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Parasitary infestation in a fox

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Case Report

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ABSTRACT

Foxes are a member of Canidae family belonging to carnivora order. There are a lot of fox species all around the world. Human population growth, anthropogenic landscape changes, ameliorated vaccine protocols, laws against hunting, the increasing interest towards wildlife and wild animals resulted in augmented fox population and human-fox interaction. These all have important biologic consequences such as prevention and treatment of zoonotic diseases and endangered species protection. Both sarcoptic mange and coccidiois are two important parasitary diseases seen in foxes. In this case, a young female fox suffering sarcoptic mange and coccidiosis is presented. Haemogram and biochemistry measurements of the patient were between normal intervals except values pointing out a slight anemia. This anemia was thought to be due to parasitary infestations. A therapy schedule including ivermectin, trimetoprim/ sulfa, vitamin-B was applied according to the literature and the treatment was judged as successful. Important conclusions gained from this report have been shared in the result of the case report.

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Introduction

Due to anthropogenic landscape alterations related to human population growth, wild terrestrial carnivores are increasingly seen in urban and peri-urban areas since these regions contains easily-accessible food sources. This highlights the augmented risk of interspecies spillover of infections and zoonotic transmission (Lempp et al., 2017).

Domestic dog is the most common carnivore of the world; which makes this species known or suspected reservoir of epidemic-related infectious pathogens of most wild carnivores. Dogs generally form large, unowned, unvaccinated, free-ranging populations worldwide. They also increase the risk of pathogen transmission since they travel long distances into wildlife habitat (Vanak et al., 2018). Interspecies infectious and parasitary disease transmission between dog and fox is very common (MacDonald, 1996; Razmjoo et al., 2013; Truyen et al., 1998).

Ectoparasites such as fleas, mite and ticks are common in carnivores (Razmjoo et al., 2013). Cruz-Vazquez et al., (2001) identified three taxa of ectoparasites in the Island fox which is endemic relative of gray fox (*U. cinereoargenteus*). These three taxa contain fleas (*Pulex irritans*), lice (*Neotrichodectes mephiditis*) and ticks (*Ixodes pacificus*) (Cruz-Vazquez et al., 2001; Emerson and Price, 1987). *Centenocephalides canis* was the most often identified flea type. Same study revealed after fleas, *R. sanguineus* tick were the most isolated ectoparasite in red foxes. Other researchers explain that although foxes can be infested with many other types or fleas and ticks they acquired from both their prey animals or from those sharing the same environment, the fox tick (*Ixodes canisuga*) and the fox flea (*Chaetopsylla globiceps*) are the most relevant types of ectoparasites identified (Forchhammer, and Asferg, 2000; Sréter et al., 2003). In a research, Mainland gray foxes are found to host at least 15 species of fleas, two species of lice and nine species of ticks (Fritzell, 1987). Their role as vectors in most of infectious disease and in flea allergy makes

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fleas a very important disease effect to investigate; thus their biology and epidemiology are widely studied (Razmjoo, et al., 2013). Cruz-Vazquez et al. (2001) also add various researchers' reports explaining that both gray foxes and island foxes may be infected by *Pulex* spp. and *Ixodes* spp. Yet, *Suricatoecus* is more often reported than *Neotrichodectes* (Cruz-Vazquez et al., 2001; Emerson and Price, 1987).

Another important disease, sarcoptic mange caused by *Sarcoptes scabiei*, is a very contagious skin infection. Mites are transmitted between species but inter-species transmission is limited. Infectious agent is transmitted either via direct contact or indirectly via environment. After having borrowed into the epidermis, mites form tunnels in order to deposit antigenic material which later causes severe skin irritation. The infection may easily and rapidly become heavy. The disease which is often seen in foxes causes fur loss, sores from scratching and a crusty film surrounding mouth, nose and eyes. Lightly infected animals represent only short-time clinical signs whereas heavily infected ones suffer hyperkeratosis, alopecia, general wastage. An ultimate muscular catabolism occurring from host response epidermal cell destruction, accompanies these clinical findings. The inflammatory trauma may result in physical self-trauma and secondary dermatologic infections. Death may occur related to several causes, some of them being starvation and hypothermia (Soulsbury et al., 2007). Animals suffering from mange are generally hungry and search for food without being afraid of humans. Several wildlife diseases including also distemper and mange mimic rabies but in fact, they are not zoonotic (Soulsbury et al., 2007; Yery, 2018). Sarcoptic mange which represents a negative correlation with habitat quality, also negatively alters female and male reproductivity (Soulsbury et al., 2007).

