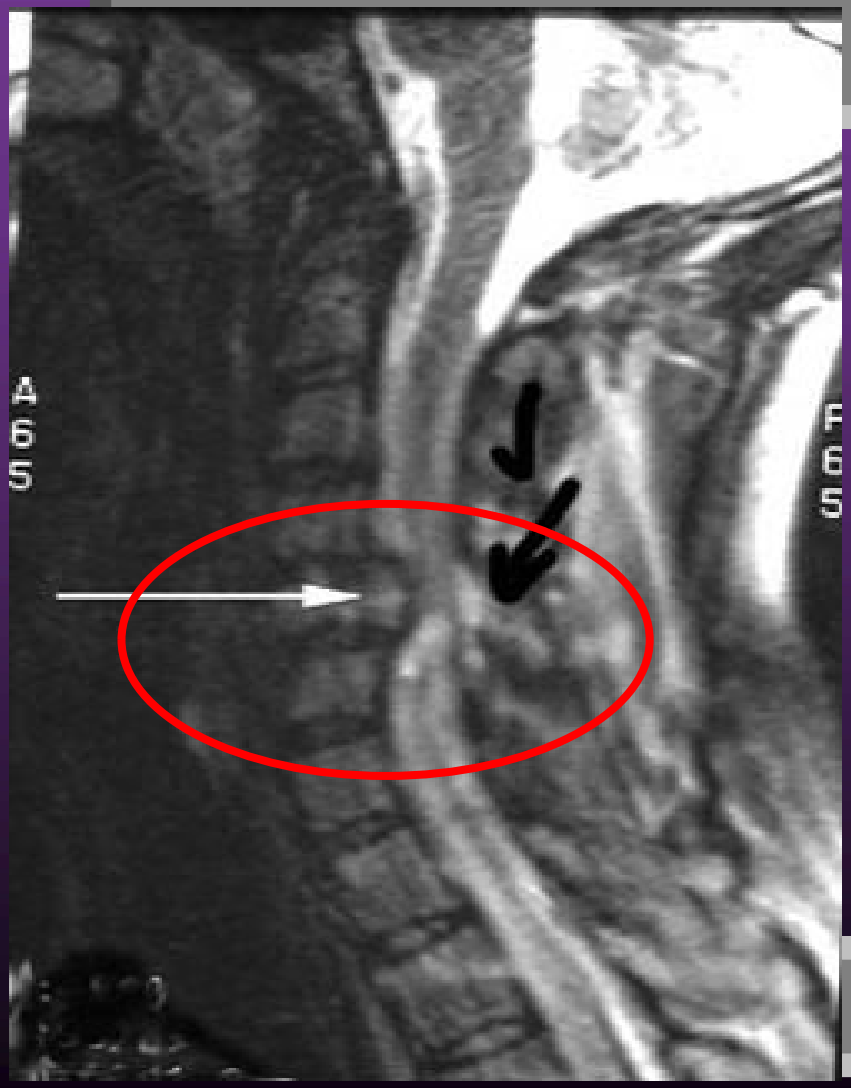
F. Netter M.D.

