Bulletin UASVM, Veterinary Medicine 68(1)/2011
pISSN 1843-5270; eISSN 1843-5378

The Therapeutic Efficacy of Some Blood Products for Transfusion in Dogs and Cats

Meda MOLDOVAN[1)], Laurent OGNEAN[1)], Iancu MORAR[1)], Sergiu IANCU[1)]

[1)] University of Agricultural Science and Veterinary Medicine, Faculty of Veterinary Medicine, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania;
Email medavety@yahoo.com

Abstract. Currently the international development of veterinary transfusion medicine has an increasing tendency. The objectives of this study were to demonstrate the efficacy of blood products therapy and the low incidence of transfusion reactions. A number of 22 patients (19 dogs and 3 cats) were included in this study during 2009 to 2011. These patients received blood component therapy (fresh whole blood-FWB, erythrocyte concentrate -EC or plasma) in the Emergency Hospital (Faculty of Veterinary Medicine-Cluj Napoca) and some private clinics, based on clinical and/or hematological parameters and they where monitored a variable period of time. The patients diagnosis were: hypovolemic shock, external or internal hemorrhage, parvovirosis or intussusception with clinically hemorrhagic gastro-enteritis, babesios, septic shock, acute renal failure, chronic renal failure, coagulopathy. Blood component therapy conducted to the clinical recovery of 45% patients. The posttransfusion increase of the basic blood parameters (erythrocytes number, hematocrit, hemoglobin) were statistically significant and support the efficacy of transfusion with FWB or EC. The cessation of small bleedings, in the first 24 hours after transfusion with FWB and plasma and restore of the bleeding and clotting time at the physiologic values in the next 24 hours, shows the efficacy of these blood products transfusion in coagulopathies with clinical manifestation. Transfusion therapy with compatible blood products appropriate to a specific disease in dogs and cats could be lifesaving in several emergency situations, especially when it is performed in time and is based on the corroboration of the clinical and hematological data of the patient.

Keywords: whole blood, erythrocyte concentrate, fresh plasma

INTRODUCTION

Transfusion medicine is a relatively new and rapidly growing area of research in Veterinary Medicine (Castellanos *et al.*, 2004). Blood products transfusion is an important component in the therapeutic protocol of many diseases and it has specific indications. Whole blood is mainly indicated for fluid substitution in severe posthemorrhagic anaemia, due to accidents or surgical intervention with large blood loss. The erythrocyte concentrate (EC) is used in normovolemic patients, with immune mediated hemolytic anemia, inefficient erythropoesis or Babesiosis to support the oxygen transport to the tissue. Blood plasma is indicated in the treatment of acquired or inherited coagulation disorders, including those due to deficit of vitamin K dependent coagulation factors or of those consumed in disseminated intravascular coagulation (Chiaramonte D., 2004).

Blood transfusion is considered a mild form of transplant, which first involves the investigation of compatibility between partners, provision of quality blood products and respectively their administration in a correct and aseptic manner.

MATERIALS AND METHODS

In the period from 2009 to 2011, 22 patients (19 dogs and 3 cats) presented at the emergency hospital and clinics of the Faculty of Veterinary Medicine Cluj – Napoca, but also at some veterinary private practices received transfusions with blood products (whole blood transfusion, EC and plasma) and were included in this study.

The patients diagnoses were: hypovolemic shock after external or internal hemorrhage, parvovirosis or intussusception with clinically hemorrhagic gastro-enteritis, Babesios, septic shock, acute renal failure, chronic renal failure, coagulopathy. Based on their clinical evaluation and hematologic parameters values of the patients, the current clinician recommended the administration of the appropriate blood product as a part of the therapeutic protocol. To perform the transfusions, the following materials were needed: blood products (FWB, EC and plasma), infusion sets, automatic injector, 50mls syringes, pulse-oximeter or monitor for supervision of vital functions, saline, hematology analyzer-Abacus Junior Vet, hemocytometers and Hayem liquid.

