Transfusion Medicine

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History

• 1616: British physician William Harvey discovered the circulation of blood around the body

• 1657: Sir Christopher Wren: 1st experiments with intravenous injections
  - “syringe” made from animal bladder attached to a goose quill; injected opium, wine and ale into a dog
  - Demonstrated transfusion blood animal to animal

• 1667: Lower and King: 1st animal to human blood transfusion in England
  - Animal donors used: fatal reactions so blood transfusions fell out of favor for 148 years.
• 1813: Dr James Blundell (Obstetrician) reintroduced blood transfusion for post partum haemorrhage
  • Recognized donor and recipient should be same sp

• 1853: Hypodermic Syringe developed

• 1864: Dr’s Roussel and Aveling: direct blood transfusions with humans using rubber tubes
  • Clotting was main problem

• 1883: Sodium phosphate mixed with blood
  • Stopped the clotting problems
  • Killed the recipients!

• 1890’s: Debate re Blood Vs Saline
• 1900’s: Recognized different blood groups: A, B, O, AB
  • Transfusions were still being done with no cross matching
  • Only direct transfusions were being done
  • Only using O as donors and using venous cut down procedures so donors limited

• 1915: Sodium citrate anticoagulant

• 1918: First blood bank

• 1933: Pre-transfusion compatibility testing became routine (discovered 1913)

• 1937: Large scale blood banks

• 1939: Adoption of ABO nomenclature

• 1940’s: Rh blood groups discovered

• 1948: polythene catheters /collection bags
Nowadays..

- Access to a variety of blood products (dogs only)
- Recognize blood is a precious finite resource
  - Weigh up risks vs benefit of a transfusion
  - Consider if component therapy more appropriate
  - Does the patient really require transfusion?
- If blood is given, ensure procedures are followed to maximize a beneficial outcome
Indications For Blood Transfusions

Anaemia

- Blood Loss
- Trauma
- Intra-Abdominal Haemorrhage
  - Ruptured Splenic /Hepatic /Renal Tumors
  - CauVC Invasion Adrenal Tumors
- Coagulopathies
  - Anticoagulant Rodenticide Poisoning
  - DIC
  - Haemophilia
  - vWD

- Whole blood is generally appropriate if patients are hypovolaemic
Haemolysis

- Fragmentation
  - DIC/Splenic torsion/HSA/Vasculitis
- Toxicants
  - Foodstuffs
    - Onions/garlic/Propylene Glycol
  - Drugs
    - Vitamin K, DMSO/Paracetamol
  - Chemicals
    - Zinc/copper
- Immune –Mediated
  - Idiopathic primary/Secondary/Neonatal isoerythrolysis/Transfusion
- Heritable
  - PFK/PK/Osmotic Fragility
- Infection Related
  - Mycoplasma/FeLV/FIV/Lepto
- Miscellaneous
  - Hypophosphataemia/Envemonation

- Transient benefit depending on the cause of the haemolysis
- It can stabilize the patient long enough for specific therapies to work
Non Regenerative Anaemia

- Immune Mediated Anaemia
- Primary Bone Marrow Disorders
  - Dysmyelopoiesis/MDS
  - Necrosis
  - Destruction (drugs/toxins/radiation/infectious causes)
- Nutrient Deficiencies (iron/folate/cobalamine)
- Neoplasia (primary/metastatic)
- Chronic Disease

- These patients are generally normovolaemic so pRBC’s are more appropriate than whole blood

- Transfused RBC’s can have a normal life span (100-120 days: dogs, 70 days: cats)
Which Blood Products?

