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An Overview of the Clinical Profile and Risk Factors Associated with Severe Scrub Typhus Infection: A Hospital Based Study in Coimbatore

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ABSTRACT

Backgrounds: Scrub typhus (ST) is an important cause of acute undifferentiated febrile illness. ST is caused by Orientia tsutsugamushi transmitted by the bite of a trombiculid mite. It is endemic in East Asia, the South Pacific, and the Indian subcontinent. In India, ST accounts for about 23% of all febrile illnesses. This study aimed to assess the clinical profile of ST and associated risk factors.

Materials & Methods: This cross-sectional study was conducted on 47 participants in the general medicine department of a tertiary medical college hospital in Coimbatore, south India from January 2020 to June 2021. All the participants suffered from fever and diagnosed with ST based on seropositivity of IgM enzyme linked immunosorbent assay (ELISA). Complete blood count, renal and liver function tests, and chest X-ray were performed. All the participants were admitted to the hospital and followed up.

Findings: The participants' age ranged from 18-80 years with a mean age of 48.40 years. Most ST cases occurred during January (48.9%). Fever was the common symptom (95.7%), while eschar was reported in only 19.1% of the individuals. Thrombocytopenia was detected in 12.8% of ST patients. Hypoalbuminemia was reported in 80% of those with hepatic dysfunction, and anemia was present in 28% of those with acute kidney injury.

Conclusion: This disease could present as a severe illness even in non-ICU (intensive care units) settings, and a high degree of suspicion is necessary for diagnosing and treating ST patients in endemic areas.

Keywords: *Orientia tsutsugamushi*, Rickettsia, Scrub typhus, Tsutsugamushi disease, Vector borne diseases

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Introduction

Scrub typhus (ST) is known by multiple names: bush typhus, jungle typhus, Tsutsugamushi disease, and Japanese river fever [1, 2]. It is an acute zoonotic infection caused by a mite-borne bacterium called *Orientia tsutsugamushi*, which is transmitted via insect bites [3]. The arthropod responsible for this transmission, which also serves as a reservoir for this bacterium, is the *Leptotrombidium* mite [4-8]. *O. tsutsugamushi* is a Gram negative, obligate, intracellular organism [4, 7]. It enters the phagocytes and vascular endothelium and begins its replication process, thereby affecting the highly vascularized organs of the body [4]. ST threatens one billion people globally and causes illness in one million people each year. Geographically, ST was initially believed to be restricted to the 'Tsutsugamushi triangle" which covers more than 8 million km^2, extending from the Pakistan region in the west to Japan in the east, and from Russia in the north to Australia in the south. But it is now being reported outside this 'triangle' [4, 9]. ST is considered as a serious public health problem in the Asia-Pacific area, which includes Korea, Japan, China, Taiwan, India, Indonesia, Thailand, Sri Lanka, and the Philippines [10]. In India, states that have recently reported high incidence rates of ST include Tamil Nadu, Andhra Pradesh, and Karnataka Kerala in the south; Himachal Pradesh, Uttaranchal, Jammu, Kashmir, Meghalaya, Assam, and Nagaland in the north; West Bengal and Bihar in the east; and Maharashtra and Rajasthan in the west [11].

The incidence rate of ST seropositivity in the Asia-Pacific region ranges from 9.3 to 27.9% [12]. A peculiar seasonality has been reported for the incidence of this disease in several countries across Asia, especially where it occurs during winters, such as southern India, while it is generally found post monsoon. This could be explained by the shrubs harboring the causative mites and growing particularly well following rainfall [13, 14]. The incidence and clinical profile of ST have not been studied in depth in southern Indian states like Tamil Nadu.

Clinically, ST manifests as high fever with malaise, headache, cough, myalgia, exanthematous rash, and lymphadenopathy along with the involvement of different systems, such as the respiratory, cardiovascular, and hepatobiliary systems as well as the brain [3, 6, 9]. This leads to manifestations like hepatitis, pneumonia, renal failure, septic shock, myocarditis, acute respiratory distress syndrome (ARDS), and multiple organ dysfunction syndrome (MODS) [3]. A high case fatality rate close to 70% has been documented for untreated ST, while the mortality rate in treated cases is close to 1.4% [3, 9].