The decision to transfuse 5 dogs and a cat was based on their clinical status, the emergency situation and the available materials, while in 14 dogs and two cats, it was made a corroboration of the clinical and paraclinical parameters.

The most patients (n=21) received whole blood from the collection bags through an administration set and small dogs or cats (1,5-10kg) from 20 or 50 mls syringes through intravenous catheters (20-24G). The EC was administrated in a single case, from the collection bag after a prior dilution with saline (3:1). Using a 50mls syringe, plasma was collected from the blood bag after a passive sedimentation and two patients were treated with this product by an automatic injector. Almost all patients received a single dose of FWB or EC (20 mL-450 mL), except two dogs: one with two FWB transfusions 2 days apart and the other with a plasma transfusion at the second day after a FWB transfusion.

The compatibility tests were held before the administration of the blood products.

The clinical intra-transfusion status of the patients was monitored during therapy for early detection of the possible transfusion reactions. Monitoring parameters included measurements of temperature, heart rate, pulse strength and synchronicity, mucous membranes and respiratory rate, 3 times in the first 30 minutes and each half hour to the end of the procedure. The patients were carefully observed if vomiting, tachycardia, dyspnoea, diarrhea, salivation, angioedema, urticaria, facial oedema or hemoglobinuria had developed during transfusion.

Post-transfusion monitoring of the patients (between a day to two weeks) depended on the severity of diagnosis, the number of transfusions and the individual post-therapeutic evolution. Before and after transfusion (48h), hematology analysis were performed and the obtained data were processed and analyzed statistically using the GraphPad InStat (Unpaired t test).

RESULTS AND DISCUSSIONS

In a group of 22 patients the introduction of blood products transfusion in their therapeutic protocol was the base for the clinical recovery of 45 % of them (9 dogs and a cat). Most patients (55 %) had severe clinical course ended with the death or euthanasia: 3 cases died during transfusion and 9 cases at various time after transfusion (24h to 7 days).

Transfusion of FWB, EC or plasma did not cause fatal adverse reactions during the administration (maximum 4h) but some of them developed mild tachycardia and a transient state of agitation, probably due to a painful reaction at the site of administration.

The immediate beneficial effects of the therapy with blood products (the first 24 hours post-transfusion) consisted in the general improvement of the most patients by the end of administration. The pale mucous color, initially white because anemia and inadequate oxygen delivery, became normal (light pink or pink as appropriate), thereby reducing the mortality and morbidity. Among post-transfusion reactions, at 24-48 hours, hyperthermia (40^0C) was noted in two dogs. Most patients under clinical supervision up to 7 days, showed steady improvement of the general condition, the physiologic restoration of the basic hematologic parameters and 10 of them were clinically recovered.

The specific disease and the prognostic played an important role in the clinical post-transfusion evolution; thereby the individual analysis presented differences among patients. In this regard, in dogs diagnosed with coagulopathy (a dog with anticoagulant rodenticide intoxication and two dogs with suspicion of disseminated intravascular coagulopathy -DIC) the micro-hemorrhages stopped (epistaxis, bleeding to the site of lesion) in the first 24 hours and the coagulation time became normal after 48 hours in two cases, only one needed an additional plasma transfusion. For one of these patients the owners decided euthanasia.

Cases with anemia of different etiology had a favorable post-transfusion clinical evolution, confirmed by the normalization of the main hematological parameters.

In dogs the comparison of the data before and after transfusion revealed increases of the average and individual values: from 2,78x10^{12}/l RBCs (1,23-4,48x10^{12}/l) to 4,84x10^{12}/l RBCs (3,19-7,17x10^{12}/l), from 6,33 g/dl hemoglobin (2,7-12,3 g/dl) to 11,31 g/dl hemoglobin (5,8-17 g/dl) and from 17,93% (8,5-32,8) to 31,28% (22,18-44,97) for the hematocrit. (fig1, 2, 3). The statistical analysis of these data showed the fact that the two-tailed P values (0.0013, 0.0055 and 0.0039 respectively) was considered very significant.

