17 Trauma

MECHANISM

Criteria for Trauma Activation/High risk features

Physiology	***Mechanism***
50 < HR > 100	> 60kph
SBP < 110	Fall > 3m
10 < RR > 26	Explosion
↓ GCS	Prolonged extrication
Amputation	Pedestrian v motor vehicle
Focal neurology	Ejection
Deep open wound	
I&V	
Pregnant	
Multi-casualties	

Trauma Scores

Revised Trauma Score

- Components: GCS + RR + SBP
- 0-4pt for each component
- Smaller numbers worse

Paediatric Trauma Score

- Cat: size, airway, SBP, GCS, Wound, #
- Graded either +2, +1 or -1
- ≤ 8 = bad

Abbreviated Injury Scale

- Type, location, severity (1-6 worst)
- Main aim is threat to life

Injury Severity Score

- Assess trauma severity

- Calculate AIS for each of 6 ISS regions

-Square the top 3 & add = ISS

SPECIAL SCENARIOS

Pregnancy

Complications

Foetal	*Mother*
- Foetal distress	- Foeto-maternal haem
- Direct foetal injury	- Amniotic fluid embolus
Uterus	*Labour*
- Uterine rupture	- PPROM
- Placental abruption (*CTG most sensitive*)	- Prem labour
- Placental or cord lac	

Indications for Peri/Post-Mortem LUCS

- ***> 24/40***
- Maternal demise/death witnessed in ED
- No evidence of foetal demise (FHR)

Crush

Complications

- Compartment	- Fluid loss
- Rhabdomyolysis	- Skin ulcers

Blast Injury

Types

- 1y: blast wave = air filled structures
- 2ry: flying things hitting patient
- 3ry: flying patients hitting things
- 4ry: burns, asphyxia, exposure to toxins
- Solid blast: direct contact of flying object initially
- Contained vs open

DAMAGE CONTROL RESUSCITATION

Triad of:

1 Permissive hypotension or min vol normotensive resus
2 Haemostatic resuscitation
3 Damage control surgery

Permissive hypotension

- In theory stop *'popping the clot'*
- Aim ***SBP 80mmHg or end-organ perfusion***
- Not applicable to head injury
- No superior evidence for use
- Better would be to use ***"minimal volume, normotensive resuscitation, aiming for MAP 65"***

Haemostatic resuscitation

- Access: IO, IV, RIC, CVL, REBOA/ECMO
- ***TXA*** 1g stat, 1g over 8 hrs
- Minimal crystalloids
- MTP

Catastrophic bleeding control

- Tourniquet	- Topical haemostatics
- Reduce # & splint	- Thoracotomy
- Pelvic binder	- Minimise handling
- Repair lacs	- OT/Angio

Special Circulation Considerations

- ***Head Injury*** Aim Plt > 100, SBP 110 (not 80)
- ***Obstetrics*** DIC usually present = ***cryoprecipitate***

Massive Transfusion Protocol

system to ensure transfusion with minimal trauma induced coagulopathy

- Indication: Adult: likely to need ½ vol 4h or all v in 24h
  Paed: likely to need > 40ml/kg vol
- Dose: 1:1:1 PRBC:Plt:FFP

Goals of MTP

T	> 35	Fibrinogen	>1
pH	> 7.2	iCa	> 1.1
BE	> -6	INR	≤ 1.5
Lactate	< 4	APTT/PT	< 1.5x norm
		Plt	> 50 (> 100 HI)

Traumatic Arrest

1. IV access, ***MTP, TXA***
2. Look for external bleeding
3. Airway & Bilateral ***finger thoracostamies***
4. Look for internal bleeding incl tamponade: ***FAST***
5. ***Resus thoracotomy*** (internal defib 10-15J)

Thoracotomy

- Types: clamshell vs left lateral approach
- Indications: 1. Arrest with SOL prior
  2. Peri-arrest despite all other measures
  3. Tamponade physiology
- Procedures: - decompress tamponade
  - internal defib
  - interna cardiac massage
  - hilar twist
  - aortic compression
  - suture ventricular wound

