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# A CASE REPORT ON A RESCUED RED FOX IN AN URBAN AREA (BUCHAREST, ROMANIA) SUGGESTS POTENTIAL RISKS FOR PARASITIC DISEASES IN PETS

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***Abstract***

*Red foxes (Vulpes vulpes) have been increasingly detected as carriers of multiple pathogens throughout Europe, being considered to be asymptomatic to the presence of most. Currently, a rapid urbanization of red foxes has been reported in many European countries, posing high risks for the both human and animal health. Here we describe a clinical case on a young male red fox which was rescued in March 2020 from an urban area of Bucharest (Romania). The fox was found collapsed and unresponsive on the street and immediately was referred to a wildlife rehabilitation center. On the clinical examination, the animal showed underweight (5 kg), hypothermia (T = 35.6°C), severe dehydration, pale mucosae, nystagmus, tremors, and hemoglobinuria. Whole body, cranial and thoracic radiographs revealed no traumatic injuries. Subsequently, a specific therapy for stabilizing the body temperature, oxygen and supportive therapy was administered. In the following two days, the general status of animal was improved, however, anorexia, slight fever (39.1°C-39.3°C), hemoglobinuria, glucosuria, proteinuria and apathy, were registered. Hepatic and renal parameters determined by biochemical analyses showed increased values. Based on this pathology, babesiosis was suspected and subsequently a blood sample was collected and analyzed by molecular qPCR technique which confirmed the Babesia DNA in the fox blood. The animal showed good response to the symptomatic treatment, therefore, no babesiicid treatment was considered. During the monitoring period, the fox displayed a clinical status significantly improved and at 13 days after its admission, it was released in a natural wild habitat. This case clearly shows that foxes invading urban areas pose potential risks for pathogens of medical and veterinary interest.*

***Key words****: fox, urban area, pathogen-risks, Romania.*

## INTRODUCTION

Red foxes (*Vulpes vulpes*) are increasingly adapting to urban environments all around the world, as their opportunistic feeding habits are allowing them to establish stable populations close to human settlements (Handler, 2020). This can favor increased contact rates within different wildlife species and between foxes and domestic animals or humans that can lead to a higher transmission rate of infectious and parasitic diseases (Couper, 2016).

Currently, a rapid urbanization of red foxes has been reported in many European countries, posing high risks for the both human and animal health (Plumer et al., 2014).

Due to the expansion of their geographic range, increase in population density and probably a more present scientific interest, foxes have been reported to harbor a variety of parasitic agents, such as *Babesia/Theileria*., *Hepatozoon, Leishmania*), but also bacterial diseases transmitted by hematophagous vectors (Hodžić et al., 2017).

This report describes a clinical case of a red fox rescued from an urban area (Bucharest, Romania) and discusses the associated risks for emerging wild-life borne diseases for domestic animals.

## MATERIALS AND METHODS

*Case presentation*

In March 2020, a young male fox (approx. 1 year old) was referred to a wildlife center by the local police. The fox was found collapsed and unresponsive on a closed boulevard in the urban area of Bucharest (Romania).

Immediately, the animal was subjected for a routine general clinical examination followed by laboratory and imagistic investigations. Accordingly, a supportive therapy was administered to the fox under a permanent clinical follow-up.

## RESULTS AND DISCUSSIONS

On clinical examination, the animal, with an underweight (5 kg) aspect, was unresponsive to external stimuli, hypothermic (T = 35.6°C), severely dehydrated (> 10%), displaying pale and dry mucosae, nystagmus, and tremors.
The capillary refill time was over 2 seconds. No lesions of the musculoskeletal system or any other evidence of trauma were identified.
Ophthalmological examination has been performed and excluded any hemorrhages or retinal detachment.
In order to stabilize the body temperature, a specific, shock and analgesic therapy, and oxygen have been administered. An injectable protocol, of dexamethasone (1.6 mg/kg) and Butorphanol (0.15 mg/kg) were administered intramuscularly as shock therapy and analgesia. Supportive treatment, including fluids (Ringer Braun - 50 ml as bolus in the first hour and 10 ml/h for the next 24 h), vitamin cocktails (Duphalite), glucose (10%) and antihemorrhagic (250mg etamsylate) drugs were iv administered.
The next day, whole body, cranial and thoracic radiographs were performed and no traumatic injuries were present (Figures 1 and 2).