The administered average of the therapeutic dose was 10 ml/kg FWB, 5 ml/kg plasma and 2,5 ml/kg EC in one case.

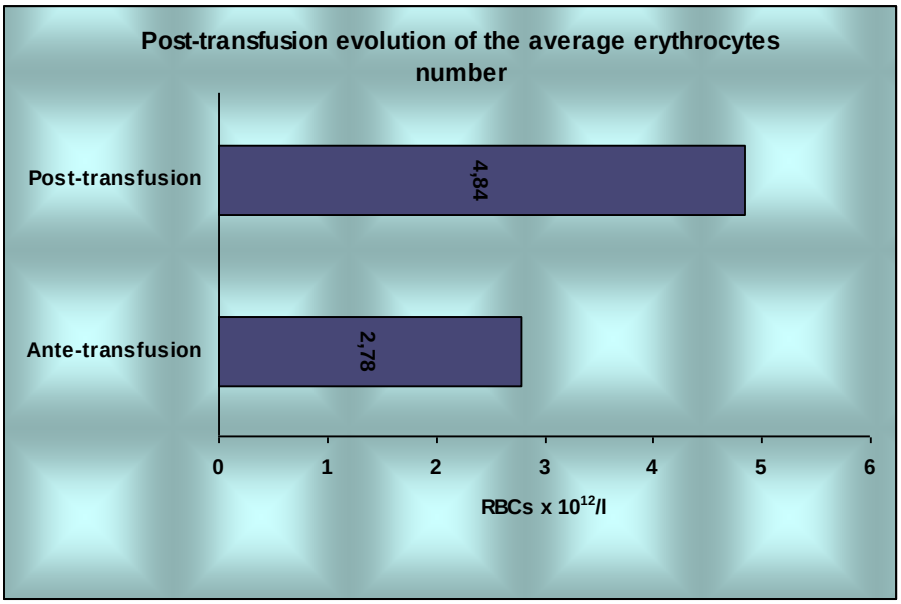

Fig.1. Post-transfusion evolution of the average erythrocytes number

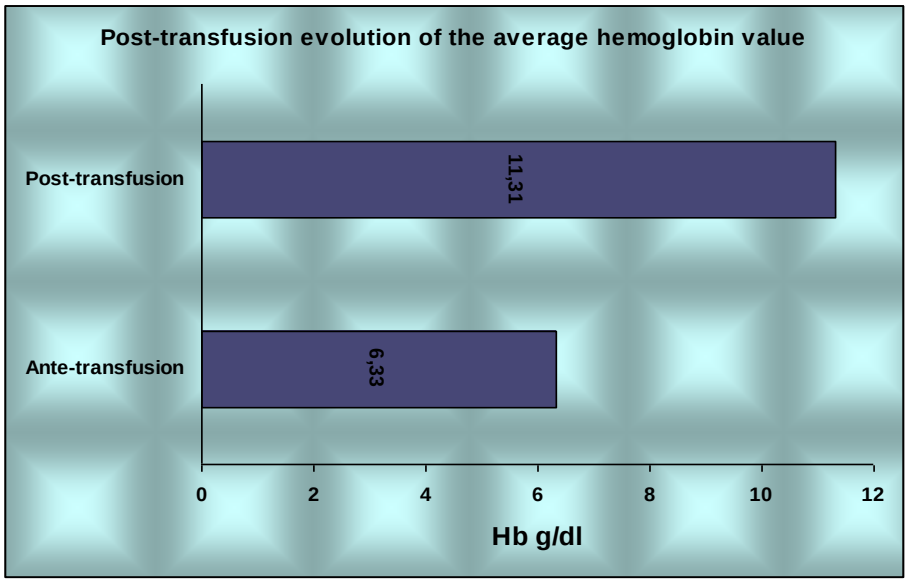

Fig. 2 Post-transfusion evolution of the average hemoglobin value

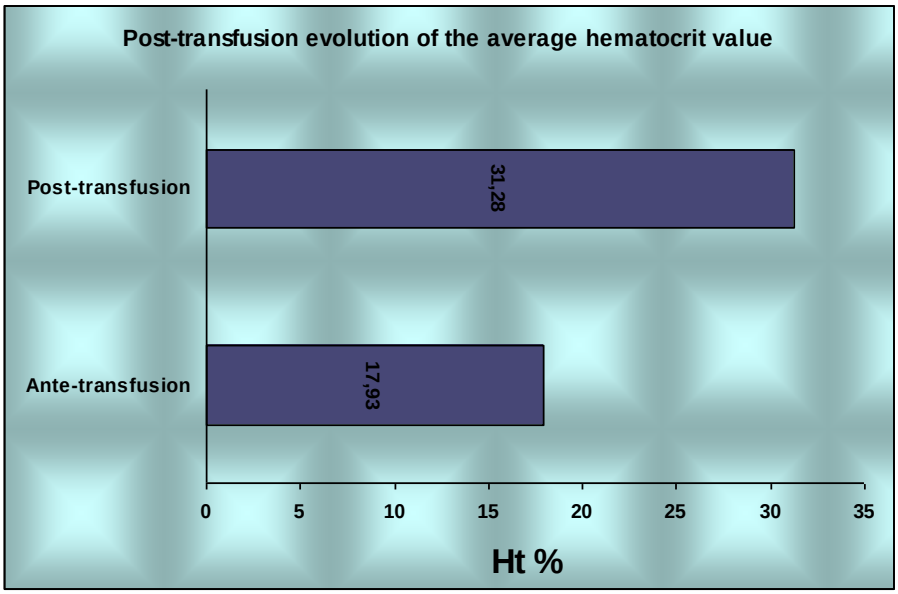

Fig. 3 Post-transfusion evolution of the average hematocrit value

Concerning transfusion decision in cats, the ante-transfusion hemoglobin (average-2,65 g/dl) and hematocrit values (average-8,7%) represented an important element.

At the deceased patients there was not found any incompatibility before transfusion and there was no post-transfusion reaction, thereby, the cause of death was not attributed to blood component administration.

Blood transfusion therapy in dogs and cats experienced a considerable expansion in recent years, including in our country, becoming an important component in different therapeutic protocols, with much lower risk of adverse reactions due to availability of compatibility tests.

The analysis of the obtained data requires their integration into the general clinical context of the patients, that underwent blood component therapy (FWB, whole blood, EC or

plasma), which usually have an unfavorable prognosis, being in critical state, with severe evolutions.