Diagnosis of ST may be challenging as other tropical fevers which also tend to occur seasonally, such as dengue, malaria, typhoid, or leptospirosis, may overlap with ST clinical features [6]. Though the disease is endemic in Tamil Nadu state, limited studies are available regarding the clinical profile of ST. Also, as far as we know, no study has been conducted to analyze the disease pattern in the western and southern parts of the state. With this background, the present study was undertaken to assess the clinical profile of patients with ST in the city of Coimbatore, south India.

Objectives: The objectives of this research were to assess the clinical and epidemiological profile of ST patients as well as the risk factors associated with severe ST infection.

Materials and Methods

This cross-sectional study was conducted on 47 participants in the general medicine department of a tertiary medical college

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hospital located in Coimbatore from January 2020 to June 2021. All the study participants were diagnosed with ST through seropositivity of IgM enzyme-linked immunosorbent assay (ELISA) [15]. The Institutional Human Ethics Committee approved the study protocol prior to conducting the study [PSG/IHEC/2019/APPR/EXP/293]. Sample collection was done by collecting 3 mL of blood in a plain redtop tube, followed by serum processing through indirect ELISA for scrub IgM.

Inclusion criteria: All male and female patients above 18 years of age, who exhibited IgM seropositivity for ST and consented to participate in the study were included in this study.

Exclusion criteria: Patients who were diagnosed with ST elsewhere or had already started their treatment, patients suffering from other infections (dengue, malaria, leptospirosis, or other bacterial infections), and those not willing to participate in the study were excluded from this study.

Procedure: All the participants signed the informed consent form. A detailed history was obtained from the participants, which included demographic data, occupation, and symptoms. After that a thorough general and systemic examination was performed. Routine investigations namely complete blood count, renal function test, liver function tests, and chest X-ray were performed. All the participants were admitted to the hospital and followed up until discharge. Organ failure and related risk factors were also recorded for these individuals.

The participants were monitored for acute kidney injury (AKI), hepatic involvement, central nervous system (CNS) involvement, myocarditis, acute respiratory distress syndrome (ARDS), and hematological involvement, and monitoring was performed based on criteria available in the literature [16]. Arterial blood gas analysis, electrocardiogram, and echocardiogram were done wherever necessary. The obtained data were tabulated and analyzed using SPSS (Statistical Package for the Social Sciences Inc, Chicago, USA) software Version 16.0. Continuous variables were expressed as mean and standard deviation (SD). Student t-test was performed to test two variables, and $p< .05$ was considered as statistically significant.

Findings

The current study included a total of 47 participants, among whom 48.9% belonged to the age group of 41-60 years, 31.9% were in the age group of 17-40 years, and 19.1% were above 61 years of age. In the present study, about 51.1% of the participants were male, indicating a male predominance. The majority of the participants had an urban background (68.1%), and about 34% of them were farmers by occupation. Most ST cases occurred during the winter months of January (48.9%), December (12.8%), and February (10.6%), followed by a resurgence during the monsoon months of June and July (8.5 and 6.4%, respectively) (Figure 1).

Fever was the most common symptom (95.7%), followed by chills and rigors (31.9%). Wheezing was reported in 17% of the individuals, while hypoxia and hypotension were detected in 14.9 and 12.8% of them, respectively. Eschar was observed in only 19.1% of the individuals (Table 1).