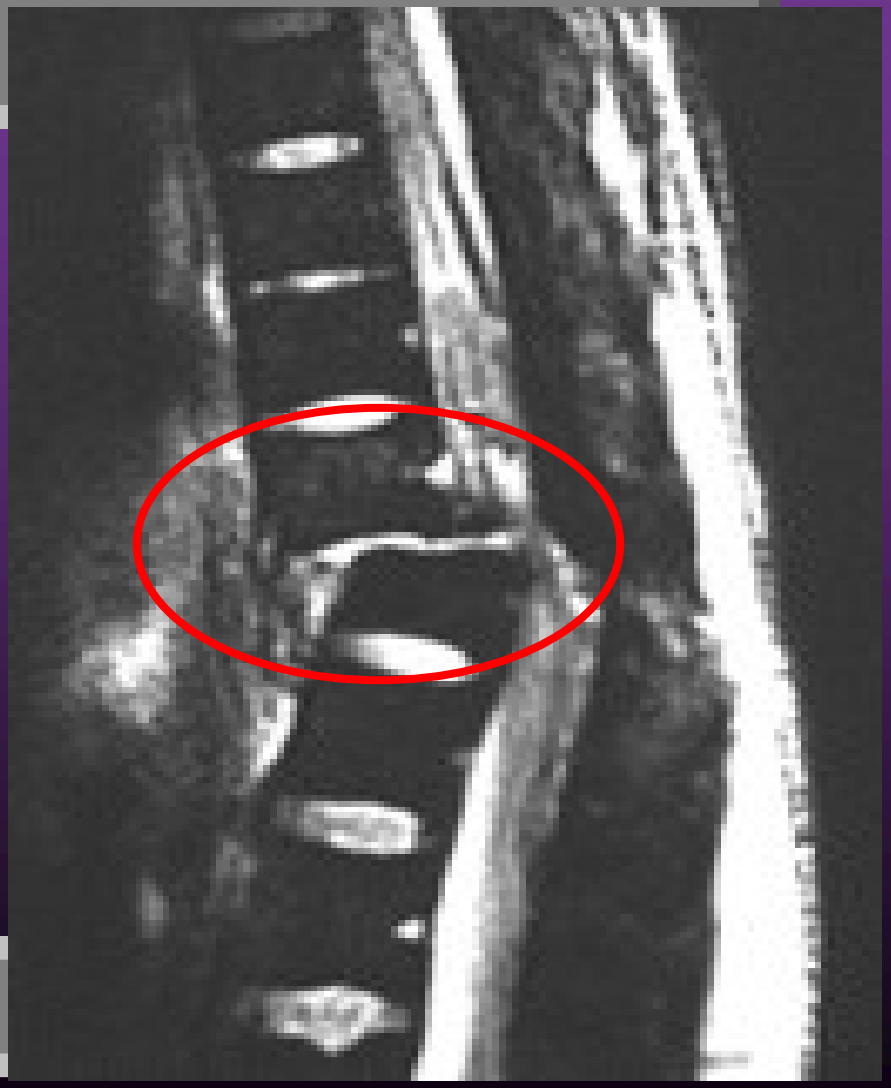
©CIBA–GEIGY

Subluxation and Ligamentous Instability of Cervical Spine



Complete Cord Transection





INTRODUCTION

1700 - 2000 BC	Egyptian manuscript → SCI is an ailment not to be treated
7th C	Paulus of Aegina → Decompressive laminectomy
16th C	Aulus Cornelius C → Traction reduction of a spinal collum dislocation
18th C	Antrine Louis → Removal of a bullet from a spine
19th C	Henry Cline → Laminectomy for spinal cord inj.
1911	Alfred Reginald Allen → Drop weight impact spinal cord injury model

SPINAL ANATOMY

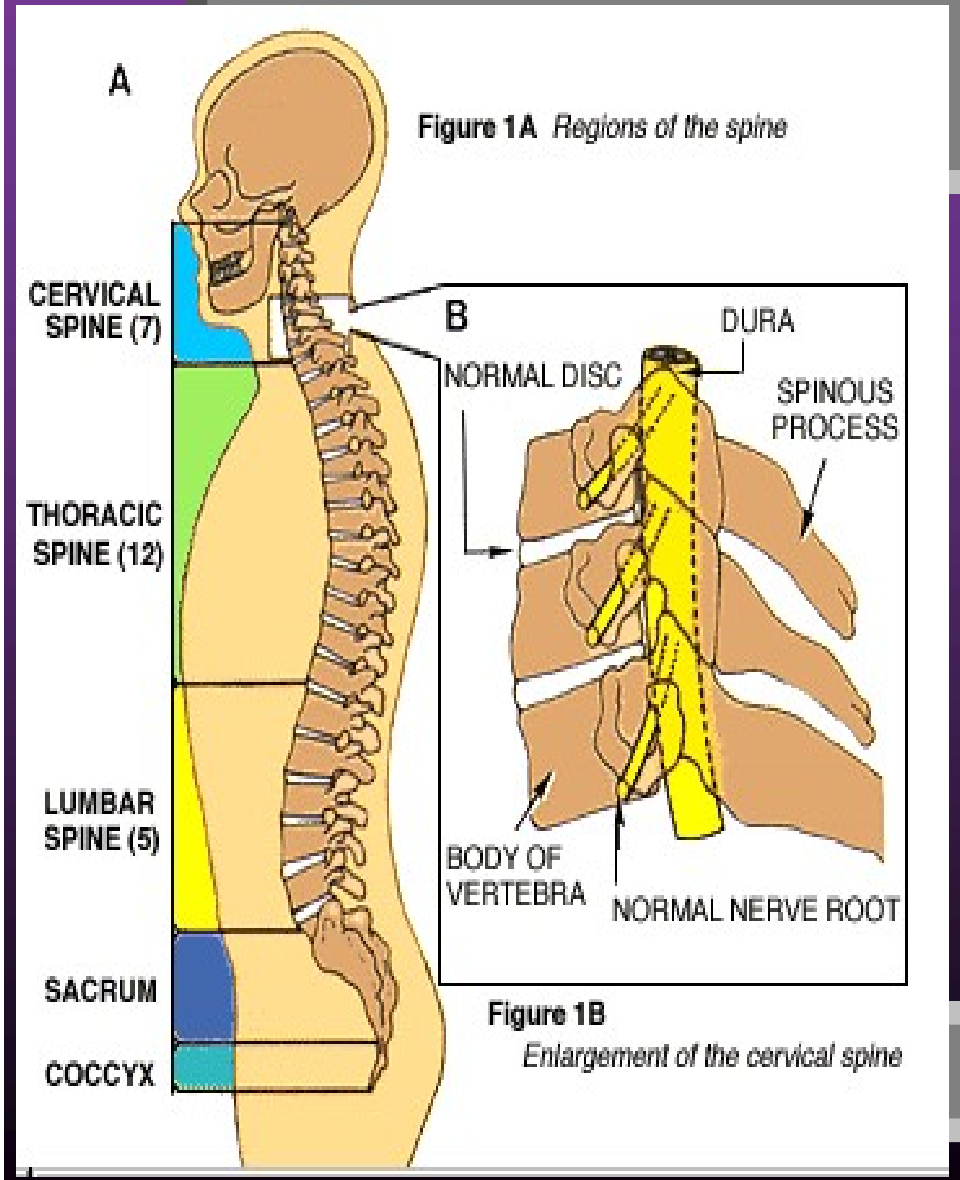
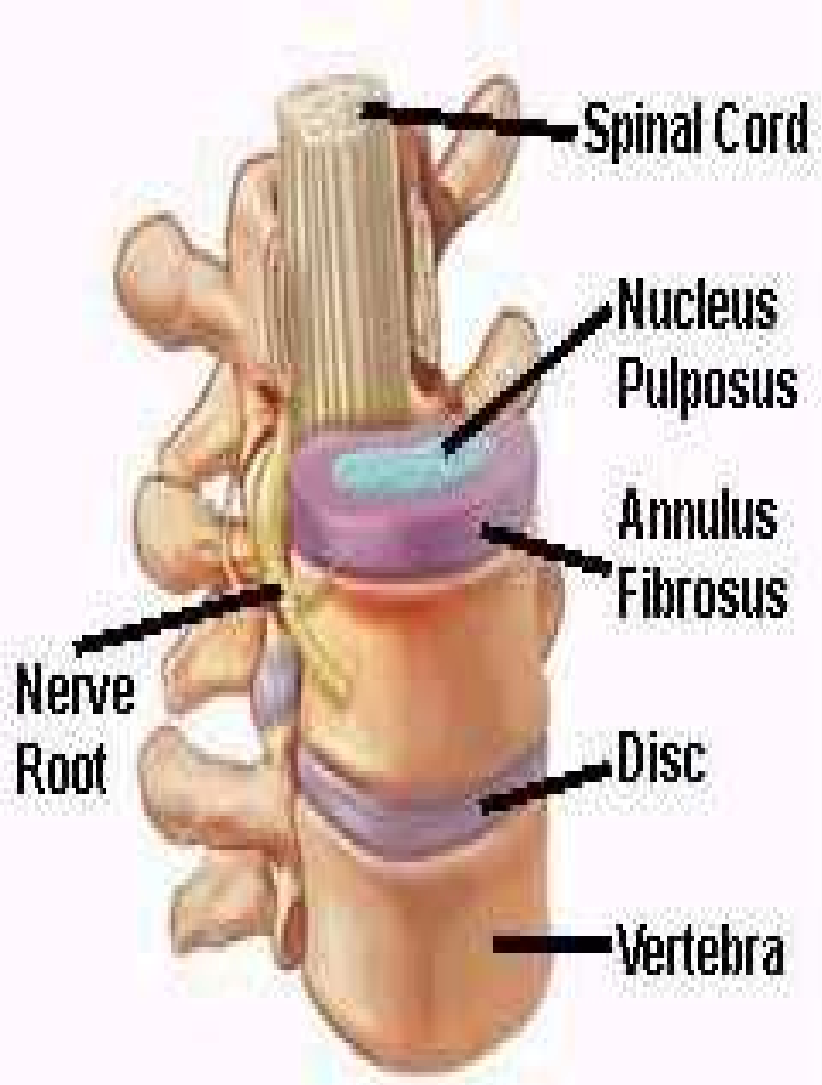


