Slide 1

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Dr. Elisa Mazzaferro is a Staff Criticalist at Cornell University Veterinary Specialists in Stamford, CT and an Adjunct Associate Clinical Professor of Emergency and Critical Care at Cornell University College of Veterinary Medicine. She is a 1997 graduate of Michigan State University College of Veterinary Medicine. She completed a four-year combined Emergency and Critical Care Residency and PhD in Small Animal Clinical Sciences at Colorado State University and became board-certified by the American College of Veterinary Emergency and Critical Care (ACVECC) in 2002. She is a Past-President of ACVECC and is the current President of the Veterinary Emergency and Critical Care Society. In 2018, she was the recipient of the VECCS Ira Zaslow Distinguished Service Award. Dr. Mazzaferro has given presentations in more than 10 countries and 21 States within the U.S. and has published 4 books, as well as numerous manuscripts and book chapters topics related to Small Animal Emergency and Critical Care. In her spare time, she enjoys gardening and relaxing with her 3 dogs and cat.

Slide 2

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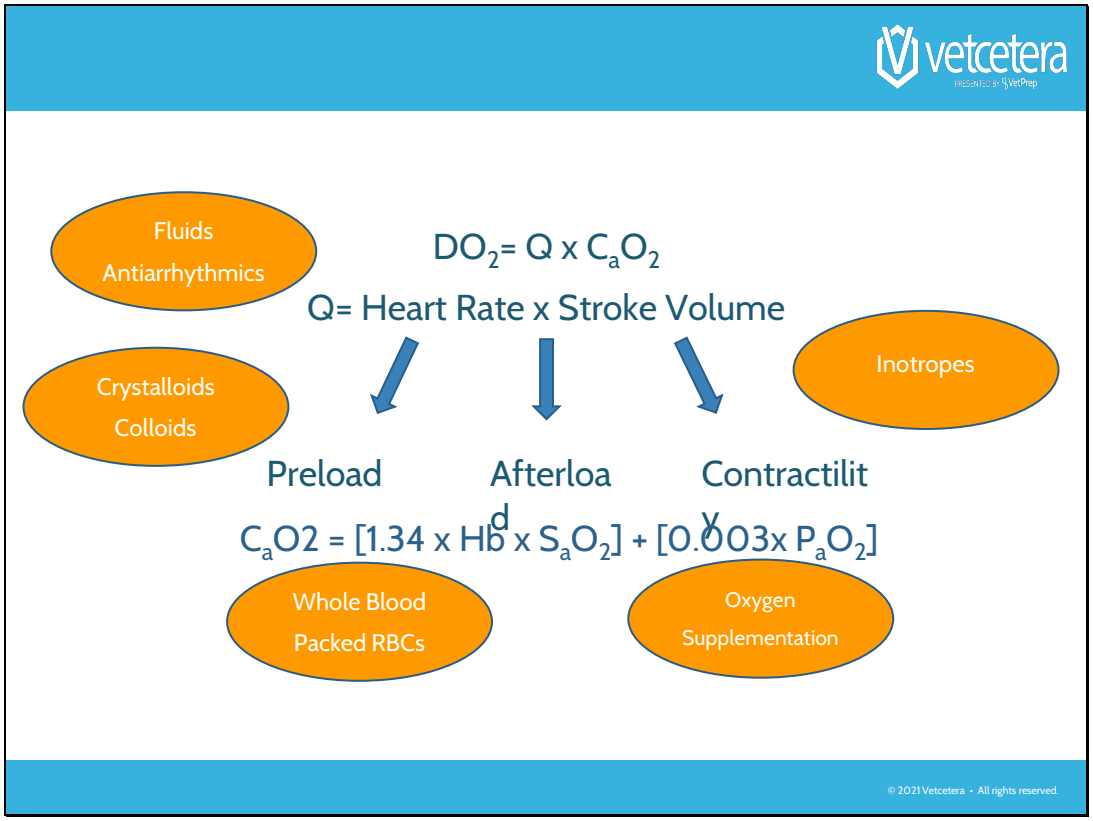
Triage STAT! Emergency Approach to the Small Animal Trauma Patient

Elisa M. Mazzaferro MS, DVM, PhD, DACVECC

Slide 3


vetcetera
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Fluids
Antiarrhythmics
$DO_2 = Q \times C_aO_2$
Q= Heart Rate x Stroke Volume
Crystalloids
Colloids
Inotropes
Preload
Afterload
Contractility
$C_aO2 = [1.34 \times Hb \times S_aO_2] + [0.003 \times P_aO_2]$
Whole Blood
Packed RBCs
Oxygen
Supplementation
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Slide 4

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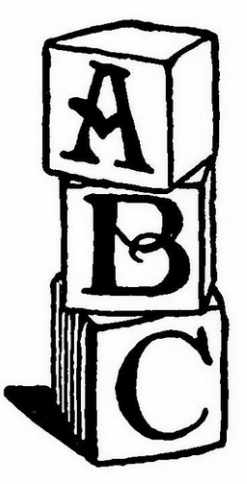
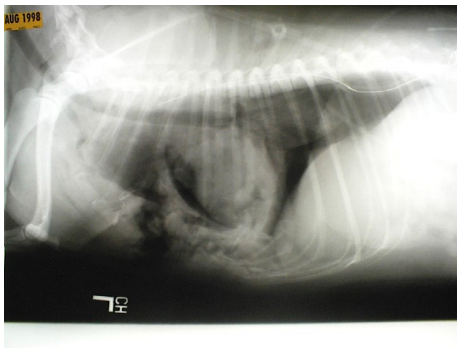
- Airway
- Breathing
- Circulation
- Disability



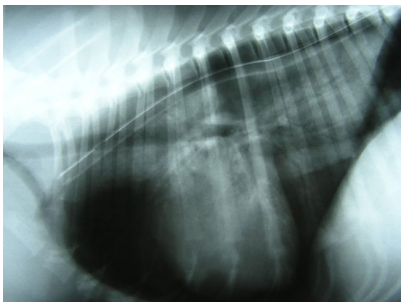
Slide 5

- Tension
- Shear Force
  - Pulmonary contusions
- Compression
  - Crushing
    - Pneumothorax
- Overpressure
  - Force applied to gas or fluid filled structure
  - Pneumothorax



Slide 6

- 49% dogs, 63% cats had radiographic signs of trauma
- 72% of patients with no visible injuries
- RR not a good predictive indicator of thoracic trauma



Clinical findings and diagnostic value of post-traumatic thoracic radiographs in dogs and cats with blunt trauma. JVECC 14(4):259, 2004

Slide 7

- Thoracic trauma most common
  - Pulmonary Contusions (68%)
  - Pneumothorax (47%)
  - Hemothorax (18%)
  - Fractured ribs (14%)
  - Diaphragmatic hernia (6%)
  - Bullae (2%)
  - Flail chest (2%)

Severe blunt trauma in dogs: 235 cases (1997 – 2003) JVECC 19(6):588:2009

Slide 8

- Retrospective Study
- 63 dogs, 96 cats
- Blunt trauma
- 49% dogs, 63.5% cats radiographic abnormalities
  - 73% no clinical abnormalities
  - Normal RR/RE

Sigrist et al. Clinical findings and diagnostic value of post-traumatic radiographs in dogs and cats with blunt trauma. J Vet Emer Crit Care 14(4):259-268, 2004.

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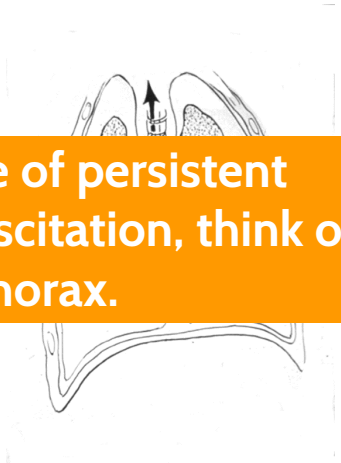
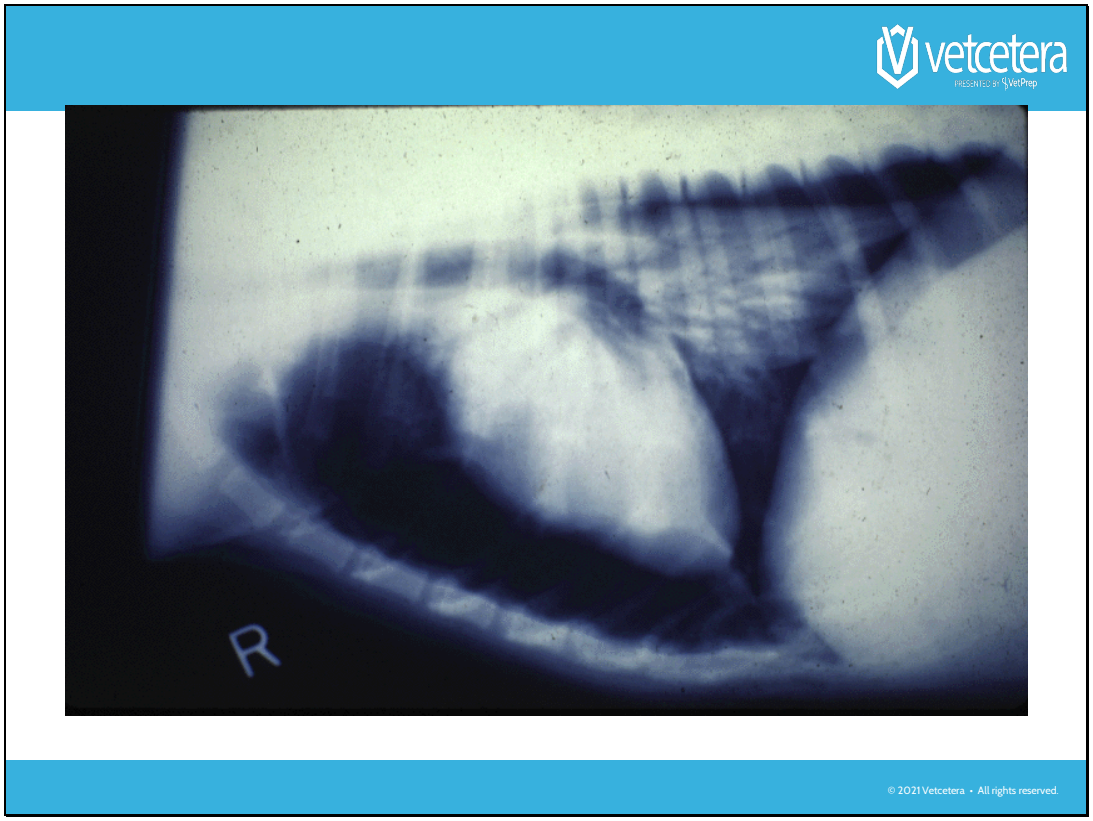
Slide 10

- Sources of Gas
  - Cervical injury – mediastinum



Learning point: In the case of persistent hypotension despite fluid resuscitation, think of a tension pneumothorax.