Figure 2 summarizes the laboratory and clinical parameters, and Figure 3 summarizes the distribution of organ dysfunction. Hematological abnormalities were observed in 31.9% of ST patients. About 14.9% of the individuals exhibited leukopenia, while 27.7% of them had leukocytosis. In the present study, about 12.8% of ST patients had severe thrombocytopenia with a platelet count of less than 50000 cells/mm^3, while

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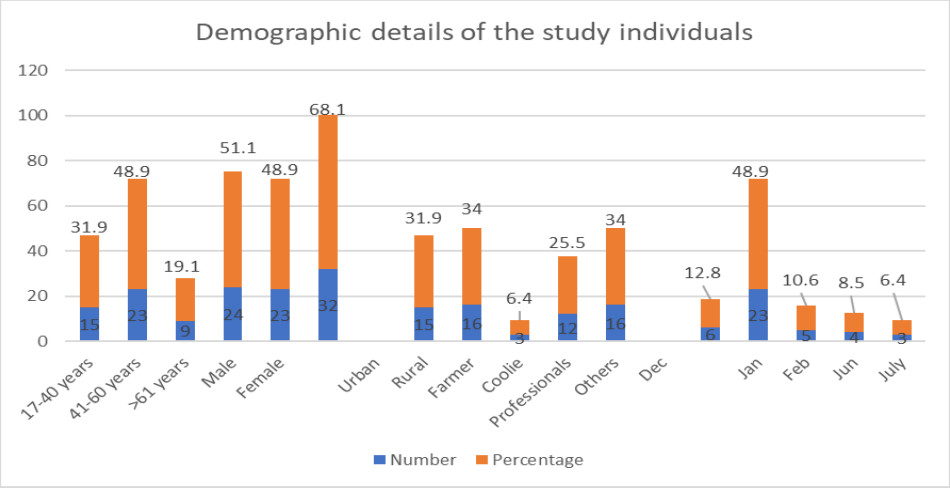

Figure 1) Demographic details of the study participants

27.7% of them had a platelet count of 50000 to 100000 cells/mm^3, and the remaining 59.6% had a platelet count of above 100000 cells/mm^3. Hepatic dysfunction was detected in 61.7% of ST patients. Elevated serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) levels (>50 IU/mL) were detected in 78.7 and 70.2% of the participants, respectively. Serum albumin was low in 46.8% of the participants. Serum creatinine was elevated in 31.9% of the participants. Myocardial involvement was the least common, with only 2.1% of the individuals having features suggestive of this issue.

The association of various laboratory and clinical parameters with organ dysfunction was evaluated. The association of organ dysfunction with age, gender, and eschar was not statistically significant (p> .05). These results are presented in Table 2. However, the sample size might not have been sufficient to detect more subtle differences.

About 53.2% of the study participants had hypoalbuminemia, among them 68.1% had normal renal function, whereas 31.9% had deranged renal parameters. In the present study, among the 22% of patients who developed shock, about 14.3% had hemoglobin levels less than 11 g/dL. Among the patients with low hemoglobin, 71.4% developed hepatic dysfunction, 28.6% had renal dysfunction, and 23.8% developed ARDS, and this difference was statistically significant (p= .06). Out of the six individuals who had hypotension, 50% developed ARDS, and the rest did not. This difference was also statistically significant (p= .010), these results are presented in Tables 3, 4, and 5. According to Figure 3, about 17% of the individuals had more than one organ dysfunction.

Discussion

ST has recently re-emerged in certain areas of India after years of quiescence [11]. The main driving factors behind this re-emergence could be deforestation, urbanization, changes in antimicrobial use, availability of better diagnostic tests, as well as climate changes [2, 17].

The majority of the individuals suffering from ST in the current study belonged to the age group of 41-60 years (48.9%). Previous studies have reported that people in the age group of 20-50 years are more commonly affected with ST, which is similar to a study in south India by Varghese et al. (2016) who reported the mean age of patients to be 45 years [8]. This could be due to the fact that people in this age group are actively involved in various occupations and frequently

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Table 1) Distribution of signs and symptoms observed by the study participants

Symptoms (Present)	Frequency	Percentage(%)
Fever	45	95.7
Breathlessness	7	14.9
Fatigue	4	8.5
Rash	3	6.4
Headache	13	27.7
Chills and rigors	15	31.9
Cough	14	29.8
Abdominal pain	8	17.0
Myalgia	11	23.4
Vomiting	10	21.3
Loss of appetite	4	8.5
Joint pain	1	2.1
Urinary disturbances	3	6.4
Loose stools	3	6.4
Signs (Present)	**Frequency**	**Percentage(%)**
Abdominat enderness	4	8.5
Rashes	2	4.3
Altered sensorium	2	4.3
Organomegaly	3	6.4
Wheeze	8	17.0
Hypotension	6	12.8
Hypoxia	7	14.9
Pedal edema	2	4.3
Icterus	2	4.3
Neck stiffness	2	4.3
Lymphadenopathy	2	4.3
Tachycardia	2	4.3

venture out [8, 18, 20].

