ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Epizootological Monitoring and Control Measures against Rabies in Moscow Region

Vladimir A. Astrakhantsev[1], Albert N. Chernov[1]*, Antonina G. Mukhamedzhanova[1], Sergey B. Voskresensky[2], Marina A. Efimova[1], Sergey Yu. Smolentsev[3], Damir N. Latfullin[1]

[1]*laboratory of bacterial infections, Federal center for toxicological, radiation and biological safety, Scientific town-2, Kazan city, 420075, Russia*

[2]*Veterinary Service of the Ministry of Agriculture and Food of the Moscow Region, st. Sadovaya-Triumfalnaya, 10/13, Moscow city, 127006, Russia*

[3]*Agrarian Institute of technology, Mari State University, Lenin Square 1, Yoshkar-Ola city, 424000, Russia*

Abstract.

Currently, it is important to conduct a comprehensive epizootological analysis of the territorial spreading of rabies and develop a system of preventive and antiepizootic measures. The reason why such a research is important is the worsening of the epizootic situation of rabies in the Russian Federation and all over the world. This article presents the results of the epidemiological monitoring of rabies in the Moscow Region during the period of 2014–2018, assessing the risk of infection spreading and developing algorithms for preventive measures of regional importance. Ranking of the territories of the Moscow region by the degree of epizootic intensity was completed. The results were analyzed by using the methods of comparative geographical description and mapping. The obtained information on the zoning of territories unfavorable for rabies will further determine the order of complex measures for the elimination of rabies.

Key words: Moscow region, rabies, epizootological monitoring

Introduction.

Rabies is an acute zooanthroponotic disease with signs of progressive viral encephalitis, which is clinically characterized by a disease of the central nervous system and mainly ending in death [1, 2, 5]. According to the WHO, rabies is a vaccine-preventable disease that occurs in more than 150 countries and it is one of the five zoonoses that cause the greatest economic damage, being a significant threat to human and animal life [3, 4, 10]. Lethal cases of human deaths are annually recorded, high rates of morbidity among animals and a high rate of appeal for the rabies infection of people at risk of infection with a rabic infection should be studied [6, 7, 8, 9]. Cases of rabies among animals are recorded in all federal districts of the Russian Federation [2]. At the same time, a number of regions of Russia remain safe for rabies, in particular, St. Petersburg and the Leningrad Region, in which the last case with animal rabies was revealed in 1988.

There is evidence that scientifically proved anti-epizootic and anti-epidemiological measures should be based on the features of the regional epizootology of this zoo anthroponosis. These measures should account for climatic, meteorological and environmental factors, as well as the timely detection of the rabies pathogen and the study of its biological properties. The effectiveness of preventive measures is largely determined by the characteristics of epizootic manifestations of rabies in a particular region.

Thus, the purpose of this research was to study the epidemiological and epizootic manifestation of a rabies infection in the Moscow region in 2014–2018 and the algorithm development of antiepizootic measures.

Material and Methods.

The research shows the statistical analysis of the rabies spread and outbreaks and the effectiveness of anti-epizootic measures in the Moscow Region for 2014–2018. It is based on analyzing and processing the archives and data of the Veterinary Service of the Ministry of Agriculture and Food of the Moscow Region. Indication of the rabies virus antigen in samples of pathological material was performed using diagnostic kits — Fluorescent Anti-Rabies Globulin (FAG) (FGBNU VNITIBP, Moscow Region), Set for Laboratory Diagnostics of Rabies in Animals Using Immunoassay Analysis (IFA), (FGBR FTCR -VNIVI, Kazan) with confirmation of the bioassay on white mice according to GOST 26075-2013.

The characteristics of the territorial location of rabies outbreaks and mapping of unfavorable areas (urban districts) were carried out by dividing the districts of the Moscow Region into 4 conditional groups. The region was ranked according to the number of cases of rabies per 100 km^2.

The intensity of the epizootic situation (intensity of manifestation) was calculated by the formula:

$W = n/N*t/T$

W – the tension coefficient of the epizootic situation;

n – the number of unfavorable points for a certain period in the area;

N – the total number of settlements in the area;

t – the number of time periods during which the disease was recorded (days, months, years);

T – observation time (days, months, years).

The epizootic index was calculated by the formula:

$EI = t/T$

t – the number of days (months, years) during which rabies was recorded (3-5 years or more);

T – the number of days (months, years) of observation.

The charts, graphs and tables presented in this paper are compiled based on the methods of geographical description and epizootic analysis of rabies in the Moscow region. The zoning of the Moscow Region according to the intensity of the epizootic situation of rabies infection was accomplished by the method of mapping. A graphical analysis of the epizootic process of the rabies infection in the Moscow Region was performed using the computer program Microsoft Excel (2016).

