Approach to the trauma patient

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Trauma

- Trauma is very common
- Most trauma cases have polytrauma (>70%)
- Leading cause of death in primary care setting in many studies
- With good care, survival rates of >80% can be achieved (referral centres)

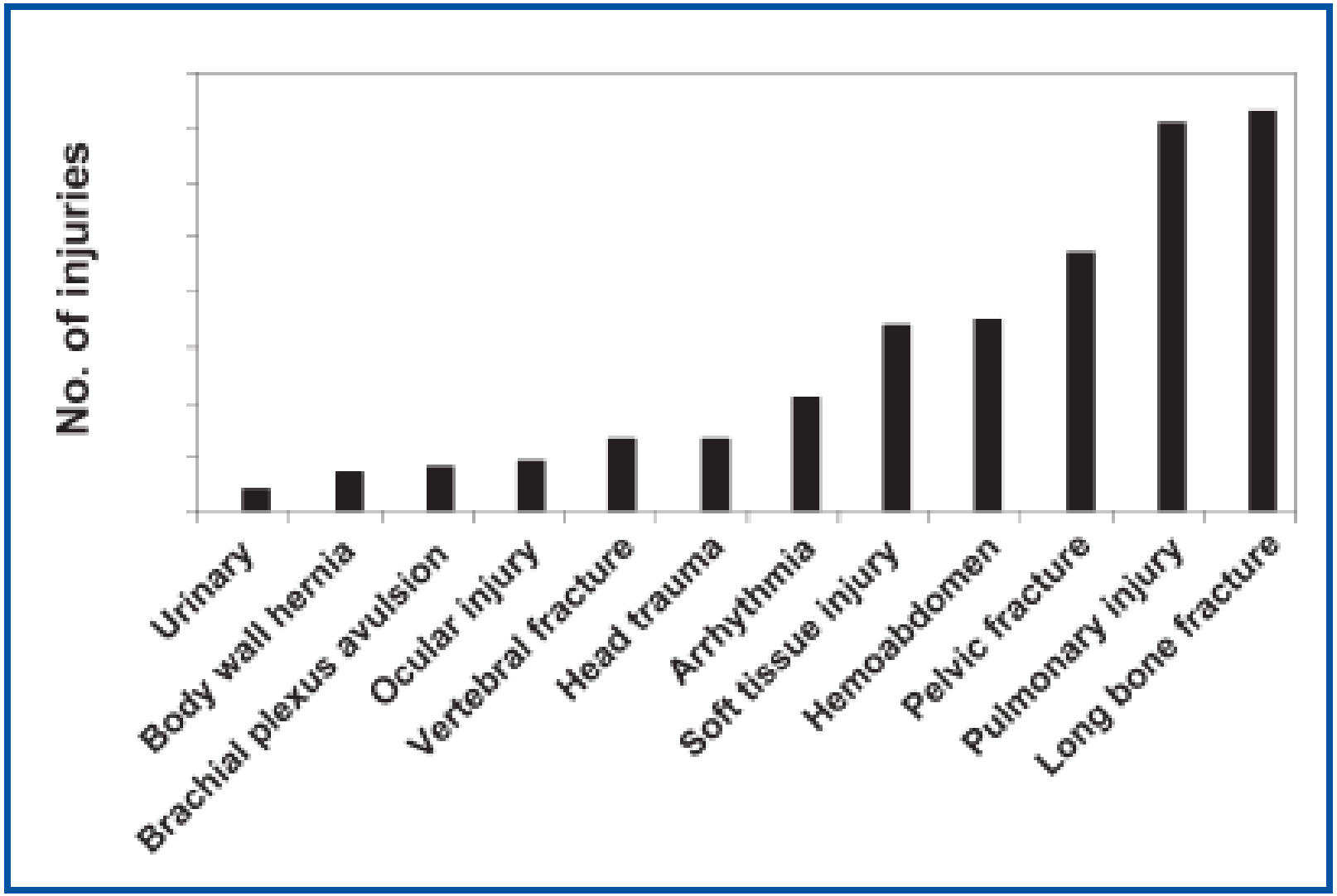
Trauma – what do we see?

Blunt trauma

- RTA

Penetrating trauma

- Bite wounds



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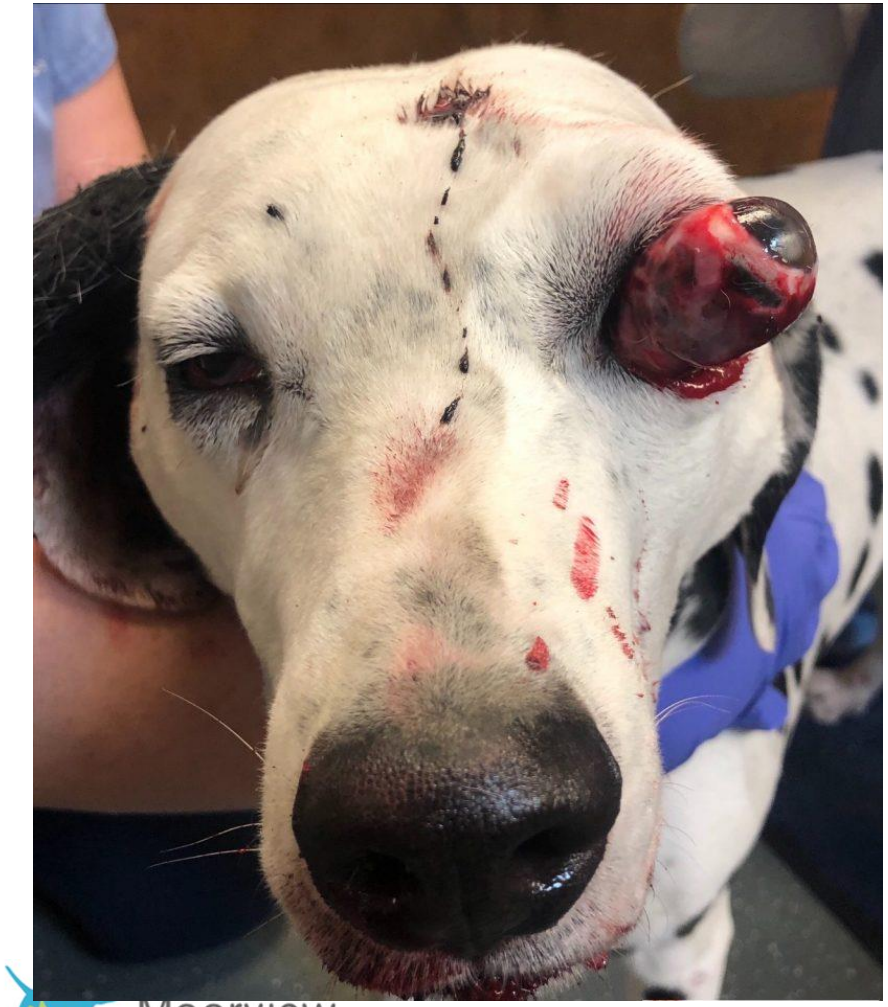
Things that freak out the
…but less worrying to the



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…things that worry me and not so much the owner…

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Things that freak us both out*

*ECC vets never freak out. We are always calm and controlled

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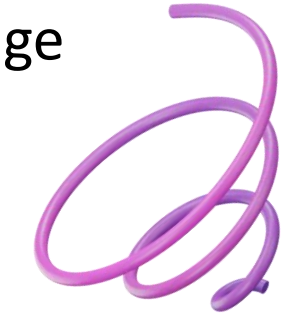
Very brief pathophysiology of trauma

Why do patients die of trauma?

- Maldistribution of blood flow – change in circulating catecholamines, hormones, hypovolaemia
- Microcirculatory perfusion deficits and 'occult shock'
- Endothelial injury and damaged cell membranes
- Cellular damage
- Inflammation → Coagulopathy → Perpetuation of above damage

- **The primary goal in the trauma patient is to optimize oxygen delivery to the tissues**
- **In initial resusc, *everything* is geared towards this goal**
- **This depends on only 3 things:**
  - **Cardiac output**
  - **Blood Hb concentration**
  - **Oxygen saturation of Hb**



SIRS/ Sepsis
DIC
ARDS
AKI/ MODS
Death

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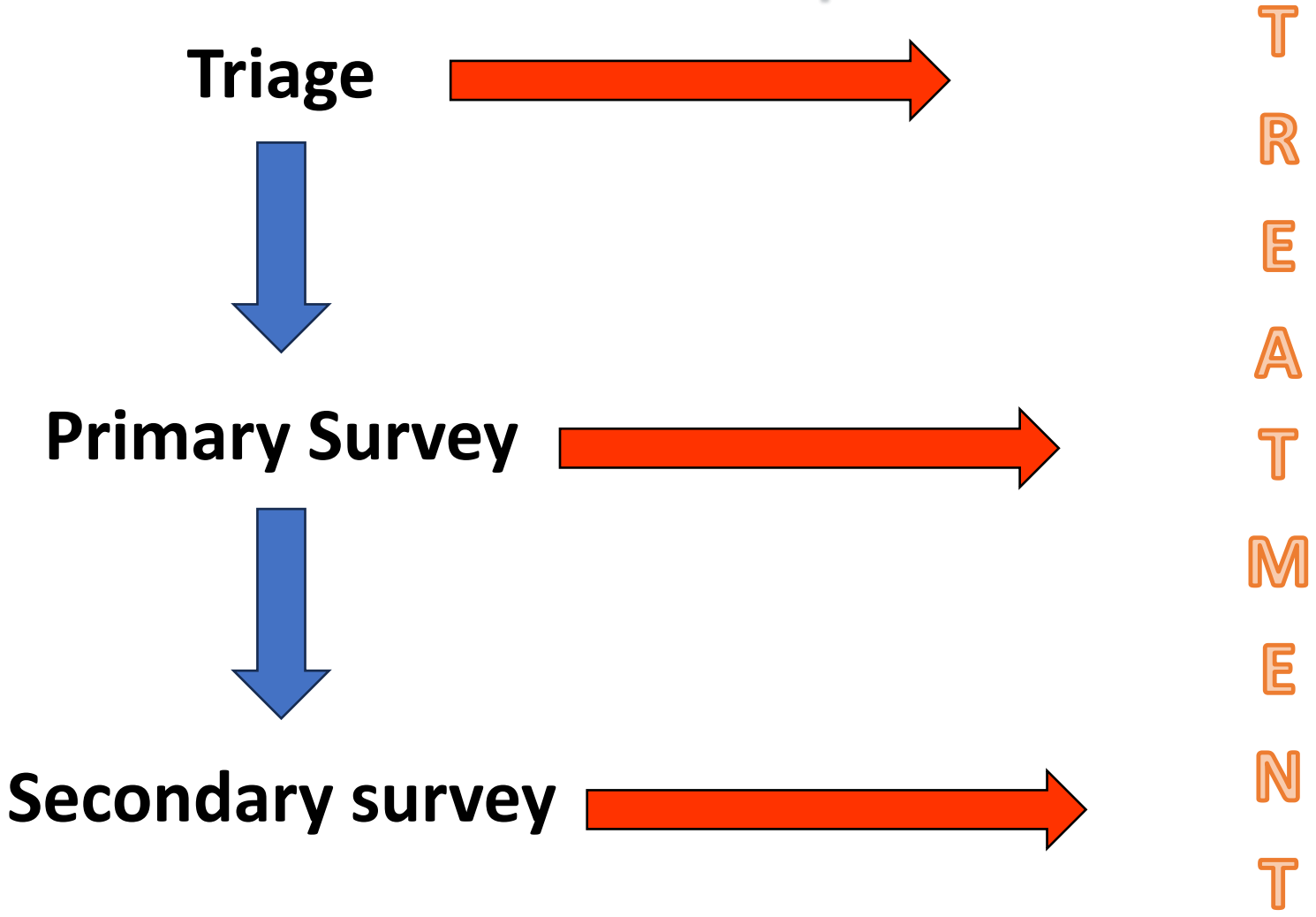
Systematic approach to the trauma patient



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TRIAGE

The art and science of **prioritising**
Patients and their problems

‘What’s going to kill this animal first?’

‘If you’re the worst, you come first!’

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Systematic approach to the trauma patient

Triage →

- The call – Telephone Triage
- The prep – ‘Run the bundle’
- The arrival - Reception Triage
  Nurse triage

Primary Survey

Secondary survey

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TRIAGE

The call – Telephone Triage

- Be calm

- Get *brief* details of what's happened
- Give advice to client
- Advise attend without delay – get an ETA
- Advise the team – prepare for arrival

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TRIAGE

The prep – Preparing for arrival

- The nursing team are invaluable in preparing for the arrival of the emergency or critical patient

- This minimises delay and stress once the patient has arrived and allows the plan to flow smoothly

- Have pre-prepared protocols (‘care bundles’) for different types of emergency/ presentation:
  - The kit
  - The protocol
  - ? Trauma checklist

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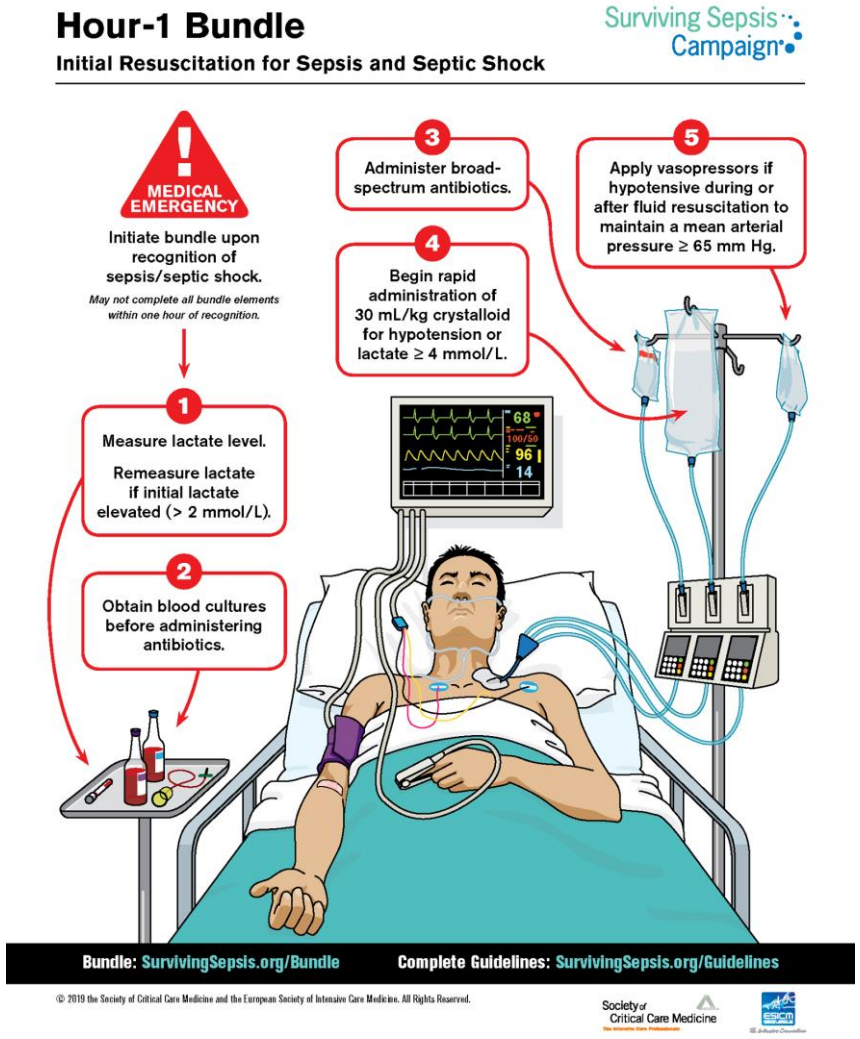
Care Bundle

A care bundle is a group of evidence-based interventions which, when used together, give a better outcome than if performed individually



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TRAUMATIC BRAIN INJURY CARE BUNDLE

Equipment

iv kit
ET kit
Infusion pump, syringe driver
Blood tubes
Multimonitor
Oxygen, breathing circuit & Ambubag
Ventilator
Doppler BP machine
Arterial line pressure transducer
Ophthalmoscope
Padded board and towel

CRASH TROLLEY

Medication

Anti-seizure medication:	Diazepam/Midazolam, phenobarbital Levetiracetam, propofol
Analgesia:	Methadone, fentanyl, buprenorphine, paracetamol

Also:
Medetomidine
Lidocaine
Mannitol 20% (200mg/ml)
Hypertonic (7.5%) saline

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TRAUMATIC BRAIN INJURY CARE BUNDLE

Protocol

Tier 1: Extracranial stabilisation

1) Perform MBS assessment and identify life-threatening extracranial injuries, address as needed
2) Perform survey neurological exam and record MCGS score
3) Take baseline blood pressure – place arterial line now, or later if possible. Obtain arterial blood-gas values if possible
4) Obtain iv access, obtain blood sample for electrolytes, acid-base, glucose, lactate, PCV/TS. Use peripheral vein for sampling, DO NOT take jugular samples
5) Attach multi-monitoring
6) Treat hypotension/ hypovolaemia – initially with crystalloid fluid boluses (0.9% saline thought to be better than LRS). Consider use of HTS or vasopressors if poor fluid-responsiveness. Aim to keep MAP 90-120mmHg, and at least >70mmHg
7) Treat hypoxaemia – flow-by or loosely-fitting mask. Aim for SpO2 > 95%
8) Treat hypercapnia – initially increase oxygen flow-rate, if poorly responsive use high-flow consider intubation and ventilation. Aim for PaCO2/ ETCO2 35-45mmHg. Excessive reduction in CO2 pressure can result in cerebral vasoconstriction; therefore, it is not advised to drop below 30mmHg
9) Treat any identified electrolyte, acid-base or blood-gas derangements
10) Treat pain – methadone, fentanyl CRI – see doses below
    Use low dose initially to avoid respiratory depression. NB MGCS score will be difficult following opioid administration

Mild hypothermia (1-2◦C below normal) may be beneficial

Consider blood transfusion if PCV low

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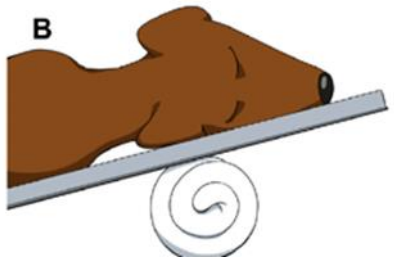
TRAUMATIC BRAIN INJURY CARE BUNDLE

Tier 2: Intracranial stabilisation

- Treat seizures – iv diazapem +/- iv phenobarbital
- Monitor for signs of increased or increasing ICP (see above)
- Monitor and maintain MAP 90-120mmHg (most crucial)
- Treat raised ICP:
  - Hypertonic saline 7.4%: 4ml/kg iv (2ml/kg cats) over 15mins, can be repeated q8hrs
  - Mannitol: 0.25mg/kg to 1g/Kg (5ml/kg of 20%) iv over 15mins

  Mannitol can be repeated not more than every 4hrs to a maximum of 3x per 24hrs
  In both cases follow-up with crystalloids

- Elevate head 15-30◦ - use a rigid board to avoid neck-kinking



- Control pain
- Prevent events that would increase ICP eg vomiting (treat with maropitant), coughing (treat with butorphanol or lidocaine)

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TRAUMA CHECKLIST

Name	
Helix Case No.	
Date/Time	
Vet	
Nurse	

Major Trauma Checklist

Tick each action to confirm it has been considered and/or actioned
Actions in bold are critical steps

Before Consultation

- ❑ **Prepare fluids & analgesia**
- ❑ **Check oxygen on**
- ❑ **Prepare for CPR**

Consultation

Initial Assessment and Stabilisation

- ❑ **Ensure airway is clear – suction?**
- ❑ **Check respiratory function – give oxygen?**
- ❑ **Check pulse/apex beat – initiate CPR?**
- ❑ Clinically examine the thorax
- ❑ Check bleeding and create suitable vascular access
- ❑ **Consider IV fluid therapy: crystalloid/colloid/blood product**
- ❑ Assess consciousness, motor function and sensitivity
- ❑ **Pain score, give analgesia**[1]
- ❑ Treat wounds - stabilise, immobilise, flush/cover
- ❑ Consider antibiotics
- ❑ Ensure body heat is preserved – Bair Hugger, warm fluids
- ❑ **Full physical exam once stable**
- ❑ Complete Trauma Score

Primary diagnostics

- ❑ **AFAST**
- ❑ **TFAST - Thoracocentesis**
- ❑ **MDB**
- ❑ **EPOC**

After Consultation

Multi-parameter Monitor

- ❑ Blood pressure
- ❑ ECG
- ❑ Capnography if intubated

Secondary diagnostics

- ❑ X-ray surveys[2]
  - ○ Assess entire films
  - ○ Check for fractures
- ❑ Lactate series
- ❑ Blood smear & WBCs
- ❑ Coags

- ❑ ***Repeat diagnostics to assess progress***

Consider Ongoing Problem List

- ❑ Shock
- ❑ Head trauma
- ❑ Bleeding
- ❑ Pulmonary contusions
- ❑ Penetrating wounds
- ❑ Hypothermia
- ❑ Fractures
- ❑ Spinal damage
- ❑ Organ damage/rupture e.g. bladder, GI
- ❑ Monitor for Sequelae[3]
- ❑ Soft tissue wounds – record all[4]
- ❑ Consider feeding tube placement
- ❑ Repeat Trauma Score

End of Checklist

✓ *Checklists reduce errors and save lives*

Jul 2018 Version

Additional information on Trauma

1 Consider multi-modal analgesia which may include; pure opioids, constant rate infusions e.g. MLK, local or regional anaesthesia.
NSAIDs are contraindicated in hypovolaemia.

2 X-ray surveys should include entire thorax and abdomen – including pelvis (minimum 2 views per body area)

3 Sequelae following trauma may include (but are not limited to) ARF, SIRS, ARDS, MODS, sepsis, DIC

4 Record wounds below

LEFT **RIGHT**

✓ *Checklists reduce errors and save lives*

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TRIAGE

The arrival – Reception/ Nurse triage

This is the initial assessment carried out on arrival

A B C D

A – **A**irway
B - **B**reathing
C - **C**irculation (?Pulse or heartbeat)
D - **D**isability – eg presence of any major injury

Moorview REFERRALS

TRIAGE

The arrival – Reception/ Nurse triage

This is the initial assessment carried out on arrival
(you should already be prepared for this)

C A B D

A – **A**irway
B - **B**reathing
C - **C**irculation (?Pulse or heartbeat)
D - **D**isability – eg presence of any major injury

This allows rapid identification of any major problems and reassures the owner.
The animal can then be classified as follows…

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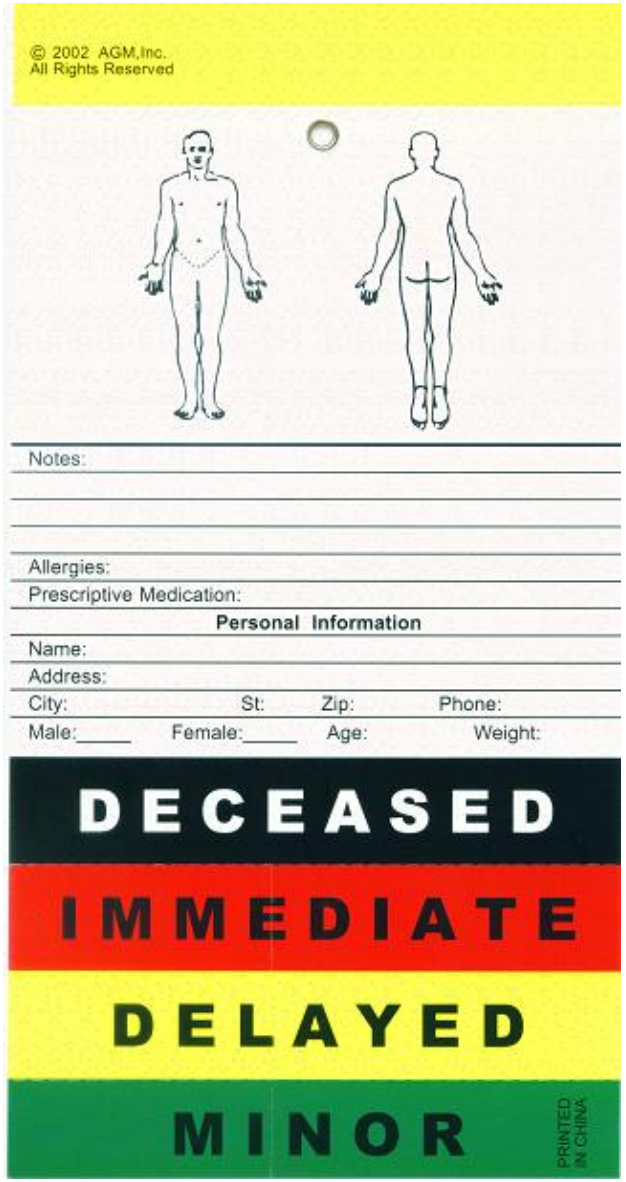
TRIAGE

Minor	delayed care
Delayed	urgent care
Immediate	immediate care / life-threatening
Dead	victim is dead / no care required



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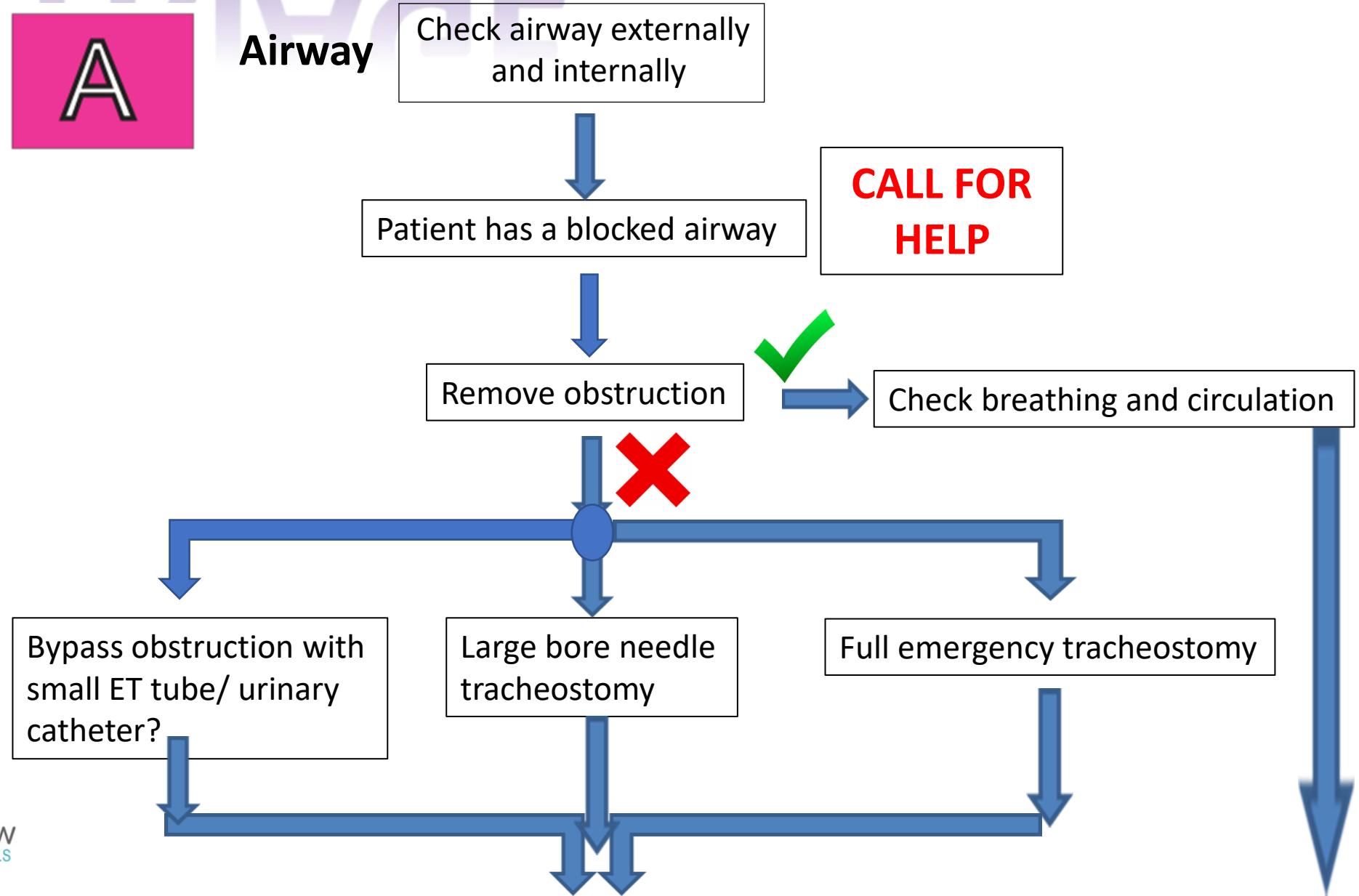
TRIAGE

