Section: Medicine

Original Research Article

A RETROSPECTIVE OBSERVATIONAL STUDY ON SCRUB TYPHUS: AN EXPERIENCE FROM A TERTIARY CARE HOSPITAL IN A NORTH EASTERN STATE(ASSAM)

Sudeep Saha[1], Anupam Dutta[2], Krishnakshi Bhuyan[3]

[1]PGT Medicine, Department of Medicine, Assam Medical College & Hospital, Dibrugarh, Assam, India.
[2]Associate Professor, Department of Medicine, Assam Medical College & Hospital, Dibrugarh, Assam, India.
[3]MBBS, Department of Medicine, Assam Medical College & Hospital, Dibrugarh, Assam, India.

Received *: 08/06/2024*
Received in revised form *: 24/07/2024*
Accepted *: 09/08/2024*

Corresponding Author:
Dr. Sudeep Saha
PGT Medicine, Department of Medicine, Assam Medical College & Hospital, Dibrugarh, Assam, India
Email: drsaha.sudeep23@yahoo.com

DOI: 10.70034/ijmedph.2024.3.89

Source of Support: Nil,
Conflict of Interest: None

Int J Med Pub Health
2024; 14 (3); 496-501

ABSTRACT

Background: To study and describe the clinical features, laboratory manifestations in patients diagnosed with scrub typhus at a tertiary hospital in Assam.

Materials and Methods: A total of 28 patients in whom the diagnosis of scrub typhus was confirmed admitted between 1st January 2021 to 30 September 2022 in Unit 1 of Department of Medicine in AMCH who filled the inclusion and exclusion criteria were analysed.

Results: 28 confirmed cases of scrub typhus were studied over a period of 21 months. The mean age of patients was 46±19.1. The female to male ratio was 2.5:1. The maximum number of cases i.e. 14 (50%) patients belong to 20-40 years age group, 27 patients (96.4%) come from rural background with maximum number of patients being farmers and mostly working in paddy field i.e. 15 (53.5%). For the clinical features, 100% patients presented with fever. The average duration of fever was 7±3.1. 20 patients (71.4%) presented with myalgia. Jaundice was seen in 25% cases of cases. Respiratory symptoms seen in 7 cases (25%). Neurological manifestations were seen in 7 cases (25%) where 3 cases (10.7%) cases presented with altered sensorium. Renal symptoms seen in 7 cases (25%). Pedal edema seen in 9 cases (32.1%) Eschar seen in 3 patients (10.7%). Complications of scrub typhus, ARDS was observed in 1 (3.5%) cases, Meningeal signs seen in 2 (7.1%) cases, Decompensated liver disease with Ascites seen in 5 cases (17.8%). ALT and AST raised in 22 (78.5%) and 24 (84.7%) cases respectively. Leucocytosis seen in 30% cases. Ultrasonography shows hepatomegaly in 2 cases (7.1%) splenomegaly in 4 cases (14.2%) hepatosplenomegaly in 2 cases (7.1%) hepatic parenchymal disease with dilated portal vein in 5 (17.8%) cases. 15 cases (53.5%) with raised total bilirubin, 4 cases (14.2%) with Serum Creatinine > 1.6 mg/dl i.e. patients developing AKI.

Conclusion: Scrub typhus is prevalent in the northeastern part of India. It mimics infections like malaria, leptospira, dengue, salmonella typhi, pneumonia for which it should be considered as a differential diagnosis in a patient presenting with acute febrile illness associated with or without gastrointestinal symptoms, altered sensorium etc. and with Leucocytosis and thrombocytopenia and elevated liver enzymes. A history patients residing in rural areas and agriculture based occupation should raised the suspicion of the diagnosis being more towards scrub typhus.

Keywords: Fever, Orientiatsutsugamushi, scrub typhus, eschar, Rural area, laboratory abnormalities, Doxycycline.

