

OUTCOME IN ADULTS WITH SCRUB TYPHUS WITH SPECIAL REFERENCE TO SERUM PROCALCITONIN

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Received : 20/02/2026
Received in revised form : 01/04/2026
Accepted : 18/04/2026

Keywords:

Scrub Typhus, Serum Procalcitonin, observational cross-sectional study.

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DOI: 10.47009/jamp.2026.8.2.149

Source of Support: Nil,

Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (2); 802-809



ABSTRACT

Background: Aim: To study the role of serum procalcitonin in outcome of scrub typhus. **Materials and Methods:** An observational cross-sectional study was conducted in adult IPD patients in Department of Medicine for one year duration. A total of 132 cases were included in the study. **Results:** 132 patients aged between 17-80 years were included in the study, of which 33.33% patients were males and 66.67% were females. 100% of the patients had fever on presentation. Jaundice was present in a significant percentage of patients (45.45%). Other significant presenting features included altered sensorium (34.85%), pain abdomen (33.33%), vomiting (31.06%), seizure (15.91%), headache (13.64%) and dyspnea (12.12%). 93.2% patients recovered and were successfully discharged. 6.8% patients expired. Significant positive association was found between outcome of scrub typhus and serum procalcitonin level, serum ALP, LDH with a p-value of <0.001, 0.048 and 0.03 using Chi-square test. 13.6% patients required mechanical ventilator support. Significant positive association was found between serum procalcitonin levels and the need for mechanical ventilation (p<0.001). **Conclusion:** To conclude, we found that scrub typhus has a varied clinical presentation, often a multisystem involvement. Procalcitonin, which in bacterial infections is a diagnostic and prognostic marker, is not routinely elevated in patients of scrub typhus. In scrub typhus patients who have elevated procalcitonin, it is associated with poor outcomes, including increased requirements of ventilatory support. ocalcitonin, in combination with other biomarkers, may have a role in predicting outcomes in patients with scrub typhus, though larger multicentric studies are needed to establish a correlation.

INTRODUCTION

Scrub typhus is an undifferentiated febrile illness caused by the bacterium *Orientia tsutsugamushi*. It is primarily transmitted through the bites of larvae from trombiculid mites. This disease is significant as it represents one of the key causes of undifferentiated fever in India.^[1] Illness presents a spectrum of severity, ranging from mild and self-limiting cases to severe instances that necessitate ICU admission and may result in death. The clinical manifestations can include symptoms such as fever and body aches, progressing to more critical conditions like multiorgan failure, encephalopathy, and acute respiratory distress syndrome.

Patients with acute febrile illness (AFI) exhibiting symptoms such as headache, anorexia, cough, breathlessness, chest pain, abdominal pain and

distension, diarrhoea, and facial puffiness, along with laboratory findings of transaminitis and hypoalbuminemia, tested positive for scrub typhus IgM antibodies using the indirect fluorescent antibody (IFA) method.^[2] Pain abdomen, nausea and vomiting was seen as most common presenting symptoms in some patients³ Untreated patients have exhibited a range of cranial nerve deficits, with acute hepatitis identified as the most frequent complication observed in certain individuals. Patients may have crepitations, wheeze; of which crepitations carry a poorer prognosis. Features of pneumonitis, ARDS, pleural effusion, bronchitis, consolidation and interstitial pneumonitis was seen on chest radiograph in scrub patients presenting with respiratory distress. Respiratory failure is a complication, often requiring ventilatory support. Signs of cardiac dysfunction can manifest through minor electrocardiographic

abnormalities such as first-degree heart block and inverted T waves. In cases of myocarditis, additional indicators may include the presence of a gallop rhythm, diminished heart sounds, and systolic murmurs. Scrub is typically linked with increased liver enzymes and alkaline phosphatase (ALP), alongside a reduced platelet count.