Using blood transfusion as therapy we consider that we obtained an appreciable percentage of survival (45%), which must be correlated with the severity of the syndromes in question. These results along with a higher survival percent of transfused patients (80%) reported by Ognean *et al*. (2010), encourages the process of blood component therapy in our area. In this study blood transfusion was more indicated in anemic conditions (81%), caused by hemorrhages, hemolysis, inefficient erythropoiesis, immune mediated hemolytic anemia or neoplasm. Although in the case of one anemic patient with acute or chronic evolution, it is appropriate to administer FWB or EC, but to avoid circulatory overload, especially in a patient with cardiopathy in chronic evolution the wisest choose is EC (Cotter SM, 1991, Pisciotto PT, 1993). In the case of one feline patient (female in the last stage of gestation) with hemolytic anemia (probably due to *Haemobartonella felis* infection), FWB was the best choice, because the young age of the transfused erythrocytes was important. This cat had a positive evolution and later she was sterilized and subjected to specific antibiotic therapy. The oldest erythrocytes from a donor blood are the most susceptible to hemolysis (Smith JE, 1991; Cotter SM, 1991). Therefore a unit of WB fresher than 5 days contains a higher percentage of young red blood cells, which will have better chance to survive hemolysis. Thus, in patients with immune mediated hemolytic anemia is recommended the transfusion of FWB stored up to 5 days, increasing in this way the beneficial effects of transfusion (Cotter SM, 1991, Miller E and Green M, 1994), because the transfused red blood cells will be destroyed in the same rate like the patient own cells (Smith JE, 1991).