While burrowing, mite ingests living cells and tissue fluids. Life cycle of *S. scabiei* is well known (Mueller, 2000). Mites leaves behind excretions and secretions which causes an irritant and allergic effect; which is pursuited by an immense amount of antigenic material released into the skin. As a result, the biggest part of sarcoptic mange pathogenesis is due to mite hypersensitivity. In spite both type 1 and type 4 hypersensitivity were explained in other species, only hypersensitivity type-1 is known to be represented in foxes (Little et al., 1998b). The worse becomes the hypersensitivity, the lesser becomes the amount of mites in the lesions. Moreover, at the same time the pruritus increases, also does the amount of the traumatic lesions. The change of non pruritic and localized lesions into generalized, urticarial and diffuse ones is the hallmark of allergic response developed by the host. In wildlife, allergic response and self-trauma related to intense pruritus are the most relevant symptoms of sarcoptic mange. Yet, some recently exposed individuals may develop non pruritic severe crusting dermatitis characterized with severe hyperkeratosis (Pence and Ueckermann, 2002).

The degree to which animals are affected, depends on animals' immunological and nutritional condition as well as parasite intensity. Infestations may even lead to death in severe situations (Kočišová, et al., 2006). Not only parasitary and/or host related factors, but also sociological ones as native husbandry being runned by people living in a geography is an important factor. Environmental contamination with ascarids also forms another important health issue for humans (Razmjoo, et al., 2013).

Thus, foxes suffering endoparasitary infestations may be a risk factor for humans either via direct contamination by contamination of soil with eggs or with indirect way by infecting intermediate hosts and cats and dogs (Vervaeke et al., 2005).

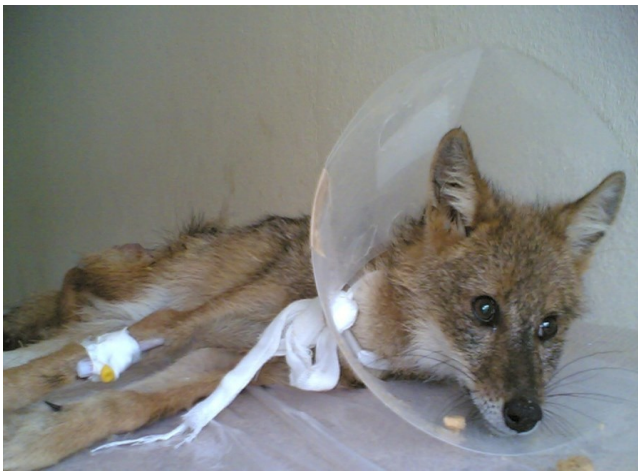

Figure 1: The fox on the first day of the treatment.

Case

Clinical examination and findings

A young female fox was brought to the clinic. She was in poor condition, she showed poor corporal status and she was slightly dehydrated (Figures 1 and 2). Only a few crustaceous, reddish, alopecic lesions, a mild pruritus and a wound were arousing attention. The lesions were localized in ventral and lumbar areas and paws. First of all, "less is best" rule highlighting

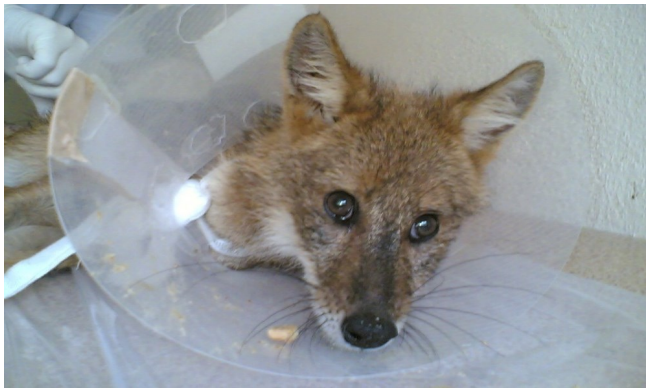

Figure 2 = The fox on the first day of the treatment.

minimal handling must be made was taken into consideration. The less possible drug administration, especially streoid use avoidance also very important (Burwell, 2018).

