

AD 688753

TRANSLATION NO. 2447

DATE:
June 69

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JUN 24 1969

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CHARACTERISTIC EPIDEMIOLOGICAL FEATURES OF HAEMORRHAGIC FEVER WITH RENAL SYNDROME IN THE MIDDLE POVOLZHE (Epidemiologicheskaya kharakteristika gemorragicheskoi likhorsaki s pochecnym sindromom na srednem Povolzhe)

by

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ZHURNAL MIKROBIOL EPIDEM. IMMUN. 1966 (11) pages 122-127.

Study of the zonal parasitology of haemorrhagic fever with renal syndrome, from the point of view of geographical boundary features, is still topical. In the Middle Povolzhie, this disease was classified in 1952 as an independent nosological form, endemic in the taiga zone of Mari and Udmurt ASSR. In subsequent years, however, with improved diagnostic methods, sporadic cases and group outbreaks of haemorrhagic fever were reported, not only in the taiga, but also in many forest-steppe regions of the Tatar, Chuvash ASSR, Ulianovsk and Kuibyshev Provinces.

An analysis was made of 511 cases of haemorrhagic fever which occurred in the period 1952 - 64; 376 were in taiga foci and 135 in islands of forest in the forest-steppe zone of the Middle Povolzhie. Clinico-epidemiological observations have confirmed that natural foci of this infection are widespread (see diagram).

The clinical course of haemorrhagic fever is similar in the taiga and forest-steppe foci of the Middle Povolzhie, and is characterized by the same symptoms as haemorrhagic nephritis in the Far-East. The haemorrhagic diathesis is, however, less severe in patients with fever, and changes in the blood are limited to moderate leucocytosis; left shift of the leucocyte formula occurs at the expense of rodnulear forms only, and young cells and Turok cells are rare. Complication by azotemic uraemia and spontaneous rupture of the kidneys is rare. Oedema of the lungs, which is not mentioned in descriptions of the clinical course of Far-East nephritis, was observed in 8 out of 9 haemorrhagic fever patients who died; 2% of patients developed pneumonia. In 35% of patients, haemorrhagic fever took a severe course, in 47% moderately severe, and in 18% mild. Fatalities throughout the period averaged 2.1%.

In the Middle Povolzhie, most occurrences of haemorrhagic fever are associated with permanent residence of the patients in large forests. No reports are available of proven cases of infection within the precincts of populated areas, except for the taiga settlements of lumber-jacks and building workers constructing new settlements. This epidemiological feature becomes evident when the incidence of haemorrhagic fever in the Middle Povolzhie is compared with that in Yaroslavl, Kalinin and Tula Provinces, in the Khabarovsk territory, and other endemic areas where outbreaks are recorded mainly among farming communities (Avakyan and Lebedev, 1955; Myasnikov et al 1961). A study of the taiga and forest-steppe foci showed that sporadic cases and endemic outbreaks occurred only in those communities living in forest areas with large numbers of red and tawny field-mice -- the carriers of the pathogen of haemorrhagic fever in the Middle Povolzhie.

A significant factor is the endemic outbreak of haemorrhagic fever among workers on new settlements in the forest-steppe of the Tatar ASSR. Of 89 building workers who settled on the edge of an isolated deciduous forest of 50 hectares in the last ten days of May, 1959, 16 (18%) fell ill. The cases were reported over a period of 70 days (first case 23rd April, last case 31st August). The incubation period averaged 17 days; in 6 cases infection apparently occurred in June, in 8 cases in July, and in 2 in August. The patients were all persons who worked in the forest and were in contact with items contaminated by the excretion of rodents (collecting forest litter and straw, clearing the ground with bulldozers, and other jobs involving the creation of dust). The total number of rodents in the focus was 46 individuals per 100 trapping days; 87% were tawny field-mice, 8% forest mice, and 5% yellow-throated mice. The presence of diseased and dead rodents indicated an epizootic, and this was confirmed by patho-anatomic investigations. The post-mortem examination of 230 tawny field-mice revealed clear-cut enlargement of the spleen and haemorrhages in the liver and medullar layer of the kidneys in 42 (18%). The microscopic changes in the kidneys of the rodents resembled the kidney lesions in

humans with haemorrhagic fever (haemorrhage in the medullar layer secondary to general vasculitis, dystrophic changes in the canalicules, and the presence of cylinders). In diagnosis, the possibility of tularemia and leptospirosis was excluded, and this was confirmed by serological tests (Gonoharova, Karimova).

Incidence of the disease ceased after the destruction of rodents throughout the territory of the focus by means of poisoned bait (oatmeal mixed with zinc phosphide and vegetable oil). The liquidation of this focus was completed by transforming the whole area of the forest into a park; during the next five years, no cases of haemorrhagic fever were notified.

The above-mentioned changes in the organs of rodents in foci of haemorrhagic fever have been observed by other authors (Dersy, 1957; Solovev et al. 1964). Patho-anatomic changes in the organs of the rodent carriers of the virus of haemorrhagic fever should be taken into account as indicating natural foci of the disease.

