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СЕРОМОНИТОРИНГ КОНГО-КРЫМСКОЙ ГЕМОРРАГИЧЕСКОЙ ЛИХОРАДКИ СРЕДИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ЖИВОТНЫХ

SEROMONITORING OF CRIMEAN-CONGO HEMORRHAGIC FEVER IN FARM ANIMALS

Аннотация
В статье представлены данные серологических исследований сывороток крови сельскохозяйственных животных на наличие антител к вирусу ККГЛ. В 2022 году было исследовано 590 сывороток крови МРС собранные в 4 областях, а в 2023 году 1004 сывороток МРС и 1090 сывороток КРС из 15 областей Казахстана. В результате проведенных исследований установлено, что серопревалентность к вирусу ККГЛ среди КРС в 2023 году составила 5,32%. Серопозитивные КРС выявлены в 6 (Атырауской (9,38%), Кызылординской (57,5%), Жамбылской (40%), Туркестанской (78,58%), Алматинской (4,77%), Западно-Казахстанской (1,93%) областях. Серопозитивные овцы в 2022г были выявлены в 4 областях, а 2023г в 5 из 15 исследованных областей. Серопозитивные овцы в 2022г были выявлены в 4 областях, а 2023г в 5 из 15 исследованных областей. Серопозитивные овцы в 2022г были выявлены в 4 областях, а 2023г в 5 из 15 исследованных областях. Наличие антител к вирусу ККГЛ было выявлено в 2022г в Западно-Казахстанской (4,5%), Туркестанской (11,3%), Жамбылской (30,9%) и Кызылординской (44,3%) областях, а 2023г в Западно-Казахстанской (6,9%), Туркестанской (14,52%), Жамбылской (15%), Кызылординской (70%) и Северо-Казахстанской (12,1%) областях. Результаты наших исследований показывают, что ареал распространения ККГЛ значительно расширился. На основании полученных данных можно заключить, что на территории Казахстана образовалось два
The article presents data from serological studies of blood sera of farm animals for the presence of antibodies to the Crimean-Congo haemorrhagic fever virus (CCHF). In 2022, 590 small cattle blood sera collected in 4 regions were examined, and in 2023, 1004 small cattle sera and 1090 cattle sera from 15 regions of Kazakhstan. As a result of the studies, it was established that the seroprevalence of CCHF virus among cattle in 2023 was 5.32%. Seropositive cattle were detected in 6 (Atyrau (9.38%), Kyzylorda (57.5%), Zhambyl (40%), Turkestan (78.58%), Almaty (4.77%), West Kazakhstan (1.93)) from 15 studied regions. Seropositive sheep were detected in 4 regions in 2022 and in 5 out of 15 studied regions in 2023. The presence of antibodies to the CCHF virus was detected in 2022 in West Kazakhstan (4.5%), Turkestan (11.3%), Zhambyl (30.9%) and Kyzylorda (44.3%) regions, and 2023 in West Kazakhstan (6.9%), Turkestan (14.52%), Zhambyl (15%), Kyzylorda (70%) and North Kazakhstan (12.1%) regions. The results of our research show that the distribution area of CCHF has expanded significantly. Based on the data obtained, we can conclude that two endemic regions for CCHF have formed on the territory of Kazakhstan: the southern endemic region, including Kyzylorda, Turkestan, Zhambyl, and Almaty regions, as well as the western endemic region, including West Kazakhstan and Atyrau regions. Given the constant movement of wild and farm animals within the country, there is a high risk of CCHF spreading from endemic regions to free regions. To confirm these data, it is necessary to conduct constant monitoring of farm animals, ticks, and other blood-sucking carriers of this virus.

Key words: small cattle, cattle, Congo-Crimean haemorrhagic fever, ticks, seroprevalence, monitoring, antibodies.

