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Hazards of transborder transmission of trichinellosis and echinococcosis

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Introduction

At present the occurrence of zoonoses has serious impact on the agriculture and economy of European countries. On, using the example of two zoonoses, trichinellosis and alveolar echinococcosis, we want to show different causes and various means of their spreading and resulting hazard on humans. These helminthozoonoses have been chosen for increasing occurrence of their agents in domestic or wildlife animals in Europe. Humans get infected with trichinellosis quite frequently, taking into account that meat of domestic or wildlife animals is the source of infection. Despite the large spread of *Echinococcus multilocularis* in red foxes in many countries of Central Europe, the occurrence of alveolar echinococcosis in humans is rare.

Trichinellosis

Trichinellosis circulates in one domestic cycle and three sylvatic cycles, which are, according to (4), determined by different climatic conditions. Taxonomic revision of the genus *Trichinella,* however, has showed that etiological agents differ for each of these sylvatic cycles (25). Out of 10 genotypes identified in the genus *Trichinella,* only two *(T. spiralis* and *T. pseudospiralis)* are distributed worldwide, while other genotypes are restricted to a given zoogeographical region (24). *T. spiralis* is primarily maintained in a domestic cycle, although it can be present in a sylvatic cycle and returned into the domestic cycle (21). This species has high reproductive ability in all animals as well as it is the most pathogenic for humans. For all other species of *Trichinella* maintained in Europe, the most prevalent is *T. britovi*, less *T. nativa*, and sporadically *T. pseudospiralis* (23). These species are maintained in the sylvatic cycle in wildlife animals, predominantly in carnivores. Furthermore, they can infect domestic and synanthropic animals too, but they cannot exist in domestic cycle for their low reproductive ability and short survival time in these animals (23).

Despite precautionary measures against trichinellosis, the risk of infecting humans is still rather high. In particular, this mainly concerns Eastern-European countries, which in the last decade have been undergoing political changes with negative impact on agriculture. A great number of large

capacity pig farms has been closing down and replaced by small capacity farms without adequate sanitary protection. Pigs in these farms are often reared on pastures with free access for wildlife animals. Hunters frequently infect pigs by feeding them with wild boar scraps or carcasses of carnivores hunted for fur.

According to OIE (Office International des Epizooties) data (22) the highest number of trichinellous pigs was recorded in Romania, Croatia and Yugoslavia. Nevertheless, in other countries of the Balkans and former republics of the U.S.S.R. trichinellosis frequently occur in pigs (2). In these countries the most frequent source of trichinellosis is pork while in other European countries it is the meat of wild boars or horses, rarely of other animals (23).

Large geographical distribution of trichinellosis in pigs and wildlife animals poses risk for infections of humans, even with transborder transmission of this zoonosis. Despite the mentioned hazard, the risk of transmitting trichinellosis by pork and wild boar meat is small as the meat for the EU market has to meet the requirements of the Council Directive 77/96/EEC (11) and other regulations effective within the EU (3). The meat is inspected for trichinellosis or frozen according to applicable regulation.

Even examined meat may represent high danger for the transmission of trichinellosis. This statement is supported by repeated outbreaks of trichinellosis caused by infected horse meat in France and Italy. Horses or horse meat were imported either from European countries or North America (8). Adjustment of methods based on the examination of a bigger sample (5-10 g) taken from sites of predilection (tongue, masseter or diaphragm) (3).

Trichinellosis may also be distributed to distant places by transmigration of infected wildlife animals. Primarily, the sylvatic cycle of trichinellosis occur when a larger number of infected animals migrates in an enclosed area. The presence of trichinellosis in a certain region is revealed after humans are infected. This type of transmission happened in the Danubian region of Slovakia covering the area of 5.593 km^2. In this region, similarly as in the neighbouring regions, trichinellosis was not found in the last 50 years. By serological examination of red foxes and wild boars during 1994-1996, we found the occurrence of seropositivity in both wild animals of the Danubian region. It is interesting because this region is separated from other regions of Slovakia with the occurrence of trichinellosis by continuous territory, 30-50 km wide, with no presence of seropositivity (6). This type of local occurrence of trichinellosis was surprising. When possible causes of this state were clarified, it became probable that trichinellosis could have been brought to the Danubian region by jackal *(Canis aureus)* migrating from Balkan (20, 31). Jackal was also observed in Austria (32) and other European countries (Slovenia, Italy).