According to this, a quick examination was performed. As she was docile, she could be manually and easily restrained during examination procedure without anesthetic use. The body temperature (BT), heart rate (HR) and resting respiratory rate (RR) were evaluated according to reference values accepted for domestic dogs. The measured values were respectively as BT = 39.2, HR = 84/min. and RR = 26/min. All values were between normal intervals (BT = 39.1, HR =70-120/min. and RR = 18-34/min. for domestic dogs) (Khan and Line, 2005).

No life threatening situation such as head trauma, any breathing problem or another kind of trauma was detected. Then, as suggested, wound, external parasites, possible fractures and dehydration were checked. Weight was controlled; she was weighting 12 kg. Five mL. of blood was collected from V. jugularis following physical restraint. Urine was also collected. Haemogram, blood biochemistry analyses and urinalysis were performed immediately.

As feeding an animal which is dehydrated, in shock, cold or in starvation state can result in worse their situation since they will be unable to digest the food which is going to be decomposed and fermented in their GI tract, feeding didn't started until the animal was completely stabile. Moreover feeding wild species with wrong foods can cause severe GI distress. Feeding should be started when GI tract is sure to be functional. Otherwise putting food in a non functional GI tract may cause the animal to die since the food will spoil into the patient (Burwell, 2018).

The fox has been kept warm. Since a slight dehydration was present, fluid therapy started. In case the animal is stable, it is recommended to keep him/her in a warm and quiet environment. The fluid therapy consisted on lactated Ringer's solution. On the second day, as the very slight dehydration has been no more observed, fluid therapy has been stopped since she was also eating and drinking well and a slight anemia was present

In addition to all of these, attention was made in order to not to let anyone who is not vaccinated against rabies to contact patient. The fox was not encouraged to become too friendly to go back to natural habitat. It is well known that friendly wild animals are likely to be killed. First of all, they cannot survive in wildlife. Secondly, they die eventually either because they become pests or because someone may misunderstand this attitude for rabies (Burwell, 2018).

Diagnosis and Treatment

Biochemical values were evaluated both according to reference values explained for foxes that could be found in the literature and according to those accepted for domestic dogs. They were all accepted to be between reference values or close; at least not abnormal. Urinalysis didn't represent any pathology neither. Haemogram results showed only a slight anemia. Skin scrapings and gaita samples were sent to the parasitological examination. Sarcoptes scabiei in dermatologic samples and Coccidian oocystes in fecal samples were identified.

As recommended in literature, the wound was cleaned. Following the wound cleaning, ivermectin (IvomecTM; Topkim, Turkey) treatment for sarcoptic mange and trimetroprim/sulfa (BactrimTM Roche, Turkey) application for coccidiosis was organized. Sarcoptes treatment in foxes is similar to what must be adopted when domestic dogs are infested; moreover ivermectin should be added to treatment protocol (Canadian Council on Animal Care, 1984). Other researchers confirm that the avermectins, especially ivermectin is very effective in the treatment of various domestic and wild species (Arends et al., 1999). Ivermectin dosage is recommended as 0.2-0.4 mg/kg SC every 1-2 weeks for 3-4 treatments (Tilley and Smith, 2004). In this case 0.2 mg/kg. ivermectin was applied SC once a week. At the end of 4th. week, no scabies was detected in skin samples. Trimetoprim/ sulpha was dosed as 15 mg/kg PO q 12h. for 2 weeks (Tennant, 2005). Vitamin B Complex (Dodex™; Vetaş, Tukey) was added into therapy in order to control slight anemia existing. The dosage was as 0.5 ml/daily (IM) (Steneroden and Wydallis, 2014; Tennant, 2005). The therapy didn't cause any side effect. Slight anemiahadn't been noticed at the end of the second week. The therapy was judged as successful.

Table 1: Reference values of haemogram of different fox breeds resulted from various researches and measured value in this case.