Slide 11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Slide 12


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mergency Approach to the Small Animal Trauma Patient
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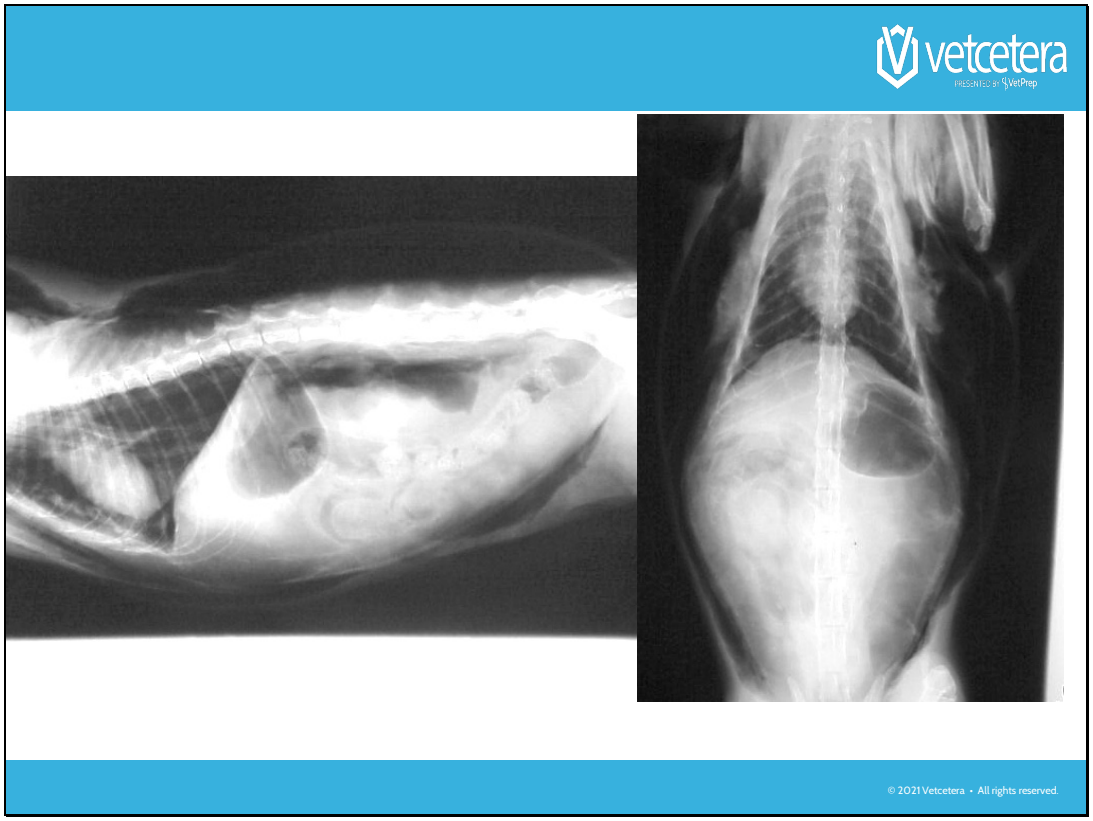
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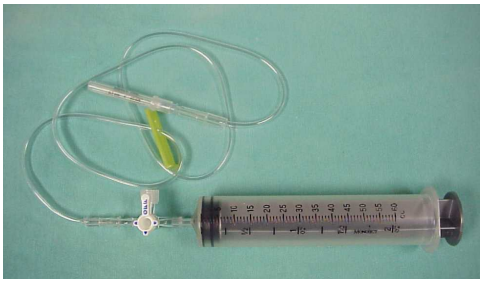
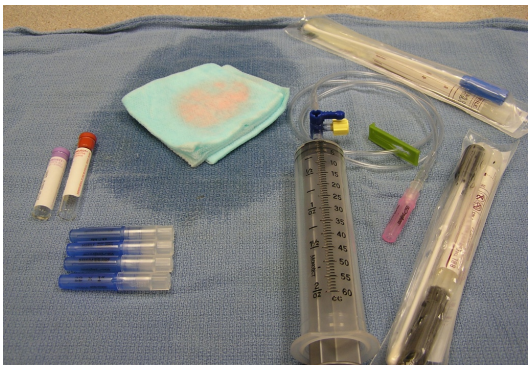
Slide 14

- Thoracocentesis
  - Diagnosis and treatment
- Thoracostomy tube
  - Continuous production
    - Multiple thoracocentesis



Slide 15

- Antimicrobial scrub
- Clipper/blades
- 60 mL syringe
- 3-way stopcock
- Extension tubing
- Red/purple topped tubes
- 22 g needles



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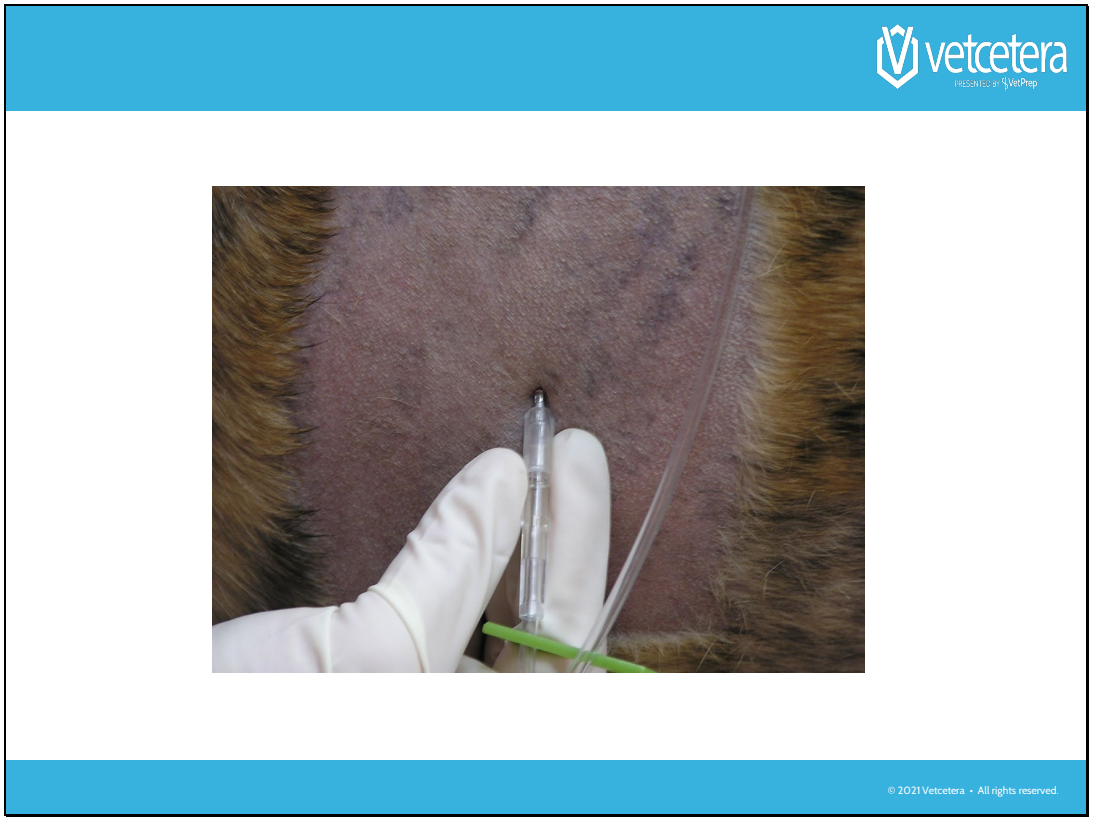
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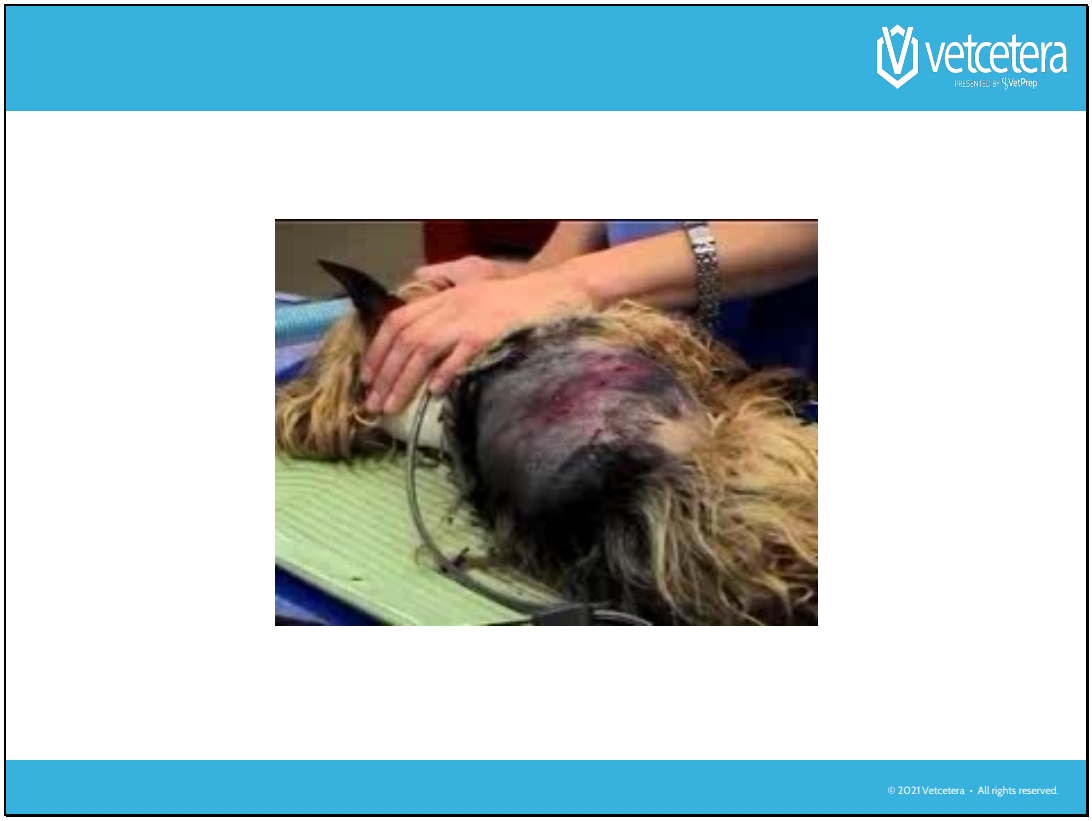
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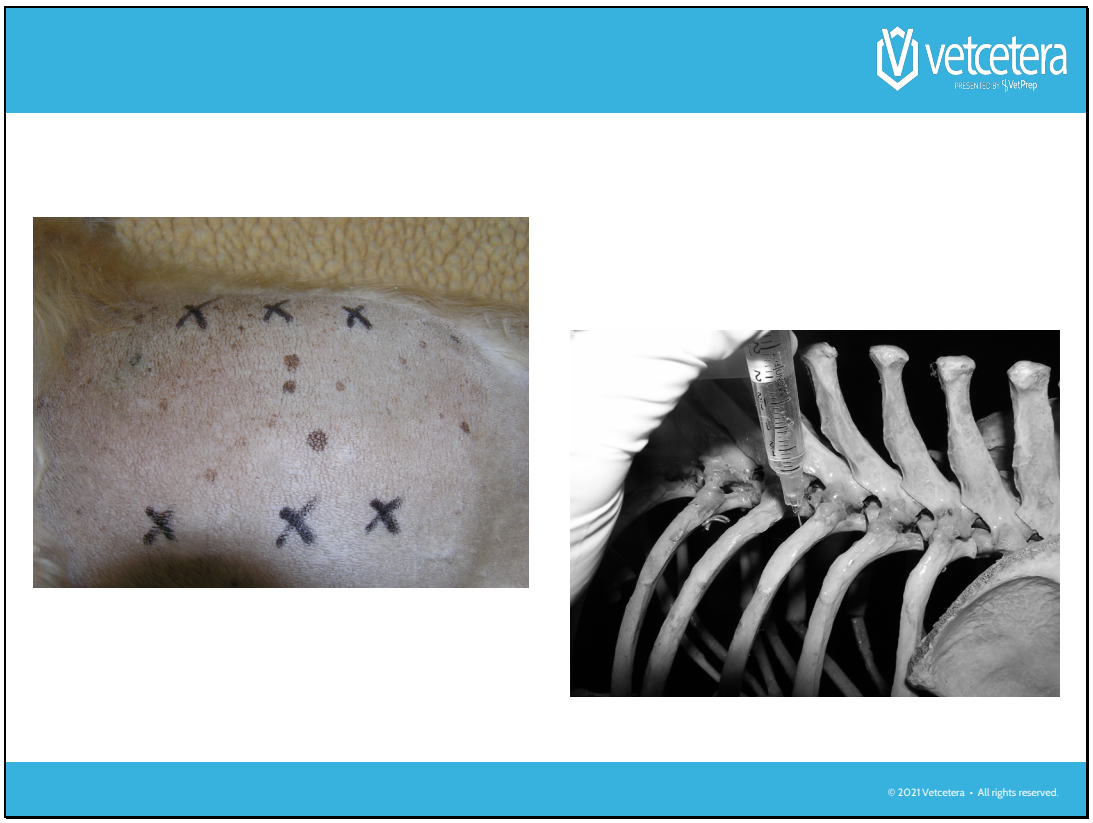
Slide 22

- Pain
  - Hypoventilation
  - Atelectasis
- Treatment
  - Local analgesia
  - Systemic analgesia

Slide 23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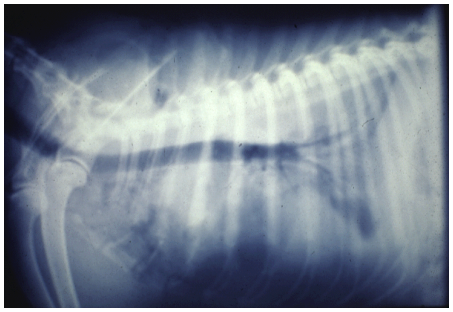
Slide 24

- Complications of blunt chest trauma
- Under wounds, rib fractures, or without obvious external injury
- Alveoli fill with blood and fluid
  - Intrapulmonary shunt
  - hypoxemia