INTRODUCTION

Scrub Typhus is an endemic rickettsial illness that is transmitted by vectors. It is the most common type of rickettsial disease, caused by the organism Orientiatsutsugamushi, which is an obligate intracellular gram negative bacterium. Scrub typhus is a zoonotic disease and human is the accidental host, transmitted to them by means of the vector Leptotrombidum delicense, through the bite of its larval trombiculid mites known as "chiggers".[1] Historical reference to the rickettsial disease scrub typhus was first described in China (313 AD) by Hong Ge in a clinical manual (Zhouhofang) and in Japan (1810 AD) when Hakuju Hashimoto described tsutsuga, a noxious harmful disease in the Niigata prefecture. Other clinicians and scientists in Indonesia, Philippines, Taiwan, Australia, Vietnam, Malaysia, and India reported on diseases most likely to have been scrub typhus in the early 1900.[2] In 1906, a British bacteriologist named Gerald Gale isolated the causative agent, Orientiatsutsugamushi, from the eschar of a patient in the Malayan Peninsula.[3] This marked a significant milestone in understanding the etiology of scrub typhus. Since then, further research has been conducted to better understand the disease, its transmission, and treatment options. The disease presents with a wide range of clinical manifestations, including fever, eschar formation at the site of the chigger bite, rash, and systemic complications affecting multiple organ systems. Microbiologically, the bacterium exhibits antigenic variation, contributing to the challenges in vaccine development and serological diagnosis. Studies have highlighted the genetic diversity of Orientiatsutsugamushi strains, influencing the disease severity and immune response. Additionally, research has focused on understanding the pathogenesis and immune evasion mechanisms of the bacterium.[4–7] After some factors like improvement in hygiene, understanding of the pathogenesis, usage of appropriate antibiotics etc. weighed in, we could get a hold of the disease and its manifestations in Northeast India. However in the recent years, resurgence of the cases on Scrub Typhus in Northeast India has been observed. also described in studies by Barman B et al in Meghalaya,[8] K S Ngulani,Kakati S et al in Manipur.[1] After observation of a similar trend of resurgence of the cases of Scrub Typhus at our Tertiary Care Centre in Assam, we have conducted a study onScrub Typhus at our hospital.

MATERIAL AND METHODS

This is a retrospective observation study of 28 patient in whom the diagnosis of scrub typhus was confirmed, who fulfilled the inclusion and exclusion criteria and were admitted between 1st January, 2021 to 30th September, 2022 in Unit 1 of Department of Medicine of Assam Medial College and hospital (AMCH), Dibrugarh, Assam.

Methodology

All relevant data about patient demography i.e age, gender, residency, clinical features, complication of the 28 patients who met the inclusion and exclusion criteria were collected and analysed. IgM ELISA for Orentia Tsutsugamushi, Complete blood count was done using Sysmex SN 550, Renal function test (RFT), Serum electrolytes, Liver function test (LFT) were done by using Vitros 5600. MP Opti MAL for malaria, IgM ELISA and NS1 antigen test for Dengue, Immunochromatography test for Salmonella typhi and for confirmation Widal test, IgM ELISA for Lepto spiral were also done. Imaging studies like ultrasonography of whole abdomen, Computed tomography scan and magnetic resonance imaging to brain wherever required.

Inclusion criteria includes fever for more than 3 days; age 13 years and above and patients who came to be positive enzyme linked immunosorbent assay (ELISA)specific IgMfor scrub typhus.

Exclusion criteria includes patients with other established causes of pyrexia, such as malaria, dengue, leptospirosis, enteric fever, and viral meningitis, Urinary tract infection, negative serology for scrub typhus, incomplete case records

RESULTS

Data from 28 patients between the age of ≥ 18 years were interpreted which showed the mean age of patients at presentation to be 46 ±19.1. The female to male ratio was 2.5:1. The maximum number of cases i.e 14 (50%) patients belong to 20-40 years age group. 27 (96.4%) come from rural background as mentioned in with maximum number of patients being farmers and mostly working in paddy fields i.e 15 (53.5%)Table No. 1. In our study scrub typhus showed seasonal variation and maximum number of cases occurred in the monsoon and post monsoon season, July to October. [Table 1]

The Clinical symptoms are summarised in table 2 which shows that 100% patients presented with fever and the average duration of fever was 7±3.1. 20 (71.4%) cases presented with myalgia which was the most common symptoms. Clinical Jaundice was seen in 35.7% of cases which is the most common Gastrointestinal symptom, shortness of breath being the most common respiratory symptoms seen in 17.8% cases. Other symptoms are as described on the table no 2. [Table 2]

The most common finding on clinical examination seen in table 3is pedal edema present in 9 (32.1%) study subjects. Eschar, the diagnostic clinical signs of scrub typhus and skin rash was found in 3 (10.7%) and 7 (25%) patients respectively. If we focus on the complication of scrub typhus, ARDS was observed in 1 (3.5%) patients. Meningeal signs is seen in 2 (7.1%) cases which was due to

neurological complication of scrub typhus and other clinical signs are as observed in table 3. [Table 3]