		Reference values (According to various research results)				
	Measured Values	Rui et al., 2011	Mattoso et al., 2012	Korhonen and Huuki, 2014	McCue and O'Farrell, 1987	Canadian Council on Animal Care, 1984
RBC (X 10^6/µL.)	4.2	-	-	-	6.6-10.2	7.1-11.2 (RR) 7.8-9.4 (WR)
HGB (g/dL)	14.2	F = 139.7±14.5 (g/L) M= 140.3 ± 10.9 (g/L)	(both sex) 10.0-18.1	-	11.5-17.5 (S) 12.6-18.6 (W)	-
HCT (%)	30	-	(both sex) 28-53	52.0- 58.4	38.9-54.9	-
WBC (X 10^3 /µL.)	8.3	-	-	-	2.0-10.4 (RR) 3.9-11.1 (WR)	4.9-12.4 (RR) 4.4-7.3 (WR)
PLT (X 10^3 /µL.)	284	-	-	-	-	-
MCV (fL)		F = 53.2 ± 1.6 M = 54.4 ± 1.1	(both sex) 78.1-100	-	49.3-63.3	-
MCH (pg)	21.4	F = 15.6 ± 0.4 M = 16.3 ± 0.3	(both sex) 28.1-34.9	-	15.6-20.0 (S) 17.0-19.8 (W)	-
MCHC (%)	34.2	-	(both sex) 30.2-38.4	-	-	-

F= Female ; **M** = Male ; **RR** = Ranch raised ; **WR** = Wild raised ; **S** = Summer ; **W** = Winter

Discussion

Sarcoptic mange due to Sarcoptesscabiei has been identified and published in 104 species of domestic and wild mammals The disease is the most often diagnosed one in both domestic and wild Red foxes (*Vulpes vulpes*) which are living worldwide (Bornstein et al., 2001; Little et al., 1998a).

It has been discussed that the mite causing disease in wild and domestic animals is a single species and it represents physiological specifity across different hosts. Thus, *S. scabiei* has at the same time high specificity of host and low degree of cross infectivity. The varieties are named according to their predominant host species, such as *S. Scabiei varcanis*, *S. Scabiei varsuis*, etc. (Pence and Ueckermann, 6446). Host specifies may vary related to various strains. Though dogs may acquire sarcoptic mange from canids, it is not clear how frequently domestic canids cause infection in foxes and other species. Standing in contrast to other species, the red foxes failed to develop immunity against mange (Little et al., 1998a). While the immune response in sarcoptic mange is poorly understood, the immune reaction seems to be cellular one (Pence and Ueckermann, 2002). Mueller (2000) explains both cellular and humoral immune responses develop.

Any pruritic dog can possibly be infected with Sarcoptes scabiei ; particularly if these pruritic lesions are localized in pinna, ventrum and elbows thus; treatment is necessary (Mueller, 2000).

Although sarcoptic mange is generally difficult to detect, examining deep skin scrapings in % 10 potassium hydrochloride is very effective when mites are still abundant in the skin. Skin scrapings generally necessity to be repeated. Detecting only one mite and/ or egg is sufficient in order to identify sarcoptic mange. Furthermore, negative results doesn't mean sarcoptic infestation doesn't exist especially in canine mange. ELISA tests for sarcoptes specific IgG may be used. According to a research, in atopic individuals, these tests have a very high predictive value despite having very low positive predictive value due to false positive results. A positive pinnal scratching reflex also generally confirms the infection (Mueller, 2000; Harvey et al., 2009). In dogs, primary lesions are erythematous papules with a grayish-yellow crust. Self-trauma may accompany severe excoriation, lichenification and patchy alopecia. Malaise, weight loss, lymphadenopathy and crusting in severe long-standing cases are also known (Harvey et al., 2009). In a study about scabies in foxes, it is explained that the commencement, the progression and the clinical signs of the lesions vary according to various species and the host's immunologic properties. As the immunologically competent host develops hypersensitivity, intensely pruritic lesions, hyperkeratosis, alopecia and dermal

Table-2 : Serum biochemistry reference values of different fox breeds obtained from different studies and serum biochemical measurements in this case