Figure 1A *Regions of the spine*

Figure 1B
Enlargement of the cervical spine



Incidence of Spinal cord injury

- **Multitrauma → 20 %**
- **Head injury → 10 %**
- **Spine injury → 20 % second injury**

Type of Spinal cord injury

- **Direct :** tembus → bacok/tusuk/peluru

- **Indirect:**
  - ✓ fleksi-ekstensi
  - ✓ kompresi
  - ✓ burst
  - ✓ instabilitas

Type of Spinal cord injury

- Cervical 40%
- Thoracic 10%
- Lumbar 3%
- Dorso lumbar 35%
- Any 14%

Type of Spinal cord injury

- Incomplete:
  - Masih ada fungsi(motorik/sensorik)
- Complete:
  - Tidak ada motorik/sensorik > 24 jam

Spinal shock

1. vascular → hipotensi& bradikardi:
   - Tonus vaskular << (simpatis) → vasodilatasi
   - Tonus otot << pooling di vena → hati-2 posisi tubuh

2. neuronal →
   - Paralisa total : "flaksid"
     - 1-2 minggu → bulan

Whiplash injury

- Lesion of soft tissue - muscle - ligament
- **Grade :**
  - 0 → tanda/keluhan (-)
  - 1 → nyeri & kaku di leher
  - 2 → gerakan leher terganggu
  - 3 → motorik/sensorik/reflek (+)
  - 4 → fraktur (+)

→ **Spine injury**

Initial management

- Penyebab kematian:
  - aspirasi dan hipotensi/shock
- “Masking” cidera lain:
  - torak , abdomen , kepala

Harus curiga → spinal cord injury

- ✓ Trauma berat
- ✓ Trauma multipel
- ✓ Trauma jatuh dari Ketinggian
- ✓ Trauma dgn gangguan kesadaran
- ✓ Trauma dgn nyeri leher
- ✓ Trauma dgn defisit neurologis
- ✓ Trauma dgn nafas abdominal
- ✓ Trauma dgn hipotensi & bradikardi

Initial management

- **Immobilisasi:**
  - Saat evakuasi / transportasi / proses dx
  - Collar , bantal pasir & plester , back board , log-roll
- **Oksigenasi**
- **Sirkulasi → dopamine & atropin**
- **Cek : “motorik”**

