

Experience of GIS Technology Application in the Surveillance of Tick-Borne Infections

Iryna Ben^{*1}, Igor Lozynskyi¹ and Oksana Semenyshyn²

¹Laboratory of Transmissible Virus Infections, State Institution Lviv Research Institute of Epidemiology and Hygiene of the Ministry of Health of Ukraine, Lviv, Ukraine; ²SI "Lviv regional laboratory center of the Ministry of Healthcare of Ukraine", Lviv, Ukraine

Objective

The main aim of this work is to estimate the projected risks based on the incidence rate of natural foci infections and to expand the list of criteria for the characterization of natural foci of tick-borne infections.

Introduction

The epidemiological situation of natural foci of tick-borne infections (TBI) in Ukraine, as well as globally, is characterized by significant activation of processes due to global climate change, growing human-induced factors and shortcomings in the organization and running of epidemiological surveillance [1]. For the Western region of Ukraine, among all tick-borne zoonoses the most important are tick-borne viral encephalitis (TBVE), Lyme disease (LD), human granulocytic anaplasmosis (HGA) among others [2-4]. Taking into account the increased incidence rate for these infections, we have developed baseline criteria (indicators of natural contamination of the main carriers and levels of the serum layer among the population in relation to the TBI pathogens in the endemic areas) to identify areas with different risk of contamination through GIS-technologies [5].

Methods

Epi Info 7.1.1.14 software was used to analyze patient questionnaires with tick-borne infections (TBI) for 2010-2015. Prevalence maps of vector-borne infections were created by means of GIS technology using the QGIS 2.0.1. software to assess the risks of infection. Maps demonstrating the distribution of TBVE, LD and HGA were also developed based on contamination risk assessment criteria.

Results

Retrospective epidemiological analysis of incidence rates for TBVE, LD and HGA was conducted based on laboratory tests that were performed in the laboratory of vector-borne viral infections of the State Institution Lviv Research Institute of Epidemiology and Hygiene of the Ministry of Health of Ukraine. A direct correlation between the infection of *I. ricinus*, *B. burgdorferi* and LB ($P < 0.05$) and infections of *I. ricinus* ticks, anaplasma and incidence of HGA ($P < 0.05$) was established. However, this connection has not been confirmed for indicators with TBE.

Data was obtained during the assessment of possible risks of tick-borne infections. For TBVE, the indicator of predicted risks based on the basic criteria was 60.3%, taking into account the cases of the disease. This was based on indicators of natural infection of the main carriers and the level of the serum layer among the population on the TBI activators in the endemic areas. The data obtained can be explained by the low level of morbidity and the detection of TBVE cases. The predicted risk for LD according to these criteria is 88.9%, due to the high level of clinical and laboratory diagnosis.

As for the HGA, the predicted risk indicator reaches 66.7% due to the fact that the study of human anaplasmosis in Ukraine is at the initial level (the incidence rate and incidence are not included in the official reporting system).

Taking into account the results obtained, it is advisable to supplement the list of criteria for determining the degree of activity

of natural foci of tick-borne infections and the identification of areas with high risk of morbidity. These calculations were made by grouping statistical data (indicators) [5]. The reliability of the difference between the same indicators for individual zones was 95% (Table 1).

Conclusions

Tick-borne zoonoses are a serious problem for the public health system of the Western region of Ukraine. Extending the list of criteria for the characterization of natural foci of tick-borne infections will improve epidemiological surveillance and focus on key measures in high and medium-risk areas for the rational use of funds.

Parameters and criterias for epidemic risk areas ($p < 0,05$)

Epidemic risk areas			
Parameters	High	Moderate	Low
Regarding TBVE			
Natural tick infection rate (%)	>2,6	from 1,7 to 2,6	<1,7
Serological interlayer rate in healthy population (%)	>8,6	from 6,2 to 8,6	<6,2
Morbidity	>9	from 5 to 9	<5
Regarding LD			
Natural tick infection rate (%)	>14,0	from 5,5 to 14,0	<5,5
Serological interlayer rate in healthy population (%)	>34,2	from 22,1 to 34,2	<22,1
Morbidity	>50	from 10 to 50	<10
Regarding HGA			
Natural tick infection rate (%)	>3,3	from 2,1 to 3,3	<2,1
Serological interlayer rate in healthy population (%)	>13	from 7,7 to 13	<7,7
Morbidity	> 10	from 6 to 10	<6

Keywords

tick-borne viral encephalitis; Lyme borreliosis; human granulocytic anaplasmosis; risk zone; western region of Ukraine

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*Iryna Ben

E-mail: Iryna_Ben@ukr.net

