Subcutaneous ticks: first report in a golden jackal and further proof for the negativity of non-canid carnivores

Noureddine Mechouk
Universite Badji Mokhtar Annaba
Georgiana Deak
USAMV Cluj
Angela Monica Ionica
Universitatea de Stiinte Agricole si Medicina Veterinara din Cluj-Napoca
Dan Traian Ionescu (dionescu@unitbv.ro)
Universitatea Transilvania din Brasov
Gabriel Bogdan Chisamera
Muzeul National de Istorie Naturala Grigore Antipa
Calin Mircea Gherman
University of agricultural sciences and veterinary medicine of cluj-napoca
Andrei Daniel Mihalca
USAMV

Short report

Keywords: Golden jackals, Subcutaneous, Ticks, Romania

Posted Date: July 30th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-50745/v1

Version of Record: A version of this preprint was published on January 5th, 2021. See the published version at https://doi.org/10.1186/s13071-020-04510-7.

Abstract

Background: Ticks are hematophagous arthropods which normally attach to the surface of the skin of the host for the blood meal. Their aberrant presence in the subcutaneous tissue of few carnivores, predominantly foxes has been reported. However, there are no reports in other carnivores such as mustelids or golden jackals. Our aim was to investigate and broaden the host spectrum for this aberrant localization of ticks.

Methods: Between 2015 and 2020, 198 carnivore carcasses from 12 species have been examined by parasitological necropsy. If subcutaneous ticks were found, the nodules were removed, carefully dissected, and stored in ethanol. The identification of the subcutaneous ticks was carried out at the species level.

Results: A single subcutaneous tick was found in one sample, a golden jackal and was identified as a female *Ixodes ricinus*. All other carcasses were negative for subcutaneous ticks.

Conclusion: The present paper represents the first report of a subcutaneous tick in a golden jackal (*Canis aureus*), extends the host spectrum of this unusual phenomenon and demonstrates to date its presence only in canid carnivores.

Background

Ticks represent a large group of blood-sucking arthropods that are parasitic in a wide range of mammals, birds, and reptiles, and occasionally in amphibians, being also important vectors for various pathogens. [1]. All active life stages require a blood meal in order to molt (larva, nymph), to lay eggs (female), or to become ready to mate (males of certain species) [2].

Despite their typical localization on the host, on the surface of the skin, there are several reports of subcutaneous localization of ticks. The vast majority of reports of subcutaneous ticks were in red foxes, with occasional reports in a raccoon dog, one domestic dog, and a human (Table 1). So far, several hypotheses were suggested to explain the presence of ticks in the subcutaneous tissue, but none of them has been confirmed by experimental studies. It is not known if the number of reports and the relatively common occurrence of subcutaneous ticks in red foxes is related to some host preference or to more extensive studies. Hence, understanding the full host spectrum is important to fill in the puzzle of this unusual phenomenon. It is also unclear why most reports are from Eastern and Central Europe or if this geographical bias is related to the fact that foxes are here the most common and studied wild canids. Nevertheless, in the last twenty years, the population of another canid, the golden jackal (*Canis aureus*) has increased significantly [3]. Golden jackals also have an important role as reservoir hosts for parasites [4]. Moreover, it is not clear if other wild carnivores, such as mustelids can harbor subcutaneous ticks, as the lack of published reports can be related to the lack of studies. In this context, the aim of the present paper was to investigate the occurrence of subcutaneous ticks in various species of wild carnivores in a

geographical area where this aberrant localization is known to be prevalent in red foxes, in order to elucidate the role of the host species.

Materials And Methods

Between 2015 and 2020, 198 carnivore carcasses from 12 species (57 golden jackals, 6 gray wolves, 19 wild cats, 2 Eurasian lynxes, 76 Eurasian badgers, 20 beech martens, 8 European polecats, 4 European pine martens, 3 Eurasian otters, 1 stoat, 1 European mink, 1 least weasel) (Suppl. material) have been examined by parasitological necropsy. Carcasses originated from road kills or legally hunted animals. The carcasses were stored at -20°C until processing. The age of the animals was estimated based on the state of tooth wear [5] and sexual maturity [6]. The carcasses were subjected to external inspection, body condition appreciated and checked for the presence of ectoparasites then necropsied using a standard method, starting with the removal of the skin. If subcutaneous ticks were found, the nodules were removed, carefully dissected, and stored in ethanol. The identification of the subcutaneous ticks was carried out at the species level under an Olympus® binocular magnifier and was based essentially on the taxonomic criteria according to literature [1].