- Fresh Whole Blood
- Stored Whole Blood
- Fresh Frozen Plasma
- Frozen Plasma
- pRBC’s
- Cryoprecipitate (?)
Whole Blood

- **Fresh Whole Blood**
  - RBC’s, WBC’s, Stable Clotting Factors, Plasma Proteins
  - Labile clotting factors (Factor V, Factor V111)
    - Last for 24 hours
  - Some platelets
    - Last 2-4 hours
- **Indications:**
  - Acute Blood Loss with hypovolaemia
  - Bleeding 2ry Thrombocyopaenia in vital areas
  - Coagulopathies if fresh
  - If FWB >24 hours old = Whole Blood
- **Stored Whole Blood**
  - No labile clotting factors or platelets
  - Accumulates storage products:
    - Ammonia
    - Hydrogen Ions
    - Pro-inflammatory Cytokines
    - Potassium
  - Indications:
    - Anaemia 2ry haemolysis
    - Chronic anaemia
    - Intra-operative blood loss
Packed Red Blood Cells

- Indicated to address anaemia in:
  - Normovolaemic patients
  - Patients who don’t require clotting factors
  - Patients who are not hypoproteinaemic
  - Hyperglobulinaemic patients
- Certain conditions:
  - Haemolysis
  - Chronic Anaemia
  - Conditions with risk circulatory overload
    - Cardiac disease
    - Renal disease
What about using the patients own blood?

- Allergenic blood transfusions still carry many risks
  - Transfusion reactions
  - Infectious diseases transmission
  - Effects on tumor growth /recurrence
  - Higher post operative infections
  - Up-regulation of Systemic Inflammation
  - Adverse effects on natural killer cell activity (important in malignancy surveillance)

- Ensuring the safety of allergenic blood supply is expensive and difficult
  - Processing/screening/elimination of blood contaminants
  - HIV/Hepatitis/Creutzfeldt-Jakob

- In human medicine clerical errors lead to a lot of mismatched transfusions
Autologous blood transfusions remove these risks

- Human patients often donate blood for their own procedures 3-4 weeks in advance

Transfusion conservation mechanisms also employed

- Erythropoietin
- Iron supplementation
- Pre-operative isovolaemic haemodilution
- Intraoperative /post op cell salvage techniques
• Techniques for “cell salvage” developed in 1970’s
• Whole blood was collected from the operative field into canisters, anticoagulated, filtered and re-infused.

• Techniques evolved so that the harvested blood is now washed /centrifuged and filtered before returning to the patient
  • Plasma/Platelets/activated clotting factors/anti-coagulants/systemic medications/complement all removed
  • Haemocentrate blood to PCV60% then suspend in saline
  • Reinfuse within 6 hours

• There are different systems available
Initially there was a fear of increased risk of contamination with re-transfused blood

Modern cell salvage techniques remove unwanted components
- Leukoreduction filters remove WBC’s, Bacteria and Malignant cells
- There is a higher risk of infection with allergenic transfusions than with cell salvaged transfusions

Indicated with procedures potentially associated with high levels of blood loss
- Liver mass resections
- Adrenalectomies with vessel invasion
- Splenic mass ruptures
- Thyroid Cancer Surgeries

May be indications with immune mediated diseases
- Therapeutic plasmapheresis
  - M gravis, IMHA
• 1998 Consensus Conference on Autologous Transfusions
  • Intra-operative cell salvage and leukoreducing filters gives 100% protection from infusion of tumor cells
  • Some people still feel blood should be irradiated to completely eliminate the risk

• Blood that is salvaged but NOT washed/filtered adequately:
  • Renal damage
  • Hyperlactataemia
  • Decreased Hct
  • Hyperbilirubinaemia
  • ARDS/DIC/DEATH
    \[\text{Cell Salvage Syndrome}\]
• Cell salvage syndrome is rare with modern cell salvage techniques and equipment
  • This blood is equal to or superior to banked blood
    • Red cell osmotic resistance, morphology, pH
    • Levels of 2,3-diphosphoglycerate
  • Cost effective and reduces hospital stays
Plasma

- Plasma (fresh/fresh frozen/frozen)
  - Albumin
  - Clotting factors
  - Immunoglobulins

