# Clinical Features And Outcome Of Leptospirosis

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## ABSTRACT

**Background:** Leptospirosis is a common zoonotic infection with varied clinical presentation and significant morbidity and mortality, especially in tropical regions. Early identification of severe disease remains a challenge in clinical practice.
**Aim:** To study the clinical features and outcome of leptospirosis in adults with special reference to serum procalcitonin.
**Materials and Methods:** A prospective observational study was conducted in adult IPD patients in the Department of Medicine for a duration of one year. A total of 70 cases were included in the study.
**Results:** A total of 70 patients aged between 16–79 years were included, of which 48.6% were males and 51.4% were females. Majority of patients (60.0%) belonged to the <40 years age group. Common presenting features included altered sensorium (60.0%), abdominal pain (20.0%), vomiting (15.7%), jaundice (17.1%), dyspnea (17.1%), seizure (17.1%) and headache (10.0%). 95.7% patients were discharged successfully, while 4.3% patients expired. A statistically significant association was found between serum procalcitonin levels and outcome (p=0.023). Patients with higher procalcitonin levels showed more severe biochemical derangements and elevated inflammatory markers. No significant association was observed between outcome and other parameters such as ALP, ferritin, LDH, creatinine, CRP, urea, age, and duration of fever.
**Conclusion:** Leptospirosis has a varied clinical presentation with frequent multisystem involvement. Serum procalcitonin is a useful prognostic marker and is significantly associated with clinical outcome. Higher procalcitonin levels are associated with increased disease severity and adverse outcomes. Early measurement of procalcitonin may help in identifying high-risk patients and guiding clinical management, although larger studies are required for further validation.

## INTRODUCTION

Leptospirosis is a widely prevalent zoonotic infection caused by pathogenic spirochetes of the genus Leptospira. It is commonly seen in tropical and subtropical regions where environmental conditions such as heavy rainfall, poor sanitation, and close human–animal contact favor its transmission. The disease spreads through exposure to water or soil contaminated with urine of infected animals, especially rodents, and remains an important cause of acute febrile illness in India, particularly during the monsoon season.[1]

The illness shows a wide clinical spectrum ranging from a mild febrile illness to a severe form with multiorgan involvement. In severe cases, organs such as the kidneys, liver, lungs, and central nervous system may be affected, leading to complications like acute kidney injury, jaundice (often bilirubin >2 mg/dL and may be markedly elevated in severe disease), pulmonary hemorrhage, and shock. Mortality varies depending on severity, ranging from less than 5% in mild cases to around 10–20% in severe disease, especially in patients with multiorgan dysfunction. One of the major challenges in clinical practice is that the severity of the disease cannot be predicted at the time of presentation, as patients who initially appear stable may rapidly deteriorate.[2] Routine laboratory investigations including leukocyte count, platelet count, and liver and renal function tests are often abnormal in leptospirosis. Common findings include leukocytosis (>10,000 cells/mm³), thrombocytopenia (<100,000 cells/mm³),

elevated transaminases (usually 2–5 times normal), and raised serum creatinine (>1.2 mg/dL). However, these parameters are nonspecific and do not reliably predict disease progression or outcome, creating a need for a simple and reliable biomarker for early risk assessment.[3]

Procalcitonin (PCT), a precursor of the hormone calcitonin, has emerged as an important biomarker in infectious diseases. Under normal conditions, serum procalcitonin levels are usually <0.05 ng/mL, but during systemic bacterial infections, levels rise above 0.5 ng/mL and may exceed 2 ng/mL in severe infections due to increased production from extra-thyroidal tissues. This property makes it useful in distinguishing bacterial infections from viral or non-infectious inflammatory conditions.[4]