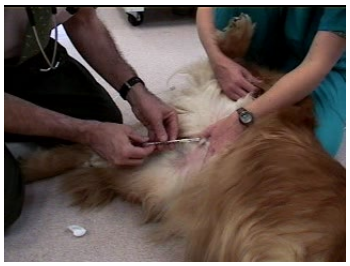
Slide 25

- Interstitial to alveolar lung pattern
- May not be evident on early radiographs
- Radiographic changes may continue to develop for 2 to 24 hours



Slide 26

- Arterial blood gas analysis
  - Most objective way to document gas exchange impairment and response to treatment

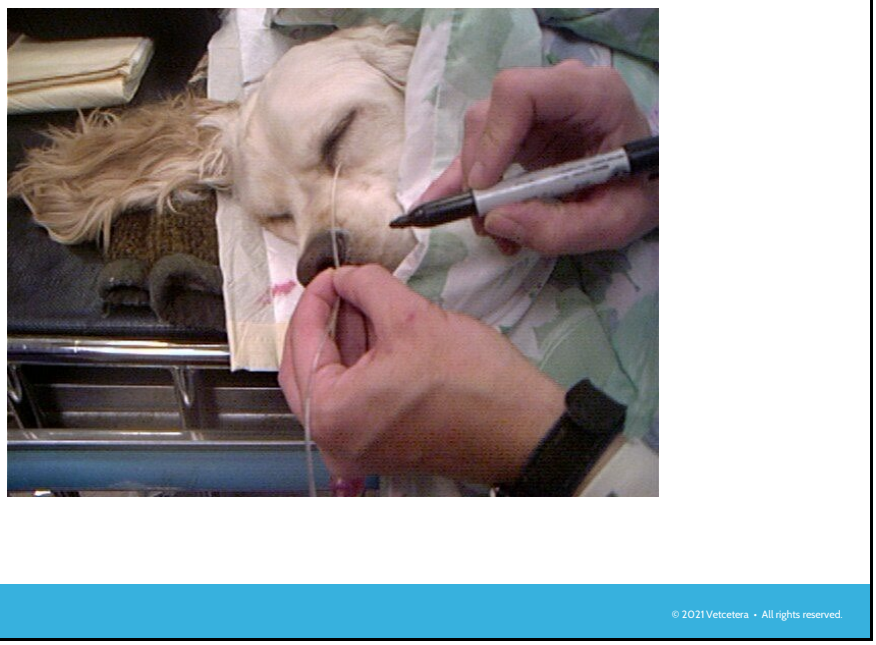


Slide 27

- N = 143, 82% survived to discharge
- Concurrent injuries common (pneumothorax, pleural effusion)
- O_2 for 35 hours
- Hospitalized 48 hours
- <2% developed infection

Powell LL, et. al. A Retrospective Analysis of Pulmonary Contusion Secondary to Motor Vehicular Accidents in 143 Dogs: 1994 – 1997 J Vet Emerg Crit Care 1999

Slide 28



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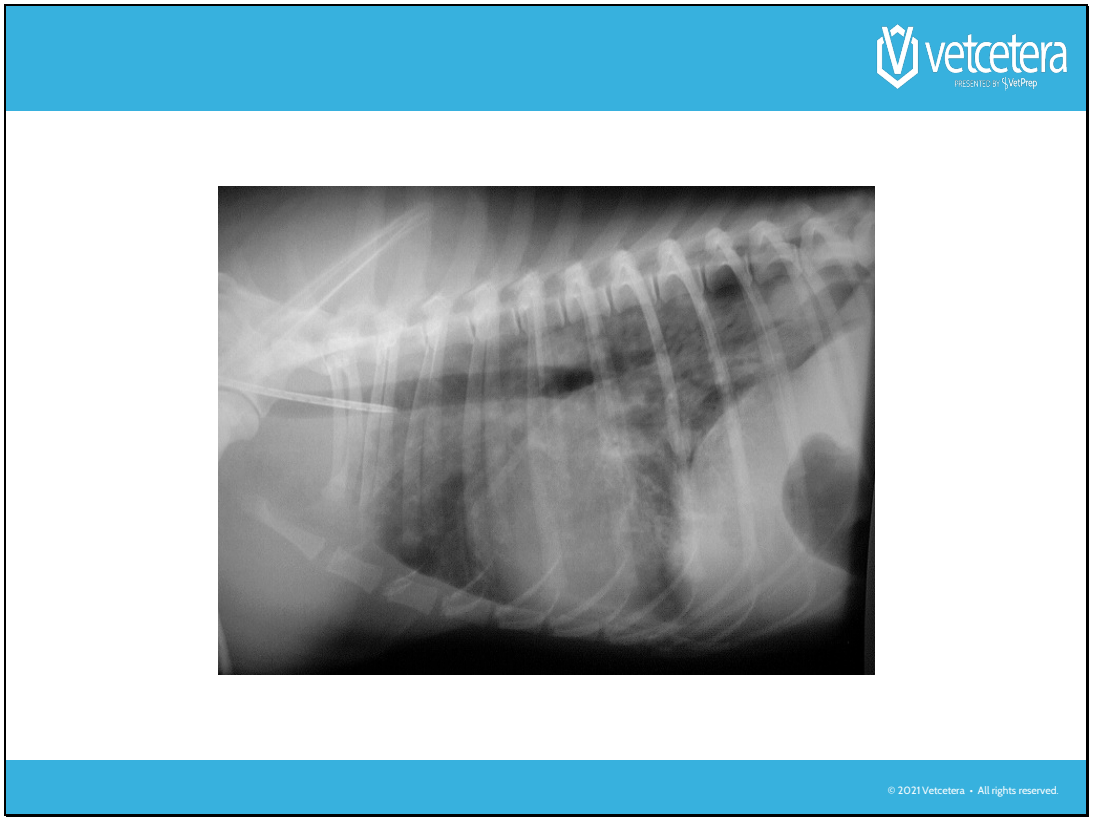
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Slide 30

- Subjective
  - Hemoptysis, anxiety, persistent dyspnea
- Objective
  - PaO_2 < 60 mm Hg
  - PaO_2:FIO_2 < 200
  - Hypercapnea
  - Acidosis

Slide 31

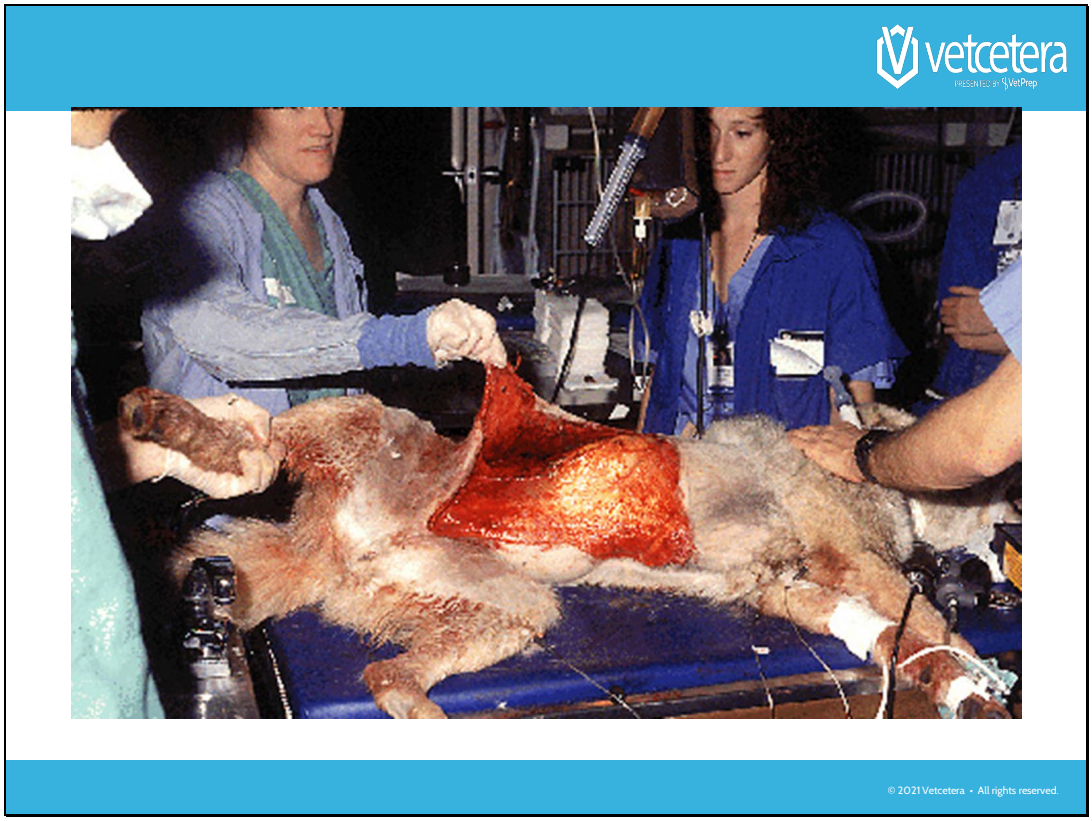
- N = 10; 30% survived to discharge
- Improved with ventilation
  - Improved compliance
- Progressive disease or cardiac arrest
  - Lung compliance deteriorated
- Conclusions
  - Dogs with severe pulmonary contusions may benefit from IPPV
  - Prognosis is better for bigger dogs > 25 kg

Campbell VL, King LG. J Am Vet Med Assoc 2000

Slide 32

- Large (shock) bolus dosing of crystalloid, hypertonic or colloid fluids can raise pressures to supernormal levels
- Newly formed clots to break off damaged vessels
- Dilutional coagulopathy

Slide 33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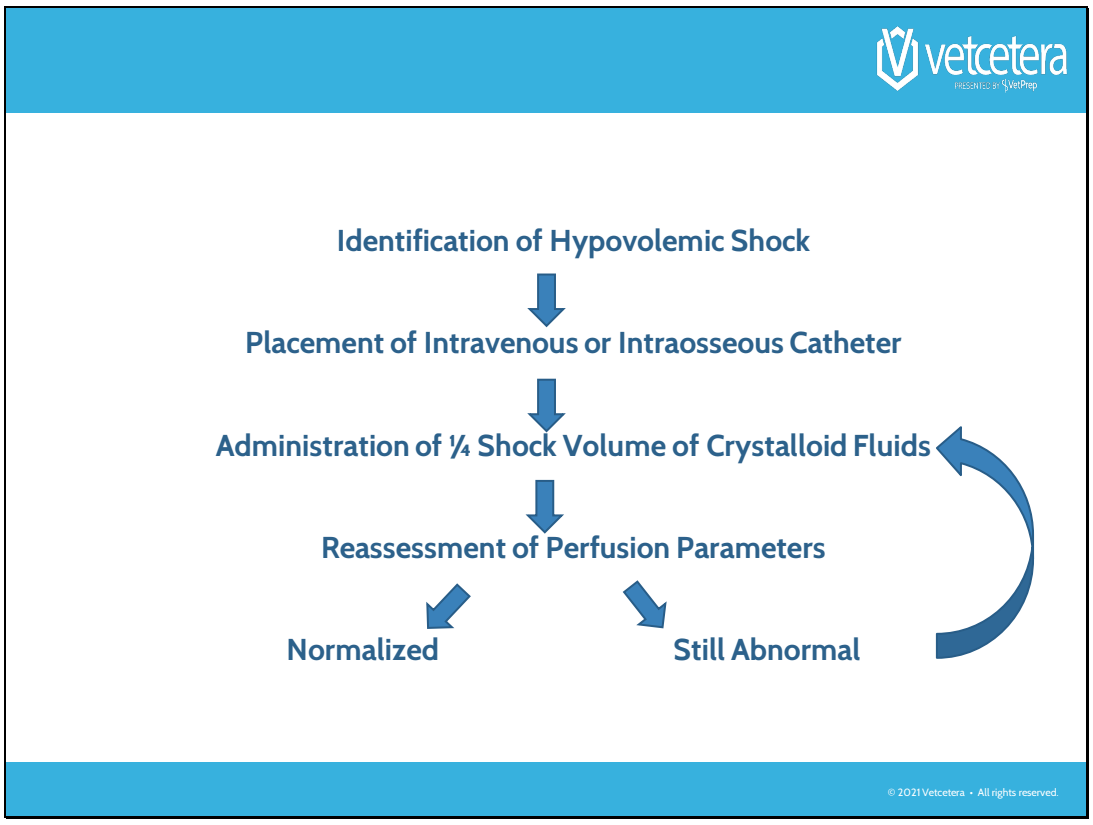
Slide 34

	Compensatory 15-30%	Early Decompensatory 30-40%	Late Decompensatory > 40%
Heart Rate	Increased	Increased	Decreased
Mucous Membranes	Hyperemic	Pale	Pale
CRT	Rapid	Prolonged	Prolonged
Pulse Quality	Normal to bounding	Normal to decreased	Weak
Blood Pressure	Normal to increased	Normal to decreased	Decreased
Core Temperature	Normal	Normal	Decreased

Slide 35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Identification of Hypovolemic Shock
Placement of Intravenous or Intraosseous Catheter
Administration of ¼ Shock Volume of Crystalloid Fluids
Reassessment of Perfusion Parameters
Normalized
Still Abnormal
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- First identify underlying possible complicating factors:
  - Closed cavity hemorrhage
  - Pulmonary contusions
  - Head/brain trauma
  - Cardiac dysfunction

Slide 37

- IV or IO are the only ways to go
  - SQ fluids not appropriate for volume replacement in an animal in shock
- Be prepared to infuse one whole blood volume if a healthy vasculature is present
  - 90 ml/kg for dogs
  - 40-45 ml/kg for cats

Slide 38

- Start with ¼ of the calculated "shock" dose, then reassess perfusion parameters
  - Heart rate
  - Blood pressure
  - Capillary refill time
  - Urine output

Slide 39

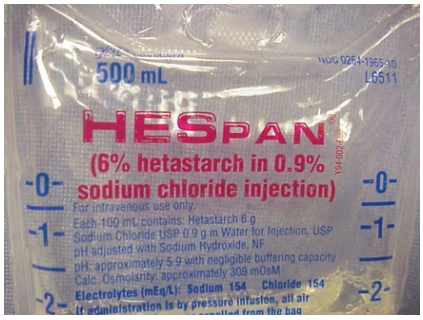
- Helpful Hint
  - For dogs, take their body weight in POUNDS, and add a zero
  - This equals ¼ shock dose of fluids!