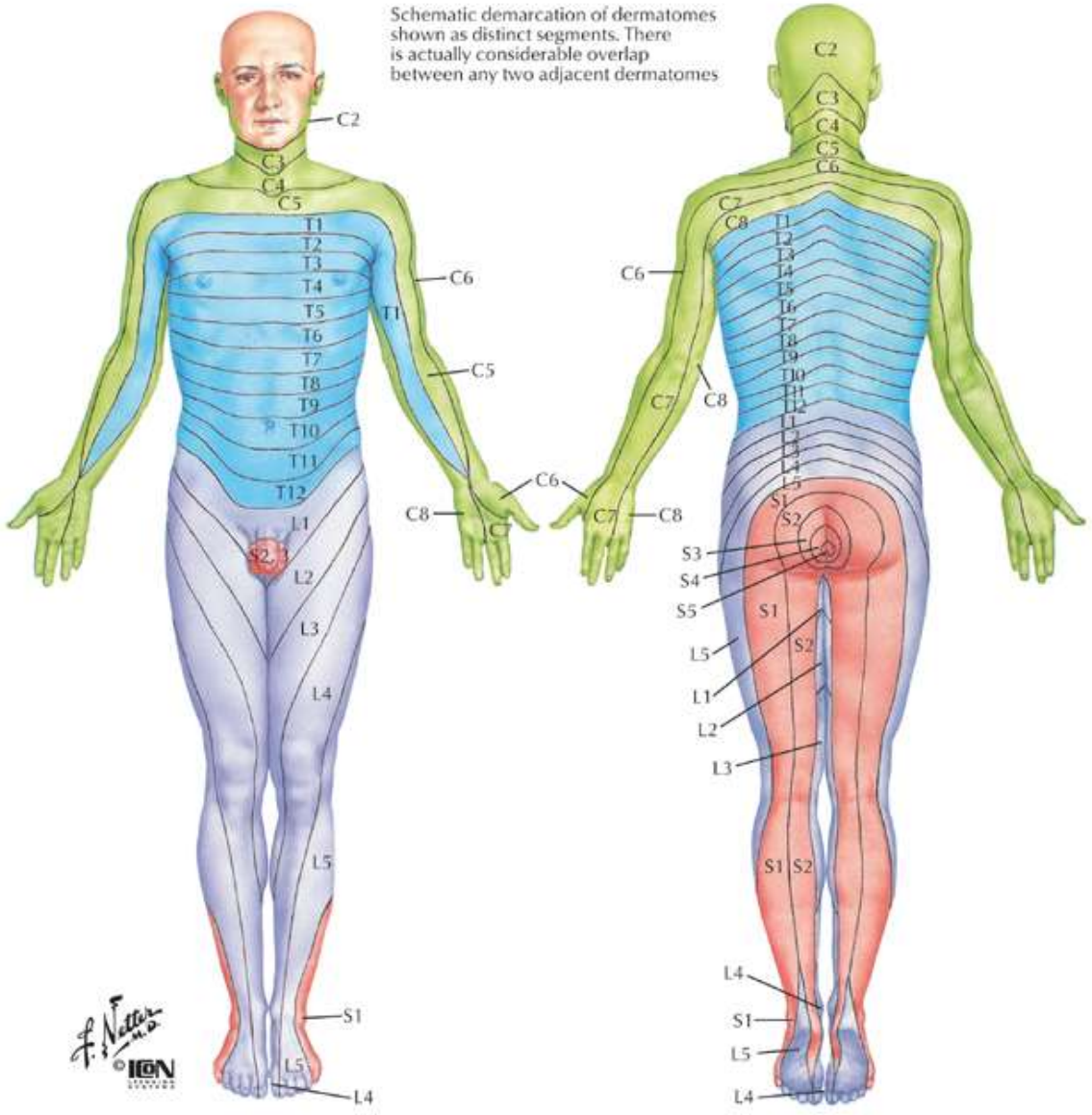
In hospital management

- **Medikal terapi** → "Metil Prednisolon"
- **Elektrolit**
- **Neurologis**
- **Urin Kateter**
- **Radiologis**
- **NG-tube**
- **Suhu**

Neurologis

- **Frenkel:**
  - 1 (A): Komplit
  - 2 (B): Sensorik (+)
  - 3 (C): Motor (+) tapi tdk bisa dipakai
  - 4 (D): Motor (+) bisa dipakai
  - 5 (E): Normal
- **Mekanisme injury**
- **Palpasi** → "step-off"
- **Level :** (motorik / sensorik / reflek / otonom)

Neurologis



Levels of principal dermatomes

C5	Clavicles
C5, 6, 7	Lateral parts of upper limbs
C8, T1	Medial sides of upper limbs
C6	Thumb
C6, 7, 8	Hand
C8	Ring and little fingers
T4	Level of nipples
T10	Level of umbilicus
T12	Inguinal or groin regions
L1, 2, 3, 4	Anterior and inner surfaces of lower limbs
L4, 5, S1	Foot
L4	Medial side of great toe
S1, 2, L5	Posterior and outer surfaces of lower limbs
S1	Lateral margin of foot and little toe
S2, 3, 4	Perineum

Neurologis

- **Motorik V.Cervical:**
  - **C 5 - abduksi bahu / fleksi siku**
  - **C 6 - ekstensi tangan**
  - **C 7 - ekstensi siku**
  - **C 8 - genggam tangan**

Neurologis

- **Motorik V.Lumbal:**
  - **L 2 - fleksi hip**
  - **L 3 - ekstensi lutut**
  - **L 4 - dorso fleksi kaki**
  - **L 5 - ibu jari**
  - **S 1 - plantar fleksi kaki**

Neurologis

- **Sensoris:**
  - **C 4 - bahu**
  - **C 6 - ibu jari tangan**
  - **C 7 - jari tengah**
  - **C 8 - jari kelingking**
  - **T 4 - *papilla mamae***
  - **T 6 - xiphoid**
  - **T 10 - *umbilikus***
- **Sensoris:**
  - **L 1 - inguinal**
  - **L 3 - atas lutut**
  - **L 4 - maleolus medialis**
  - **L 5 - ibu jari kaki**
  - **S 1 - maleolus lateralis**

