

Emergency stabilisation of the trauma patient

Dr Rebekah Donaldson

BVSc(hons) MVetMed MANZCVS DACVECC MRCVS

Registered Specialist - Small Animal Emergency and Critical Care

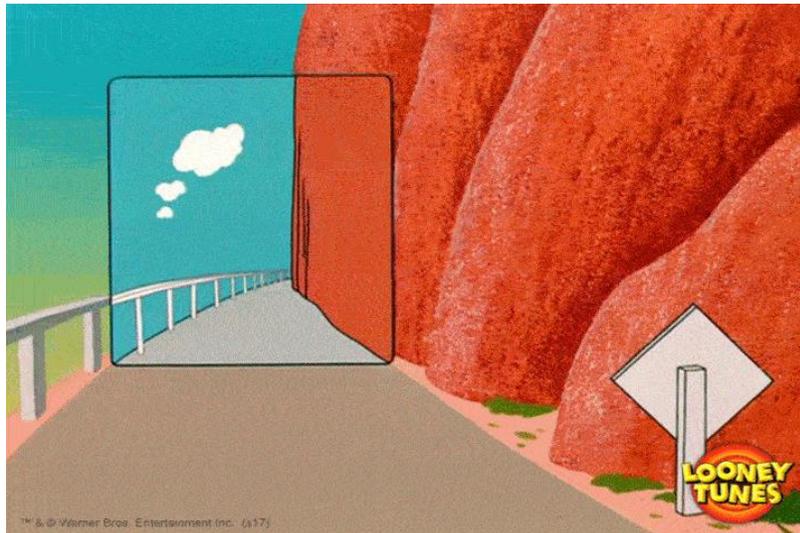
QVS

QUEENSLAND VETERINARY SPECIALISTS

Trauma

- Injury sustained by an external force
- Polytrauma = >1 body system affected
- Mechanism of trauma:

Blunt



Penetrating

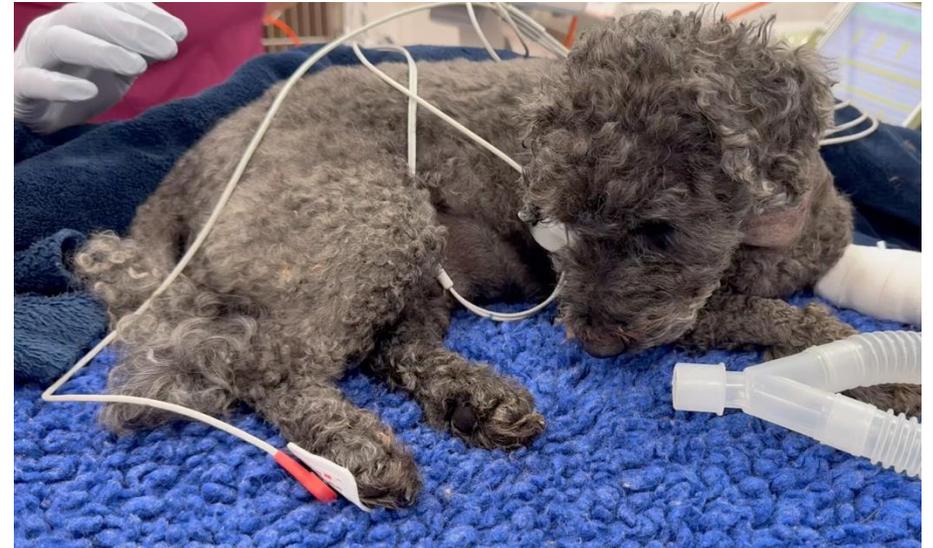
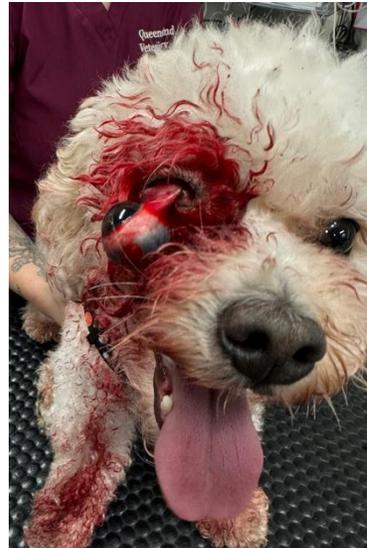


Both

Initial Assessment

- Management challenges:
 - Rapid intervention required
 - Presentations varied, dramatic and confronting
 - Numerous injuries

How do we know where to start?



Initial Assessment

Triage

- Trier = 'to sort'
- Prioritisation of patient care based on:
 - illness and injury,
 - severity of disease,
 - prognosis and
 - available resources
- Treat the most life threatening problem first



Initial Database

1. Major Body Systems Assessment (MBSA)

- Cardiovascular (Perfusion)
- Respiratory
- Neurological

2. Packed Cell Volume/Total Solids (PCV/TS)

3. Venous Blood Gas, Metabolite, Electrolyte Analysis

4. Point of Care Ultrasound (POCUS)

5. Accession Scoring

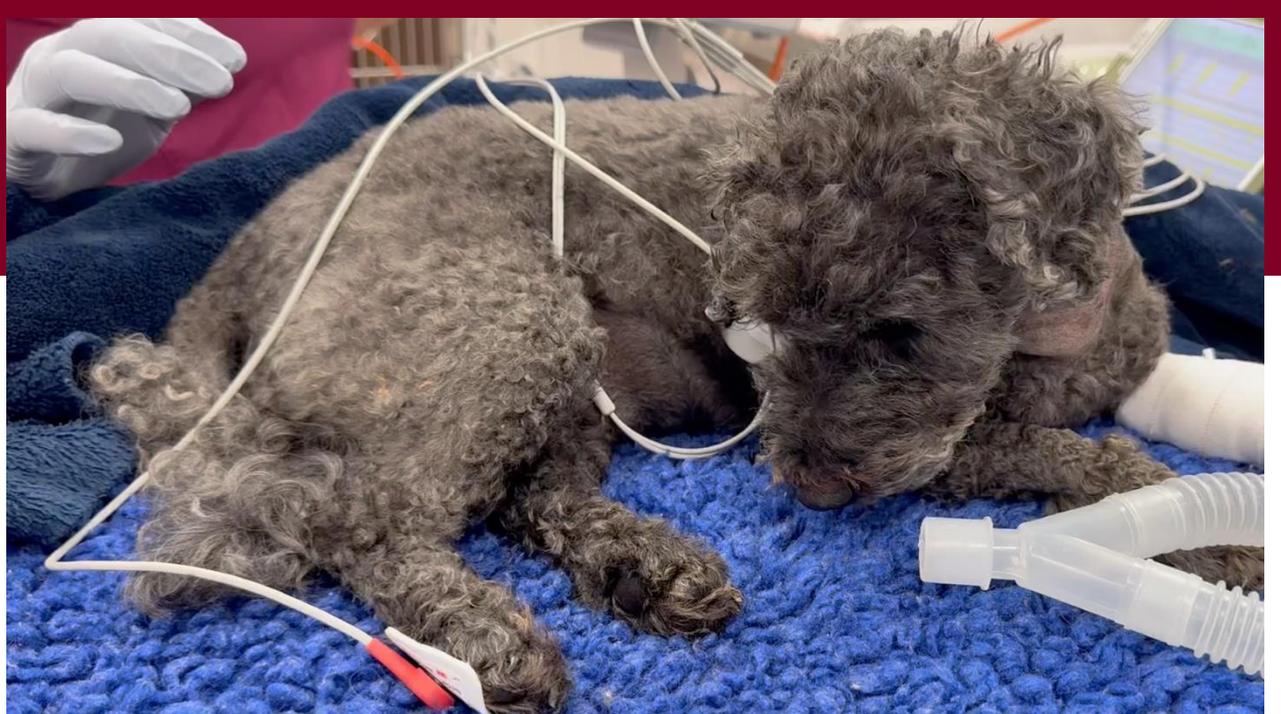
- Animal Trauma Triage Score (ATTS)
- Modified Glasgow Coma Scale (MGCS)