A Airway



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TRIAGE

B Breathing

Patent airway but patient not breathing

CALL FOR HELP

Intubate & connect 100% oxygen

Start assisted ventilation with ambu-bag/ circuit bag/ ventilator @ 8-12 bpm

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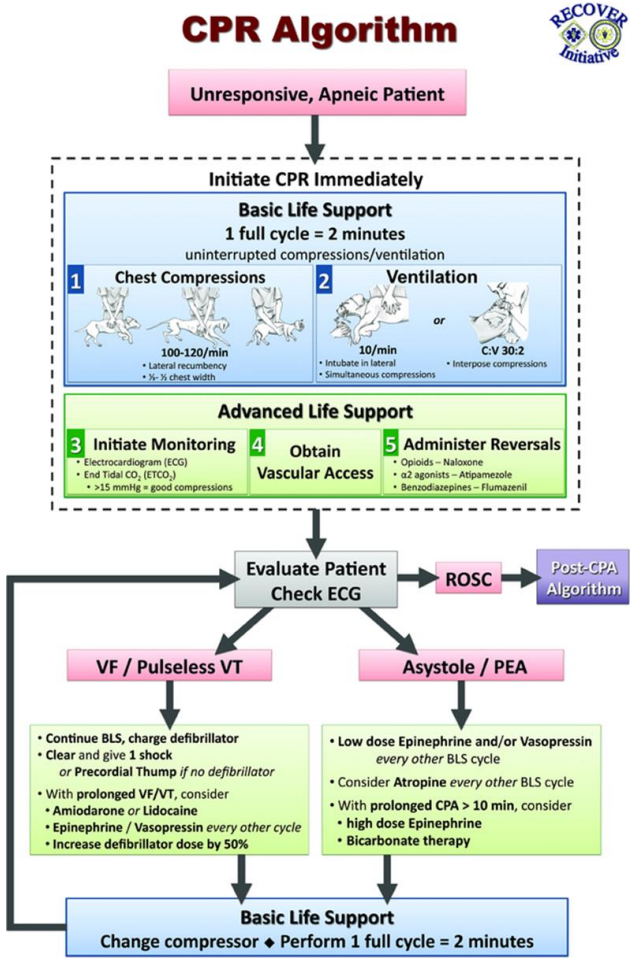
TRIAGE

C Circulation



Check heart rate, rhythm mm colour, CRT, pulse, rectal temperature

↓

No apex beat or femoral pulse

CALL FOR HELP

↓

Start external cardiac compressions

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Primary Survey

- The Primary Survey is an extensive of triage and amplifies the information obtained so far
- Performed by the Vet
- The aim is to identify and treat any potentially life-threatening problems, after ABCD
- The Primary Survey is based on the **M**ajor **B**ody **S**ystems assessment (MBS assessment)

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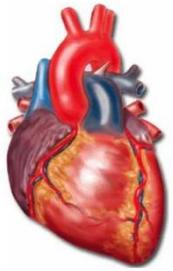
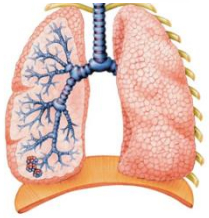
Primary Survey
The Major Body Systems assessment

C R N A O – **C**onsider **R**ight **N**ow **A**s a matter of urgency…

Cardiovascular

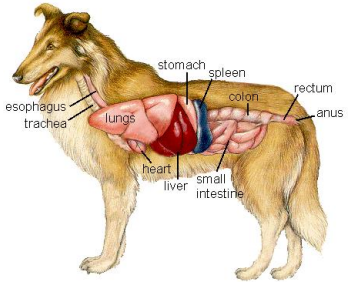


Respiratory

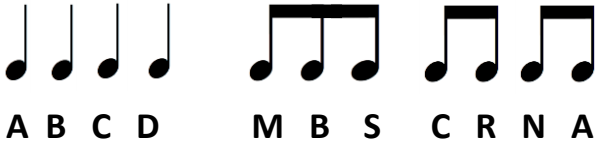


Neurological

Abdominal



Other



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Trauma – things to worry about

Cardiovascular

- Hypovolaemia/ hypotension
- Arryhthmias
- Cardiac contusions

Respiratory

- Pneumothorax
- Diaphragmatic hernia
- Haemothorax
- (Rib fractures)
- (Pulmonary contusions)

Neurological

- Traumatic brain injury
- Spinal trauma

Abdominal

- Haemoabdomen
- Uroabdomen
- (Septic peritonitis)

Other

- Significant internal bleeding
  - Abdomen
  - Pelvis/ around femur
- Wounds and fractures

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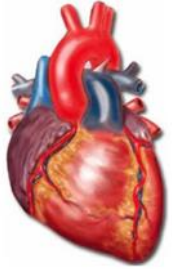
Primary Survey – Cardiovascular system

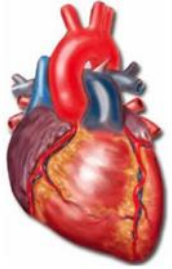


- Mucous membrane colour – pink, pale, cyanotic
- CRT - <2s, prolonged, rapid
- Heart rate & rhythm
- Quality of apex beat
- Pulse quality

< 1 second:	Distributive shock (sepsis)
> 2 seconds:	Hypovolaemia, hypothermia
> 3 seconds:	Severe hypovolaemia Peripheral vasoconstriction/ Bradycardia/ Arrhythmia Cardiac dysfunction

Moorview REFERRALS

Primary Survey – Cardiovascular system



- Mucous membrane colour – pink, pale, cyanotic
- CRT - <2s, prolonged, rapid
- Auscultation of heart rate & rhythm, quality of apex beat
- Pulse quality

Heart rate

Is the heart rate appropriate for the situation?

Tachycardia

Hypovolaemia, Pain, Hypoxaemia, Hypercapnia, Hyperthermia, Sepsis, Anaemia, Stress, Heart failure

Bradycardia

Head trauma, severe decompensatory shock

Cats!

Hyperkalaemia (eg Uroperitoneum) – *nowhere near as common as the textbooks suggest*

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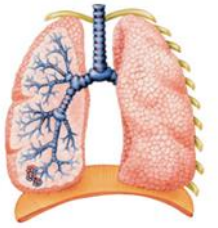
Primary Survey – **R**espiratory system



Respiratory effort
Respiratory rate
Any abnormal noise eg stridor, stertor
Palpation and inspection of the neck and chest
Chest auscultation – wheeze, crackles, dull
Chest percussion – dull, hyper-resonant
Paradoxical abdominal movement

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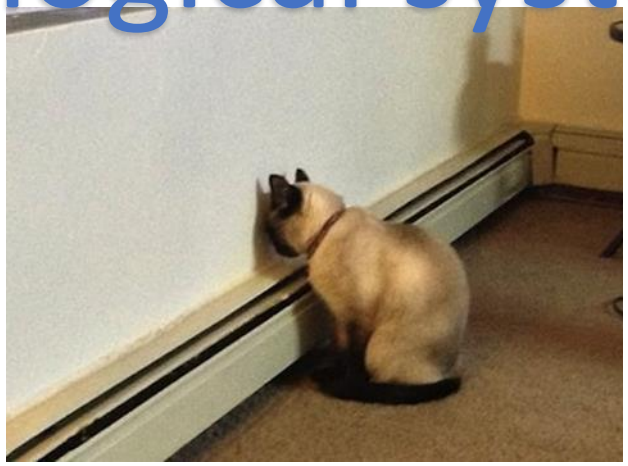
Primary Survey – **N**eurological system

- Mentation
  - **D**epressed
  - **O**btunded
  - **S**tuporous
  - **C**omatose



- Pain perception & spinal reflexes

- Voluntary movement/
  Ambulatory status

- Cranial nerves (Especially eyes)

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Traumatic brain injury (TBI)

NOT the same as head trauma….but TBI should be carefully assessed and monitored in every head trauma patient

Owner worried
ECC vet less worried

Owner not worried/ oblivious
ECC vet worried

Both worried

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Traumatic brain injury (TBI)

Actively consider:

Following any history of trauma

- **Any evidence of head trauma**
  - Wounds or fractures to the head
  - Ocular or aural injuries or haemorrhage
  - Epistaxis

- **Neurological abnormalities**
  - Altered mentation
  - Cranial nerve abnormalities esp pupil changes

- **Traumatic brain injury is a major cause of mortality in trauma patients**

- **The main concern with head trauma is the risk of raised intracranial pressure (ICP)**

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Traumatic brain injury (TBI)

Signs that alert you to raised ICP

- Dull mentation, obtundation, stupor, coma, or sudden change in mentation
- *(Progressive)* cranial nerve abnormalities, especially sudden decrease in PLR or changed pupil size (mydriasis > miosis)
- Bradycardia
- Systemic hypertension

Cushing's reflex
Sign of impending or in-progress brain herniation

- Decerebrate posture (opisthotonos and all 4 limbs hyperextended)
- Decreasing MGCS/ loss of physiological nystagmus
- Hypoventilation/ irregular respiration
- Presence of significant head injuries

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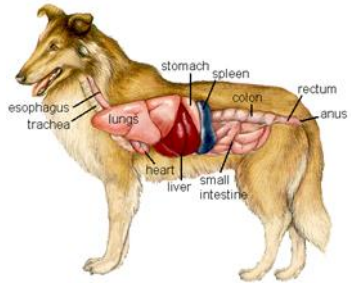
Primary Survey – Abdomen



Palpation –

- Fluid
- Pain
- Gas/ tympany
- Wall rupture

Bladder – intact?

Look for bruising/ **puncture wounds**

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Primary Survey – Other

- A brief survey to include other, less life-threatening injuries
  - Open wounds
  - Fractures
  - Other trauma eg ocular/ jaw/ dental
  - Body temperature

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The capsule history

This can be taken at any appropriate time
Eg while doing MBS assessment or once a plan is made and initial stabilization is underway

- Signalment
- Presenting complaint & ***brief*** history
- Last normal
- Any other current conditions/ medications

- Likely injuries/ cost/ prognosis
- Resuscitation status (code status)

Keep it brief, focused and directed!
Do not let the owner waffle

Moorview REFERRALS

Trauma Scoring Systems

Physiologic	Anatomic	Combined
Revised Trauma Score	Abbreviated Injury Score	TRISS
APACHE	Injury Severity Score	ASCOT
SOFA	New Injury Severity Score	ICISS
SIRS	Anatomic Profile	
Emergency Trauma Score	PATI	
	ICISS	
	TMPM-ICD9	

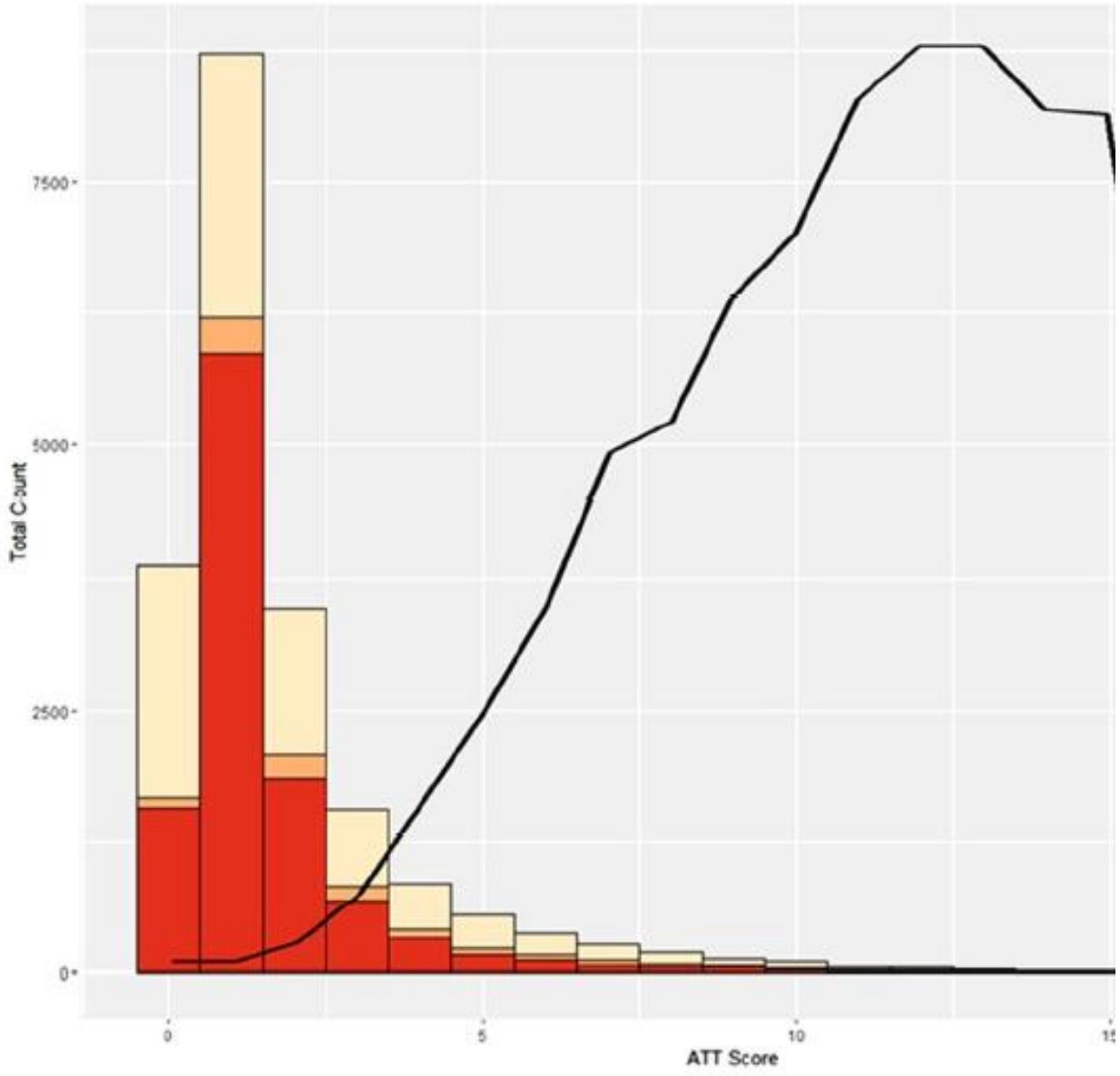
Moorview REFERRALS

Animal Trauma Triage Score (ATT)

Grade	Perfusion	Cardiac	Respiratory	Eye/muscle/integument	Skeletal	Neurological
0	mm pink & moist CRT ~ 2 sec Rectal temp 37.8°C (100°F) Femoral pulses strong or bounding	HR: Dog: 60–140 Cat: 120–200 Normal sinus rhythm	Regular resp rate with no stridor No abdominal component to resp	Abrasion, laceration: none or partial thickness Eye: no fluorescein uptake	Weight bearing in 3 or 4 limbs, no palpable fracture or joint laxity	Central: conscious, alert →sl dull; interest in surroundings Periph: normal spinal reflexes; purposeful movement and nociception in all limbs
1	mm hyperemic or pale pink; mm tacky CRT 0–2 sec Rectal temp 37.8°C (100°F) Femoral pulses fair	HR: Dog: 141–180 Cat: 201–260 Normal sinus rhythm or VPCs <20/min	Mildly incr resp rate & effort ± some abdominal component Mildly incr upper airway sounds	Abrasion, laceration: full thickness, no deep tissue involvement Eye: corneal laceration/ulcer, not perforated	Closed appendicular/rib fx or any mandibular fx Single joint laxity/luxation incl. sacroiliac joint Pelvic fx with unilateral intact lilium-acetab Single limb open/closed fx at or below carpus/tarsus	Central: conscious but dull, depressed, withdrawn Periph: abnormal spinal reflexes with purposeful movement and nociception intact in all 4 limbs
2	mm v pale pink & v tacky CRT 2–3 sec Rectal temp <37.8°C (100°F) Detectable but poor femoral pulses	HR: Dog: >180 Cat: >260 Consistent arrhythmia	Mod incr resp effort with abdmon component, elbow abduction Moderately incr upper airway sounds	Abrasion, laceration: full thickness, deep tissue involvement, and arteries, nerves, muscles intact Eye: corneal perforation, punctured globe or proptosis	Multiple grade 1 conditions (see above) Single long bone open fx above carpus/tarsus with cortical bone preserved Non-mandibular skull fx	Central unconscious but responds to noxious stimuli Periph: absent purposeful movement with intact nociception in 2 or more limbs or nociception absent only in 1 limb; decr anal and/or tail tone
3	mm gray, blue, or white CRT >3 sec Rectal temp <37.8°C (100°F) Femoral pulse not detected	HR: Dog: <60 Cat <120 Erratic arrhythmia	Marked resp effort or gasping/agonal resp or irregularly timed effort Little or no detectable air passage	Penetration to thoracic/abd cavity Abrasion, laceration: full thickness, deep tissue involvement, and artery, nerve, or muscle compromised	Vertebral body fracture/luxation except coccygeal Multiple long bone open fx above carpus/tarsus Single long bone open fx above tarsus/carpus with loss of cortical bone	Central: nonresponsive to all stimuli; refractory seizures Periph: absent nociception in 2 or more limbs; absent tail or perianal nociception

Gives an ATT score of 0-18

Animal Trauma Triage Score (ATT)



Moorview
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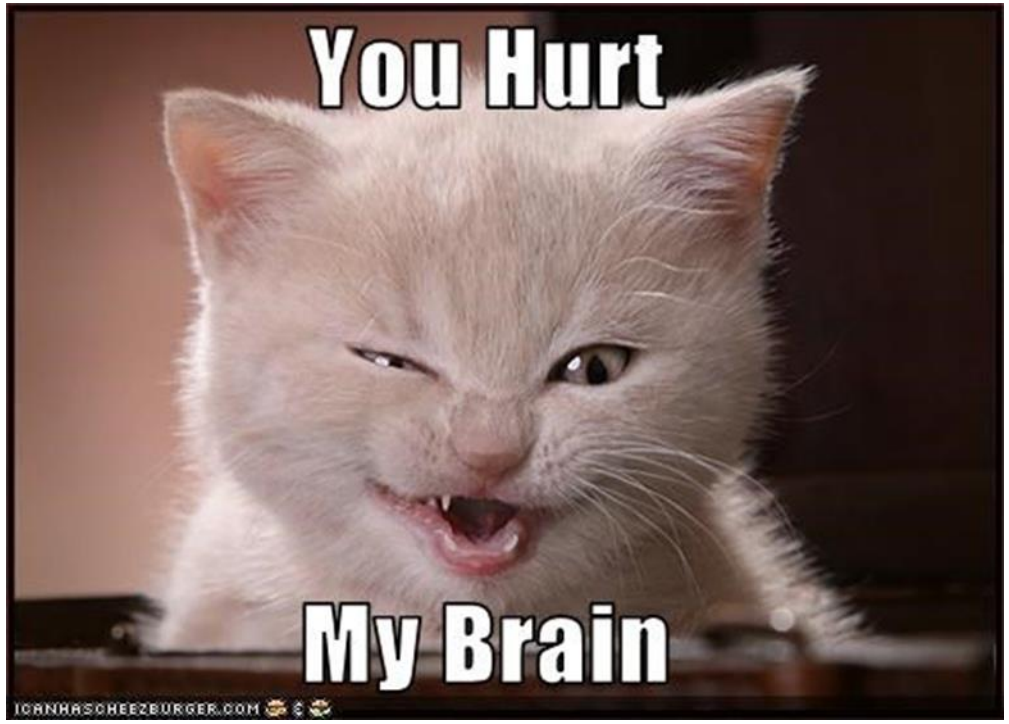
Glasgow Coma Scale



Serial monitoring over time is critical

Modified Glasgow Coma Scale (MGCS)

Patient name:
Date:

		Time							
MOTOR ACTIVITY	**Score**	Admission							
Normal gait, normal spinal reflexes	6								
Hemi-paresis/ Tetra-paresis/ Decerebrate rigidity	5								
Recumbent, intermittent extensor rigidity	4								
Recumbent, constant extensor rigidity	3								
Recumbent, constant extensor rigidity with opisthotonus	2								
Recumbent, hypotonia, depressed/ absent spinal reflexes	1								
BRAINSTEM REFLEXES									
Normal PLR and Oculocephalic reflexes	6								
Slow PLR/ normal or reduced Oculocephalic reflexes	5								
Bilateral unresponsive miosis/ normal-reduced Oculocephalic reflexes	4								
Pinpoint pupils/ reduced to absent Oculocephalic reflexes	3								
Unilateral unresponsive mydriasis	2								
Bilateral unresponsive mydriasis	1								
LEVEL OF CONSCIOUSNESS									
Responsive to environment/ periods of alertness	6								
Depression/ delirium	5								
Semi-comatose: responsive to visual stimuli	4								
Semi-comatose: responsive to auditory stimuli	3								
Semi-comatose: responsive to noxious stimuli	2								
Comatose: unresponsive to repeated noxious stimuli	1								
Total MGCS score /18									

Moorview REFERRALS

Primary survey ⟹ Secondary survey

- Any significant problems identified during the Primary Survey should be addressed
- There is discrepancy between what is included as ‘Primary’ vs ‘Secondary’ survey, but this is largely semantic, as the next steps are:

    - Secure vascular access and obtain EDTA and heparinised blood samples
    - Obtain further information (ideally a multiparameter monitor):
        - Blood pressure
        - ECG
        - SpO_2
    - Imaging

Moorview REFERRALS

Bloodwork

- Standard bloodwork is of little use in the trauma patient
- Much more useful is the '**Emergency database**', which should include:
  - PCV (manual NOT machine HCT) and TP (refractometer)
  - Blood glucose (glucometer)
  - Lactate (lactate meter)
  - Electrolytes*
  - Blood urea nitrogen (urea stick or machine)
  - Acid-base parameters*
  - Blood film exam
  - Coagulation profile
  - Urine SG (before fluid therapy!)

These parameters most reliably distinguish trauma severity and survival (correlate ATT score)
*Really good way to get these is to use machine like iSTAT or EPOC which will give you most of the emergency database information from a single blood sample

Moorview REFERRALS

Bloodwork – Emergency database

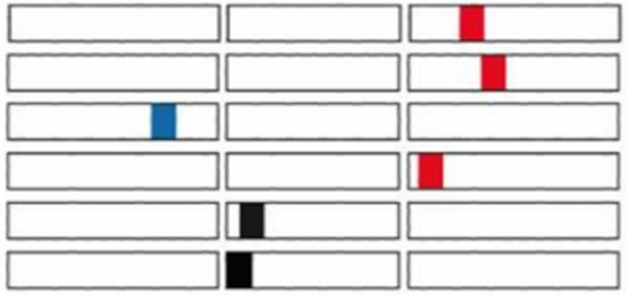
Some useful tips

- PCV/TP is usually initially normal even after severe blood loss
  - Values give a baseline for further monitoring
- BG can go very high due to stress (in cats up to 25mmol/L or more)
- Can see hyperglycaemia in dogs due to head trauma or severe hypovolaemia
- High BUN/creatinine in a trauma case raises suspicion for uroabdomen
- In the trauma case, lactate is a good indicator of hypovolaemia/ tissue perfusion
- Electrolyte/ acid-base changes, if severe, can be life-threatening
- Stress leucogram is common – this is NOT inflammation OR infection
  - BUT if inflammation then increased risk of vasodilatory shock
  - Consumptive thrombocytopaenia seen in significant haemorrhage
  - BUT NB DIC!! (Low platelets combined with prolonged coag times)

Moorview REFERRALS

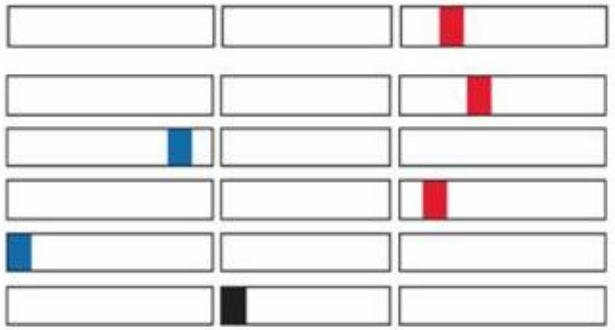
Bloodwork – Emergency database

WBC	21.65	K/µL	HIGH	(6.00 – 17.00)	
NEU	18.84	K/µL	HIGH	(3.00 – 12.00)	
LYM	0.65	K/µL	LOW	(1.00 – 5.00)	
MONO	1.95	K/µL	HIGH	(0.15 – 1.35)	
EOS	0.22	K/µL		(0.10 – 1.25)	
BASO	0.00	K/µL		(0.00 – 0.10)	



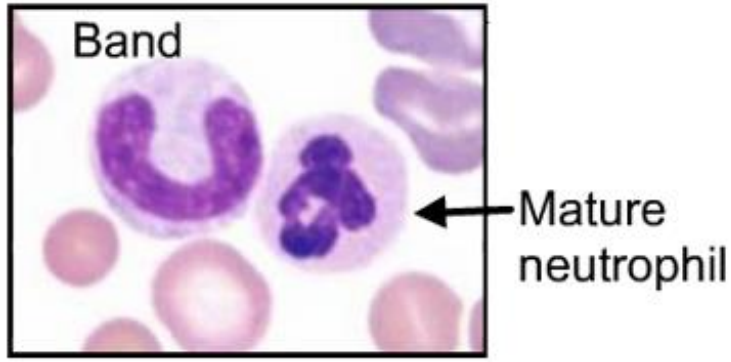
Stress leucogram

WBC	22.85	x10³/µL	HIGH	(5.50 – 16.90)	
NEU	19.93	x10³/µL	HIGH	(2.00 – 12.00)	
LYM	0.53	x10³/µL	LOW	(0.70 – 4.90)	
MONO	2.40	x10³/µL	HIGH	(0.30 – 2.00)	
EOS	0.00	x10³/µL	LOW	(0.10 – 1.49)	
BASO	0.00	x10³/µL		(0.00 – 0.10)	



Inflammation

Neutrophilia + Left shift
Lymphopenia
Eosinopenia
Minimal monocytosis



Moorview REFERRALS

Assessment of severity

The following parameters have been consistently associated with survival across many studies:

- ATT score (especially > 5)
- GCS and ↓GCS
- BE and ↓BE
- pH
- ↑ Lactate
- Traumatic brain injury is a particularly poor prognostic indicator…but is treatable

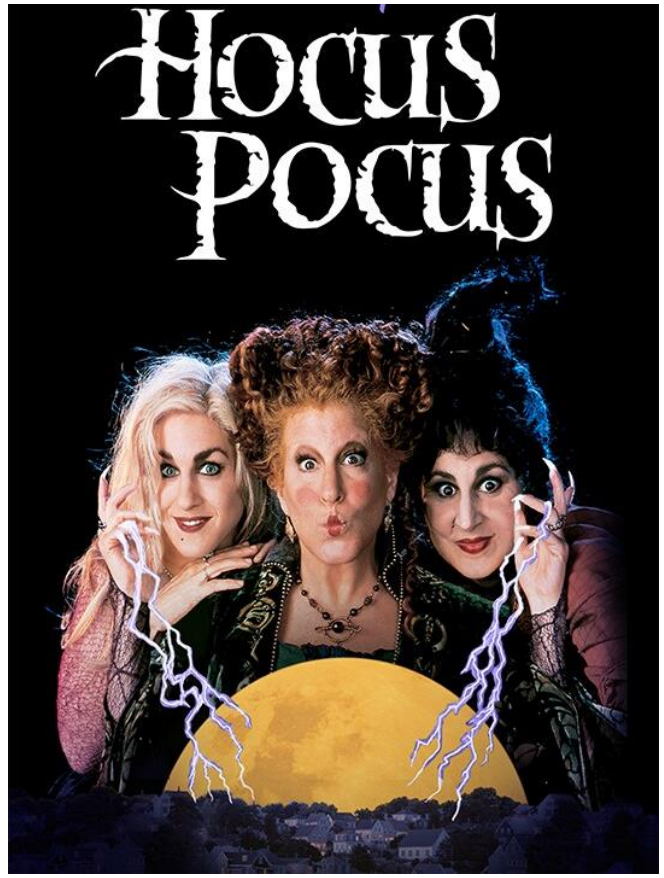
BUT!!!

