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Dr Kit Sturgess graduated from Cambridge University in 1986 and then spent 6 years in general veterinary practice. He has further professional qualifications in imaging, cardiology and internal medicine as well as a PhD awarded for looking at the effects of FIV on mucosal immune function. Kit is recognised by the Royal College of Veterinary Surgeons as a specialist in small animal medicine. Kit has been seeing referral small animal medicine cases for the past 20 years both at university-based and private specialist practices. Kit's love of teaching and learning that has led him to develop a new, more flexible role, centred on lecturing, writing and 60% clinic time. The majority of his clinical time is spent providing an internal medicine referral service at Optivet Referrals in Havant. Kit is a member of the Royal College of Veterinary Surgeons Council and is chairman of the Small Animal Medicine Society.

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Fresh frozen plasma – why every practice should keep a bag in the freezer

Suspected rodenticide poisoning is a common presentation to primary care practices and is the second most common reason for seeking advice from the Veterinary Poisons Information Service. Keeping a unit of fresh frozen plasma (FFP) in the practice makes practical and commercial sense allowing rapid treatment of such cases as well as other coagulopathies, post surgical bleeding and dysproteinaemias where appropriate. In many situations, plasma is a better choice than fresh whole blood not least as significant adverse reactions are rare. Furthermore FFP has a one year shelf-life and subsequent availability as frozen plasma (FP) for another 4 years means that likelihood of a unit being discarded is very low.

This article reviews the indications for using FFP and FP and provides answers to common questions about the use of plasma as well as providing a practical guide for its administration. Like many newer therapies, having FFP readily available in the practice will mean that it is used more frequently and in a more timely manner improving outcome for patients.

Key words: frozen, fresh, plasma, transfusion, coagulation, dog

Introduction

Keeping stock at reasonable levels in a practice is vital to good business management. The need to have a product available must be balanced against the cost of keeping unused stock that gets outdated and requires replacement (as well as subtle small costs of space, stock taking, disposal of out-of-date product etc.).

However, practices also need to be prepared for 'what if' scenarios. The question is how bizarre/rare should these scenarios be to warrant keeping a drug or treatment in stock or buying a specialist piece of equipment. In treatment terms, the likelihood of such an event happening should be matched against the critical need for a drug and the ease with which it can be obtained if not in stock (neighbouring practices, courier delivery) and this to some extent will be influenced by whether the practice undertakes any out-of-hours work. Such calculations are complex as a range of factors needs to be taken into account. For example, is it better to set a higher mark-up for a drug or treatment and accept that it may go out of date, but when used will the charges cover these costs? Or is it better to pay for a courier or lose a member of staff at a time when a critical patient is in the practice, in order to collect a product from a neighbouring practice?

Fresh frozen plasma is one such treatment; how likely is your practice to use a single unit of FFP within its shelf life? FFP has a long freezer (-18˚C) life of one year and can provide life saving therapy to critical patients quickly and effectively if readily available. Like many treatments, having plasma available encourages use at an appropriate time improving success rather than it being a big hassle to get hold of and only ends up being used as a 'hail Mary pass' often with associated disappointing results. The added advantage of FFP is that at the end of its shelf life it does not have to be discarded but can be used as frozen plasma for another 4 years.

How do I assess a patient's clotting ability?

There are a variety of tests that can be used to assess the clotting system (Fig. 1) including measurement of individual factors. However, for the majority of patients assessment is confined to:

Assessment of primary haemostasis

- Buccal mucosal bleeding time – tests primary haemostasis and the interaction between vascular endothelium and platelets including von Willebrand's factor.
  - Care should be taken if there are already indicators of reduced primary haemostasis such as thrombocytopenia or petechiation as bleeding can be difficult to stop.
- Platelet count – estimates number and morphology but does not indicate whether there is a defect in platelet function (thrombocytopathy).

Assessment of secondary haemostasis

- Activated clotting time (ACT) – assesses the intrinsic and common pathways.
- Activated partial thromboplastin time (APTT) – assesses the intrinsic and common pathways.
- Prothrombin time (PT) - assesses extrinsic and common pathways.
- Fibrinogen – reduced levels usually indicate consumptive process such as DIC but will also occur in advanced hepatic disease.
- Thrombin clotting time – prolonged if there is hypofibrinogenaemia, dysfibrinogenaemia or inhibition of thrombin by other substances e.g. heparin, FDPs or abnormal serum proteins.
- Fibrin degradation products (FDPs) – assesses whether there is increased fibrinolysis usually indicating DIC but will also be found with anticoagulant rodenticide toxicity, hepatic disease and thrombotic conditions.
- D-dimers – are a fibrin degradation product and an alternative to FDP measurement, values in the reference range have a good negative rule out (95%) for DIC.

What is the difference between fresh frozen plasma and frozen plasma?

Fresh frozen plasma (FFP) is made from a fresh, anticoagulated, whole blood donation that has been separated into two parts, the packed red cell portion and plasma by centrifugation. In order for it to be called FFP, this process needs to have occurred within 8 hours of the donation being made (Wardrop, Brooks, 2001) though this is an area of ongoing research (Walton, Hale, Brooks, et al 2014).

FFP contains labile clotting factors (fibrinogen, FV, FVIII, von-Willebrand's factor) as well as non-labile factors (FII, FVII, FIX, FX, FXI) immunoglobulins, albumin, lipids and electrolytes. It DOES NOT contain viable platelets. (Fig. 1 – Clotting cascade)

Frozen plasma (FP) is the anticoagulated portion of centrifuged blood if the separation has occurred later than 8 hours from collection or FFP that has been stored for more than a year. It contains the non-labile clotting factors (FII, FVII, FIX, FX, FXI) immunoglobulins, albumin, lipids and electrolytes.