Results and Discussion

Studying the Dynamics of the Epizootic Process.

The retrospective analysis of the dynamics of the rabies incidence among animals (based on the data presented by the Office of the Federal Service for Veterinary and Phytosanitary Surveillance in the city of Moscow, Moscow and Tula regions) showed that one of the largest epidemics of rabies in the Moscow region broke out in 1952 (1225 animal rabies cases). In order to eliminate this epizootic, a total shooting of stray dogs, cats, foxes was conducted with the involvement of the army and the police. By analogy with the positive European experience, this strategy led to a positive result: no cases of animal rabies were recorded in the region over the next 25 years. The first single cases of rabies infection in the Moscow region began to re-register since 1976, mainly in the south of the region. Since 1987, the disease has regained zoo-anthroponosis status. Over the next 20 years, the number of cases did not exceed 30 per year. With the increase in the population of stray dogs in the mid-90s a significant negative trend was identified: the number of infected animals increased by 10% annually. In 2012–2013 the number of infected animals approached 300. The analysis of natural and geographical conditions indicates the formation and maintenance of epizootic rabies infection of urban and natural types in this area. The increase in the number of homeless dogs, cats and wild carnivores contributes to the exacerbation of the epizootic and epidemic manifestations of the rabies infection in the Moscow Region.

A retrospective analysis of morbidity cases showed that the territory of the Moscow region was unfavorable for rabies infection during the entire study period and over the past 26 years showed a gradual steady increase in the incidence of animal rabies with a decline in epizootic tensions in some years. Figure shows the dynamics of the epizootic process for a specified time period.

The cyclicality of rabies infection on the territory of the Moscow Region is characteristic of a 4-year period, but there is no strict periodicity in the manifestation of rabies infection. The manifestation of epizootic upsurges is due to the increased density of migratory wild ill animals, which become sources of increased danger among domestic animals and people. The maximum number of infected animals is recorded in autumn that happens as a result of an increase in population density due to juveniles and it coincides with the rutting period of foxes. During the study period, the maximum manifestation of rabies was noted in the autumn period - 27.23%, in the spring period the incidence was 27.05%; the minimum incidence was recorded in the summer season - 22.41%. The dynamics of seasonal manifestations of rabies in the Moscow region is presented in Table 1.

The maximum number of foxes, as well as raccoon dogs, per 1000 hectares of hunting grounds is up to 1 individual which is noted in the standards for the number of hunting resources in hunting areas, established by Order No. 138 of the RF Ministry of Natural Resources "On Approval of Standards for Allowable Withdrawal of Hunting Resources and Standards for the Number of Hunting Resources in Hunting Areas" (30.04.2010).

The total area of the Moscow Region hunting grounds is 2604.8 thousand hectares. This makes up 72% of all hunting areas of the Moscow Region. As the total forest area of the Moscow Region is 1941 thousand hectares, the number of foxes should be less than 3 thousand individuals.

According to the latest data of the Moscow Society of Hunters and Fishermen, the number of foxes in the Moscow region is 4867, while the population density is 1.87 individuals per 1000 hectares, which is 2.4 times more than the standard figure. The maximum number of foxes was recorded in 2005 and amounted to 5782 individuals, the minimum - 4004 individuals in 2018.

Zoning Unfavorable Areas.

As a result of the mapping, the unfavorable territories of the Moscow Region were divided into 4 groups. Selected epizootic areas of I, II, III, IV groups are characterized by a corresponding risk of infection in humans and animals.

The analysis of the areas with high spreading rabies risk allows y to specify the scale and timing of preventive vaccination of animals, keep records of stray dogs and regulate the number of wild carnivores. It is impossible not to take into account the risk of infection being carried out from adjacent territories bordering the Moscow region (Tver, Yaroslavl, Vladimir, Ryazan, Tula, Kaluga and Smolensk regions).

On the basis of the data obtained (Table 2), the intensity indicators ranged from 0.02 to 0.08 (low); from 0.1 to 0.24 (medium); from 0.26 to 0.40 (high); from 1.2 to 2.80 (the highest). Along with the increase in the incidence of rabies in wild and domestic animals in some areas, the situation is aggravated by the high number of neglected dogs and cats in the settlements and the lack of permanent teams for catching them, including those with rabies. In this regard, the appealability of the population for anti-rabies help remains high. In the Moscow Region, a purified culture concentrated vaccine is commonly used to vaccinate people. Sources of infection were mainly foxes (38.8%), raccoon dogs (22.5%) and neglected dogs (16.6%). All human deaths from hydrophobia are confirmed laboratory in the Center for Special Laboratory Diagnostics and Treatment of Especially Dangerous and Exotic Infectious Diseases of the RF Ministry of Defense.

