Transfusion Medicine: When, What and How?
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Emergency and Critical Care

Outline
- Canine and feline blood groups
- Blood typing
- Cross-matching
- Blood donor screening
- Donor collection
- Transfusion administration
- Blood component therapy
- Risks of transfusions
- Controversies in transfusion medicine

Transfusion history
- First transfusion in 1665 in a dog

Canine blood groups
- 13 blood groups
  - DEA 1.1, 1.2, 3, 4, 5, 7
  - No natural antibodies to DEA 1 system
  - Natural antibodies present 3, 5, 7
  - Dal

Universal blood donor?
- DEA 1.1, 3, 5, 7 negative; 4 positive
Canine blood typing

- Laboratory testing
  - Tube agglutination
- In-house typing DEA 1.1
  - DMS card
  - Cartridge Quick Test, Alvedia
  - Gel column test

Feline blood groups

- A, B, AB
  - Differences in alloantibody strength
- Mik antigen
- No universal donor

Feline blood typing

- Laboratory testing
  - Tube agglutination
- In-house typing AB system
  - RapidVet-H feline card test
  - Cartridge Quick Test A+B, Alvedia
- No in-house testing for Mik

DMS card
Cartridge quick test

http://avmhk.com/ufiles/Alvedia1.jpg

Cross-matching

- Major crossmatch
- Minor crossmatch

Canine cross-matching

- Recommended if...
  - Unknown transfusion history
  - Severe hemolytic transfusion prior
  - >3-7 days since first transfusion
  - Donor 7 blood type unknown

Feline cross-matching

- Should be considered first transfusion

Cross-matching methodology

- Manual method
- RapidVet-H gel method

RapidVet-H gel method

Weltman 2014

http://www.alvedia.com/images/forme%20chats%20orange.jpg

http://www.rapidvet.com/xmatch.html
Blood donor screening

• Healthy

• Physical exam

• CBC, chemistry, urinalysis, fecal

Canine blood donor screening

• Heartworm

• Babesia

• Ehrlichia

• Neorickettsia

• Bartonella

• Mycoplasma haemocanis

• +/- Leishmania, Trypanosoma cruzi

• +/- Brucella canis

Feline blood donor screening

• FeLV/FIV

• Mycoplasma

• Bartonella

• +/- Ehrlichia, Anaplasma, Neorickettsia, Cytauxzoon felis

Donor collection

• Dogs 15-20ml/kg

• Cats 10-15ml/kg

• Jugular vein

Anticoagulants and preservatives

Transfusion administration

• Core principles

• Monitoring

• Gravity, pump, syringe administration
  – Dogs: Gravity + in-line filter
  – Cats: Syringe + HemoNate filter

• Leukoreduction
Blood component therapy

- Whole blood
- Packed red blood cells
- Fresh frozen plasma
- Frozen plasma
- Cryoprecipitate
- Cryo-poor plasma
- Albumin
- Platelet concentrate
- Frozen platelets
- Lyophilized platelets

Whole blood

- Red blood cells, white blood cells, pro- and anti-coagulant factors, platelets
- Anemia
- Use within 4-6 hours
- Stable for ~ 1 month if refrigerated

Packed red blood cells

- Red blood cells +/- white blood cells
- Anemia
- 20-37 days in refrigerator (additives)
- Dosing

Formulas for transfusions

- VT (mL) = kg BW x blood volume (90ml) x [(desired PCV-recipient PCV)/ donor PCV]
- VT (mL) = 1.5 x desired rise PCV x kg BW
- VT (mL) = 1ml x % PCV rise x kg BW overestimated
- VT (mL) = 2ml x % PCV rise x kg BW underestimated

Fresh frozen plasma

- All pro- and anti-coagulant factors, albumin
- Coagulopathy
- 1 year in freezer; frozen within 8 hrs
- Dosing: 10-20ml/kg

Frozen plasma

- II, VII, IX, X, albumin
- Vitamin K1-dependent coagulopathy
- 1-5 years in freezer; frozen >8hrs
- 10-20ml/kg
Refrigerated frozen plasma

- Time to thaw ~ 35 minutes
- Refrigerated storage (14 days) resulted in significant decrease in activity of clotting factors
- No values outside of RR
- No contamination of units documented

Grochowsky 2014

Cryoprecipitate

- VIII, vWF, fibrinogen, fibronectin, XIII
- vWD, hemophilia A
- 10 months in freezer
- 1U/10kg

Cryo-poor plasma

- II, VII, IX, X, albumin
- Vitamin K1-dependent coagulopathy
- 1 year in freezer
- 10-20ml/kg

Albumin

- Concentrated albumin (human)
- Hypoalbuminemia
- Stable for 3 years at room temp
- Dosing 1.5 g/kg or albumin deficit

Platelet-rich plasma and concentrate

- Platelets, plasma
- Severe thrombocytopenia
- Stable for 5 days, constant agitation
- 1U/10kg

Frozen platelets

- Platelets, 6% DMSO or 2% DMSO + Thrombosol
- Severe thrombocytopenia
- 6 months in freezer
- 1U/10kg; humans 2.5U:1U fresh
**Lyophilized platelets**
- Platelets
- Severe thrombocytopenia
- 2 years in refrigerator
- Dosing based on weight ranges

**Lyophilized platelets**
- No difference between lyophilized vs. fresh platelets
  - transfusion reaction rates
  - need for additional transfusions
  - 24 hour blood loss score (BLS)
  - hospitalization time
  - survival to discharge
  - 28 day survival

**Autologous transfusions**
- Simple autotransfusion
  - Crowe 2004
- Cell salvage devices
  - Hirst 2012 (case series)
  - Kellet-Gregory 2013

**Massive transfusions**
- Greater than blood volume in 24 hrs
- Greater than 1/2 blood volume in 3 hrs
- Mortality 74%
- Complications
  - 1:1:1 ratio

**Transfusion reactions**
- Immunologic
  - Type I hypersensitivity reactions
  - Severe hemolytic reactions
  - Non-hemolytic febrile reactions
  - Acute lung injury (TRALI)
  - Immunomodulation (TRIM)
  - Decreased red cell survival

**Transfusion reactions**
- Non-immunologic
  - Sepsis
  - Electrolyte derangements
  - Volume overload (TACO)
  - Hypothermia
  - Storage lesions
  - Infectious diseases
Transfusion reactions

• What are the most common?
• How frequently do they occur?
• What do we do when they occur?

Controversies

• When to treat anemia?
• Plasma for DIC?
• Plasma for hypoalbuminemia?
• When to give platelets?

When to treat anemia?

• Goal to increase oxygen delivery
  – $\text{DO}_2 = \text{CO} \times \text{CaO}_2$
  – $\text{CaO}_2 = [\% \text{ Sat} \times 1.39 \text{ (ml/g)} \times \text{[Hb]} \text{ (g/dl)} + \text{(arterial PaO}_2 \times 0.003)]$
• Target [Hb]

Plasma for DIC?

• Human guidelines
  – Cornerstone of DIC treatment is treatment of underlying condition
  – Blood component therapy (platelets or plasma) should not be given on basis of laboratory derangements alone
    • Active bleeding
    • Invasive procedures

Plasma for hypoalbuminemia?

• Generally not indicated
• 22.5ml/kg to raise albumin 0.5g/dl
• No difference in albumin pre-/post-transfusion in canine retrospective

Platelet transfusions?

• Severe thrombocytopenia
• Invasive procedures
• Life-threatening hemorrhage
References


Questions?