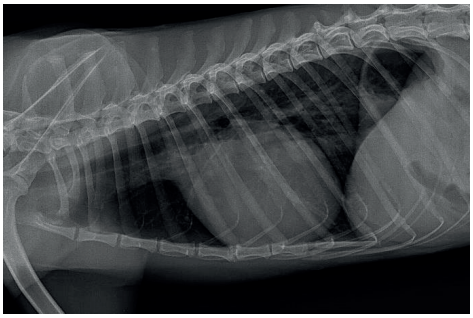

Figure 1. Latero-lateral thoracic radiograph of a rescued fox showing no abnormalities

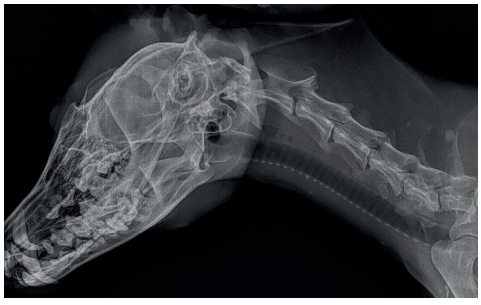

Figure 2. Latero-lateral cranial radiograph of a rescued fox showing no abnormalities

After 12 hours of its admission, the fox became awake but not responsive to external stimuli and appeared to be blind (Figure 3). The rectal temperature increased at 39.2°C.

Figure 3. The rescued fox at 24 hours after

Urine was sampled and analyzed using a multiparameter strip (Combur$^{5}$ test® HC, Roche Diagnostics) that showed: the presence of glucose and proteins in moderate levels; hemoglobin in high levels; hematuria was not indicated (Figure 4).
Capillary refill time was around 2 seconds and mucosae were still pale.

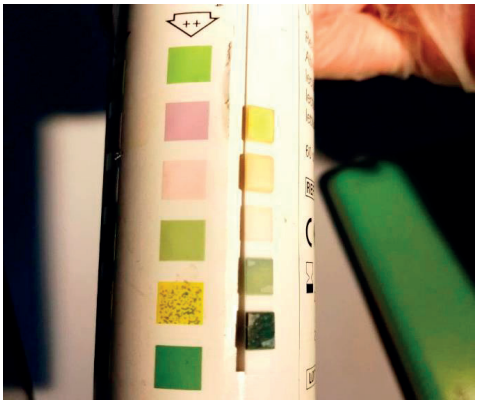

Figure 4. Urine analysis of a rescued fox showing: hemoglobinuria, proteinuria and glucosuria

The medical team decided to administer antibiotic (Amoxicillin trihydrate, dosed at 15 mg/kg (0.5 ml q 48 h, subcutaneous injection, for eight days) and antipyretic (metamizole sodium, Novasul®; 1 ml, every 24h) therapy. The body temperature was monitored daily (at 12 pm), before and after (p.t.) the administration of the antipyretic drug. The body temperature daily dynamics is depicted in Figure 5.

For the next 3 days p.t., the body temperature was characterized as slight hyperthermia (39.1°C-39.3°C), according to the normal range of body temperature in red foxes (*Vulpes vulpes*) of 37.8-39°C (Stocker, 2013).