The laboratory abnormalities most commonly encountered in the study as seen in table 5 and table 6 is development of acute hepatitis i.e with raised ALT and AST in 22 (78.5%) and 24 (84.7%) patient. The average value of AST was found to be 196.0+- 150.1 and ALT to be 176.93 +- 132.2. 5 (17.8%) patients developed anemia i.e Hemoglobin below 11g/dl. Leucocytosis which is one of the predictor severe disease was seen in 32.1% patients. The lowest leukocyte count was found to be 2870 cumm and highest was found to be 28760 cumm. Other findings are plotted in table 5 and table 6

Ultrasonography of whole abdomen shows hepatomegaly in 6 (21.4%) cases, splenomegaly in 4 (14.2%) cases and hepatosplenomegaly in 2 (7.1%) cases. Ultrasonography also showed hepatic parenchymas disease with dilated portal vein in 5 (17.8%) patients which can also be attributed to chronic alcoholic as an etiological factor. Serum creatinine > 1.6 mg/dl is seen in 4 (14.2%) cases i.e. the patients developing AKI. [Table 4]

Table 1: Table summarising the demographic variation of the study subjects

Variable	Male		Female		Total	
	n = 8	%	n = 20	%	n = 28	%
Age Group (in years):						
• 13—<40	5	62.50	9	45.00	14	50.00
• 40—<60	0	0.00	5	25.00	5	17.86
• 60—80	3	37.50	6	30.00	9	32.14
Residency:						
• Rural	8	100.00	19	95.00	27	96.43
• Urban	0	0.00	1	5.00	1	3.57
Occupation:						
• Homemaker	0	0.00	5	25.00	5	17.86
• Farmers	6	75.00	9	45.00	15	53.57
• Students	2	25.00	1	5.00	3	10.71
• Others	0	0.00	5	25.00	5	17.86

Table 2: Table summarising the symptoms observed in the study subjects

Symptoms	Number (n = 28)	Percentage (%)
Fever (in days)	28	100.00
• <7	13	46.43
• 7—14	14	50.00
• 15—21	1	3.57
Gastrointestinal:		
• Pain abdomen	4	14.29
• Vomiting	5	17.86
• Loose stools	3	10.71
• Hematemesis	0	0.00
• Melena	1	3.57
• Jaundice	10	35.71
Respiratory System:		
• Cough	2	7.14
• Shortness of breath	5	17.86
CNS:		
• Headache	2	7.14
• Altered sensorium	3	10.71
• Convulsion	2	7.14
Renal System:		
• Decreased urine	7	25.00
Musculoskeletal:		
• Myalgia	20	71.43

Table 3: Table summarising clinical signs at the time of presentation

Clinical Signs	Number (n = 28)	Percentage (%)
Pedal Edema	9	32.14
Rash	7	25.00
Ascitis	5	17.86
Lymphadenopathy	4	14.29
Facial Puffiness	4	14.29
Hepatomegaly	4	14.29
Pallor	3	10.71
Eschar	3	10.71
Petechiae	3	10.71
Splenomegaly	3	10.71

Pneumonia	3	10.71
Pallor	3	10.71
Hepatic Encephalopathy	2	7.14
Meningeal Signs	2	7.14
Pleural Effusion	1	3.57
Hepatosplenomegaly	1	3.57
ARDS	1	3.57
Ecchymosis	0	0.00
Sub conjunctival Hemorrhage	0	0.00
Pericardial Effusion	0	0.00

Table 4: Table showing mean laboratory findings

Abnormalities	Mean	±S.D.
Haemoglobin (gm/dl)	11.13	2.91
Total Count (cumm)	12421	7028.40
Platelet Count (/cumm)	177922	72753.58
ALT (IU)	176.93	132.20
AST (IU)	196.05	150.19
ALP (IU)	177.39	89.06
Albumin	3.07	0.91
Serum creatinine (mg/dl)	1.357	1.42
Serum bilirubin (Total) (mg/dl)	2.937	3.29
Direct bilirubin (mg/dl)	1.874	2.57
Blood urea (mg/dl)	135.37	103.33

Table 5: Table summarising laboratory abnormalities observed in the study

Abnormalities	Number (n = 28)	Percentage (%)
Anemia (<11 gm/dl)	5	17.85
Leukopenia (<4000 cumm)	2	7.14
Leucocytosis (>12000 cumm)	9	32.14
Thrombocytopenia (<1 lakh/cumm)	4	14.28
Raised ALT (>40 IU)	22	78.57
Raised AST (>40 IU)	24	85.71
Raised ALP (>130 IU)	16	57.14
Hypoalbuminemia (<3.5 g/dl)	12	42.85
Serum creatinine (>1.6 mg/dl)	4	14.28
Serum bilirubin (Total) (>1.3 mg/dl)	15	53.57
Direct bilirubin (>0.3 mg/dl)	14	50
Blood Urea (>20mg/dl)	16	57.14
CSF DLC- Lymphocyte predominant	2	7.14

