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Microbiology

IS SCRUB TYPHUS VIOLATING THE NORMAL SEASONAL PATTERN OF VECTOR BORNE DISEASES?

KEY WORDS: Vector borne disease, Orientia tsutsugamushi, Scrub typhus, Dengue, Malaria, ELISA.

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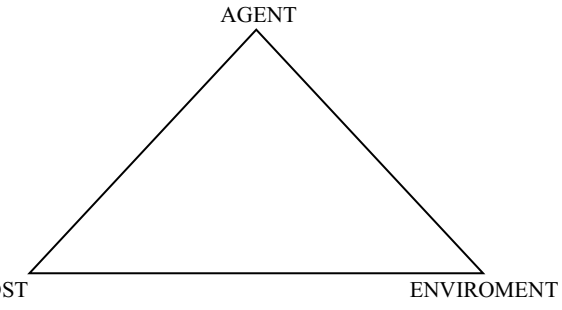
ABSTRACT

INTRODUCTION: Scrub Typhus is an important emerging vector borne disease being reported now in many parts of the country. Scrub Typhus is caused by bacteria called *Orientia tsutsugamushi* and is transmitted to people through bites of infected chiggers (larval mites). The disease occurs preferentially in spring and in autumn. As the ecological parameters varies with variation of season, so also the different stages in the life cycle of the vector varies. Thus it is logical to assess that the incidence of vector borne diseases will keep changing with change of season. Our study was performed to investigate this seasonal variation among the three important Vector borne diseases which are diagnosed in our departmental laboratories i.e Scrub typhus, Dengue and Malaria. **METHODS:** The observational study was conducted from January 2020 to December 2020. Blood from febrile patients was collected and tested for Scrub typhus, Dengue and Malaria. All of them were tested negative for SARS CoV2 by RTPCR. ELISA was the method of choice for detection of Scrub typhus and Dengue (both NS1 & IgM) and for detection of Malaria parasites we performed Blood smear microscopy along with Rapid Diagnostic Test (RDT). **RESULTS:** Total 1080 samples were tested for Detection of Dengue NS1 antigen, out of them 78(7.2%) were positive and 990 samples underwent Dengue IgM testing, 42(4.2%) samples were positive. Out of 480 cases of Malaria, 27(5.6%) cases were positive. Positive cases of Malaria followed the same seasonal pattern as Dengue i.e late monsoon and early winter. Total 623 cases were tested for Scrub typhus, among them 143 (22.4%) were positive and positivity rate was much higher than other two Vector borne diseases and positivity rate was persistent all throughout the year , violating the usual seasonal pattern of Vector borne diseases , thus causing a persistent threat to human population.

INTRODUCTION

All infectious diseases show



That means the diseases occur as a result of permutation and combination among the three important factors. Agent- means the microorganism responsible for the actual pathogenesis. Host- in case of Doctors is his patient (in case of veterinarians, animals are the host, in case of plants, botanists are the host etc). And the Environment- includes whole of the ecosystem including air, soil, plants, temperature , humidity and most important of all VECTORS IN THE LOCALITY. We may consider the host to be the constant factor. Agent may show slight variation with time (Variable but not culturable form of Vibrio cholerea). However, the environmental status along with the stage of the life of a vector varies from season to season. The net result is a variation in the incidence of Vector borne diseases with the change of season. Some Vector borne diseases are found more during the monsoon season for example Bacterial diarrhoea . Dengue fever in the recent year characteristically is found to increase in incidence during the late monsoon month and early winter i.e just before and during the Durga Puja festival in our part of the World. Considering these factors, our study was performed to investigate this seasonal variation in the three important Vector borne diseases which are diagnosed in our departmental laboratories i.e Scrub typhus, Dengue and Malaria.

Scrub typhus, first described in Japan caused by *Orientia tsutsugamushi* (formerly known as Rickettsia), is an acute infectious disease of variable severity, transmitted to humans by the larval stage(Chiggers) of the Trombiculid mites, possibly Leptotrombidium delience[1]. A number of small rodents, particularly wild rats are the natural host for Scrub typhus. Infection of human takes place by accidental bite of infective larval mite while walking. . **In general, Scrub typhus positivity starts from rainy season with the peak incidence in July followed by October. This might be because the occurrence of Leptotrombidium is influenced by rainfall.** Scrub typhus is manifested clinically by high fever, intense generalized headache, diffuse myalgias and in many patients rash and an Eschar at the site of the Chiggar bite. But presence of Eschar is variable in proportion and in our institution, we found patients with fever and diarrhoea who turned out to be Scrub typhus positive. The disease lasts for 14 to 21days without treatment. Severe infections may be complicated by interstitial pneumonia, pulmonary oedema , congestive cardiac failure, circulatory collapse and a wide range of signs and symptoms of Central Nervous System dysfunction, including delirium, confusion and seizures. Death may occur as a result of these complications, usually late in the second week of illness .Most patients are treated with Doxycycline and Azithromycin is given in pregnant patients.