		Reference values (According to various research results)			
	Measured Values	Rui et al., 2011	Mattoso et al., 2012	Nowakowicz-Dębek et al., 2015	Korhonen and Huuki, 2014
Urea (mg/dL)	28	-	22 - 87	-	-
Creatinine (mg/dL)	1.3	-	0.5 -1.5	-	-
ALT (IU/L)	124	F = 136.3 ± 59.4	2.6 - 231.5	164.8 (FL)	171.5
		M = 168.7 ± 95.1		88.9 (B)	
AST (IU/L)	74	F = 55.9 ± 15.1	-	117.5 (FL)	49.2
Glucose (mg/dl)	82	M = 62.7 ± 14.5	-	48.9 (B)	-
Total Bilirubin (mg/dl)	0.4		-		
LDH (IU/L)	226	F = 68.08 ± 48.4	-	529.0 (FL)	-
		M = 84.4 ± 80.8		654.9 (B)	-
CK (IU/L)	114	F = 119.9 ± 77.7	-	-	84.0
	-	M = 258.9 ± 117.8	-	-	-
Total Protein (g/dL)	6.3		4.6 - 9.4	-	-
Albumin (IU/L)	33.4	-	-	-	-

F= Female, **M** = Male, **FL** = Free-Living , **B** = Breeding

inflammation develop. Finally, greatly thickened, wrinkled, hairless, discolored or grey skin is observed.

In the end, the animal becomes listless, dehydrated, emaciated and dies from the disease (Pence and Ueckermann, 2002). In the later stages of sarcoptic mange animals seek shelter; which makes difficult to help them to recover (Soulsbury et al., 2007). Death realizes within 3-4 months from first infection (Stone et al., 1974). In red foxes sarcoptic mange is not limited with skin lesions; lymphoid hyperplasia and testicular degeneration develop (Little et al., 1998a).

Ivermectin use resolves sarcoptic mange problems in foxes as it does in dogs (Arends et al., 1999; Canadian Council on Animal Care, 1984; Pence and Ueckermann, 2002). It makes also the related lesions vanish (Little et al., 1998a). The dosage is scheduled as 0.2-0.4 mg/kg. either weekly P.O. or every 14 days SC for 4-6 weeks. Ivermectin is not licensed in dogs and should be avoided in sensitive breeds (Harvey et al., 2009). Though idiosyncratic toxicities are documented in Collies and Old English Sheepdogs, other dog breeds may also be affected inversely. Gradual dose increase from 50 µg/kg on day 1 to 100 µg/kg on day 2, 150 µg/kg on day 3, on day 1 to 100 µg/kg on day 2, 150 µg/kg on day 3, 200 µg/kg on day 4 and 300 µg/kg on day 5 to identify sensitive patients is recommended before adverse reaction develops. An administration of gradual increase from 50 to 300 µg/kg within 4 days for SC scabies treatment is recommended. Lethargy, ataxia, tremors, mydriasis, coma and respiratory arrest are noted between side effects (Mueller, 2000).

Topical treatment is difficult, time consuming is not always safe. Amitraz dip application (every 7-14 days, for 4-6 weeks) and 0.25 % fipronil solution (3-6 ml./kg. every 7-21 days for 3-6 weeks in young, pregnant and nursing dogs when more potent cures are dangerous) aid to the treatment. An application of 2.5 % lime sulfur (weekly for 4-6 weeks) is also effective (Harvey et al., 2009).

Since mange causes juvenile deaths, failure to undergo spermatogenesis and female reproduction decline, population recovery during the enzootic stage is limited (Newman et al., 2002). The success to either endure infection and/or survive is affected by various factors including age, genetic predisposition, nutrition and physical status and finally environmental conditions and habitat properties which directly influences stress. According to various reports, the initial decline in population density is due to mortality increase of both juveniles and adults, juveniles being more susceptible to the disease since they experience more physical contact during their early development. Yet, direct transmission between adults is also common because adults in the same social group share the same densities. The importance of indirect transmission in urban habitat is related to the concordance of mange levels between foxes and dogs (Soulsbury et al. 2007).

In this case, the infestation wasn't heavy. Only a mild pruritus and some reddish, alopecic lesions were arousing attention. The lesions were localized in ventral and lumbar areas and paws. These findings were in concordance with reports explaining that some