DISCUSSION

Finding out the exact cause of fever is important in region where several infection like dengue fever, malaria, leptospira, scrub typhus, community acquired pneumonia are common. It is because treatment is different for each disease and this would decrease the unnecessary use of anti-microbial agents. In India epidemics of scrub typhus is observed in north east and south India.[1]

Scrub typhus, a vector-borne zoonotic infection, ranks among the most prevalent rickettsial infections globally. The disease is endemic in regions such as South Asia, Southeast Asia, East Asia, the Pacific Islands, and northern Australia, forming the tsutsugamushi triangle. Immunological analysis of strain DNA indicates that the Karl strain is responsible for approximately 50% of cases in these endemic areas, including South.[9]

The basic pathologic changes are focal vasculitis and perivasculitis of the small blood vessels in the involved organs, arising from multiplication of the organisms in the endothelial cells lining the small blood vessels.[10]

A study of seasonal variation showed higher incidence in the month of July to October which is also evident in other literature like K S Ngulani et al.[1] Scrub vegetation, optimum amount of monthly rainfall, soil bound moisture while other reasons like farmers being involved in the paddy fields in this season where they are exposed to the bites of larval mites.[1] So the use of personal protective can provide impact in decreasing the transmission.[11]

The age group most affected in this study is 13-40 years i.e. 14 (50%) patients since this age group spends most of their time outside and also increase prevalence is observed in rural areas which in our study is 27 (96.42%) patients which corresponds to other studies such as S SNila et al.[12] A female preponderance is seen in our study which is also observed in other literatures like Pathania M et al,[11] S SNila et al.[12]

Most common symptoms observed were fever which is seen in 28 (100%) cases which is in congruence to the data published in Narnawar UW et al,[13] and myalgia seen in 71.4% cases. Other clinical symptoms seen in the study are jaundice 35.7%, pain abdomen 14.2%. Black tarry stool is also seen in3.5% cases.

The pathognomic sign of scrub typhus is an eschar which is seenin chigger feeding, lymphadenopathy and a macular rash. Eschar in our study is seen in 10.7% patients which is contrast to Narlawal UW et al,[13] where eschar is seen in2.3% cases. 12.5% patients presented with Eschar which in observed in Subbalaxmi MVS et al,[14] and 13.1% patients had eschar in KS Ngulani et al,[1] which is almost similar to our study.

Gastrointestinal symptoms in the form of vominting and loose stools are common symptoms of scrub typhus. One should suspect a case is scrub typhus in patient presenting with fever and loose stool if it is accompanied with respiratory tract symptoms and CNS symptoms. Loose stool is seen in 15.9% cases in K S Ngulani et al.[1] In our study clinical Jaundice is seen in35.7% and if we look into Ngulani et al,[1] jaundice is seen in 22.7% cases. AST and ALT elevation are seen in 84.7% and 78.57% respectively with however the elevation in most of the cases is mild. AST more than ALT is seen in 68.7% cases. One patient developed Acute liver failure with AST and ALT being raised >1000U/L who was shifted to Medicine ICU who even developed Acute Respiratory distress syndrome (ARDS), Multi organ dysfunction syndrome (MODS) and expired in the ICU. Chrispal et al,[15] found elevation of liver enzymes >1000 u/L in patients with septic shock and MODS. In Subbalaxmi MVS et al,[14] AST and ALT were elevation in 100% patients. Pathania M et al,[11] shows ARDS developed in 4 patients and one of them died.. Ultrasound shows hepatomegaly in 21.4% patients, splenomegaly in 14.2% patients, hepatosplenomegaly in 7.14% in our study which is in contrast to Ngulani et al. Hepatomegaly is seen in37–59.5% patients in two studies.[16] Where hepatosplenomegaly is observed in 28.9% patients.[1] Scrub typhus has been called the most commonest cause of febrile jaundice.[17] 53.5% patients in our study developed icteric fever and 46.42% developed anicteric fever. Barman B et al,[8] showed icterus developing in 53.8% patients.