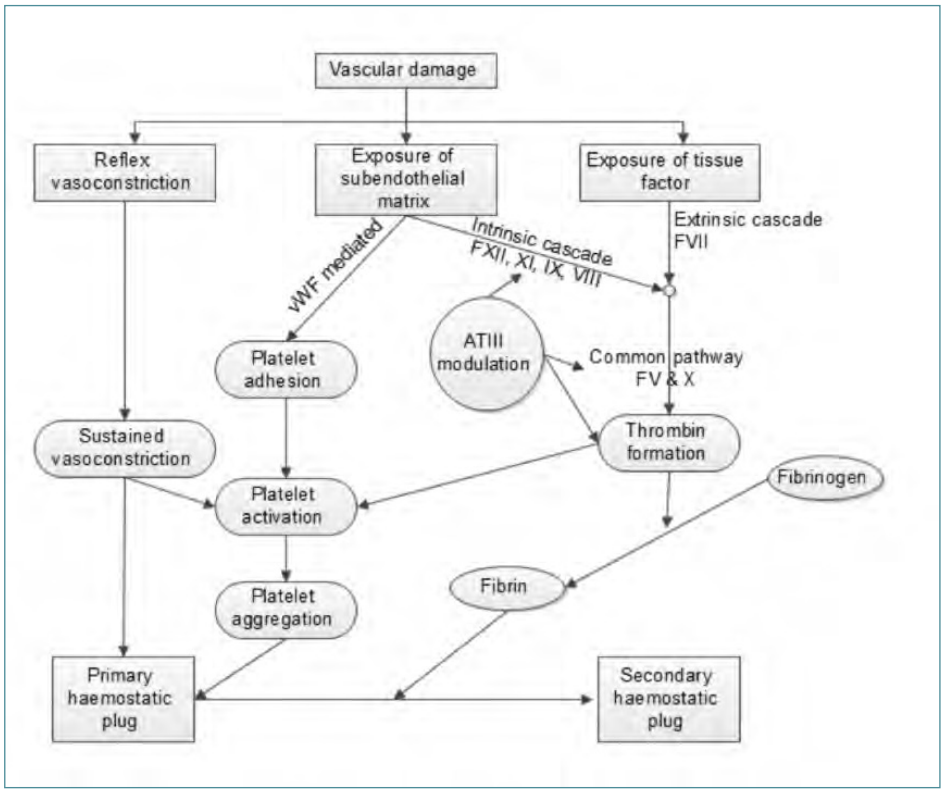

Figure 1. Cartoon overview of the clotting system

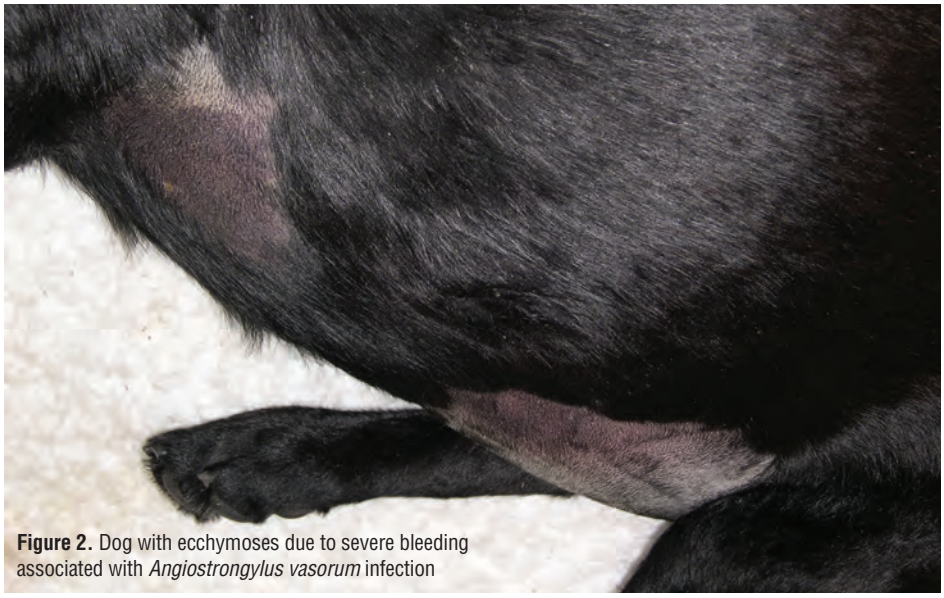

Figure 2. Dog with ecchymoses due to severe bleeding associated with *Angiostrongylus vasorum* infection

How long does it last?

FFP lasts for 1 year from the date of production and a further 4 more years as FP. Frozen plasma lasts 5 years from the date of production and still retains significant haemostatic activity at this time (Urban, Couto, Iazbik, 2013).

Storage

FFP or FP should be stored in a freezer at less than -18˚C (0˚F); freezer temperature should be monitored and recorded daily or electronic records reviewed at least weekly to ensure it remains below -18˚C.

Plasma should be kept in a separate drawer of the freezer or protected by a padded external cover/box as the bags become brittle when stored and can crack leading to possible contamination or leakage when thawed.

When should I use FFP?

FFP is most commonly used for dogs presenting with bleeding associated with inherited or acquired coagulation disorders (Fig. 2). It can also be used when labile clotting factors are not required as frozen plasma but is a more expensive option. The most common condition likely to be seen in primary care practice requiring FFP or FP is anticoagulant rodenticide toxicity. There are no accurate estimates of the frequency of anticoagulant rodenticide