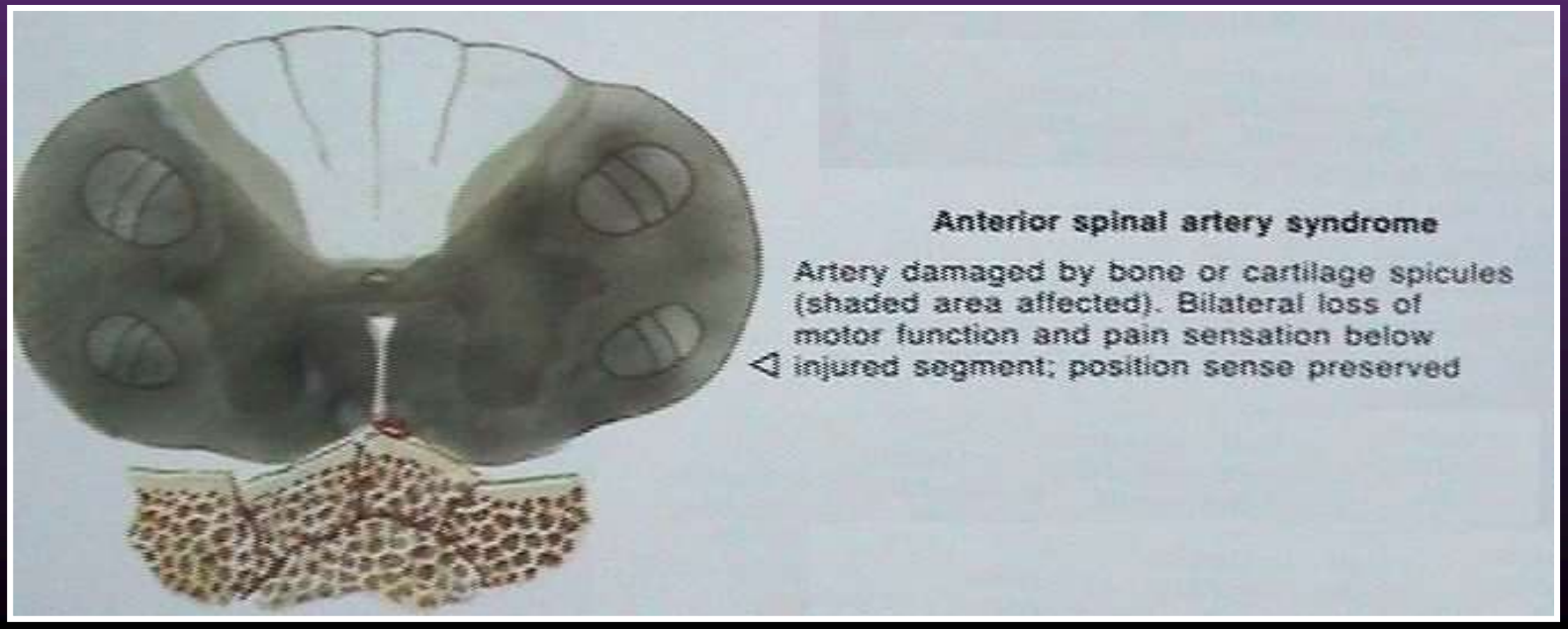
GAMBARAN KLINIS

SINDROM-SINDROM:

- **Anterior Cord**
- **Brown-Sequard**
- **Central Cord**
- **Cauda equina**

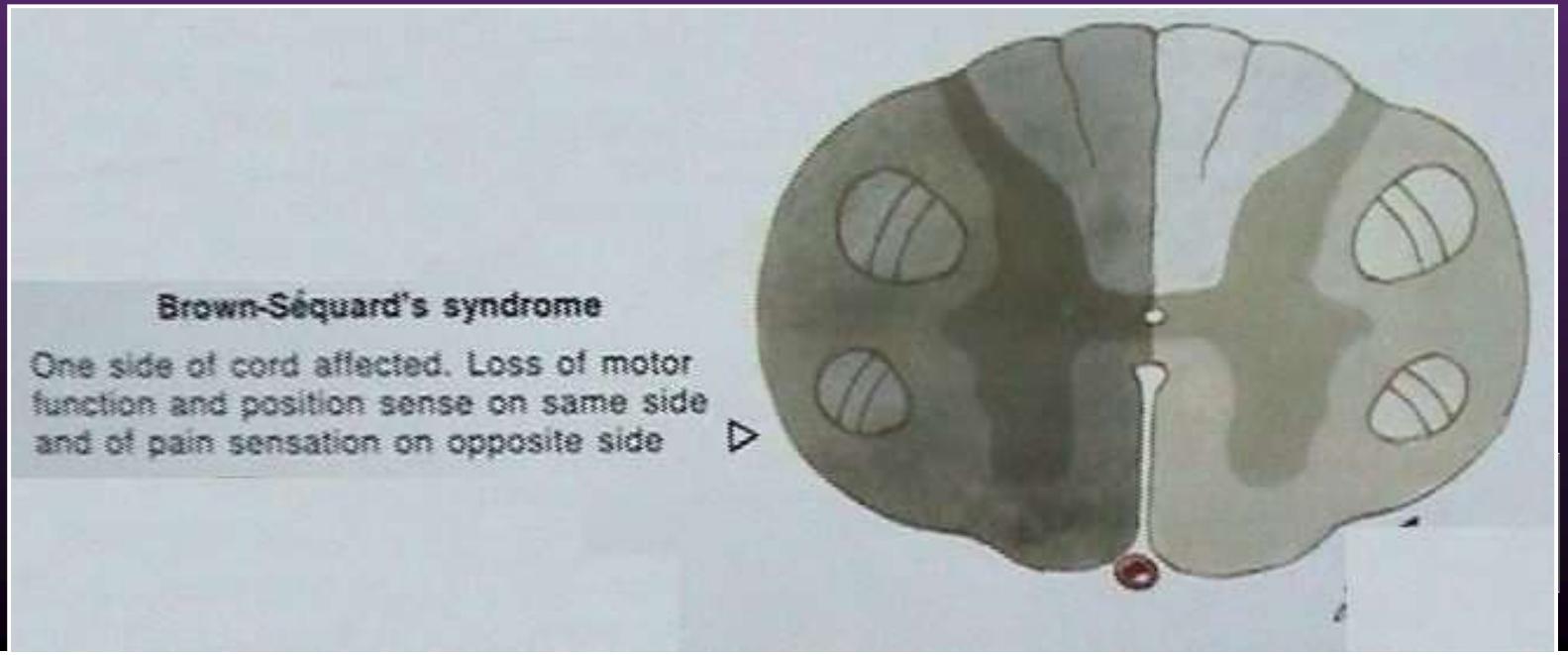
Sindrom Anterior Cord

- **Lesi di 2/3 anterior spinal cord (vascular)**
- **KELUMPUHAN BILATERAL KOMPLIT** (corticospinal tract)
- rasa nyeri hilang (level lesi kebawah)
- Rasa posisi normal