In recent years, procalcitonin has also been studied as a marker of disease severity. Elevated levels, particularly >2 ng/mL, have been associated with systemic inflammation, organ dysfunction, and increased mortality in patients with sepsis and other severe infections. Higher procalcitonin values have also been linked with the need for intensive care, mechanical ventilation, and inotropic support, suggesting its role in predicting clinical outcomes.[5] Leptospirosis often presents with features similar to sepsis, including systemic inflammation and multiorgan dysfunction. Because of this overlap, procalcitonin may have a role in assessing disease severity in leptospirosis. Some studies have shown that higher procalcitonin levels are seen in severe cases and may be associated with adverse outcomes, although the available evidence is still limited and not consistent.[6,7]

In regions where leptospirosis is common and healthcare resources are limited, early identification of severe cases is essential to improve patient outcomes. The disease has a wide range of clinical features, and predicting outcome at an early stage remains difficult. Although routine laboratory parameters provide some information, they are often not sufficient to assess prognosis accurately. Serum procalcitonin, as a marker of systemic infection and inflammation, may help in identifying severe cases and predicting outcome. Therefore, this study was conducted to evaluate the clinical features and outcomes in adults with leptospirosis with special reference to serum procalcitonin.

## MATERIALS AND METHODS

This prospective observational study was conducted on IPD basis patients in the Department of Medicine, BRD Medical College, Gorakhpur, over a period of one year. All adult patients diagnosed with leptospirosis and admitted in the medicine ward of Nehru Hospital during the study period were included in the study.

### Inclusion Criteria

- All patients admitted in the medicine ward with acute febrile illness and confirmed leptospirosis (IgM positive).
- Patients of age 17 years or above.
- Patients willing to give informed consent.

### Exclusion Criteria

- Acute febrile illness due to causes other than leptospirosis such as dengue, malaria, typhoid, tuberculosis, etc.
- Pre-diagnosed cases of chronic kidney disease (CKD) and chronic liver disease (CLD).
- Known cases of autoimmune diseases such as SLE, RA, or other similar conditions.
- Pregnant females.
- Known cases of cardiac dysfunction or congestive heart failure.
- Patients receiving immunosuppressive therapy.
- All cases of malignancy.

All eligible patients were evaluated through detailed history, clinical examination, and relevant laboratory investigations. Serum procalcitonin levels were measured at the time of admission. Patients were managed as per standard treatment protocol and were followed throughout their hospital stay till discharge or death. Clinical outcomes such as recovery, complications, need for ventilatory support, and mortality were recorded.

### Statistical Analysis

Microsoft Excel was used for tabulation of data. IBM Statistical Package for Social Sciences (SPSS) was used for statistical analysis. Continuous variables were expressed as mean and standard deviation,

while categorical variables were expressed as percentages. Association between serum procalcitonin levels and clinical outcomes was analyzed using appropriate statistical tests. A p-value of <0.05 was considered statistically significant.

**Ethical Consideration**

The study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants before inclusion in the study. Confidentiality of all patient information was strictly maintained throughout the study.

**RESULTS**

A total of 70 patients were included in the study, with age ranging from 16–79 years and a mean age of 39 years. The mean hemoglobin was 10.9 g/dL on day 1 and 10.5 g/dL on day 3. Mean total leukocyte count was 14480 cells/mm³ on day 1, which decreased to 11340 cells/mm³ on day 3. Platelet count was 145970 cells/mm³ on day 1 and remained similar on day 3. Mean total bilirubin was elevated (2.80 mg/dL on day 1), which decreased on day 3. Liver enzymes (SGOT and SGPT) were raised, with mean SGOT 181 U/L and SGPT 121 U/L on day 1. Renal parameters showed raised urea (68 mg/dL) and creatinine (1.81 mg/dL). Mean procalcitonin level was 9.75 ng/mL, indicating significant elevation.