Slide 40

- Hypertonic saline
- Colloid
- Crystalloids
- Blood

Slide 41

- Colloidal administration 5 ml/kg bolus
- Reassessment of perfusion parameters
- Used in:
  - Head trauma or closed cavity hemorrhage
  - Pulmonary contusions



Slide 42

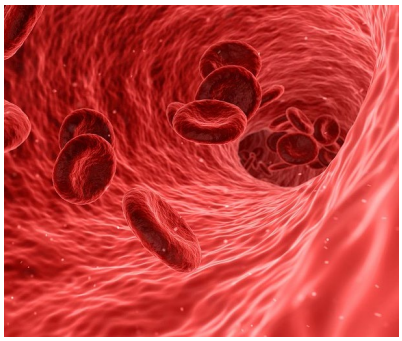
- 3-5 ml/kg IV over 10-15 minutes
- Peak effect in 2 minutes
- Osmotic effect to decrease cerebral edema
- Effect persists 30 minutes
- Improved cerebral perfusion
- Synergistic with colloids
- Indications:
  - Shock with head trauma
  - Profound life-threatening shock

Slide 43

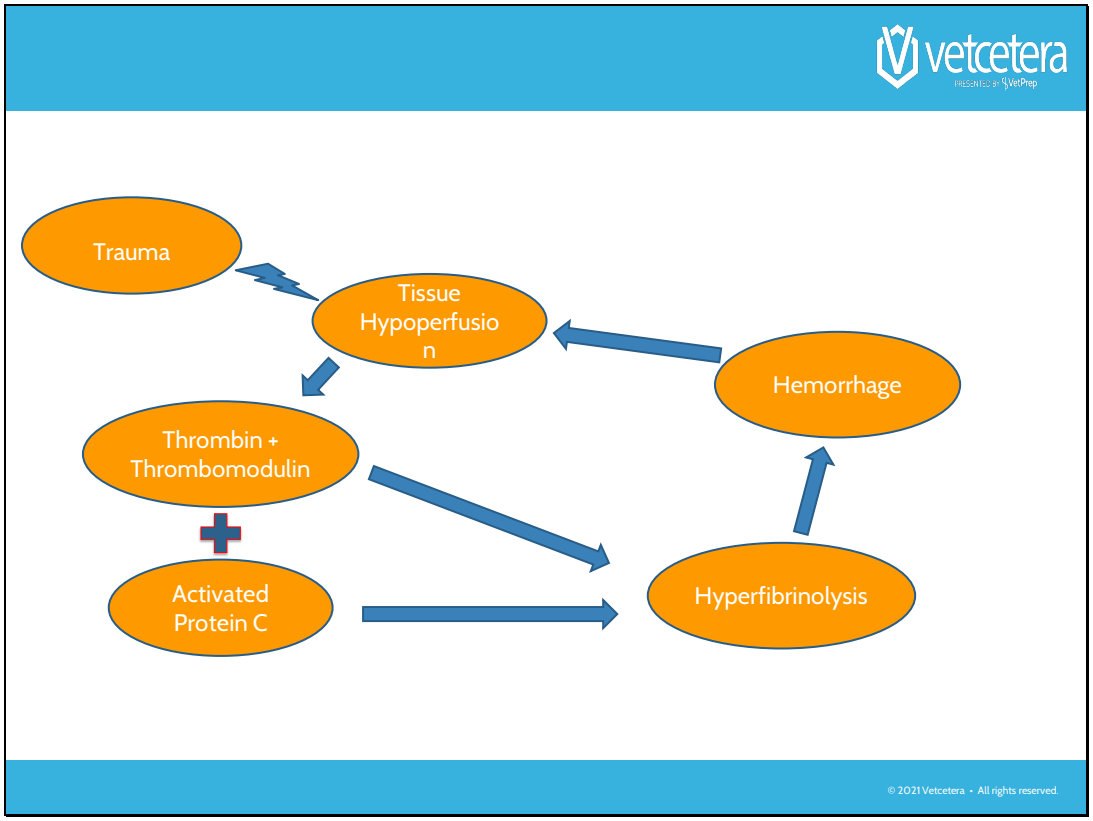
- Clinical signs of anemia
  - Lethargy
  - Anorexia
  - Tachycardia or Bradycardia
  - Tachypnea
  - Volume unresponsive hypotension
  - Acute drop in PCV

Slide 44

- Consider what is actually being lost
- Whole blood = RULE OF ONEs
  - Each 1 ml/pound will raise PCV by 1%
- Plasma
  - 15-20 ml/kg



Slide 45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Trauma
Tissue Hypoperfusion
Hemorrhage
Thrombin + Thrombomodulin
Activated Protein C
Hyperfibrinolysis
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Slide 46

- Pulmonary contusions worsen with overzealous fluid therapy
- Large volumes quickly can increase fluid loss into damaged tissues
- Iatrogenic interstitial fluid overload worsens hypoxemia and oxygen delivery
- Iatrogenic dilutional coagulopathy

Slide 47

- 18 dogs, 19 cats blunt trauma
- VBG/lactate, BG iCa, PCV/TP, PT, APTT, fibrinogen, platelet count, thromboelastography
- Acute traumatic coagulopathy 1 cat, 1 dog
- Hypercoagulopathy 19% dogs, 5% of cats
- Animal Trauma Triage (ATT) scores significantly associated with PT, APTT and MA on TEG in dogs

Gottlieb et al. Evaluation of acute traumatic coagulopathy in dogs and cats following blunt force trauma. J Vet Emerg Crit Care 27(1):35-43, 2017.

Slide 48

- 15% cats hypocoagulable at presentation by ROTEM
- Cats with acute traumatic coagulopathy required significantly more transfusions
- Hypercoagulable after 24 hours, more common that hyperfibrinolysis

Muri et al. Serial evaluation of haemostasis following acute trauma using rotational thromboelastometry in cats. Vet Compar Traumatol 12:289-296, 2019.

Slide 49

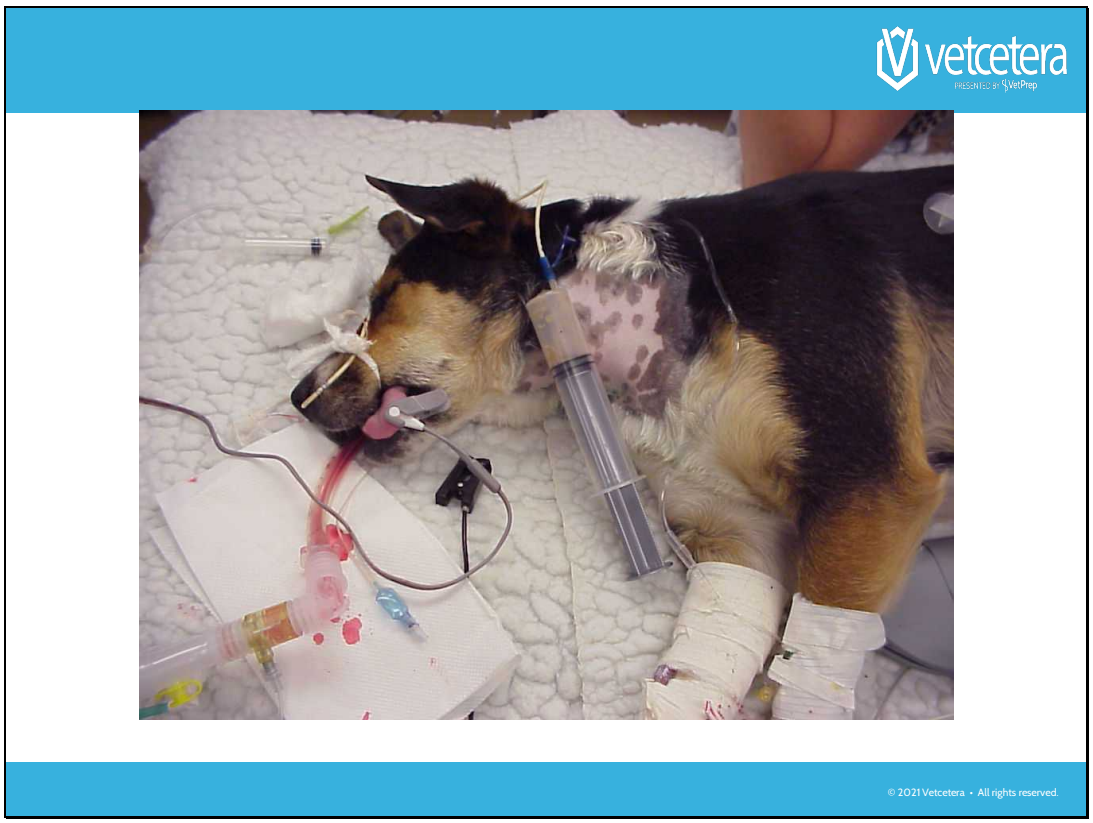
- 11/33 dogs hypocoagulable at presentation
- More hypercoagulable at 24 hours
- Hypocoagulability more common than previously described

Herrero et al. Serial evaluation of haemostasis following acute trauma using rotational thromboelastometry in dogs. Vet Compar Traumatol 14:206-213, 2021.