Patients may recover well. Some may require hospitalisation. Patients may develop shock, multiorgan dysfunction syndrome and acute respiratory distress syndrome, requiring ventilator support or even die. Commonest cause of death includes multiorgan dysfunction syndrome, followed by ARDS, AKI and DIC.^[2] Elevated TLC, liver enzymes, coagulation profile, urea, uric acid are found to be significantly associated with mortality in scrub patients with high PCT³. Good proportion of patients were found to have hepatorenal syndrome. Anaemia (hemoglobin levels below 12 g/dl), elevated creatinine levels above 1.4 mg/dl, and low serum albumin concentrations have been identified as independent predictive factors for the severity of scrub typhus in several studies.^[2] Presence of eschar was found to be associated with fatal outcome. TNF alpha serves as a prognostic marker indicating the severity of scrub typhus. Key clinical findings that correlate with prolonged hospitalization include the absence of skin rash, the presence of pulmonary edema and pleural effusion, elevated creatinine levels (≥ 1.5 mg/dl), total bilirubin levels (≥ 1.5 mg/dl), adenosine deaminase (ADA) levels (≥ 100 /L), and ferritin levels (≥ 500 ng/ml).

Procalcitonin (PCT) is emerging as a significant biomarker for identifying sepsis and bacterial infections. Typically, in cases of bacterial infections, serum procalcitonin levels begin to increase approximately 4 hours following the onset of a systemic infection, achieving peak levels between 8 to 24 hours thereafter.^[4] When bacterial endotoxins are detected by the immune system, proinflammatory cytokines such as IL-1 β , TNF- α , and IL-6 trigger the production of procalcitonin (PCT). Additionally, lipopolysaccharides from bacterial cell walls activate immune cells, leading to a systemic immune response and subsequent PCT release. In contrast, viral

infections primarily engage interferons (INF- γ), which inhibit PCT production. Notably, elevated levels of IL-6 and TNF- α have been observed in patients with scrub typhus, correlating with increased mortality rates.^[5] The study is being done to evaluate various biochemical markers and the role of procalcitonin and clinical parameters in the outcome of scrub.

MATERIALS AND METHODS

This cross sectional observational study was conducted in IPD basis patients in Department of Medicine, BRD Medical College, Gorakhpur for one year duration. All scrub typhus patients diagnosed and admitted in medicine ward of Nehru Chikitsalay during the study data collection period will comprise the sample size.

Inclusion Criteria

- All patients admitted in medicine ward with acute febrile illness and positive for scrub typhus IgM.
- Patients of age 17 years or above.

Exclusion Criteria

- Acute febrile illness due to cause other than scrub typhus like dengue, malaria, typhoid, tuberculosis etc.
- Pre diagnosed cases of CKD, CLD.
- Known case of SLE, RA or other auto-immune diseases.
- Pregnant females.
- Known case of congestive heart failure or any other cardiac dysfunction.
- Patients taking any immunosuppressant.
- All cases of malignancy.

Statistical Analysis: Microsoft Excel will be used for tabulation of data. IBM Statistical Package for Social Sciences (SPSS) will be used for statistical analysis

Ethical Consideration: The protocol requires review by the Institutional Ethics Committee, and the study was proceeded only after obtaining approval. Written informed consent was obtained from all participants before the study begins, and all information collected were kept confidential.

RESULTS

Table 1a: Mean age of patients

MINIMUM (years)	MAXIMUM (years)	MEAN (years)	STD. DEVIATION
17	80	34.60	15.132

Table 1b. Age distribution of patients

Age	Frequency
<40YEARS	90 (68.18%)
40-60YEARS	34 (25.76%)
>60YEARS	8 (6.06%)

A total of 132 patients were included in the study, with age ranging between 17- 80 years with a mean age of 34.60 years. Majority (68.18%) belonged to <40years age group.

Table 2: Distribution of patients according to gender and age

GENDER	<40YEARS	40-60YEARS	>60YEARS	TOTAL
MALE	28 (31.1%)	14 (41.2%)	2 (25%)	44 (33.33%)
FEMALE	62 (68.9%)	20 (58.8%)	6 (75%)	88 (66.67%)

33.33% patients were males, 66.67% were females. Majority of males and females belonged to <40years age group, comprising of 31.1% and 68.9% respectively.

