

# Wild Felids Blood Group System and Transfusion Medicine

Subjects: Veterinary Sciences

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The AB blood group system has been identified in wild felids, as well as in the domestic cat. In both, type A blood seems to be the most common, although the majority of wild felid species exhibit one single blood type, showing that there seems to be variation between species, but not within species, and no evidence of geographical variation was yet found, showing apparently no genetic variability.

Keywords: wild felids ; blood type ; cat ; blood transfusion

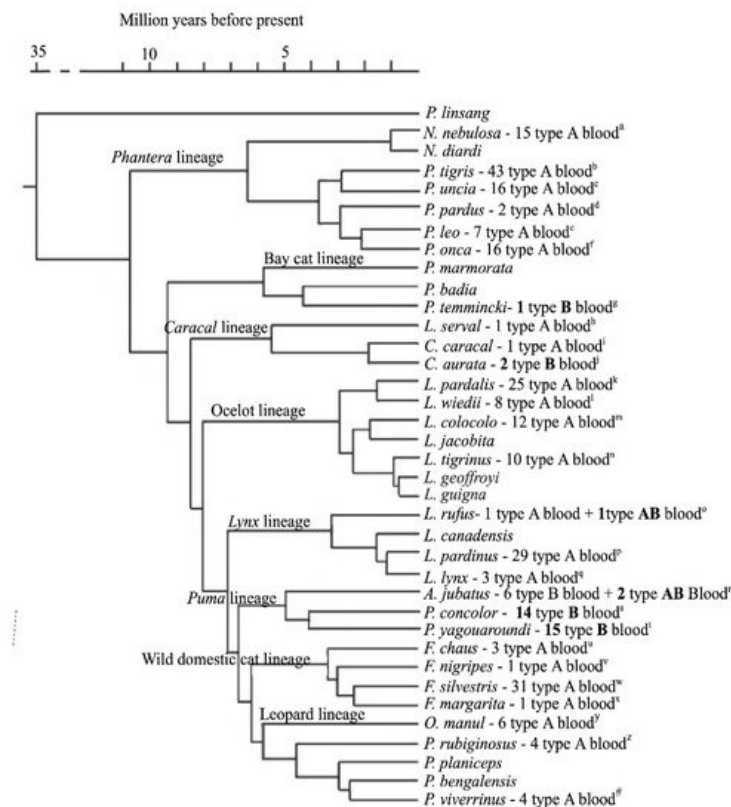
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## 1. Introduction

Knowledge of blood type systems in animals is of paramount importance mainly for blood transfusion medicine, phylogenetic studies, and reproductive compatibilities. Concerning phylogenetic studies, the analysis of the phylogenetic tree for the primate ABO blood group allowed for an estimation of the divergence time between human and nonhuman primates <sup>[1]</sup>. Although sharing a similar nomenclature, the human ABO blood group and the feline AB blood group do not share the same glycolipid antigenic determinants of the erythrocyte membrane <sup>[2]</sup>. Recently, in order to avoid misinterpretations, it was proposed that the feline blood group system should be renamed to ABC, where C corresponds to the blood type AB <sup>[3]</sup>. In felids, the divergence is estimated to have occurred over 9000 years ago, where the domestic cat was considered a member of the subspecies *Felis silvestris catus*, derived from the domestication of the Libyan cat (*Felis silvestris lybica*). Genetic studies show that, in some European regions, most European wildcats are hybrids between the wild and domestic subspecies <sup>[4]</sup>. However, the phylogenetic relationships among the felids need to be further studied, and it is also unknown how the feline blood type systems have been inherited among the Felidae family. Blood transfusions can be life-saving when required <sup>[5]</sup>. In wild felids medicine, there are common problems like run overs, parasitism, blood loss, and hypotension associated with surgical procedures, where a blood transfusion can be a life-saving procedure <sup>[6][7]</sup>. Reports of blood transfusions in species other than dogs and cats are very scarce in the literature, even more so in regard to wild felids <sup>[8]</sup>. In order to perform a blood transfusion in a safe manner, there is a need for knowledge of feline blood groups; however, blood groups remain mostly unstudied or unknown for wild felids <sup>[9][10]</sup>. Mismatched transfusions can produce immune reactions that result in red blood cells hemolysis and recipient death; blood typing and crossmatching ensure compatible and effective transfusions <sup>[8][9]</sup>. Xenotransfusions have been tried, both between domestic cats and wild cats, or even between dogs and domestic cats, but the results do not always lead to an effective result <sup>[10][11][12][13][14]</sup>.