Anti-Trichinella antibody was detected in red foxes and wild boars for the first time in 1994 in the Danubian region. In March 2001 trichinellosis occurred in a domestic pig in this region. A hunter reared the pig, thus there was a precondition for the infection by litter of hunted wild boars that were repeatedly processed by the hunter. Eleven people were infected consuming smoked sausages and ham.

Alveolar echinococcosis

On the contrary to sporadic transmission of trichinellosis, the transfer of echinococcosis by wildlife carnivores is the serious problem of Central-Europe countries in the last decade (12). The present spread of *Echinococcus multilocularis* in red foxes in this region has never been observed before. After a long period when this zoonosis has been endemic in four countries of Central Europe, namely Austria, France, Germany and Switzerland, it has spread to neighbouring countries (9). *E. multilocularis* was found in red foxes in the Czech Republic and Poland in 1995 (13, 15), in Slovakia in 1999 (7) but until 2000 it was recorded in as many as 30 districts.

Clearly, there is no doubt about transborder transmission of *E. multilocularis*. There are still other opinions saying that this tapeworm has always been endemic in Slovak Republic, Czech Republic

Table 1:
Parasitological examination of carnivores.

Locality	Number of species	Number of individuals	Authors
Bohemia and Moravia	9	93	26
Czechoslovakia	2	7	1
Czechoslovakia	17	1101	28
Slovakia	15	954	18
Total		**2155**	

Table 2:
Parasitological examination of micromammals.

Locality	Hosts	Number of Species	Number of individuals	Authors
Czechoslovakia	Rodents	28	4478	10
Czechoslovakia	Insectivores	10	1268	27
Slovakia	Rodents	1	552	17
Slovakia	Insectivores	2	477	18
Eastern Bohemia	Micromammals	8	3090	29
South Bohemia	Micromammals	17	3036	30
Total			**12 901**	

and Poland and its present occurrence in this territory is simply the consequence of new diagnostic methods. Cases of alveolar echinococcosis reported in literature support this opinion. Two cases of alveolar echinococcosis were diagnosed in Poland in 1955 and 1960, one case in the Czech Republic in 1979 and in Slovakia in 1989 (12). The diagnosis was not proved reliably in all cases what supports the view that probably *E. multilocularis* was not endemic in the territory of these countries prior to 1990.

There is a lot of former evidence of transborder transmission of echinococcosis in Central Europe. Spread of *E. multilocularis* from Germany and later from Austria to the territory of former Czechoslovakia was prevented by borderline wired fences. Removal of the fences in 1990 opened the region of Czech Republic for transborder migration of red foxes and transmission of the tapeworm. First cases in red foxes were recorded in south-western territory neighbouring the regions of Germany (5) with high prevalence of *E. multilocularis* (14).

Indirect evidence, that *E. multilocularis* is not endemic in the territory of former Czechoslovakia, comes from autopsy findings of carnivores and micromammals. Papers from 1958 to 1972 state autopsy findings of 2 155 wildlife carnivores, of which 467 were red foxes (Tab. 1). *E. multilocularis* was not found in any case.

From 1958 until 1970, 12 901 micromammals, mainly rodents, were helminthologically examined by autopsy (Tab. 2). In no case larval stages of Echinococcus were found in liver. Even papers published before the year 1990 do not state the finding of mature or larval stages of *Echinococcus multilocularis* in this territory.

To explain the cause of unusually extensive spread of *Echinococcus multilocularis* in Central Europe from the epidemiological point of view, we have to consider that the replacement of previous methods to limit the population of red foxes by oral vaccination against rabies led to an increase of the number of foxes and consecutive migration. Other ecological factors were also involved. Mainly, enlargement of uncultivated land leads towards the increase of micromammals populations. Extensive floods, affecting large areas of Europe, reduce numbers of hosts and intermediate hosts. These factors have increased the risk of contamination with *E. multilocularis* eggs (16) and could have been the cause of transborder transmission of this zoonosis as well as other parasitic and infectious diseases.