recently exposed individuals may develop non pruretic severe crusting dermatitis characterized with severe hyperkeratosis even the lesions were not severe. The lesions vanished slowly and the pruritus ceased as treatment went on.Coccidia is an obligate intracellular parasite normally found in the intestines and all warm-blooded animals are infected with this agent. Coccidia of dogs and cats were accepted biologically clinically unimportant until *T. gondii* life cycle was discovered. Coccidia is now divided into several distinct genera such as *Toxoplasma*, *Neospora, Isospora* (*Cystoispora*), *Hammondia*, *Besnoitia*, *Sarcocystis*, *Cyrptosporidium* and *Cyclospora* (Dubey and Lindsay, 644[3]). Foxes are generally infested with *I. bigemina*. The signs vary from mild to bloody diarrhea, anorexia and death (Khan and Line, 2005). A case report focusing on foxes explains the first clinical symptoms seen in three weeks old fox whelps unthriftinesse, watery stool, moisted and clamped furs. Poor growth accompanied by significantly smaller body size were the other signs (Juokslahti et al., 2010). Parasitised free foxes have a higher mass/body ratio than infested ones. (Vervaeke et al., 2005). According to Skirnisson et al. (1993), food consumed by the fox influences the number and species of parasite type causing the infection.

The treatment of coccidiosis in fox consists of the procedures adopted in dogs (Khan and Line, 2005). The primal aim of the cure in *Isospora* spp. infections is to resolve diarrhoea. Supportive care including fluid therapy in order to correct dehydration is recommended. An important amount of the drugs used in coccidiosis treatment have only coccidiostatic effect. Amprolium is used in puppies despite being unapproved in dogs (25 mg/kg. PO q24h. for 3-5 days). Ponazuril, diclazuril and toltrazuril are widely chosen nowadays. Toltarzuril is known to cause the oocysts shedding to diminish, at least temporarily. A dosage of 30-60 mg. trimeptoprim/sulfamethoxazole daily for 6 days is recommended for the dogs if the animal weights more than 4 kg. Another source suggest sulfadimethoxine, trimetoprimsulfa treatment for 10-20 days. But, some sulfa drugs are known to cause GI irritation, keratoconjunctivitis sicca, cholestasis, hepatocellular necrosis and thrombocytopenia. The prognosis is good unless there is an underlying cause (Nelson and Couto, 2009; Steneroden and Wydallis, 2014).

A report explains foxes suffering the disease were cured with oral sulfadiatzine/trimetoprim dosed as 120 g per ton of semimoist feed for five days. The treatment was accepted to be satisfactory. When a second outbreak occurred, a treatment of oral toltrazuril was applied at a dose of 10 mg. supplied by oral sulfadiatzine-trimetoprim per whelp for 5 days. Recovery was recorded (Juokslahti et al., 2010). In a report about emergency stabilization of wildlife, the dosage of trimetoprim/sulfamethoxazole is scheduled as 30 mg/kg. PO q12 hrs. in mammals (Burwell, 2018; Steneroden and Wydallis, 2014).

In this case, the fox could be accepted as asymptomatic. Asymptomatic ongoing of coccidiosis is explained in older individuals. Despite the exact age of the fox in this case was unknown, she was a young one.

The only signs that could be related to the disease were poor growth, a slight dehydration and a slight anemia, which all were resolved with appropriate therapy.

Mattoso et al., (2012) explain that hematologic values they had found for crab-eating foxes were in general similar to those explained for domestic dogs. These measurements didn't differ between genders. Yet, female foxes' percentage of eosinophil was higher compared with the percentage of eosinophil in males. (Crooks et al., 2000; Rui et al., 2011).

Hemoglobin, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), WBC, band and segmented neutrophils and lymphocytes showed significant variations between sub-adults and adults. MCH and MCHC showed higher results in older individuals. This should be due to bigger hemoglobin reduction in youngers. WBC, segmented neutrophils and lymphocytes were higher in sub-adults; which was evaluated to be due to higher stress expressed by younger when physical and chemical restraint are applied (Jain, 1993; Mattoso et al., 2012).

In our case, the measured haemogram values were compared to both with reference values explained for foxes by different researchers and the reference values accepted for domestic dogs showing similar values with foxes since fully established and accepted reference values for each haemogram parameter in foxes don't yet exist. According to a such comparison, only a slight decrease in RBC and HCT values were present. Thus, the patient was accepted to be suffering a slight anemia. This was thought to be related to both sarcoptes and coccidosis infestations. I

n foxes, serum biochemical parameters such as ALT, ALP, GGT, TP and albumin levels are similar to those measured in dogs (Choi et al., 2011; Zhan et al., 1991). Nowakowicz-Debek et al. (2015) concluded ALT and AST activity as well as urea level were measured

