Epizootic features of the rabies manifestation in the Krasnodar region and the improvement of the combat measures

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Abstract. Rabies is one of the top ten deadly human infections. It is found in more than 150 countries. Rabies is malignant progressive encephalitis that affects all mammalian animals due to its ubiquity and high lethality. It is still a widespread threat. The epizootic situation for rabies is unfavourable in most countries of the world, with the exception of some island states, as well as some countries in Western Europe. Despite the significant progress in improving the effectiveness of epizootic monitoring, introducing specific prevention tools into widespread veterinary and medical practice, as well as improving diagnostic tools, developing countries in Asia and Africa are considered to be disadvantaged territories. The Russian Federation and most of the countries that have a land border with the Russian Federation are endemic for rabies. At the same time, the fight against rabic infection can be successful with a scientific systematic integrated approach that takes into account all the issues of regional epizotology with the study of the found isolates distributed in certain areas that are included in natural foci of rabies. The basis of the antiepzootic measures for rabic infection are climatogeographic factors that can be used in the conditions of the Krasnodar territory.

1 Introduction

Rabic infection is registered on 5 continents. The greater number of rabic infections of the established in the world is represented classically. This nosological unit is absent in New Zealand, Japan, Antarctica, Australia, and Hawaii (Clark. H. F., 1980). The disease in tropical countries is widespread among wild, agricultural and domestic animals. More than 55 thousand people and 1 million animals die every year (Cherkassky B. L., 2005). The most part is registered in the states of Africa and Asia where mostly the urban form of rabies infection is established. Every year, more than 15 million people on the globe receive rabies aid for medical and preventive purposes. The annual global economic damage is caused by the expenses of anti-epizootic and anti-epidemic measures, the deaths of both

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people and animals, and comes to more than 1 billion dollars (Botvinkina.D., 2006). Every year, there is hydrophobia and very high animal incidence in Russia. From year to year, the appeal for rabies help increases. (Onishchenko G. G. et al., 2017; Lozovoy D. A. et al., 2017). Cases of animal rabies infection are registered in all the federal regions of Russia (Vedernikov V. A. et al., 2002, Onishchenko et al., 2017). However, according to a number of authors (K. N. Gruzdev et al., 2001; hismatullina N. A. et al., 2011, Chernov A. N., 2014, etc.), the fight against rabies infection can be successful. It takes a scientific system-integrated approach that takes into account all the issues of regional epizootology with the study of the found isolates distributed in certain areas that are included in natural foci of rabies.

We have made an attempt to study the regional features of epizootic process manifestation of rabies infection in the Krasnodar territory and to have a look at the control measures in the region.

2 Materials and Methods

The "Sheep" strain of VB GNKI and street CVS were used in laboratory and scientific-experimental studies, as well as epizootic (field) isolates of VB taken from pathological material. The studies were conducted on 120 weighing 6-7 Gy white mice and 12 rats.

The following devices and equipment were used during the research: scanning spectrophotometer "Titertekmultiskan" (Switzerland); spectrophotometer SF-16; biological safety boxes for working with PBA 1-2 group pathogenicity, laboratory centrifuges; luminescent microscope LUMAM-I2, pharmaceutical refrigerator; freezer; pH meter; analytical scales, pipettes 8-12 channel automatic "Flowlaboratories", microtitrators of the "Takachi" system, thermostats, water bath, etc.

To formulate the reactions, we used the methods presented in the International standard "Methods of laboratory diagnostics of rabies", in particular: a bioassay; ELISA; MFA; method of isolation of the rabies virus in cell culture; RDP – diffuse precipitation reaction. We also used "Recommendations on the methodology of epizootological research", Bakulov I. A. (1975) while we were studying the epizootic process of the rabies infection on the territory of the Krasnodar region (epizootic chain, distribution, seasons and seasonality of manifestation, relative species incidence, epizootological timing, territorial mapping, evaluation and analysis of evaluation of preventive anti-rabic measures, etc.) The obtained experimental data was processed using the Microsoft Excel 2016 application program. During the laboratory and scientific-experimental studies the number of repetitions was at least three that provided reliable results.

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3 Results and discussion

Our analysis showed that over the period of 2010-2019, rabies was registered in 13 animal species in the Krasnodar territory. The obtained data shows that animal rabies disease is registered annually. 84 cases of animal rabies infection were registered in the Krasnodar territory in 2010-2019. A retrospective analysis of 2 five-year periods-2010-2014 and 2015-2019- showed a 2.1-fold decrease in the incidence of rabies in animals, and the number of cases of the rabies infection decreased 2.2 times in dogs. There was observed the next variability in animals: cats - 2, cattle - 6, foxes 2,6. The epizootic process of the rabies infection in the region for the period 2010-2019 is presented below (Fig.1).