**Table 1. Baseline and Follow-up Hematological and Biochemical Parameters**

| Parameter | Mean ± SD | Minimum | Maximum |
|---|---|---|---|
| Age | 39 ± 18 | 16 | 79 |
| Hb Day 1 | 10.9 ± 2.1 | 5.6 | 15.6 |
| Hb Day 3 | 10.5 ± 1.9 | 6.2 | 14.5 |
| TLC Day 1 (cells/mm³) | 14480 ± 9933 | 4000 | 53000 |
| TLC Day 3 (cells/mm³) | 11340 ± 6210 | 2600 | 40000 |
| Platelets Day 1 (cells/mm³) | 145970 ± 92157 | 10900 | 420000 |
| Platelets Day 3 (cells/mm³) | 145914 ± 68937 | 10000 | 384000 |
| Total Bilirubin Day 1 (mg/dL) | 2.80 ± 3.93 | 0.23 | 19.74 |
| Total Bilirubin Day 3 (mg/dL) | 2.14 ± 3.01 | 0.20 | 14.75 |
| Total Protein Day 1 (g/dL) | 6.3 ± 1.0 | 4.4 | 8.9 |
| Total Protein Day 3 (g/dL) | 5.8 ± 0.9 | 4.2 | 8.2 |
| Albumin Day 1 (g/dL) | 3.24 ± 0.62 | 1.80 | 4.30 |
| Albumin Day 3 (g/dL) | 3.07 ± 0.54 | 2.10 | 4.30 |
| SGOT Day 1 (U/L) | 181 ± 200 | 21 | 980 |
| SGOT Day 3 (U/L) | 169 ± 171 | 19 | 780 |
| SGPT Day 1 (U/L) | 121 ± 109 | 17 | 489 |
| SGPT Day 3 (U/L) | 103 ± 84 | 15 | 334 |
| ALP Day 1 (U/L) | 678 ± 800 | 57 | 3697 |
| ALP Day 3 (U/L) | 581 ± 626 | 86 | 2566 |
| Urea Day 1 (mg/dL) | 68 ± 53 | 22 | 215 |
| Urea Day 3 (mg/dL) | 72 ± 78 | 15 | 475 |
| Creatinine Day 1 (mg/dL) | 1.81 ± 1.75 | 0.20 | 7.63 |
| Creatinine Day 3 (mg/dL) | 2.01 ± 2.63 | 0.46 | 15.43 |
| Sodium Day 1 (mmol/L) | 142 ± 9 | 119 | 158 |
| Sodium Day 3 (mmol/L) | 142 ± 7 | 123 | 168 |
| Potassium Day 1 (mEq/L) | 4.0 ± 0.8 | 2.3 | 6.0 |
| Potassium Day 3 (mEq/L) | 3.9 ± 1.1 | 2.7 | 8.3 |
| pH Day 1 | 7.390 ± 0.070 | 7.241 | 7.504 |
| pH Day 3 | 7.395 ± 0.080 | 7.214 | 7.564 |
| $HCO_3$ Day 1 (mmol/L) | 22.4 ± 4.8 | 12.8 | 33.4 |
| $HCO_3$ Day 3 (mmol/L) | 23.0 ± 4.4 | 11.8 | 29.6 |
| CRP (mg/L) | 31.70 ± 20.49 | 3.93 | 90.10 |
| Ferritin (ng/mL) | 988.20 ± 715.32 | 116.81 | 2000.00 |

| | | | |
|---|---|---|---|
| LDH (U/L) | 428.9 ± 239.4 | 129.7 | 1122.4 |
| Triglycerides (mg/dL) | 219 ± 193 | 52 | 1117 |
| Procalcitonin (ng/mL) | 9.75 ± 15.31 | 0.02 | 73.74 |

60.0% belonged to <40 years age group, 22.9% to 40–60 years, and 17.1% were ≥60 years. 51.4% patients were females and 48.6% were males. Majority of both males and females belonged to the younger age group.