Introduction. The situation with Crimean-Congo haemorrhagic fever (CCHF) still remains an important problem for several regions where the natural foci of this infection are located [1]. This disease exists in the south of Europe, in Asia, Africa, Crimea, Moldova, Kazakhstan and in the other republics of Central Asia [2]. The expansive geographical circulation of the CCHF virus is determined by its reservoirs - ticks. The huge habitat of ticks is due to their ability to adapt well and survive in various climatic zones.

Congo-Crimean haemorrhagic fever is considered as one of the most dangerous zoonotic infections to be registered in the territory of the Republic of Kazakhstan. The CCHF has been documented in the republic since 1948. The southern regions of our country are the most unfavorable for this infection. Natural foci of CCHF in our country occupy the southern flats of the republic within Kyzylorda, Turkestan, and Zhambyl regions [3, 4].

In addition to the southern region, in the territory of the West Kazakhstan region, which has common borders with the southern regions of Russia, there are also multiple natural foci of this infection, as proved by regularly registered cases of the disease. In this region, 1,871 cattle were tested for the carriage of the CCHF virus over the course of three years, and as a result, the annual stable circulation of the CCHF virus was established. At the same time, a high level of cattle infestation in this territory by ticks of the *Hyalomma* species, genus *Marginatum*, has been established. This type of tick is the main vector of CCHF in the Astrakhan and Orenburg regions of the Russian Federation, bordering the West Kazakhstan region [5, 6].

The entirety of the circumstances of the epizootic and epidemiological situations of the Crimean-Congo haemorrhagic fever in our country shows that there is a stepwise expansion of the boundaries of this infection. In particular, the number of natural foci of CCHF is intensively increasing in the Kyzylorda and Turkestan regions. Pasture migration of farm animals and their excessive infestation by ticks play a primary role in increasing the area of infection spread. In addition, the activation of the process is favored...
by the features of the southern region’s topography, climatic conditions, and the circulation in nature of ticks infected with the CCHF virus.

The main natural carriers of the CCHF virus are ticks of genera *Hyalomma*, *Dermacentor*, and *Ixodes*. The named tick genera parasitize in the imago stage on farm animals, and in preimaginal stages on rodents and other small animals [7].

Carriers of the CCHF virus are wild and domestic animals, including cattle, sheep, and goats, as well as the ticks themselves, which are virus carriers for life and capable of transmitting the virus to their offspring through eggs. Animals become infected as a result of the bite of infected ticks, and the virus remains in their bloodstream for about one week after infection, which ensures the continuation of the tick-animal-tick cycle during subsequent tick bites [8]. Animals play an important role in the epidemiology of CCHF as they provide food for the ticks and in turn, support their populations. By contrast, animals transport ticks across wide geographic areas and transmit CCHF to other ticks and humans during viremia. Many features of animals involve in the preservation and spread of CCHF are still poorly interpreted.

Natural CCHF foci are maintained by the circulation of the virus between ticks and their warm-blooded hosts. Preimaginal phases (larvae and nymphs) of ticks of the genus *Hyalomma* feed on small mammals (hares, hedgehogs, gophers, jerboas, mouse-like rodents) and birds (rooks, turkeys), adults feed on ungulates, including small ruminants and cattle. Short-term viremia develops in the blood of feeders, except birds when bitten by a tick infected with the CCHF virus, which can lead to infection of other feeders of ticks [9].

The situation regarding CCHF in Kazakhstan remains tense, which necessitates further study of epidemiological and epizootological aspects. In addition, serological monitoring was not carried out in Kazakhstan and the goal of our research was to study the prevalence of CCHF among small cattle in Kazakhstan.

**Materials and research methods.** Animal blood sera were collected from all regions of Kazakhstan in 2022 and 2023 using BD Vacutainer® Plus Serum vacuum tubes according to the manufacturer's instructions.

The presence of antibodies to the causative agent of Congo-Crimean haemorrhagic fever was defined by the ELISA method using the ID Screen® CCHF Double Antigen Multi-species (Innovative Diagnostics) according to the test-system instruction.

The results were statistically processed using Microsoft Excel software.