Initial Database: MBSA

Neurological

- Mentation
 - Consciousness
- Cranial Nerve assessment
- Ambulation status
 - Positioning
 - Don't assess ability to walk just yet..
- Pain



Initial Database: MBSA

Respiratory

- Presence of breathing
- Airway patency
- Character of breathing
 - Dyspnoea
 - Cyanosis
 - Paradoxical movements



Initial Database: MBSA

In any patient that is **apnoeic** and **unresponsive**:



START CPR

Initial Database: MBSA

Cardiovascular

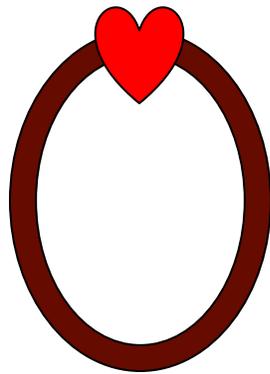
- Perfusion parameters:
 1. Mentation
 2. Mucous membrane colour
 3. Heart Rate
 4. Capillary Refill Time
 5. Peripheral pulse quality
 6. Peripheral temperature



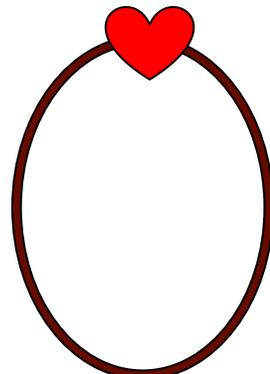
Initial Database: MBSA

Shock

- Inadequate cellular energy production
- Oxygen consumption (VO_2) exceeds delivery (DO_2)



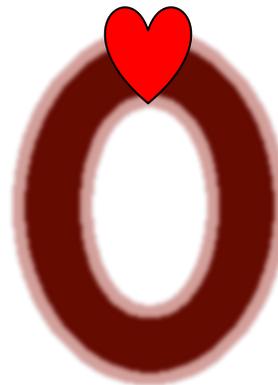
Normal



Hypovolaemic shock

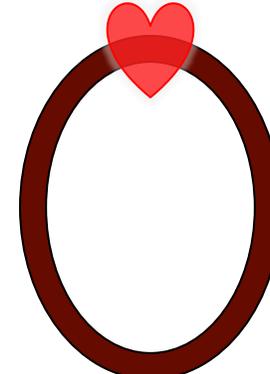
Volume failure

Haemorrhage



Distributive shock

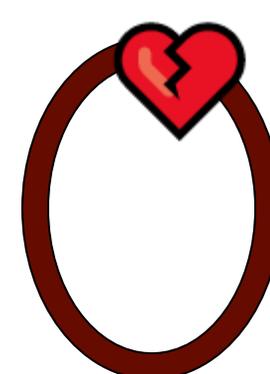
Circuit failure



Obstructive shock

Pump obstruction

Pneumothorax



Cardiogenic shock

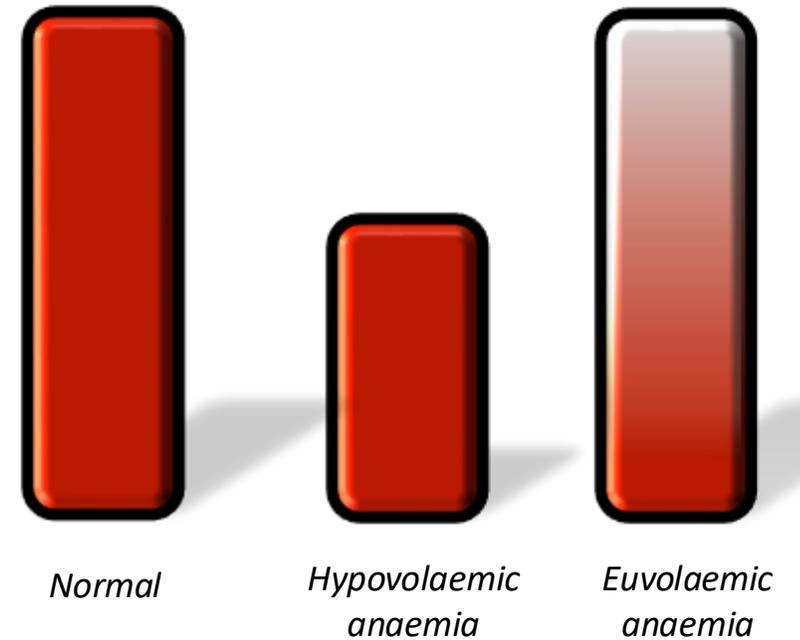
Pump failure

Adapted T DeFrancesco 2018

Initial Database: PCV/TS

- A PCV without its TS is useless!

		Total Solids
Haemorrhage	Hypovolaemic	Decreased
Haemolysis	Euvolaemic	Normal
Decreased production		



Initial Database: Venous Blood Gas Analysis

Acidaemia

- Lethal triad: Acidosis, hypothermia, coagulopathy

Dysglycaemias

- Correct hypoglycaemia

RADIOMETER ABL90 SERIES
ABL90 OLD Vet Specialists - Stafford I393-092R
PATIENT REPORT Capillary - C 65uL 11:33 AM 15/08/2024
Sample # 16832

Identifications
Sex Male
Accession No.
Patient last name JRT
Patient first name
Sample type Venous

Blood gas values
↓ pH 6.970 [7.380 - 7.440]
↑ pCO₂ 53.0 mmHg [40.0 - 50.0]
pO₂ 29.4 mmHg [20.0 - 60.0]

Oximetry values
↓ ctHb 10.7 g/dL [12.0 - 18.0]
↓ sO₂ 27.2 % [90.0 - 100.0]
FO₂Hb 26.3 % [0.0 - 100.0]
FCOHb 2.4 % [0.0 - 20.0]
FHHb 70.5 % [0.0 - 100.0]
FMetHb 0.8 % [0.0 - 20.0]

Electrolyte values
cK⁺ 4.2 mmol/L [4.0 - 5.6]
cNa⁺ 151 mmol/L [141 - 156]
cCa²⁺ 1.31 mmol/L [0.98 - 1.45]
cCl⁻ 117 mmol/L [110 - 120]

Metabolite values
cGlu 15.7 mmol/L [- -]
cLac 18 mmol/L [0.0 - 2.0]
↓ ctBil -17 μmol/L [0 - 15]
cCrea 99 μmol/L [- -]
cUrea 6.7 mmol/L [- -]