- These are all drawn from population analysis
- Extreme care should be used in making decisions for individual animals
- Trends and response to therapy is MUCH more important
- Use the scoring to determine the intensity of care required…….referral……

Moorview REFERRALS

Emergency imaging

- By far the best way of performing emergency imaging is with point-of-care ultrasound (POCUS)



Moorview
REFERRALS

Emergency imaging

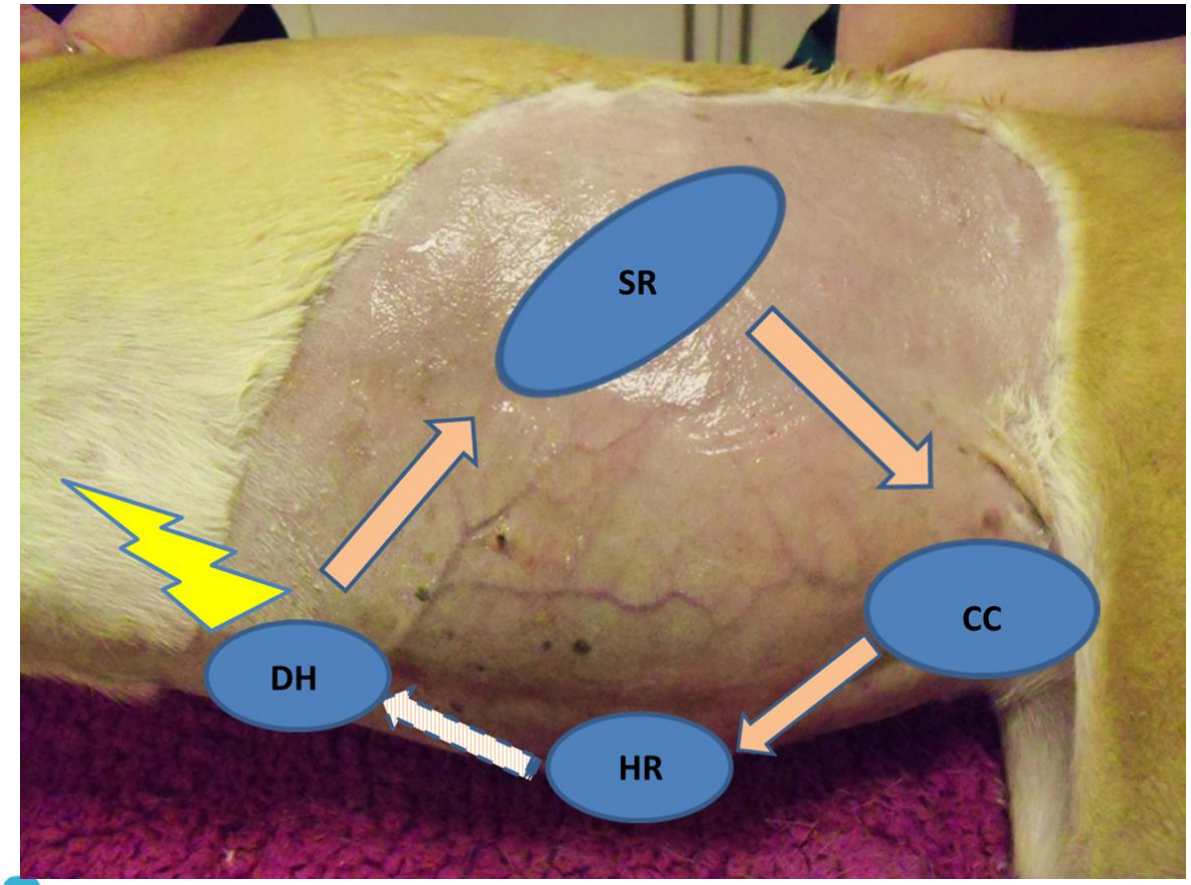
POCUS should consist of rapid ‘bedside’ assessment of:

- Abdomen – APOCUS – record volume of fluid and give AFS score
- Thorax – TPOCUS
- Heart – POCUS Echo

Moorview
REFERRALS

Emergency imaging - APOCUS

- This is a rapid scan assessing the abdomen in 4 sites, moving round like a clockface

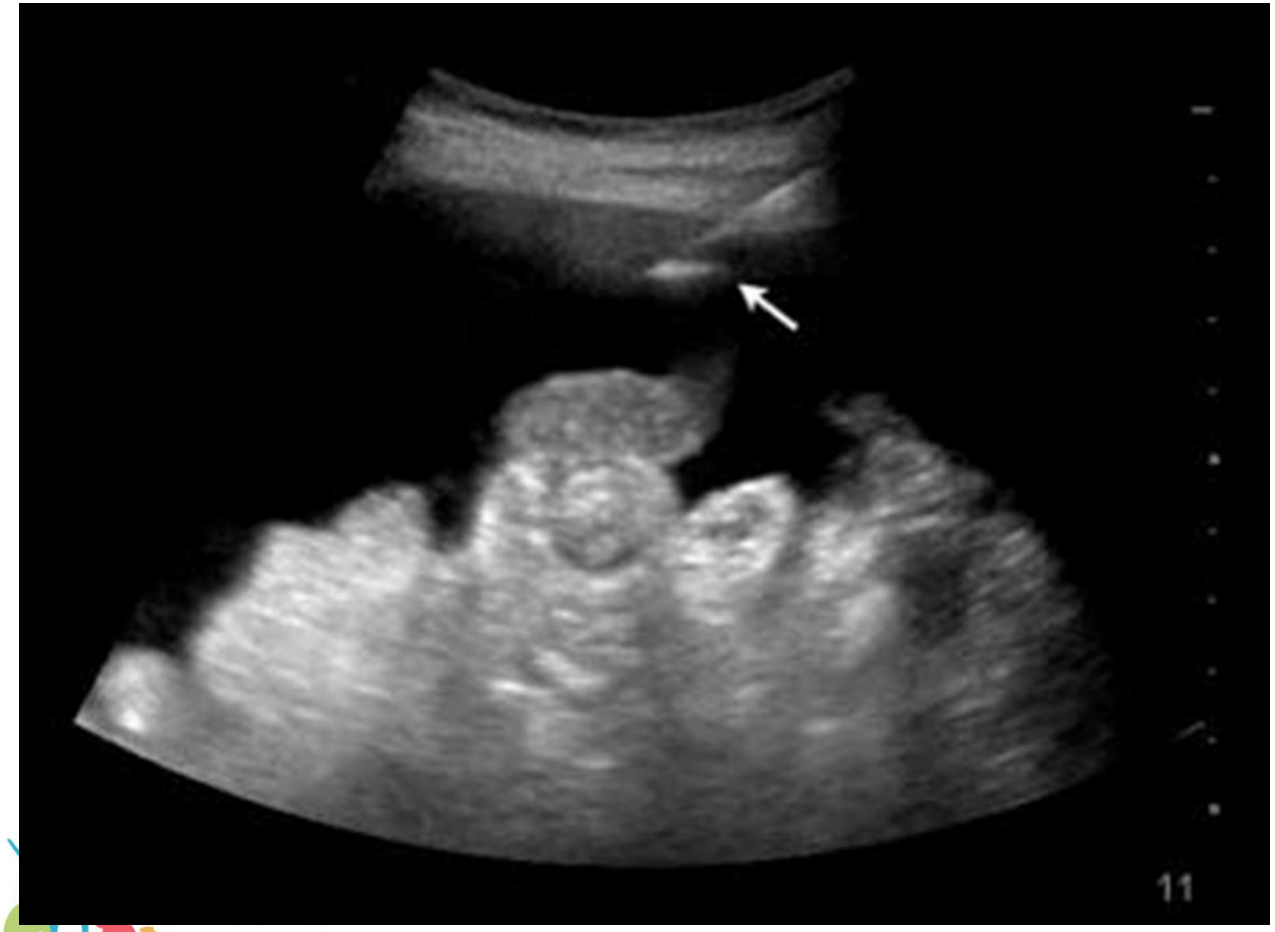


Moorview REFERRALS

Emergency imaging - APOCUS

Key assessment points:

- Presence of free fluid – if present then tap and analyse
- Damage to liver, spleen, bladder



Emergency imaging - APOCUS

- The majority of animals with free abdominal fluid following blunt trauma (eg RTA) **DO NOT** require abdominal surgery/ 'exploratory laparotomy'

- Monitor these animals with repeat FAST scanning

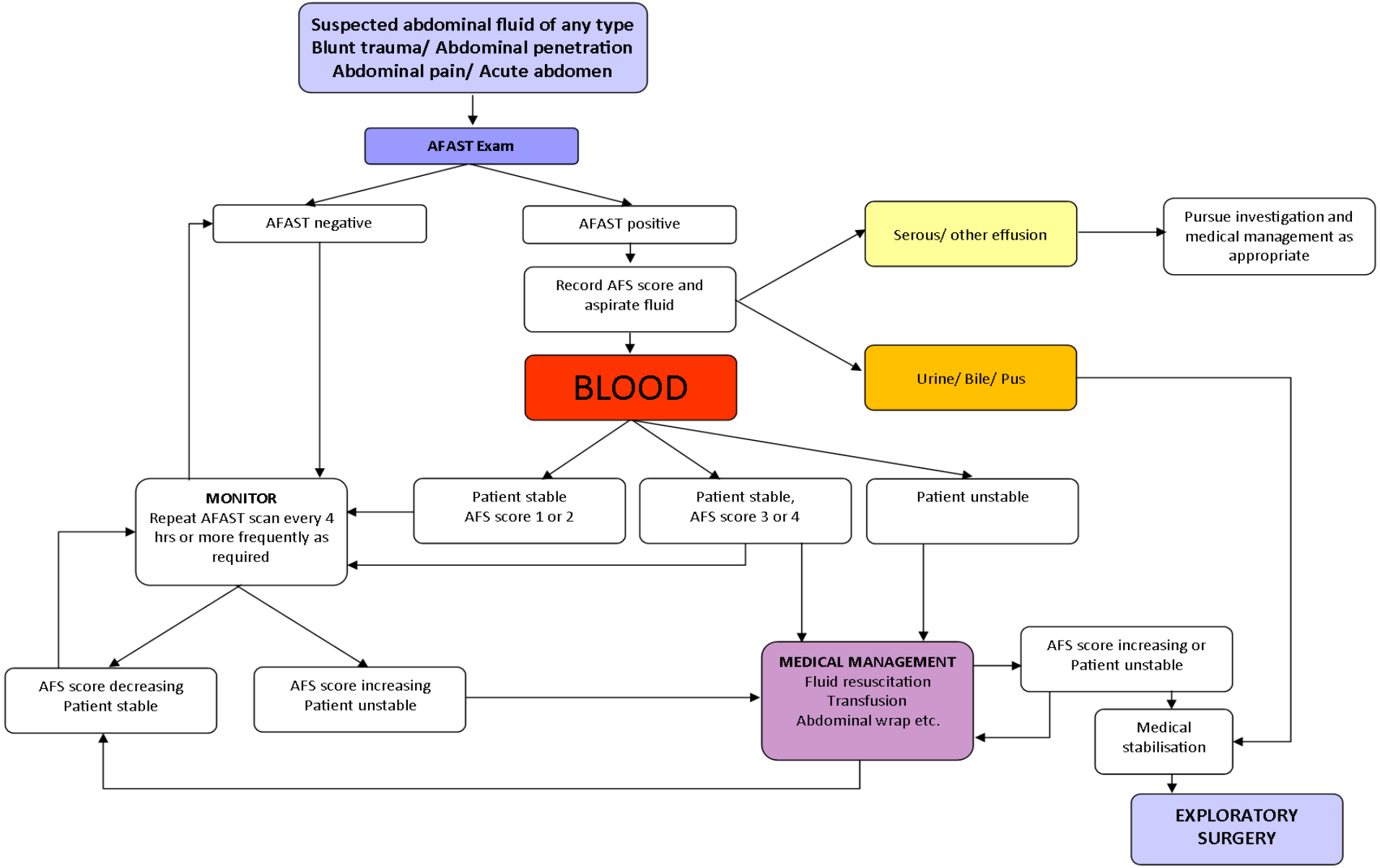
- Indications for surgery are:
  - Obvious site of bleed eg ruptured spleen
  - AFS score increasing despite medical stabilisation
  - Patient deterioration despite medical stabilisation
  - The abdominal fluid is urine, bile or pus

- **Only about 5% of RTA/ blunt trauma cases need abdominal surgery/ exploratory laparotomy**

Moorview REFERRALS

Emergency imaging - APOCUS

Algorithm for approach to cases with suspected abdominal fluid using serial AFAST scoring system



Emergency imaging - TPOCUS

TPOCUS is incredibly useful for thorax assessment in the trauma patient:

- Pneumothorax
- Pulmonary contusions
- Pleural effusion (haemothorax)
- Diaphragmatic hernia

Use a systematic method:

- DH site
- CTS site
- PCS site

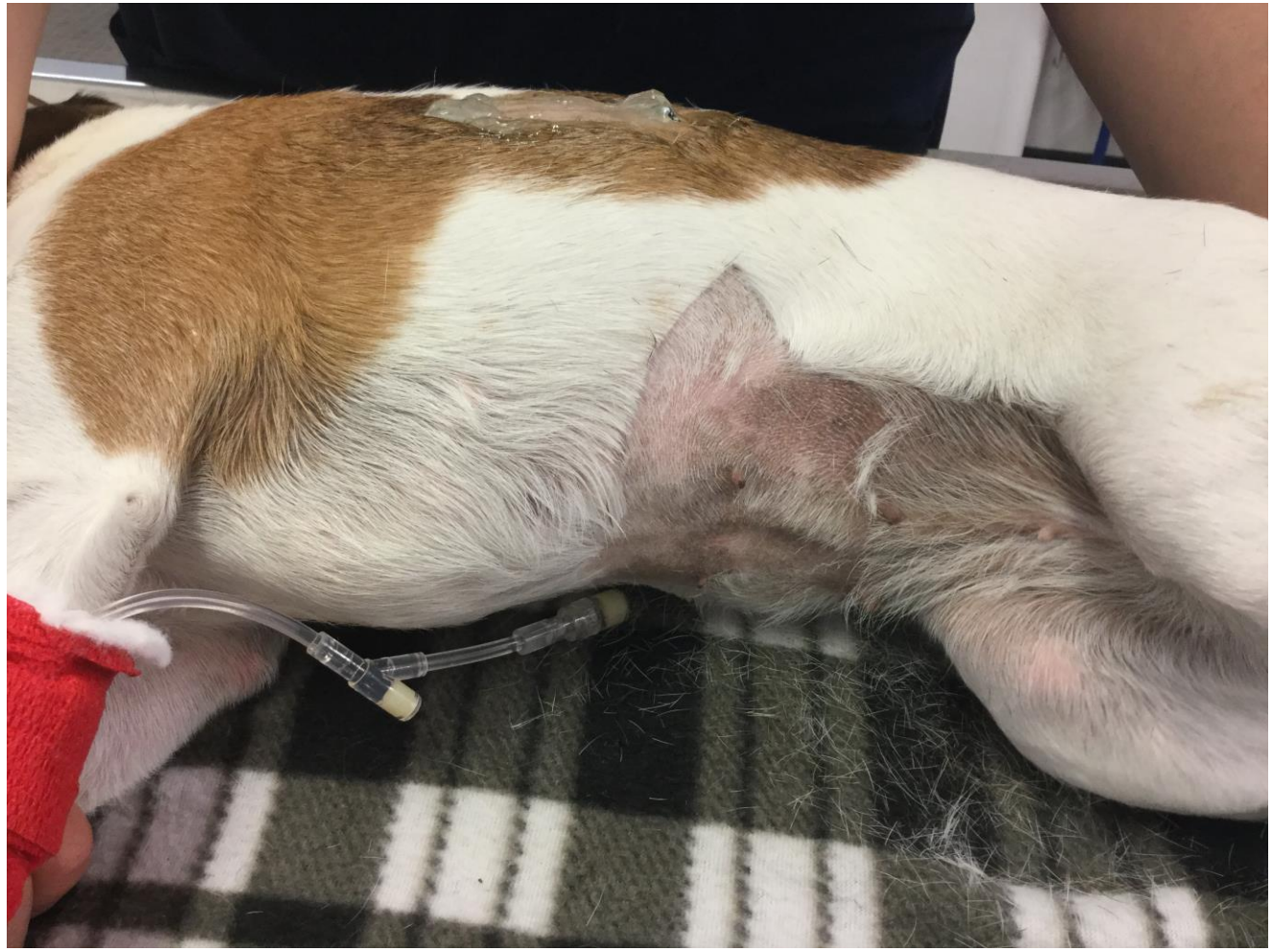
Moorview REFERRALS

Emergency imaging – TPOCUS – DH site

Moorview REFERRALS

Emergency imaging - TPOCUS

DH → CTS site



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Emergency imaging - TPOCUS

Moorview
REFERRALS

Emergency imaging - TPOCUS

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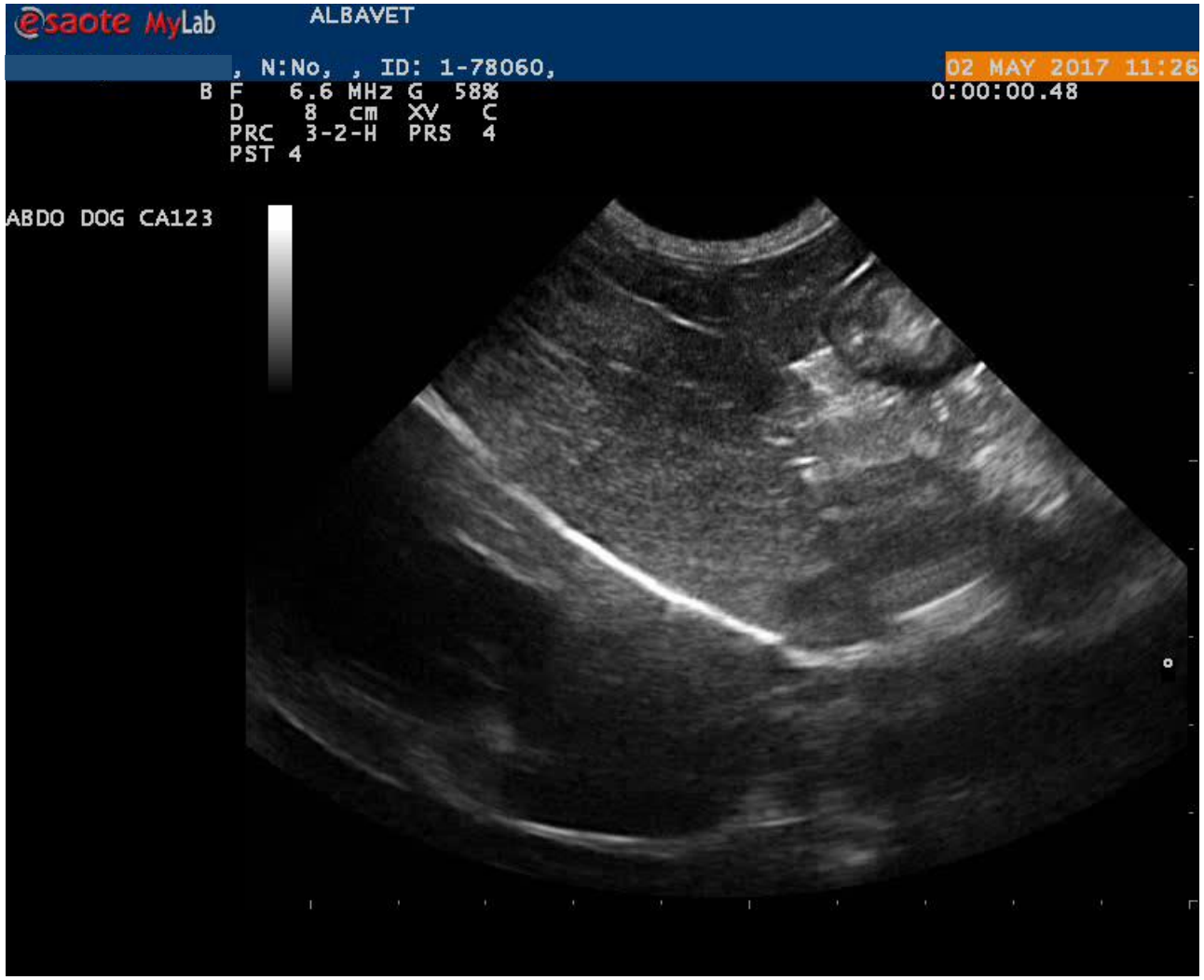
Emergency imaging – TPOCUS – DH site



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Emergency imaging - TPOCUS

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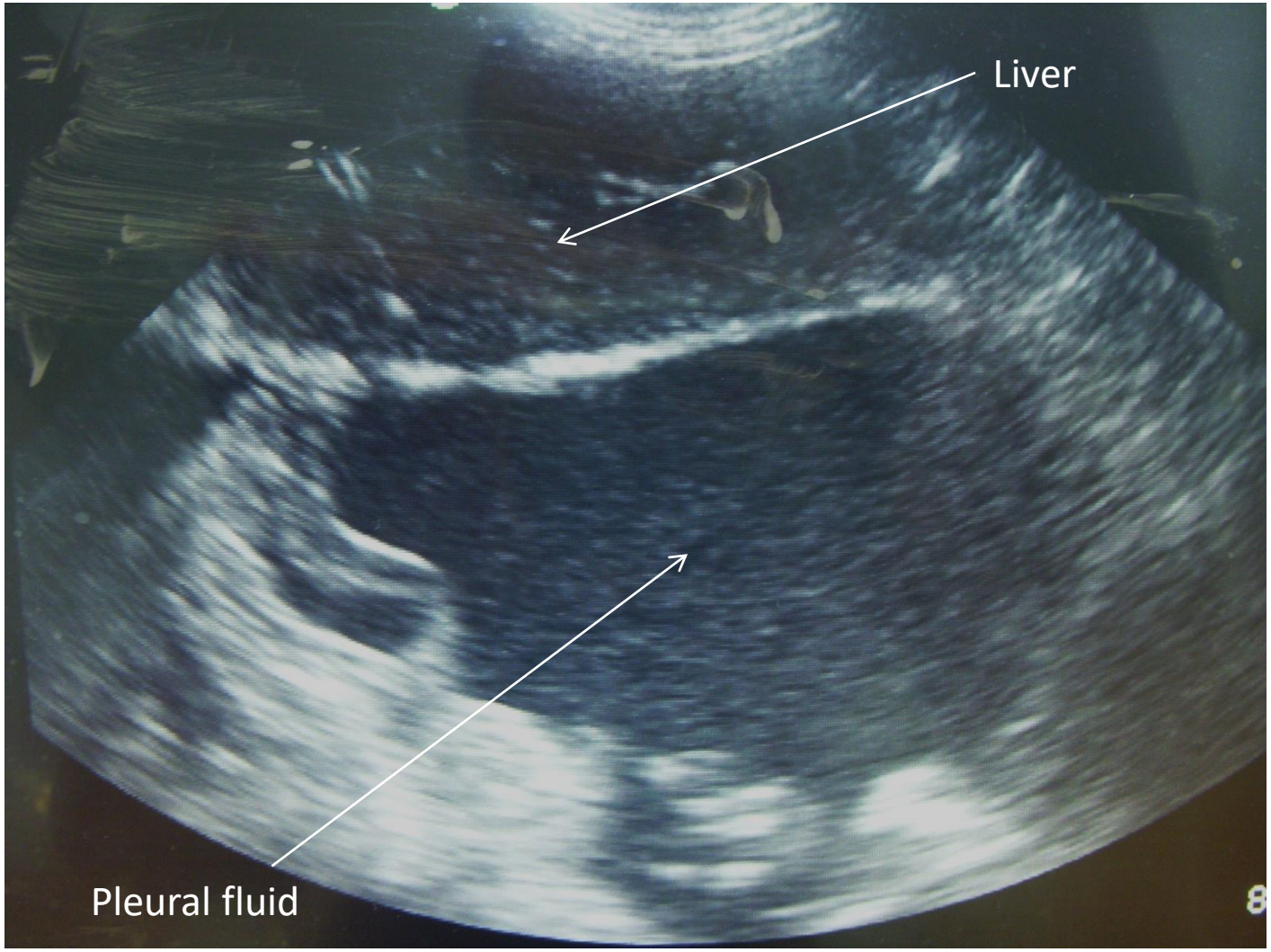
Emergency imaging - TPOCUS



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Emergency imaging – TPOCUS – CTS site

Moorview REFERRALS

Emergency imaging - TPOCUS

Moorview
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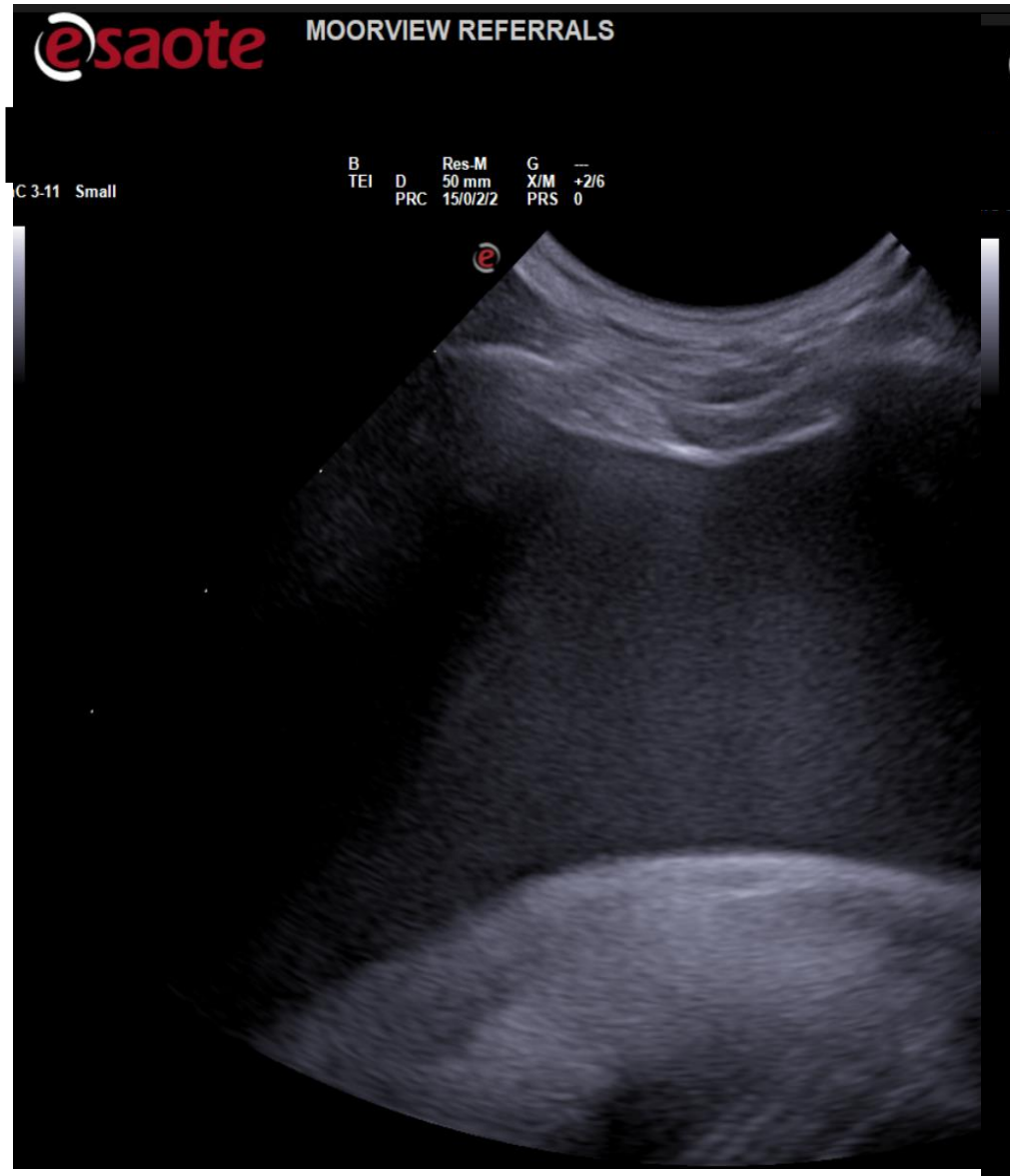