Dengue virus is a mosquito borne illness. There are mainly four Dengue Serotypes DENV1 to DENV4 and a fifth variant (DENV5) has been isolated but not found in Indian climate. This year Dengue Type 4 was prevalent in West Bengal as found by species identification from NS1 positive samples.

Dengue virus is transmitted mainly by bite of *Aedes aegypti* mosquito and to a lesser extent by *Aedes albopictus*. Dengue presents clinically after an incubation period of 3-14 days as sudden onset fever, headache, retrobulbar pain, pain in the back and limbs (break-bone fever), lymphadenopathy and maculopapular rash. Dengue is also associated with grave complications like hemorrhagic manifestations (Dengue hemorrhagic fever) or with shock ((Dengue shock syndrome) [2]. Complications are particularly fulminant in case of second attack with DENV 2 serotype. This is primarily an immunological phenomenon. Dengue is a self limiting disease. Close monitoring along with antipyretics and maintenance of hydration is necessary.

Next important vector borne disease is Malaria. There are five important species of Malaria. :*Plasmodium falciparum, P.vivax, P.ovale, P.malariae and P.knowlesi* . The disease is transmitted by bite of infected female *Anopheles stephensii* or female *Anopheles culicifacies* mosquitoes [3]. Patient comes with fever, chills, arthralgia, myalgia, headache, splenomegaly, anaemia, thrombocytopenia, pulmonary or renal dysfunction and altered sensorium. *P.falciparum and Pknowlesi are* the species associated with most complicated cases. Patients are generally treated with Chloroquine but in complicated cases patients require hospitalization. Drug resistance in Malaria is an important problem in treatment and new drugs in the form of Artemisinin, Pyrimethamine/Sulfadoxine combination, Minocycline etc are helping to a great extent. In spite of its toxicity, Quinine has again come back to combat drug resistance.

METHODS

The study was conducted between January 2020 to December 2020 to observe the variation of incidence of vector borne diseases with change in climate throughout the year . Sample was collected from patients having fever(body temperature >37^{0}C), headache, cough, rashes and with gastrointestinal symptoms. Diagnostic assays were performed in our departmental laboratory. All the selected patients were SARS CoV2 negative as confirmed by RTPCR. We performed ELISA for detection of Scrub typhus and Dengue whereas for detection of Malaria parasites blood smear microscopy (Thick and thin smear) and Immunochromatographic method or Rapid diagnostic test (RDT) were the methods of choice.

Scrub typhus was detected by InBios Scrub typhus IgM ELISA kits, which is a semi quantitative method for the detection of IgM antibodies to Orientia tsutsugamushi in serum. Dengue NS1 ELISA was done by Bhat Bio-Scan ELISA kit whereas InBios DENV Detect IgM Capture ELISA kit was used for detection of Dengue IgM ELISA antibodies. MAL CARD J Mitra Rapid Malaria Card was utilized for Malaria parasite detection. But the Gold Standard was examination of Leishman stained smear of peripheral blood.

RESULTS

Total 1080 samples were tested for Detection of Dengue NS1 antigen, out of them 78(7.2%) were positive and 990 samples underwent Dengue IgM testing, 42(4.2%) samples were positive. It is observed in our study that peak season of Dengue positivity mostly seen between July to December and some cases are also seen from January to March. Whereas, out of 480 cases of Malaria, 27(5.6%) cases were positive . Positive cases followed the same seasonal pattern as Dengue i.e most cases are seen during late monsoon and early winter. **BUT, Scrub typhus showed different a result from the other Vector borne diseases. Total 623 cases were tested for Scrub typhus, among them 143 (22.4%) were positive and positivity rate was much higher than the other two Vector borne diseases. Most of all, they altered the normal seasonal occurrence and showed high positivity all throughout the twelve months of the year.**

Seasonal variation among the positive cases

Table-1 Dengue Cases (2020)– Ns1

Month	Total cases	Positive Cases	Percentage
JANUARY	150	5	3%
FEBRUARY	121	3	2.4%
MARCH	104	3	2.9%
APRIL	46	0	0
MAY	8	0	0
JUNE	21	0	0
JULY	39	5	12.8%
AUGUST	48	6	12.5%
SEPTEMBER	117	5	4.3%
OCTOBER	128	20	15.6%
NOVEMBER	171	21	12.3%
DECEMBER	127	10	7.9%