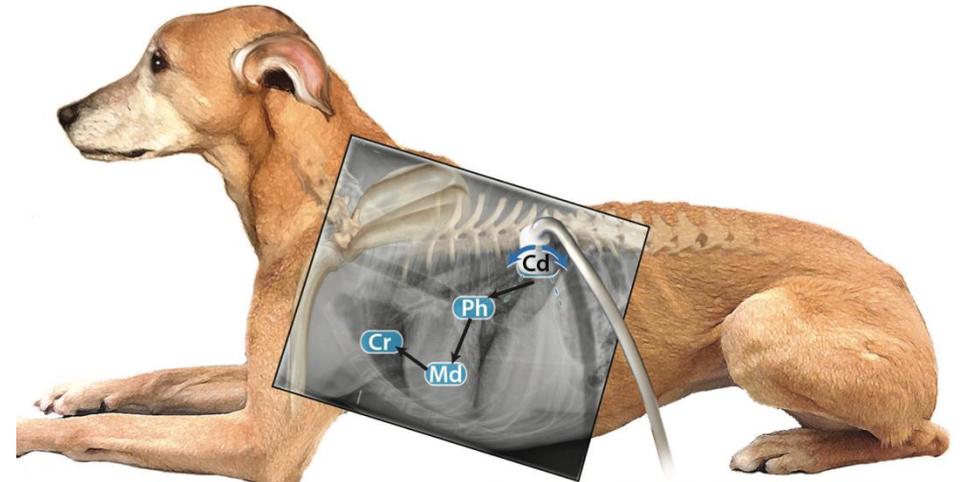
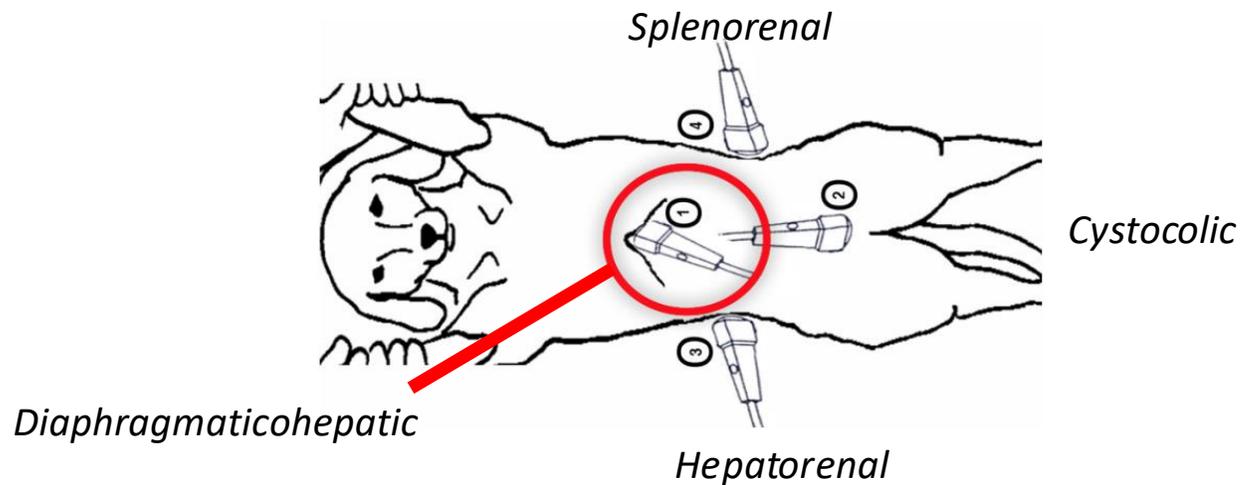
Oxygen status
ctO_{2c} 4.0 Vol%
p50c 42.98 mmHg

Acid-base status
cBase(Ecf)c -19.6 mmol/L
cHCO₃⁻(P)c 12.2 mmol/L

Notes

Initial Database: POCUS

- Abdomen AND Thorax



- 33% emergency presentations (and 75% unstable patients) have a cavitory effusion (McMurray 2016)

Initial Database: POCUS

- Abdominal Fluid Score (AFS)
 - **Abdominal Fluid Score = (number sites where fluid detected)/4**
- Dogs:
 - higher AFS have lower PCV/TS, and pulse oximetry
 - higher initial heart rate, ALT, lactate
 - positive AFS: more likely to require blood transfusions
- Cats:
 - Positive AFS had lower TS but similar PCVs
 - Positive AFS more likely to require blood transfusions
 - Positive AFS have higher ATTS and mortality



Initial Database: POCUS



Pleural effusion

- Haemothorax



Pulmonary B lines

- Suggests pulmonary contusions



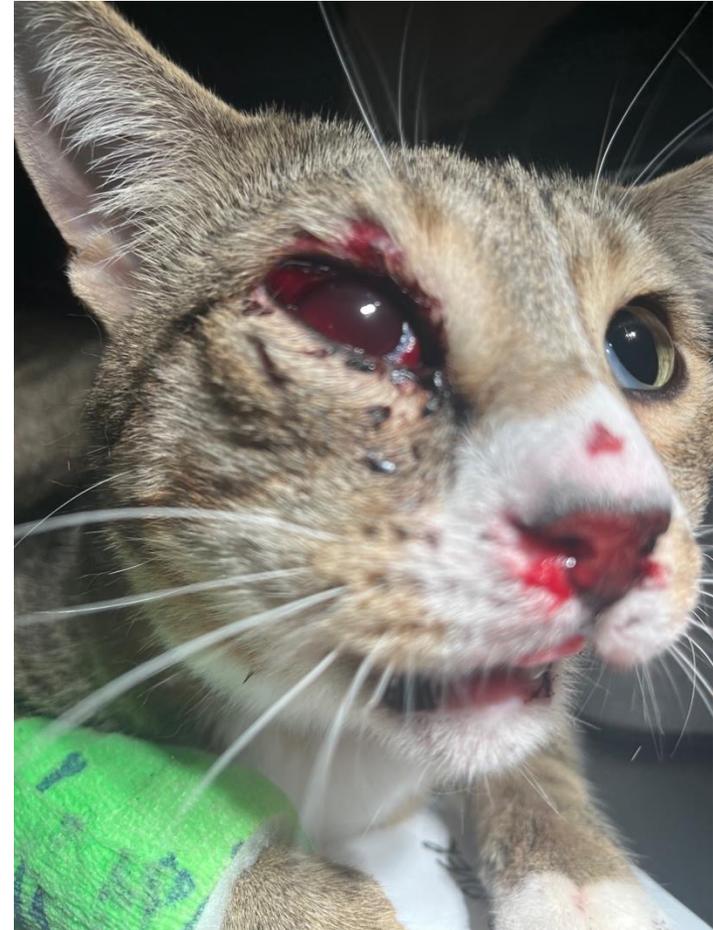
Glide sign

- Excludes pneumothorax

Initial Assessment: Accession Scoring

Validated scoring systems in dogs and cats:

- Animal Trauma Triage (ATT) Score
- Modified Glasgow Coma Score (MGCS)



Accession Scoring: ATT

- Predictive of mortality in dogs and cats
- Dogs:
 - Each 1 point increase ATT score - 2.07 x increased mortality odds (Ash 2018)
- Cats
 - Feline bite wounds (Tinsley 2023):
 - Each point increase ATT score – 1.78 x increased mortality odds
 - $ATT \geq 5$ – significantly decreased survival
 - High rise syndrome (Girol-Piner 2022):
 - ATT cut-off 6.0 - 75% sensitivity, 90% specificity for non-survival
 - ATT cut-off 10 - 25% sensitivity, 100% specificity for non-survival.