Summary The current spread of the agents of two helminthic zoonoses, trichinellosis and alveolar echinococcosis, poses hazard for infecting humans in Europe. Trichinellosis can be transmitted by meat, most frequently by horse meat, either to neighbouring or distant countries. The transmission, however, may be done by migrating wildlife animals to regions, where it has not occurred yet. There are other aspects which allow to spread of parasitozoonoses. The spread of *Echinococcus multilocularis* in red foxes in Central Europe is the latest example of transborder transmission of helminthozoonoses. It also applies to Czech Republic, Poland and Slovak Republic at the present. In 1999 *E. multilocularis* was first found in red foxes in some border districts of Slovak Republic. However, in the spring 2000 it was already found in 30 districts.

Key words Transmission, helminthic zoonoses, trichinellosis, alveolar echinococcosis.

Zusammenfassung

Risikofaktoren für die Transmission der Trichinellose und der alveolären Echinokokkose in Mitteleuropa

Anhand der Trichinellose und der alveolären Echinokokkose werden jene Risikofaktoren aufgezeigt, die eine Weiterverbreitung dieser Helminthozoonosen über Ländergrenzen hinweg ermöglichen. Dies ist in einem Fall trichinöses Pferdefleisch, das an Wildtiere (Rotfüchse, Wildschweine) verfüttert wird; im anderen Fall trägt die Tollwut-Vakzinierung der Füchse in Mitteleuropa dazu bei, das Eindringen von *Echinococcus multilocularis* auch in bislang fuchsbandwurmfreie Gebiete zu ermöglichen.

Schlüsselwörter Transmission, Helminthozoonosen, Trichinellose, alveoläre Echinokokkose

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References

1. BARUS, V. (1961):
A contribution to the helminthofauna of Canis lupus L. and Felis silvestris Schr. on the territory of USSR
Csl. parasitol. 8, 11-14.
2. BESSONOV, A. S. (1994):
Trichinellosis in the former USSR. Epidemic situation (1988-1992).
In: Campbell, W. C., Pozio, E., Bruschi, F. (Eds.). Trichinellosis. 505-510. Instituto Supe-riore di Sanità Press, Rome.
3. BOIREAU, P., VALLÉE, J., ROMAN, T., PERRET, C., LIU MINGYUAN, GAMBLE, H. R., GAJADHAR, A. (2000):
Trichinella in horses: a low frequency infection with high human risk.
Vet. Parasitol. 93, 309-320.
4. CAMPBELL, W. C. (1998):
Trichinellosis revisited, another look at modes of transmission.
Parasitol. Today 4, 83-86.
5. CADA, F., HUML, O. (1996):
Echinococcus multilocularis in red foxes from West-Czech area in 1996.
Veterinárství 46, 160-163.
6. DUBINSKY, P., SOKOL., J., DVOROCÁKOVÁ, E., STEFANCÍKOVÁ, A., REITEROVÁ, K., KINCEKOVÁ, J., SVRCEK, A., DUROVE, A. (1998):
Epidemiology of trichinellosis in Slovakia.
Slov. vet. cas. 23, 120-125.
7. DUBINSKY, P., SVOBODOVÁ, V., TURCEKOVÁ, _., LITERÁK, J., MARTINEK, K., REITEROVÁ, K., KOLÁROVÁ, L., KLIMES, J., MRLÍK, V. (1999):
Echinococcus multilocularis in Slovak Republic.
The first record in red foxes (Vulpes vulpes). Helminthologia 32, 105-110.
8. DUPOUY-CAMET, J. (2000):
Trichinellosis: a worldwide zoonosis.
Vet. Parasitol. 93, 191-200.
9. ECKERT, J., DEPLAZES, P. (1999):
Alveolar echinococcosis in humans: The current situation in Central Europe and the need for countermeasures.
Parasitol. Today, 15, 315-319.
10. ERHARDOVÁ, B. (1958):
Parasitic worms of rodents in Czechoslovakia.
Csl. parasitol. 5, 27-103.
11. European Economic Community (2000):
Commission Directive 77/96/EEC.
Off. J. Eur. Communities 26, 67-77.
12. KOLÁROVÁ, L. (1999):
Echinococcus multilocularis: New epidemiological insights in Central and Eastern Europe.
Helminthologia 36, 193-200.