- Indicated
  - hypoalbuminaemia (???)
  - Clotting disorders

- Specialized plasma products
  - Cryoprecipitate
    - Factor VIII, vWF
    - If give desmopressin 1ug/kg s/c 30-60 min prior to blood collection : increased vWF levels in collected blood
## Blood products usages

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage guidelines</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh whole blood</td>
<td>12-20ml/kg</td>
<td>Anaemia, VWD, factor deficiencies</td>
</tr>
<tr>
<td>Fresh frozen plasma</td>
<td>10-12ml/kg</td>
<td>All coagulation factor deficiencies and VWD</td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td>1 unit/10kg</td>
<td>VWD, fibrinogen and factor VIII deficiency</td>
</tr>
<tr>
<td>Cryosupernatent</td>
<td>10-12ml/kg</td>
<td>Factor II, VII, IX,X and XI deficiencies</td>
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When to transfuse?

- If the patient is symptomatic for the anaemia***
  - Weakness
  - Tachypnea
  - Tachycardia

- No exact number as a transfusion trigger
  - Cats often tolerate quite low PCV’s
  - Dogs are more sensitive to the effects of anaemia
  - Chronic anaemia better tolerated than acute anaemia

- If PCV <10-12% ?? (chronic anaemia)

- If PCV has dropped rapidly to 20% (dogs) , 15% (cats)
What else do you need to know?

- Anaemic animals should all have a full CBC
  - Regenerative vs Non Regenerative
  - Heinz Bodies
  - Infectious Agents
    - Mycoplasma haemofelis
  - Leukaemias
  - Concurrent cytopaenias
    - ITP
    - IMN
    - Preferably through a commercial laboratory
- FeLV/FIV (cats)
- Icterus
- Haemoglobinaemia / Haemoglobinuria
- Autoagglutination
- Coombs Test
- Tests of haemostasis
  - Pt/aptt
  - BMBT
- Albumin/globulin levels
How much to give?

- Transfusion to a normal PCV is unnecessary
  - May remove stimulus for regenerative response
  - Aim to improve clinical condition

- Post transfusion PCV 20% (cats), 25-30% (dogs)

- Blood volume to be transfused:
  - \( K \times \text{Wt(kg)} \) (required PCV-recipient PCV)
  - \( \frac{\text{PCV of donated blood}}{\text{PCV of donated blood}} \)
  - \( K=90 \) (dogs), 66 (cats)
  - 2mls/kg whole blood to raise PCV by 1%
  - 1ml/kg pRBC to raise PCV by 1%
Transfusion Reactions

- Adverse reactions associated with administration of blood products
- Rare
  - 3-13% incidence rate
  - Blood Typing /Cross Matching
  - Blood stored and administered properly
- Most significant reactions associated with mismatched transfusions
- Recommendations to start slow with transfusion to detect adverse reactions don’t prevent serious reactions
Signs of Transfusion Reactions

- Urticaria (esp dogs)
- Erythema /Pruritis
- Vomiting
- Vocalisation (cats)
- Pyrexia
- Depression

- Tachypnea/Coughing
- Tachycardia or Bradycardia
- Tremors/convulsions
- Cardiopulmonary Arrest
- Anorexia, Jaundice (delayed)
Specific Transfusion Adverse Reactions

- **Acute or Delayed / Immunologic vs Non Immunologic**

- **Immunologic:**
  - Febrile Non Haemolytic Transfusion Reaction (FNHTR)
    - Most common
  - Acute Haemolytic Transfusion Reaction (AHTR)
    - Type 2 hypersensitivity reaction
  - Delayed Haemolytic Reactions
  - Acute Hypersensitivity Reactions
    - Type 1 hypersensitivity reactions
• **Non immunologic**
  • Bacterial contamination
  • Hypocalcaemia
  • Hypomagnesaemia
  • Vomiting
  • Circulatory Overload
  • Transmission Infectious Diseases
Acute haemolysis results from destruction of donor erythrocytes by recipient alloantibodies

