INCREASING INCIDENCE OF TICK-BORNE ENCEPHALITIS AND ITS IMPORTANCE IN THE SLOVAK REPUBLIC

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SUMMARY

Tick-borne encephalitis (TBE) is caused by tick-borne encephalitis virus (TBEV), a virus species of the genus *Flavivirus* within the *Flaviviridae* family. In Western Europe, TBEV is transmitted primarily by the *Ixodes ricinus* (*I. ricinus*) tick. During the last 30 years, there has been a continued increase in human cases of TBE in Europe. A total number of 102 cases in Slovakia was reported in 2012 (1.89/100,000), with two local outbreaks after the ingestion of raw milk and dairy products. Active vaccination is the most effective method of preventing TBE. According to the available data in Slovakia from 2012, 8,491 children under 15 years of age were vaccinated that year, which, when compared to 2009 with approximately 17,000 vaccinated children, represents a decrease of more than 50%. The data on vaccination of adults are not available, but the estimated vaccination coverage in Slovakia is around 1% (1.3/100,000). The education of the population is also an important precautionary measure in the prevention of tick-borne illnesses.

Key words: tick-borne encephalitis, Ixodes ricinus, occurrence, prevention

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INTRODUCTION

Tick-borne encephalitis (TBE), a potentially fatal neurological infection affecting humans in Europe and Asia, is caused by tick-borne encephalitis virus (TBEV) (1, 2).

Generally, the prevalence of zoonotic tick-borne illnesses is increasing and represents a growing public health concern. There are speculations that this is likely due to a complex combination of changes in the ecology, climate, increased human activity in affected areas, and improved detection of pathogens including higher awareness of primary health care providers (2, 3).

During the last 30 years, TBE has become an increasing health problem in Europe and other parts of the world. TBE is endemic in areas extending from Central and Eastern Europe to Siberia and parts of Asia. TBEV occurs in Central Europe, the Baltic and Scandinavian countries, and the Russian Federation (2).

To understand the above mentioned changes, it is necessary to know where TBEV occurs, where the vectors are a potential hazard, and where, as a consequence, autochthonous TBE cases have been registered.

The primary objective of this study is to provide an overview of local incidence of TBE in Slovakia during the period from 1992 to 2012. The authors also analyzed cases of TBE according to age, clinical forms of the disease and possible modes of transmission of infection. In the study, the authors discuss possible causes of the increase of TBE in Slovakia.

MATERIALS AND METHODS

The data were obtained from the Annual Reports for the years 2007–2012 available on the websites of the Public Health Authority (4) and from the Epidemiological Information System EPIS (5). Children population data about vaccination coverage are reported by primary health care paediatricians to the local Public Health Authority.

The comprehensive tables and graphs were created with the purpose to show changes in TBE frequency and incidence to demonstrate and confirm the most common mode of transmission of TBE disease, and also to confirm the most prevalent clinical forms of TBE and age differences in the occurrence of the disease between 2007 and 2012. Graphic complete outputs were created using summary contingency tables and graphs in the EXCEL programme.

RESULTS

A total number of 107 (1.98/100,000) human TBE cases in Slovakia was confirmed and reported in 2012 (as diagnosis A84 Tick-borne viral encephalitis in the IDC-10 classification).

The European subtype (A84.1 Central-European tick-borne encephalitis) was reported in 102 cases (1.89/100,000), which is a decrease of 6% compared to 2011 and an increase of 24% compared to the 5-year average values. Five cases (0.09/100,000) were reported as Unspecified tick-borne viral encephalitis (A84.9).

The incidence was reported separately for each region, with the highest values in Žilina (4.64) and Trenčín (4.54). The diseases occurred in each age group except for the infants. The highest age-specific morbidity was noted in the groups of 45–54 (2.40) and 55–64 years old subjects (2.39). The following clinical forms of diseases were reported: meningeal in 78 cases, febrile in 24 cases, neurological (disorders of balance, concentration, memory and speech, mood swings, fatigue, headache) in 4 cases, and intestinal in 1 case. The epidemiological history of patients reported: tick bite in 58 cases, indeterminate cause in 22 cases, ingestion in 18 cases, inoculation in 5 cases, and bites by other unknown insect in 3 cases. The majority of diseases occurred in June (n=34) and October (n=20). No case was reported in the previously vaccinated subjects. There was only one case of infection imported from the Czech Republic. Two outbreaks of TBE reported in 2012 were associated with raw goat milk and dairy products consumption. In the first case, it was an outbreak involving 12 infected people in Lučenec city district. In the second case, it was a family outbreak in Žilina city district, where 3 persons out of 4 family members were infected. TBE was serologically confirmed using the ELISA test with positive expression of IgM antibodies.