13. KOLÁROVÁ, L., PAVLÁSEK, J., CHALUPSKY, J. (1996):
Echinococcus multilocularis Leucart, 1863 in the Czech Republic.
Helminthologia 33, 59-65.

14. LUCIUS, R., BILGER, B. (1995):
Echinococcus multilocularis in Germany: Increased awareness of spreading of a parasite?
Parasitol. Today 11, 430-434.

15. MALCZEWSKI, A., ROCKI, B., RAMISZ, A., ECKERT, J. (1995):
Echinococcus multilocularis (Cestoda), the causative agent of alveolar echinococcosis in humans: first record in Poland.
J. Parasitol. 83, 318-321.

16. MARTYNENKO, W. B., ROMANENKO, N. A., STARKOVA, T. V. (1996):
Epidemiological characteristic of echinococcosis in the settlement of the Yakut ASSR with regard to defferent water supply type.
Meditcins. Parasitol. Parazitar. Bolezni 3, 84-86.

17. MITUCH, J. (1960):
On the distribution of helminths at the Rattus norvegicus in Slovakia.
Helminthologia 2, 114-132.

18. MITUCH, J. (1964):
Contribution on the knowledge of the helminthofauna of the genus Neomys (Insectivora) in Slovakia.
Studia Helminthol. 1, 83-100 (In Slovak)

19. MITUCH, J. (1972):
The helminthofauna of carnivores on the territory of Slovakia and USSR.
Polov. zbor. (Folia Venatoria) 2, 161-172.

20. MOSANSKY, A. (1995):
Jackal (Canis aureus) in Slovakia.
In: Urban, P., Baláz, D. (Eds.): Vyskum a ochrana cicavcov na Slovensku, 107-108.

21. MURRELL, K. D., STRINGFELLOW, F., DAME, J. B., LEIBY, D. A., DUFFY, C., SCHAD, G. A. (1987):
Trichinella spiralis in a agricultural ecosystem. II. Evidence for natural transmission of Trichinella spiralis from domestic swine to wildlife.
J. Parasitol. 73-103-109.

22. OFFICE INTERNATIONAL DES EPIZOOTIES (1999):
World Animal Health 1998.
OIE, Paris.

23. POZIO, E. (1998):
Trichinellosis in the European Union: Epidemiology, ecology and economic impact.
Parasitol. Today 14, 35-38.

24. POZIO, E. (2000):
Factors affecting the flow among domestic, synantropic and sylvatic cycles of Trichinella.
Vet. Parasitol. 93, 241-262.

25. POZIO, E., LA ROSA, G., MURRELL, K. D., LICHTENFELS, J. R. (1992).
Taxonomic revision of the genus Trichinella.
J. Parasitol. 78, 654-659.

26. PROKOPIC, J. (1958):
Study on the helminthofauna of carnivores in Bohemia and Moravia.
Csl. parasitol. 5, 157-164.

27. PROKOPIC, J. (1959):
Parasitic worms of our insectivores.
Csl. parasitol. 6, 87-134. (In Czech).

28. PROKOPIC, J. (1965):
The helminthofauna of carnivores in Czechoslovakia.
Csl. parasitol. 12, 207-226.

29. PROKOPIC, J. (1970a):
Eine bionomisch-faunistische Auswertung der stationären Erforschung der Cestoden bei den Mikromammalien in der Umgebung von Novy Bydzov (Östböhmen).
Helminthologia 11, 195-200.

30. PROKOPIC, J. (1970b):
Eine bionomisch-faunistische Analyse der Ergebnisse der stationären Erforschung der Cestoden bei Mikromammalien in der Umgebung von Klec (Südböhmen).
Helminthologia 11, 201-206.

31. RAJSKY, D., NAGY, Z. (1998):
Some aspects of the occurrence of a jackal (Canis aureus) in Slovakia.
Slov. vet. cas. 23, 34-35.

32. ZEDROSSER, A. (1995):
Eine neue Tierart für Österreich: Der Goldschakal (Canis aureus).
Stapfia 37, zugleich Kataloge des OÖ. Landsmuseum N. F. 84, 237-242.

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