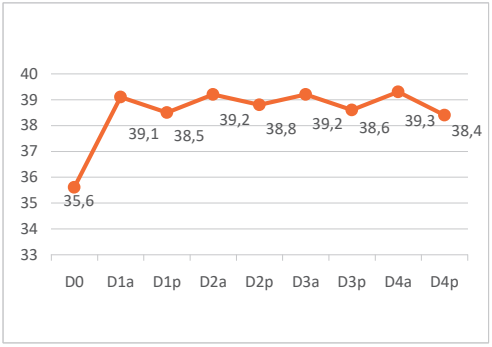


Figure 5. Dynamics of the body temperature in a rescued fox, ante (a)- and post (p)- antipyretic treatment
(D= day; D0: admission day; D1-D4: day 1-day 4)

Three days after admission, the fox regained its appetite and the clinical signs improved. However, the hemoglobinuria was still present (during of the next five days). Therefore, a blood sample was collected and subjected for laboratory investigations. The biochemical examination of the blood revealed higher levels of glucose, total cholesterol, total bilirubin, total protein, and uric acid, and lower levels of blood urea, creatinine and albumin, indicating slight alterations of the hepatic and renal functions (Tabel 1).

Table 1. Blood biochemistry parameters in the rescued fox

| **Parameter*** | **Value registered** | **Reference value**** |
|---|---|---|
| Glucose | 141 mg/dL ↑ | 65-120 mg/dL |
| T-Cho | 13.37 mmol/L ↑ | 2.23-12.64 mmol/L |
| BUN | 1.6 mmol/L ↓ | 3.57-21.78 mmol/L |
| T-Bil | 30.78 µmol/L ↑ | 7-26 µmol/L |
| AST | 54 IU/L | 8-160 IU/L |
| ALT | 502 IU/L | 39-607 IU/L |
| T-Pro | 81 g/L ↑ | 35-76 g/L |
| Albumine | 23 g/L ↓ | 23-44 g/L |
| UA | 0.099 mmol/L↑ | 0.006-0.03 mmol/L |
| Creatinine | 27.36 µmol/L ↓ | 35-194 µmol/L |

*T-cho: total cholesterol; BUN: blood urea; T-BIL: total bilirubin AST: Aspartate Aminotransferase; ALT: Alanine transaminase; Pro: total protein; UA: uric acid.
**Reference values according to the BSAVA Manual of Wildlife Casualties, which adapted them from the International Species Information System reference ranges.

Blood sample was sent also to the diagnostic laboratory of molecular biology and analyzed by using a Real Time- qPCR (polymerase chain reaction) technique for the presence of *Babesia* DNA, which was found positive (Ct = 34). However, piroplasms were not detected by light microscopy, probably due to the low parasitemia (Ct = 34).
Considering the different approach used in wildlife medicine (Couper, 2016) and the suspected natural resistance of foxes to piroplasms (no clinical cases have been described), instead of the babesiisicid treatment, to continue the symptomatic therapy, under permanent clinical monitoring, was the treatment protocol of choice.
In the following four days, the animal responded well to the symptomatic treatment, its clinical status improved significantly, and the body temperature became normal (38.4°C), it began eating normally and gaining weight (BW = 5.4 kg). Therefore, at 10 days post-admission, the fox was moved in an outside pen, where showed to continue its recovering during the following days, expressing normal behavior (hiding, digging, jumping on fences) (Figure 6). Therefore, on the 13$^{th}$ day after its admission, the fox was released in a wild habitat, outside of the metropolitan area.

Figure 6. The rescued fox, displaying normal behavior (hiding), 13 days post-admission

*Discussion*

Rapid urbanization of wildlife forced many species to adapt to anthropic habitats, including foxes, hedgehogs, bats, hares and different bird species. As most species of wildlife are carriers for various pathogens, the distribution of those diseases is changing at the same pace (Hassel et al., 2017). Moreover, it is stated that at least 70% of the current emerging zoonotic infection

diseases have a wildlife origin, with cross-species spread and transmission (Jones et al., 2008). Red foxes are nowadays invading many cities worldwide, and they have colonized urban areas in numerous European countries (Plumer et al., 2014),

Recently, foxes have been found positive for different tick-borne pathogens, such as *Babesia canis, Babesia vulpes,* or *Hepatozoon canis* in studies performed in Europe (Hodžić et al., 2015). All of these species have been reported to cause clinical disease in domestic dogs (Simões et al., 2011; Ionita et al, 2012; Solano-Gallego et al., 2016).