**Table 2. Demographic Distribution of Study Participants**

| Variable | Category | N (%) |
|---|---|---|
| **Age Group** | <40 | 42 (60.0%) |
| | 40–60 | 16 (22.9%) |
| | ≥60 | 12 (17.1%) |
| **Sex** | Female | 36 (51.4%) |
| | Male | 34 (48.6%) |

Most common clinical feature was altered sensorium (60.0%). Other presenting complaints included abdominal pain (20.0%), vomiting (15.7%), jaundice (17.1%), dyspnea (17.1%), seizure (17.1%) and headache (10.0%). Majority of patients did not have these symptoms except altered sensorium.

**Table 3. Distribution of Clinical Features (Strictly from Thesis Data)**

| Clinical Feature | Present | Absent |
|---|---|---|
| **Abdominal Pain** | 14 (20.0%) | 56 (80.0%) |
| **Vomiting** | 11 (15.7%) | 59 (84.3%) |
| **Headache** | 7 (10.0%) | 63 (90.0%) |
| **Jaundice** | 12 (17.1%) | 58 (82.9%) |
| **Dyspnea** | 12 (17.1%) | 58 (82.9%) |
| **Altered Sensorium** | 42 (60.0%) | 28 (40.0%) |
| **Seizure** | 12 (17.1%) | 58 (82.9%) |

58.6% patients had a GCS ≤14, indicating impaired consciousness, while 41.4% patients had GCS >14. This shows that a significant proportion of patients had moderate to severe illness.

**Table 4. Distribution of Glasgow Coma Scale**

| GCS | N (%) |
|---|---|
| ≤14 | 41 (58.6%) |
| >14 | 29 (41.4%) |

Out of 70 patients, 95.7% were discharged successfully, while 4.3% patients expired, indicating overall good outcome with low mortality.

**Table 5. Outcome Distribution of Study Participants**

| Outcome | N (%) |
|---|---|
| Discharged | 67 (95.7%) |
| Expired | 3 (4.3%) |

Most patients did not have co-infections. Dengue was present in 1.4% cases, typhoid in 11.4% cases and scrub typhus in 15.7% cases, while no patient had malaria.

**Table 6. Distribution of Co-infections**

| Co-infection | Present | Absent |
|---|---|---|
| Dengue | 1 (1.4%) | 69 (98.6%) |
| Malaria (RDT MP) | 0 (0.0%) | 70 (100.0%) |

| | | |
|---|---|---|
| Typhoid | 8 (11.4%) | 62 (88.6%) |
| Scrub Typhus | 11 (15.7%) | 59 (84.3%) |

All patients with serum procalcitonin <1.3 ng/mL were discharged (100.0%), while among those with ≥1.3 ng/mL, 82.9% were discharged and 17.1% expired. A statistically significant association was found between serum procalcitonin and outcome (p=0.023).

**Table 7. Association of Serum Procalcitonin with Outcome**

| Serum Procalcitonin | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <1.3 ng/mL | 35 (100.0%) | 0 (0.0%) | 2.187 | 0.023 |
| ≥1.3 ng/mL | 29 (82.9%) | 6 (17.1%) | | |

Among patients with ALP <400 IU/L, 95.0% were discharged and 5.0% expired. In patients with ALP ≥400 IU/L, 96.7% were discharged and 3.3% expired. No significant association was found (p=0.773).

**Table 8. Association of Alkaline Phosphatase with Outcome**

| ALP (IU/L) | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <400 | 38 (95.0%) | 2 (5.0%) | 0.116 | 0.773 |
| ≥400 | 29 (96.7%) | 1 (3.3%) | | |

Among patients with ferritin <500 ng/mL, 94.7% were discharged and 5.3% expired. Among those with ≥500 ng/mL, 96.9% were discharged and 3.1% expired. No significant association was found (p=0.66).

**Table 9. Association of Ferritin with Outcome**

| Ferritin (ng/mL) | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <500 | 36 (94.7%) | 2 (5.3%) | 0.194 | 0.66 |
| ≥500 | 31 (96.9%) | 1 (3.1%) | | |

Among patients with LDH <500 U/L, 94.5% were discharged and 5.5% expired. All patients with LDH ≥500 U/L were discharged. No significant association was found (p=0.355).

