HOW DO I TREAT… ANEMIA IN REPTILES

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Anemia is characterized by decreased number of erythrocytes, hemoglobin deficiency or both. The difficulties associated to the measurement of such parameters in reptiles are the following:

1) These parameters cannot be compared with the values usual in mammals or birds. The hematocrit value is always lower than that of these other species.
2) There is high inter-specific seasonal and even individual idiosyncrasy in these parameters.
3) Systems for measuring the total erythrocytic counts are not yet resolved, and they must still be performed by manual methods, which results in high subjectivity in counts.
4) Apparently very anemic reptiles may bear this condition for a very long time due to various physiological mechanisms compared to mammals, which diminishes the emergency of the treatment.

Anemia is a sign of disease. It should not be treated without determining and removing the cause. As for the classification in the rest of animal species, anemia in reptiles can be classified according to the morphology and etiology. However, the casuistry in such species is restricted to a few general causes of the disease that must be addressed:

Diagnostic of the anemia:

Behavioral. Although it is very subjective, it has been proven that in certain species the anemic specimens have abnormal behavior, specially in reproductive seasons (Pellieri-Rossa et al. 2011) or associated to capture and captivity processes (Christopher, 1999).

Examination of mucous membranes. Oral mucous membranes paleness is the commonest technique. It applies to tortoises, lizards and snipes. White mouths in iguanas use to suggest indirectly anemia due to kidney disease. Examination of the ocular conjunctiva and even the iris color in American box turtles (*Terrapene sp*) has also been reported, associating the pale iris with low hematocrit and potential anemia (Lewbart et al. 2008).

Blood analysis:

Hemoglobin. The use of Hemocue meters has shown to be useful to measure hemoglobin in reptiles (Ardiaca *et al*. 2013). The normal values range from 8 to 9.9 according to the species. Lower values should suggest anemia. The mean corpuscular hemoglobin concentration (MCHC) is calculated according to the hematocrit and hemoglobin, like the mean corpuscular hemoglobin (MCH), and therefore these parameters show variation in case of anemia. However, individual variations should also be known, in order to be applied to reptiles practice.

Hematocrit. The normal values use to range from 20 to 45%. Values below 20 suggest anemia in the most cases. And values below 10 suggest transfusion. Seasonal variations in this parameter should also be considered before making clinical decisions. In hibernating reptiles, low hematocrit together with increased polychromasia index (see below) are physiological during hibernation, but pathologic during the active season.

Presence of erythroblasts. It has also been associated to the presence of blood parasites, especially in lizards (Martínez Silvestre et al. 2001; Martínez Silvestre & Arribas 2013). The presence of blood parasites is significantly associated to the appearance of erythroblasts. Results suggest that the blood parasitism in this species stimulates high rates of blood cells regeneration. Erythroblasts in general suggest significant need of erythrocytes in peripheral blood, which uses to mean regenerative anemia. Occasionally, the high amount of erythroblasts lies in the micro-hematocrit tube forming an intermediate layer between the buffy-coat and the red blood concentrate (Pendl 2013), which suggests potential anemia. This activity uses to be accompanied by the presence of erythrocyte precursors in peripheral blood (erythroblasts, occasionally polychromatophils, which mean immature forms). However, the presence of these cell types not associated to anemia has been reported (Garner 2001), and therefore this factor should not be the only one considered in the diagnostic of anemia. Thus, like a polychromasia index is used for birds, this semi-quantitative system of classification should be used in reptiles to classify anemias (Pendl 2013). According to the birds medicine, immature cells can be classified on the basis of a 1 to 5 score, thus allowing a better differentiation between physiologic changes (low value) and true anemia (high value).

Erythrocytic mitoses. When detected in peripheral blood as anecdotal finding it is not a manifestation of anemia. It should only be considered when mitoses appear in erythrocytes together with the presence of abundant erythroblasts and other markers described, such as altered hematocrit, etc.

Low erythrocytes count. The total erythrocytes count lower than normal suggests anemia in the most reported cases of reptiles, although it should be combined with the rest of tests if the type of anemia is to be classified. The Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin (MCH) are also affected. Reptiles and amphibian erythrocytes use to be large, and the MCV is high. The diagnostic changes of the MCV useful to classify the anemia in those species are not yet known.

Types of anemias common in reptiles:

Hemorrhagic anemia: This is the most common anemia, due to trauma (shell very hemorrhagic fractures) or loss of limbs in saurians and chelonians. In such cases, the treatment is based on the administration of haemostatic agents such as D-aminocaproic acid or ethamsylate. None of them has been tested in reptiles, and therefore the doses are empirical (0.1 ml/kg), although the application has been reported to reduce the loss of blood and worsening of the process. Aggressive fluid therapy and blood replacers such as oxyglobin (bovine hemoglobin glutamer) (1 ml /100g IV for 5 minutes by means of perfusion; repeat 4 hours later) may improve the urgency success of such cases of severe anemia (Wak & Anderson 2004). The use of Hemoes 6% has been tested at 0.3 ml/kg/h.

Next, the need of transfusion is assessed according to the hematocrit. The transfusion may be homologous (rarely, in species of which appropriate sized and health donors are available (Gibbons 2009)) or heterologous (pond sliders (*Trachemys scripta*) are good donors for tortoises, and iguanas (Iguana iguana) are for saurians). Up to 1% of the donor weight is extracted from the donor, by means of heparinized syringes and needles, and the blood is administered to the receptor by means of an infusion pump at 5 ml/h flow rate. It is advisable to use a proportion of 0.5 ml of heparin/10 ml of blood during the transfusion. Although some blood groups are described in tortoises, no anaphylactic reaction has been reported in such interventions. The receptors use to increase their hematocrit by 2 -10% within 24 hours post-transfusion, apart from obtaining erythrocytes, albumen and coagulation factors, which takes them out of the emergency condition.

Poor adaptation syndrome associated anemia. It is reported in stressed reptiles, associated to captivity or to catching of wild reptiles. The treatment consists of fluid therapy and stimulation of blood regeneration by means of dextran iron (12 mg/kg, IM every 7 days) and cyanocobalamin (vit B12) (10-2000 IU according to the animal weight as single IM or SC dose). It can be administered mixed with other fluids. It can also be used combined with Ethyl-Methyl phosphonous acid (Catosal (BAYER)) (0.2 ml/Kg once a day for 1 week), which stimulates the general metabolism by increasing hunger. Fluid therapy is also applied by administering Ringer o Gluco Salino (15 ml/kg by perfusion and mixed with dextran iron).

Blood parasites associated anemia. Common in snipes and lizards. In such cases, the anemia may be mild and the treatment should be anti-parasitic (Atovaquona-Proganil (Foronda et al. 2007) 15-25 mg/kg once a day for 3 days; combined with fluids will be enough.

Anemia due to depression: Secondary to other diseases. Associated to malnutrition, infections, autoimmune disease, over-parasitism in lizards, hypovitaminosis A in tortoises, contamination by organchlorate in marine turtles, renal disease (due to absence of erythropoietin), or tumors (Boyer *et al.* 2002; Keller, 2003; Knotova 2005; Levine 2011; Tabares dias *et al.* 2009; Shilliger *et al.* 2011). In such cases, treating the primary concomitant cause of the anemia is essential. The use of ESA (Erithropoiesis Stimulating Agent) (EPOGEN) at 100 U/kg SC has been tested every 3 days for 3 doses, then every 4 days for 4 doses and finally every 7 days for 5 doses (Zachariach 2010), but it has not been useful in *Testudo hermanni* tortoises.

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