Some studies have noted a slight female preponderance for ST, with a female to male ratio ranging from 1.16:1 (F:M) to 2.8:1 (F:M) [20, 21]. In the present study, a marginal male predilection was observed (51.1%, 24 of 47 patients). While Varghese et al. (2016) [8] found an equal gender distribution, Grover and Mehalingam (2021) in their study found a male preponderance (60.52%) [22]. Higher female dominance is attributed to greater involvement of women in agricultural and outdoor activities [20]. A study in south India in Telangana also found that 24.1% of patients had a history of exposure to vegetation and agricultural works [5]. Similarly, about 34% of the current study participants were involved in agricultural activities.

As reported in previous studies, ST predominantly affects the rural population [19]. However, in the present study, a higher percentage of participants had an urban background (68%). This could be attributed to increased urbanization, deforestation, and conversion of these areas into residential and commercial places, bringing humans closer to mite habitats. Similar result was also reported in a study by Bansod et al. (2021), where 52.14% of the individuals had an urban background [2].

Jain and colleagues (2019) observed that 61.53% of ST cases occurred during September and October [9], while Sivaranjan et al. (2016) found that most cases occurred from September to December [16]. Pathania and colleagues (2019) reported that most cases occurred during July, August, and September [21]. In the present study, most ST cases occurred during the winter months of December (12.8%), January (48.9%), and February (10.6%), followed by a resurgence during the monsoon months of June and July (8.5 and 6.4% respectively). Similar findings were also reported in a study by Varghese et al. (2016) in south India [8].

In ST, fever is the most common presenting symptom. In the present research, 95.7% of the individuals had fever. Varghese et al. (2016) found fever among 100% of their

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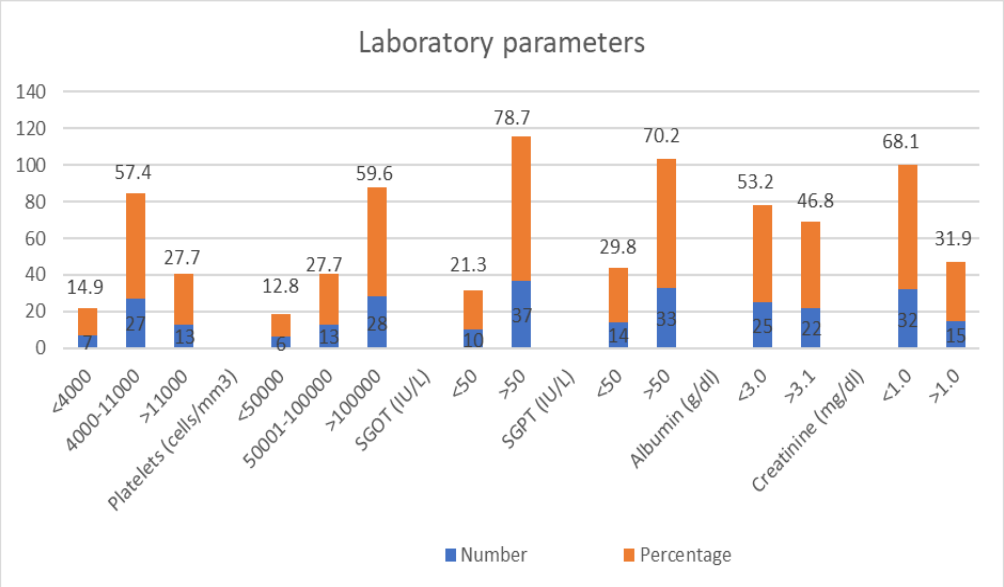