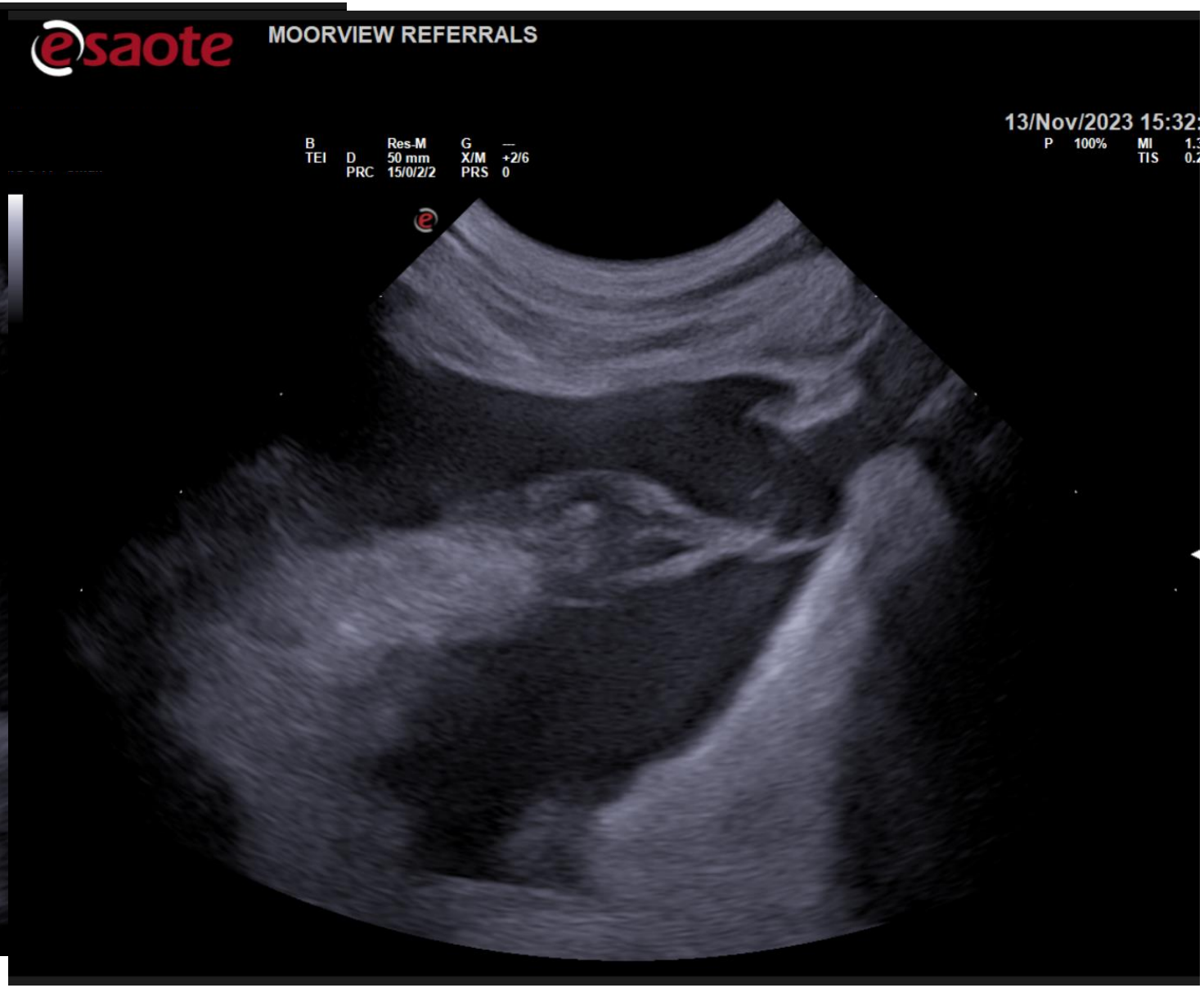

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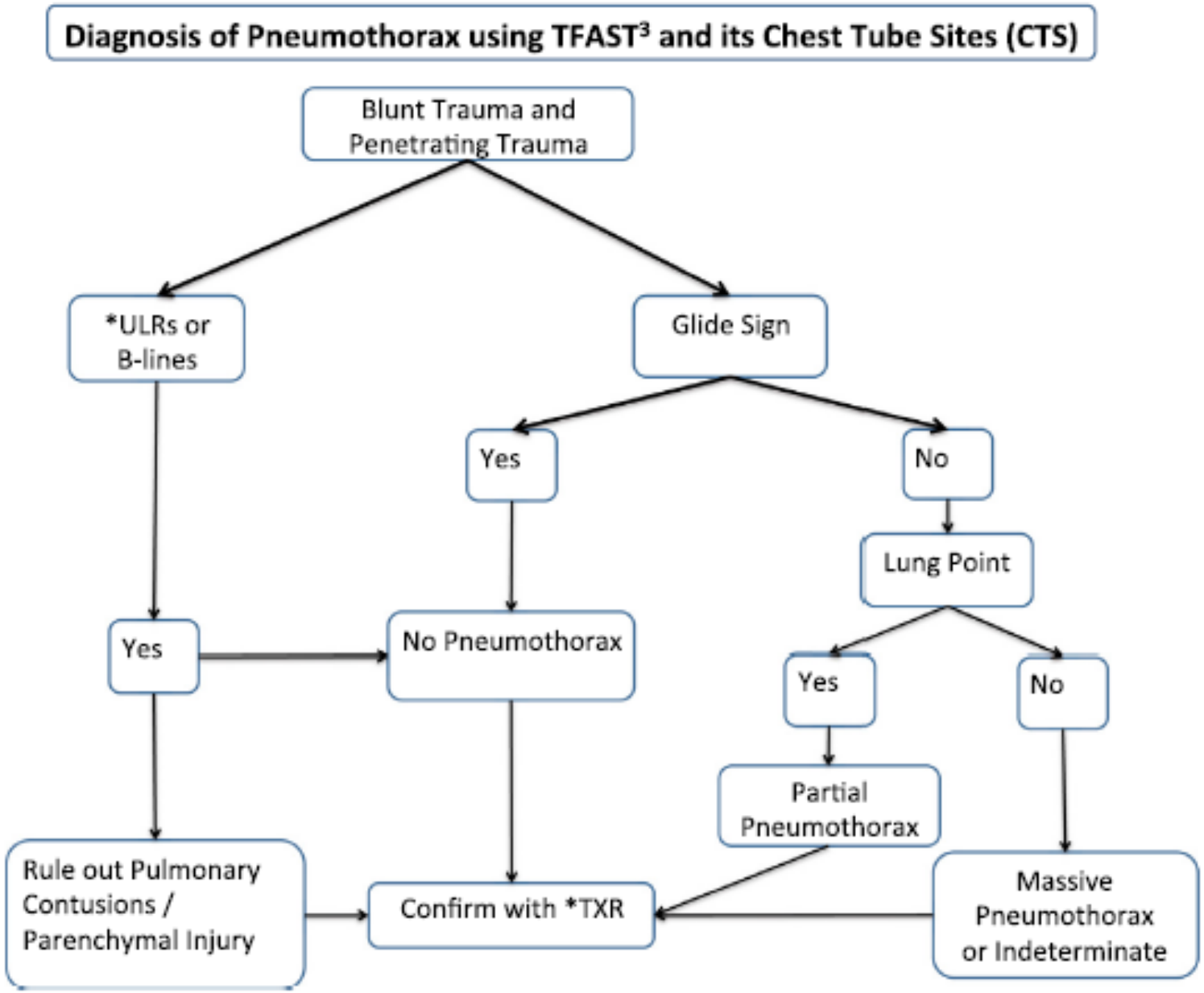

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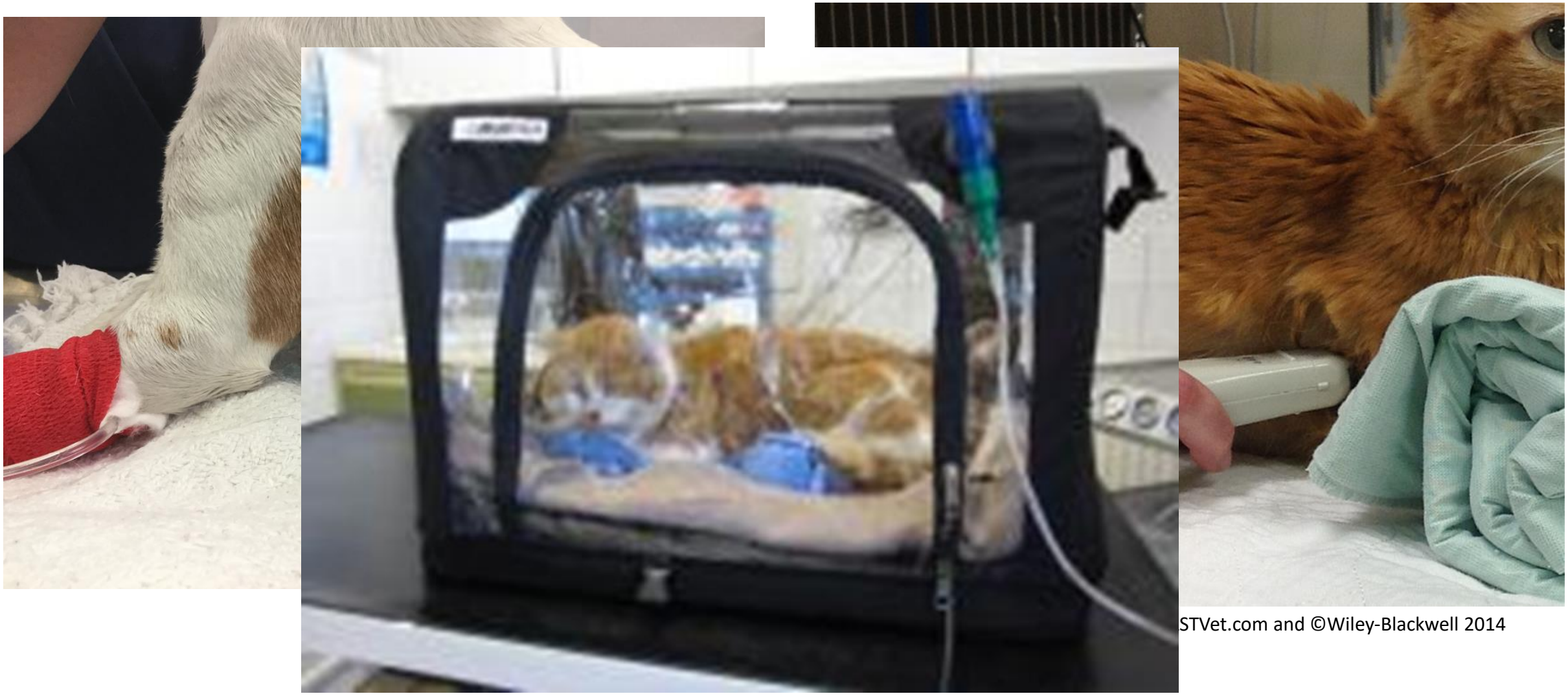
Emergency imaging - TPOCUS



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TPOCUS – pericardial (PCS) site

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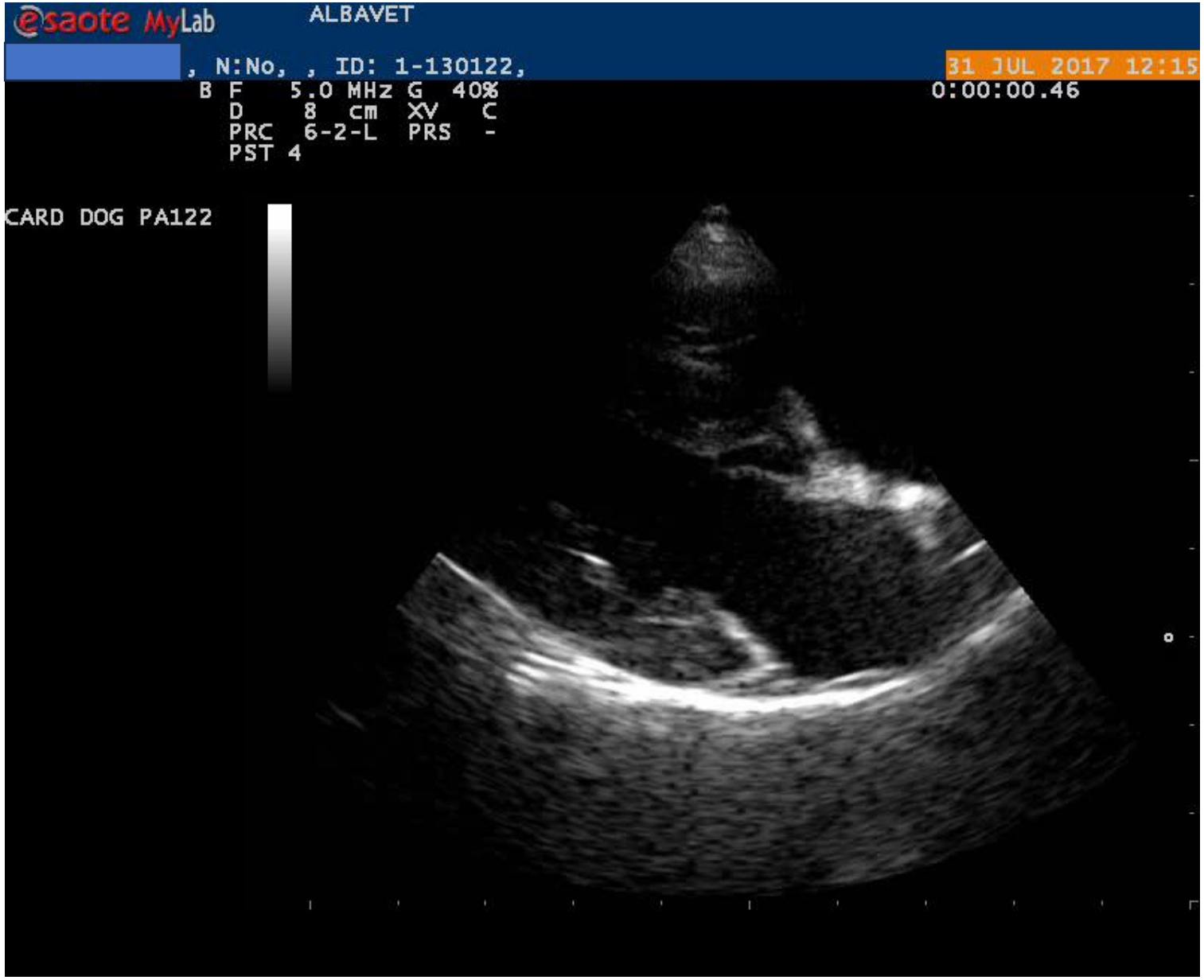

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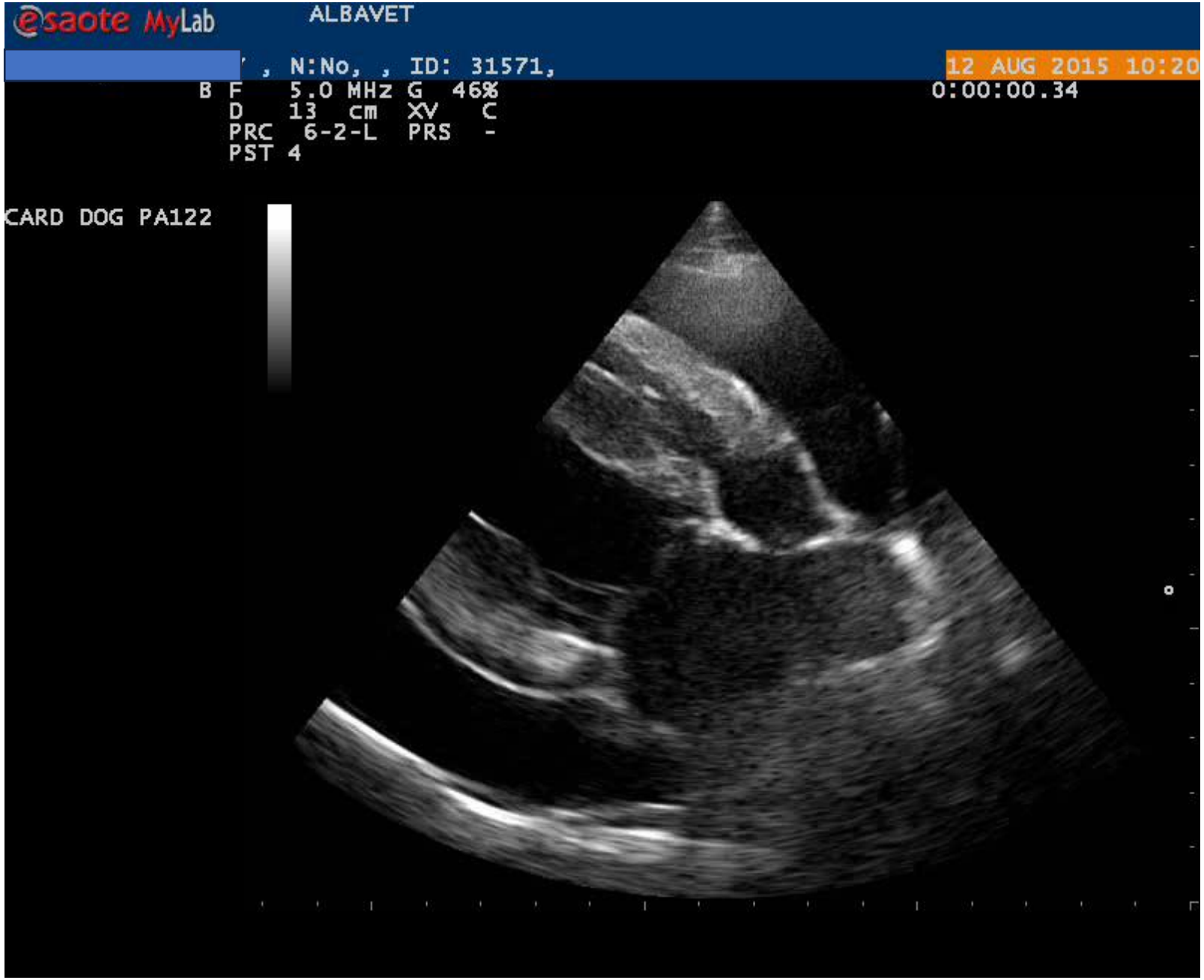
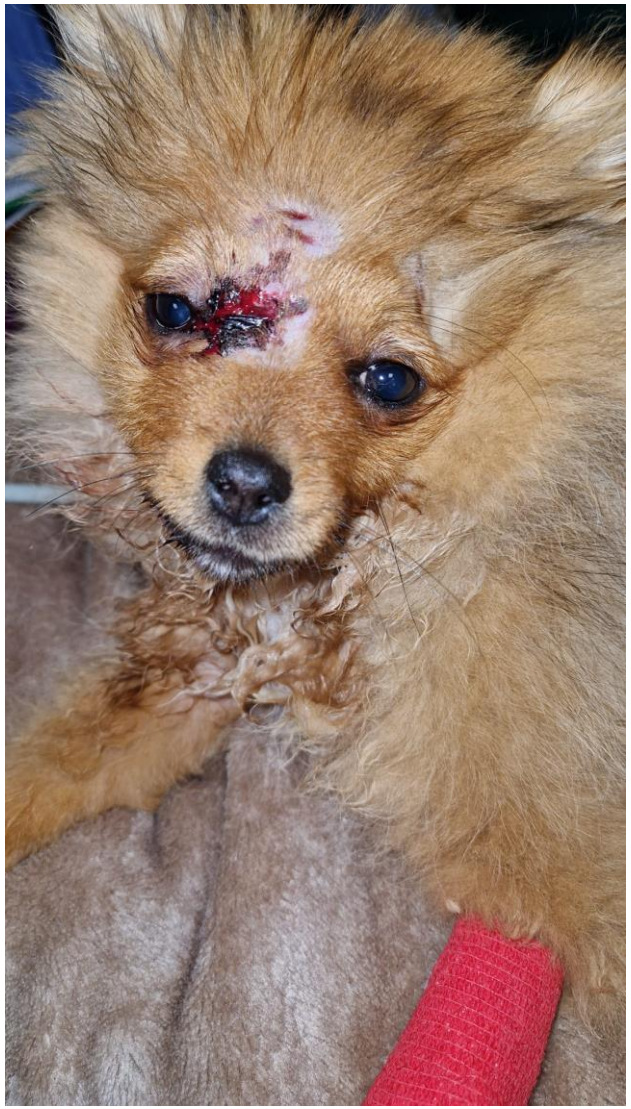


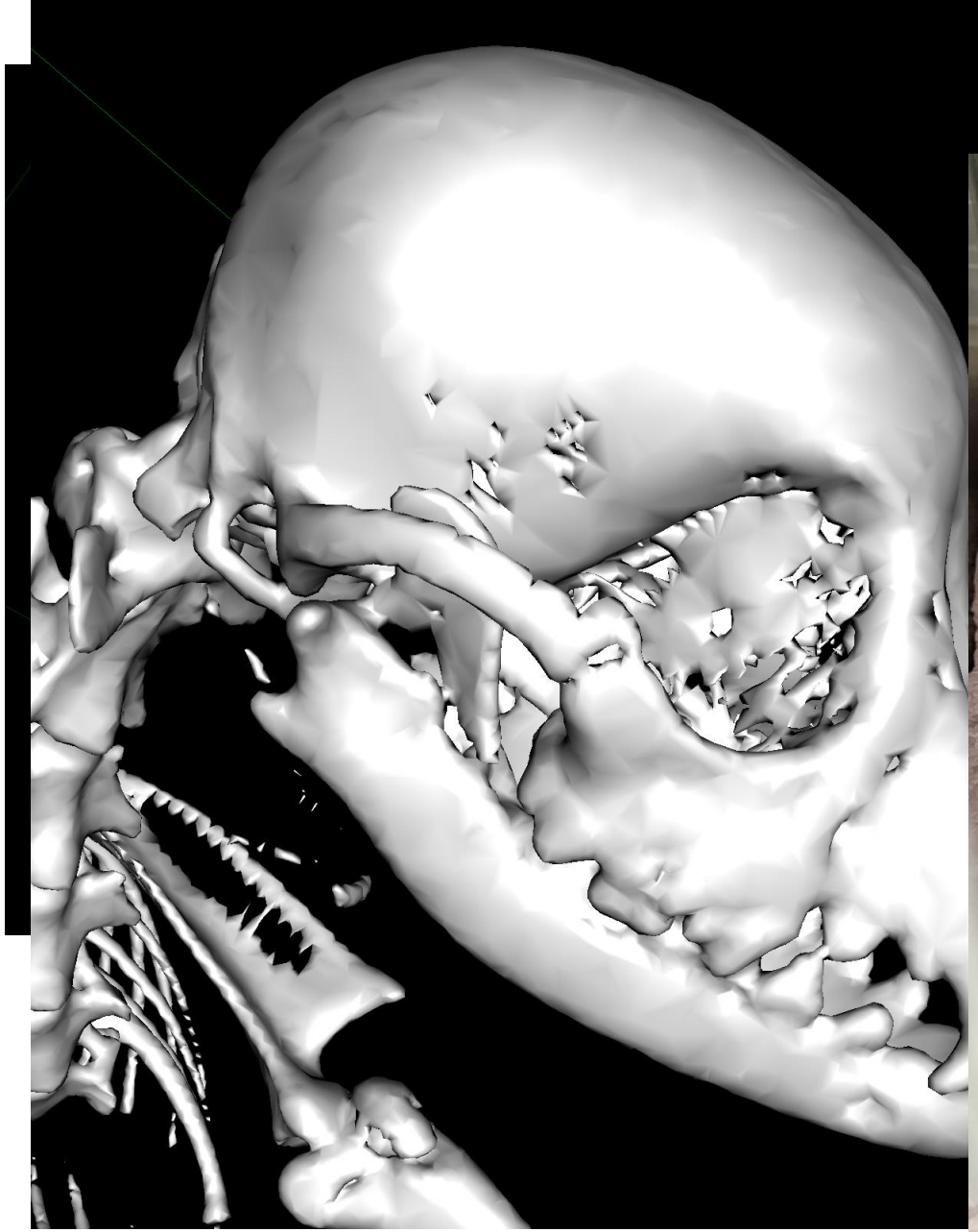
Moorview REFERRALS

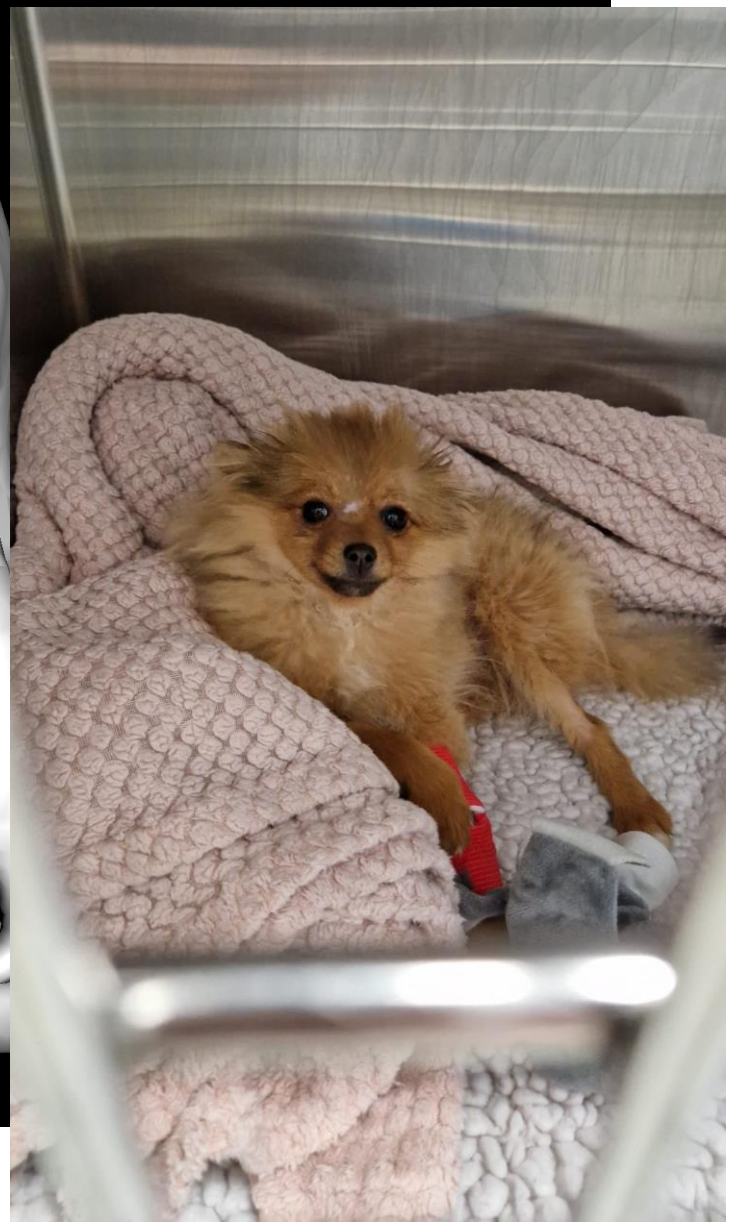
Trauma CT – fantastic if you've got it

Moorview REFERRALS

Trauma CT







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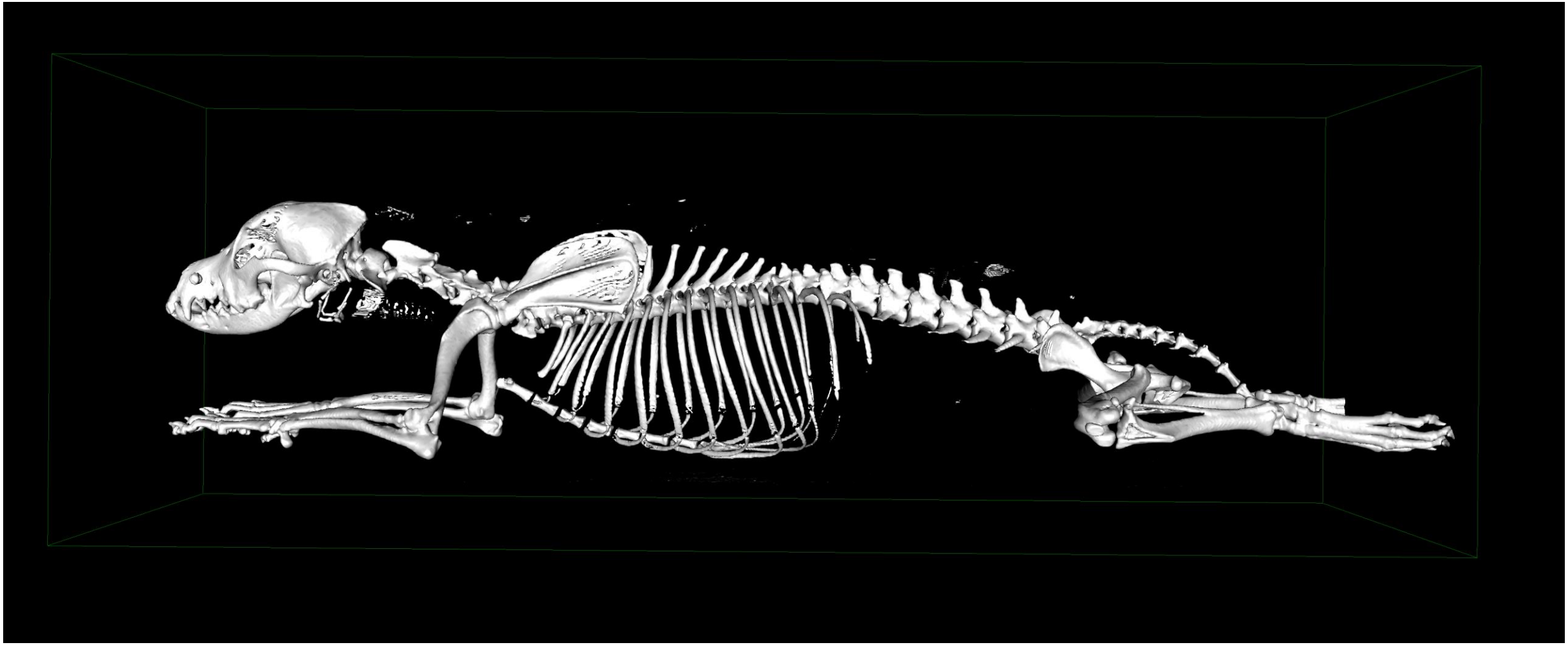
Trauma CT