Accession Scoring: ATT

Assessment Parameter	Score
Perfusion	
MM pink/moist CRT 2sec T \geq 37.8C, strong/bounding femoral pulses	0
MM hyperaemic OR pale pink, MM tacky, T \geq 37.8C CRT 0-2sec, fair femoral pulses	1
MM very pale pink and tacky, CRT 2-3sec, T <37.8C, poor femoral pulses	2
MM gray/blue/white, CRT >3sec, T <37.8C, non-palpable femoral pulses	3
Cardiac	
HR canine: 60-140 bpm feline: 120-200bpm, normal sinus rhythm	0
HR canine: 140- 180bpm feline: 200- 260bpm, NSR or VPC <20/min	1
HR canine: >180bpm feline: >260bpm, consistent arrhythmia	2
HR canine: <60bpm feline: \leq 120bpm, erratic arrhythmia	3
Respiratory	
Regular respiratory rate with no stridor, no abdominal component to resp	0
Mild increase respiratory rate and effort, +/- abdominal component, mild upper airway sounds	1
Moderate increase respiratory rate and effort, some abdominal component, elbow abduction, moderate increase upper airway	2
Marked respiratory effort OR gasping/agonal resp, little/no air passage	3
Eye/Muscle/Integument	
Abrasion/laceration: none or partial thickness. Eye: no fluorescein uptake	0
Abrasion/laceration: full thickness. No deep tissue involved. Eye: Corneal laceration, not perforated.	1
Abrasion/laceration: full thickness, deep tissue involved, art/nerve/muscle intact. Eye: corneal perforation, punctured globe or proptosis.	2
Penetration of abdomen/thorax. Abrasion/laceration full thickness, deep tissue invol, artery/nerve/muscle compromised	3

Accession Scoring: ATT

Assessment Parameter	Score
Skeletal	
Weight bearing 3 or 4 limbs. No palpable fracture/joint laxity	0
Closed limb fracture/rib fracture or any mandibular fracture. Single joint laxity/luxation (including SI). Pelvic fracture with unilateral intact SI-ilium-acetabulum. Single limb open/closed fracture at or below carpus/tarsus	1
Multiple grade 1 conditions, single long bone open fx above carpus/tarsus with cortical bone preserved. Non-mandibular skull fracture	2
Vertebral body fracture/luxation except coccygeal, multiple long bone open fracture above tarsus/carpus, single long bone open fracture above tarsus/carpus with loss of cortical bone.	3
Neurologic	
Central: consciousness: alert to slightly dull, interest in surroundings Peripheral: normal spinal reflexes; purposeful movement and nociception in all limbs.	0
Central: Dull/depressed/withdrawn Peripheral: abnormal spinal reflexes with purposeful movement and nociception intact in all 4 limbs	1
Central: Unconscious, responds to noxious stimuli Peripheral: Absent purposeful movement with intact nociception in 2 or more limbs or nociception absent in 1 limb, decreased anal or tail tone.	2
Central: nonresponsive to all stimuli, refractory seizures. Peripheral: absent nociception in 2 or more limbs, absent tail or perianal nociception.	3
Total Score	
Perfusion + cardiac + respiratory + eye/muscle/integ + skeletal + neurologic	/18

Accession Scoring: MGCS

- Positively correlated with survival
- Head trauma:
 - ATT predicts mortality better (Ash 2018)

Assessment Parameter	Score
Motor Activity	
Normal gait, normal spinal reflexes	6
Hemiparesis, tetraparesis, or decerebrate activity	5
Recumbent, intermittent extensor rigidity	4
Recumbent, constant extensor rigidity	3
Recumbent, constant extensor rigidity with opisthotonos	2
Recumbent, hypotonia of muscles, depressed or absent spinal reflexes	1
Brainstem Reflexes	
Normal pupillary light reflexes and oculocephalic reflexes	6
Slow pupillary light reflexes and normal to reduced oculocephalic reflexes	5
Bilateral, unresponsive miosis with normal to reduced oculocephalic reflexes	4
Pinpoint pupils with reduced to absent oculocephalic reflexes	3
Unilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes	2
Bilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes	1
Level of Consciousness	
Occasional periods of alertness and responsiveness to environment	6
Depression or delirium, capable of responding but response may be inappropriate	5
Semicomatose, responsive to visual stimuli	4
Semicomatose, responsive to auditory stimuli	3
Semicomatose, responsive only to repeated noxious stimuli	2
Comatose, unresponsive to repeated noxious stimuli	1
Total Score	
Motor activity score + brainstem reflex score + level of consciousness score	/18

Prognosis: 3-8 = grave; 9-14 = guarded; 15-18 = good/reasonable

Accession Scoring: MGCS

Traumatic Brain Injury (TBI)

- Neurological progress is the most valuable diagnostic
- Serial MGCS
 - decreasing scores associated with worse survival
- Extremely affected patients can have great treatment response and complete functional recovery



Case study 1:

Tilly 4.5y FS Cavoodle

- Vehicular polytrauma
- Hit by car after escaping house.
- Not conscious or walking, presented to local vet. Seizure on presentation. Emergently intubated.



Case study 1:

1. Major Body Systems Assessment (MBSA)

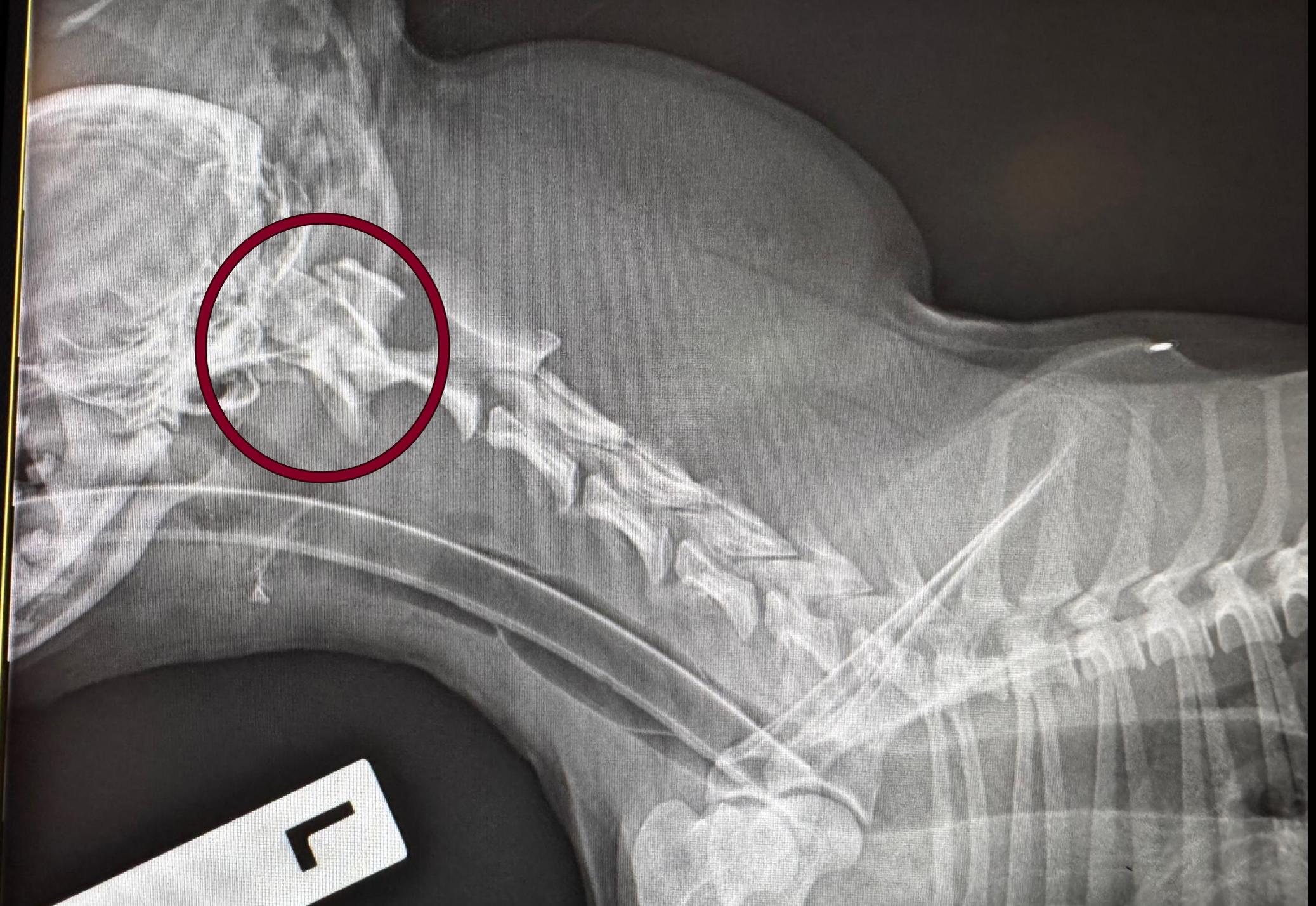
- Cardiovascular (Perfusion):
 - HR 112
 - MM pink. CRT <2 seconds
 - Metatarsal pulses normokinetic, synchronous
 - Temp 36.9C
 - Peripheries warm
- Respiratory
 - Intubated
 - Not breathing spontaneously
- Neurological
 - Comatose
 - Laterally recumbent
 - No VMF
 - Bilateral unresponsive mydriasis



Case study 1:

- Immobilisation
 - In case of vertebral fracture/luxation
 - Common blunt trauma
 - Concurrent with pneumothorax, appendicular fractures, haemoperitoneum
 - Spinal board/splinting
 - Exclude with lateral spinal radiographs





TBI

Treat ↓ BP

Normal O₂

Normal BG

Opioid analgesia

**Optimise
Intracranial
Pressure**

Normal CO₂

Treat ↑ temp

**Minimise
Secondary
Brain Injury**

Treat ↑ ICP

No seizures

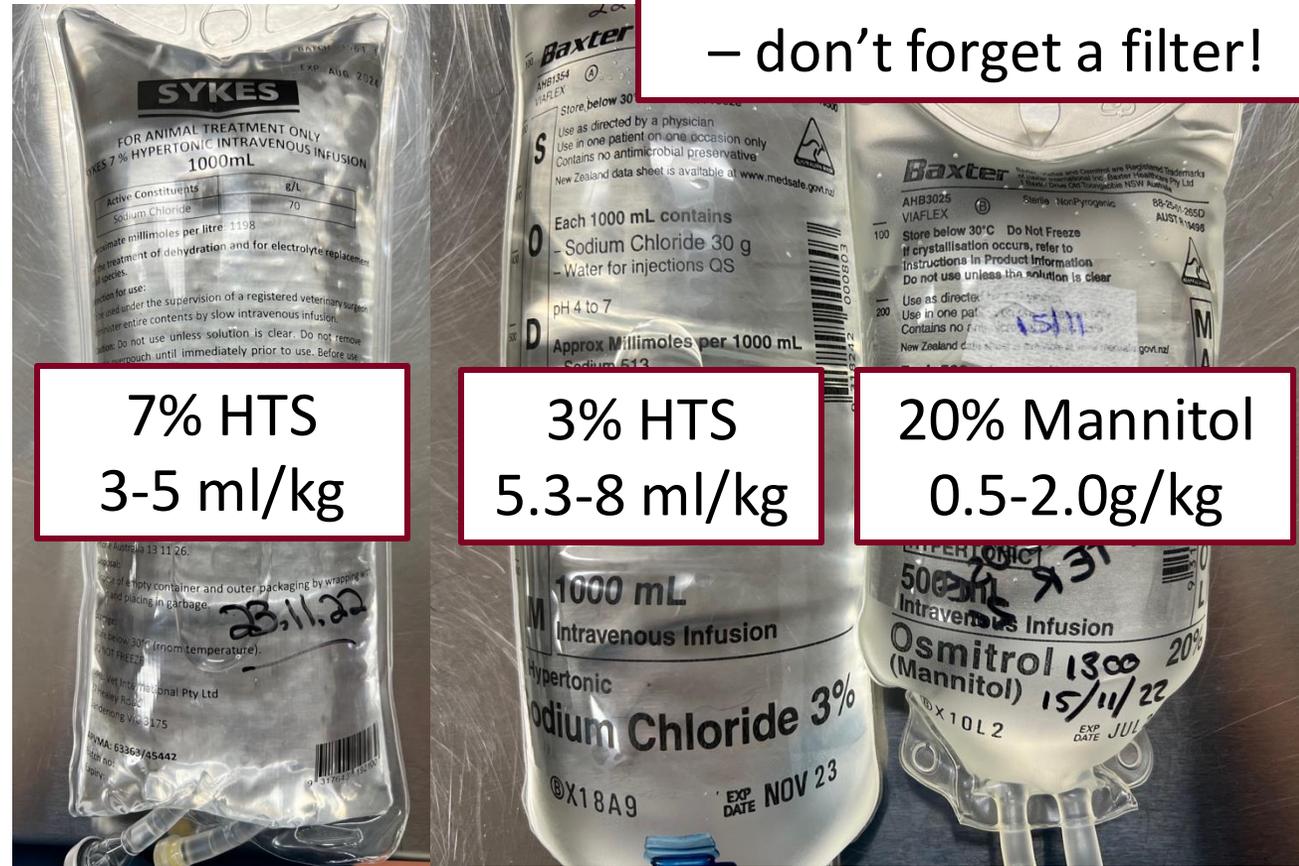
Optimising intracranial pressure



Practical Considerations

1. Avoid jugular vein compression
 - Avoid leads, collars
 - NO jugular venipuncture
2. Hyperosmolar agents
 - Hypertonic saline (HTS) preferable in trauma
3. Head elevation – 30°

Mannitol
– don't forget a filter!