A cat from this study, with nonregenerative anemia (suspected of bone marrow neoplasm) received FWB as it is indicated, with a higher percentage of young red blood cells which prolong the life and viability of transfusion. (Smith JE, 1991). Even if the anemia is very severe in cats and the hematocrit under 15%, some studies reports that recovery percentage can achieve 84 % (Weingart *et al.* 2004)

The post-transfusion target values for the hematocrit are 25-35% in dogs and 20-25% in cats (Kerwin, S.C. and G.E., Mauldin 2003). These values were achieved according to our obtained data: the post-transfusion hematocrit average of 32,33% in dogs and 20% in cats.

Based on the investigation results of the haemostatic system in 3 dogs, which showed the prolongation of the bleeding and coagulation time in association with clinical signs (wound bleeding, lung rales and epistaxis) the whole blood and plasma transfusion was decided. In this situation the products used by us are indicated to provide red blood cells and labile or stable clotting factors (Cotter SM, 1991, Pisciotto PT, 1993, Kerwin, S.C. and G.E., Mauldin, 2003). Two of these dogs recovered spectacular, but the 3rd, a dog with a very serious prognostic couldn't be saved for economic reasons, because he required further plasma transfusions even if he had an encouraging transient clinical posttransfusion evolution.

Fresh plasma, used in a dog with DIC suspicion, also has several indications, such as von Willebrand disease, congenital coagulopathy as hemophylia A or severe warfarin intoxication, because contains the stable vitamin K factors (II,VII, IX, X) and FV, VIII and vWF (Meyers KM and Wardrop KJ, 1991, Cotter SM, 1991).

A single plasma administration usually stops bleeding and rapidly improves the prolonged clotting times (Hohenhaus, A. E. 2006). Thereby at an hour after transfusion the efficacy could be evaluated by testing the clotting time (Kerwin, S.C. and G.E., Mauldin, 2003).

In a quarter of patients (24 %) the decision of transfusion relied exclusively on clinical signs, because the emergency situations or high costs for owners. The clinical signs indicating

to transfuse a patient appear when the hematocrit in dangerously low. In humans exertional dyspnea occurs when the hemoglobin concentration falls to less then 7 g/dL. When the value is less then 6 g/dL some patients experienced tachycardia, hypotension and impaired consciousness, but for animals there are few available data. Therefore, relying on clinical signs of anemia to guide transfusion decision probably results in significant under-transfusion of patients. Moreover, relying on clinical signs in anesthetized animal obviously is fruitless. Healthy animals subjected to acute hemodilution, tolerate hemoglobin levels between 3 and 5 g/dL. When Hb is less than 3 g/dL, ischemic electrocardiograph, increased lactate production, depressed ventricular function and death occur (Wingfield, W. E., 2001). In this context, the patients transfused exclusively based on clinical signs, were already in a very critical status, evidenced by a increased rate of mortality (86%).

Blood typing and Crossmatch reduce considerably the risk of severe hemolytic reactions, but still can occur acute hypersensitive and allergic reactions, to thrombocytes and leucocytes and therefore their rapid recognition and treatment is essential (Kerwin, S.C. and G.E., Mauldin, 2003). The febrile reaction in two transfused dogs was probably due to the transfused leucocytes, but it was transient and the treatment with antithermics was effective.

If blood administration is performed too fast can cause hypersalivation, emesis and muscular fasciculation (Brown D. and Vap L., 2004), as it happened in one dog strongly unbalanced hidro-electrlytic at the 2nd blood transfusion, after the 2nd enterectomy.

In patients with circulatory overload, tachypnea, dyspnea or tachycardia occurred, but in such cases, slowing or stopping the blood product administration resulted in restoration of heart and respiratory rate and the transfusion could be continued in a slower rate.