**Results and Discussion.** The detection of antibodies to the CCHF virus in livestock is important for obtaining initial data on the circulating virus, as well as for localization of CCHF foci and increased risk of human infection. Numerous studies have shown that CCHF is conserved in nature in the tick-vertebrate-tick enzootic cycle. Wild and livestock are susceptible to CCHF, but do not develop clinical disease. Although livestock develops transient viremia (7-15 days), it usually remains asymptomatic [10].

Serological data show that CCHF can productively infect a wide range of domestic and wildlife animals, from rabbits to cattle, ostriches and turtles, but only in humans develops symptomatic disease [11]. Since CCHF -infected wild and livestock do not show signs of disease, serological studies are the primary source of information for identifying virus-exposed species and for monitoring areas with natural transmission. The data from these studies are useful for evaluation the risk of CCHF appearing in new geographical areas to reduce endemic transmission of the virus. The CCHF was described over a wide geographical area including Asia, Africa and Europe (fig. 1).
This disease has not been spared Kazakhstan, and our study demonstrated a very high seroprevalence of antibodies in domestic animals in the southern regions of Kazakhstan. The priority selection of study areas was based on previous data on the presence of CCHF in these regions. 590 samples were examined in 2022 and 1004 samples in 2023 and 1090 samples were collected from small cattle and cattle in 2023.

The results of our studies showed that antibodies specific to CCHF in small cattle in 2022 were detected in 134 out of 590 tested samples (22.7%), while in 2023, out of 1004 samples, antibodies were detected in 53 samples (5.28%). At the same time, the Kyzylorda, Zhambyl and Turkestan regions had the greatest prevalence (Fig. 2, 3, 4). In turn, antibody samples for CCHF from cattle collected this year showed a prevalence of positive samples in Turkestan (78.58%), Kyzylorda (57.5%) and Zhambyl (40.0%) regions (Fig. 4, 5). It should be noted that there are positive samples in West Kazakhstan (4.5% in 2022 and 6.9% in 2023), Atyrau (9.38%), North Kazakhstan (12.1%) and Almaty regions (4.77%).

Analyzing the results, it can be concluded that the detection of seropositive animals in the southern endemic areas was expected, but the detection of seropositive animals in the northern and western regions is of concern. The detection of antibodies among animals in West Kazakhstan and Atyrau regions may be associated with a natural outbreak of CCHF in the border areas of the Russian Federation. The spread of the virus range to the southeast into the Almaty region was expected, since animals from the southern endemic regions constantly enter this region. The detection of seropositive sheep in North Kazakhstan may be associated with the uncontrolled movement of animals from the southern regions of our country or other disadvantaged regions.
Figure 2 – CCHF seroprevalence among small cattle in the regions of Kazakhstan

Figure 3 - CCHF seroprevalence among small cattle in 2022
Domestic animals are often involved in the transmission of CCHF when human cases are identified. Sheep have been recognized as very important reservoirs of CCHF virus in some endemic regions and have been epidemiologically linked to human cases in several cases [12–14]. Thus, increased CCHF seropositivity in livestock often coincides with reports of CCHF cases in people exposed to
livestock, especially those who handle the blood and organs of infected livestock (eg, slaughterhouses, butchers, and farmers). CCHF has been reported in endemic countries in the southern and western Europe [15–17], suggesting that the distribution of CCHF may further increase in the coming years [18].

Ticks play a major role in the prevalence of antibodies to the CCHF virus, and this indicator is highest in biotopes where Hyalomma spp. ticks predominate. In addition, sustained endemic transmission occurs only where Hyalomma spp. ticks are present, and epizootic transmission occurs during periods of increased abundance of these ticks [19, 20].

In our previous study, we detected CCHF virus in ticks in three southern regions of Kazakhstan [19]. The results obtained in this study complement the data on the circulation of this virus in these regions. An interesting fact is that antibodies to the CCHF virus were detected in animals from the western region of Kazakhstan, although the CCHF virus was not detected in ticks collected in this region. Therefore, there is a need for additional research on CCHF in this region. Or a possible reason is the migration of animals from the neighboring Kyzylorda region, which is endemic for CCHF. In addition, vector control to reduce tick burden has been shown to be associated with reduced seroprevalence [21].