- Occurs during or soon after transfusion
- Rare in first transfusions in dogs given low incidence of naturally occurring antibodies against DEA1.1 and DEA 1.2
- Incidence much higher in subsequent transfusions due to induction of antibodies
- Cats have naturally occurring alloantibodies so reactions can occur with first transfusions
  - Type B cats have high levels of Anti Type A antibodies
• Signs of an acute haemolytic reaction:
  • Depression
  • Recumbency
  • Cardiac Arrhythmias
  • Seizures
  • Shock
  • Urinate
  • Defaecate
  • Vocalize/Salivate (cats)
  • Tachycardic/Tachypneic
  • Haemoglobinuria/Haemoglobinaemia can occur within hours but are only clinically apparent if large volumes of blood transfused
  • Dramatic fall in recipients PCV
• Delayed Haemolytic Reactions
  • Reduced lifespan of transfused RBC’s (1-3 weeks post transfusion)
  • Cats:
    • Induction of antibodies to RBC antigens other than AB group
    • Induction of anti B antibodies in a Type A cat without naturally occurring alloantibodies
  • Dogs
    • Induction of antibodies against DEA 1.1 and DEA 1.2 (and other RBC antigens) by a first transfusion
    • These might not be detected by a cross match as titers might be low
• Other Causes of Haemolysis
  • Pre-transfusion
    • Wrong fluid used with blood
    • Wrong in line filter
    • Wrong infusion pump
      • Gravity delivery preferred if possible
Fever

• Most common transfusion adverse reaction

• Causes:
  • **Infectious**
    • Bacterial contamination via incorrect collection or storage of blood
    • Bacteria survive refrigeration and start to multiply once blood is warmed
    • Pyrexia develops within 15 mins
    • Signs of shock/abdominal pain/vomiting/diarrhoea

• Check blood bag for haemolysis and culture sample

• Treat with antibiotics and supportive care
• **Non-Infectious**: Antibody response to donor platelets, leukocytes or plasma proteins

  • Leukocyte lysis during storage releases immunomodulators such as histamine, myeloperoxidase, plasminogen-activator-inhibitor 1 and eosinophilic cationic protein
  
  • Cytokines increase in bag with increased storage time
  
  • Not often detected by cross matching
  
  • Most common type
  
  • Usually transient (within 4 hours of a transfusion)
  
  • Doesn’t require therapy
  
  • Leukoreduction in people helps reduce and may eliminate the inflammatory response to a blood transfusion.
Thrombocytopenia 2ry Transfusions

• Non Immune Causes:
  • Splenic sequestration
  • Sepsis
  • DIC

• Immune Causes
  • Antibody production to Human Leukocyte Antigen (HLA) or Human Platelet Antigen (HPA)
  • HLA antigen likely cause of transfusion associated acute lung injury in humans (TRALI)
  • WBC aggregates in pulmonary circulation ------- hypoxaemia -----respiratory distress----death
Hypocalcaemia

- Tremors/Vomiting/Cardiac Arrhythmias
- Rarely seen
  - Large volumes of blood transfused rapidly
  - Liver disease (citrate not metabolized)
  - Inappropriate volume citrate used
  - Often concurrent hypomagnesaemia
Vomiting

- Common during and post transfusion
  - Rapid administration of blood
  - Feeding around time of transfusion
- If no other symptoms of a transfusion reaction or haemolysis then wait 15 mins and continue at a slower rate
Circulatory Overload

- Reasonably common adverse event
- Rapid administration of whole blood to patients with cardiac disease, renal failure or normovolaemic anaemia
- CATS!
- Tachycardia/Tachypnea/Coughing/Dyspnea
- Use appropriate flow rates and pRBC’s rather than whole blood
- Therapy: Stop transfusion/frusemide/supplemental o2
Infectious Diseases