## 2. Wild Felids AB Blood System

A study on 131 wild felids of 26 different species from zoos and wild animal parks in the USA and Dubai identified for the first time the AB blood group system in the species studied <sup>[15]</sup>. The authors also demonstrated, by high performance thin layer chromatography, that erythrocyte membrane glycolipids of the wild cats correspond to the major disialoganglioside patterns observed in domestic cats, with type B cells expressing exclusively N-acetylneuraminic acid (NeuAc) and type A cells predominantly N-glycolylneuraminic acid, with small amounts of NeuAc <sup>[2][15][16][17]</sup>. Thus, it has been assumed that the traditional and the commercial feline blood typing methods could also be applied for wild felids blood typing <sup>[18]</sup>. Since then, a few new studies on wild felids blood group system have been performed in different species and with different blood typing methods (**Table 1**). In **Figure 1**, according to a study on phylogeny of Felidae based on a data set of 22,789 base pairs of DNA, including autosomal, Y-linked, X-linked, and mitochondrial gene segments <sup>[19]</sup>, we added to the phylogenetic tree data showing the number of animals studied, their blood type and place of origin. Naturally occurring alloantibodies were also studied <sup>[15][20][21]</sup> and identified <sup>[20][21]</sup>.



**Figure 1.** Phylogeny of Felidae, with the number of animals studied, their blood type, and place of origin. Adapted from Werdelin (2010) [19]. a,c,d,e,g,h,i,j,o,q,r,u,v,x,y,z,# USA/Dubai [15]; b 30 Thailand [6] + 13 USA/Dubai [15]; f,l,s 5 USA/Dubai [15] + 11 Brazil [22]; k,t 9 USA/Dubai [15] + 8 Brazil [7] + 8 Brazil [22]; m 5 USA/Dubai [15] + 7 Brazil [7]; n Brazil [22]; p Spain—subsequently expanded to 140 animals [21]; w 6 USA/Dubai [15] + 25 Spain [20]. In bold, species where type B or type AB blood were found.

**Table 1.** Frequencies of blood type A, B, and AB in wild felids based on different countries, blood typing methods, and the presence of alloantibodies.

Lineage	N° Animals	Blood Type			Typing Method	Alloantibodies	Country
		A	B	AB			
Ocelot	15	15				-	
Caracal	8	6	2				
Asian leopard	4	4					
Puma	23		21	2			
Lynx	5	4		1	Tube hemagglutination	Not detected	USA/Dubai [23]
Bay cat	1		1				
Wild domestic cats	17	17					
Panthera	58	58					
Felis silvestris	25	25			Tube hemagglutination	Detected	Spain [24]
Lynx pardinus	29	29			Tube hemagglutination	Detected	Spain [25]
Lynx pardinus	111	111			Immunochromatographic	Not determined	Spain *
Panthera tigris tigris	30	30			Slide agglutination test	Not determined	Thailand [6]
Ocelot	15	15					
Puma	8		8		Tube hemagglutination	Not determined	Brazil ** [7]

Lineage	Nº Animals	Blood Type	Typing Method	Alloantibodies	Country
Ocelot	25	25	Tube hemagglutination and card ***	Not determined	Brazil **** [26]
Puma	6	6			
Panthera	11	11			

\* Unpublished material from authors, blood typing with QuickTest BT A+B, Alvedia (Lyon, France); \*\* Goiás State; \*\*\* RapidVet H Feline Blood typing, DMS laboratories (New Jersey, USA); \*\*\*\* States of São Paulo, Paraná, Botucatu, Roraima, Pará, Amazonas.