Slide 50

- Aminocaproic Acid
- 50-100 mg/kg IV, then 15 mg/kg/hr IV CRI
- Transexamic acid

Slide 51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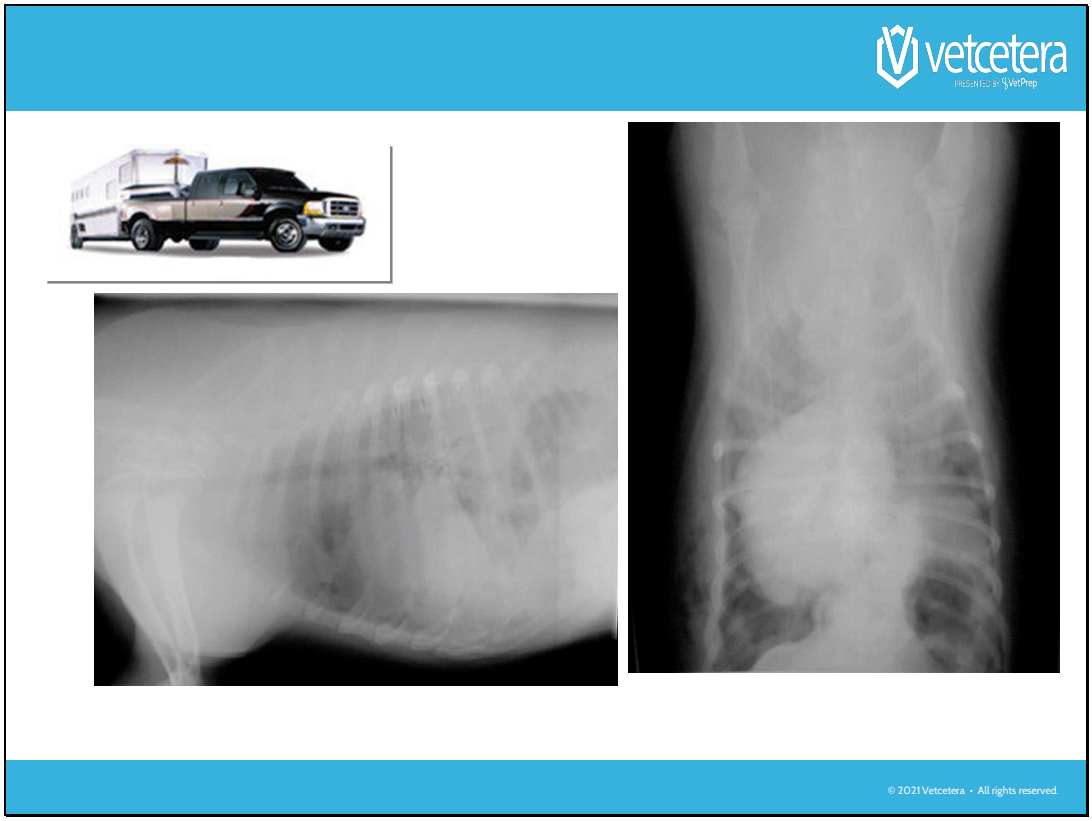
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Slide 53

- Etomidate (0.5–2.0 mg/kg IV),
- Fentanyl (0.05 mg/kg IV)

diazepam (0.1 mg/kg IV)

+/- atracurium (0.25 mg/kg)

- Fentanyl (0.05 mg/kg IV)

diazepam (0.1 mg/kg IV)

+/- Propofol 1-2 mg/kg

- Ketamine + diazepam (0.1 mg/kg IV)

Slide 54


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OUTLET
5.0
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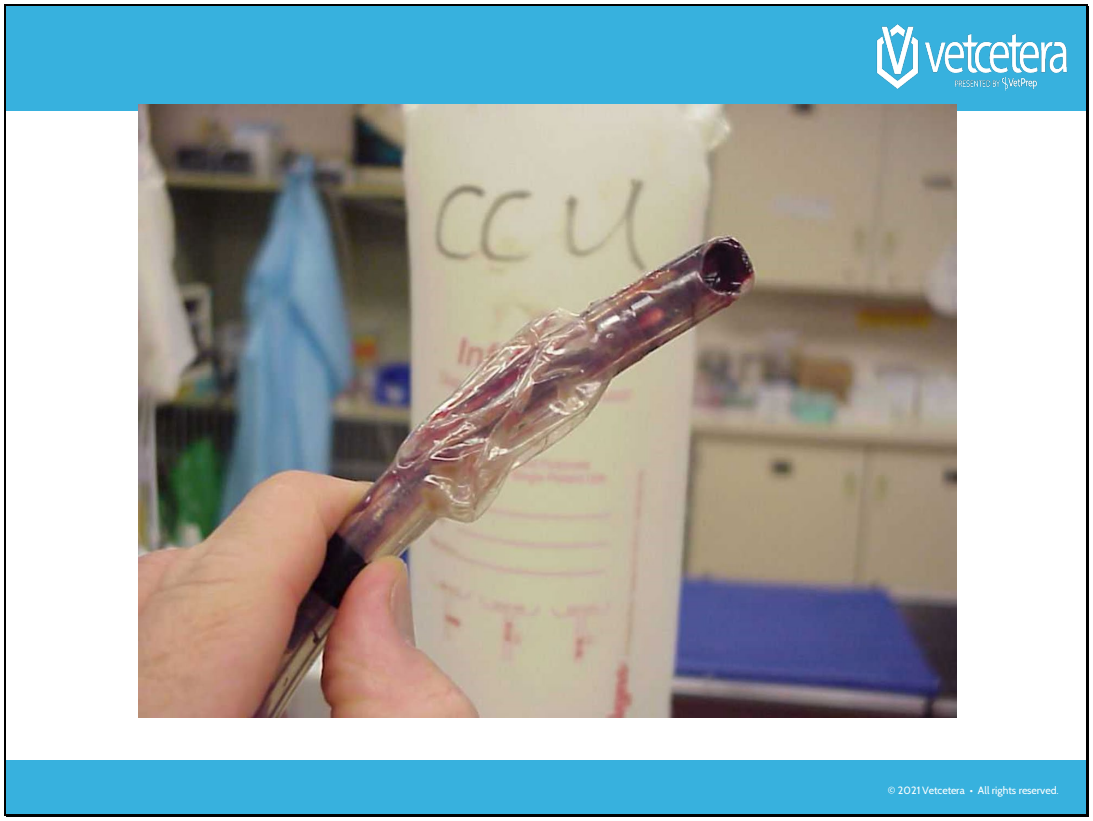
Slide 55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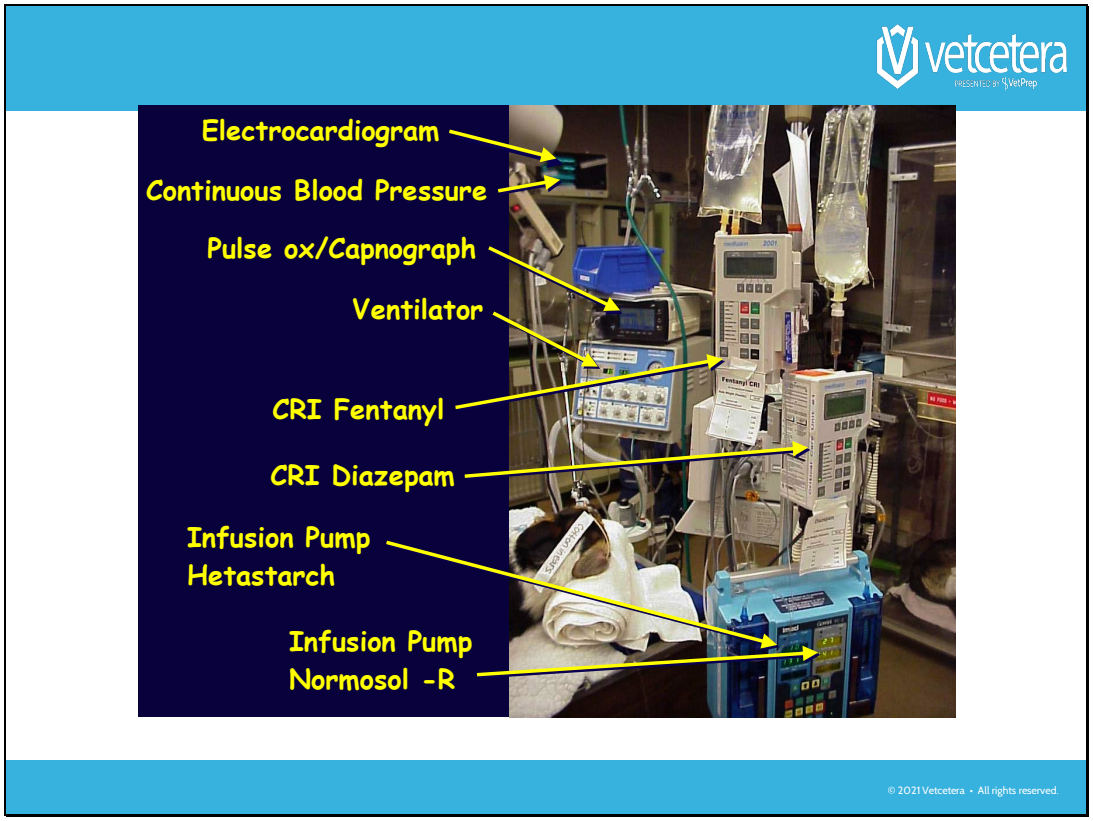
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Electrocardiogram
Continuous Blood Pressure
Pulse ox/Capnograph
Ventilator
CRI Fentanyl
CRI Diazepam
Infusion Pump
Hetastarch
Infusion Pump
Normosol -R
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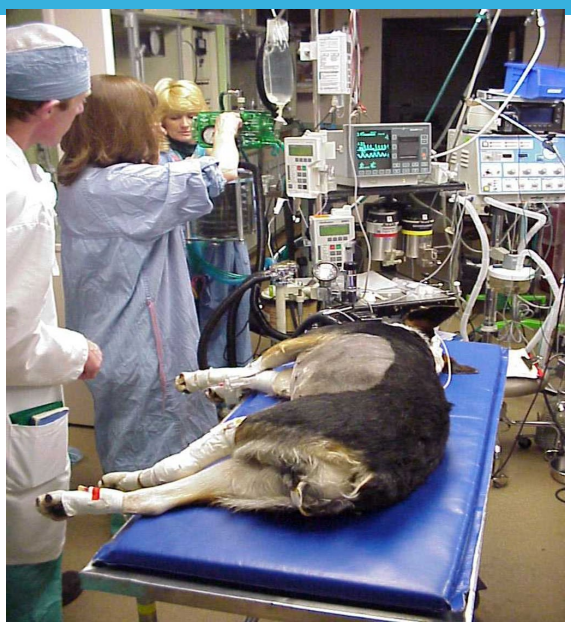

