Evidence of Typhus Infection in Domestic Animals in Egypt*

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Previous work suggested that domestic animals could act as a reservoir of epidemic typhus. To test this hypothesis, sera from buffaloes, camels, donkeys, goats, pigs and sheep in different parts of Egypt were submitted to the complement-fixation test, using the common soluble typhus antigen. The highest percentage of positive results was obtained with camel and donkey sera and the positivity rate was higher towards the end of the year than in June and July. Animals from the Western Desert area were more frequently positive than those from other regions. Attempts to isolate rickettsiae by intraperitoneal injection of guinea-pigs resulted in some febrile reactions, but so far no rickettsiae have been isolated.

Giroud and co-workers (Giroud, 1961; Giroud, Ceccaldi & Roger, 1954; Giroud & Jadin, 1953; Giroud et al., 1952, 1953) and Reiss-Gutfreund (1955, 1956, 1961) reported finding antibodies to epidemic typhus in the blood of domestic animals in areas in Africa where the disease is endemic, and *Rickettsia prowazekii* having the same pathogenic and antigenic properties as the classical strains of the organism have been isolated from a goat, sheep, and ticks collected from cattle and camels (Reiss-Gutfreund, 1955, 1956, 1961). These findings suggested that domestic animals could act as a reservoir for epidemic typhus.

In 1962 investigations were carried out in Egypt to test this hypothesis. By means of the complement-fixation (CF) test, it was shown (Imam & Alf, 1963; Imam et al., 1955) that sera from domestic animals — camels, donkeys, goats and sheep — gave positive reactions to both epidemic and murine typhus antigens. Moreover, it was also found (Imam et al., 1965) that there was a strong association between man and domestic animals in an area where a proven case of typhus had occurred. In two villages where there had

been cases of typhus, there was a very high positive reaction to typhus in the sera of animals and men, whereas in control villages that had not experienced typhus, both men and animals gave negative CF reactions to typhus antigens.

The present study was carried out in an attempt to confirm the earlier findings.

MATERIALS AND METHODS

From June 1965 to the end of January 1966, blood samples were collected each month from domestic animals in 13 provinces in Egypt. The samples were collected from the same village in each province each month, and in Cairo and Alexandria blood samples were obtained from the abattoirs.

Sera were separated from the blood in the usual way and tested against the common soluble typhus antigen by the complement-fixation (CF) test. The anticomplementary reaction of the animal sera, especially those of donkeys, presented a problem. Heating the sera to 60°C for 30 minutes lessened the problem, but did not completely solve it. It was eventually found that treatment of the sera with “dry-ice” (solid carbon dioxide) completely inhibited the anticomplementary reaction.

RESULTS

Table 1 shows the percentage of each type of animal sera found to be positive in the CF test. Values

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TABLE 1

RESULTS OF COMPLEMENT-FIXATION TEST ON SERA OF DOMESTIC ANIMALS IN EGYPT, USING COMMON SOLUBLE TYPHUS ANTIGEN

Type of animal	No. of sera examined	Positive sera	
		No.	%
Buffalo	151	3	2.0
Camel	1 818	257	14.1
Donkey	821	201	24.5
Goat	612	34	5.6
Pig	1 469	8	0.5
Sheep	1 821	29	1.6
Total	6 692	532	7.9

ranged from 24.5% for donkeys to 0.5% for pigs, the average for all animals being 7.9%. Seasonal variations in the positivity rate were also studied (Table 2). Because the number of animals of each type collected each month varied, an "adjusted positivity rate" was calculated on the assumption that the number examined each month consisted of equal numbers of each type; this ranged from 3.2% in June 1965 to 20.0% in January 1966. The increase over this period was not a steady one, the figures for October and January being high (15.4% and 20.0%, respectively), whereas the figures for November (4.7%) and December (10.4%) were lower than those for the three preceding months.

The highest percentage of positive reactions was found among sera collected from animals in the Western Desert area.

Some sera, especially those that showed a high titre (1/80-1/160), were retested against specific epidemic and murine antigens. Of 41 camel sera, 16 were classified as epidemic and one as murine; the remainder could not be differentiated. Of 10 donkey sera four were classified as epidemic and the others could not be classified.

ATTEMPTS AT ISOLATION OF RICKETTSIAE

A total of 441 blood samples from camels, donkeys, goats and sheep were inoculated intraperitoneally into guinea-pigs between September 1965 and the end of January 1966. Fifty-three of these guinea-pigs (12.0%) showed a febrile reaction of above 40°C, which appeared seven days after the day of inoculation (Table 3).

TABLE 2

SEASONAL VARIATION OF PERCENTAGE OF POSITIVE SERA IN COMPLEMENT-FIXATION TEST

Month	No. of animals examined ^a	Positive sera		Adjusted positivity rate (%) ^b
		No.	%	
1965				
June	397	5	1.3	3.2
July	1 194	42	3.5	7.2
August	1 592	125	7.9	10.8
September	980	65	6.6	11.0
October	513	106	21.0	15.4
November	703	54	7.7	4.7
December	861	87	10.1	10.4
1966				
January	301 ^a	45	14.6	20.0
Total	6 541	529	8.1	

^a Except in January, the animals consisted of camels, donkeys, goats, pigs and sheep. In January, no pigs or sheep were examined; in calculating the adjusted positivity rate for this month, it has been assumed that the number of pigs and sheep was the same as in December.