Fig. 1. Number of cases of rabies infection in animals in the Krasnodar region for the period 2010-2019.

Fig. 1 shows that the incidence of the rabies infection in animals in the Krasnodar region is characterized by a 3-5-year periodicity. The analysis of the ten-year period showed that the maximum number of cases was registered in 2013, and the minimum number in 2017 and 2019.

A pattern of rabies infection on the territory of the Krasnodar region has been identified. It is characterized by a general sharp rise in the incidence of all types of animals: domestic, agricultural and wild, as well as for particular species. The increase in the incidence of dogs, cats and foxes is observed in productive animals. From the general picture of the incidence of the rabic infection in the Krasnodar territory in relation to the registered cases

of the disease is clear that 2013 was the year of the rise in the incidence of wild animals with rabies. Growth in other warm-blooded animals is observed also. The growth of aggression in foxes is identical to the rise of epizootic among dogs and cats. Along with natural rabies, rabies infection in the Krasnodar region manifests itself in the urban form. Cases of the disease are registered in dogs and cats.

According to the results of the research, it was established that the rabies infection in animals in the Krasnodar territory has a 3-5-year periodicity. For 10 years, the minimum number of cases was established in 2017 and 2019, the biggest number of cases of rabies was established in 2013. The incidence of the rabies infection in wild animals has been on the rise for years, particularly in foxes it was in 2013, with the increase in the incidence of other animal species. This rise in the rabies infection in the Krasnodar region coincided with the growth of the disease among dogs and cats. Along with natural rabies, the rabies infection manifests itself in the urban form. Cases of the disease are registered in dogs and cats. As a source of the rabies infection on the territory of the region foxes prevail. But don't underestimate cats and dogs. The following species are highly likely to be carrying it: raccoons, martens, muskrats, raccoon dogs, ferrets, and jackals. Rabies virus antigen was detected in these species. Productive animals (large and small cattle) are the dead end of the rabies infection and act as the indicator of the epizootic process in the rabies infection. Domestic animals (dogs and cats) support the epizootic process on the territory of the Krasnodar region and along with wild carnivores (foxes) transmit the pathogen of the rabies infection to other types of animals being bitten or during slobbering. All types of warm-blooded animals are susceptible to rabies in the Krasnodar region.

Rabies in animals in the Krasnodar territory is registered monthly. For the period from 2010 to 2019 rabies in animals was registered in 84 cases. During this period, the rabies infection was detected in animals of 13 species. The rabies infection was diagnosed: in cats-24, dogs-25, foxes-13 and cattle-2. In indicators of the rabies infection: cattle – 7, goats-2.

It is established that the main reservoir in the Krasnodar territory, the carriers and the transporters of the rabies infection are dogs, cats and foxes, the share of which is 78.6% of the total number of animals infected with the rabies infection. Of the total number of registered cases, 15.5% are foxes, which indicates the natural foci of the disease, along with its manifestation in the urban form.

The rabies infection during the seasons manifests its activity in the Krasnodar territory in different seasons of the year due to the biological cycle in wild carnivores. By season, the relative number of cases of the rabies infection in animals prevails in spring-31%, in winter-23.8, in summer-23.8%. The fall counts 21.4% (Fig.2).

There was established the seasonality of the rabies infection on the territory of the Krasnodar region. According to the seasons, the relative number of cases of the rabies infection in animals prevails in the spring – 31%. While autumn – 21%. In winter and summer - 23.8%, respectively. The seasonality of the rabies infection is due to the biology of animal carriers of the pathogen. Knowing the seasonality of rabies in animals is an important element of anti-rabies measures.

The distribution of the incidence of the rabies infection in animals in the Krasnodar region for the period from 2010 to 2019 showed that the disease was diagnosed in 13 species of animals. Dogs had the largest number-25 cases, cats-24, foxes-13, cattle-7, rats-2, goats-2 (Fig. 3).

The relative specific incidence of different animal species in rabic infection has been established. The main reservoir in the Krasnodar territory and the carriers of the rabies virus are wild and domestic predators (dogs, cats, foxes), the relative share of which is 78.6% of the total number of the animals with the rabies infection during the studied period. 15.5% of the total number of the registered cases are foxes. It indicates the natural foci of the disease, along with the manifestation of the disease in the urban form. Knowledge of the specific

incidence of rabies in animals is an important aspect in the development and the implementation of a set of anti-epizootic measures.

Fig. 2. Seasons and rabies infection in the Krasnodar territory for the period 2010-2019.

Fig. 3. Relative specific incidence of rabic infection in animals of different types, for the period 2010-2019.