Figure 2) Laboratory parameters of the study participants

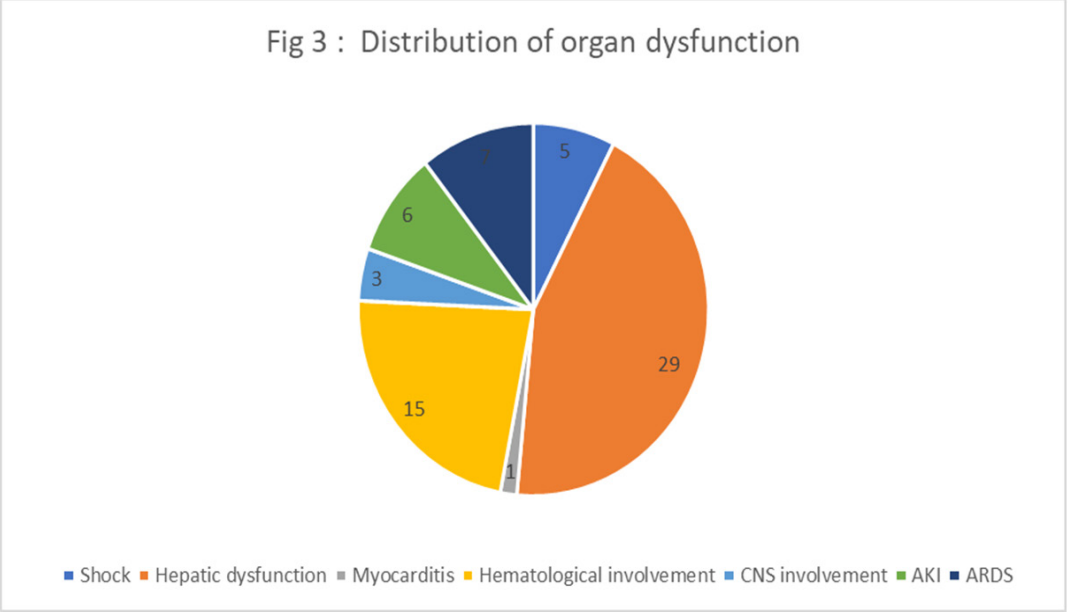

Figure 3) Distribution of organ dysfunction

study population [8]. Previous studies have also reported high incidence rates of fever as the most common presenting ST symptom, ranging from 76.0 to 100% [23, 24]. Other symptoms reported in the present study included cough (29.8%), headache (27.7%), myalgia (23.4%), vomiting (21.3%), and abdominal pain (17%). Similar symptoms have also been reported in previous studies [16, 19].

The incidence of eschar among ST patients in India has been reported to be low, ranging from 8-15%. This could be attributed to the prevalence of darker complexions among Indians and the low level of ST suspicion among practicing physicians [9, 22]. Conversely, higher incidence rates of eschar have been reported in previous studies by Varghese

Table 2) Association of organ dysfunction with age and gender of the study participants