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Trauma CT

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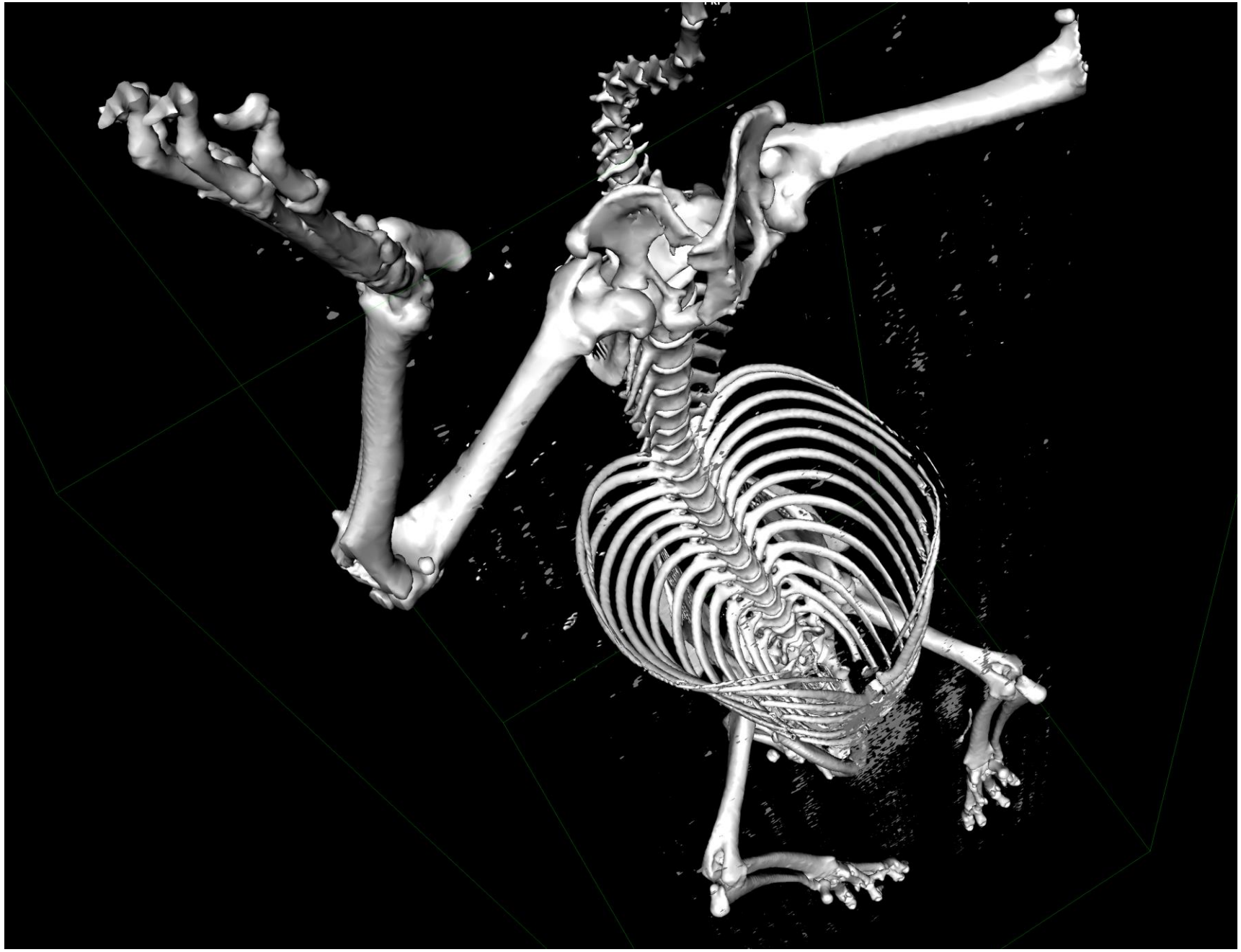
Trauma CT



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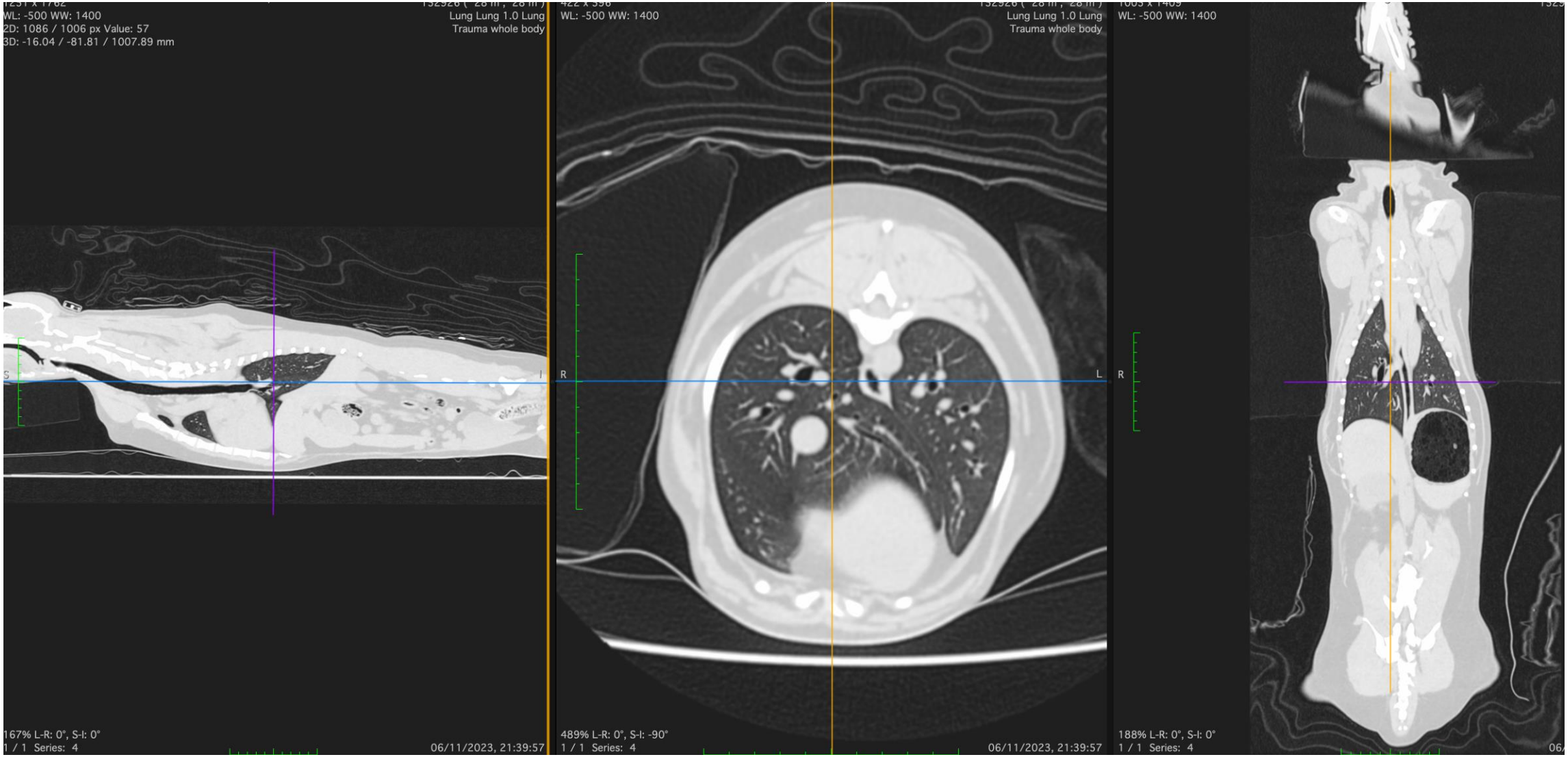

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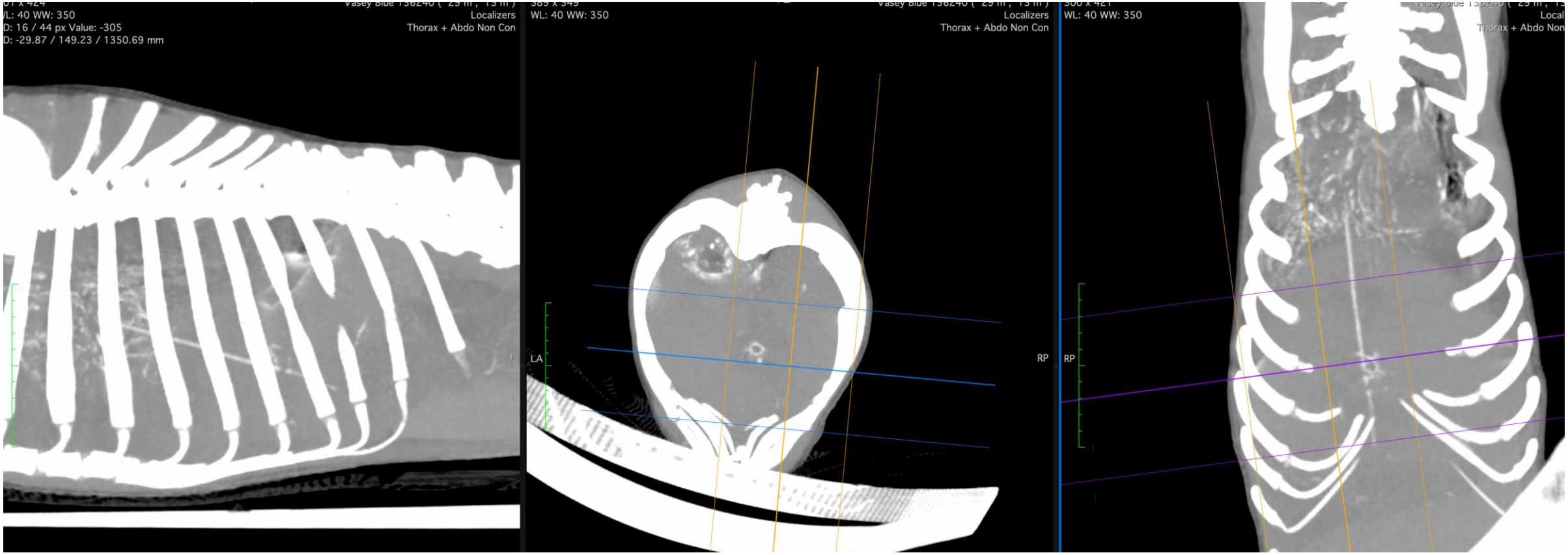
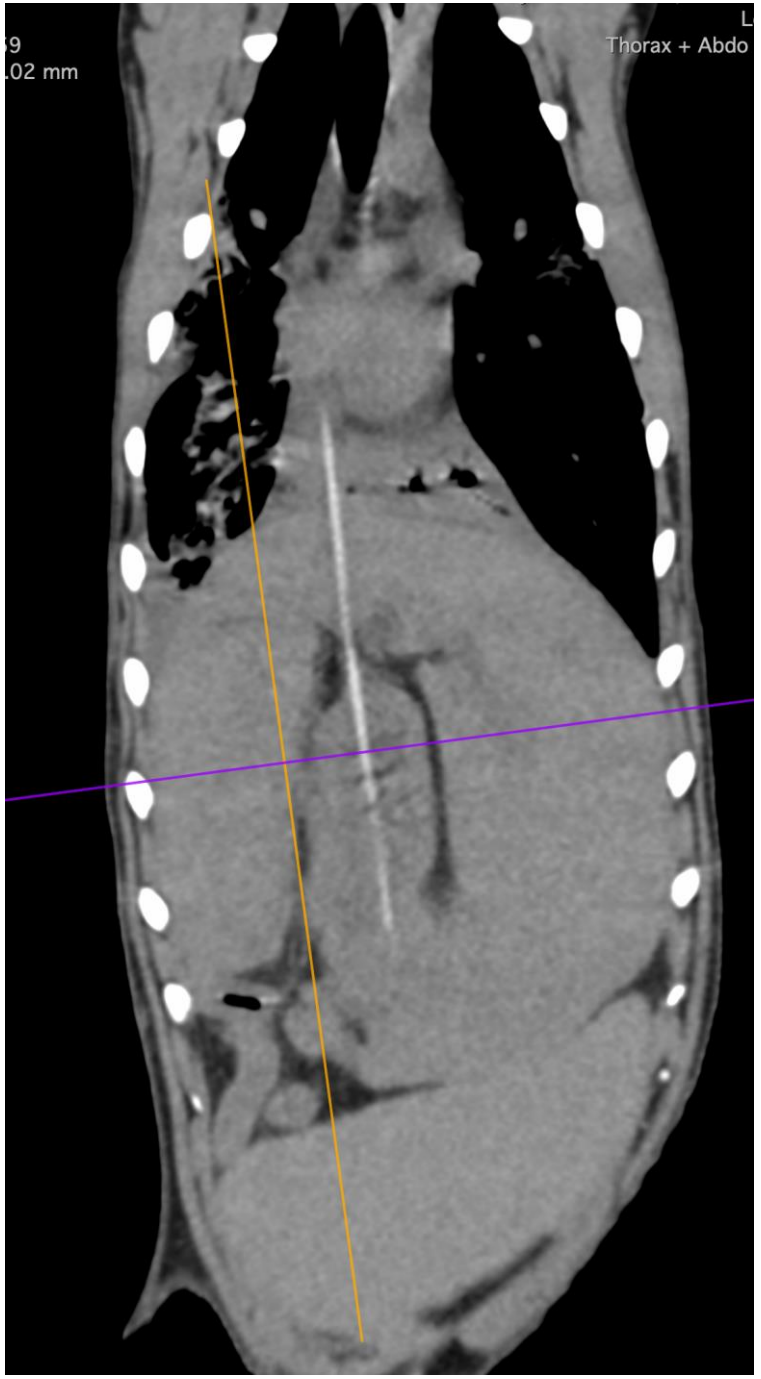
Trauma CT



Moorview REFERRALS

Trauma CT

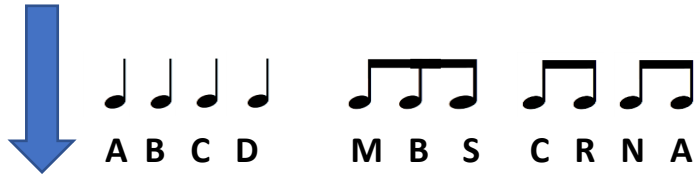


Triage and Primary/Secondary Survey - Summary

The Call

The Prep

The arrival – **Reception/ Nurse Triage - ABCD**



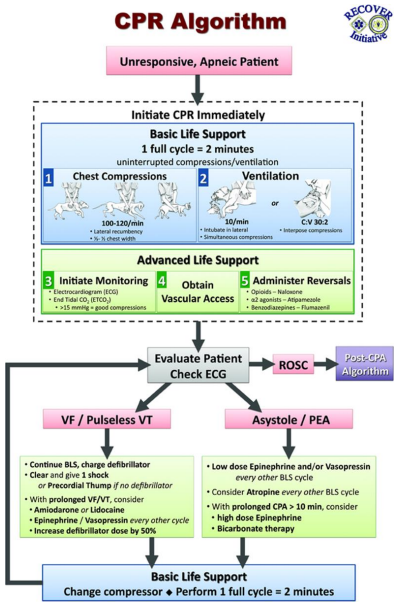
Primary Survey – MBS CRNA O

Secondary Survey

Bloodwork

Imaging

The Emergency Plan
Initial stabilisation
Monitoring/ Response
Further diagnostics

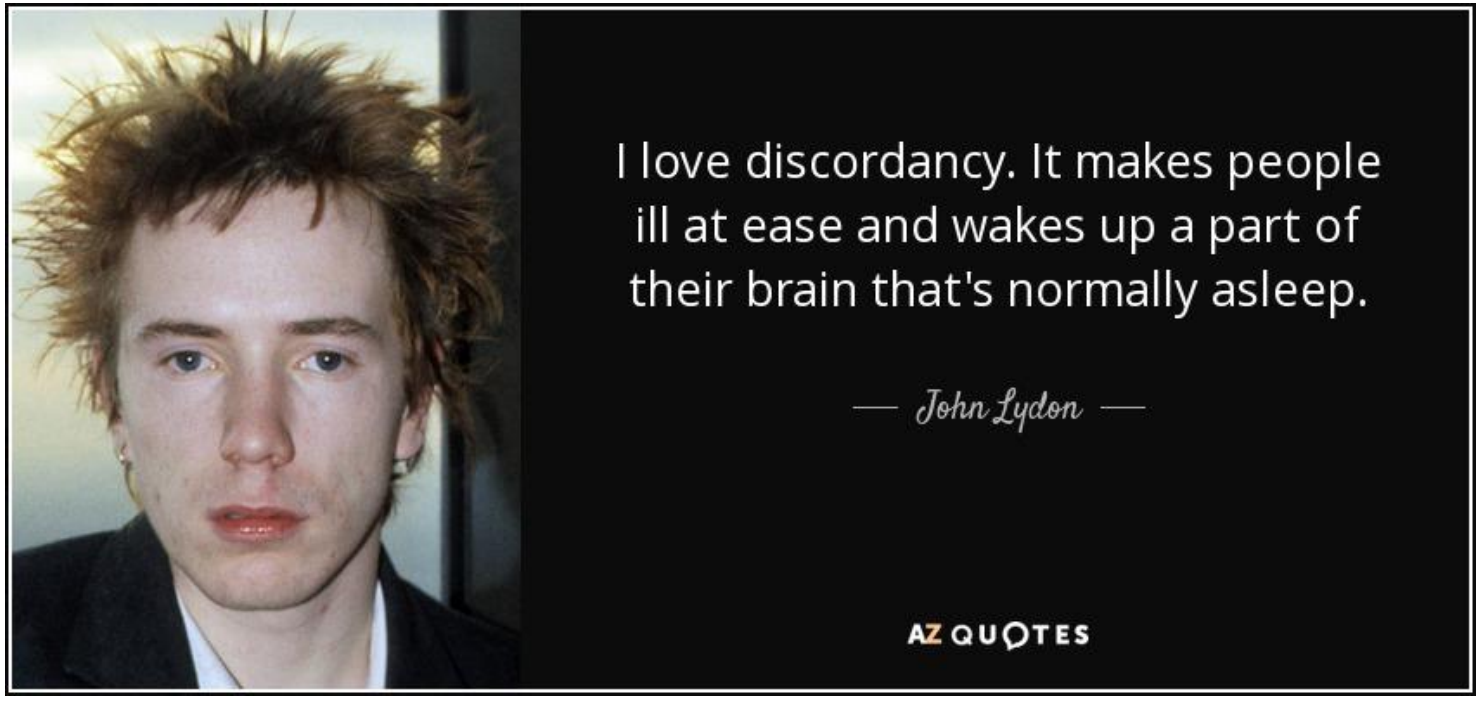


TREATMENT

Moorview REFERRALS

Emergency Plan

- Treatment of any life-threatening injuries identified during the primary survey
- Treatment of any life-threatening injuries identified during the secondary survey
- Treatment should have a specific end-goal **‘goal-directed therapy’** and continue until that goal is achieved
- Clinical signs should be integrated, cross-referenced, and serially monitored
- Inadequate or unexpected response, or discordancy, should be investigated



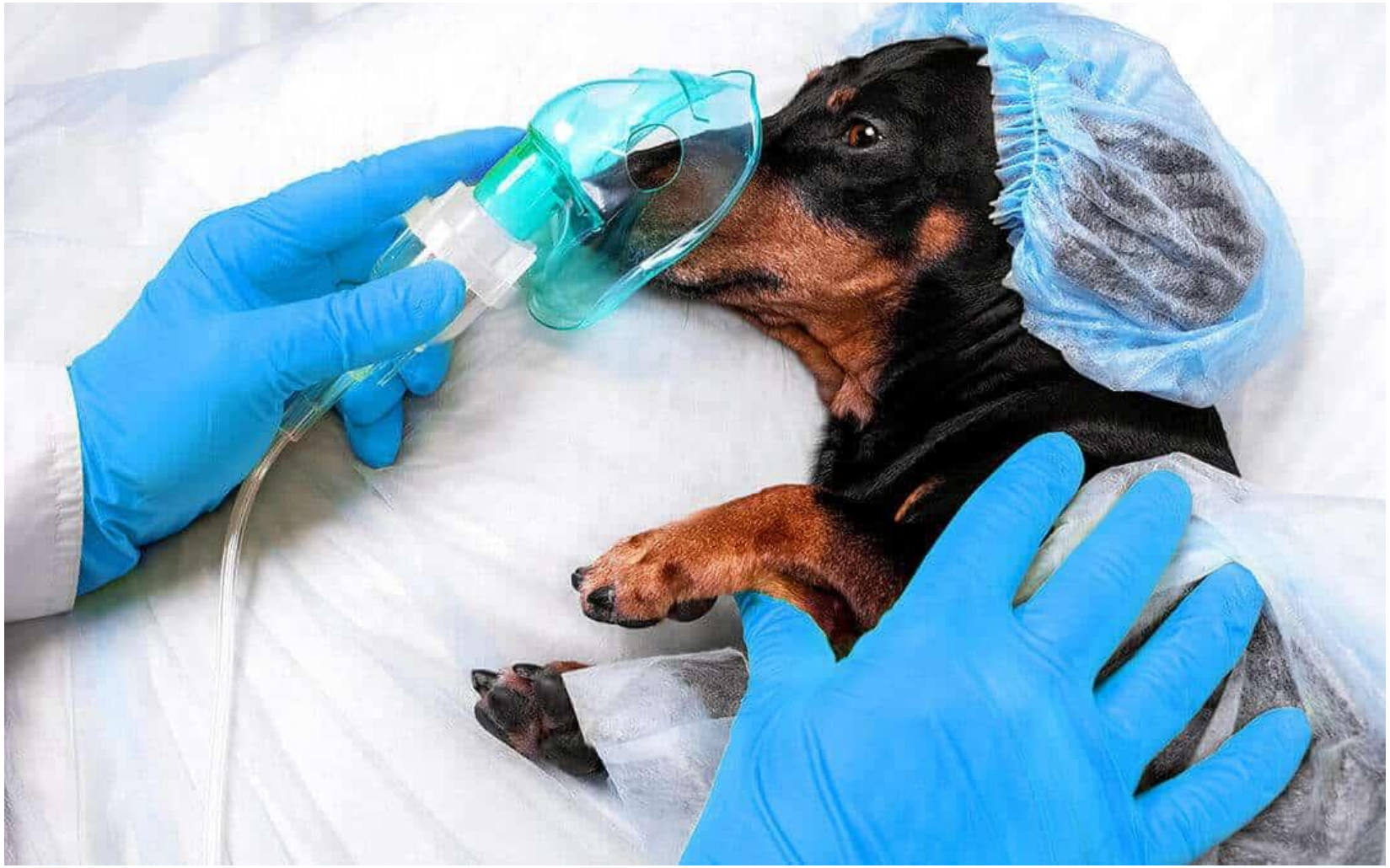
Moorview REFERRALS

Target resusc endpoints in the trauma patient

Parameter	Target endpoint
Mentation	Alert
HR	Dog 80-140, Cat 180-200
MM colour	Pink
CRT	1-2 seconds
Pulse quality	Good
MAP (mmHg)	60-80 (>65)*
sABP (mmHg)	90-100*
Respiratory rate and effort	20-30bpm, normal effort
SpO_2(%)	>95
PCV (%)	>25
Lactate (mmol/L)	<2.5
pH	>7.32
BE (mmol/L)	-5 to +5
Electrolytes	Normal
UOP (ml/kg/hr)	>1

Moorview REFERRALS

Emergency Plan – 1) Oxygen



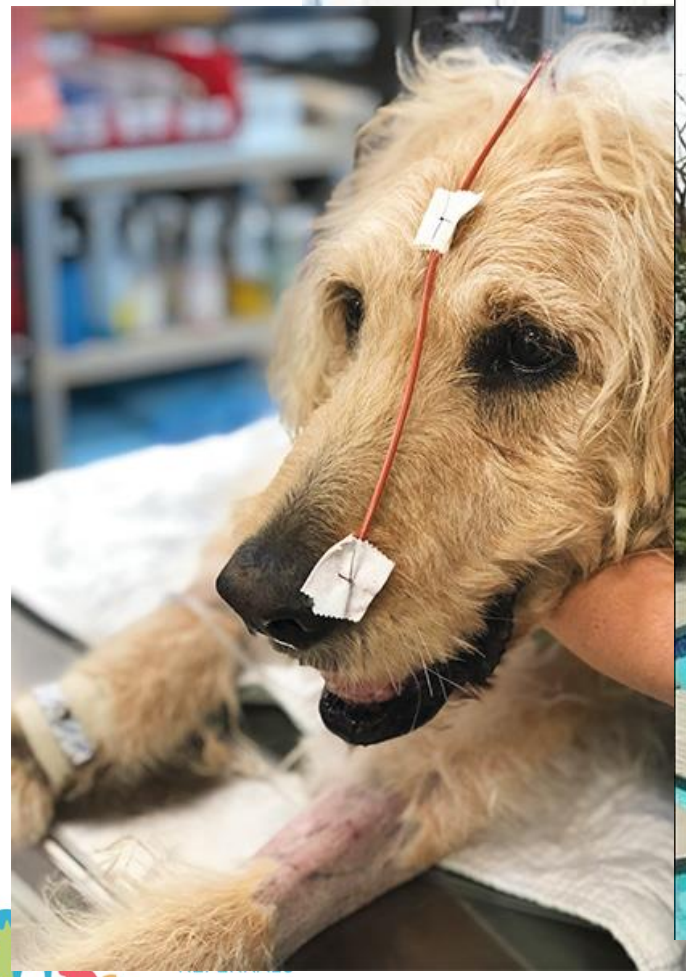
Moorview REFERRALS

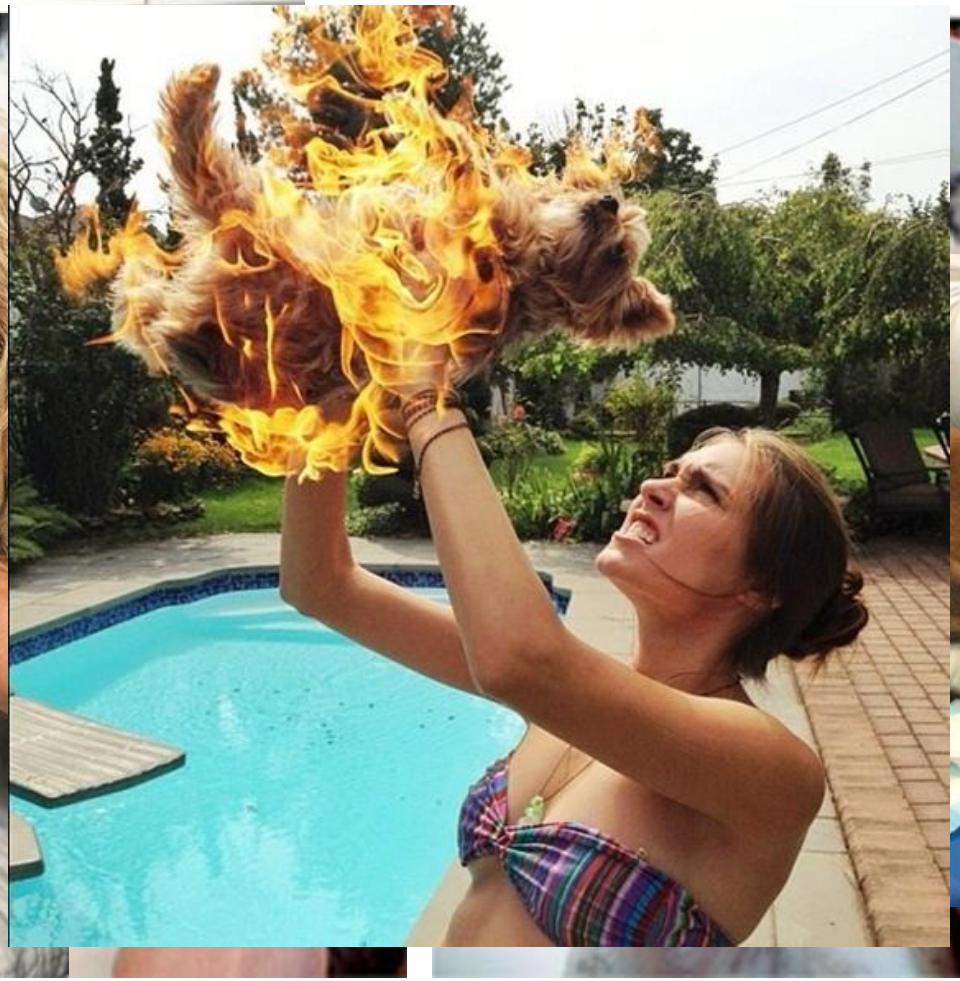
The 1st commandment for the emergency patient

Oxygen supplementation

For **every** patient.