**Table 10. Association of LDH with Outcome**

| LDH (U/L) | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <500 | 52 (94.5%) | 3 (5.5%) | 0.855 | 0.355 |
| ≥500 | 15 (100.0%) | 0 (0.0%) | | |

Among patients with creatinine <1.5 mg/dL, 72.7% were discharged and 66.7% expired, while in those with >1.5 mg/dL, 27.3% were discharged and 33.3% expired. No significant association was found (p=0.818).

**Table 11. Association of Creatinine with Outcome**

| Creatinine (mg/dL) | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <1.5 | 48 (72.7%) | 2 (66.7%) | 0.053 | 0.818 |
| >1.5 | 18 (27.3%) | 1 (33.3%) | | |

Among patients with CRP <3 times normal, 18.6% were discharged and none expired. Among those with >3 times normal, 81.4% were discharged and 100% expired. No significant association was found (p=0.633).

**Table 12. Association of CRP with Outcome**

| CRP | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <3 times normal | 11 (18.6%) | 0 (0.0%) | 0.228 | 0.633 |
| >3 times normal | 48 (81.4%) | 1 (100.0%) | | |

Among patients with urea <100 mg/dL, 82.1% were discharged and 66.7% expired, while among those with >100 mg/dL, 17.9% were discharged and 33.3% expired. No significant association was found (p=0.463).

**Table 13. Association of Urea with Outcome**

| Urea (mg/dL) | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <100 | 55 (82.1%) | 2 (66.7%) | 4.566 | 0.463 |
| >100 | 12 (17.9%) | 1 (33.3%) | | |

Among patients <40 years, 97.6% were discharged and 2.4% expired. In 40–60 years group, 87.5% were discharged and 12.5% expired. All patients ≥60 years were discharged. No significant association was found (p=0.17).

**Table 14. Association of Age with Outcome**

| Age Group | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <40 | 41 (97.6%) | 1 (2.4%) | 3.541 | 0.17 |
| 40–60 | 14 (87.5%) | 2 (12.5%) | | |
| ≥60 | 12 (100.0%) | 0 (0.0%) | | |

Among patients without typhoid, 95.2% were discharged and 4.8% expired. All patients with typhoid were discharged. No significant association was found (p=0.525).

**Table 15. Association of Typhoid with Outcome**

| Typhoid | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| Absent | 59 (95.2%) | 3 (4.8%) | 0.404 | 0.525 |
| Present | 8 (100.0%) | 0 (0.0%) | | |

Among patients with fever <7 days, 53.7% were discharged and 33.3% expired. Among those with fever >7 days, 46.3% were discharged and 66.7% expired. No significant association was found (p=0.489).

**Table 16. Association of Duration of Fever with Outcome**

| Duration of Fever | Discharged | Expired | Chi-square | p value |
|---|---|---|---|---|
| <7 days | 36 (53.7%) | 1 (33.3%) | 0.479 | 0.489 |
| >7 days | 31 (46.3%) | 2 (66.7%) | | |

Patients with serum procalcitonin ≥1.3 ng/mL had higher mean values of TLC, bilirubin, urea, creatinine, CRP, ferritin, LDH, and triglycerides compared to those with <1.3 ng/mL. This indicates that higher procalcitonin levels are associated with increased inflammation and organ dysfunction.