Organ Dysfunction		Age in Years			*P*-Value	Gender		*P*-Value	Eschar		*P*-Value
		17-40	41-60	>61		Male	Female		Absent	Present	
Shock	Present	1(6.7%)	4(17.4%)	0(0.0%)	.298	1(4.2%)	4(17.4%)	.142	4(10.5%)	1(11.1%)	.959
	Absent	14(93.3%)	19(82.6%)	9(100.0%)		23(95.8%)	19(82.6%)		34(89.5%)	8(88.9%)	
Hepatic dysfunction	Present	9(60.0%)	16(69.6%)	4(44.4%)	.416	15(62.5%)	14(60.9%)	.908	25(65.8%)	4(44.4%)	.236
	Absent	6(40.7%)	7(30.4%)	5(55.6%)		9(37.5%)	9(39.1%)		13(34.2%)	5(55.6%)	
Myocarditis	Present	0(0.0%)	1(4.3%)	0(0.0%)	.587	1(4.2%)	0(0.0%)	.322	0(0.0%)	1(4.2%)	.322
	Absent	15(100.0%)	22(95.7%)	9(100.0%)		23(95.8%)	23(100.0%)		38(100.0%)	8(89.8%)	
Hematological involvement	Present	5(33.3%)	10(43.5%)	0(0.0%)	.059	7(29.2%)	8(34.8%)	.680	14(36.8%)	24(63.2%)	.136
	Absent	10(66.7%)	13(56.5%)	9(100%)		17(70.8%)	15(65.2%)		24(63.2%)	8(88.9%)	
CNS involvement	Present	1(6.7%)	2(8.7%)	0(0.0%)	.663	1(4.2%)	2(8.7%)	.525	3(7.9%)	0(0.0%)	.384
	Absent	14(93.3%)	21(91.3%)	9(100%)		23(95.8%)	21(91.3%)		35(92.1%)	9(100.0%)	
AKI	Present	1(6.7%)	5(21.7%)	0(0.0%)	.175	2(8.3%)	4(17.4%)	.352	6(15.8%)	0(0.0%)	.352
	Absent	14(93.3%)	18(78.3%)	9(100%)		22(91.7%)	19(82.6%)		32(84.2%)	9(100.0%)	
ARDS	Present	0(0.0%)	4(17.4%)	3(33.3%)	.076	2(8.3%)	5(21.7%)	.197	7(18.4%)	0(0.0%)	.163
	Absent	15(100.0%)	19(82.6%)	6(66.7%)		22(91.7%)	18(78.3%)		31(81.6%)	9(100.0%)	

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Table 3) Association of organ dysfunction with Hemoglobin levels in the present study

Organ Dysfunction		Hemoglobin		*P*-Value
		<11.0 gm/dL N(%)	>11.0 gm/dL N(%)	
Acute kidney injury	Present	6(28.6%)	0(0.0%)	.004*
	Absent	15(71.4%)	26(100.0%)	

* signifies statistically significance (p< .05).

Table 4) Association of organ dysfunction with Albumin levels in the present study

Organ Dysfunction		Albumin		*P*-Value
		<3.0 mg/dL	>3.1 mg/dL	
Hepatic dysfunction	Present	20(80.0%)	9(40.9%)	.006*
	Absent	5(20.0%)	13(59.1%)	

* signifies statistically significance (p< .05).

Table 5) Association of organ dysfunction with hypotension in the present study

Organ Dysfunction		Hypotension		*P*-Value
		Absent	Present	
Shock	Present	0(0.0%)	5(83.3%)	.000*
	Absent	41(100.0%)	1(16.7%)	
Hepatic dysfunction	Present	25(61.0%)	4(66.7%)	.006*
	Absent	16(39.0%)	2(33.3%)	
ARDS	Present	4(9.8%)	3(50.0%)	.010*
	Absent	37(90.2%)	3(50.0%)	

* signifies statistically significance (p< .05).

et al. (2016) (43.5%) [8] and Premraj et al. (2018) (58%) [18], both conducted in south India. Such a high incidence of eschar could probably be due to more outdoor activities. While the presence of eschar is consistent with the diagnosis of ST, its absence does not totally rule out ST [9]. In the present study, eschar was observed in only 19.1% of ST cases. Leukopenia and leukocytosis are commonly reported in ST cases. In the present study, leukopenia and leukocytosis were detected in 14.9 and 27.7% of the individuals. In previous studies, the incidence of leukopenia has been reported to vary from 1.87 to 15.1% [16, 21]. Similarly, the incidence of thrombocytopenia has been found to vary from 12.9 to 78.8% in previous studies [16, 19, 23]. In the present study,

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thrombocytopenia with a platelet count of less than 50000 cells/mm^3 was observed in 12.8% of ST patients, while a platelet count of 50000-100000 cells/mm^3 was observed in 27.7% of the individuals, which is similar to previous literature [16, 19, 21, 23].