- Less likely in Australia
- Screening depends on species/geographic area
- **CATS**
  - FeLV/FIV/Mycoplasma haemofelis/FIP/Bartonella
- **DOGS**
  - HW/Rickettsia/Bartonella/Leishmania/Babesia/Anaplasma/Borrelia/Brucella/Ehrlichia
Complications Massive Transfusions

- Definition: transfusion of 1 or more blood volumes in 24 hours
- Hypocalcaemia/Hypomagnesaemia
- Hyperkalaemia
- Metabolic Acidosis
  - Lactic acid release with storage
  - Excess citrate
- ARDS
  - Secondary to WBC’s in blood
- Dilutional Coagulopathy +Thrombocytopenia
  - Secondary to inappropriate ratio of RBC’s to FFP and platelets as well as the large amounts of anti-coagulants and additive solutions
Mild Transfusion Reactions

- Hypersensitivity reactions to non autologous plasma proteins
  - More likely in plasma transfusions

- Mild febrile non haemolytic reactions

- Fever/Urticaria/Facial Oedema

- Diphenhydramine 1-4mg/kg s/c, IM or IV (if cutaneous signs)

- Often wait 15-30 mins and restart the transfusion at a slower rate

- No evidence that prophylactic antihistamine or steroid therapy is of any benefit
Moderate Transfusion Reactions

- Can be seen with both haemolytic and non haemolytic transfusion reactions
  - Fever/tachycardia/tachypnea/weakness/vomiting
  - IV fluids 1/2-1/3rd shock volume if no signs of fluid overload
  - Antihistamines not generally helpful
  - Glucocorticoids probably don’t help in the acute reactions but might help prevent delayed reactions
  - Unless the signs of the transfusion reaction resolve quickly-the transfusion should not be restarted
  - The remaining blood product should not be given to another patient.
Severe Transfusion Reactions

- Anaphylactic Shock
  - Rare
  - Collapse/tachycardia/bradycardia /hypotension/fever or hypothermia
  - Cats: tachypnea (lungs shock organ in the cat)
  - Dogs: hypotensive collapse (vasodilation splanchnic circulation)
- Adrenalin 0.01mg/kg IV
- Stop transfusion
- Check bag for evidence of haemolysis
- Iv fluid support
- Albuterol /Supplementary O2 in cats
How to Avoid Transfusion Reactions + Complications

- Always blood type feline donors and recipients
- Cross Match canine donors and recipients or use DEA1.1 and DEA 1.2 negative donors
- Use an appropriate flow rate;
  - 2mls/kg/hr: cardiac or renal disease
  - 5-10mg/kg/hr: normovolaemic
  - Up to 20ml/kg/hr in hypovolaemic patients
- Prevent contamination of blood
- Use correct ratio of blood: citrate
- Use giving sets with blood filters
- Monitor recipients closely
Incompatibility and disease transmission used to be the main issues with blood transfusions.

2008: Koch et al reported adverse outcomes related to the age of stored red blood cells.

Human medicine packed RBC’s can be stored up to 42 days based on RBC survival time:
- <0.8% haemolyzed RBC’s and at least 75% cells intact following transfusion.
- No trials have ever looked at the impact of these parameters.
• RBC’s experience a rapid form of aging in storage

• “Storage Injury”
  • Reduced cell deformability
  • Osmotic fragility
  • Cells need to synthesize ATP to maintain flexibility but ATP levels decrease with storage
  • Storage leads to decreased levels of intracellular 2,3-diphosphoglycerate which is necessary for affinity to oxygen

• Koch looked at effect of blood storage on patient outcome

• Implications for both blood bank management and patient management

• End-organ microcirculatory beds react differently to anaemia/hypoxaemia so effects of RBC storage likely to be different in various conditions
**Duration of red-cell storage and complications after cardiac surgery.**

**Conclusion:**

In patients undergoing cardiac surgery, transfusion of red cells that had been stored for more than 2 weeks was associated with a significantly increased risk of postoperative complications as well as reduced short-term and long-term survival.
Association between duration of storage of transfused red blood cells and morbidity and mortality in adult patients: myth or reality?