Results

A single subcutaneous tick was found in one sample, a golden jackal collected in Comana Natural Park, Romania (Fig. 1). The nodule was found under the skin in the hind leg of the left internal hip area. The tick was in an advanced stage of decomposition. However, despite the state of tick degradation, the gnathosoma and the scutum were well preserved, and the tick was identified as a female *Ixodes ricinus*. All other carcasses were negative for subcutaneous ticks.

Discussion

The mechanism by which ticks get into the subcutaneous tissue is still unexplained. Several tick-related factors such as the species or the sex were incriminated as favoring factors. According to currently available literature, a more common presence under the skin was noted for ticks with a long rostrum (i.e. *Ixodes* spp.) or ticks feeding for longer periods (adults in general and females in particular), which seem to be predisposing factors [7, 8]. Although it is evident that the vast majority of reports of subcutaneous ticks are from red foxes (Table 1), it is not clear if also host-related factors are involved. It is also unclear if the lack of reports from other hosts is related to the absence of subcutaneous ticks or the lack of studies or incomplete necropsies in other hosts. To understand the full host spectrum of this unusual occurrence, negative reports are also useful. However, with the exception of one study in roe deer [9], no other negative reports are known.

Table 1. Review of reports of ticks in subcutaneous tissues of various hosts

Host	Species	Country	Reference
Red fox *Vulpes vulpes*	*Ixodes ricinus* *Ixodes hexagonus*	UK	[12]
	Ixodes ricinus	Poland	[13]
	Ixodes ricinus	Austria	[14]
	Ixodes ricinus	Slovakia	[15]
	Ixodes ricinus	Slovakia	[16]
	Amblyomma americanum	USA	[17]
	Ixodes ricinus *Ixodes hexagonus* *Ixodes crenulatus* *Dermacentor reticulatus*	Czech Republic	[7]
	Ixodes ricinus	Romania	[7]
	Ixodes ricinus	Slovakia	[18]
	Ixodes ricinus	Sweden	[19]
	Ixodes ricinus *Dermacentor reticulatus*	Poland	[20]
	Ixodes ricinus *Ixodes hexagonus* *Ixodes canisuga*	Germany	[8]
Raccoon dog *Nyctereutes procyonoides*	*Ixodes ricinus*	Poland	[21]
Domestic dog *Canis familiaris*	*Ixodes ricinus*	Sweden	[19]
Human *Homo sapiens*	not identified Ixodidae	South Korea	[22]
Golden jackal *Canis aureus*	*Ixodes ricinus*	Romania	current study

We report here for the first time the presence of a subcutaneous tick in golden jackals (frequency 1/57; 95% CI 0.04-9.39%) and the absence in 11 other carnivore host species. However, with the exception of few hosts, such as Eurasian badgers, beech martens and wild cats, the number of samples from other carnivore species is too low to draw a stronger conclusion.

What is clear at the moment is that so far, with the exception of one human case, all other reports originate from canids, with high local prevalence in red foxes [7, 8]. The vast majority of these reports refer to ticks of genus *Ixodes* (Table 1) but this may also be related to the more common occurrence of these ticks in red foxes [10, 11].

Conclusion

The present paper reports a new host for the presence of subcutaneous ticks and confirms the canids as the single group of animals to show this phenomenon indicating a possible role of the host as a risk factor. We highlight the importance of further studies, on other hosts, but also in other geographical region than Europe.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interest.

Funding

The research was carried out under the frame of the UEFISCDI project PCCDI 57/2018.

Authors ‘contributions

NM wrote the manuscript and identified the tick species. GD performed the necropsies and revised the manuscript. CMG and AMI performed necropsies. DTI and GBC collected carnivore samples. ADM and CMG coordinated the study and revised the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We are indebted to all the people who collected carnivore carcasses.