Table 3: Minimum, maximum and mean values of the biochemical parameters

LAB PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
Hb (g/dL)	2.7	15.6	10.146	2.2295
TLC(cells/mm ³)	3200	36000	13086.36	5808.927
PLC(cells/mm ³)	20000	480000	114909.09	74090.872
SBT (mg/dL)	0.25	34	4.2141	4.71335
T. protein (g/dL)	4.3	8.8	6.0049	0.84864
S. albumin (g/dL)	1.8	4.7	2.9740	0.53
SGPT (U/L)	28	682	231.85	149.604
SGOT (U/L)	17	553	158.80	107.671
ALP (U/L)	23	4111	939.39	803.903
S. Urea(mg/dL)	16	475	74.09	61.602
S. Cr (mg/dL)	0.2	15.43	1.7114	1.98
S. Na ⁺ (mmol/L)	124	157	138.69	6.2475
S. K ⁺ (mEq/L)	1.8	6.32	4.0027	0.67
CRP (mg/L)	0.47	113	36.5533	22.11
Ferritin (ng/ml)	144	2654	1096.6537	678.02
LDH (U/L)	117	3888	599.407	446.9652
TAG (mg/dL)	52	1364	298.8889	189.356
PCT (ng/ml)	0.01	61	2.0798	7.068
pH	7.2	7.56	7.40374	0.67
HCO ₃ (mmol/L)	9.8	39	23.531	4.6732
pCO ₂ (mm Hg)	13.8	68	37.208	9.2557
pO ₂ (mm Hg)	52	181	103.998	23.37

Table 4: Clinical features distribution

Clinical feature	Present	Absent
Fever	132 (100%)	0
Pain abdomen	44 (33.33%)	88 (66.67%)
Vomiting	41 (31.06%)	91 (68.94%)
Headache	18 (13.64%)	114 (86.36%)
Jaundice	60 (45.45%)	72 (54.55%)
Dyspnoea	16 (12.12%)	116 (87.88%)
Altered sensorium	46 (34.85%)	86 (65.15%)
Seizure	21 (15.91%)	111 (84.09%)

100% of the patients had fever on presentation. Jaundice was present in a significant percentage of patients (45.45%). Other significant presenting

features included altered sensorium (34.85%), pain abdomen (33.33%), vomiting (31.06%), seizure (15.91%), headache (13.64%) and dyspnea (12.12%).

Table 5: Duration of fever (days)

FEVER	MINIMUM	MAXIMUM	MEAN	STD.DEVIATION
	2	30	9.01	4.522

The duration of fever varied from 2-30 days, with a mean duration of 9.01 days.

Table 6: GCS

GCS	Number of patients
≥14	86 (65.15%)
<14	46 (34.85%)

Majority (65.15%) patients had a GCS of ≥14.

Table 7: Leptospira co-infection

PRESENT	ABSENT
9 (6.8%)	123 (93.2%)

Among 132 patients, 9 (6.8%) had Leptospira co-infection.

Table 8: Outcome of Scrub typhus

DISCHARGED	EXPIRED
123 (93.2%)	9 (6.8%)

93.2% patients recovered and were successfully discharged. 6.8% patients expired.

Table 9: Association of outcome with serum procalcitonin

Serum PCT	Discharged	Expired	p-value
<1.3ng/ml	104 (98.1%)	2 (1.9%)	<0.001
≥1.3ng/ml	19 (73.1%)	7 (26.9%)	
Total	123 (93.2%)	9 (6.8%)	

Significant positive association was found between outcome of scrub typhus and serum procalcitonin level with a p-value of <0.001 using Chi-square test, using a cut-off value of 1.3ng/ml.

Table 10: Association of outcome of Scrub typhus with serum ALP

ALP (U/L)	Discharged	Expired	p-value
<400	31 (86.1%)	5 (13.9%)	0.048
≥400	92 (95.8%)	4 (4.2%)	
Total	123 (93.2%)	9 (6.8%)	

Significant positive association was found between outcome of scrub typhus and serum ALP level with a cut-off of 400U/L, with a p-value of 0.048 using Chi-square test.

Table 11: Association of outcome of Scrub typhus with serum Ferritin

Ferritin (ng/L)	Discharged	Expired	p-value
<500	36 (100%)	0 (0%)	0.057
≥500	87 (90.6%)	9 (9.4%)	
Total	123 (93.2%)	9 (6.8%)	

No significant positive association was found between outcome of scrub typhus and serum Ferritin, with a p-value of 0.057 using Chi-square test with cut-off value of 500ng/L.