The only contra-indication to oxygen therapy is if the patient is on fire.





Emergency Plan – 1) Oxygen

Percent of oxygen achieved and time taken to reach noted levels	
Method of supplemental oxygen delivery	**% of oxygen concentration achievable**
Nasal cannula	40%-50%
Nasal catheter	40%-70%
Nasopharyngeal catheter	60%-80%
Nasotracheal catheter	60%-90%
(Crowe) oxygen collar	50%-80%
Oxygen cages	30%-60%
Non-rebreathing mask	90%-100%

Flow rates

- Nasal prongs 50-100ml/kg/min
- Nasal catheter 25-50ml/kg/min

Moorview REFERRALS

Emergency Plan – 2) Fluids

Moorview REFERRALS

The fundamental difference between hypovolaemia and dehydration

- Dehydration refers to loss of fluid from the interstitial space
- Hypovolaemia refers to loss of fluid from the intravascular space
- **These produce different clinical signs and are assessed differently**

Classic signs of hypovolaemic shock:

- Decreased mentation
- Pale mm
- Prolonged CRT
- Tachycardia
- Poor pulse quality
- Reduced temperature of the extremities

Classic signs of dehydration:

- Skin ‘tenting’
- Tacky or dry mucous membranes
- Increased PCV/TP ‘Haemoconcentration’

In trauma cases, we will be assessing and treating hypovolaemia not dehydration

Moorview REFERRALS

Hypovolaemia versus dehydration

This table summarises the differences between mild to moderate dehydration and acute hypovolaemia, with respect to the volume changes in each fluid compartment, clinical signs and laboratory parameters

	Mild to moderate dehydration	Acute hypovolaemia
Intravascular volume	↓ ??	↓ ↓ ↓
Interstitial volume	↓	↓ /No change
Intracellular volume	↓	No change
Heart rate	No change	↑ ↑ ↑
Capillary refill time	No change	↑ progressing to ↓
Skin turgor	↑ ↑	No change
Total solids/packed cell volume	↑	No change/ ↓ total solids
Urine output	↓	↓
Pulse quality	No change	Hyperdynamic pulses (obvious but short) progressing to hypodynamic (weak and short)

Moorview REFERRALS

Emergency Plan – 2) Fluids

- Before fluid therapy, take a moment to consider types of shock
  - **HYPOVOLAEMIA –** by far the most common type
  - **Distributive –** severe tissue trauma → Systemic vasodilation

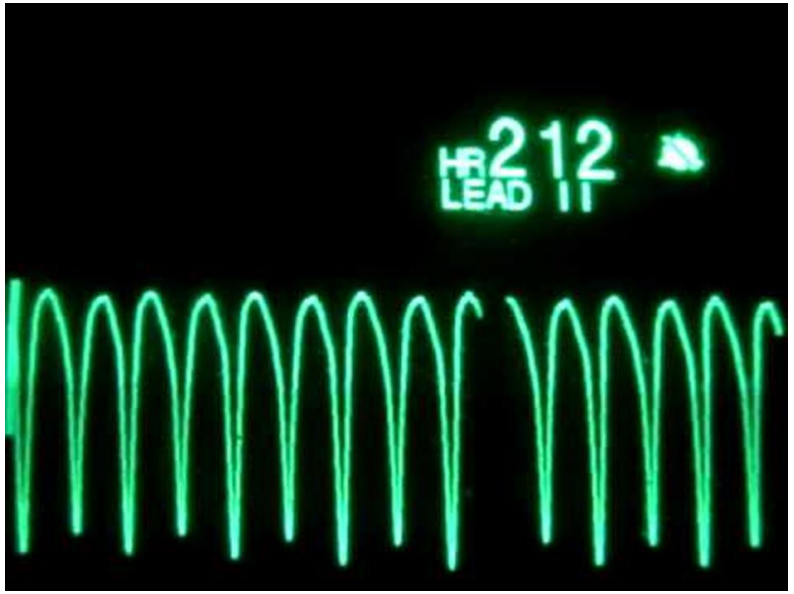
Moorview REFERRALS

Emergency Plan – 2) Fluids

- Before fluid therapy, take a moment to consider types of shock
  - **HYPOVOLAEMIA –** by far the most common type
  - **Distributive –** severe tissue trauma → Systemic vasodilation
  - **Cardiogenic –** 'pump failure'
    - Cardiac contusions
    - Pericardial effusion ('Obstructive')
    - Severe arrythmia

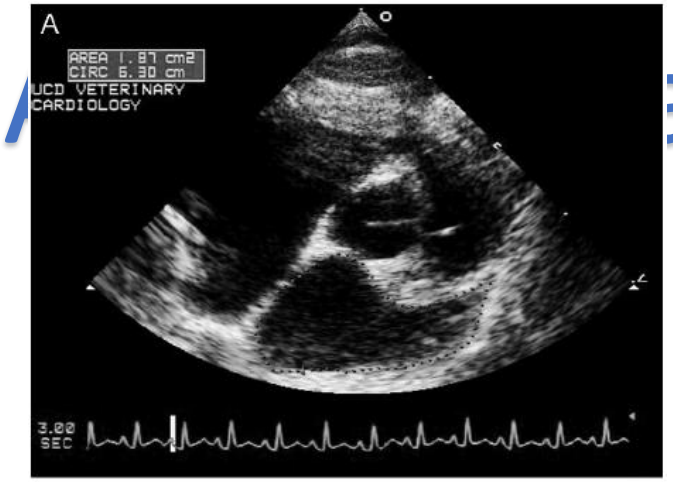
Important!

- Hypovolaemia → Fluids…..Vasopressors
- Distributive → (Fluids), Vasopressors eg noradrenaline
- Cardiogenic → NO FLUIDS! →
  - Drain pericardial effusion
  - Treat arrhythmia
  - Inotropes eg Dobutamine

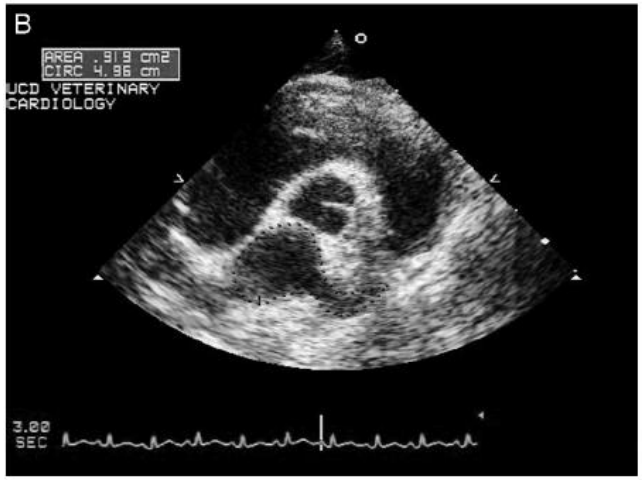


Moorview REFERRALS

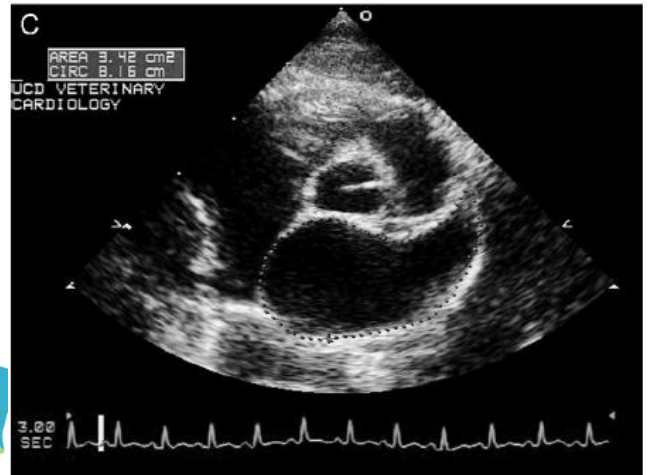
Assessment of fluid status



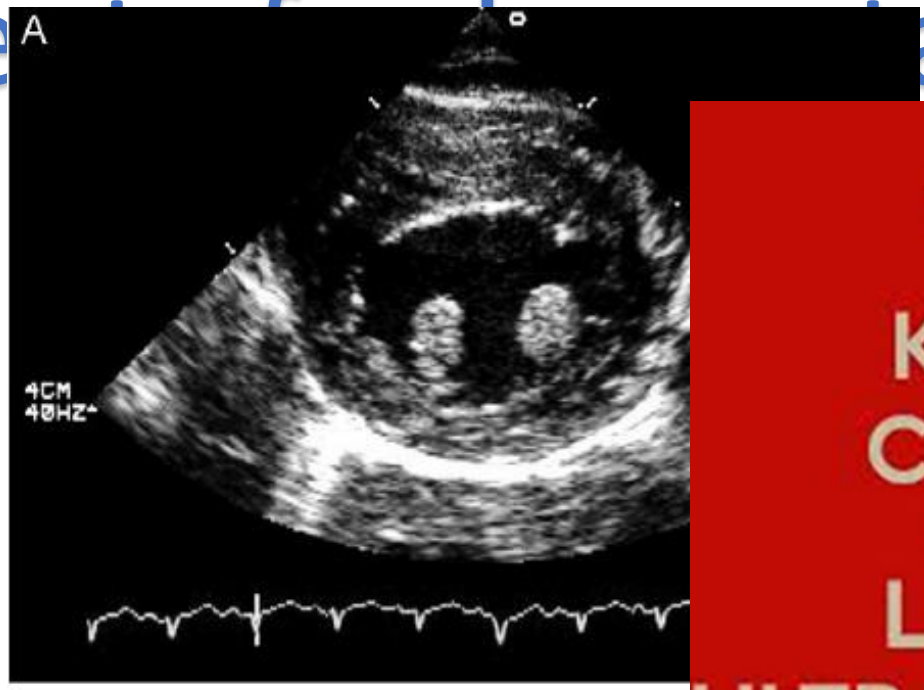
Normal

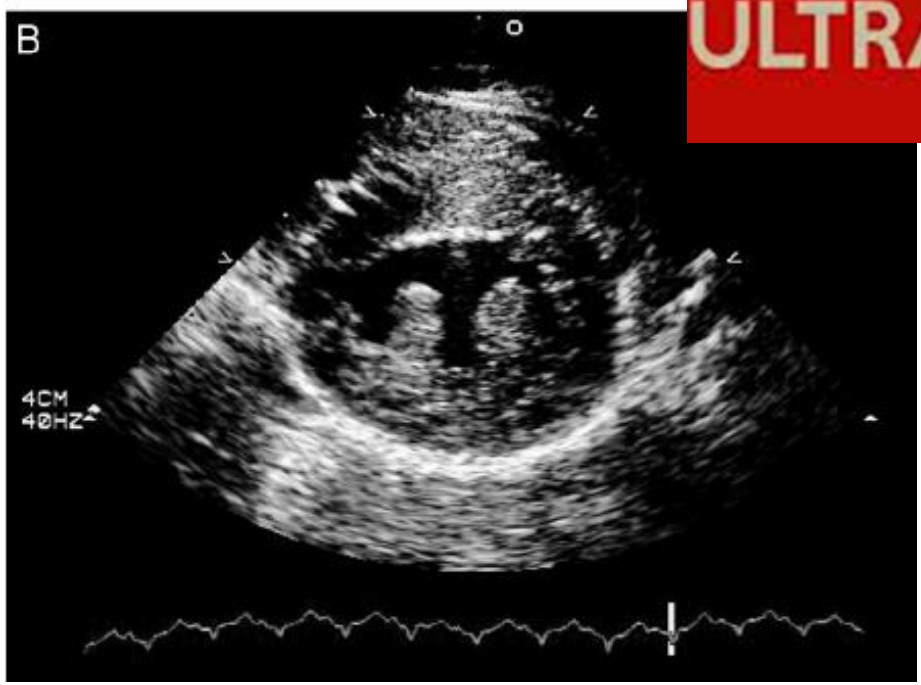


Hypovolaemia



Hypervolaemia





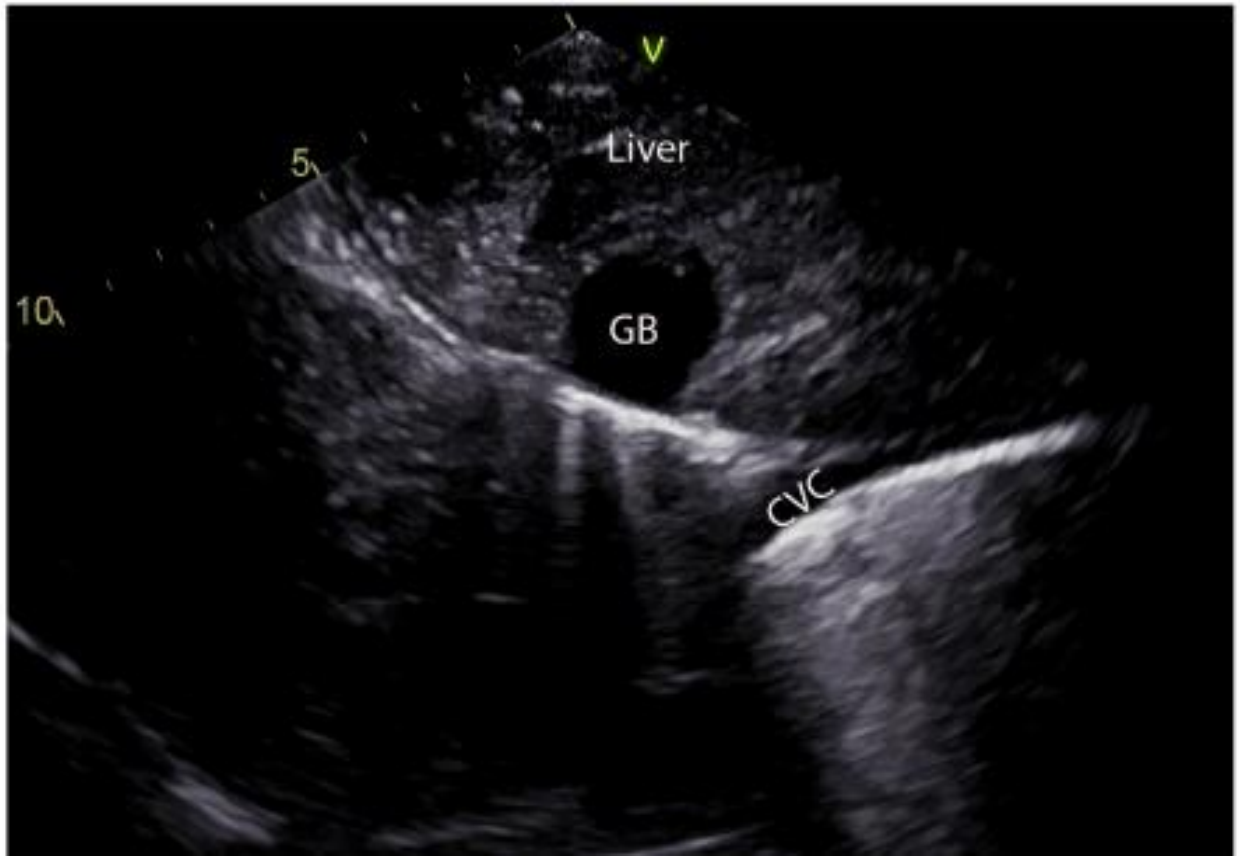
Hypovolaemia

Additional assessment of volume status

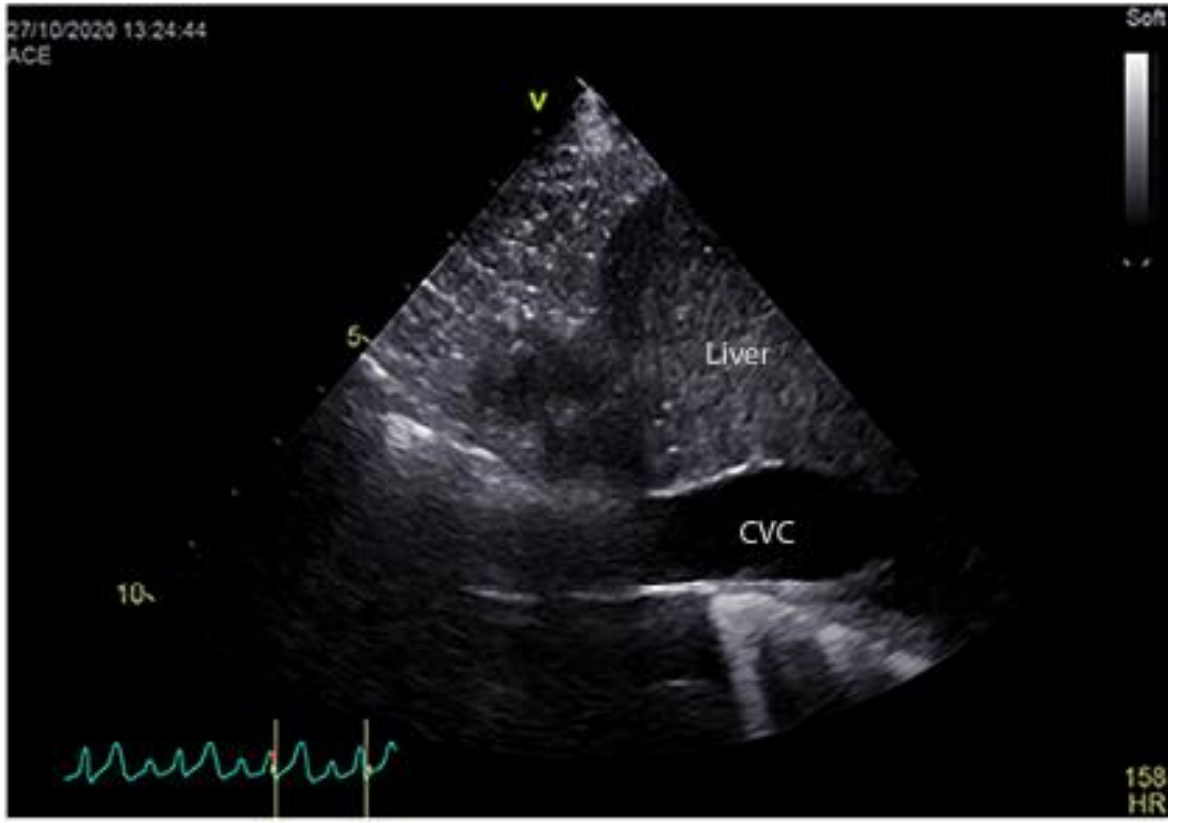
DH site

Moorview REFERRALS

Additional assessment of volume status



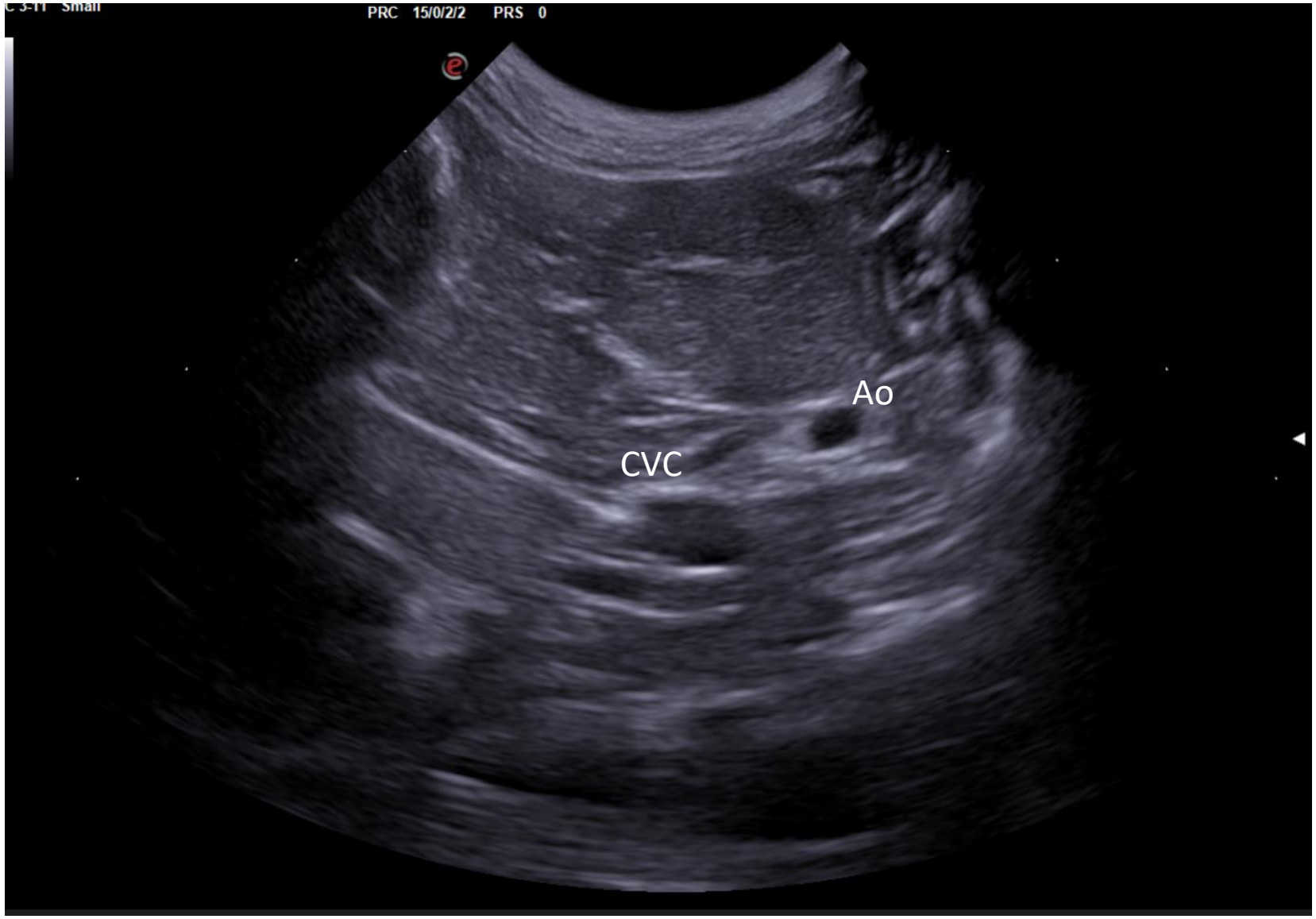
Hypovolaemia



Normal/ hypervolaemia

Moorview REFERRALS

Iliac site



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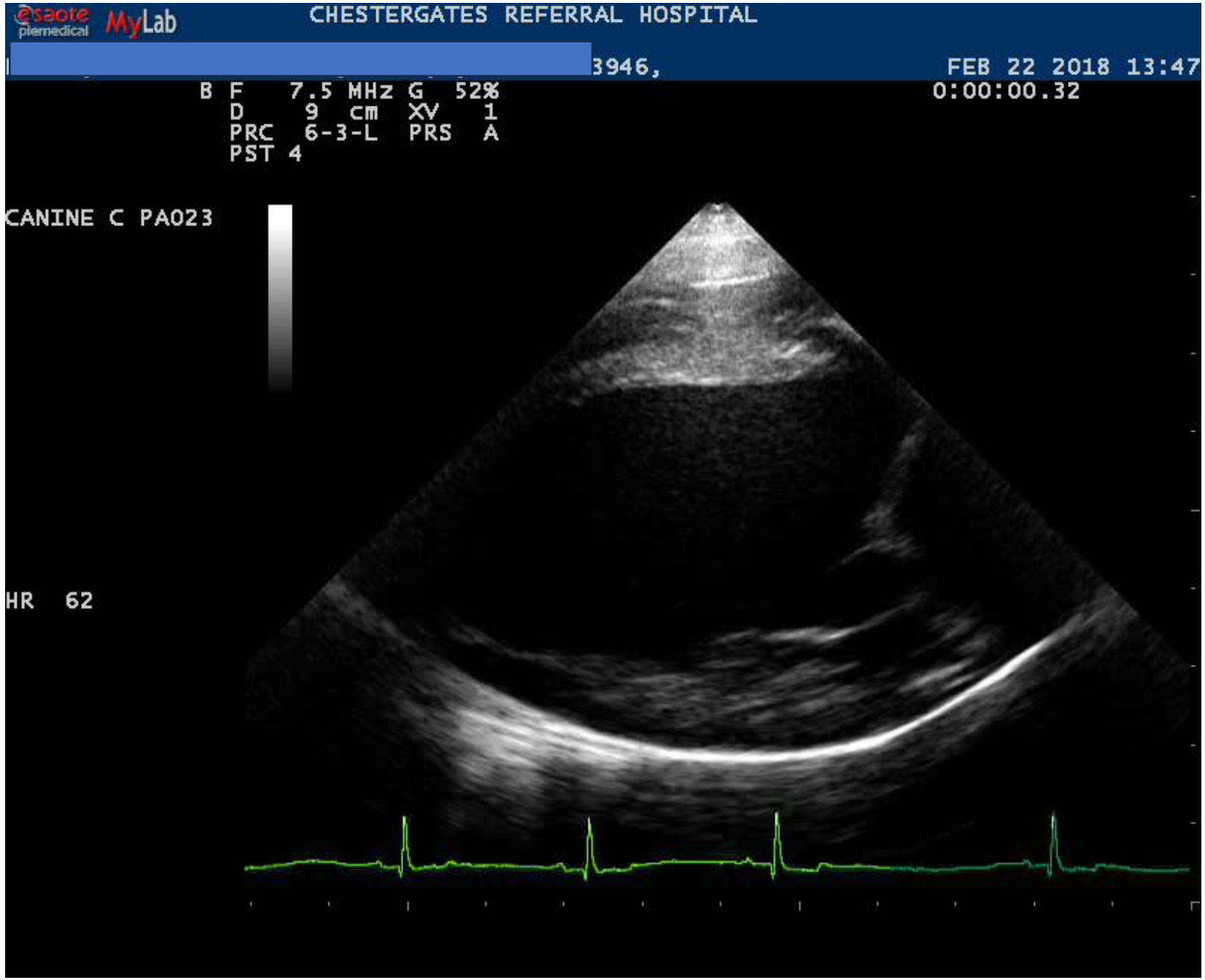
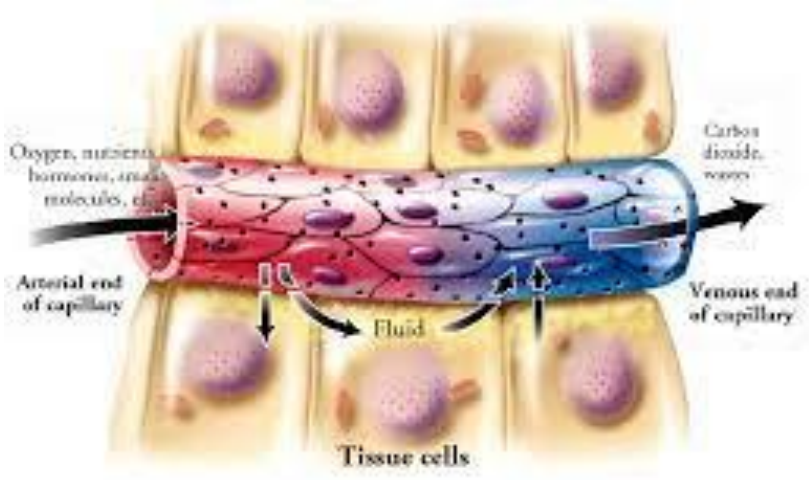