In 2011, a total number of 108 cases was reported. Only one death of a 45-year-old man was confirmed. He lived in Levoča district and performed community service work. The epidemiological history was obtained from relatives since he was comatose. There was no history of vaccination and there was no evidence of acquiring a tick bite. The consumption of sheep and goat milk was ruled out by relatives. The autopsy showed a bilateral lobular pneumonia associated with tick-borne encephalitis as the primary disease.

Furthermore, a total number of 91 cases (1.68/100,000) was reported in 2010, compared to 76 cases (1.40/100,000) in 2009, 79 cases (1.46/100,000) in 2008, and 57 cases (1.06/100,000) in 2007. Table 1 and Figure 1 summarize the total number of human TBE cases and the incidence from 1992 to 2012. In the study period, morbidity was highest in 2011 with 108 reported cases and lowest in 1992 with 16 cases. The surveillance of TBE in the other years showed the following results: 1993 n=51, 1994 n=60, 1995 n=89, 1996 n=101, 1997 n=76, 1998 n=54, 1999 n=63, 2000 n=92, 2001 n=75, 2002 n=62, 2003 n=74, 2004 n=70, 2005 n=50, 2006 n=91 (4, 5).

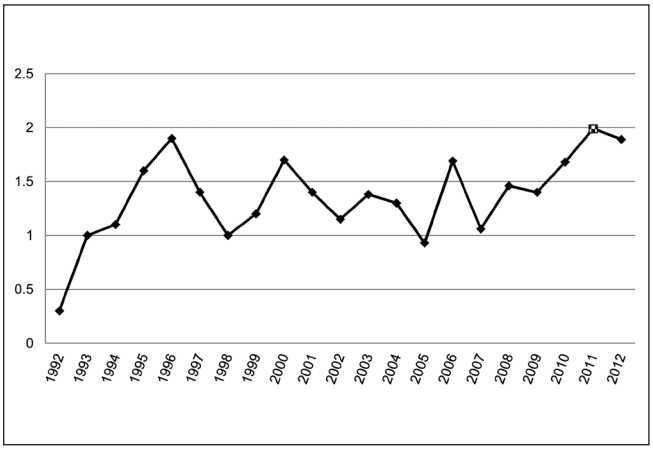

Fig. 1. *Time trends in the incidence of TBE in Slovakia from 1992 to 2012 (4, 5).*

Tables 2–4 and Figures 2–4 show TBE cases according to age, clinical form and the mode of transmission for the period 2007–2011 (for the year 2012, no accurate data were available – age, clinical form of the disease or the supposed mode of TBE infection transmission). The five-year reference period shows the highest incidence of TBE in the age group of 55–64 years (n=83). The most common mode of transmission was tick bite (n=241) and the most frequent was the meningeal form of disease (n=302) (4, 5).

DISCUSSION

The apparent increase in incidence of TBE in Central and Eastern Europe, especially since 1990, has been attributed to global warming or various socioeconomic factors. It has been shown that the climate change in Europe during the past decades has influenced the distribution of *I. ricinus* tick, which is the main TBEV vector in several European countries.

Table 1. *The number of human TBE cases and incidence in Slovakia from 1992 to 2012 (4, 5)*

1992	n	16	1999	n	63	2006	n	91
	inc.	0.30		inc.	1.20		inc.	1.69
1993	n	51	2000	n	92	2007	n	57
	inc.	1.00		inc.	1.70		inc.	1.06
1994	n	60	2001	n	75	2008	n	79
	inc.	1.10		inc.	1.40		inc.	1.46
1995	n	89	2002	n	62	2009	n	76
	inc.	1.60		inc.	1.15		inc.	1.40
1996	n	101	2003	n	74	2010	n	91
	inc.	1.90		inc.	1.38		inc.	1.68
1997	n	76	2004	n	70	2011	n	108
	inc.	1.40		inc.	1.30		inc.	1.99
1998	n	54	2005	n	50	2012	n	102
	inc.	1.00		inc.	0.93		inc.	1.89

Table 2. *The occurrence of TBE according to age from 2007 to 2011 (4, 5)*

Age	2007	2008	2009	2010	2011	Total
1–4	1	–	1	0	2	4
5–9	1	4	2	2	3	12
10–14	4	1	2	2	2	11
15–19	3	5	5	0	10	23
20–24	2	5	6	8	11	32
25–34	10	11	11	10	11	53
35–44	9	17	13	15	16	70
45–54	12	18	17	15	18	80
55–64	9	9	11	28	26	83
65+	6	9	8	11	9	43
Total	57	79	76	91	108	411

Table 3. *The number of clinical forms of TBE from 2007 to 2011 (4, 5)*

Clinical forms	2007	2008	2009	2010	2011	Total
Meningeal	37	63	56	70	76	302
Febrile	11	11	19	16	22	79
Neurological	7	4	1	4	9	25
Other	2	1	–	1	1	5
Total	57	79	76	91	108	411