Lelubre C1, Piagnerelli M, Vincent JL.

From the currently available published data, it is difficult to determine whether there is a relationship between the age of transfused RBCs and outcome in adult patients, except possibly in trauma patients receiving massive transfusion.
[The ABLE study: A randomized controlled trial on the efficacy of fresh red cell units to improve the outcome of transfused critically ill adults].

[Article in French]

Lacroix J1, Hébert PC2, Fergusson D3, Tinmouth A4, Capellier G5, Tiberghien P6, Bardiaux L6; Canadian Critical Care Trials Group.

The conclusion is that the transfusion of red blood cell units stored seven days or less does not improve the outcome of critically ill adults compared to the transfusion of units stored about three weeks (22.0±8.4 days).
The age of erythrocyte concentrates (EC) in transfusion medicine and the adverse outcomes when transfusing long-term-stored EC are highly controversial issues. Whereas the definition of a short-term-stored EC or a long-term-stored EC is unclear in clinical trials, data based on in vitro storage assays can help defining a limit in addition of the expiration date. The present review merges together these data in order to highlight an EC age cut-off and points out potential misleading consideration. The analysis of in vitro data highlights the presence of reversible and irreversible storage lesions and demonstrates that red blood cells (RBC) exhibit two limits during storage: one around 2 weeks and another one around 4 weeks of storage. Of particular importance, the first lesions to appear, i.e. the reversible ones, are per se reversible once transfused, whereas the irreversible lesions are not. In clinical trials, the EC age cut-off for short-term storage is in general fewer than 14 days (11 ± 4 days) and more disperse for long-term-stored EC (17 ± 13 days), regardless the clinical outcomes. Taking together, EC age cut-off in clinical trials does not totally fall into line of in vitro aging data, whereas it is the key criteria in clinical studies. Long-term-stored EC considered in clinical trials are not probably old enough to answer the question: "Does transfusion of long-term-stored EC (older than 4 weeks) result in worse clinical outcomes?" Depending on ethical concerns and clinical practices, older EC than currently assayed in clinical trials should have to be considered. These two worlds trying to understand the aging of erythrocytes and the impact on patients do not seem to speak the same language.
Transfusion therapy in immune mediated disease

- **Immune mediated thrombocytopenia**
  - Platelet transfusions indicated with life threatening haemorrhage due to thrombocytopenia or thrombocytopenia.
    - Brain/heart/lungs
    - Generally seen with counts <20-30,000/ul
    - Platelets in fresh whole blood maintain their activity for up to 8 hours
    - It's important not to refrigerate blood prior to use as this inactivates the platelets
    - Normal platelet lifespan is around a week
    - Destroyed within minutes of transfusion in ITP cases
    - Platelet rich plasma (PRP) and Platelet concentrate (PC) are made from FWB but are not commercially available
ITP patients often bleed into the GI tract, epistaxis, oral cavity, bladder and subcutaneous tissue.

- Bleed in response to mild trauma.

- Transfusion triggers generally more conservative than with IMHA as it can take several hours post acute bleeding for the loss to be reflected in the PCV.

- Multiple transfusions often required to support the patient pending response to immunosuppressive therapy. VCR can reduce hospitalisation time by 2 days.

- Pulmonary bleeding can be very difficult to manage in ITP patients.
Platelet Therapy

- Fresh Whole Blood
  - Can produce PRP or PC
  - 1 unit of either FWB/PRP or PC given to a 30k dog would be expected to increase the plt count by approx 10,000/ul.