Territorial timing of the occurrence of rabies in the municipalities of the Krasnodar territory was carried out according to the degree of the intensity of the epizootic process. For the period of 2010-2019 the animal rabies was registered in 22 of the 37 municipal districts of the Krasnodar territory and in 3 cities out of 7. The analysis of the relative number of the animal rabies cases per a 1000 km² showed that the maximum number of 4.1 or more cases of rabies per 1000 km² was in a number of municipal districts during the studied period. Similarly we divided the districts into 3 conditional groups where the first

group of municipal districts of rabies cases is not established (conditionally safe territory), the 2nd group (low risk of rabies), where the relative number of cases of animal rabies from 0.1 to 2 per 1000 km², and the 3rd group from 2.1 to 4 (average risk of rabies). Based on the obtained data, the map of the territorial occurrence of rabies in the municipal districts of the Krasnodar territory has been developed, which is an important tool in the development and the implementation of a set of the anti-epizootic measures.

Studies of rodents – common voles, captured in three municipal districts of the Krasnodar territory, were conducted in order to study their possibility of being the carrier of the rabies virus and the presence of a tetracycline mark indicating the eating of an oral vaccine. As a result of the conducted research, the pathological material taken from 48 captured common voles by MFA and ELISA methods of the rabies virus antigen was not detected. There were no deposits of tetracycline in the bone tissue which indicates that mouse-like rodents ate the oral vaccine. Thus, the circulation of the rabies virus among mouse-like rodents is not established.

Vaccination in the Krasnodar territory is carried out annually and the number of the vaccinated animals is growing from year to year. But in some cases oral vaccination of wild fauna is not carried out in municipal areas. Monitoring the effectiveness of specific prevention is essential conducting a set of antiepidemiological measures.

We conducted a study of 8 samples of pathological material from wild carnivores (foxes) after using the Rabistav vaccine. The studies of the pathological material (blood serum) were carried out in accordance with the current instructions for using the ELISA method for the laboratory diagnostics of the rabies infection of a set of drugs.

The presence of tetracycline-type antibiotics is found in all the received branches of the lower jaw which confirms that the anti-rabies vaccine can be eaten. The titers of the specific antibodies in the examined samples of photomaterial (blood and aqueous chambers of the eye) are in the range of 1:200-1:1,600 IFPRI K2,1. It is found out that the fired foxes received the rabies vaccine that induced the production of the specific antibodies to the rabies virus in the credits level sufficient to protect animals from the rabies infection.

We conducted researches of the effectiveness of the anti-rabies vaccination in cattle on the territory of the Krasnodar territory. We used the anti-rabies inactivated liquid culture vaccine (Rabikov), the developer of the FCP "Shchelkovsky biocombinat". The control and evaluation was carried out in 20 days, 2, 3, 6 and 12 months. Titers in the blood serum of cattle specific anti-rabies antibodies were detected in the following indicator: 1: 2560 (CPR=2.1 or more). The maximum level was up to 1:20480. This indicator corresponds to the activity of 1-20 IU / ml or more, after 20 days, 2, 3, 6 and 12 months.

To control and evaluate the effectiveness of the rabies vaccination in domestic animals for testing for the presence of anti-rabies antibodies by ELISA, the blood of 12 dogs was studied before and in 21 days after the vaccination with the Rabikan anti-rabies vaccine. The inactivated Rabikan vaccine provides protection against rabies and the titer of the anti-rabies virus neutralizing antibodies ranges from 1:200 to 1:800.

In order to determine the pathogenicity of the field (epizootic) isolates of the rabies virus circulating in the Krasnodar region, the laboratory animals – rats and white mice - were experimentally subjected to the intracerebral infection. The field isolates of the bacterial infection circulating in the Krasnodar region are pathogenic and lead to a fatal outcome. Their average incubation period varies from 14 to 27 days, and the index of invasiveness is from 1.2 to 2.3, which indicates a different degree of pathogenicity of circulating epizootic isolates of a specific virus, the circulation of weakly and strongly pathogenic epizootic (field) isolates.

The field isolates of the biological infection isolated in the Krasnodar region actively interacted in serological reactions with blood serum obtained for the "Sheep" strain of GNKI (vaccine strain), which indicates their antigenic relationship.

4 Conclusion

Thus, considering problems of the municipal districts of the Krasnodar region for the rabies infection, the research will be continued. On the basis of studying the peculiarities of the epizootic process, we have proposed and introduced measures in "The comprehensive plan of preventive measures against rabies infection". These measures were approved by the veterinary Department of Krasnodar region and include the assessment of risk of spread and resistance to all the factors affecting the epidemic in the region.

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