Table 12: Association of outcome of Scrub typhus with serum LDH

LDH (U/L)	Discharged	Expired	p-value
<500	73 (97.3%)	2 (2.7%)	0.03
≥500	50 (87.7%)	7 (12.3%)	
Total	123 (93.2%)	9 (6.8%)	

Significant positive association was found between outcome of scrub typhus and serum LDH, with a p-value of 0.03 using Chi-square test, with LDH cut-off value of 500U/L.

Table 13: Association of outcome with other biochemical parameters

Biochemical parameters	p-value
CRP	0.207
Urea	0.522
Creatinine	0.076

No significant association was found between the outcome of scrub typhus and CRP, urea and creatinine level using Chi-square test.

Table 14: Association of outcome of Scrub typhus with Leptospira co-infection

Leptospira	Discharged	Expired	P-value
Present	115 (93.5%)	8 (88.9%)	0.597
Absent	8 (6.5%)	1 (11.1%)	
Total	123	9	

No significant association was found between outcome of scrub typhus and Leptospira co-infection.

Table 15: Ventilator support requirement

	Yes	No	Total
Ventilator support	18 (13.6%)	114 (86.4%)	132

13.6% patients required mechanical ventilator support.

Table 16: Association of serum procalcitonin with ventilator support requirement

Serum PCT	No Ventilator support	Ventilator needed	P-value
<1.3ng/ml	97 (91.5%)	9 (8.5%)	<0.001
≥1.3ng/ml	17 (65.4%)	9 (34.6%)	
Total	114	18	

Significant positive association was found between serum procalcitonin levels and the need for mechanical ventilation, with a p-value of <0.001 using Chi-square test.

Table 17: Association of outcome with the need of mechanical ventilation

	No Ventilator support	Ventilator needed	P-value
Discharged	114 (92.7%)	9 (7.3%)	<0.001
Expired	0 (0%)	9 (100%)	
Total	114	18	

Significant positive association was found between serum procalcitonin levels and the need for mechanical ventilation, with a p-value of <0.001 using Chi-square test.

Table 18: Association of outcome with duration of fever

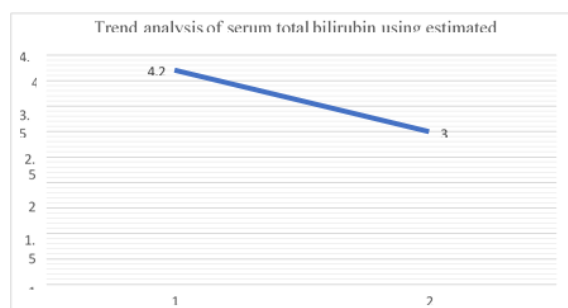
	Illness <5days	Illness ≥5days	P-value
Discharged	12 (9.8%)	111 (90.2%)	0.241
Expired	2 (22.2%)	7 (77.8%)	
Total	14	118	

No significant association was seen between outcome and duration of fever.

Table 19: Association of outcome with age

	≤65years	>65years	P-value
Discharged	118 (95.9%)	5 (4.1%)	0.327
Expired	8 (88.9%)	1 (11.1%)	
Total	126	6	

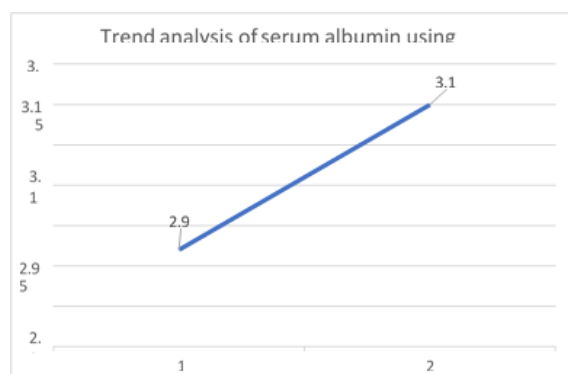
No significant association of outcome found with age and gender.