Optimising intracranial pressure



Case study 2:

Percy 7y MN Golden Retriever

- 'ROBOT'
- Run over by owners' tractor 2 hours prior to presentation



Case study 2:

1. Major Body Systems Assessment (MBSA)

- Cardiovascular (Perfusion):
 - HR 182
 - MM pale pink. CRT 2 seconds
 - Metatarsal pulses thready, occasional pulse deficits
 - Temp 37.3C
 - Peripheries cool
- Respiratory
 - RR = 48
 - Increased respiratory effort
- Neurological
 - Dull but responsive
 - Laterally recumbent, non ambulatory
 - Voluntary motor function all limbs
 - **Abdominal pain**



Case study 2:

Emergency Stabilisation

1. Correct shock and increase DO₂

- Flow by/mask oxygen supplementation
- Isotonic crystalloid bolus 10ml/kg over 15 min

2. Analgesia

- Pure mu opioid analgesia
 - Methadone 0.2mg/kg IV
 - NB NSAIDs contraindicated in shock



Case study 2:

2. Packed Cell Volume/Total Solids (PCV/TS): 39%/51g/l

3. Venous Blood Gas:

- Mild hypokalaemia (3.6mmol/l)
- Moderate hyperlactataemia (5.3mmol/l)
- Moderate azotaemia (creatinine 200umol/l)

4. Point of Care Ultrasound (POCUS):

- Thorax: No pulmonary B lines. No pleural or pericardial effusion
- Abdomen: AFS 2/4 (DH + CC view)

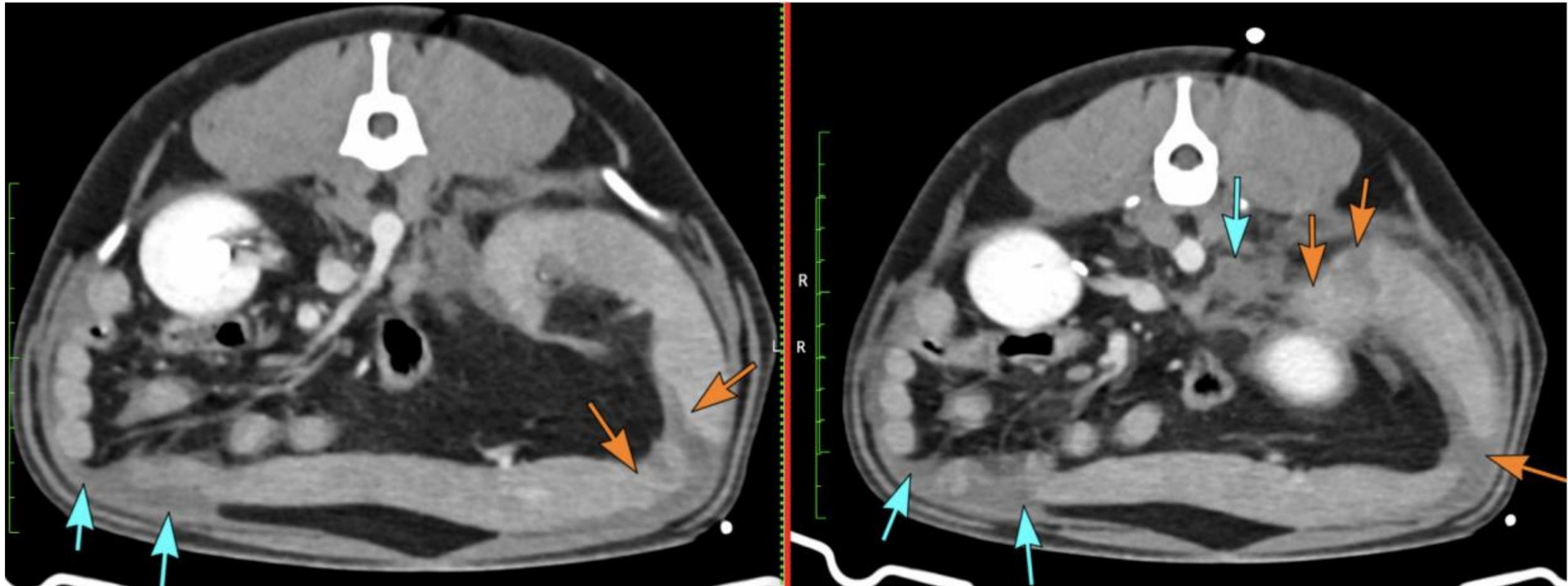
5. Accession Scoring

Animal Trauma Triage Score (ATTS):

Modified Glasgow Coma Scale (MGCS): 16/18 (5/6-6/6-5/6)

Note			
Blood Gas Values			
pH	7.350		[7.350 - 7.470]
pCO ₂	35.4	mmHg	[- -]
pO ₂	37.0	mmHg	[- -]
Oximetry Values			
sO ₂	60.0	%	
Hct _c	39.1	%	
ctHb	12.7	g/dL	
FMetHb	0.0	%	
FCOHb	2.4	%	
Electrolyte Values			
cNa ⁺	148	mmol/L	[140 - 153]
↓ cK ⁺	3.6	mmol/L	[3.6 - 4.6]
cCl ⁻	119	mmol/L	[106 - 120]
↑ cCa ²⁺	1.43	mmol/L	[1.13 - 1.33]
Metabolite Values			
cGlu	6.7	mmol/L	[4.7 - 7.3]
↑ cLac	5.3	mmol/L	[0.6 - 2.5]
↑ cCrea	200	μmol/L	[50 - 140]
‡ ctBil		μmol/L	[- -]
Temperature Corrected Values			
pH(T)	7.350		
pCO ₂ (T)	35.4	mmHg	
pO ₂ (T)	37.0	mmHg	
Oxygen Status			
ctO _{2c}	10.5	Vol%	
p50 _c	31.85	mmHg	
Acid Base Status			
cBase(Ecf) _c	-5.5	mmol/L	
cHCO ₃ ⁻ (Pst) _c	19.3	mmol/L	
Notes			
↑	Value(s) above reference range		
↓	Value(s) below reference range		
‡	Value(s) below the reportable range		
c	Calculated value(s)		
	0902: Adaptive measuring mode applied		
ctBil	0094: Value below the reportable range < -20		

Case study 2:



Antifibrinolytic Therapy

Tranexamic acid 10-20mg/kg slow IV q8h

- Optimal dosing regime unknown

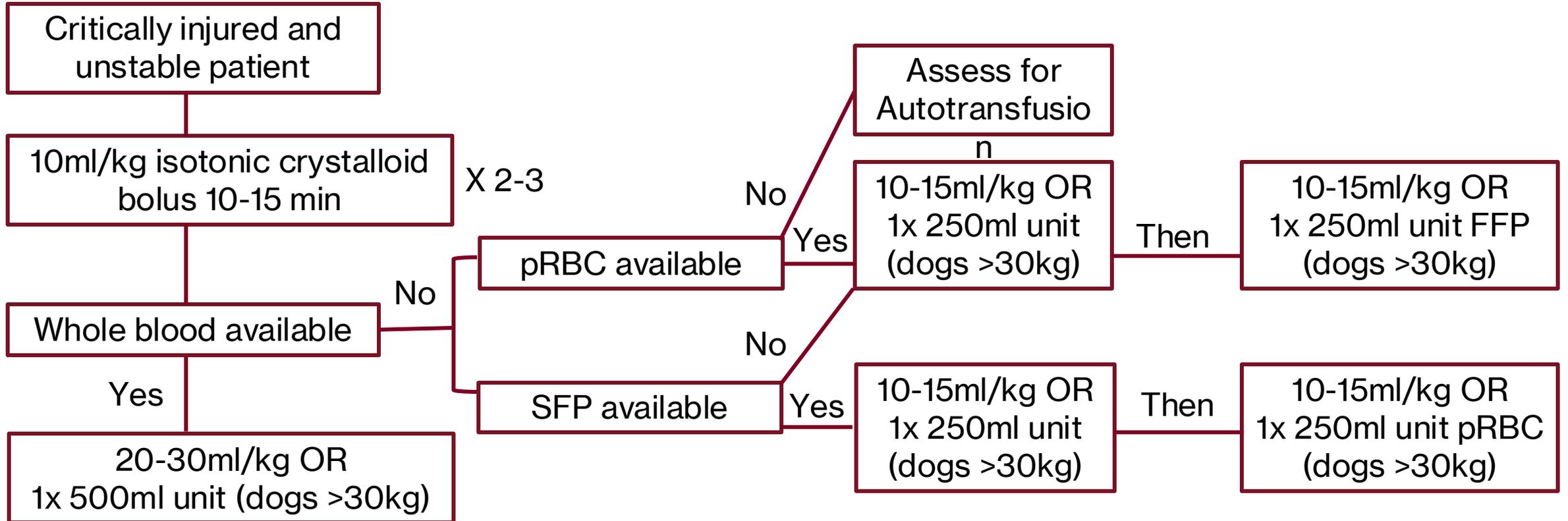
Indications:

- Hyperfibrinolysis
- Greyhounds
- **Acute trauma <3h (CRASH-2 2013)**
 - **(may be beneficial in patients without hyperfibrinolysis on viscoelastic testing)**
 - Resolves hyperfibrinolysis in haemorrhagic shock model but did not affect survival or blood product requirement (Mays 2025)

Considerations:

- Nausea common – consider concurrent maropitant 1mg/kg IV
- No decrease surgical bleeding tendency or transfusion requirements (Sigrist 2018)

Allogenic Transfusion



Autologous Transfusion

Indications

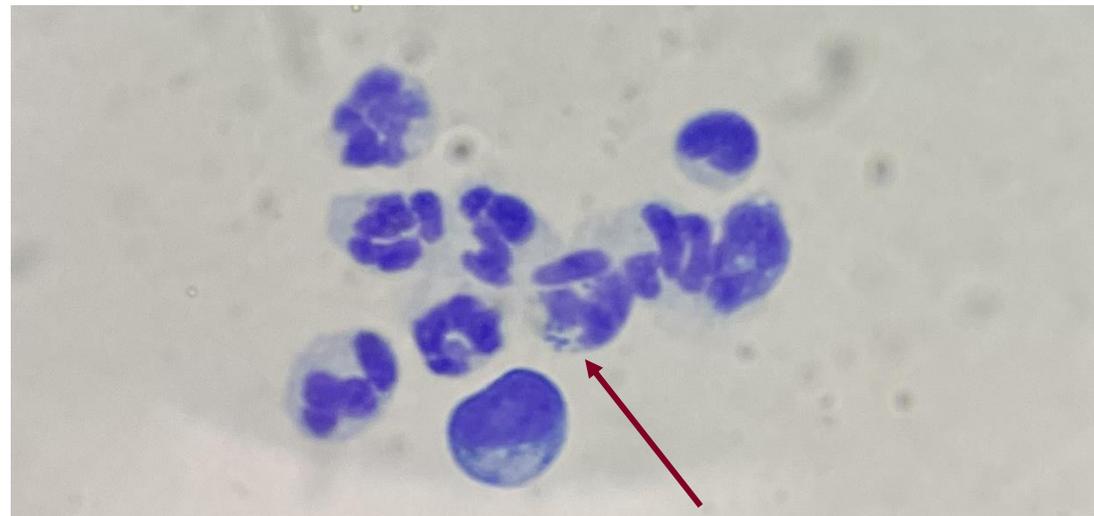
- Significant cavitory haemorrhage
- Haemodynamically unstable after isotonic crystalloid bolus 20ml/kg