**Table 17. Comparison of Hematological and Biochemical Parameters Based on Serum Procalcitonin Levels**

| Parameter | <1.3 ng/mL (Mean ± SD) | ≥1.3 ng/mL (Mean ± SD) |
|---|---|---|
| Hb Day 1 | 11.2 ± 2.1 | 10.5 ± 2.1 |
| Hb Day 3 | 11.0 ± 1.9 | 10.1 ± 1.8 |
| TLC Day 1 | 12651 ± 8119 | 16309 ± 11289 |
| TLC Day 3 | 9931 ± 3824 | 12749 ± 7717 |
| Platelets Day 1 | 138254 ± 83926 | 153686 ± 100347 |
| Platelets Day 3 | 146143 ± 60645 | 145686 ± 77242 |
| Total Bilirubin Day 1 | 2.13 ± 3.10 | 3.47 ± 4.56 |
| Total Bilirubin Day 3 | 1.80 ± 2.97 | 2.48 ± 3.06 |
| Total Protein Day 1 | 6.4 ± 1.0 | 6.2 ± 1.0 |
| Total Protein Day 3 | 5.8 ± 0.8 | 5.9 ± 1.1 |

| | | |
|---|---|---|
| Albumin Day 1 | 3.32 ± 0.63 | 3.16 ± 0.60 |
| Albumin Day 3 | 3.13 ± 0.55 | 3.01 ± 0.54 |
| SGOT Day 1 | 178 ± 159 | 185 ± 237 |
| SGOT Day 3 | 153 ± 139 | 184 ± 198 |
| SGPT Day 1 | 124 ± 96 | 118 ± 122 |
| SGPT Day 3 | 106 ± 77 | 100 ± 92 |
| ALP Day 1 | 540 ± 608 | 815 ± 943 |
| ALP Day 3 | 436 ± 551 | 599 ± 643 |
| Urea Day 1 | 51 ± 35 | 85 ± 62 |
| Urea Day 3 | 49 ± 35 | 95 ± 101 |
| Creatinine Day 1 | 1.25 ± 1.22 | 2.39 ± 2.03 |
| Creatinine Day 3 | 1.26 ± 1.56 | 2.75 ± 3.24 |
| Sodium Day 1 | 140 ± 7 | 144 ± 10 |
| Sodium Day 3 | 140 ± 5 | 144 ± 9 |
| Potassium Day 1 | 4.0 ± 0.8 | 4.0 ± 0.8 |
| Potassium Day 3 | 3.9 ± 1.0 | 3.9 ± 1.1 |
| pH Day 1 | 7.387 ± 0.077 | 7.393 ± 0.063 |
| pH Day 3 | 7.387 ± 0.066 | 7.404 ± 0.092 |
| $HCO_3$ Day 1 | 21.5 ± 4.7 | 23.3 ± 4.8 |
| $HCO_3$ Day 3 | 22.5 ± 4.5 | 23.6 ± 4.4 |
| CRP | 23.96 ± 18.39 | 39.45 ± 19.80 |
| Ferritin | 719.90 ± 664.52 | 952.87 ± 698.75 |
| LDH | 354.5 ± 189.9 | 469.9 ± 258.4 |
| Triglycerides | 186 ± 144 | 252 ± 230 |
| Procalcitonin | 0.37 ± 0.32 | 19.41 ± 17.12 |

**DISCUSSION AND CONCLUSION**

The present study was conducted to evaluate the clinical outcomes in adult patients with leptospirosis with special reference to serum procalcitonin. The findings of the study show that leptospirosis is a multisystem disease with varied clinical presentation and significant laboratory abnormalities, and that serum procalcitonin has a meaningful role in predicting disease severity and outcome.

In the present study, the majority of patients were below 40 years of age, with a relatively balanced distribution between males and females. This finding is consistent with studies by Gupta N et al.[8], who reported that leptospirosis commonly affects younger, active individuals due to increased environmental and occupational exposure. Similarly, Aydemir EA et al.[9] also highlighted that outdoor exposure and occupational risk play a key role in disease transmission, explaining the higher involvement of younger populations.

The clinical presentation in our study was predominantly non-specific, with common symptoms including abdominal pain, vomiting, and headache, along with jaundice and dyspnea in a subset of patients. A significant proportion of patients had altered sensorium, indicating severe systemic involvement. These findings are in agreement with Gupta N et al.[8], who reported gastrointestinal symptoms and multiorgan involvement as common features in leptospirosis. Aydemir EA et al.[9] also described a wide range of symptoms including systemic and neurological manifestations, supporting the heterogeneous clinical presentation observed in our study.