^b Calculated on the assumption that the total number of animals examined consisted of equal numbers of each type.

Excluding the relatively small number of blood samples from sheep, it was found that blood from camels gave the highest percentage of febrile reactions (15.4%). Of the 53 febrile guinea-pigs harvested either on the first or second day of febrile reaction, four showed a positive CF reaction to the common typhus antigen at a titre of 1/4-1/8; the rest were negative.

Brains, spleens and livers of the harvested guinea-pigs were kept at -70°C for further passage of material in guinea-pigs and eggs in an attempt to isolate rickettsiae. Blood samples from 55 guinea-pigs that showed an afebrile reaction (12.5%), taken one month after inoculation, gave positive CF reactions with the common typhus antigen in titres of 1/8-1/16 (Table 3). The highest percentage of positive reactions was observed among sera of afebrile guinea-pigs previously inoculated with the blood of camels or donkeys (12.1% and 13.8%, respectively).

With regard to the locality in which the original blood samples were collected, the highest percentages of febrile reactions and of positive sera were observed in guinea-pigs inoculated with the blood of animals from the Western Desert and nearby provinces.

TABLE 3
REACTIONS INDUCED IN GUINEA-PIGS INOCULATED WITH ANIMAL BLOOD

Type of animal	No. of guinea-pigs inoculated	Guinea-pigs with febrile reaction		No. of guinea-pigs killed	Guinea-pigs with afebrile reaction		
		No.	%		Positive CF reaction		Negative CF reaction
					No.	%	No.
Camel	91	14	15.4	8	11	12.1	58
Donkey	283	33	11.7	33	39	13.8	178
Goat	62	4	6.5	7	5	8.1	46
Sheep	5	2	40.0	1	0	0	2
Total	441	53	12.0	49	55	12.5	284

When an analysis in terms of the month of inoculation was carried out, little difference was found in the percentage of febrile reactions, except in October 1965, when it was very low (2.2%, compared with an average of 12.0%). However, the percentage of positive sera from afebrile guinea-pigs was much higher in November and December 1965 and January 1966 than in the previous two months.

No isolations of rickettsiae were achieved in these tests.

DISCUSSION

The results of the present investigation confirm the previous findings of typhus antibodies in the blood

of domestic animals, especially camels and donkeys. The highest percentages of positive reactions were found during the latter part of the year and in animals from the Western Desert region.

Attempts to isolate rickettsiae by the intraperitoneal injection of animal blood into guinea-pigs resulted in some febrile reactions, especially to the blood of camels and donkeys collected during the latter part of the year. No rickettsiae have yet been isolated, but work is at present in progress on the tissues of the febrile guinea-pigs to determine whether these febrile reactions were due to rickettsial infection.

TABLE 4
SEASONAL VARIATION IN REACTIONS INDUCED IN GUINEA-PIGS INOCULATED WITH ANIMAL BLOOD

Month	No. of guinea-pigs inoculated	Guinea-pigs with febrile reaction		No. of guinea-pigs killed	Guinea-pigs with afebrile reaction		
		No.	%		Positive CF reaction		Negative CF reaction
					No.	%	No.
1965							
September	44	6	13.6	5	1	2.3	32
October	46	1	2.2	6	1	2.2	38
November	106	15	14.2	17	16	15.1	58
December	89	10	11.2	6	21	23.6	52
1966							
January	156	21	13.5	15	16	10.3	104
Total	441	53	12.0	49	55	12.5	284

RÉSUMÉ

Les enquêtes menées par différents chercheurs suggèrent que les animaux domestiques peuvent représenter un réservoir du typhus épidémique et les auteurs, dans le but de confirmer ces premiers résultats, ont examiné des sérums prélevés chaque mois, de juin 1965 à janvier 1966, sur des animaux domestiques dans des villages égyptiens et aux abattoirs du Caire et d'Alexandrie.

Les pourcentages de sérums renfermant des anticorps fixant le complément vis-à-vis de l'antigène rickettsien ont varié de 24,5% pour les mulets à 0,5% pour les porcs; la moyenne pour l'ensemble des espèces animales a été de 7,9%. Le taux de positivité a varié suivant la saison: il était de 3,2% en juin 1965 et de 20,0% en janvier 1966; le chiffre d'octobre était le plus élevé après celui de janvier tandis que les taux notés en novembre et en décembre étaient inférieurs à ceux des trois mois précé-

dents. Les réactions positives les plus nombreuses ont été observées avec des sérums d'animaux provenant de la région du désert occidental. Au total, 441 échantillons de sang de chameaux, de mulets, de chèvres et de moutons ont été inoculés par voie intrapéritonéale à des cobayes. Sept jours après l'inoculation, 53 (12%) des animaux inoculés ont présenté une réaction fébrile, avec une température supérieure à 40°C. Le premier ou second jour de cette réaction, les sérums de quatre d'entre eux donnaient une réaction de fixation du complément positive avec l'antigène du typhus épidémique; les sérums des autres animaux de cette série donnaient une réaction négative. Un mois après l'inoculation, on a observé une réaction sérologique positive chez 55 cobayes (12,5%) chez lesquels aucun épisode fébrile n'était apparu. Aucune souche de rickettsies n'a pu être isolée.

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