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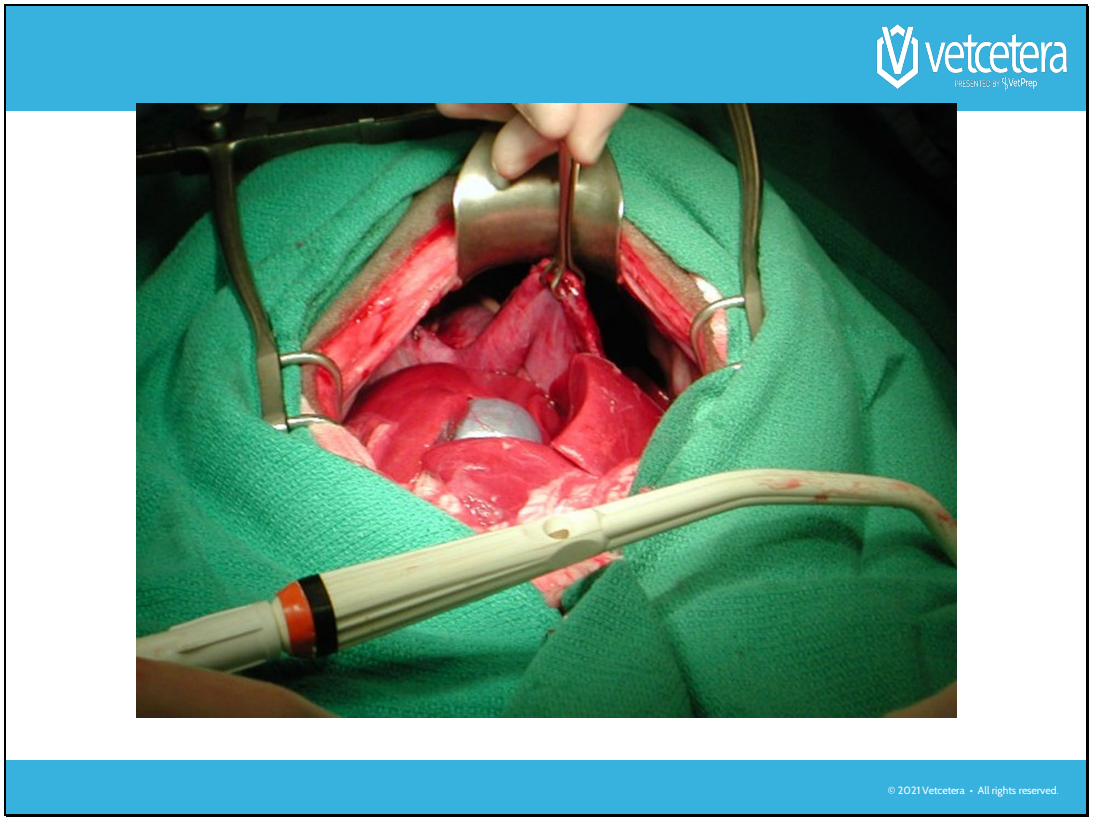
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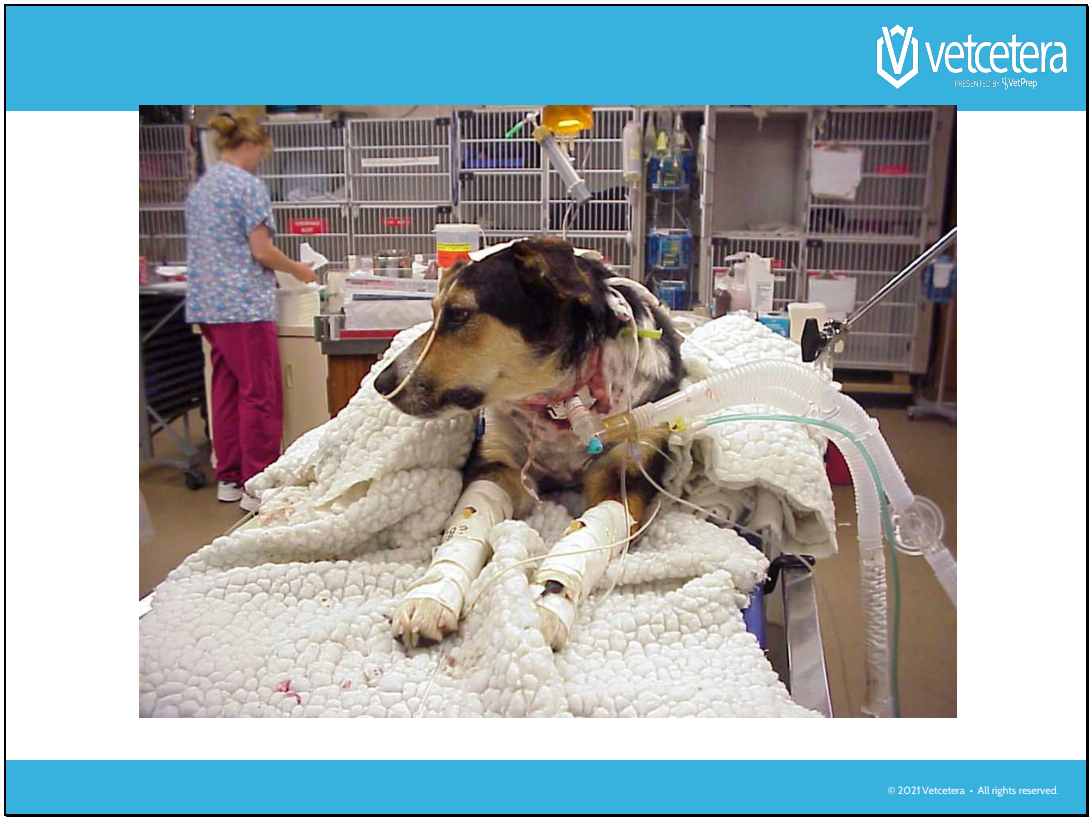
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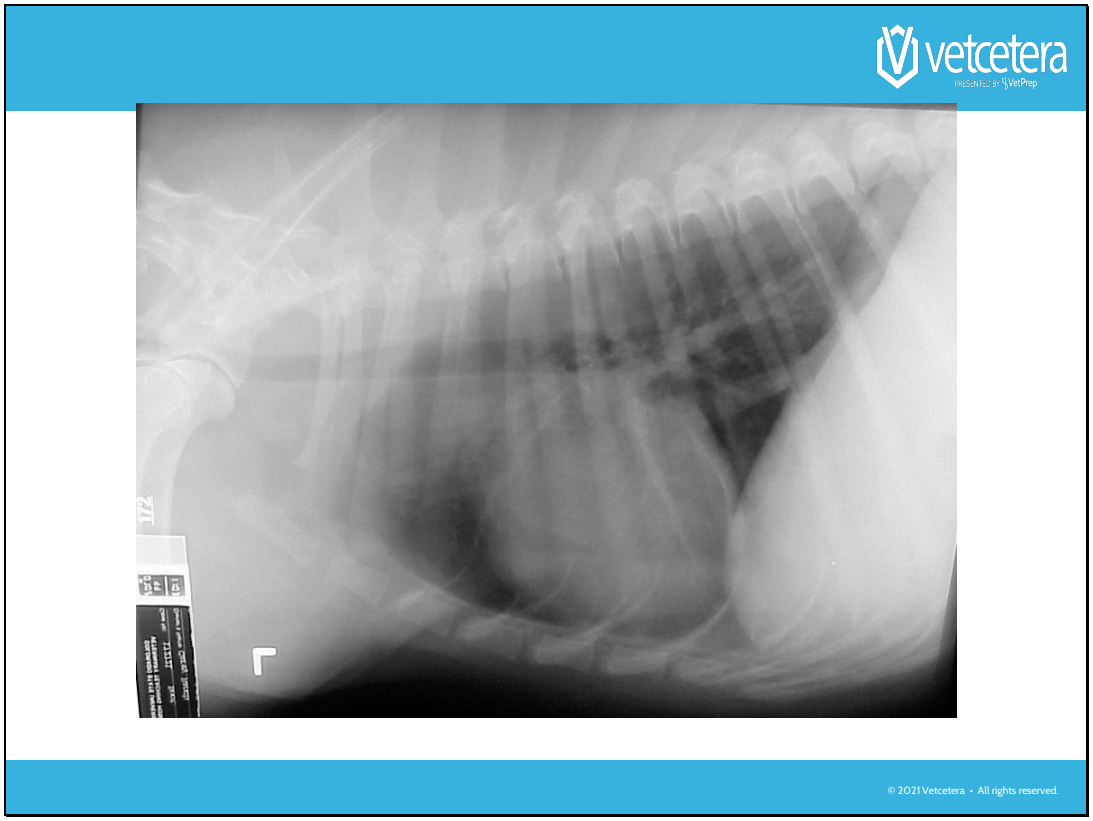
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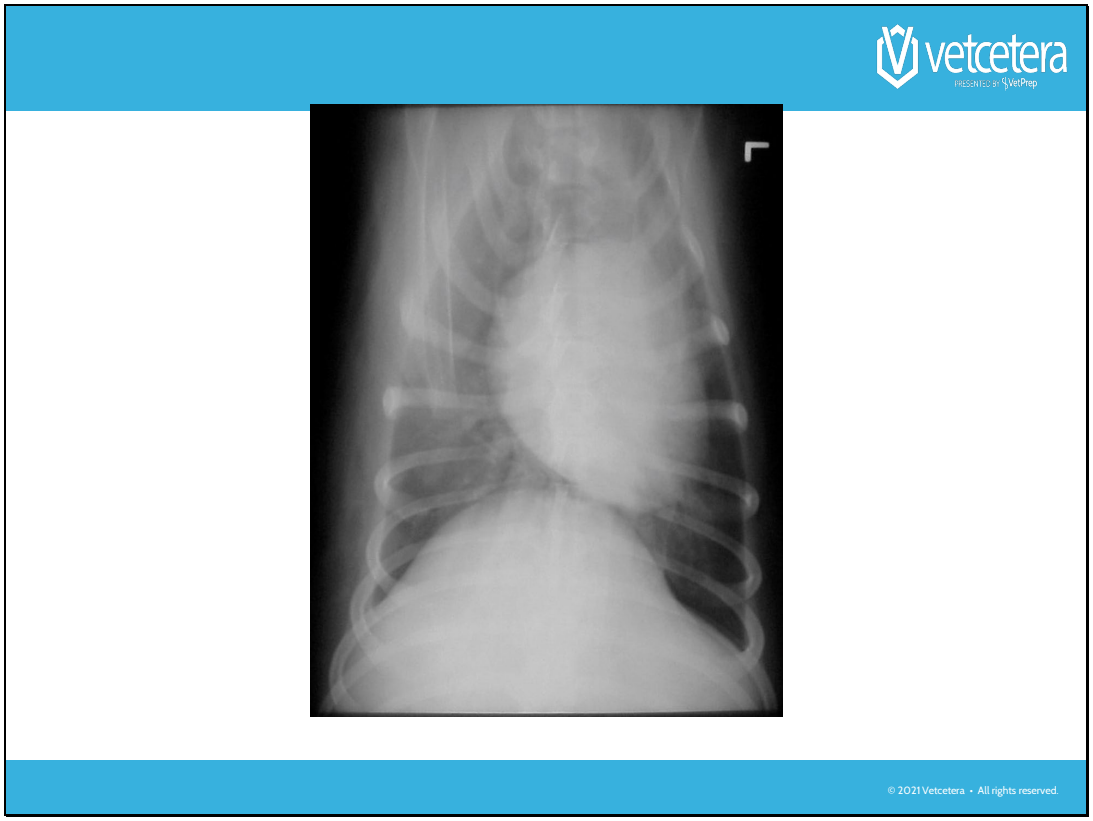
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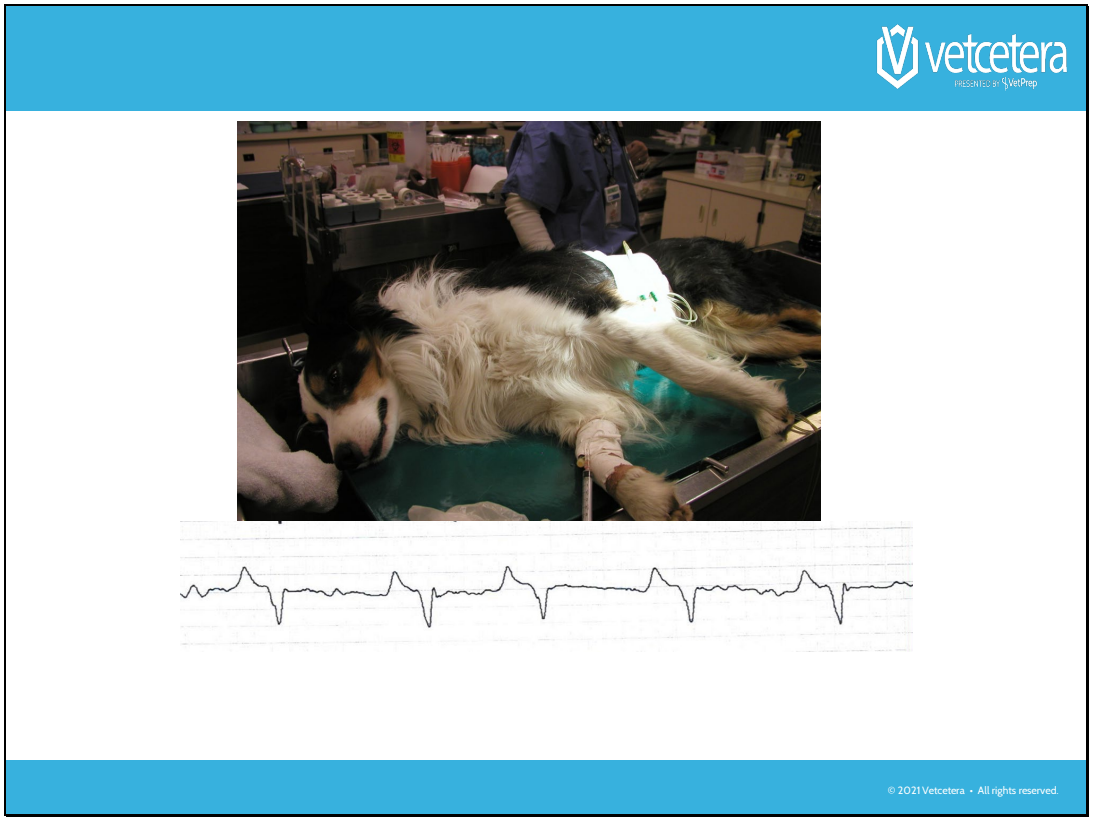
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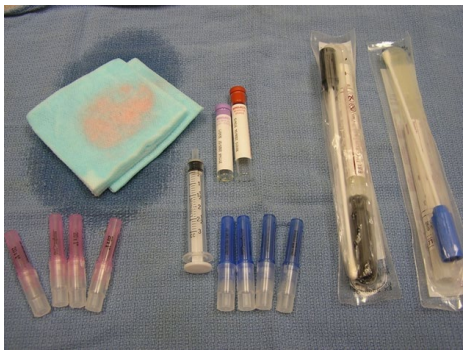
Slide 64

- Clippers and blades
- Antimicrobial scrub
- 20 – 22 gauge needles
- 3 ml syringe
- Red and purple topped tubes
- Culturettes