Caution

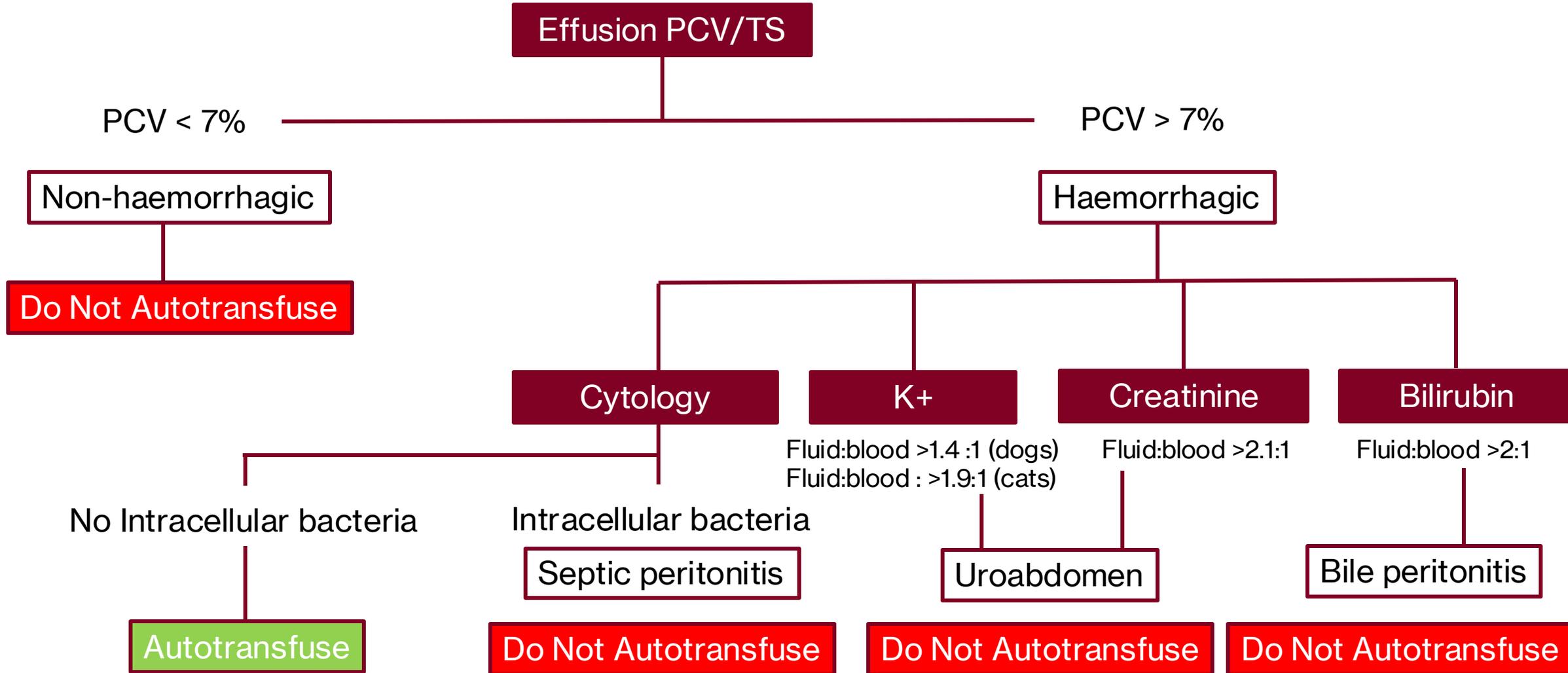
- Neoplastic effusions – unclear risk

Contraindications

- Septic effusions
- Uroabdomen
- Bile peritonitis



Autologous Transfusion



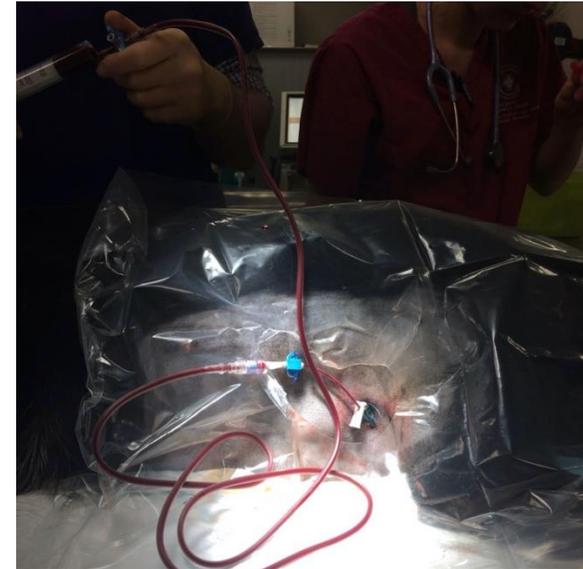
Autologous Transfusion

Autotransfusion options

1. Direct aspiration

- Butterfly catheter + 60ml syringe PLUS:
 - 3-way tap + extension tubing + haemonate filter, OR
 - Blood collection bag/sterile empty crystalloid bag + 210um filter
- Anticoagulant not required

2. Cell Salvage Device



Case study 1:



Case study 3:

Milo 11y MN Lhasa Apso

- **Dog bite wound polytrauma**
- **Attacked by 65kg dog on a walk**



Case study 3:

1. Major Body Systems Assessment (MBSA)

- Cardiovascular (Perfusion):
 - HR 200
 - MM pale pink. CRT 2 seconds
 - Metatarsal pulses thready, occasional pulse deficits
 - Temp 38.2C
 - Peripheries cool
- Respiratory
 - RR = 60
 - Increased respiratory effort
 - Absent lung sounds left thorax, reduced lung sounds R thorax
- Neurological
 - Obtunded
 - No nystagmus/anisocoria
 - Able to stand and ambulate short distance

Large full thickness laceration over dorsal neck

Full thickness punctures on dorsal and ventral R lateral thorax





Case study 2:

Emergency Stabilisation

1. Correct shock and increase DO₂

- Flow by/mask oxygen supplementation
 - > Intubation and 100% O₂
- Isotonic crystalloid bolus 10ml/kg over 15 min

2. Analgesia

- Pure mu opioid analgesia
 - Fentanyl 2mcg/kg bolus then CRI 2-5mcg/kg/h
 - NB NSAIDs contraindicated in shock

3. Thoracocentesis*



Case study 2:

Thoracostomy drain placement

- Indications
 - Failure to achieve negative pressure
 - Open thoracic wounds
 - Risk of tension pneumothorax
 - Close wounds at time of drain placement
- Does not replace definitive management



Case study 2:

2. **Packed Cell Volume/Total Solids (PCV/TS): 44%/48g/l**

3. **Venous Blood Gas:**

- Mild metabolic acidosis (pH 7.206, pvCO₂ 38.2, BECf -12.8mmol/l)
- Severe hyperlactataemia (6.3mmol/l)
- Mild hyperglycaemia (9.7mmol/l)

4. **Point of Care Ultrasound (POCUS):**

- Thorax:
 - Absent glide sign dorsally.
 - Coalescing B lines R thorax, R thorax pleural effusion
- Abdomen:
 - AFS 0/4, urinary bladder small

5. **Accession Scoring**

Animal Trauma Triage Score (ATTS): 8

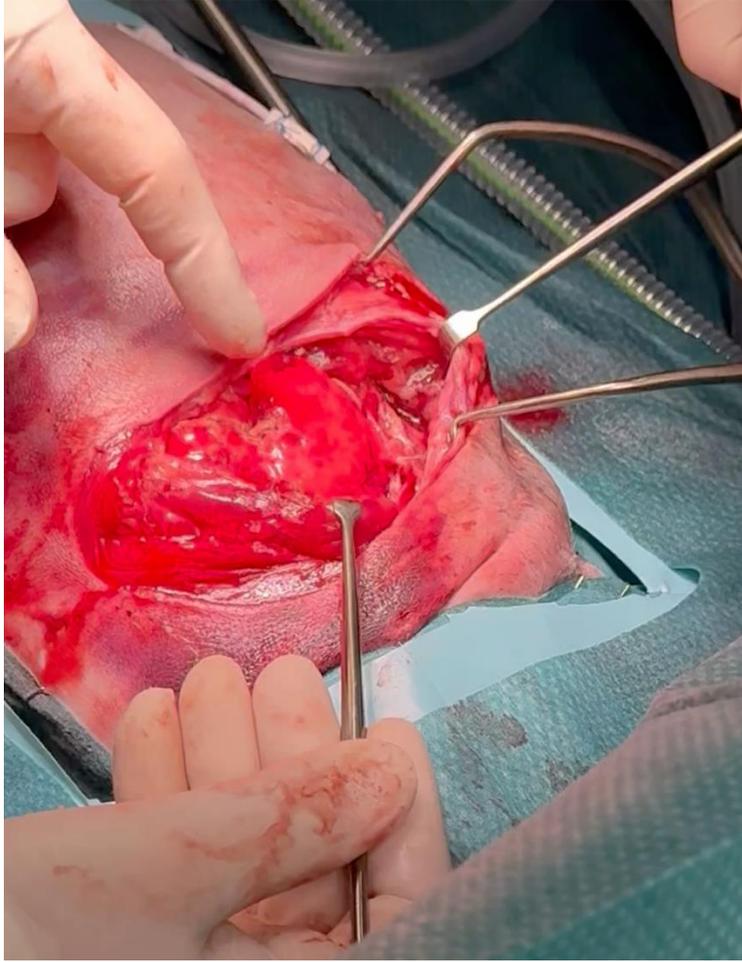
Modified Glasgow Coma Scale (MGCS): 16 (5/6-6/6-5/6)



Case study 2:



Case study 2:





Case study 2:

Stabilising flail (+/- pseudoflail) segments

Circumferential Bandaging

- Adjunctive analgesia
- Improves hypoventilation
- Improves respiratory function



Antibiosis

- Intravenous, broad spectrum
 - E.g. Potentiated amoxicillin
- Indicated in penetrating wounds
- Common isolates from bite wounds: *Pasteurella* spp., *Staphylococcus* spp, *Enterococcus* spp, *Staphylococcus* spp., *Escherichia coli*, *Pseudomonas* spp., *Bacillus* spp, *Clostridium* spp, *Corynebacterium* spp.

Prognosis

- Complete recovery often possible if survive hospitalization period
 - Long term health implications rare
- Consider ATTS
- Populations with higher mortality risks
 - Geriatric patients
 - Entire patients

Summary

1. Treat most life-threatening injuries first

- *Not the most obvious*

2. Optimise tissue oxygen delivery

- *Treat shock*

3. Provide analgesia

- *pure mu opioid*



**Thank You!
Questions?**

Email: rebekah.donaldson@qvs.com.au



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