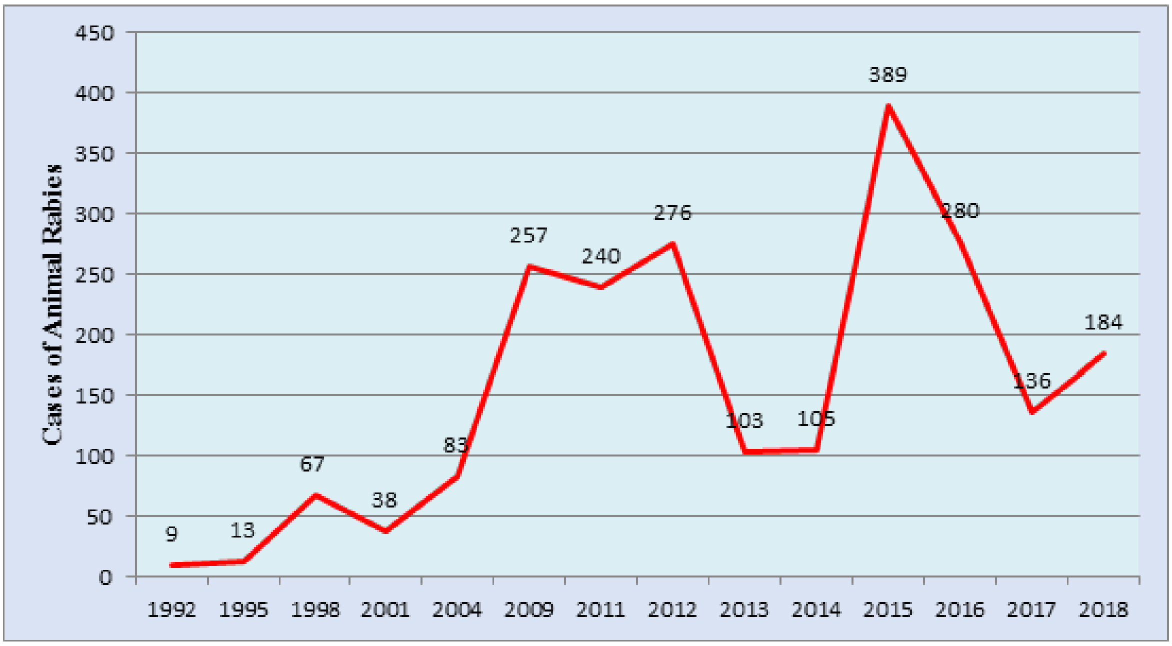

Fig. 1 - Specific Morbidity of Different Animal Species in the Moscow Region during 1992-2018

Table 1 - The Relative Number of Rabies Cases in the Moscow region during 2010-2018

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	Relative number of rabies cases
January	8	17	21	13	1	29	27	6	11	133	7,11%
February	11	12	36	9	8	24	25	15	6	146	7,9%
March	16	20	31	18	0	33	32	18	14	182	9,8%
April	11	18	36	9	8	29	29	10	22	172	9,3%
May	14	14	23	10	4	26	30	9	18	148	8,0%
June	21	26	12	6	6	29	21	11	12	144	7,8%
July	4	21	17	5	9	25	24	9	11	125	6,7%
August	10	10	19	5	8	31	25	11	29	148	8,0%
September	20	27	19	6	10	45	22	13	9	171	9,2%
October	15	22	31	9	12	43	20	6	15	173	9,3%
November	14	28	18	10	18	34	8	18	13	161	8,6%
December	12	25	13	3	21	41	17	10	14	156	8,4%
Total	156	240	276	103	105	389	280	136	184	1859	100%

Table 2 - The Intensity of the Epizootic Situation in Animal Rabies in the Moscow Region during 2014-2018