Laboratory findings in the present study showed significant hematological and biochemical abnormalities. Leukocytosis was commonly observed, reflecting an ongoing inflammatory response. Hepatic involvement was evident with elevated bilirubin, transaminases, and alkaline phosphatase levels. This pattern of liver injury is consistent with findings reported by Đukić T et al.[10], who demonstrated that elevated bilirubin is associated with severe leptospirosis. Gupta N et al.[8] also reported hepatic dysfunction as a common feature, supporting our observations. Renal dysfunction was also noted with elevated urea and creatinine levels, which is in line with studies by Đukić T et al.[10] and Gupta N et al.[8], where renal involvement was associated with severe disease.

Inflammatory markers such as CRP, ferritin, and LDH were elevated in many patients, indicating a strong systemic inflammatory response. Similar findings have been reported by Gupta N et al.[8], who

observed elevated inflammatory markers in leptospirosis. Wangrangsimakul T et al.[11] also highlighted the role of CRP in acute febrile illness, supporting its use as an inflammatory marker.

The central focus of the study was the role of serum procalcitonin. It was observed that patients with higher procalcitonin levels had more severe laboratory abnormalities, including elevated leukocyte count, bilirubin, urea, creatinine, CRP, ferritin, and LDH levels, indicating multiorgan involvement. This finding is supported by Crouzet J et al.[12], who reported that procalcitonin and other biomarkers are useful in assessing disease severity in leptospirosis. Similarly, Hoeboer SH et al.[13] demonstrated that rising procalcitonin levels are associated with persistent organ dysfunction and poor outcomes in critically ill patients.

In the present study, serum procalcitonin showed a statistically significant association with outcome ($p = 0.023$), indicating its prognostic value. This is in accordance with findings by Meng FS et al.[14], who demonstrated that procalcitonin is a strong predictor of short-term mortality and is superior to other markers. Sharma A et al.[15] also reported that procalcitonin is useful in identifying patients with poor outcomes in sepsis. Additionally, Sahu et al.[16] found that higher procalcitonin levels are associated with increased mortality and longer hospital stay, further supporting its role as a prognostic marker.

Although CRP was elevated in most patients, its association with outcome was less significant compared to procalcitonin. Similar observations have been made by Hoeboer SH et al.[13], who reported that CRP is more useful for monitoring inflammation, whereas procalcitonin is a better predictor of severity and outcome. Meng FS et al.[14] also showed that procalcitonin has better prognostic accuracy compared to CRP.

Other parameters such as ALP, ferritin, LDH, creatinine, urea, age, and duration of fever did not show a statistically significant association with outcome in the present study, although they were elevated in severe cases. Similar variability has been reported in previous studies such as Wangrangsimakul T et al.[11] and Meng FS et al.[14], where multiple factors contribute to disease severity rather than a single parameter.

The presence of co-infections such as scrub typhus and typhoid did not show a significant association with outcome. Wangrangsimakul T et al.[11] also reported that co-infections may not independently influence outcomes unless associated with severe disease.

The overall outcome in the present study was favorable, with the majority of patients being discharged and a small proportion of mortality. This may be attributed to early diagnosis and prompt management. However, elevated procalcitonin levels in some patients highlight the importance of early identification of high-risk cases.

In conclusion, leptospirosis is a multisystem disease with varied clinical features and significant laboratory abnormalities. The disease can present with a wide spectrum ranging from mild illness to severe multiorgan involvement, making early prediction of outcome difficult. In the present study, serum procalcitonin was found to be a useful biomarker and showed a significant association with clinical outcome. Higher procalcitonin levels were associated with increased disease severity and adverse outcomes. Therefore, early measurement of serum procalcitonin may help in identifying high-risk patients and guide timely clinical management.

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