References

1. Estrada-Peña A, Mihalca AD, Petney TN (editors). Ticks of Europe and north Africa: a guide to species identification. Springer, 2018;1-195.
2. Oliver JH. Biology and systematics of ticks (Acari: Ixodida). Annu Rev Ecol. Syst. 1989;20:397-430.
3. Papp CR, Banea OC, Szekely-Sitea AL. Applied ecology and management aspects related to the golden jackal specific ecological system in Romania. Act Mus Maram. 2013;9:275-292.
4. Gherman CM, Mihalca AD. A synoptic overview of golden jackal parasites reveals high diversity of species. Parasit Vectors. 2017;10:419.

5. Lombaard LJ. Age determination and growth curves in the black-backed jackal, *Canis mesomelas* Schreber, 1775 (Carnivora: Canidae). Ann Transv Mus. 1971;27(7):135-169.
6. Klevezal G, Kleinenberg S. Age determination of mammals by layered structure in teeth and bone (in Russian). Moscow Nauka; 1967.
7. D'Amico G, Juránková J, Tăbăran FA, Frgelecová L, Forejtek P, Matei IA, et al. Occurrence of ticks in the subcutaneous tissue of red foxes (*Vulpes vulpes*) in Czech Republic and Romania. Ticks Tick Borne Dis. 2017;8(2):309–312.
8. Haut M, Król N, Obiegala A, Seeger J, Pfeffer M. Under the skin: *Ixodes* ticks in the subcutaneous tissue of red foxes (*Vulpes vulpes*) from Germany. Parasit Vectors, 2020;13:189.
9. Król N, Chitimia-Dobler L, Dobler G, Karliuk Y, Birka S, Obiegala A, et al. Tick burden on European roe deer (*Capreolus capreolus*) from Saxony, Germany, and detection of tick-borne encephalitis virus in attached ticks. Parasitol Res. 2020; 119:1387–1392.
10. Dumitrache MO, D'Amico G, Matei IA, Ionică A, Gherman CM, Barabási SS, et al. Ixodid ticks in red foxes (*Vulpes vulpes*) from Romania. Parasit Vectors. 2014;7:P1.
11. Karbowiak G, Stanko M, Miterpaková M, Hurníková Z, Víchová B. Ticks (Acari: Ixodidae) ticks parasitizing red foxes (*Vulpes vulpes*) in Slovakia and new data about subgenus *Pholeoixodes* Acta Parasitol. 2020; https://doi.org/10.2478/s11686-020-00184-4 (online ahead of print).
12. Nuttall GHF. Penetration of *Ixodes* beneath the skin. Parasitology. 1914;7(3):258-259.
13. Drozdz J. Penetration of *Ixodes ricinus* under the skin of the host. Acta Parasitol Polon. 1958;6:383-385.
14. Hinaidy HK. Ein weiterer beitrag zur parasitenfauna des rotfuchses *Vulpes* (L.), in Österreich. Zentralbl. Veterinarmed. B. 1976;23:66–73.
15. Lebeda M. Findings of *Ixodes ricinus* in the deep layers of the skin and in the lymphatic ganglion (lymph node) of foxes (*Vulpes vulpes*). Vet Cas Bratislava. 1962;11:193-205.
16. Tovornik D. Penetracija klopov (Ixodidae) v globoke plasti kože gostitelja. Biol Vestnik. 1984;32:117-120.
17. Smith DD, Frenkel JK, Smith EI. Intradermal infestation of a red fox (*Vulpes vulpes*) by the lone star tick (*Amblyomma americanum*). J Wildl Dis. 1986;22(1):122–124.
18. Pet'ko B, Stanko M. Finding of the tick *Ixodes ricinus* under the skin of a fox in Slovakia. Folia Vet. 1991;21:159–162.
19. Zakrisson G. Ticks, *Ixodes ricinus* in the subcutaneous tissues of a dog and foxes (in Swedish). Svensk Veterinartidning. 2010;62:25–27..
20. Dwużnik D. Ectoparasites of red fox (*Vulpes Vulpes*) with peculiar focus on ticks in the subcutaneous tissues. Ann Parasitol. 2019;65(Supplement1):s250.
21. Matysiak A, Wasielewski O, Włodarek J, Ondrejkova A, Tryjanowski P. First report of ticks in the subcutaneous tissue of the raccoon dog *Nyctereutes procyonoides*. Vet Med-Czech. 2018;63(12):571-574.

