



Original Research Article

Eco-entomological investigation in Scrub Typhus affected area of Thiruvananthapuram, Kerala (India) and their control/containment measures

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ABSTRACT

Keywords

Scrub Typhus;
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Rattus rattus;
Mus musculus;
Thiruvananthapuram.

Scrub Typhus, a disease commonly found in regions having dense vegetation, is spreading fast in the urban and suburban areas of India. It is highly endemic in suburban regions of Thiruvananthapuram, Kerala (India). Present study was undertaken to observe the prevalence of rodent – ectoparasite association with special reference to vector of scrub typhus in *Thiruvananthapuram district*. Rodents were collected, identified and ectoparasites were recovered. Ectoparasites were identified using standard identification keys. Blood from rodents was collected to detect *Orentia* and plague antibody. Dissection of rodents were done for taking the organs in culture medium and contact smears of heart, lung, liver and spleen for examination of Plague bacilli. Collected rodent species in order of their prevalence were *Rattus rattus*, *Mus musculus*, *Bandicota indica* and *Suncus murinus*. During the combing of these rodents scrub typhus vector mite (*Leptotrombidium deliense*) (66) were collected from rodents giving an overall chigger index as 1.74 per rat. In addition, fleas were also retrieved giving an overall flea index as 0.13. A total of 35 blood serum samples were taken from various rodents species captured alive. These rodent samples were processed for detection of *Orentia* (Scrub typhus) & plague antibodies and all samples were found to be negative. Similarly, 35 rodent organ smears and tissue organ samples were examined to see the activity of plague bacilli and all the samples were found to be negative. Results of the study suggest regular and continuous rodent and mite/flea surveillance to monitor the activity of scrub typhus, plague bacilli and vector so as to institute early control measures if needed

Introduction

Worldwide, rats and mice spread over 35 diseases. These diseases can be spread to humans directly, through handling of rodents, through contact with rodent feces, urine, or saliva, or through rodent bites.

Diseases carried by rodents can also be spread to humans indirectly, through the bite of ticks, mites or fleas that have fed on an infected rodent. Scrub typhus and plague are the important zoonotic diseases

cause by bite of mites and fleas. Scrub typhus is a well known disease in India and has been documented in several states like Haryana, Jammu and Kashmir, Himachal Pradesh, Uttaranchal, West Bengal, Assam, Maharashtra, Tamilnadu and Kerala (Mahajan *et al.*, 2006).

In the present study area the cases of scrub typhus was reported as early as in year 2000 at the Government Medical College Hospital from Nedumangad, Attingal and Mamom areas. Thereafter, scattered cases and small clusters have been reported every year from district Thiruvananthapuram and other districts Kollam, Pathanamthitta and Kozhikode in Kerala (Table 1 & 2). In order to ascertain the prevalence of rodent – ectoparasite association in these areas a team from the National Centre for Diseases Control (NCDC) visited *Thiruvananthapuram*, Kerala during October 2012 with the following objectives:

To know the potential of rodent ectoparasitic borne diseases in the study area. To determine the prevalence of rodents/ectoparasite species. To know the presence of *Orentia* (scrub typhus) and plague bacilli infection in rodents if any present. The findings of the above studies are given in the present communication.

Materials and Methods

Geographical information on study area

Thiruvananthapuram is located on the west coast of India near the extreme south of the mainland. The city is characterized by its undulating terrain of low coastal hills and busy commercial alleys. The city has a population of more than 750,000 inhabitants and a population of around

1.68 million in the urban agglomeration. Thiruvananthapuram is the largest and most populous city in Kerala. The district is situated between North latitudes at 8.17° – 8.54° and East longitudes 76.41° – 77.17°. Thiruvananthapuram district has a reserve forest area of 495.1 km² and vested forest area of 3.534 km². There are three rivers in the district, namely the Neyyar, the Karamana and the Vamanapuram. The second-highest peak in the Western Ghats is also situated in the district. The climate of Thiruvananthapuram district is generally hot tropical. The large forest reserves favorably affect the climate and induce rains. The total annual average rainfall in the district is about 1,500 mm per annum. Cold weather is experienced in the mountain ranges, whereas lower down, the weather is bracing and is generally hot in the coastal regions. The mean maximum temperature is 95 °F and the mean minimum temperature is 69 °F.