HEAD

Prevention 2ry Brain Injury

HEADS UP

Hypoxia, **h**ypocarbia	- RSI - pCO_2 35-40
Environment	- Normothermia
Anticonvulsant,	- ***Phenytoin*** 20mg/kg
Anticoag/antiplt	- ***Plt*** & reverse coagulopathy
Diabetic Control	- BSL 4-9mmol/L
Sedation	- ***Morphine & Midazolam*** ± ***Roc***
Up	- ***Head up 30***
Pressure	- Map 85 - High: I&V, sedate, paralyse, ***GTN*** - Low: fluids, ***norad, adr*** - ***3%NS*** 3ml/kg over 10min, or ***mannitol*** 1g/kg

Mannitol vs 3%Saline

- M has more fluid & osm per g = overload
- Rebound cerebral oedema

Discharge Criteria

- Home with carer 1st 24hrs, avoid ***aspirin***, alcohol

Concussion advice

24hrs for each activity, back 1 step if sx

1. No activity	4. Practice: non-contact
2. Aerobic: light	5. Practice: full contact
3. Aerobic: sport-specific	6. Return to play

Imaging CDRs Adults

- Canadian:	Sens 99% ***spec 40%*** LR 0.04
- New Orleans:	Sens 99% spec 13% LR 0.08

Canadian

*Must be **minor head injury** ie LOC, definite amnesia or witnessed disorientation, GCS13-15*

Scan if any of (***ME BAGS***)

- **M**echanism; high risk	- **B**OS # signs
- **E**mesis ≥ 2	- **A**ge > 65
	- **G**CS < 15 @ 2hrs
	- **S**kull # open or depressed

Imaging CDRs Kids

PECARN, CATCH, CHALICE, NEXUS II

Overview

- All have high sens (eg PECARN 96%) but low sens
- PECARN only ***prospectively*** validated
- PECARN is ***rule out*** (who not to scan), others rule in
- CHALICE has lowers CT rate (14%)

PECARN

- 2 rules depending on age
- Risk of clinically important TBI (ciTBI)
  < 2yo <0.05% ciTBI
  > 2yo <0.02% ciTBI

< 2 (non-verbal)	***> 2 (verbal)***
- normal mentation	- normal mentation
- no scalp haematoma[1]	- no LOC
- LOC < 5s	- no vomiting
- Non-severe mech[2]	- non-severe mech[2]
- No palpable skull #	- no evidence BOS#
- Normal behaviour	- no severe headache

[1]*Frontal ok*

[2]*Severe = MVA ejected, death, rollover; ped v or cyclist without helmet struck by motorised vehicle; fall > 1.5m, > 0.9m for >2 vs < 2yo; head strike by high impact object*

CHALICE

If none present = low risk

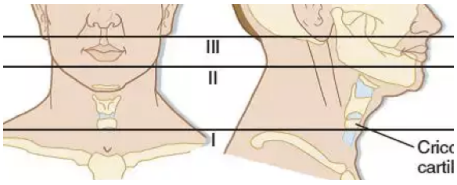
Hx… - LOC > 5min	- Abnormal drowsiness
- Amnesia > 5min	- ?NAI
- 3 vomits	- Seizures with hx
Ex… - ***Tense fontanelle***	- GCS < 14 (< 15 < 1yo)
-Focal neurology	- ***Penetrating/depressed skull #***
- BOS#	- ***Bruise/swell/lac > 5cm (< 1yo)***
Mech…	- High speed ie > 40kph
	- Fall > 3m
	- Projectile at high speed

Common Factors in PECARN & CHALICE

- No BOS#	- LOC < 5s
- No Skull#	- Normal mentation
- No scalp haematoma	- Non-severe mechanism
- No Vomiting	- GCS <14 = always scan