- Apheresis Platelets
  - Main way platelet concentrates prepared from human donors now.
    - Greater platelet yield (donors return to baseline in 6 days)
    - Negligible RBC and WBC contamination
    - Problems using this technique with dogs (hypocalcaemia/hypomagnesaemia) so limited to donors 20kg
Immune Mediated Haemolytic Anaemia

- Blood transfusions required when tissue perfusion/oxygenation cannot be maintained with crystalloids
- Transfuse on basis of clinical signs of tissue hypoxaemia
  - Weakness/tacycardia/tachypnea
  - Rapidly dropping PCV
- Blood transfusions do not impose an increased risk in these cases
- If agglutination is present then blood typing and cross matching is impossible
  - Use DEA 1.1 neg blood
- pRBC transfusions preferred over whole blood if patient doesn’t require coagulation factors
  - Volume transfusion less
  - Reduced risk reaction plasma proteins

- IMHA patients are at a greater risk of fluid overload as severe anaemia leads to cardiovascular compromise
  - Use slower infusion rates (esp is concurrent cardiac/pulmonary/kidney dz)
    - 2-4ml/kg/hr
  - Another reason to use pRBC’s

- Disadvantages of transfusing
  - Suppression of the erythropoietic response
  - Prolongation of time to erythroid recovery
  - Increased risk PTE
  - Autoantibodies likely shorten the survival of transfused RBC’s (maybe only hours or days)

- Target PCV??? How much to give??
Von Willebrand Disease

- Canine vWD is most common inherited bleeding disorder in dogs
- vWF mediates platelet adhesion to exposed sub epithelium after vascular injury, promotes platelet aggregation in high shear conditions and is a carrier factor V111
- 3 types:
  - Type 1: Partial quantitative deficiency vWF (Dobermans)
  - Type 2: Low concentration of high MW multimers vWF
  - Type 3: Severe quantitative deficiency of vWF
• Screening tests: BMBT (insensitive)

• Definitive Tests:
  • Elisa : plasma vWF concentration (expressed as % pooled canine plasma concentration (n=65-150%)
  • Genetic Tests : Identifies DNA mutations

• Symptomatic patients managed with :
  • FWB (if <6 hours old)
  • Desmopressin Acetate (DDAVP): increases plasma factor VIII, plasminogen factor and vWF release from storage sites
    • 1mcg/kg s/c
    • Takes 30min to work , only effective 2 hours
  • FFP: 10mg/kg q6hr (10-15uvWF/kg when given 15-20ml/kg)
  • Cryoprecipitate 2-5ml/kg (5-10u vWF /kg or 10-20u VFW /kg for surgery)
  • Transfused factors are clear from circulation within hours
• DDAVP can increase vWF in Type 1 dogs and boost VWF concentration in donors

• Protocol for planned surgeries with vWD dogs (Type 1)
  • BMBT (n<4 mins)
  • Desmopressin 1mcg/kg sq
  • Repeat BMBT at 35mins
    • If BMBT +Desmo < BMBT w/o Desmo – no other Tx
    • If BMBT +desmo = BMBT w/o Desmo : start cryo
  • Assess at 2 hours to see if more cryoprecipitate required
What about those bleeding greyhounds?

- Greyhounds have inherent coagulation dysfunction with respect to their fibrinolytic system
  - Enhanced fibrinolysis

- Traditional coagulation tests normal

- Ohio State University has been researching this problem
  - Treat with anti-fibrinolytic drugs
  - Aminocaproic Acid 500-1000mg PO q8hr
    - IV: load 50-100mg/kg then 50mg/kg q6-8hr
    - OR CRI IV 15mg/kg/hr 6-8 hours

Marín LM et al

Pre-emptive post operative administration of EACA is efficaceous in reducing frequency of bleeding in RRG
Epsilon aminocaproic acid for the prevention of delayed postoperative bleeding in retired racing greyhounds undergoing gonadectomy.


PMID: 22712787

Post operative administration EACA significantly decreased prevalence of post operative bleeding in retired racing greyhounds