Several recent molecular studies have reported the presence of diverse bacterial and protozoan tick-borne pathogens at the tick-host interface in Romania, highlighting potential risks for serious diseases of veterinary and medical interest (Ionita et al., 2013; 2016).

Wild animals, including foxes, represent a readily available host for hematophagous tick-vectors and subsequently reservoir for the vectored-pathogens. Therefore, urban foxes may represent a source of infections, especially for domestic carnivores, but also for other zoonotic pathogens.

Thus, recent studies in Romania report foxes as carriers of various tick-borne pathogens, such as *Anaplasma phagocytophilum* (2.55%) and *Borrelia burgdorferi* (1.42%) (Dumitrache et al., 2015). Other pathogens, *Toxoplasma gondii* (Șuteu et al., 2014), *Angiostrongylus vasorum* (Deak et al., 2017), have been also reported.

Additionaly, seven different species of fleas and five species of ticks (*Ixodes hexagonus*, *I. ricinus, I. crenulatus, Dermacentor marginatus* and *Haemaphysalis punctata)* infesting foxes in Romania have been reported, all potential vectors of pathogens of medical and veterinary interest (Dumitrache et al. 2014; Foley et al., 2017). Of these, *I. hexagonus* was reported as the most common tick infesting foxes in Romania (Mihalca, 2012; Dumitrache, 2014; Sandor et al., 2017).

*I. hexagonus* is recognized as main vector of the newly named piroplasm, *Babesia vulpes* n. sp., infecting dogs (Baneth et al., 2015; 2019).

Therefore, risk associated with the migration of foxes towards anthropic habitats is posed especially for domestic dogs, as many pathogens, including piroplasms can cause severe clinical diseases.

Of these, an increasing interest is emphasized on *B. vulpes* n. sp. (Baneth et al., 2015). This is a small piroplasm (for which several synonyms have been used such as, *Babesia* Spanish dog isolate, *Babesia cf. microti, Babesia microti*-like, *Theileria annae*), highly pathogenic for dogs, causing anemia, thrombocytopenia, and azotemia, but are mostly subclinical in red foxes (Criado-Fornelio et al., 2003; Baneth et al., 2019).

Infection of red foxes by *T. annae* was molecularly detected, by using PCR-based methods and subsequent sequencing, in many European countries, such as Croatia (5.0%) (Dežđek et al., 2010), Hungary (20.0%) (Farkas et al., 2015), Italy (22.88%) (Ebani et al., 2017), Austria (50.7%) (Hodžić et al., 2017), Spain (72.0%) (Checa et al., 2018).

Also, a recent study in Romania reports a prevalence of 20.17% (70/347) of the examined foxes (hunted and found dead as road kills) positive for *T. annae* (Daskalaki et al., 2018).

Therefore, as *B. vulpes* n. sp. is spreading from its thought-to-be endemic area (North-western Spain, Galicia), and is being harboured by wild canid species, all reports about its presence are important for the assessment and control of the clinical disease in domestic dogs (Falkenö et al., 2013).

Clinical disease associated with the fox-related piroplasm species, *T. annae*, has been recently described in a domestic dog (a 12 weeks old puppy), in Sweden, characterized by severe regenerative anaemia; a vertically transmission it was assumed for the infection route (Falkenö et al., 2013).

Despite of the fact foxes are believed to be asymptomatic carriers of *Babesia* infections, the clinical panel described in the present case indicate that some animals might suffer from subclinical forms of the disease, probably associated with immunosuppression or other concurrent pathologies.

However, more data and further investigations are planned in order to asses the real prevalence and molecular epidemiology of piroplasm infections in Romanian foxes and the risks they may represent for domestic animals and humans.

## CONCLUSIONS

This case clearly shows that foxes adapting to urban habitats may represent potential risks for the spread and transmission of pathogens of veterinary interest.

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# ANIMAL PRODUCTION, PUBLIC HEALTH AND FOOD QUALITY CONTROL