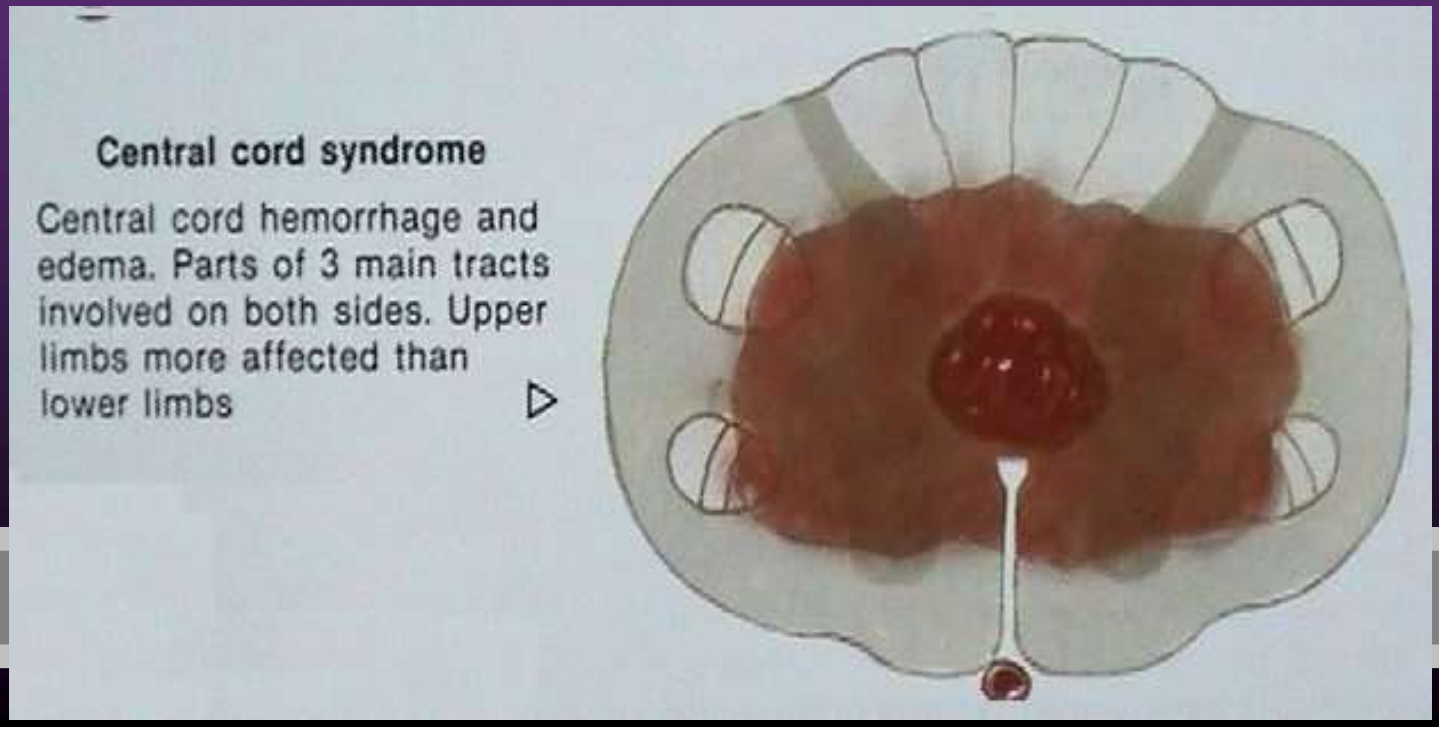
Brown-Sequard Syndrome

- **penyebab**: fraktur / dislokasi /trauma tembus
- **tanda:** Hemitranseksi (inkomplit)
  - **ipsilateral: motoric & rasa posisi**
  - **kontralateral: gg rasa nyeri dan suhu**