Current knowledge about the main environmental factors contributing to the persistence and transmission of CCHF is insufficient. Like many other zoonotic agents, CCHF causes little or no disease in its livestock host and is not usually of concern to veterinarians. However, CCHF deserves serious veterinary consideration because animal hosts are important for tick vectors. Vertebrates play a critical role in maintaining the virus; moreover, the movement or transport of viremic animals or animals carrying infected ticks can lead to the introduction of CCHF into new geographic areas [22]. On the other hand, climate change plays an important role in the spread of the pathogen - ticks. Research shows a tendency for ticks to expand their range northward due to climate change [23].

**Conclusion.** Thus, serological studies conducted show that the distribution area of CCHF has expanded significantly. To confirm these data, it is necessary to conduct constant monitoring among farm animals, ticks and other blood-sucking carriers of this virus.

Based on the data obtained, it can be concluded that two CCHF endemic regions have formed on the territory of Kazakhstan: the southern endemic region, including the Kyzylorda, Turkestan, Zhambyl and Almaty regions, as well as the western endemic region, including the West Kazakhstan and Atyrau regions. Given the constant movement of wild and farm animals within the country, there is a high risk of CCHF spreading from endemic regions to free regions.

### СПИСОК ЛИТЕРАТУРЫ

REFERENCES


ТУЙІН

Макалада Конго-Қырым геморрагиялық қызбасының вирусуына (КҚГҚ) антиденелердің болуына ауыл шаруашылығы жануарларының қан сарысуының серологиялық зерттеулерінің деректері келтірілген. 2022 жылы 4 областың 590 ұсақ малдың қан сарысуы, ал 2023 жылы Қазақстандың 15 областың 1004 ұсақ малдың қан сарысуы әрі 1090 ірі кара малдың қан сарысуы зерттелді. Жұрттілген зерттеудер нәтижесінде 2023 жылы ірі кара мал арасында КҚГҚ вирусуының серопреваленттілігі 5,32% құрайды. Зерттелген 15 областың 6 (Атырау (9,38%), Қызылорда (57,5%), Жамбыл (40%), Туркістан (78,58%), Алматы (4,77%), Батыс Қазақстан (1,93%) областырында серопозитивті ірі кара мал анықталды. Серопозитивті қой 2022 жылы 4 областың, ал 2023 жылы 15 областың 5-інде 2022 жылы БҚО (4,5%), Туркістан (11,3%), Жамбыл областырында КҚГҚ вирусуына антиденелердің болуы анықталды. (30,9%) және Қызылорда (44,3%) областырында, ал 2023 жылы Батыс Қазақстан (6,9%), Туркістан (14,52%), Жамбыл (15%), Қызылорда (70%) және Салтусті Көзүледе (12,1%) областырында. Біздің зерттеулеріміз көрсеткіндеді, КҚГҚ таралу аймағы айтарлықтай кеңейген. Алынған мәліметтерге сүйене отырып, Қазақстан аумағында КҚГҚ үшін екі эндемикалық аймақ қалыптасқан деген қорытындыға келуге болады: оңтүстік эндемикалық аймақ, оның ішінде Қызылорда, Туркістан, Жамбыл, және Алматы областы, сондай-ак батыс эндемиялық аймақ, соньы ішінде Батыс Қазақстан және Атырау областы. Жабайы және ауыл шаруашылық жануарларының ел ішінде тұрақты қозғалысы ескер сатырғы деп, эндемиялық аймақтардан бөл аймақтарға КҚГҚ таралу қаупі жоғары. Бұл деректерді растау үшін ауыл шаруашылық жануарлары, кенелер және осы вирустың басқа қансорының тағы жаңа қоғамдық шешім дайындығын мониторинг жүргізу қажет.