Respiratory tract symptoms are seen in 25% cases with shortness of breath 17.8% being the common presentation compared 9.7% cases of breathlessnes found in Kamath SD et al.[18] Pneumonia is observed in 10.71% cases in our study with findings of consolidation, pleural effusion (3.5%), ground glass opacities. While reviewing Pathania et al,[11] it was observed that 1.8% patient developed pneumonia. In our study 3.5% people developed Acute respiratory distress syndrome (ARDS)

Chest radiograph abnormalities in the form of reticulonodular opacities, air space consolidation, peribronchial infiltration, pulmonary congestion, pulmonary oedema, acute respiratory distress syndrome (ARDS) and pleural effusion were known to occur in scrub typhus.[1]

Urinary symptoms such as decreased urine output is seen in 25% cases. Acute kidney injury with laboratory abnormality showing serum creatinine > 1.6 mg/dl in 14.2% cases which when compared to KS Ngulani et al,[1] elevated serum creatinine was seen in 27.8% cases and Subbalaxmi MVS et al,[14] showed AKI in 33% patients.

Other frequently observed clinical features documented in our study was edema particularly pedal edemain 32.1% cases, facial puffiness in 14.2% patients. Upper eyelid edema is not seen in our study. However upper eye lid edema is seen Pathania M et al.[11] The edema occurs due to multiplication of Orientia in the endothelia cells of small blood vessels resulting in break of vascular barrier (perivasculitis) and subsequent accumulation of fluid in the interstitial spaces.[10]

Complete blood count and Peripheral blood smear may help in ruling out the causes of fever. Laboratory findings highly suspicious of scrub typhus are thrombocytopenia, Leucocytosis and elevated transaminases. Complicated falciparum malaria will show anaemia, leucopenia along with thrombocytopenia. Dengue fever will show increase in Packed cell volume (PCV), leucopenia and thrombocytopenia. Our study show Leucocytosis in 32.1% patients, thrombocytopenia in 14.2% patients. If compared to other studies Leucocytosis is seen in 34.3% patient thrombocytopenia is seen 68.8% patient of which 25% had platelet count less than <50,000, in Kamath SD.[18]

Patients presenting with CNS symptoms were 25% out of which 7.1% patients were found to have headache, 10.7% cases with altered sensorium and 7.1% presented with convulsions. On examination 7.1% patients were found to have meninges signs. CSF analysis done for the patients with presented with CNS symptoms and lymphocyte predominant Leucocytosis was found in 10.7% cases. As reported in KS Ngulani et al,[1] 33 (18.8%) of patients had drowsiness on examination during hospital stay. Seizures were present in 11 (6.3%) and one patient presented with status epilepticus.[1] The pathologic changes in the brain are predominantly vascular in nature and actual tissue destruction is rare and they are potentially reversible despite widespread lesions.[17] Aseptic meningitis was seen in 21.8% cases in Kamath SD et al.[18]

Our study shows high transaminases, low platelet count, leukocytosis, low serum albumin, and were found to be predictors of severe disease.

As the serological tests for scrub typhus become positive during the second week of the illness, they cannot provide early diagnosis, and specific treatment may be delayed while awaiting reports, resulting in a high complication rate and mortality. A recent study from Manipur of 176 confirmed cases of scrub typhus by Ngulani et al,[1] revealed a mortality rate of 4.5%. In our study 1 patient who developed ARDS and MODS expired after being shifted to ICU. So the Case fatality rate in our study is 3.5%.

Doxycycline, a tetracycline-class antibiotic, is highly effective and minimally toxic in treating rickettsial infections, even in children and pregnant women. For scrub typhus, the recommended

doxycycline dosage is 100 mg twice daily for adults or 2.2 mg per Kg for children under 45.5 Kg, administered orally or intravenously. Initiate this treatment empirically upon suspected diagnosis, with a suggested seven-day duration, extending to 14 days for complicated cases with MODS. In cases of doxycycline resistance, alternatives like azithromycin and rifampicin may be considered, with azithromycin preferred for pregnant women, for whom doxycycline is contraindicated.

CONCLUSION

Scrub typhus is prevalent in the northeastern part of India. It mimics infections like malaria, leptospira, dengue, salmonella typhi, pneumonia for which it should be considered as a differential diagnosis in a patient presenting with acute febrile illness associated with or without gastrointestinal symptoms, altered sensorium etc. and with Leucocytosis and thrombocytopenia and elevated liver enzymes. A history patients residing in rural areas and agriculture based occupation should raised the suspicion of the diagnosis being more towards scrub typhus.