Area visited

The following areas in and around Thiruvananthapuram, India reported scrub typhus cases in the recent past were visited for the studies:

- 1.Kizhuvilam village
- 2.Mamom village
- 3.Kochalummoodu village
- 4.DHS, Thiruvananthapuram
- 5.Rajaji Nagar, Thiruvananthapuram

Rodent collection, identification and dissection

Rodents were collected using live traps (wire cage and wonder traps). The traps were baited with fried eatables smeared with butter and laid in the evening at pre - selected sites.

Table.1 District wise scrub typhus cases/death reported from Kerala state (India) during 2011

District	Total Cases	Confirmed Cases	Probable Cases	Death
Thiruvananthapuram	141	131	10	2
Kollam	16	16	0	0
Pathanamthitta	1	1	0	0
Kozhikode	3	2	1	0
Total	161	150	11	2
Source: Directorate of Health Services, Kerala (India)				

Table.2 Month wise scrub typhus cases/death reported from Kerala state (India) during 2011

Month	Total Cases	Confirmed Cases	Probable Cases	Death
January	8	8	0	1
February	18	17	1	0
March	1	1	0	0
April	7	7	0	0
May	2	2	0	0
June	6	6	0	0
July	12	12	0	1
August	15	15	0	0
September	21	21	0	0
October	16	15	1	0
November	17	13	4	0
December	38	33	5	0
Total	161	150	11	2
Source: Directorate of Health Services, Kerala (India)				

Table.3 Results of entomological investigation of Scrub Typhus in *Thiruvananthapuram*, Kerala (India)

S.No.	Place/ Locality	No. of traps used	Traps +ve	Rodent species (Per cent)					Ectoparasites collected (No. of Infested Rodent)				
				B.i.	R.r.	S.m.	M.m.	Total	Mite	Tick	Flea	Lice	Total
1	Kizhuvilam Village	40	7	-	-	-	3-M, 4-F	7	-	-	-	-	-
2	Mamom Village	60	8	-	6-M, 2-F	-	-	8	45 (R.r.-3M, 2F)	-	5 (R.r.-1M)	-	50(6)
3	Kochalumoodu village	35	13	-	4-M, 1-F	5-M, 3-F	-	13	21 (S.m.- 2M, 3-F)	4 (S.m.-1M)	-	-	25(6)
5	DHS, Secretariat Building	30	0	-	-	-	-	0	-	-	-	-	-
6	Rajaji Nagar	50	10	2-M, 6-F	-	-	2-M	10	-	-	-	52 (B.i.-2F)	52(2)
	Total	215	38	8 (21.1)	13 (34.2)	8 (21.1)	9 (23.7)	38 (100)	66 (10)	4 (1)	5 (1)	52 (2)	127 (14)

M-Male, F-Female, B.i.-*Bandicota indica*, R.r.- *Rattus rattus*, S.m.- *Suncus murinus*, M.m.-*Mus musculus*
Ectoparasite collected: *Xenopsylla cheopis* (5), *Leptotrombidium deliense* (66), *Haemaphysalis spp.* (4) and Lice (52)

The traps were collected on the next morning and brought back to the laboratory. Rodents collected were anaesthetized and identified after recording their different morphological characteristics. To detect *Orentia* and plague bacilli infection rodent blood was drawn, serum was separated and tested for Weil Felix reaction and plague antibody test (Lal, 2005; NCDC, 2009). Dissection of rodents was done and organs impression smear of rodent heart, lung, liver and spleen were made and fixed for identification of plague bacilli. These organs were also placed in culture medium for isolation of *Yersinia pestis*. Serological and bacteriological studies were carried out at Zoonosis Division.

Ectoparasites collection and processing

The ectoparasites were recovered by combing the rodents against the fur of rodents over a white tin pan. The snout, ears, limbs and axillary region of individual rodents were combed and ectoparasite were collected and preserved in 70% alcohol for further processing. Occasionally forceps were used for tick collection. All preserved ectoparasite were later mounted using clearing, dehydration and mounting procedure for identification using standard identification keys and methods described by Kumar *et al.*, (1997).