Name	n	N	t	T	W	Иэ
Balashikha	21	13	5	5	1,61	1
Volokolamsky District	23	269	5	5	0,08	1
Voskresenskiy District	23	83	4	5	0,22	0,8
Dmitrov	8	401	5	5	0,02	1
Domodedovo	31	150	4	5	0,16	0,8
Yegorievsk	25	199	3	5	0,07	0,6
Zaraysk	4	125	3	5	0,02	0,6
Istra	40	240	4	5	0,13	0,8
Kashira	11	98	5	5	0,11	1
Klin	35	265	5	5	0,13	1
Kolomna	58	147	5	5	0,40	1
Krasnogorsk	5	37	4	5	0,10	0,8
Lenin District	17	55	4	5	0,24	0,8
Lotoshinsky District	49	124	5	5	0,40	1
Lukhovitsky	70	93	5	5	0,75	1
Lyuberetsky	4	22	2	5	0,07	0,4
Mozhaisky	46	358	5	5	0,12	1
Mytishchi	6	92	4	5	0,05	0,8
Naro-Fominsky	36	206	5	5	0,17	1
Bogorodskiy (Noginsk)	40	82	4	5	0,39	0,8
Odintsovskiy District	33	235	4	5	0,11	0,8
Ozory	14	60	5	5	0,23	1
Orekhovo-Zuyevo	52	37	4	5	1,12	0,8
Pavlovo Posadsky	29	60	4	5	0,38	0,8
Podolsk	13	76	5	5	0,17	1
Pushkin District	6	88	3	5	0,04	0,6
Ramenskiy District	59	21	5	5	2,80	1
Ruzsky	60	203	5	5	0,29	1
Sergiev-Posad District	18	295	5	5	0,06	1
Serebryane Prudy	20	82	5	5	0,24	1
Serpukhov District	40	141	5	5	0,28	1
Solnechnogorsk District	19	199	4	5	0,07	0,8
Stupino	31	238	4	5	0,10	0,8
Taldom	9	178	4	5	0,04	0,8
Khimkie	4	1	2	5	1,6	0,4
Chekhov	58	146	5	5	0,39	1
Shatura	49	187	5	5	0,26	1
Shakhovskaya	9	152	5	5	0,05	1
Schelkovsky District	7	80	3	5	0,05	0,6
Bronnitsy	3	1	2	5	1,2	0,4
Dzerzhinsky	1	1	1	5	0,2	0,2
Chernogolovka	2	10	2	5	0,08	0,4
Likino-Dulyovo	2	141	2	5	0,1	0,4
Dubna	2	1	2	5	0,8	0,4
Korolev	1	1	1	5	0,2	0,2
Zvenigorod	1	1	1	5	0,2	0,2
Total	**1094**	**5694**	**179**	**5**		

CONCLUSION.

A study of seasonal cycles in the incidence of wild animal rabies in the Moscow region revealed correspondence between the maximum increase in rabies epizootic among foxes and the manifestation of certain physiological features of its reproduction: the rise of epizootic in April-May is due to the release of burrows from the holes at this time. Thus, during this period, it is advisable to carry out large-scale oral immunization of wild carnivorous animals, ensuring maximum contact of the offspring with the rabies vaccine briquettes.

The main reasons for insufficient control over measures to combat rabies were the organization of interaction in reporting and analytical work. The local governments lack knowledge on the issues of rabies, prevention and control measures. There are certain difficulties in carrying out some organizational activities, insufficient funding for the implementation of measures to regulate the number of stray animals, misunderstanding of the importance of recording and vaccination of domestic flesh animals.

Thus, regular monitoring of the dynamics in epizootic tensions of some territories and the analysis of the prevailing factors of the epizootic process will significantly improve the effectiveness of planning antiepizootic measures.

REFERENCES

[1] Khismatullina N.A. et al. Nuclease Composition with Anti-Rabies Activity. J. of Pure and Applied Microbiology. 2014, 8, 499-504.

[2] Khismatullina N.A. et al. A Rapid Method for Diagnosis of Rabies in Cell Culture Neuromas of Rats Gasser host. Genes and Cells. 2015, 3, 1-5.

[3] Meslin F., Kaplan M. and Koprowski H. Laboratory Techniques in Rabies. Geneva, WHO: 467. Manual of Diagnostic Tests and Vaccines for Terrestrial Animals: Rabies. 2008, 1, 304-323.

[4] Deviatkin A.A. et al. The Phylodynamics of the Rabies Virus in the Russian Federation. PLoS One. 2017, 2, 17-18.

[5] Senthilkumaran S. et al. Rabies Treatment: Are We Anywhere Close to Cure? Indian J Crit Care Med. 2018, 22(3), 199–200.

[6] El-Sayed A. Advances in Rabies Prophylaxis and Treatment with Emphasis on Immunoresponse Mechanisms. Int J Vet Sci Med. 2018, 6, 8–15.

[7] Cliquet F et al. Oral Vaccination of Dogs: a Well-studied and Undervalued Tool for Achieving Human and Dog Rabies Elimination. Vet Res. 2018, 49, 61-65.

[8] Ngugi J.N. Epidemiology and Surveillance of Human Animal-bite Injuries and Rabies Post-exposure Prophylaxis, in Selected Counties in Kenya, 2011–2016. BMC Public Health. 2018, 18, 996-999.

[9] Realegeno S. An ELISA-based Method for Detection of Rabies Virus Nucleoprotein-specific Antibodies in Human Antemortem Samples. PLoS One. 2018, 11, 154-160.