Table-2 Dengue Cases (2020)–IgM

Month	Total cases	Positive Cases	Percentage
JANUARY	100	6	6%
FEBRUARY	123	3	2.4%
MARCH	90	3	3.3%
APRIL	34	0	0
MAY	3	0	0
JUNE	20	0	0
JULY	51	2	3.9%
AUGUST	81	6	7.4%
SEPTEMBER	100	5	5%
OCTOBER	109	8	7.3%
NOVEMBER	160	6	3.8%
DECEMBER	119	4	3.4%

Table-3 Malaria Cases (2020)

Month	Total cases	Positive Cases	Percentage
JANUARY	30	2	6.7%
FEBRUARY	20	1	5%
MARCH	25	1	4%
APRIL	20	1	5%
MAY	25	1	4%
JUNE	29	1	3.4%
JULY	51	2	4%
AUGUST	84	5	5.9%%
SEPTEMBER	55	3	5.5%
OCTOBER	44	3	6.8%
NOVEMBER	58	4	6.9%
DECEMBER	45	3	6.7%

Table-4 Scrub typhus cases (2020)

Month	Total cases	Positive Cases	Percentage
JANUARY	56	08	14.3%
FEBRUARY	105	14	13.3%
MARCH	99	13	13.1%
APRIL	80	12	15%
MAY	50	7	14%
JUNE	30	7	23.3%
JULY	20	6	30%
AUGUST	36	11	30.5%
SEPTEMBER	74	15	20.3%
OCTOBER	51	14	27.5%
NOVEMBER	123	38	30.8%
DECEMBER	74	21	28.4%

DISCUSSION

The epidemic of any disease process relies on suitable environmental and climatic condition [4]. Climatic factors affect the development of pathogens in vectors. Till now, influence of the climatic conditions in Vector borne diseases is well documented and all the Vector borne diseases are following the pattern but Scrub typhus is showing a diversity . **From our study, it is evident that, Scrub typhus positivity is much higher than Dengue and Malaria and its vector is**

continuously present in our environment all throughout the year violating the usual seasonal pattern of Vector borne diseases , thus causing a persistent threat to human population. 2020 is an unique year. This year we faced the COVID PANDEMIC which is having an effect on human population as well as on the environment, hence all data have been slightly affected by this.

Previous some studies show varying results.

A study done in Sikkim in 2013 which showed Scrub typhus incidence was highest during the rainfall followed by early winter [5].

Again, in Bangladesh a study was conducted in 2018, which showed strong seasonal pattern in incidence, with an increase before the end of the rainy season and a decrease of cases in the middle of the dry season [6].

Keeping all the above mentioned things in our mind, we have to take necessary measures for prevention of Scrub typhus so that the situation never goes out of control.

1. No effective vaccines for Scrub available till now due to antigenic diversity of the strains, lack of data regarding live vaccines in human volunteers, so we have to be dependent on physical methods of prevention.

2. First of all, health education and environmental modification in the context of Scrub typhus. Awareness and educational activities should be targeted at school children, teachers and women groups in endemic areas along with the general population.

3. Avoiding the areas with bushes and wood piles, avoiding sitting or lying on bare ground or grass , cutting down all bushes near locality.

4. Personal prophylaxis against mite vectors include, wearing protective clothes and using insect repellents containing 5% emulsion of dimethylphthalate. Also, impregnating clothes with chemicals (permethrin and benzyl benzoate) can prevent chigger attachment. When sitting on ground or camping, groundcovers and tents with closed floors should be used. Lathering with soap in a hot bath or shower will remove both attached and unattached chiggers [7].

5. Rat population can also be controlled by measures like poisoning and rat trapping as environmental measures. Mites from sites should be eliminated by application of chlorinated hydrocarbons (lindane, dieldrin and chlorane) to the ground and vegetations in camps and other populated zones in endemic areas.

6. Chemoprophylaxis once weekly dose of 200 mg Doxycycline is considered effective for nonimmune people sent to work in endemic areas and in high risk travelers.

CONCLUSION

Social and environmental changes such as urbanization, climate change, agricultural expansion and intensification, water resource development, deforestation, natural resource exploitation, trade and population movement are creating suitable conditions for Vector borne diseases transmission, and current tools do not fully address these Vector Borne Disease determinants. There is an urgent need for increased investment in strengthening program capacity for surveillance and control, as well as the development of new vector control tools. Prevention from the chigger bites can be ascertained by personal prophylactic measures, environmental management, community awareness and chemical control in the areas of heavy infestations of the chiggers. It is evident from our study, we have to be cautious for prevention of Scrub typhus all throughout the year as the climatic changes and other factors are helping the mites to be present in any environmental conditions thus causing persistent high positivity rate.

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