**Chart: Trend analysis of serum total bilirubin (mg/dl)**

Significance of test of between subject effects <0.001.

**Chart: Trend analysis of SGPT (U/L)**

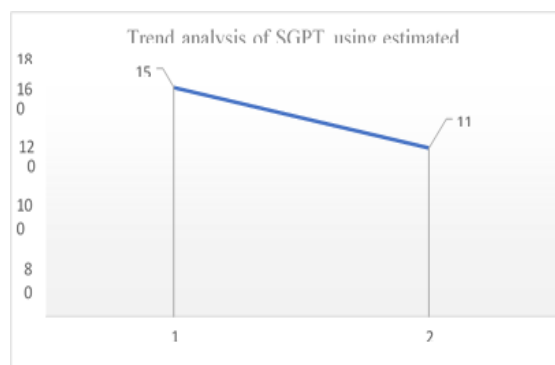
Significance of test of between subject effects <0.001.

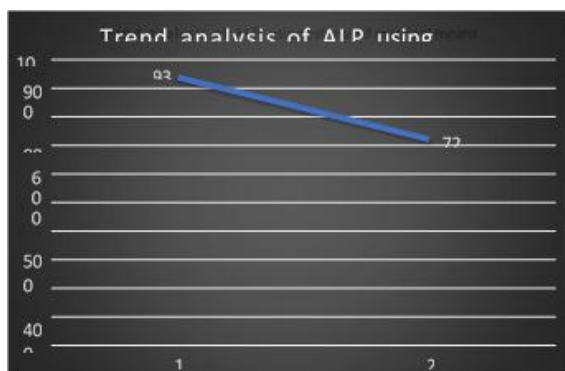
**Chart: Trend analysis of serum albumin (g/dl)**

Significance of test of between subject effects <0.001.

Chart: Trend analysis of SGOT (U/L)

Significance of test of between subject effects <0.001.

**Chart: Trend analysis of ALP (U/L)**



Significance of test of between subject effects <0.001.

Table 20: Comparison of biochemical parameters between patients with normal and raised serum procalcitonin

Parameter	PCT<1.3ng/ml	PCT ≥1.3ng/ml
Hb (g/dl)	10.07±2.26	10.43±2.12
TLC (cells/mm ³)	12800.95±5457	14196.3±7020.76
PLC (cells/mm ³)	115523±71675.5	112518.52±84269.88
S. Total bilirubin (mg/dl)	4.04±4.82	4.88±4.3
S. Albumin (g/dl)	3.03±0.53	2.74±0.46
SGOT (U/L)	224.42±150.85	260.74±143.69
SGPT (U/L)	158.6±104.14	159.56±122.6
ALP (U/L)	895.03±753.64	1111.89±972.31
S. Urea (mg/dl)	63.89±48.7	113.78±87.04
S. Creatinine (mg/dl)	1.49±1.66	2.56±2.79
S. Na (mmol/L)	138.76±6.06	138.41±7.03
S. K (mEq/L)	3.96±0.65	4.17±0.73
CRP (mg/L)	35.08±22.66	42.28±19.14
LDH (U/L)	587.43±483.15	645.98±264.59
Ferritin (ng/ml)	966.6±641.19	1602.43±581.19
S. Triglycerides (mg/dl)	277.81±177.8	380.85±213.15

The mean values of the biochemical parameters were compiled and compared between two groups: serum PCT<1.3ng/ml and PCT ≥1.3ng/ml. The mean TLC, serum total bilirubin, SGOT, ALP, s. urea, s. creatinine, CRP, LDH, ferritin and s. triglycerides were found to be higher in the group with serum

procalcitonin ≥1.3ng/ml. No significant difference was found in Hb, serum sodium levels and SGPT between the two groups. Platelet count was on the lower side in the group with ≥1.3ng/ml compared to the group with procalcitonin<1.3ng/ml.