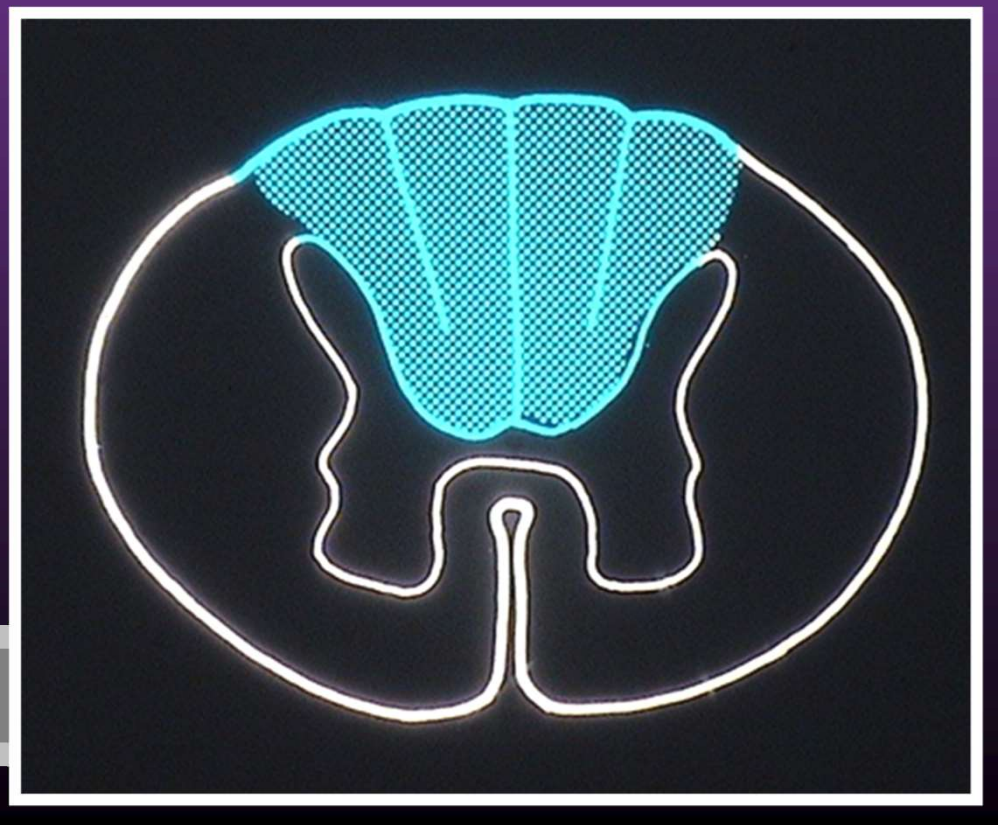
Sindrom Sentral Cord

- **Cidera Ekstensi pd umur tua**
- **Cidera sentral sp cord** : (motorik: tungkai lebih baik dari lengan)
- **Gangguan bladder and bowel**



Sindrom Posterior Cord

1. Rasa panas/terbakar
2. Parestesia
3. Motorik normal



Sindrom Cauda Equina

- Penyebab : Trauma, HNP Akut
- Prognosis cukup baik
- Cauda equina : L 1 – sacro coccygeus
- **Tanda:** - saddle back anaesthesia
  - retensi urin
  - tonus rektal lemah
  - kelumpuhan tungkai

Metil Prednisolon

- Syarat :8 jam pertama & tdk ada kontra indikasi
- Dosis : diencerkan dulu : 62,5 mg/ ml
- **Bolus: Vol (ml) = BB x 1,92** (dalam 15 menit)
- Istirahat 45 menit
- **Infus: Vol (ml) /jam= BB x 0,0864** (dlm 23 jam)

imaging

X-Ray:

- **V Cervikal:**
  - **LAT – C1 s/d T1**
  - **Bilaperlu : “Open Mouth, oblique, fleksi-ekstensi**
- **V Torakal / X Lumbal**
  - **LAT**
  - **Oblique**
  - **Fleksi-ekstensi**

CT

MRI

Prinsip manajemen

mengangkat, memiringkan, mengatur posisi atau merawat

Management Goal

- Neutral positioning of head and neck in in-line position
  - Maximizes cord space
  - Most stable position for spinal column
- Rigid collar
- Long board

Padding

- Maintains anatomical position
- Limits movement on board
- Fill all the voids
  - Pillows, blankets, towels

Tx : Cervical Spine Fracture

- **Immobilisasi**
- **Reduksi → traksi**
- **Surgery :** Dekompresi → Fusi → Stabilisasi
- **External support:**
  - philadelphia / hallo / cervico-thoracic
- **Rehab medik:**
  - segera → Pasif / aktif

Luka Tembak

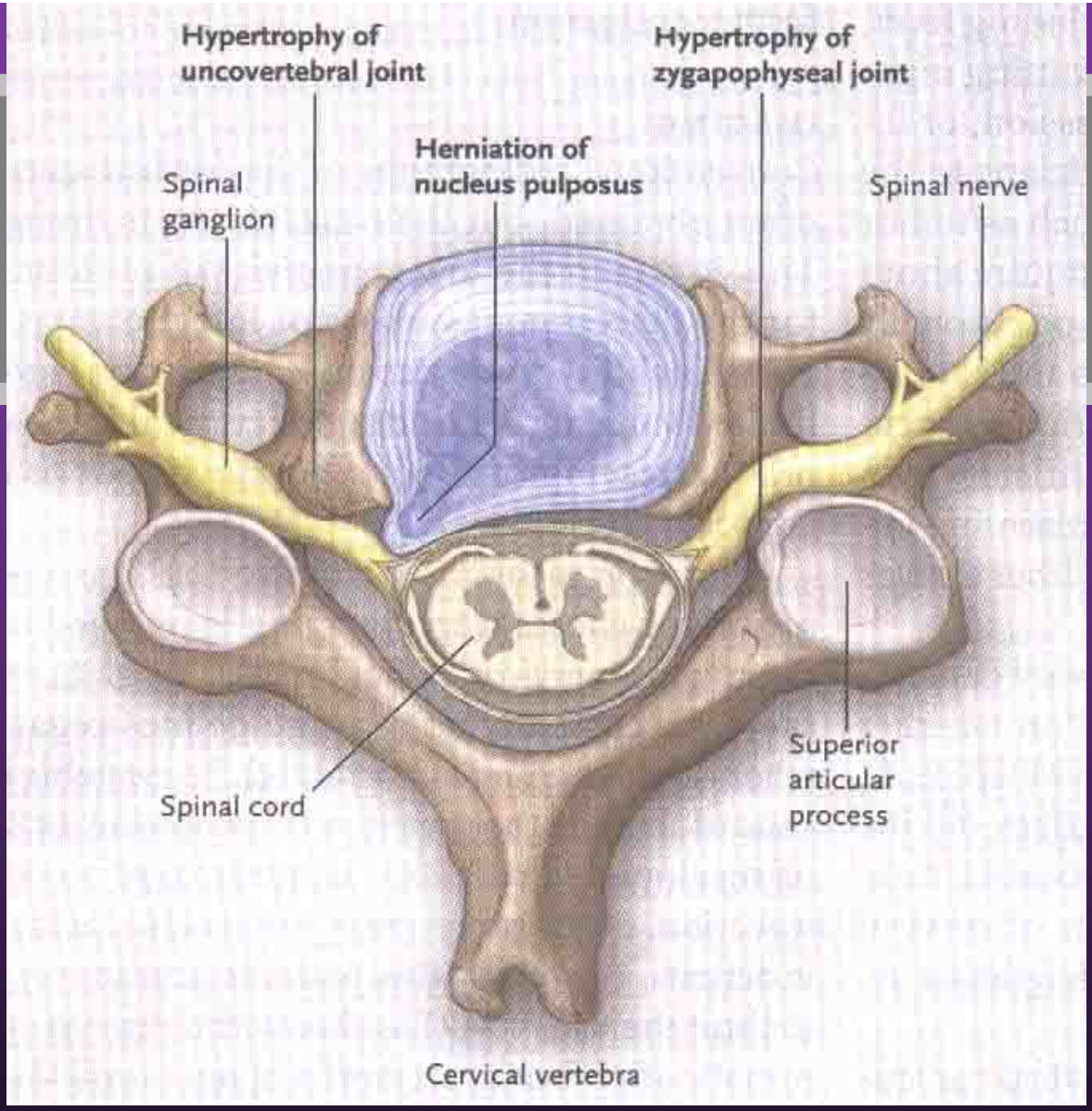
- Senapan angin (kotor) → *air rifle wound*
- Senapan Api (bersih) → *gun shot wound*