Table 4. *The occurrence of TBE according to anamnesis from 2007 to 2011 (4, 5)*

Mode of transmission	2007	2008	2009	2010	2011	Total
Tick bite	34	38	48	49	72	241
Ingestion	4	8	5	6	4	27
Tick bite + ingestion	1	–	1	–	–	2
Insect bite	–	3	1	3	4	11
Inoculation	–	–	–	3	1	4
Other	3	12	4	1	1	21
Unknown	15	18	17	29	26	105
Total	57	79	76	91	108	411

Between 1961 and 1979, the mean altitude of tick survival in the Slovak Republic varied between 180 m and 340 m above sea level. However, during the following period of 1980–2004, the highest location of vector's occurrence observed for several years in a row was 832 m (6).

In the Czech Republic, recent reports suggest that the altitude distribution limits of both *I. ricinus* and TBEV have changed from 700 m to about 1,200 m above sea level (7).

It has been reported that ticks (*I. ricinus*) and TBEV spread north in Sweden, Norway, and Finland. The geographical distribution range of *I. ricinus* used to be located below 61°N, but ticks are now established along the whole Baltic Sea coastline (up to 66°N) (3).

Factors that help tick populations thrive are non-extreme temperatures, high humidity and the presence of snow cover during the winter, which acts as insulation. The last decades' increased mean annual temperature may have provided more favourable conditions for ticks. Early springs with rapidly increasing temperatures as well as not too hot or dry summers may have been important positive factors for tick survival and reproduction success (8, 9).

Apart from changing climate conditions, social, political, ecological, economic, and demographic factors appear to play a role in aiding the spread of tick-borne diseases. These include changes in land usage (such as increased forestation or newly created gardens) and the growing popularity of outdoor pursuits such as hill-walking and fishing. In particular, socioeconomic conditions have an impact on the incidence of TBE, e.g., poor people (unemployed or dislodged due to political upheaval) are less likely to be vaccinated against TBEV and tend to look for food such as wild fruit and mushrooms in the forest, thus increasing the risk of a tick bite (1).

According to the results presented here, the highest TBE incidence was in the age group of 55–64 years old. The shift of the

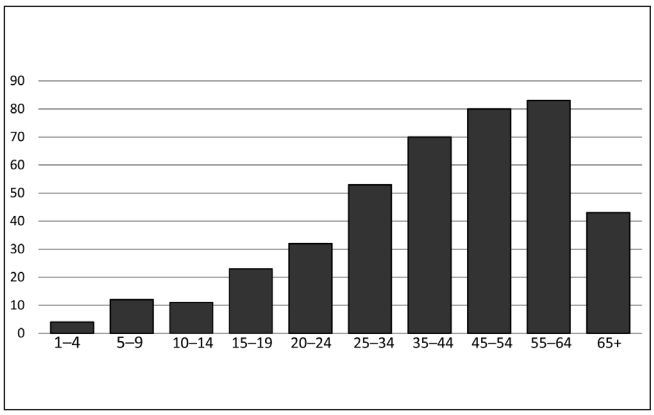

Fig. 2. *The occurrence of TBE according to age from 2007 to 2011 (4, 5).*

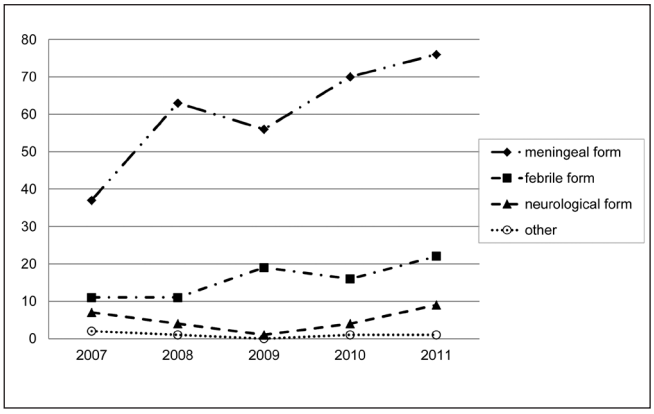

Fig. 3. *Time trends in the number of clinical forms of TBE from 2007 to 2011 (4, 5).*

disease to older age group is caused primarily by the change of lifestyle of older people – spending more time outdoors during their recreational activities (10).

According to anamnestic data, the disease occurred most often after a tick bite and after consuming unpasteurized milk from infected animals. Large domestic animals such as goats, sheep and cattle are potential hosts of *I. ricinus*. In terms of foodborne disease, the highest risk is associated mainly with sheep and goats (2), but there also have been cases related to drinking of cow's milk (11, 12).