Table 21: Laboratory findings associated with scrub typhus

Parameter	Frequency
Anaemia (Hb<12g/dl)	80.3%
Leucocytosis (TLC>10000 cells/mm ³)	62.9%
Thrombocytopenia (PLC<10 ⁵ cells/mm ³)	56.1%
Hyperbilirubinemia (T. bil.>1.2mg/dl)	68.9%
Hypoalbuminemia (Alb<3.5g/dl)	82.6%
Raised SGOT (>40U/L)	97.7%
Raised SGPT (>40U/L)	92.4%
Raised ALP (>150U/L)	96.2%
Raised urea (>40mg/dl)	68.2%
Raised creatinine (>1.2mg/dl)	37.1%
Hypokalaemia (K<3.5mEq/L)	17.4%

DISCUSSION AND CONCLUSION

The study analyzed 132 scrub typhus cases, primarily affecting young individuals with a mean age of 34.6 years, which is consistent with Verma et al.^[6] Females were slightly more affected than males at a ratio of 2:1, aligning with Verma et al.^[6] (1.16:1), Pathania et al.^[7]

The mean duration of fever in our study was 9.01 days, comparable to Verma et al.^[6] finding of 9.6 days. Majority had acute onset high grade continuous

fever, related with chills and rigor. Pathania et al.^[7] also reported the mean duration of illness to be 9.8±4 days. Other complains as per our study included jaundice (45.45%), altered sensorium (34.85%), pain abdomen (33.33%), vomiting (31.6%), seizure (15.91%), headache (13.64%) and dyspnoea (12.12%). Jaundice, pain abdomen and vomiting can be attributed to scrub typhus related hepatitis due to direct cytopathic effect of scrub, vasculitis of the hepatic microvasculature, leading to hepatocellular injury and elevation of hepatic transaminases and

inflammatory cytokine-mediated inflammation. These also explain the significant hepatic derangements found in the laboratory parameters including raised serum total bilirubin and hepatic transaminases, explained in the next paragraph. As per Verma et al,^[6] headache was reported in 69.2%, followed by nausea and vomiting in 59.6%. Sandhu et al² reported fever in 98.6%, headache in 21.4%, vomiting in 34.3%, icterus in 47.1%, pain abdomen in 31.4%; corroborating with our study findings. 34.85% patients had a GCS of <14. Compared to the adults, common symptoms noted in paediatric age group as per study by Janani G, et al,^[8] puffiness (54.2%), rashes (51.8%), and lymphadenopathy (21.7%). Like in our study, eschar was not found in any children in their study. *O. tsutsugamushi* primarily affects endothelial cells, leading to a widespread vasculitis and perivasculitis, which causes a wide variety of clinical features affecting multiple organ systems. Altered sensorium seen in 34.85% cases in our study can be explained by widespread vasculitis and perivasculitis, including the cerebral vasculature. The vascular injury can lead to cerebral edema and inflammatory changes within the brain. Also, it can occur as a result of systemic complication of severe infection like sepsis-associated encephalopathy, metabolic derangements and hypotension leading to decreased cerebral perfusion.

Laboratory findings supporting the diagnosis of scrub typhus as per our study include anaemia (80.3%), leucocytosis (62.9), thrombocytopenia (56.1%), elevated transaminases with raised SGOT in 97.7% and SGPT in 92.4% and elevated ALP in 96.2%. Anaemia can be related to inflammatory process, haemolysis or nutritional factors among the study population. Thrombocytopenia can result from endothelial injury and platelet consumption due to systemic inflammation. Endothelial injury leads to activation of inflammatory pathways and platelet consumption. Urea and creatinine were raised in 68.2% and 37.1% respectively. Renal impairment can occur due to vasculitis and renal hypoperfusion. Hypokalaemia was seen in 17.4% cases. Elevated transaminase was quite high in our study compared to Verma et al,^[6] (69.2% and 57.7% respectively). We noted significant hepatic involvement in our study. ALP levels were significantly elevated, which can occur due to sepsis-related cholestasis. In severe scrub, systemic inflammatory response and endothelial injury can contribute to cholestatic liver dysfunction, resulting in high ALP levels. Hyperbilirubinemia was present in 68.9% cases in our study. Sandhu et al,^[2] reported leucocytosis, anaemia, raised creatinine in severe scrub typhus group. We did not find any association of creatinine with outcome of scrub typhus, in contrary to the findings by Sandhu et al. Hypoalbuminemia was seen in 82.6% cases in our study. Albumin is a negative acute phase reactant of sepsis. The decreased albumin levels can be explained by reduced hepatic albumin synthesis due to hepatitis and endothelial damage,