Penetrating injury …

- ✓ **Vaskular → tensi**
- ✓ **Nerve / cord → neurologis**
- ✓ **Bone → stabilitas**

Luka Tembak / penetrating

- Indikasi bedah :
  - **Kompresi**
  - **Progresif nerologis**
  - **Kebocoran LCS**
  - **Debridement**
  - **Vascular injury**



CAUSES OF CERVICAL RADICULOPATHY (Carette 2005)

Foraminal encroachment of the spinal nerve from degenerative changes in unco-vertebral, zygapophyseal joints & HNP

Glossary of Terms

- ✓ Agnosia – failure to recognize familiar objects even though the sensory mechanism is intact
- ✓ Agraphia – the inability to express thoughts in writing
- ✓ Alexia – the inability to read
- ✓ Amnesia – lack of memory about events occurring during a particular period of time
- ✓ Anosmia – loss of the sense of smell
- ✓ Anoxia – a condition in which there is an absence of oxygen supply to an organ's tissues although there is adequate blood flow to the tissue
- ✓ Aphasia – loss of the ability to express oneself and/or to understand language
- ✓ Arachnoid – middle layer of membranes covering the brain and spinal cord
- ✓ Ataxia – shaky and unsteady movements that result from the brain's failure to regulate the body's posture and the strength and direction of movements
- ✓ Axon – the nerve fiber that carries an impulse from the nerve cell to a target and also carries materials from the nerve terminals back to the nerve cell
- ✓ Brain Stem – the stem-like part of the brain that connects to the spinal cord
- ✓ Closed Head Injury – impact to the head from an outside force, without any skull fracture or displacement

Glossary of Terms

- ✓ Concussion – a disruption, usually temporary, of neurological function resulting from a head injury or violent shaking
- ✓ CSF – a clear fluid surrounding the brain and spinal cord
- ✓ Contusion – a bruise; an area in which blood that has leaked out of blood vessels is mixed with brain tissue
- ✓ Coup-Contrecoup Injury – contusions that are both at the site of the impact and on the complete opposite side of the brain
- ✓ Depressed skull fracture – a break in the bones of the head in which some bone is pushed inward, possibly pushing on or pressing into the brain
- ✓ Diplopia – a condition in which a single object appears as two objects; also called double vision
- ✓ Dura mater – the outermost, toughest and most fibrous of the three membranes (meninges) covering the brain and the spinal cord
- ✓ Dysarthria – speech that is characteristically slurred, slow and difficult to understand
- ✓ Edema – collection of fluid in the tissue causing swelling
- ✓ Epidural – located on or outside the dura mater, the outermost, toughest and most fibrous of the three membranes (meninges) covering the brain

Glossary of Terms

- ✓ Hemiplegia – paralysis of one side of the body as a result of injury to neurons carrying signals to muscles from the motor areas of the brain or spinal cord
- ✓ Hemiparesis – weakness, paralysis or loss of movement on one side of the body
- ✓ Hemianopsia – loss of part of one's visual field in one or both eyes
- ✓ Hydrocephalus – a condition in which excess CSF builds up within the ventricles (fluid-containing cavities) of the brain and may cause increased pressure within the head
- ✓ Hypoxia – a condition in which there is a decrease of oxygen to the tissue despite adequate blood flow to the tissue
- ✓ Intraparenchymal – inside the parenchyma of the brain
- ✓ Ischemia – a reduction of blood flow that is thought to be a major cause of secondary injury to the brain or spinal cord after trauma
- ✓ Locked-in Syndrome – a rare neurological condition in which a person cannot physically move any part of the body except the eyes
- ✓ Open head injury – trauma to the brain resulting in loss of consciousness due to the penetration of the brain by a foreign object, such as a bullet
- ✓ Subarachnoid hemorrhage – Blood in, or bleeding into, the space under the arachnoid membrane, most commonly from trauma or from rupture of an aneurysm

Glossary of Terms

- ✓ Subcortical – the region beneath the cerebral cortex
- ✓ Subdural – the area beneath the dura covering the brain and spinal cord
- ✓ Vasospasm – spasm of blood vessels which decreases their diameter
- ✓ Ventricles (brain) – four natural cavities in the brain which are filled with CSF

Terima kasih