Type A blood seems to be the most common among wild species as it is in domestic

cats [27][28][29][30][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52][53][22] (Table 1 and Figure 1). The overall presentation of wild felids blood types show that there is variation among breeds, but not within breeds, and no evidence of geographical variation has yet been found, showing apparently no genetic variability and probably reflecting a relatively minor gene pool within wild felid species in contrast to domestic cats. In domestic cats, according to a recent study, there is no evidence of the relationship between blood types and phylogenetic origin, despite some similarities found in blood types prevalences between Asian and American breeds and European and Oceanian breeds that could be explained by geographical proximity and trade relations in the first case and colonization policies in the second [54]. Recently, five feline erythrocyte antigens were identified [55], raising the suspicion that other blood group erythrocyte antigens might exist either for domestic cats or wild felids. Genetic and molecular studies in a larger number of animals are needed in order to unravel the presence of new blood groups.

In domestic cats, blood loss is the most common indication for blood transfusion, followed by ineffective erythropoiesis and red blood cells destruction [56]. Little is known about the incidence of such diseases in wild felids. Blood loss in wild felids may be related to run overs, surgical procedures, or parasitism [6][7]. A study in Mato Grosso, Brazil, describes that from 211 run overs, 59 were mammals, mostly represented by carnivores, with 52 roadkilled individuals (24% of all roadkilled animals), including some rare or endangered species such as *Puma yagouaroundi*, *Leopardus colocolo*, *Puma concolor*, and ocelot (*Leopardus pardalis*) [57], but no reports of blood transfusion were found. As far as we know, no erythropoiesis disorders have been described in wild felids, but there has been a report of red blood cells destruction related to a rattlesnake bite in a caracal [58]. As a major cause of blood transfusion related to hemolytic anemia in domestic cats, erythrocyte parasitism, like hemoplasmosis, babesiosis, or cytauxzoonosis, has also been reported in wild felids [59][60][61][62][63][64][23], and is sometimes related to anemia [59][61][64], but there have been no reports of animals receiving blood transfusions. As in domestic cats, in wild felids, to ensure compatible transfusions, blood typing and crossmatching should be performed. As mismatched transfusions can produce immune reactions that might result in red blood cells hemolysis and recipient death [8][9], a major and minor crossmatch prior to blood transfusion should always be performed and, whenever possible, a blood group determination should be conducted [65][25]. However, the clinical relevancy of the AB blood group system in wild felids is still not clear. The finding of only one blood type within the majority of wild felids species evaluated can allow, in those species where blood groups have not been defined, reliance on a single transfusion that must always be preceded by a crossmatch. Sometimes, upon compatibility studies, the use of domestic cat blood can lead to a safe blood transfusion. However, because of the presence of naturally occurring alloantibodies, post transfusion reactions or neonatal isoerythrolysis cannot be completely ruled out. As blood groups are not well defined in wild felids, leaning on crossmatching to ensure a safe blood transfusion may be an alternative to identify circulating blood group antibodies, however it cannot determine blood groups [5].

Although blood transfusions can be life-saving, in domestic cats and dogs blood transfusion medicine there are descriptions of risks associated with the transmission of infectious and transmissible parasitic diseases that should also be taken in account when performing blood transfusions in wild cats [26][66][67][68][69][70].

### 3. Conclusions

Unfortunately, the amount of research conducted on this topic is scarce, however, although an absence of genetic variability has been observed, as wild felid species seem to exhibit one single blood type, the information presented here and the recent knowledge on domestic cat blood types leads us to suspect the possibility that blood groups other than AB exist in wild felids. Particular attention should be paid to the presence of naturally occurring alloantibodies. In endangered wild felids in captivity, common problems in clinical and surgical management might include blood transfusions for its resolution; however, the number of blood donors is extremely limited and are generally not available. In the case of an

urgent need for a blood transfusion, upon a crossmatch test, domestic cat blood could be used, but more studies are required before attempting xenotransfusion among felid groups. Taking into account our data, wild felids blood types knowledge could be useful not only for zoo medicine, but also for phylogenetic studies for reintroduction projects in order to preserve genetic diversity. More studies, with more species and a greater number of animals, are needed in order to clarify the importance of the AB blood group system in wild felids and its clinical relevance. In addition, because the majority of the European wildcats are hybrids between wild and domestic subspecies, we are currently left to wonder what mutations occurred in the CMHA 9000 years ago when the divergence from the wild cat to the domestic cat took place.

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