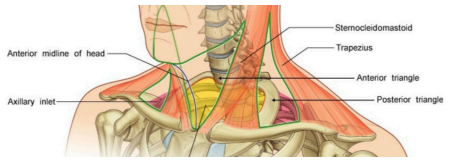
NECK

Landmarks



Zone	**I**	**II**	**III**
Landmark	clavicle →cricoid	cricoid→ mandible	mandible → BOS
Content	Ao arch Carotids Vertebrals SC A&V Lung apices Oesph Trachea Brach plexus Thoracic Duct	Carotids Jugulars Larynx Hypopharynx Oesoph	Int/Ext Carotids Vertebrals Jugulars Facial n trunk
Access	Difficult	Easiest	Difficult

Triangles of the Neck



- Ant: common carotid, IJV, CN X-XII
- Post: subclavians, CN XI, cervical plexus

Penetrating Neck Injury

Hard Signs

Wound	*Systemic*	*Airway*
- Bubbling	- Stroke	- Haemoptysis
- Bleeding	- Shock	- Obstructed
- Exp haematoma		

Soft Signs

Blood	*Airway*
- Haem-optysis/atemesis	- Dysp-noea/honia/hagia
- Oropharyngeal blood	- SC/mediastinal emphysema
- Non-expanding haematoma	- Chest tube leak

Hanging

A. True Hanging (Judicial)

- Complications: ***C1/2 dislocation***

Management

- ABC (A most difficult)	- OT reduction/stabilisation
- ***Neurogenic shock*** likely	

B. False Hanging

Complications

- venous congestion	- carotid stimulation
- arterial occlusion	- tracheal compression

Management

- assess complications	- Vascular injury
- Airway injury	- Boney injury

CHEST

Rib

Admission Criteria
- ≥ 3#
- Resp co morbidities
- Complications eg PTX
- Analgesia req
- Social issues

Mx
- Oral, IV
- Non-pharm: physio
- IC block
- Epidural
- Surgical fixation

Haemothorax
- small < 350ml; mod = 350-1.5L; large > 1.5L
- Needs ***OT*** if: ***1. > 200ml/hr for 3hrs***
  2. > 1.5L over 3hrs
  3. Unstable

Flail: High risk deterioration
- > 65yo
- ***≥ 8 ribs***
- ***Underlying lung disease***

ABDO

Diagnostic Peritoneal Lavage

Positive Criteria
- RBC > 100K
- WCC > 5K
- +ve gram stain
- +ve faeces, vegetable fibres, bile, ALP, amylase

Splenic

- ***most common***
- all need ***HiB & S. Pneumoniae vaccination***

Grade & Mx

Gr	Anatomy	Mx
I	SC <10% surface or 1cm	Conservative
II	SC 10-50% or 1-3cm (no hilum)	
III	SC > 50%, haem >5cm, lac >3cm	
IV	lac vessels > 25% devasc	Surgery
V	100% devascularised	

SC Sub capsular

Liver

- ***most common penetrating***

Grade & Mx

Gr	Anatomy	Mx
I	SC < 10%, 1cm deep	Conservative
II	SC 10-15%, 1-3cm deep, < 10cm	
III	SC > 50% lac, > 3cm deep	Surgery
IV	> 50% destruction of lobe	
V	IV+ ≥ 2 lobes	
VI	avulsion	

SC Sub capsular

Abdo Compartment Syndrome

- Measured from bladder or NGT
- Sig > 25 mmHg

Renal

- Suggested by ***macroscopic*** haematuria, loin pain
- Microscopic haematuria is ok (rpt 1wk)

Grade & Mx

Gr	Anatomy	Mx
I	Small SC	Conservative
II	Haem confined to retro, lac < 1cm	
III	Lac 1cm, no extravasation	Surgery
IV	Parenchymal lac	
V	Artery or vein lac	

PELVIS

Bladder

- 70% ass with pelvic #
- ***Dome*** most commonly involved
- Mx intraperitoneal = surgical repair
  extraperitoneal = IDC 10 days

NB surgical repair in extra if: IDC not draining, ass rectal/vaginal injury, bladder neck, open fixation of pelvis

Urethral Injury

- High riding boggy prostate
- Blood at urethral meatus
- Perianal/Periscrotal haematoma

SPINAL CORD

Neurogenic Shock

- Higher lesion = greater effect
- ↓ Sympathetic activity
- Tx = ***atropine*** & ***noradrenaline***