leading to capillary leakage of albumin. A study by Gaba et al,^[9] found that urea, creatinine, bilirubin, and aspartate transaminase levels were significantly elevated in the mortality group, while alanine transaminase was higher and albumin lower, although these latter differences were not statistically significant. Sivarajan et al,^[10] elevated levels of SGOT/AST, SGPT/ALT, and creatinine were observed in 100%, 94%, and 14% of patients, respectively, which nearly corroborated with our findings. Elevated procalcitonin (≥ 0.05 ng/ml) was seen in 111 cases (84.1%). Procalcitonin levels were above 1.3ng/ml in 26 cases. 15.9% cases had a normal serum procalcitonin level which can be attributed to treatment received before presentation. Also, there are several factors that might affect PCT levels, including age, gender, body mass index, smoking, presence of renal failure, and previous sepsis. The mean TLC, serum total bilirubin, SGOT, ALP, urea, creatinine, CRP, LDH, ferritin and serum triglycerides were found to be higher in patients with serum procalcitonin ≥ 1.3 ng/ml. In our study, a HLH (hemophagocytic lymphohistiocytosis) -like picture has been seen in the scrub typhus patients. HLH is a hyperinflammatory syndrome, characterised by elevated ferritin and LDH, cytopenia and organomegaly. The elevated levels of ferritin and LDH noted in our study, similar to HLH can be due to an underlying macrophage activation process in severe cases. Rapid resolution of LFT parameters including SGOT, SGPT and ALP were seen between day 1 and day 3, following initiation of treatment with doxycycline. Pre-treatment received by some patients can also play a significant role in this. Trend analysis showing hepatic dysfunction suggests these parameters can be used as markers of early disease severity. Serum ferritin levels were also elevated in several patients and showed a near significant association ($p=0.057$). Raised ferritin can be due to exaggerated inflammatory response and macrophage activation. Fever, thrombocytopenia, leukocytosis, elevated CRP can be associated with raised IL-6 levels, which is often associated with scrub typhus. PCT was found to have a significant association with the outcome of scrub typhus, as also inferred by Jamwal et al,^[11] and Peter et al.^[3] Jamwal et al,^[11] concluded raised leukocyte, elevated liver enzymes and elevated urea levels were significantly associated with mortality in scrub patients with raised PCT values. We did not find any significant association of outcome of scrub with these parameters. However, ALP and LDH were found to have a significant association with outcome of scrub typhus. LDH elevation indicates extensive cellular injury and tissue hypoxia, resulting from systemic vasculitis and endothelial damage caused by *O. tsutsugamushi*. Increased PCT indicates systemic inflammatory response and possible sepsis. Thus, elevated PCT and LDH can be used as markers of disease severity and poor prognosis. Serum PCT also had a significant association with the need of mechanical ventilation, indicating its prognostic value.

As per our study, lower levels of serum procalcitonin, ALP and LDH are good prognostic indicators of the outcome of scrub typhus in adults; and, the need of mechanical ventilation is a poor prognostic factor. Mortality was 6.8% in our study, compared to 14.3% by Sandhu et al.^[2] The relatively low mortality seen in our study can be due to early diagnosis, prompt initiation of treatment with doxycycline and supportive care. Also, increased awareness of scrub typhus has contributed to earlier recognition and management, reducing complications and mortality. *Leptospira* co-infection was present in 6.8% of the cases. However, no significant association was seen between the presence of co- infection and the outcome of scrub typhus.

To conclude, we found that scrub typhus has a varied clinical presentation, often a multisystem involvement. Procalcitonin, which in bacterial infections is a diagnostic and prognostic marker, is not routinely elevated in patients of scrub typhus. In scrub typhus patients who have elevated procalcitonin, it is associated with poor outcomes, including increased requirements of ventilatory support.

Procalcitonin, in combination with other biomarkers, may have a role in predicting outcomes in patients with scrub typhus, though larger multicentric studies are needed to establish a correlation.

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