Moorview REFERRALS

Additional assessment of volume status

Macrocirculatory markers

- MM colour, CRT, pulse quality, HR (NB differences in cats!)
- Echocardiography, ultrasound



Mirocirculatory markers (markers of tissue perfusion)

- Lactate, BE, pH
- Metabolic acidosis is common due to impaired tissue perfusion (usually lactate acidosis)
- Hypoperfusion can markedly ↑PCO_2 (ie distinguish from hypoventilation)

Ideally need to integrate both to give a 'global' assessment of volume status and tissue perfusion

Moorview REFERRALS

Emergency Plan – 2) Fluids

General fluid plan

- Hartmann's (LRS) – unless good reason not to (eg alkalosis – uncommon)
- 'Shock bolus'
  - Dog 10-20ml/kg iv over 15mins
  - Cat 5-10ml/kg iv over 15mins
- Then reassess volume status parameters

Reasons for poor/ unexpected response:

- Insufficient fluids – repeat bolus and reassess
- Underlying cause ongoing – eg continuing haemorrhage
- Different type of shock eg cardiogenic
- **Fluid 'non-responder'**

Moorview REFERRALS

Emergency Plan – 2) Fluids

- General plan should be to give fluid bolus then reassess
- Repeat fluid bolus 3x until reach goal-directed endpoint
- If not reached, and no other cause identified, consider vasopressor, possibly more/other fluids based on assessment
  - Hypertonic saline 3-5ml/kg over 10 minutes – also good for head trauma
  - Norepinephrine (NE) CRI
- If response to NE poor, and no other cause identified, consider:
  - Plasma transfusion (good natural colloid) – good for ATC/ DIC
  - pRBCS/ whole blood for bleeding/ anaemia
  - Hydrocortisone CRI

- Positive fluid balances (ie over-loading) is associated with worse outcomes in human and veterinary medicine
  - Fluids should be treated like drugs and dosed carefully and appropriately!

Moorview REFERRALS

Emergency Plan – 2) Fluids

Some extra tips:

- Maintaining MAP > 65mmHg is the only intervention proven to be effective in traumatic brain injury cases

- **Hypotensive/ low volume resuscitation**
  - In some cases, we want to set our 'resusc end-goal' a little lower
    - Eg cavitatory or ongoing haemorrhage
    - Pulmonary contusions/ lung oedema
- Here, the aim is to maintain MAP around 60-65mmHg
  - Minimises further haemorrhage
  - Reduces disruption of clots

- Hypothermic animals should be fluid resuscitated first before re-warming

Moorview REFERRALS

Emergency Plan – 2) Fluids

A word on venous access

- Consider the medial saphenous vein your ‘go to’ vein in traumatised cats

Moorview REFERRALS

Emergency Plan – 2) Fluids

Other options are:

- Lateral saphenous in dogs

Moorview REFERRALS

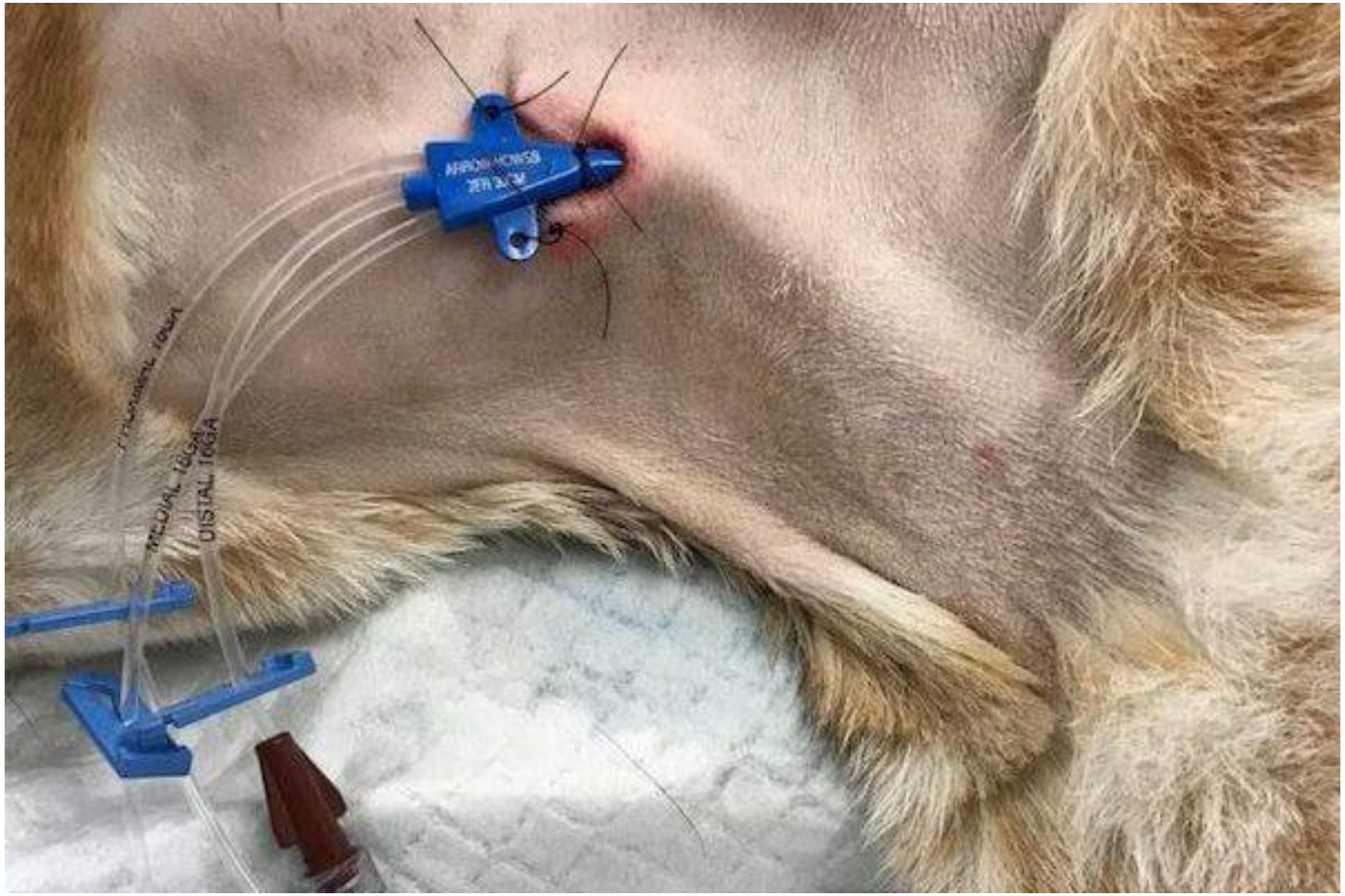
Emergency Plan – 2) Fluids

- Jugular catheter
- A normal iv catheter can be placed for temporary resuscitation

Moorview REFERRALS

Emergency Plan – 2) Fluids

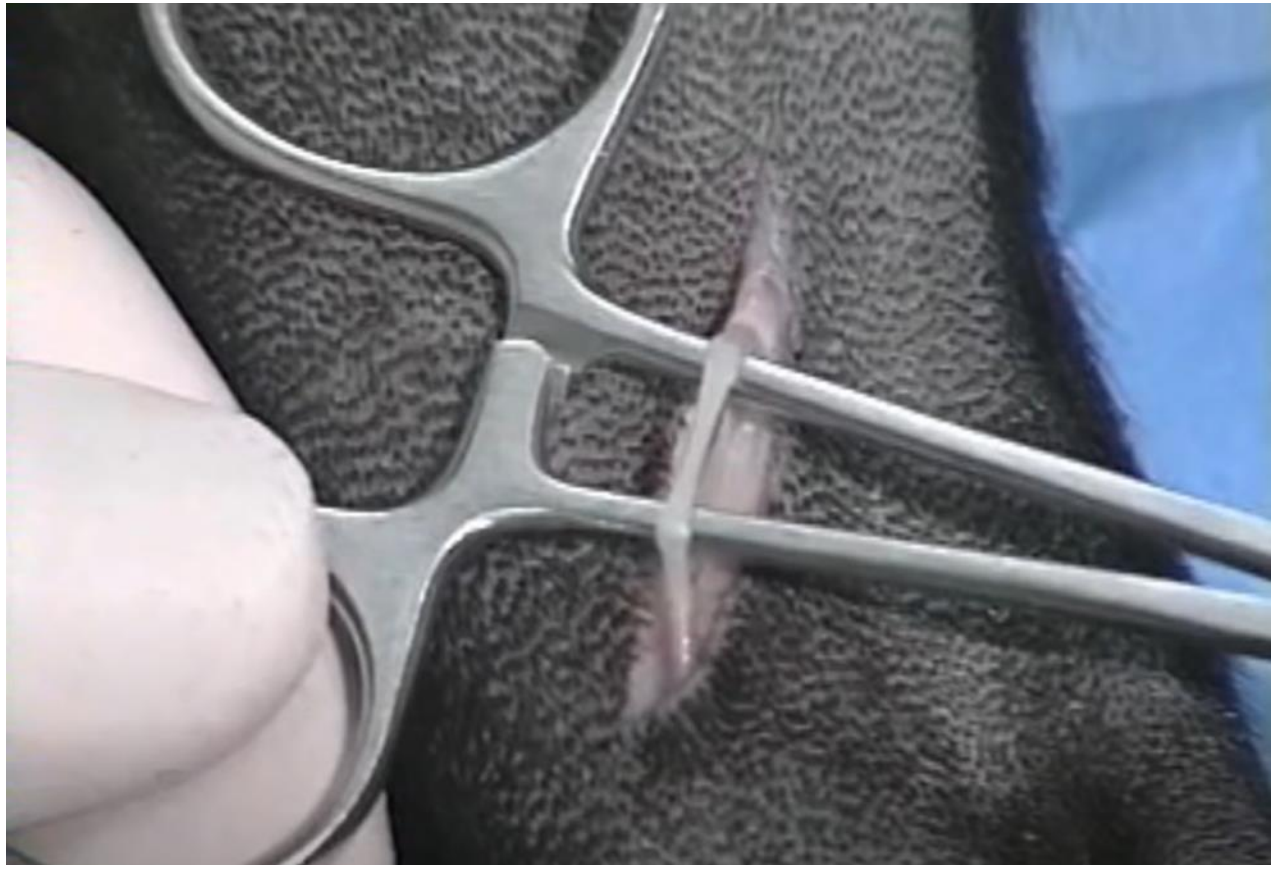
- ‘Central lines’ are also quick and easy to place (usually)



Moorview REFERRALS

Emergency Plan – 2) Fluids

Never be afraid to do a venous cut-down



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Emergency Plan – 2) Fluids

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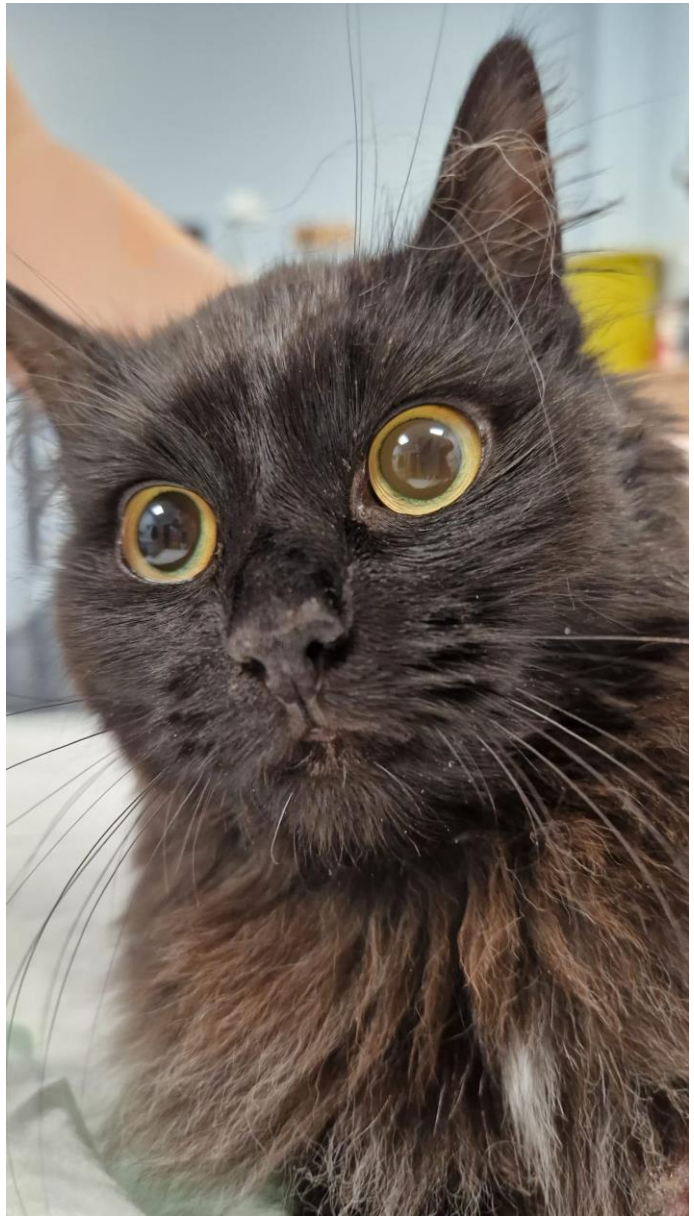
REFERRALS

Emergency Plan – 3) Analgesia



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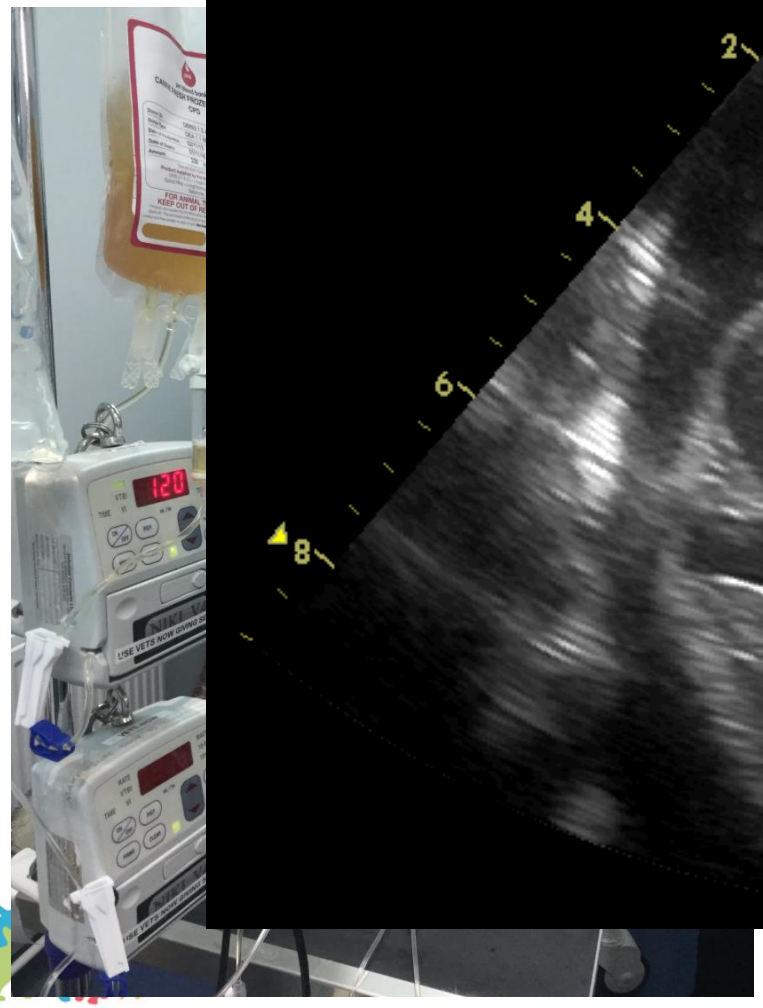
REFERRALS

Emergency Plan – 3) Analgesia

- Do not give NSAIDs to trauma cases until volume status and renal perfusion is secured
- Perform neurological assessment before giving opioids
- Use full μ-agonists eg methadone, fentanyl – do not start with buprenorphine as (controversial) may antagonise subsequent full μ agonist
- Fentanyl is not a 'stronger' analgesic than methadone, it is just more potent
- If giving CRIs, MUST start with a loading dose
- Multimodal analgesia is best
- Good combinations are:
  - Opioid + Ketamine (Dogs and cats) – CRIs ?even better
  - Opioid + Ketamine + Lidocaine
  - Opioid + Ketamine +/- Lidocaine +/- α-2 (medetomidine) *in appropriate cases*
  - +/- Benzodiazepine – safe, good anxiolysis/sedation when combined with opioid
  - Local anaesthesia/ Nerve blocks/ Wound soakers where appropriate
- Use Pain Scoring eg Glasgow Pain Scale and adjust analgesia frequently as necessary
- Butorphanol good for dyspnoea cases but a poor analgesic

Bleeding

- As well as external bleeding, animals can suffer significan
  -
  -



Bleeding – battlefield experience

SHOCK DIAGNOSED OR SUSPECTED

IMMEDIATE HEMORRHAGE CONTROL

External Bleeding
- IMMEDIATE direct pressure
- IMMEDIATE hemostatic gauze use
- Avoid tourniquets = high failure rate
- Ligate major bleeding vessels = excellent collateral circulation

Intracavitary Bleeding Suspected
- Confirm with TFAST and AFAST
- Assume any free cavity fluid is bleeding until proven otherwise
- Cautious fluid therapy!

VENOUS ACCESSCRITICAL!

IV / IO SITES:
IV: Cephalic v; External Jugular v
IO: Proximolateral Humerus; Proxim[illegible]edial Tibia

IO catheter sizes:
Dog <40 # = 15mm X 15 gauge
Dog >40 # = 25mm X 15 gauge

FLUID BOLUSES TO TARGETED END[illegible]INTS, USING FLUID CHALLENGES

Crystalloid bolus #1	Crystalloid bolus #2	Crystalloid bolus #3	Crystalloid bolus #4
1st 10 minutes	*Next 10–20 minutes*	*N[illegible] 10 minutes*	*Final 10–20 minutes*
25 kg = 550 mL	25 kg = 550 mL	25 kg = [illegible]50 mL	25 kg = 550 mL
30 kg = 650 mL	30 kg = 650 mL	30 kg = [illegible]0 mL	30 kg = 650 mL
35 kg = 750 mL	35 kg = 750 mL	35 kg = 75[illegible]	35 kg = 750 mL
40 kg = 850 mL	40 kg = 850 mL	40 kg = 850 m[illegible]	40 kg = 850 mL

TARGETED RESUSCITATION ENDPOINTS

BLOOD PRESSURE	LEVEL OF CONSCIOUSNESS	MUCOUS MEMBRANES AND CRT	HEART RATE/PULSE	RESP[illegible]ATIONS
MAP >65 mmHg SYS >90 mmHg	ALERT/NORMAL	LIGHT PINK <2 sec	HR 60–90 STRONG, SYNCHRONOUS PULSES	RR 12–4[illegible] NORMAL RESPIRA[illegible]RY EFFORT

Provide SUPPLEMENTAL OXYGEN

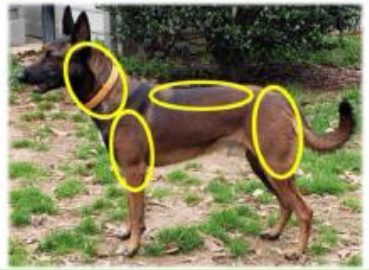
IDENTIFY and TREAT CAUSE of SHOCK

FAILURE TO RESPOND or UNSUSTAINED RESPONSE TO CRYSTALLOID BOLUSES:
- HETASTARCH bolus, 20 mL/kg IV or IO; repeat if needed
- Hypertonic saline (7–7.5%, if available), 4 mL/kg IV over 5 minutes; repeat if needed

COMPRESSIBLE

- DIRECT PRESSURE
- CIRCUMFERENTIAL PRESSURE DRESSING

Partially Compressible



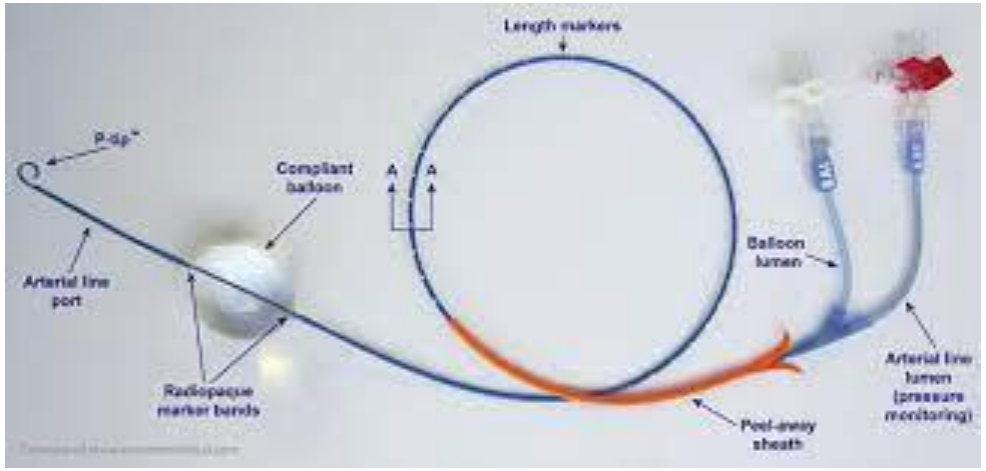
- Direct Pressure
- WOUND PACK
- HEMOSTATIC AGENT

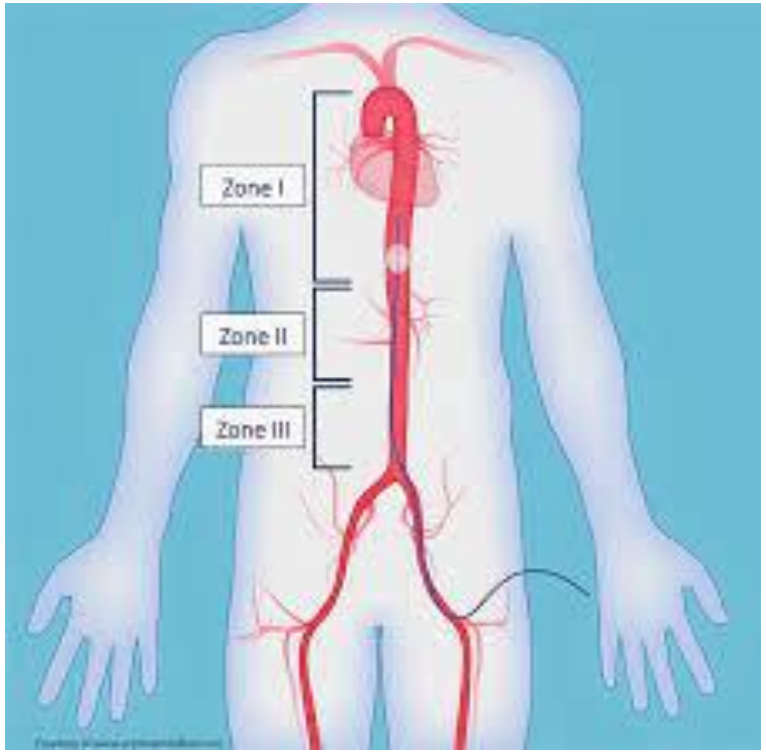
Non-Compressible Intracavitary

Internal Hemorrhage
THORACIC / ABDOMINAL
IMMEDIATE TRANSPORT

Pretty much any vessel can be ligated, or temporarily occluded – including the aorta!