As regards the channels of infection, the presence of the dust factor has been noted in other foci also, particularly in the taiga where group outbreaks of haemorrhagic fever were observed among lumber-jacks, workers in saw-mills, whip-makers, drivers, workers on bulldozers, and others helping to clear the forest). Study of material on these outbreaks, and also cases of laboratory infection (Chumakov et al, 1959; Kulagin et al, 1962) led to the conclusion that the respiratory route is the main path of infection; even the most careful investigation revealed no proof of transmission or of an alimentary route of infection as mentioned in the literature.

Throughout the years of observation in the taiga and forest-steppe zones, incidence of the disease was always linked with the occupational-industrial factor.

Of the patients in taiga foci, 92.1% were newly-settled in the taiga (lumber-jacks and construction workers). In 74.6%, the outbreak was of a group character and, according to all the data, was an occupational-industrial epidemic outbreak of haemorrhagic fever. Among other groups who

were not permanently in the taiga, incidence was limited to sporadic cases. 12.2% of the patients were persons under the age of 20, 80.2% between 21 and 30, 6.5% between 31 and 40 years, and 1.1% over the age of 40.

TABLE 1

The incidence of haemorrhagic fever among various occupational groups

Occupational Groups of Population	Taiga zone		forest-steppe		total	
	No. of cases	%	No. of cases	%	No. of cases	%
Lumber-jacks	275	73.2	9	6.7	284	55.6
Construction workers	71	18.9	42	31.1	113	22.1
Oil workers	4	-	18	13.3	18	3.5
Collective farmers	13	3.5	31	23.0	44	8.6
Employees on forest industry collectives	5	1.3	33	24.4	38	7.4
Medical workers (in foci)	5	1.3	2	1.5	7	1.4
Housewives	2	0.5	-	-	2	0.4
Children (forest camps)	5	1.3	-	-	5	1.0
TOTAL	376	100%	135	100%	511	100%

In the forest-steppe foci, group outbreaks were observed only occasionally, and solely among organized communities of building workers and workers in the mineral oil industry. The highest number of cases (21%) showed a sporadic character and the patients belonged to various occupational groups. 11.4% of the total were under the age of 20; 47.2% between 21 and 30, 31.4% between 31 and 40, 6.4% between 41 and 50, and 3.6% over the age of 50. Throughout the years of observation in the taiga and forest-steppe foci, only 9 cases of haemorrhagic fever were reported among women (1.1% of the total), and only 5 (0.9%) among children. This emphasizes the occupational-industrial nature of the disease.

The seasonal incidence of haemorrhagic fever is shown in Table 2

TABLE II

The monthly distribution of haemorrhagic fever incidence in the taiga and forest-steppe zones of the Middle Povolzhie in the period 1952-1964

Foci	Months												total cases
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Taiga	10	18	8	3	36	30	76	71	45	44	20	15	376
Forest-steppe	5	3	3	1	2	8	27	24	18	22	17	5	135
Total	15	21	11	4	38	38	103	95	63	66	37	20	511

Infection is possible at any time of the year, but the peak (72.6%) occurs in the summer-autumn period, due mainly to the date of residence, type of accommodation, and character of work and living conditions of the labour force in endemic territories.

To summarize the above, the incidence of haemorrhagic fever among lumber-jacks, construction workers and mineral oil workers, and other communities working in territories with foci, should be regarded as an occupational risk and suitable protective measures should, therefore, be taken not only by public health bodies, but also by other administrative organizations.

The notification of cases of haemorrhagic fever in winter, associated with foci of "extracted infection" (forest hamlets, straw stacks -- places where rodents accumulate in winter), conflicts with the seasonal transmission of infection. Parasitological investigations in the foci failed to establish that ticks (Ixodidae and Gamasidae) played any part in the transmission of the infection to humans.

In the natural foci of haemorrhagic fever in the Middle Povolzhie, there are five species of Ixodidae: *Ixodus persulcatus*, *I. ricinus*, *I. trianguliceps*, *Dermacentor pictus*, and *D. marginatus*.

Of these species, the most interesting is the tick *I. trianguliceps*, which is widespread in the forests of Eurasia and very common in some places, and is a specific parasite of small mammals; it was found on rodents in all the foci studied by us. The findings of a study over many years of a concomitant focus of haemorrhagic fever and tick encephalitis in the Zakamie Tatar ASSR are of interest. In 1957 - 1958 the focus was given repeated aerial treatments with DDT powder. The quantity of *I. persulcatus*, the main carrier of tick encephalitis, fell sharply, but the quantity of *I. trianguliceps* ticks, which inhabit the forest litter, started to increase. In the succeeding years it became the predominant species living on small forest mammals. Following the change in ectoparasites, an epizootic was observed among small rodents, mainly tawny field mice. Of 932 individuals of this species trapped in the summer-autumn season 1964, 214 (23%) showed organal changes analogous to those observed in other foci of haemorrhagic fever (see above-mentioned changes). During these years, the epidemiological records showed absence of tick encephalitis in the focus, but an increase in the incidence of haemorrhagic fever. Prior to 1960, only 4 cases were recorded; from 1960 - 1963 15 cases; and in the summer-autumn season 1964 16 cases. These observations cannot serve as a basis for final conclusions, and the role of the *I. trianguliceps* tick in foci of haemorrhagic fever must be further studied.