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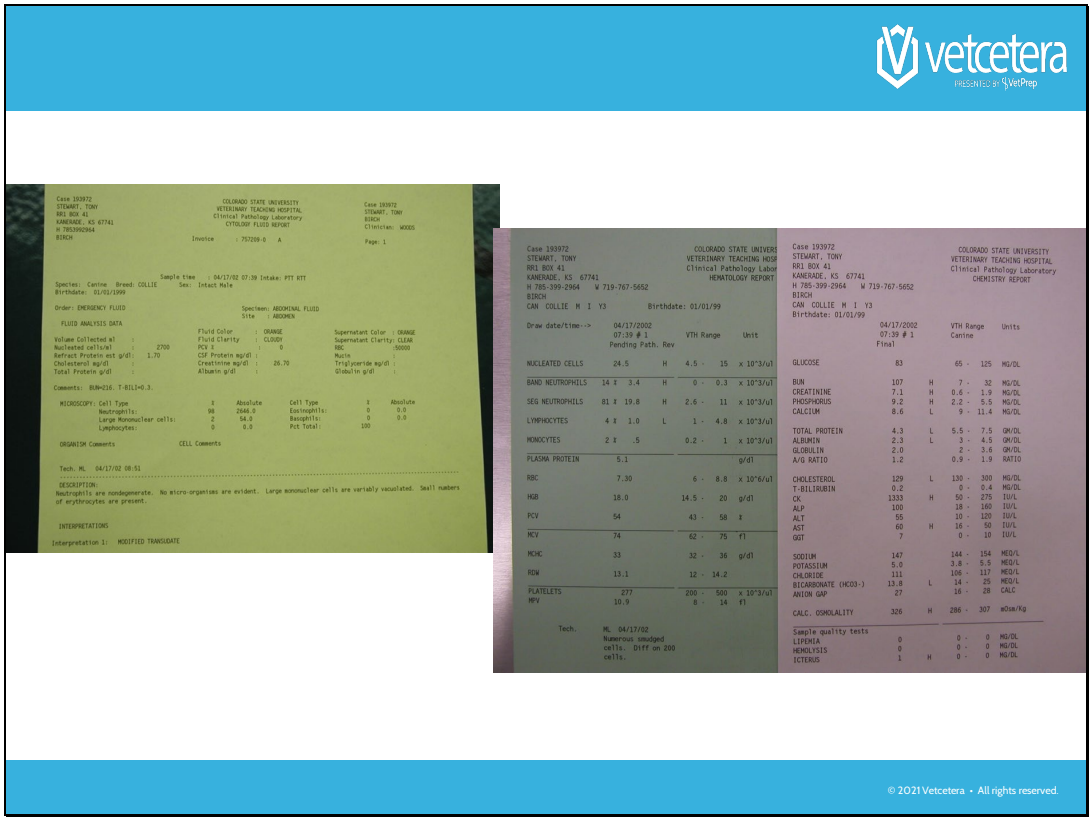
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CYTOLOGY FLUID REPORT
Invoice : 757209-0 A
Page: 1
Sample time : 04/17/02 07:39 Intake: PTT RTT
Species: Canine Breed: COLLIE Sex: Intact Male
Birthdate: 01/01/1999
Order: EMERGENCY FLUID
Specimen: ABDOMINAL FLUID
Site : ABDOMEN
FLUID ANALYSIS DATA
Volume Collected ml : 2700
Nucleated cells/ml : 1.70
Refract Protein est g/dl :
Cholesterol mg/dl :
Total Protein g/dl :
Fluid Color : ORANGE
Fluid Clarity : CLOUDY
PCV %
CSF Protein mg/dl :
Creatinine mg/dl : 26.70
Albumin g/dl :
Supernatant Color : ORANGE
Supernatant Clarity: CLEAR
RBC :50000
Mucin :
Triglyceride mg/dl :
Globulin g/dl :
Comments: BUN=216. T-BILI=0.3.
MICROSCOPY: Cell Type
Neutrophils:
Large Mononuclear cells:
Lymphocytes:
Absolute
98 2646.0
2 54.0
0 0.0
Cell Type
Eosinophils:
Basophils:
Pct Total:
Absolute
0 0.0
0 0.0
100
ORGANISM Comments
CELL Comments
Tech. ML 04/17/02 08:51
DESCRIPTION:
Neutrophils are nondegenerate. No micro-organisms are evident. Large mononuclear cells are variably vacuolated. Small numbers of erythrocytes are present.
INTERPRETATIONS
Interpretation 1: MODIFIED TRANSUDATE
Case 193972
STEWART, TONY
RR1 BOX 41
KANERADE, KS 67741
H 785-399-2964 W 719-767-5652
BIRCH
CAN COLLIE M I Y3 Birthdate: 01/01/99
COLORADO STATE UNIVERSITY
VETERINARY TEACHING HOSP
Clinical Pathology Labor
HEMATOLOGY REPORT
Draw date/time--> 04/17/2002 07:39 # 1 Pending Path. Rev
VTH Range Unit
NUCLEATED CELLS 24.5 H 4.5 - 15 x 10^3/ul
BAND NEUTROPHILS 14 % 3.4 H 0 - 0.3 x 10^3/ul
SEG NEUTROPHILS 81 % 19.8 H 2.6 - 11 x 10^3/ul
LYMPHOCYTES 4 % 1.0 L 1 - 4.8 x 10^3/ul
MONOCYTES 2 % .5 0.2 - 1 x 10^3/ul
PLASMA PROTEIN 5.1 g/dl
RBC 7.30 6 - 8.8 x 10^6/ul
HGB 18.0 14.5 - 20 g/dl
PCV 54 43 - 58 %
MCV 74 62 - 75 fl
MCHC 33 32 - 36 g/dl
RDW 13.1 12 - 14.2
PLATELETS 277 200 - 500 x 10^3/ul
MPV 10.9 8 - 14 fl
Tech. ML 04/17/02
Numerous smudged cells. Diff on 200 cells.
Case 193972
STEWART, TONY
RR1 BOX 41
KANERADE, KS 67741
H 785-399-2964 W 719-767-5652
BIRCH
CAN COLLIE M I Y3
Birthdate: 01/01/99
COLORADO STATE UNIVERSITY
VETERINARY TEACHING HOSPITAL
Clinical Pathology Laboratory
CHEMISTRY REPORT
04/17/2002 07:39 # 1 Final
VTH Range Canine
Units
GLUCOSE 83 65 - 125 MG/DL
BUN 107 H 7 - 32 MG/DL
CREATININE 7.1 H 0.6 - 1.9 MG/DL
PHOSPHORUS 9.2 H 2.2 - 5.5 MG/DL
CALCIUM 8.6 L 9 - 11.4 MG/DL
TOTAL PROTEIN 4.3 L 5.5 - 7.5 GM/DL
ALBUMIN 2.3 L 3 - 4.5 GM/DL
GLOBULIN 2.0 2 - 3.6 GM/DL
A/G RATIO 1.2 0.9 - 1.9 RATIO
CHOLESTEROL 129 L 130 - 300 MG/DL
T-BILIRUBIN 0.2 0 - 0.4 MG/DL
CK 1333 H 50 - 275 IU/L
ALP 100 18 - 160 IU/L
ALT 55 10 - 120 IU/L
AST 60 H 16 - 50 IU/L
GGT 7 0 - 10 IU/L
SODIUM 147 144 - 154 MEQ/L
POTASSIUM 5.0 3.8 - 5.5 MEQ/L
CHLORIDE 111 106 - 117 MEQ/L
BICARBONATE (HCO3-) 13.8 L 14 - 25 MEQ/L
ANION GAP 27 16 - 28 CALC
CALC. OSMOLALITY 326 H 286 - 307 mOsm/Kg
Sample quality tests
LIPEMIA 0 0 - 0 MG/DL
HEMOLYSIS 0 0 - 0 MG/DL
ICTERUS 1 H 0 - 0 MG/DL
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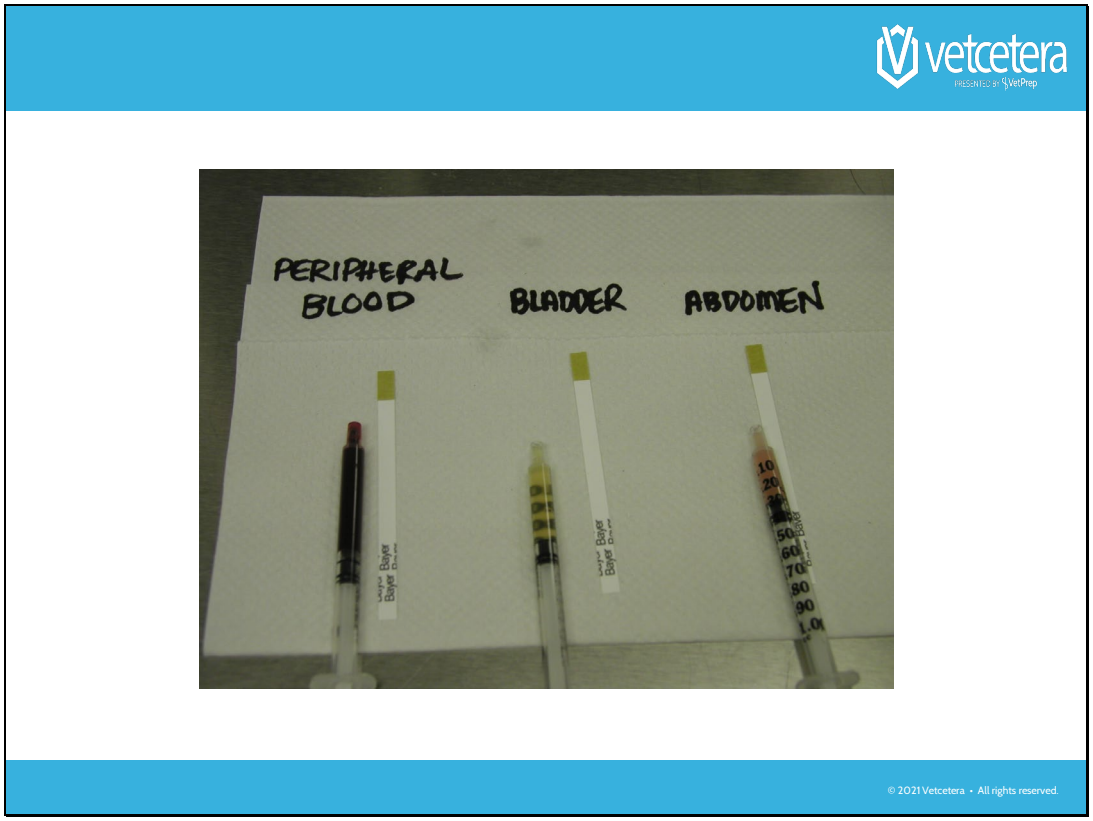
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PRESENTED BY VetPrep
PERIPHERAL BLOOD
BLADDER
ABDOMEN
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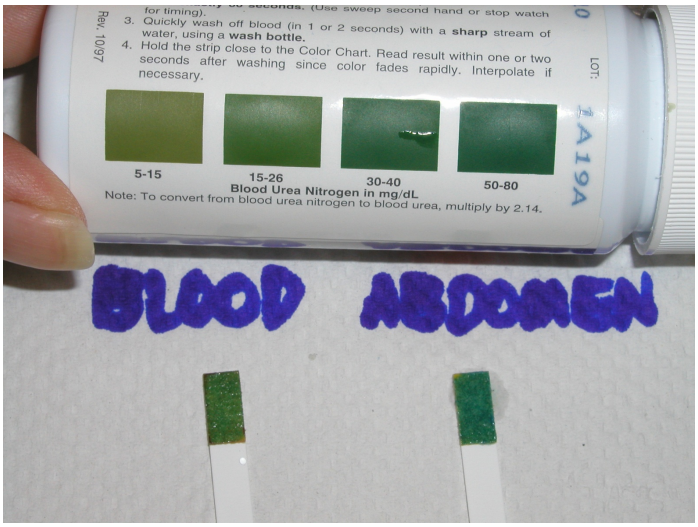

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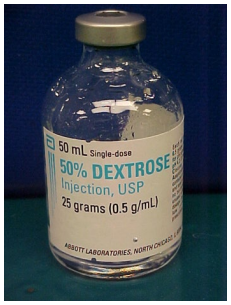
- Treatment of hyperkalemia
- Drive K^+ into the cells
- Insulin
  - Regular insulin
  - 0.5 – 1.0 units/kg IV
- Dextrose
  - 25% Dextrose
  - 1 mL/unit insulin, followed by 2.5 – 5% Dextrose CRI



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- Treatment of hyperkalemia
- Drive K^+ into the cells
- Sodium bicarbonate
  - 1 mEq/kg IV
  - Drives K+ intracellularly in exchange for H^+

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- Protect cells by raising the threshold for depolarization
- Calcium gluconate
  - 0.3 mL/kg IV 10% solution
- Calcium chloride
  - 0.1 mL/kg IV 10% solution

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- 0.01 mg/kg IV over 15 minutes