The clinical recovered patients didn't show delayed transfusion reaction, such as delayed hemolysis, immunosupression, purpura or graft versus host disease. These reactions cannot be prevented by blood typing or Crossmatch-ing (Hohenhaus, A.E., 2006)

Delayed hemolysis can be revealed by the unexpected decrease of the hematocrit at two days to 2 weeks after transfusion and appear most frequently in dogs that received before a transfusion, with a low titer of antibodies undetected by Crossmatch. In this situation the hemoglobinemia and hemoglobinuria doesn't appear, but because of extra vascular hemolysis, hyperbilirubinemia and bilirubinuria occur (Brown D. and Vap L., 2004).

CONCLUSIONS

- Following the introduction of WB, EC or plasma transfusion in the therapeutically protocol in a group of 22 dogs and cats, with critical status (anemia and coagulopathy with different etiology), conducted to the clinical recovery of 45% patients.
- The posttransfusion increase of the basic blood parameters (erythrocyte number, hematocrit, hemoglobin) were statistically very significant and support the efficacy of transfusion with WB or EC.
- The cessation of the micro hemorrhage, in the first 24 hours after transfusion with FWB and plasma, with the restore of bleeding and clotting time at the physiologic values in another 24 hours, shows the efficacy of these blood products transfusions in coagulopathies with clinical manifestation.
- Transfusion therapy with compatible blood products, appropriate to a specific disease in dogs and cats could be lifesaving in several emergency situations, especially when it is performed in time and is based on the corroboration of the clinical and hematological data of the patient.

REFERENCES

1. Castellanos, I, Couto, G, Gray, TL. (2004). Clinical use of blood products in cats: a retrospective study (1997–2000). J Vet Intern Med 18:529–532
2. Cotter, SM (1991). Clinical transfusion medicine. Adv Vet Sci Comp Med 36:181,
3. Chiaramonte, D. (2004). Blood-component therapy: selection, administration and monitoring. Clinical Techniques in Small Animal Practice, 19(2):63-67
4. Wingfield, W. E. (2001). Transfusion trigger, p.340-345. In: Wingfield, W. E. (Eds.). Veterinary emergency medicine secrets, 2nd ed..
5. Pisciotto, PT (1993). Blood transfusion therapy. A physician's handbook, 4th ed. AABB, Arlington, VA
6. Smith, JE (1991). Erythrocytes. Adv Vet Sci Comp Med 36:9.
7. Miller, E and M. Green, (1994). Canine and feline blood donor program.Colorado state University, Fort Collins, CO.
8. Kerwin, S.C. and G.E., Mauldin (2003). Hemostasis, surgical bleeding and transfusions, p.44-66. In: Slatter, D. H. (Ed.). Textbook of small animal surgery, 3rd ed. Saunders Elsevier, Philadelphia, USA.
9. Brown D. and Vap L. (2004). Principle of blood transfusion and cross-matchimg, p.197-207. In: Thrall, M. A., D. C. Baker, T. W. Campbell, D. DeNicola, M. J. Fettman, E. D. Lassen, A. Rebar and G. Weiser (Eds). Veterinary hematology and clinical chemistry. Lippincot Williams & Wilkins, Maryland, USA
10. Hohenhaus, A.E. (2006). Blood transfusion and blood substitutes, p.567-583. In: DiBartola, S. P. (Ed.). Fluid, electrolyte and acid-base disorders in small animal practice, 3rd ed. Saunders Elsevier, Missouri.
11. Meyers, KM and KJ Wardrop (1991). Platelets and coagulation. Adv Vet Sci Comp Med. 36:87-150.
12. Ognean, L., M. Moldovan, I. Morar and C. Muresan (2010). Safety and efficacy issues of whole blood transfusion in dogs, Cluj Veterinary Journal,18(2):46-51.
13. Weingart, C., U. Giger and B. Kohn (2004). Whole blood transfusions in 91 cats: a clinical evaluation, Journal of feline medicine and surgery. 6:139:148.