significantly augmented in free-living foxes while bilirubin and LDH levels were found similar in farmed ones. ALP, BUN, creatinine, cholesterol and glucose levels were higher in wet season in island foxes (Rui et al., 2011; Seal et al., 1975; Smith et al., 1980). Similar to hematologic parameters, biochemical ones didn't represent any difference related to gender (Mattoso et al., 2012; Seal et al., 1975). Yet, glucose levels in male foxes were measured higher than measured in females (Crooks et al., 2000). According to these, urea, ALP, GGT, fibrinogen, calcium and phosphorus differed between sub-adults and adults. High urea levels in older animals was related to the high-protein diet they are fed with. GGT and fibrinogen levels were also higher in older animals. ALP, calcium and phosphorus were detected higher in younger foxes. These results were thought to be related to fast osteogenesis and osteoclast differentiation in younger individuals (Mattoso et al., 2012; Rui et al., 2011; Seal et al., 1975; Smith et al., 1980).

Similar to haemogram values, completely established and accepted biochemical reference values don't exist yet for the foxes either. Thus, similar to what was done when evaluating haemogram measurements, comparison with both reference values explained for foxes in literature and with those accepted for domestic dogs were realized. In dogs measured ALT value must be lower than 100 (IU/L); thus a slight increase in the patient's value seems to exist according to this. On the other hand, when reference values explained for foxes are taken into consideration, the measured value seems normal. In our case, it was concluded no pathologic situation existed since even regarding to reference values accepted for dogs, only an increase of at least three times normal indicates a liver damage (Sodikoff, 2001).

In a research, physical examination and values of urinalysis were found similar to those known for domestic dogs. On the other hand, proteinuria measurements were higher than those of them (Lees et al., 1994). The urinalysis of the fox represented in this case didn't show any pathology. to this. On the other hand, when reference values explained for foxes are taken into consideration, the measured value seems normal. In our case, it was concluded no pathologic situation existed since even regarding to reference values accepted for dogs, only an increase of at least three times normal indicates a liver damage (Sodikoff, 2001).

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Conclusion

Wild mammals play a crucial role as vectors and host for a range of bacterial, viral and parasitary diseases transmitting in a two-way manner between humans and animals. Zoonotic infectious diseases which have a strong effect on host population dynamics, are very hard to be controlled and their controversial management has also economic costs in spite of being used in resolving feral or wildlife species' troubles. Furthermore, epizoodics permits hosts and pathogens to coexist; which also makes the diseases an occasion for establishing key evolutionary and ecological main points (Soulsbury et al., 2007). Zoonotic invasions can be transmit directly through the environment, from the water or food or from close contact with other animals (Rataj et al., 2013).

Several attempts to decline the infection in foxes with the use of distributing baits containing praziquantel is reported. Most of them are known to provide substantive decline of parasitary infestations of foxes. Other baiting campaigns with various frequencies showed various results, while applications with lower frequencies didn't represented any significant reduction. The main property of FOI is to represent wide temporal and spatial variations which necessity to establish control strategies according to local FOI conditions (Lewis et al., 2014).

For those living in captivity, the length of time the animal are removed from wildlife, adjustment to captivity, quality of life in captivity, husbandry for the species' needs and proximity to other species influence the burden of infectious diseases. Contact with other individuals, humans, food, water, mites and iatrogenic introduction may also cause such diseases (Williams and Thorne, 1996).

In spite of being an important indicator for health status, neither hematologic nor biochemical values of foxes can be properly evaluated due to the lack of reference values (Courtenay et al., 2001). The importance of haemogram and biochemical parameters in order to diagnose and evaluate the prognosis of diseases is accepted; thus it is crucial and urgent to establish studies focusing on wildlife species reference physiologic values. It is also concluded that differences related to age must always be taken into consideration (Mattoso et al., 2012). In conclusion, the necessity to establish reference values for haemogram and biochemistry for wildlife species is of crucial

importance in order to detect and treat any pathology. Wildlife specialization is another necessity if the wildlife is desired to be protected and appropriate medical prevention and care is applied. According to these, this case defines sarcoptes and coccidiosis in a fox and tries to highlight the importance of a fully examination even when definitive and severe signs don't exist since the disease (s) may be ongoing asymptomatically.

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