As there are no specific methods of prophylaxis of haemorrhagic fever, various ways of destroying rodents as the main source of infection were suggested. Experience showed that in the taiga the most effective method is to create a protective belt around settlements and temporary dwellings by clearing a patch 150 - 200 m. in radius; this prevents the migration of small animals into the dwellings.

In the islands of forest in the forest-steppe zone, foci can be successfully liquidated by totally destroying the rodents in the area and afterwards transforming the forest into a park, but as this method calls for a great deal of labour it is not widely used. Bearing in mind the concomitance of natural foci of tick encephalitis and haemorrhagic fever, we considered combined aerial treatment promising in

such cases; a single aerial dusting with a DDT preparation was combined with simultaneous destruction of rodents (also by aerial means).

Such measures were carried out in 1965 in a concomitant focus covering 1,200 hectares. Bait (oatmeal mixed with zinc phosphide and vegetable oil) was laid from an AN-2 plane at the rate of 2 kgm/hectare. Preliminary findings indicate that this combined method is highly effective and economical.

1. Natural foci of haemorrhagic fever with renal syndrome are wide-spread in the taiga and forest-steppe zones of the Middle Povolzhie. The source of infection is red and tawny field-mice. Changes observed in the organs can be used to identify foci.

2. Haemorrhagic fever in the Middle Povolzhie shows the same symptoms as haemorrhagic nephroso-nephritis in the Far East, but is distinguished by less severe haemorrhagic diathesis, a less malignant course and a lower mortality rate.

3. The incidence of haemorrhagic fever in the Middle Povolzhie is linked with occupational-industrial factors and is observed mainly among lumber-jacks, building workers and workers in the mineral oil industry; there are occasional cases on collective farms and among other groups. In taiga foci group outbreaks predominate, in the forest-steppe zones cases are mainly sporadic.

4. The duration and date of residence in the endemic territories, type of accommodation, and working and living conditions account for the summer-autumn seasonal appearance of haemorrhagic fever in the Middle Povolzhie. The path of infection is undoubtedly respiratory.

5. In isolated foci of the forest-steppe, the most promising preventive measure is total destruction of rodents. In the taiga, prophylaxis is limited to destruction of rodents around the settlements. Forestry, and other administrative authorities should pay particular attention to the prevention of haemorrhagic fever incidence.

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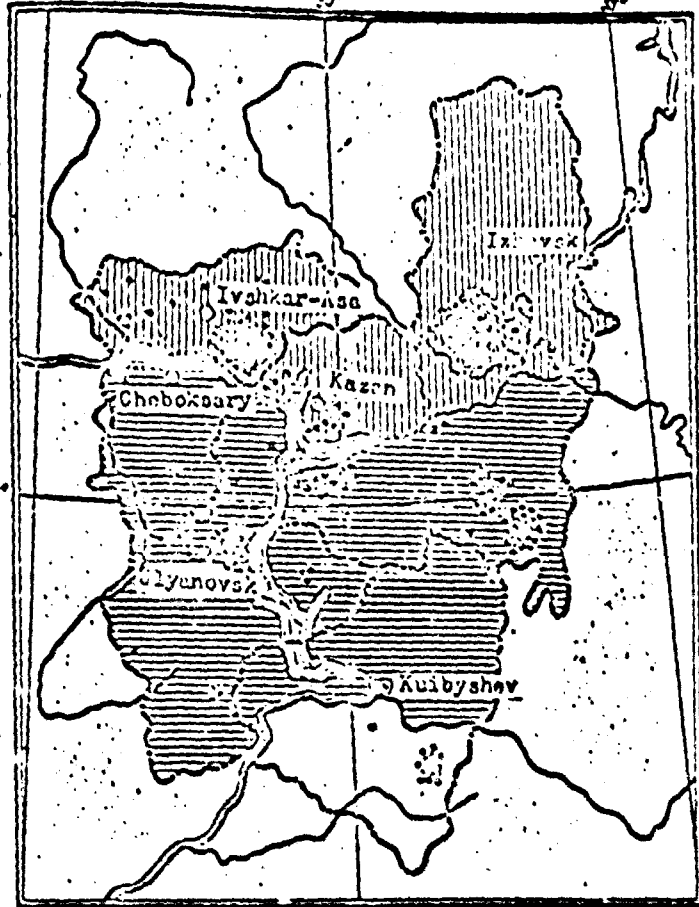
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● - No. of patients 1952-57 ○ - No. of patients 1958-61
 ⊙ - Taiga ⊙ - Forest-steppe ⊙ - Steppe

The spread of natural foci of haemorrhagic fever with renal syndrome.