Active vaccination is the most effective method of TBE prevention. Modern vaccines are safe and their effectiveness ranges from 95% to 99% (12, 13).

In Slovakia, a total number of 8,491 children under 15 years of age were vaccinated in 2012, according to data from the Public Health Authority of the Slovak Republic. Single dose of vaccine was administered in 1,276 cases, two doses in 2,137 cases, three doses in 2,715 and revaccination in 2,363 cases. The reported results show (Table 5, Figure 5) a decrease of more than 50% in vaccination compared to the year 2009 (n = 17,093) (4).

TBE immunization data of adults are not available, but the estimated vaccination coverage in Slovakia is 1% (1.3/100,000). The outputs on the percentage of TBE vaccination coverage of the Slovak adult population were obtained annually from the distributors and pharmacies or from health insurance companies. The highest vaccination coverage (88%) is in Austria (14, 15).

The decrease of TBE vaccination can be partially associated with the general upsurge of activities against vaccination. This may result in refusals of the vaccination by parents. Another aspect of the immunization process of TBE in Slovakia is the Decree No. 585/2008 Coll. of the Ministry of Health of the Slovak Republic,

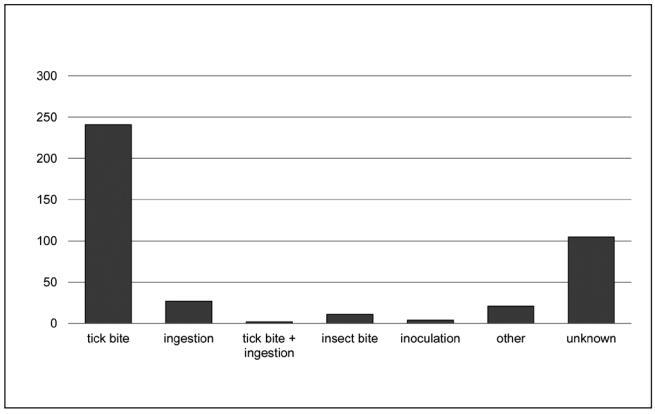

Fig. 4. *Total occurrence of TBE according to anamnesis from 2007 to 2011 (4, 5).*

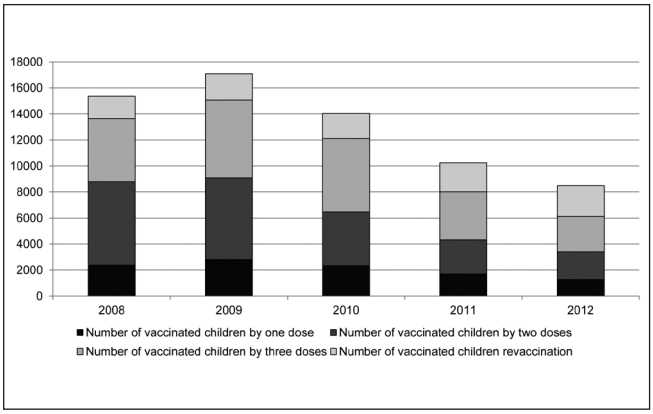

Fig. 5. *Number of TBE vaccinated children under 15 years from 2008 to 2012 (4).*

Table 5. *Number of TBE vaccinated children under 15 years from 2008 to 2012 (4)*

Year	Number of vaccinated children				
	total	one dose	two doses	three doses	revaccination
2008	15,364	2,387	6,401	4,855	1,728
2009	17,093	2,804	6,277	5,986	2,026
2010	14,025	2,330	4,133	5,654	1,916
2011	10,242	1,695	2,628	3,679	2,240
2012	8,491	1,276	2,137	2,715	2,363

which defines details on prevention and control of communicable diseases. This regulation recommends the vaccination only for the occupationally exposed persons (i.e. forest workers, agricultural workers, borderline police officers, soldiers, army forces, selected laboratory workers, etc.) but does not make it compulsory for this groups of population (16).

The low interest in vaccination is probably caused by poor economic situation as well. The vaccine is not fully reimbursed by health insurance system. The insurance companies reimburse only 50% of the total price of vaccine (17–18).

CONCLUSION

TBE with its severe symptoms, possible late effects of the disease and risk for chronic disability is of growing concern to public health authorities in Europe. High incidence and new foci have appeared in the last decades. Molecular methods, particularly PCR (polymerase chain reaction) have also brought huge changes in tick-borne disease research and detection. The incidence of tick-borne encephalitis in Slovakia in the period 2007–2012 showed an increase or fluctuation with the highest incidence point in 2011. New directions and standards approved by the European Commission (19) avoid previous problems with standard case definition and varying diagnostic procedures. These recommendations also prevent differences in the intensity and quality of national surveillance of TBE cases. Newly adopted directives exclude biases in the system of notification and reporting schemes and unify registry data for TBE disease in EU countries.

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