Bleeding – battlefield experience





Moorview REFERRALS

Bleeding – Tranexamic acid (TXA)

- TXA is used extensively in human medicine for trauma and peri-operative bleeding
- Concerns have been raised about increased risk of thromboembolism
- Net effect seems to be beneficial
- Studies in veterinary medicine are sparse and have been conflicting
- However, adverse effects seems rare and mild (most common is vomiting/ nausea)
- Therefore, may be a case for using but true benefit is unproven
- Dose is also controversial but 10-20mg/kg iv q6hrs is standard (can be given as CRI)
- *May* only be beneficial within first 3 hours post-trauma
- Acute traumatic coagulopathy (ATC) - ?not just for overt bleeding

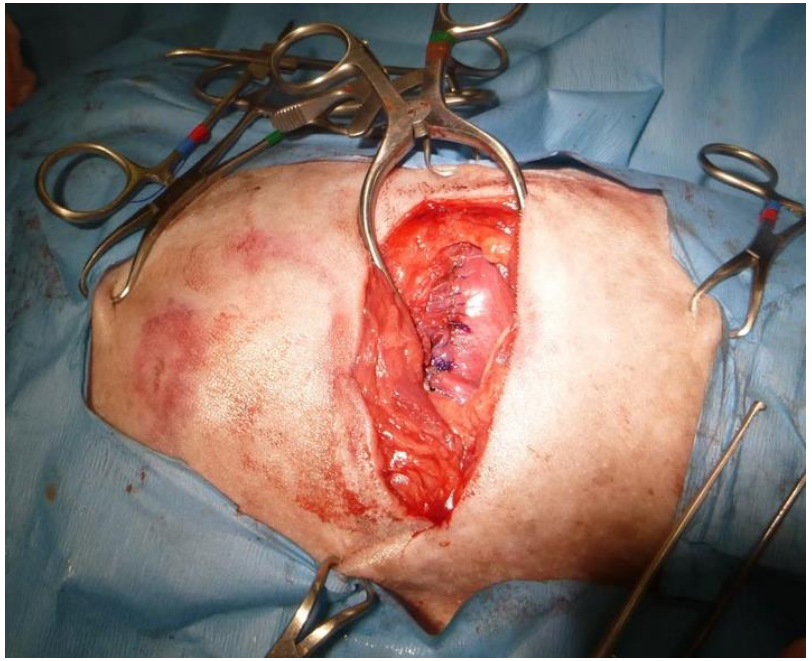
Moorview REFERRALS

Wounds

- All wounds should be taken seriously
- BUT, the most serious wounds are often those which appear minimal from the outside – the ‘tip of the iceberg effect’
- These are more commonly associated with puncture/ penetrating wounds and more serious internal linjury

Moorview REFERRALS

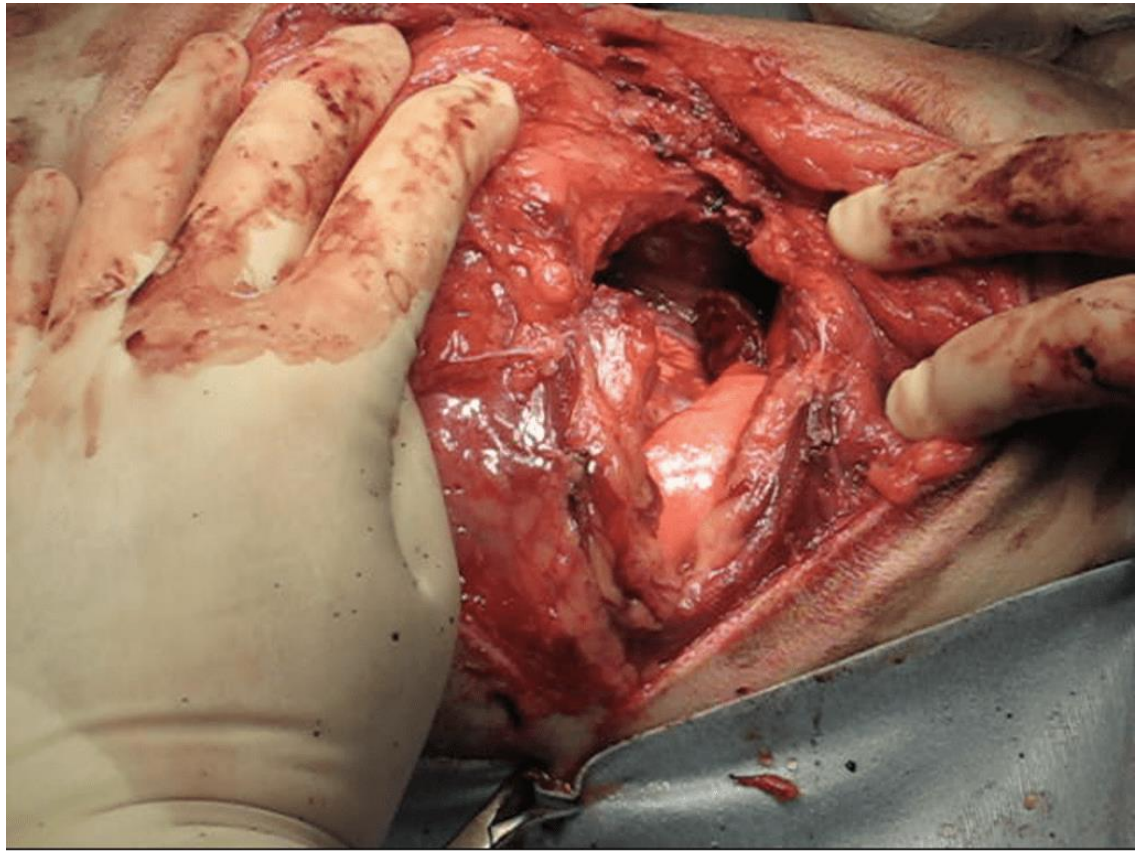
Penetrating thoracic injuries



- Bite wounds are most common cause
- Remember ‘tip of the iceberg’
- Consider common concurrent injuries
- Pneumothorax
- Cover wound and try to seal to allow negative pressure
- Be prepared for rapid intubation and/or chest drain placement
- Care bundle!
- Treat life-threatening injuries prior to addressing the wound itself
- Surgical wound exploration should be strongly considered in all cases of penetrating thoracic injury, once the patient is stabilised – NOT just haemostat ‘probing’

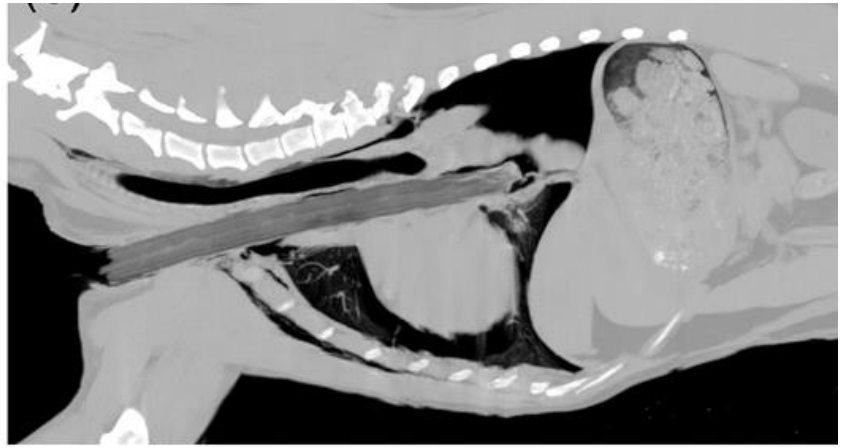
Moorview REFERRALS

Penetrating thoracic injuries



Penetrating thoracic injuries

CT is excellent for assessment of full extent of thoracic wounds



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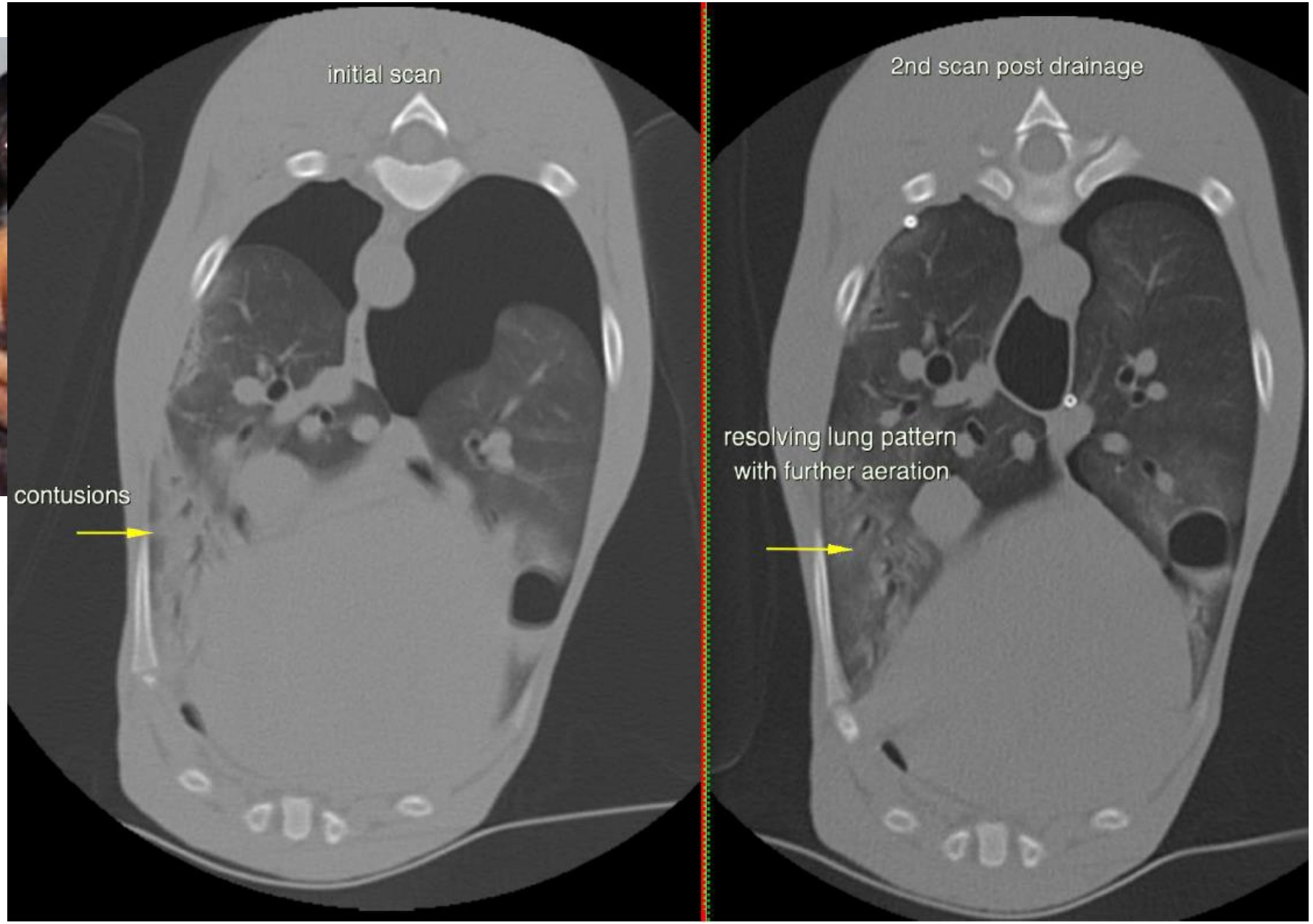
REFERRALS

Traumatic thoracic injury

- Traumatic thoracic injuries are very common and should be actively ruled in/out
- Pneumothorax is so common it should be assumed present until proven otherwise
- Pneumothorax can be:
  - Closed – pleural rupture, air enters the chest through the pulmonary parenchyma
    - Can also be associated with rupture of trachea/ oesophagus
  - Open – air enters the chest from an external penetrating injury to the thorax
  - Tension pneumothorax (closed or open) – progressive air accumulation through one-way valve effect – **life-threatening emergency**

Moorview REFERRALS

Pneumothorax



Moorview
REFERRALS

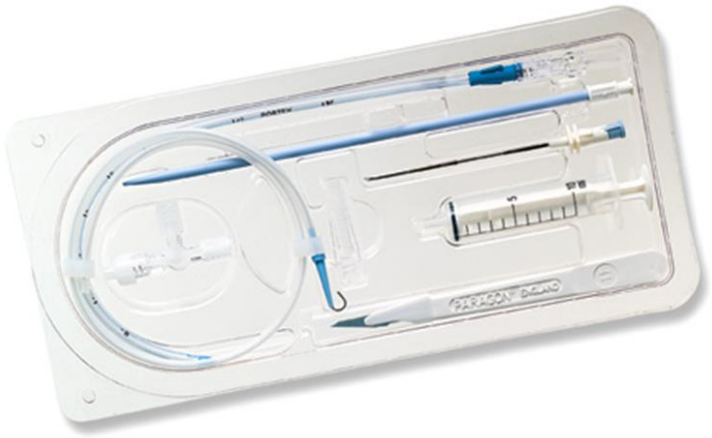
Pneumothorax

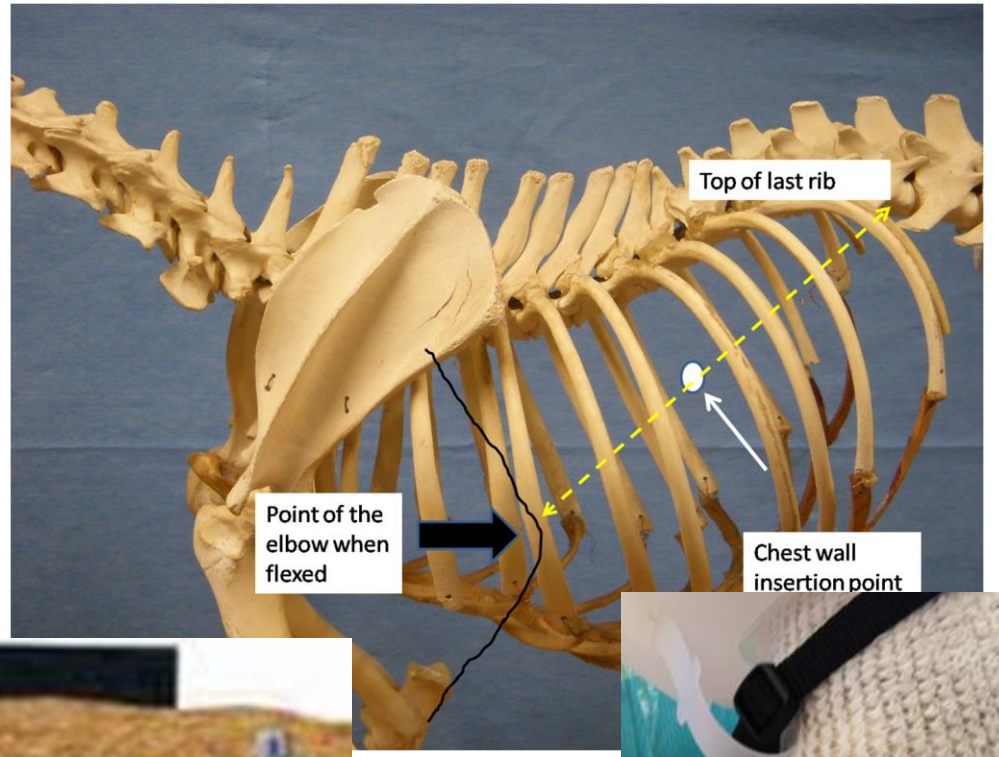
Initial management of pneumothorax

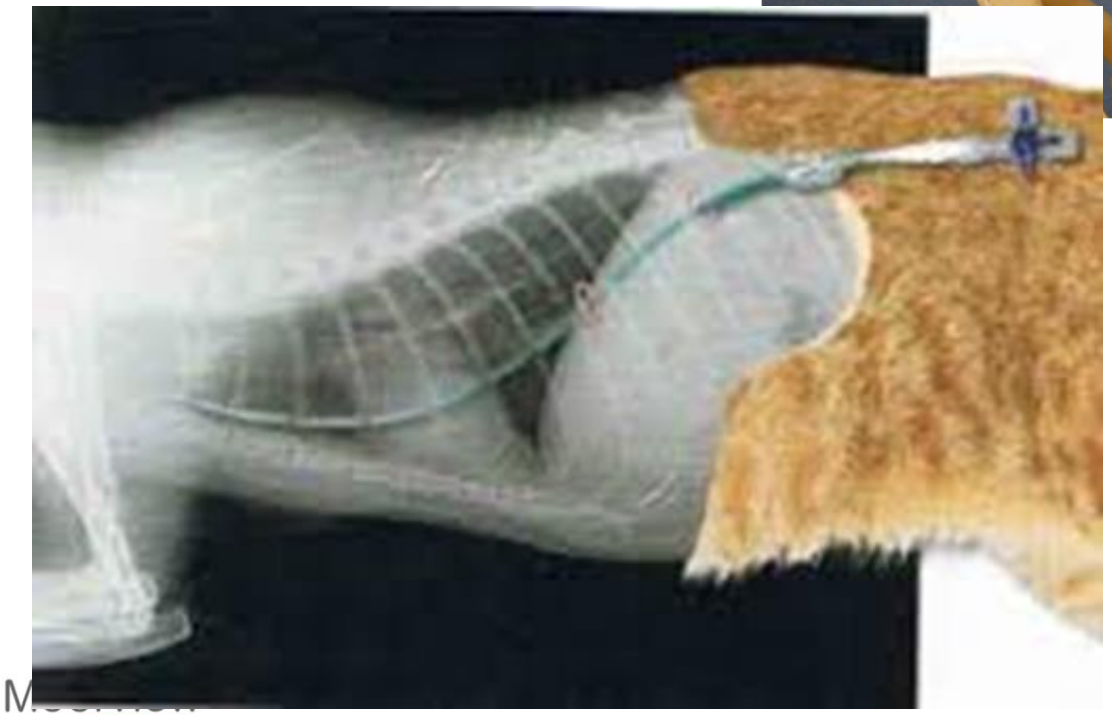
- Oxygen – for support and may accelerate resolution of closed pneumothorax
- Repeat thoracocentesis – get good at rapid butterfly catheter insertion
  - Pneumothorax is most often bilateral
- Fluid therapy
  - Can get hypotensive shock due to reduced venous return, especially tension pneumothorax
- Sedation and analgesia
- If repeat thoracocentesis required, place a thoracostomy tube
  - Get good at rapid Seldinger technique

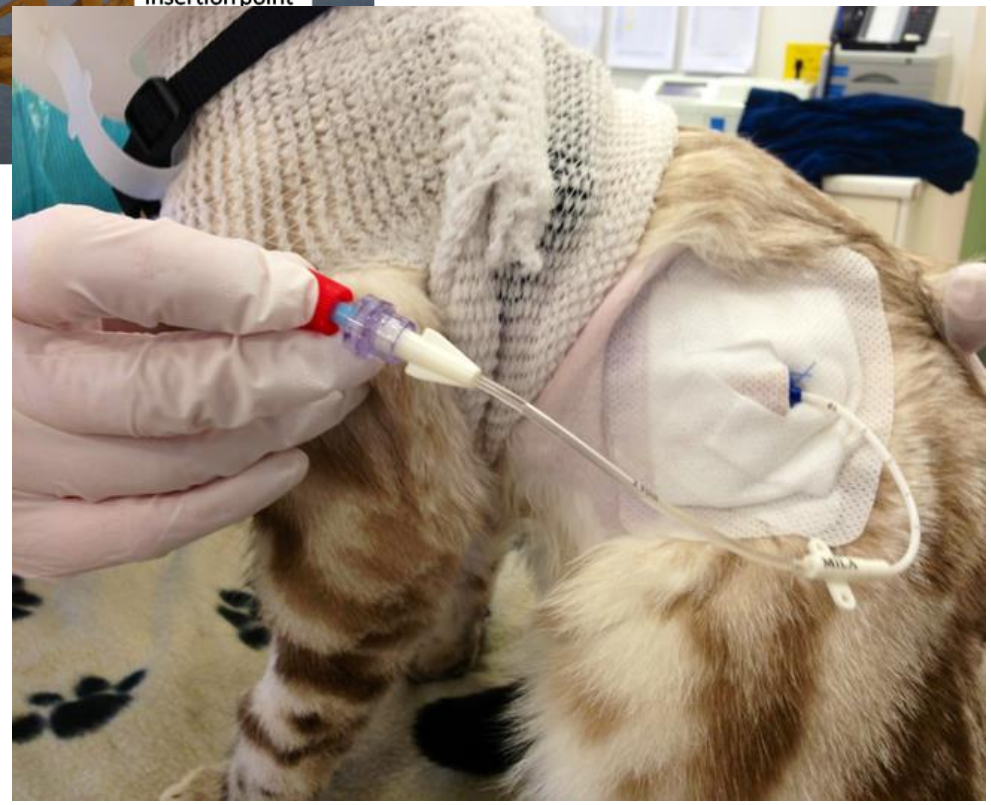
Moorview REFERRALS

Pneumothorax









REFERRALS

Pneumothorax

- Failure to achieve negative pressure:
  - Tube not fully inserted (fenestration outside the patient)
  - Lung penetration or tube somewhere else in the wrong place
  - True ongoing air leakage
    - This will require continuous suction drainage

Moorview REFERRALS

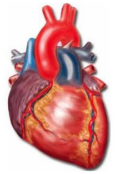
Pneumothorax

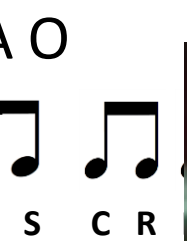
Management of open pneumothorax

- Oxygen
- Intubation and positive pressure ventilation
- Temporary wound closure with chest tube in place
  - Skin can be sutured over the open wound and then the areas dressed
- Broad-spectrum antibiosis
- Definitive wound management in due course usually requires thoracotomy/ sternotomy
- Analgesia and sedation

Moorview REFERRALS

Summary





- Oxygen
- Fluids – consider as drug
  - Macro- & micro- circulation
- Analgesia – multimodal

3 things to optimise:
Cardiac output
Blood Hb concentration
Oxygen saturation of Hb

- Triage
- ABCD/ CABD
- MBS CRNA O

A B C D M B S C R

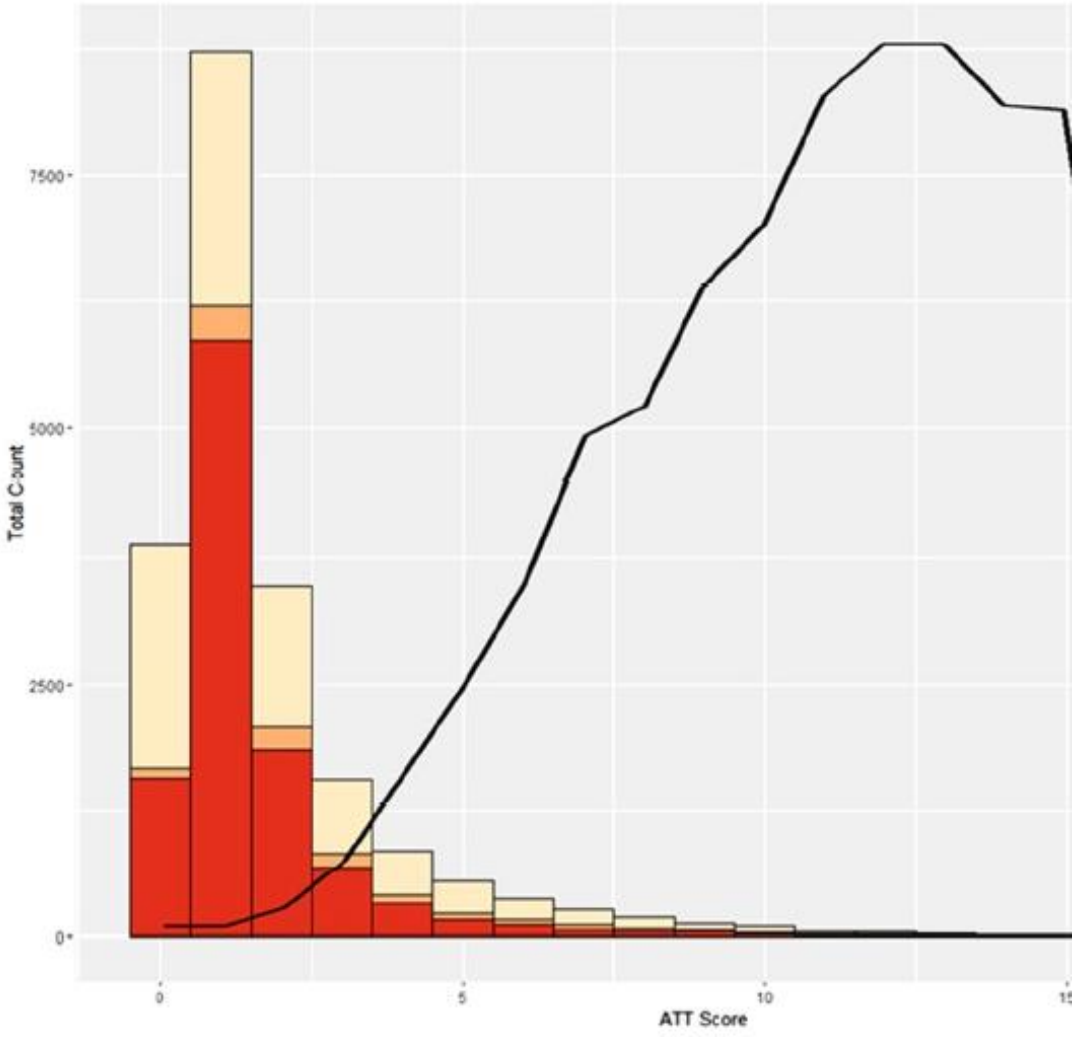
- Care bundles/ Pro
- Emergency datab
- Goal-directed the
- Imaging – POCUS

- Consider internal injuries – don't be distracted by 'freak out' injuries, think icebergs

Moorview REFERRALS

Triage

Emergency



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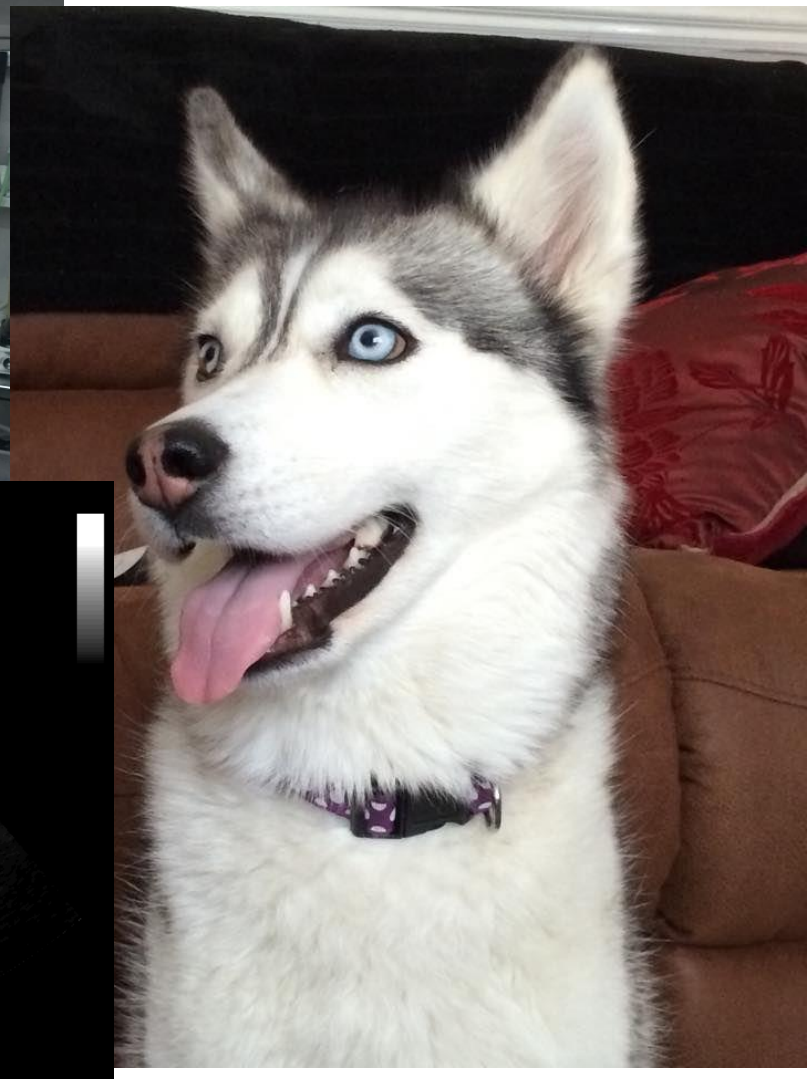

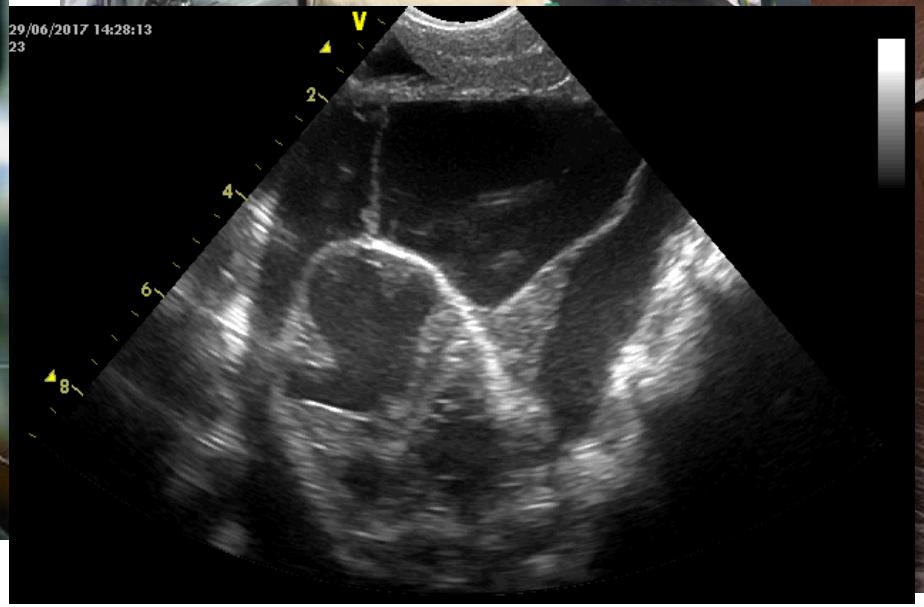

Moorview
REFERRALS

THANK YOU

Moorview
REFERRALS