22. Chang SH, Park JH, Kwak JE, Joo M, Kim H, Chi JG, et al. A case of histologically diagnosed tick infestation on the scalp of a Korean child. Korean J Parasitol. 2006;44(2):157-161.

Figures

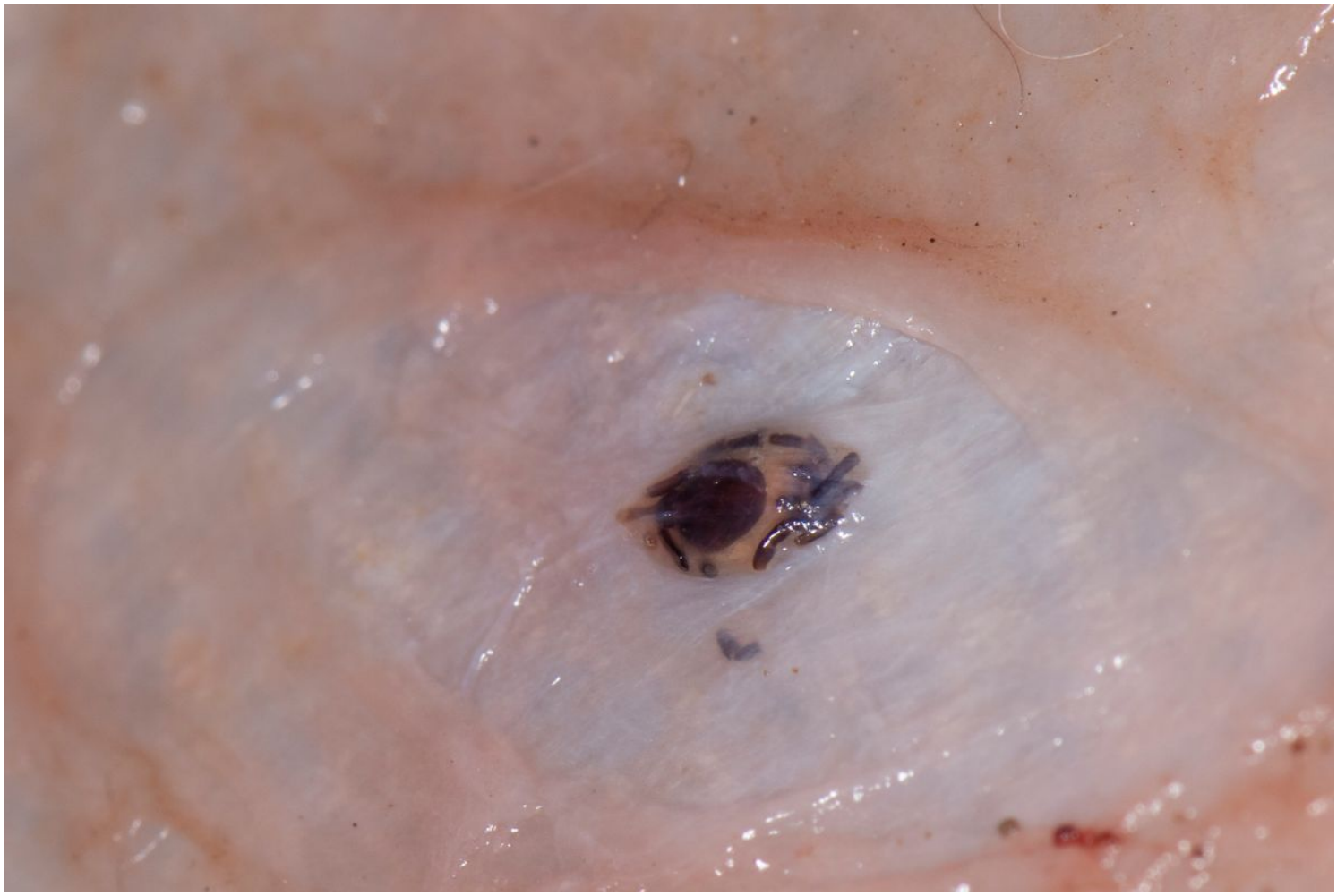

Figure 1

Ixodes ricinus in the subcutaneous tissue of a golden jackal, Canis aureus, in Romania

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarymaterial.xlsx
- Graphicalabstract.jpg