Results and Discussion

During the investigation a total of 215 rodent traps were laid in the different places. The overall traps positivity rate was recorded as 17.6 per cent. From positive traps a total of 38 rodents in order of their prevalence were *R. rattus* (34.2%), *M. musculus* (23.7%), *B. indica* (21.1%)

and *S. murinus* (21.1%). Among all the four rodent species, male 22 (57.9%) were more than 19 (42.1%) female. The overall infestation rate of ectoparasites was recorded 36.8 per cent. Locality wise number of traps laid, rodent collected and ectoparasites retrieved are given in Table-3. Ectoparasites (mite, flea, tick and lice) retrieved from the trapped rodents were preserved in 70% alcohol for identification and processing at laboratory.

As a result of combing of the rodents mites were the dominated ectoparasite (52.0 per cent) retrieved followed by lice, fleas and tick. Over all rodent ectoparasite index was 3.3 per rat. A total 66 vector larval trombiculide mite chigger (*L. deliense*) was collected from the rodents giving an overall chigger index as 1.74, which was above the critical level of chigger load i.e. 0.69 per rodent (Oleson and Bourgeois, 1982). Chigger infestation rate was found to be 6.6 per rat. The chigger infestation was found only on *R. rattus* and *S. murinus* collected from Mamom and Kochalummoodu village which have ecology supportive of Scrub Typhus. During the combing of these rodents five fleas (*Xenopsylla cheopis*) were retrieved giving an overall flea index as 0.13. These fleas were retrieved from *R. rattus* collected from Mamom village. In a similar study in Dehradun, Solanki *et al.*, (2013) recovered 10 fleas from three different species of rodents with 0.2 flea index. Only four ticks (*Haemaphysalis* spp.) were retrieved from *S. murinus* collected from Kochalummoodu village.

A total of thirty five serum samples taken from various rodents species captured alive were processed for detection of *Orentia* (Scrub typhus) and plague antibodies and all the samples were found non- reactive. Examination of organs

impression smear of rodent heart, lung, liver and spleen showed no plague bacilli activity. Similarly, inoculation from the tissue of rodents could not show *Y.pestis* isolation.

The ecology of the Thiruvananthapuram was found highly supportive for the multiplication and propagation of the rodents and their ectoparasites. Earlier in the similar kind of study (Saxena, 1989) revealed that chigger mites are habitat specific and found in abundance with forested terrain with long grasses. Studies carried out in Himachal Pradesh during the outbreak of scrub typhus in 2003 wherein, higher chigger index (2.46) was recorded because the habitat was found to be conducive for harboring/propagation of rodents and mites (Kumar *et al.*, 2004). During the present study the chigger index was recorded as 1.74 which is higher the critical level i.e. 0.69 per rodent (Oleson and Bourgeois, 1982). In Thiruvananthapuram cases of scrub typhus was reported as early as in the year 2000 and since then, scattered cases have been reported every year not only from Thiruvananthapuram but from other district of Kerala also. In the recent past (Ittyachen, 2009) reported scrub typhus as emerging infections in the midlands of Kerala. Saifudheen *et al.*, (2012) reported two cases of scrub typhus meningoencephalitis from northern Kerala. Christopher and Sreekanthan (2012) reported a case of scrub typhus presenting as a typical pneumonia from Aruvikkara in Thiruvananthapuram district, a highly endemic zone for scrub typhus.

Scrub Typhus cases reported from the four district of Kerala during 2011 and their seasonal prevalence is given in table 1 and 2. The table shows that most of the cases

occur during post monsoon season and transmission also take place during this period.

Laboratory diagnosis of the reported cases of scrub typhus was based on clinical/serological and molecular diagnostic tests. All the above studies and present investigation in Kerala on the prevalence of rodent and their ectoparasite in connection with scrub typhus showed that Kerala state is vulnerable for the transmission of scrub typhus.

In view of the regular occurrence of disease, presence of different vector mite above critical limit on rodent species suggest routine and regular mite / rodent surveillance in Kerala with special attention on Thiruvananthapuram and surrounded area being a capital of Kerala state. Before the onset of transmission season (post monsoon) early case detection through regular surveillance and lab diagnosis should be strengthen for proper and early treatment of case to prevent morbidity and mortality due to scrub typhus. Intensive health education should be imparted in the health officials and local masses about causation of disease, vector mites; it's transmission cycle and seasonality, so that they can take preventive measures. For prevention and control of the scrub typhus people frequenting forest for the work may be advised to apply locally available repellent on legs, arms and other exposed body parts to prevent mite bites.

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