A thorough search for the eschar which is pathognomic for scrub typhus should be carried out mostly in the hidden areas. Eschar was seen only in 3 cases in our study so the absence of eschar should not rule out the possibility of scrub typhus. Awareness should be carried out among the physicians for the early clinical diagnosis of the patients where scrub typhus is suspected and prompt treatment with doxycycline or macrolides since delay delay in the treatment may lead to complication and higher mortality.

REFERENCES

1. Ngulani KS, Kakati S, Hussain S, Singh MU, Kaguilan K. Outbreak of scrub typhus in Manipur experience at a tertiary care hospital. Cough. 2019; 94:53–4.
2. Richards AL, Jiang J. Scrub typhus: historic perspective and current status of the worldwide presence of Orientia species. Trop Med Infect Dis. 2020;5(2):49.
3. Gale G. The etiology of tsutsugamushi disease. J Hyg Lond. 1906;6(3):334–43.
4. Paris DH, Shelite TR, Day NP, Walker DH. Unresolved problems related to scrub typhus: a seriously neglected life-threatening disease. Am J Trop Med Hyg. 2013 Aug;89(2):301–7.
5. Kelly DJ, Fuerst PA, Ching WM, Richards AL. Scrub typhus: the geographic distribution of phenotypic and genotypic variants of Orientia tsutsugamushi. Clin Infect Dis Off Publ Infect Dis Soc Am. 2009 Mar 15;48 Suppl 3: S203-230.
6. Valbuena G, Walker DH. Infection of the endothelium by members of the order Rickettsiales. Thromb Haemost. 2009 Dec;102(6):1071–9.
7. Soong L. Dysregulated Th1 Immune and Vascular Responses in Scrub Typhus Pathogenesis. J Immunol. 2018 Feb 15;200(4):1233–40.
8. Jamil MD, Hussain M, Lyngdoh M, Sharma S, Barman B, Bhattacharya PK. Scrub typhus meningoencephalitis, a diagnostic challenge for clinicians: A hospital based study from North-East India. J Neurosci Rural Pract. 2015 Oct;06(04):488–93.
9. Islam A, Saha R, Roy A. Scrub typhus-a threatening scenario in North Bengal. J Evid Based Med Heal. 2021; 8:3417–22.
10. Allen AC, Spitz S. A comparative study of the pathology of scrub typhus (tsutsugamushi disease) and other rickettsial diseases. Am J Pathol. 1945;21(4):603.
11. Pathania M, Amisha, Malik P, Rathaur V. Scrub typhus: Overview of demographic variables, clinical profile, and diagnostic issues in the sub-Himalayan region of India and its comparison to other Indian and Asian studies. J Fam Med Prim Care. 2019;8(3):1189.
12. Nila SS, Paul SK, Kobayashi N, Nasreen SA, Ahmed S, Ahmad F, et al. Socio-demographic and Clinico-epidemiological Study of Scrub Typhus in A Tertiary Care Hospital of Mymensingh, Bangladesh. Mymensingh Med J MMJ. 2022 Jan;31(1):66–71.
13. Narlawar UW, Lilare RR, Gawande BS. Epidemiology and clinical profile of scrub typhus outbreak in a tertiary care centre of central India. Int J Community Med Public Health. 2019;6(11):4867–9.
14. Subbalaxmi M, Chandra N, Teja V, Lakshmi V, Rao M, Raju Y. Scrub typhus-experience from a South Indian tertiary care hospital. BMC Infect Dis. 2012 Dec;12(S1): P77, 1471-2334-12-S1-P77.
15. Chrispal A, Boorugu H, Gopinath KG, Prakash JAJ, Chandy S, Abraham OC, et al. Scrub typhus: an unrecognized threat in South India – clinical profile and predictors of mortality. Trop Doct. 2010 Jul;40(3):129–33.
16. Aung-Thu SW, Phumiratanaprapin W, Phonrat B, Chinprasatsak S, Ratanajaratroj N. Gastrointestinal manifestations of septic patients with scrub typhus in Maharat Nakhon Ratchasima Hospital. Southeast Asian J Trop Med Public Health. 2004;35(4):845–51.
17. Deepak N A, Patel ND. Differential diagnosis of acute liver failure in India. Ann Hepatol. 2006;5(3):150–6.
18. Kamath SD, Kumari S, Sunder A. A Study of the Profile of Scrub Typhus in a Tertiary Care Hospital in Jharkhand: An Underestimated Problem. Cureus. 2022 Jul;14(7): e26503.