Elevated levels of transaminases indicate hepatic involvement and are consistently observed in ST cases. In the present study, SGOT and SGPT were elevated in 78.7 and 70.2% of the individuals. This result is similar to the finding of a previous study conducted by Varghese et al. (2016) who reported elevated transaminases in the majority (87%) of ST patients [8]. These results are contrary to those reported in a study conducted by Peesapathi et al. (2019) who found that enzymes were elevated in only 20% of cases [25]. Pathania and colleagues (2019) found that transaminases were elevated in 74.07% of their patients [21]. Verma et al. (2021) found increased SGOT and SGPT levels in 69.2 and 57.7% of ST patients, respectively [20]. Sivarajan et al. (2016) found elevated SGOT and SGPT levels in 100 and 94% of their patients, respectively [16]. Jain and colleagues (2019) found that SGOT was higher than SGPT in 70% of ST cases [9]. These results are in accordance the present study findings.

Takhar et al. (2017) in their study reported respiratory complications in 69.7%, hepatitis in 48.5%, renal complications in 51.5%, CNS involvement in 39.4%, and CVS involvement in 30.3% of the individuals [19]. A study conducted by Premraj et al. (2018) found respiratory complications in 32% of the participants [18]. Also, a study by Varghese et al. (2016) found that 30% of the selected individuals suffered from respiratory involvement [8]. Bansod et al. (2021) found higher renal involvement (52.14%), followed by hepatic disease (48.5%) and respiratory involvement (42.14%) [2]. In the present study, hepatic involvement was recorded in 61.7%, ARDS in 14.9%, renal involvement in 12.8%, shock in 10.6%, and CNS involvement in 6.4% of all ST cases. The observed complications are within the range of complications reported in previous literature [8-19]. Some studies have reported a lower percentage of organ involvement, like the study by Hamaguchi et al. (2015), reporting ARDS in only 0.4% of the individuals [24]. Similarly, Pathania and colleagues (2019) found ARDS in only 7.4% of cases [21]. A study by Brummaier et al. (2017) found meningitis in 1.3% of ST cases [23], while Pathania and colleagues (2019) found that 20.3% of subjects were affected by meningitis [21].

In a study by Loomba et al. (2014), hypotension was observed in 12.9% of ST cases, and ST was found to be the main leading cause of septic shock. Capillary leakage and myocarditis are thought to be the cause of hypotension [13]. Hypotension was observed in 12.8% of ST cases in the present study.

In the present research, the association of multiorgan dysfunction with age and sex was assessed, but no statistically significant association was found. This finding is similar to the result of a study by Sivaranjan et al. (2016) who found no association between age and sex with multiorgan dysfunction syndrome [16].

The relationship between organ dysfunctions and clinical and laboratory parameters was investigated, and the results showed a significant relationship between reduced hemoglobin level (<11 gm/dL) and AKI (p= .004). A serum albumin level less than 3.1 mg/dl was significantly associated with hepatic dysfunction (p= .006). Similarly, hypotension was significantly associated with the development of shock (p= .000), hepatic dysfunction (p= .006), and ARDS (p= .010). These findings could be explained by effective sepsis-related blood volume

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depletion and, in our opinion, could probably be used as a sign to suspect the co-existence or impending occurrence of ARDS and hepatic dysfunction in ST patients. Similar associations have not been evaluated in previous studies. However, a study by Sivaranjan et al. (2016) reported increased serum bilirubin, SGOT, and SGPT, serum creatinine above 1.5 mg/dl, and platelet count below 100000 cells/mm^3 in ST patients, and these variables were found to be significantly associated with multiorgan dysfunction syndrome [16]. There was no mortality in the present study, which is similar to studies conducted by Hamaguchi et al. (2015) [24] and Pathania and colleagues (2019) [21], reporting low mortality rates (0.4 and 1%, respectively), while Takhar et al. (2017) in their study reported a mortality rate of 21.2% [19]. High mortality could be attributed to high bacterial load, bacterial virulence, late hospitalization, and delay in initiation of therapy. Furthermore, most patients succumb to complications such as renal or hepatic failure or ARDS [19].