Features
- ↓HR
- ↓BP
- **P**aralysis (flaccid)
- **P**aralytic ileus
- **P**oikilothermia
- **P**riapism

Spinal Shock

neuronal dysfunction with good prognosis

Phases

0-1d	hyporeflexia	1-4w	hypereflexia
1-3d	normoreflexia	1-12m	spasticity

Cord Syndromes

CEntral cord syndrome
- ***E***lderly ***hyperExtending*** = buckle & central haematoma
- Incomplete weakness
  Can't rude finger goes 1st
  - Distal > proximal
  - UL > LL
  - Motor > sensory
  - Bladder dysfunction early

Anterior cord syndrome
- ***A***xial load eg ***diving*** or ***hyper-flexing*** eg sudden stop
- Poor prognosis
- ***Intact dorsal column*** (***prop/vib***), all else gone
- Associated ***flexion tear drop #***

Brown-Sequard Lesion
- Penetrating injury
- normal sphincter tone
- ipsilateral — paralysis, dorsal column loss
- contralateral — spinothalamic loss (pain, temp, LT)

Autonomic Dysreflexia

- Due to lesion ***≤ T6***
- Painful stimulus → inappropriate sympth response
  - ↑ BP
  - Reflexive ↓ HR
  - Headache
  - Flushing
  - Diaphoresis
- Common causes: constipation, ***urinary retention***

C-SPINE

Cervical Spine Immobilisation

Not recommended

Methods
- Hard collar
- Sand bags
- Vac Pac
- Soft collar
- Strapping
- In-line
- Foam head block
- Philadelphia, aspen

Complications
- Masks trauma
- Poor vision or access
- Difficult intubation
- Aspiration
- ↑ ICP
- Uncomfortable
- Pressure sores
- Abnormal kyphosis = neuro worse

Clinical Decision Rules

NEXUS

NSAID

Can be used in paeds

- **N**euro deficit
- **S**pinal tenderness midline
- **A**LOC
- **I**ntoxicated
- **D**istracting injury

Canadian

MAP-SSAPP

GCS15 & ***> 16yo***

High risk features
- ***M***echanism
- ***A***ge > 65
- ***P***araesthesia limb

Low risk features
- ***S***itting in ED
- ***S***imple rear-end
- ***A***mbulant any time
- ***P***ain – delayed onset
- ***P***ain – absent midline

Mechanism: > 100 kph, fall ≥ 3ft, 5 stairs, axial load, roll over, ejection, motorised recreational vehicle, bicycle

LIMBS

Digital Amputation

- Most common amputation
- Best results ***prox to PIPJ;*** Terminalisation if through DIPJ

Care of Amputated part
- Cool to 4C (not freeze)
- Wrap in saline gauze
- Place in water tight bag

Viability
- best ***< 6hrs implantation***
- muscle < 12hr cold ischaemia
- bone, tendon, skin < 24hr cold ischaemia time

Finger Tip
- < 1cm = conservative
- > 1cm = graft at some stage

Compartment Syndrome

- Normal	= 0-8mmHg
- Capillary compromise	= 20-30 mmHg
- No flow	> 35mmHg

Common Compartments

- Ant lower leg	(pain on dorsiflexion)
- Post lower leg	(pain on plantar flexion)
- Lateral lower leg	(pain on eversion)
- Forearm ext/flexor	
- Hand intrinsic muscles	

Management
- Prevent
- Support: analgesia, elevate, splint, Tx rhabdo
- Fasciotomy
  - Vascular compromise
  - Neurological dysfunction
  - ***Pressure > 30mmHg***
  - ***Bad Rhabdo***

KIDS

- neurotrauma #1 COD
- most solid organ injuries non-operative (except pancreas)
- c-spine # higher (bigger head)

Kids v Adults Abdo

- ↓ size = more organs/area
- Thin abdo wall
- Ribs more compliant
- Liver & spleen proportionally bigger)
- Diaphragm falter (exposes liver/spleen down)
- Bladder in babies is intra-abdominal
- Kids safety gear usually ill fitting