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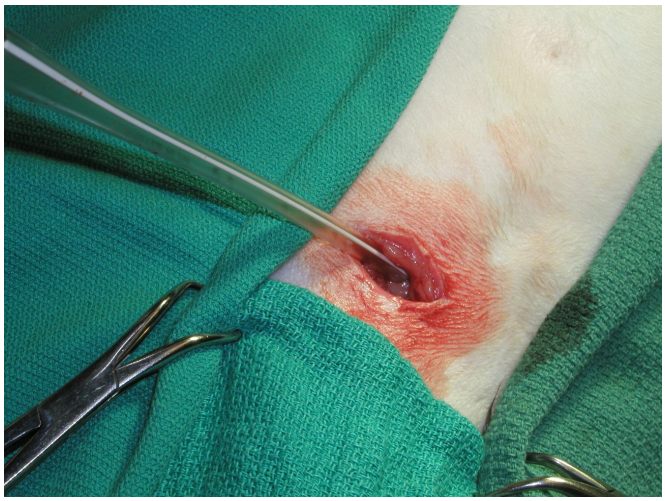

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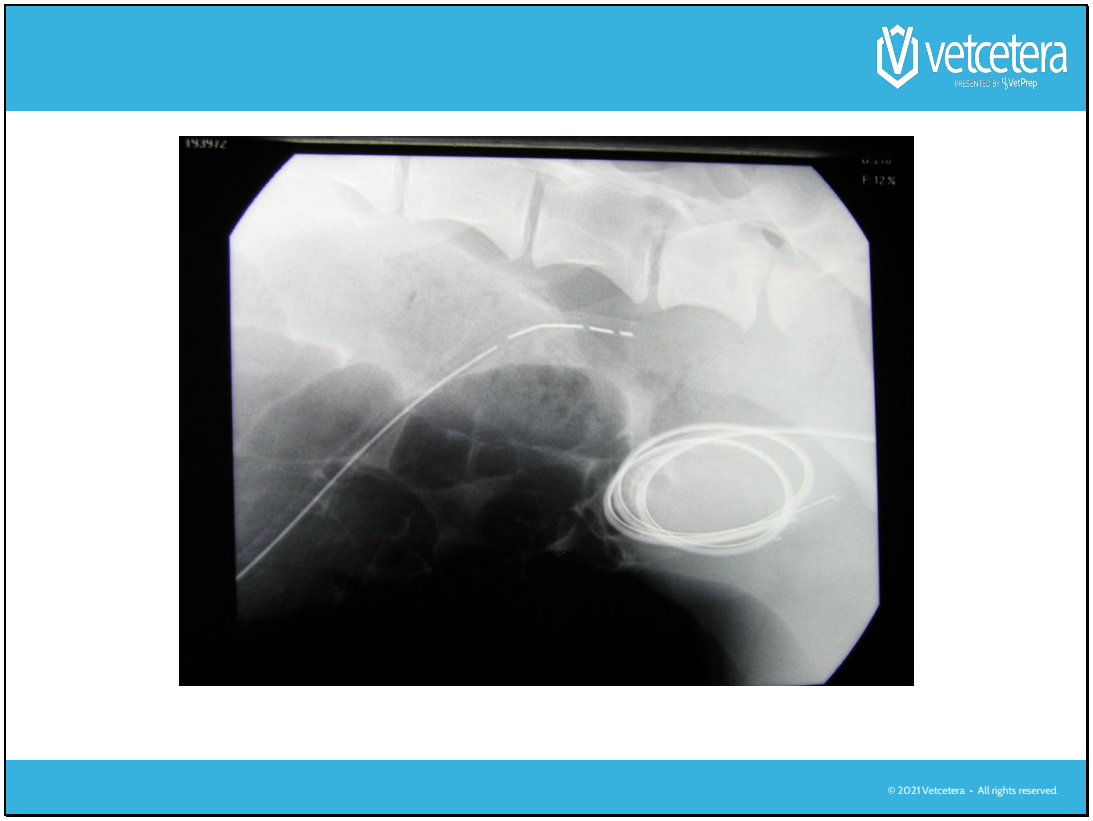
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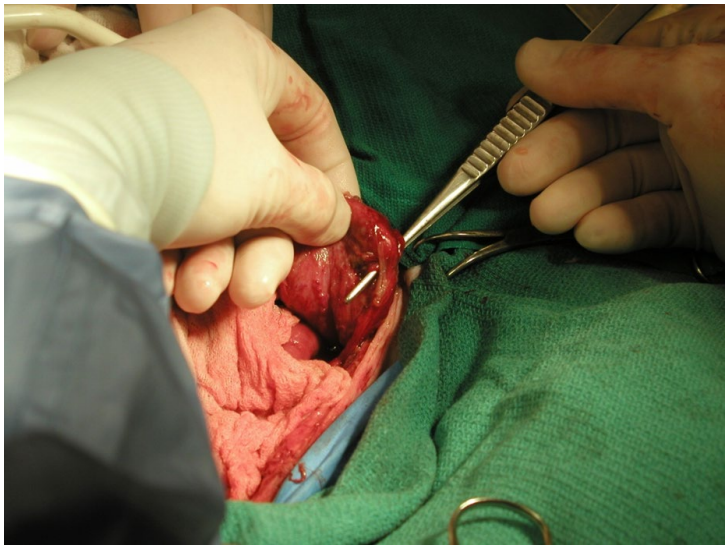

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VTH
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DV
Radiograph

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- 17 dogs with traumatic injuries
- 9 treated
- 2/9 regained function/ability to walk
- Prognosis guarded if lose deep pain

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Slide 84

- Always use judiciously

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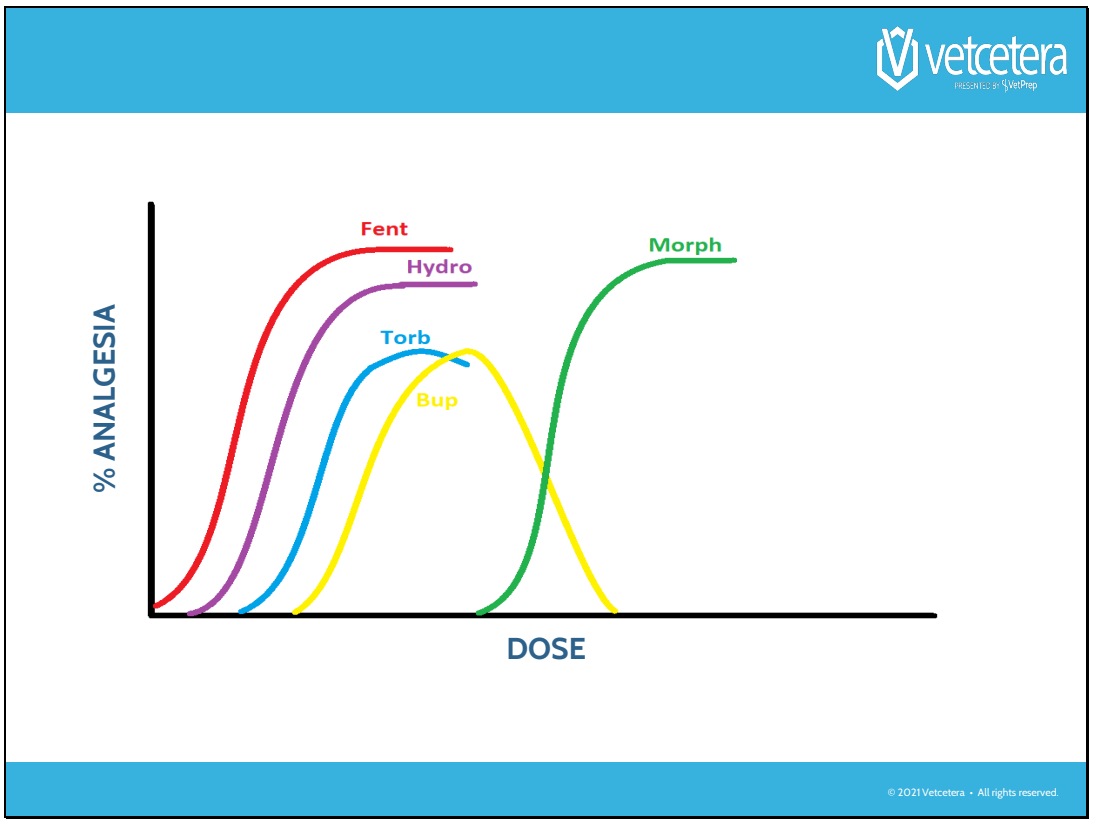
vetcetera
PRESENTED BY VetPrep
Fent
Hydro
Torb
Bup
Morph
% ANALGESIA
DOSE
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Hydromorphone HCl Injection, USP
2 mg/mL
20 mL Multiple Dose Vial
Baxter
Morphine Sulfate Injection, USP
15 mg/mL
FOR SC, IM OR SLOW IV USE
NOT FOR EPIDURAL OR INTRATHECAL
20 mL Multiple Dose Vial
Baxter
20 mL Single-dose Vial
FENTANYL CITRATE
Injection, USP
1000 mcg Fentanyl/20 mL
(50 mcg/mL) (0.05 mg/mL)
WARNING: MAY BE HABIT FORMING.
ABBOTT LABORATORIES, NORTH CHICAGO, IL
EXP 1FEB2005 LOT 01-181-
0.3 mg buprenorphine in 1 ml
Buprenex® Injectable
(buprenorphine hydrochloride)
FOR INTRAMUSCULAR OR INTRAVENOUS USE
5 ampuls—1 ml each
Rx only
02-131 → 135
Torbugesic®
Injection
CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.
NADA 135-780, Approved by FDA
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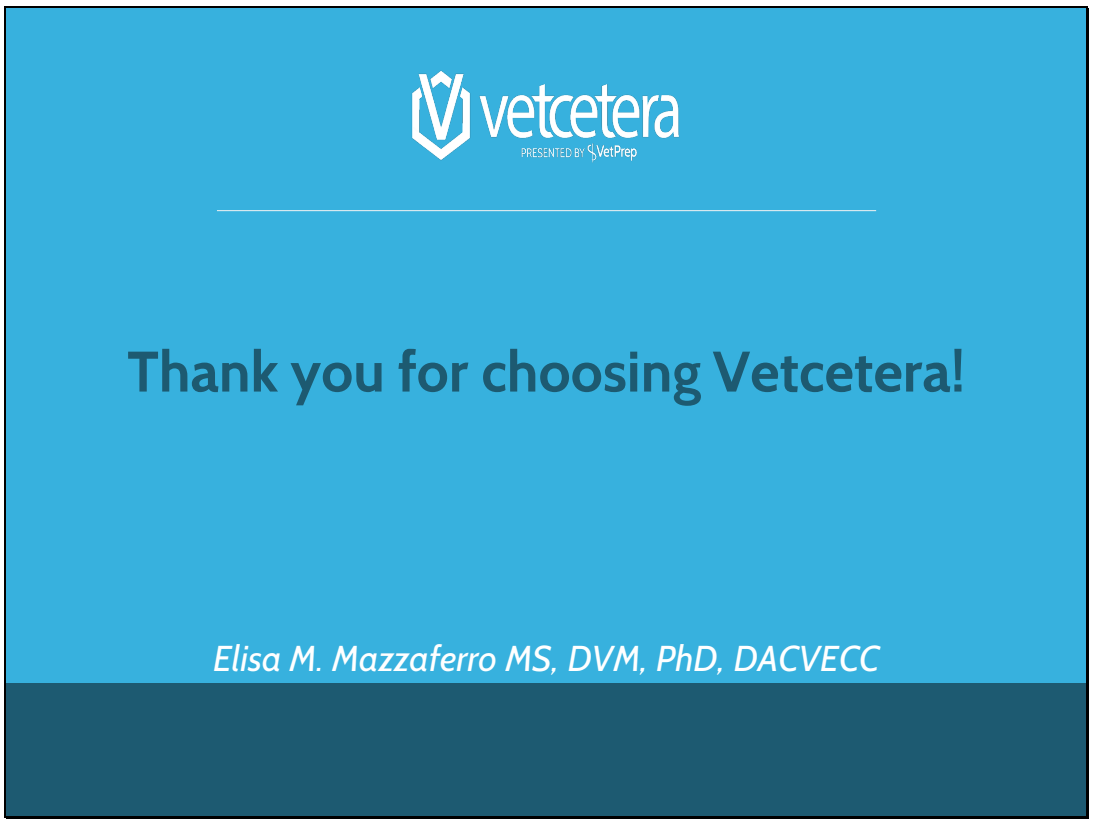
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Thank you for choosing Vetcetera!
Elisa M. Mazzaferro MS, DVM, PhD, DACVECC