A study by Karanth et al. (2014) concluded that low hemoglobin level (<12 gm/dL), leukocytosis (>10,000 cells/mm^3), thrombocytopenia (<150,000 cells/mm^3), and absence of eschar were independent predictors of ST severity [26]. Differences in clinical features, organ involvement, and laboratory parameters in various studies are due to the genotypic diversity of *O. Tsutsugamushi* attributable to its 56 kDa protein antigen. Karp-like strains seem to be predominant in north India and Kato-like strains in south India [27, 28]. However, there are limited studies describing or comparing the clinical features of each strain.

The most common laboratory abnormalities observed in ST patients are thrombocytopenia; elevated liver enzymes, bilirubin, and creatinine; leukopenia; or leukocytosis, but most patients have normal white blood cell counts. In some patients with severe illness, hypoalbuminemia is also observed [29]. While these laboratory findings are relatively non-specific, there are four methods that could be used to more definitively confirm the presence of *O. tsutsugamushi* infection: enzyme linked immunosorbent assay (ELISA), immunofluorescence, polymerase chain reaction, and rarely biopsy of eschar and rash and culture [30]. Although culturing the organisms is not a common practice, their isolation is possible from the patient's blood or eschar [9]. The sensitivity and specificity of ELISA have been found to be very high at 92–97% and 94–99%, respectively, and this makes ELISA the diagnostic test of choice [5, 29]. So far, research on ST vaccine development has been unsuccessful owing to the wide genetic variation of the organism and the organism's weakness and short lifespan. Active infection is managed using antibiotics such as doxycycline, tetracycline, azithromycin, or rifampicin as first-line drugs or a combination of chloramphenicol and tetracycline in case of resistance to first-line drugs [31].

Limitations: A few limitations that could be listed include the sample size of 47 participants, which may be considered small for a study aiming to assess risk factors associated with severe ST infection. The study lacked a comparison or control group, which limits causal conclusions about risk factors associated with severe ST infection. It was not possible to obtain a higher sample size owing to the COVID 19 pandemic, which might also have led to the underreporting of milder ST cases in the hospital. The exclusion of mixed infections also contributed to the lower sample size as a significant number of patients had either dengue or COVID as coinfections. Also, the symptoms of a few patients were highly suggestive of rickettsial infection, but serology was not done due

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to patient restraints; therefore, they were not included in the study. In this study, no statistically significant association was found between organ dysfunction and age, gender, and eschar (p> .05), and this finding could also be explained by the low sample size. The lack of multivariate analysis to control for confounding factors makes it difficult to establish a causal relationship between the studied variables and organ dysfunction. The results of this study are related to a small sample from a single center, while a multicentric approach may provide clearer clinical and epidemiological findings. This sample also represents ST cases of a hospital and not of the community; hence, community-based research may provide a true seroprevalence in this region.

Conclusion

ST could present as a severe illness even in non-ICU settings, and a high degree of suspicion is necessary for physicians, especially at the primary level for early diagnosis. As shown in this study, this disease could be observed in both urban and semi urban regions, and the 'telltale' sign of eschar might not be present in many patients. Careful examination and evaluation could lead to early diagnosis and initiation of therapy. Early resuscitation of patients with low blood pressure, examination of lung involvement at admission, considering the high incidence of lung complications, and emphasis on laboratory parameters like hemoglobin and albumin could help in assessing impending complications and preventing MODS.

Key points

Key points of this study are as follows: i) Scrub typhus (St) is a re-emerging and underdiagnosed zoonotic disease. ii) ST clinical features could be easily mimicked by any of the other tropical fevers iii) The absence of the characteristic eschar does not rule out the disease IV)Patients with acute febrile illness should be examined for ST, especially in endemic areas. V) Appropriate multisystem laboratory investigations should be performed to prevent severe typhus infection, and appropriate antibiotic therapy should be initiated as soon as possible.

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