

Original Research Article

Comparative hematological parameters at admission in Kyasanur forest disease: a single centre study in Goa

Chitralekha Nayak^{1*}, Ruth Viegas², Edwin Gomes³

¹Department of Medicine, Healthway Hospitals, Goa, India

²Dr. Ruth Clinic, Vasco da Gama, Goa, India

³Department of Geriatric Medicine, Goa Medical College, Bambolim, Tiswadi, North Goa, India

Received: 20 June 2026

Accepted: 17 September 2026

*Correspondence:

Dr. Chitralekha Nayak,

E-mail: nayakchitralekha@gmail.com

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ABSTRACT

Background: Kyasanur forest disease (KFD) is a tick-borne viral hemorrhagic fever endemic to southern India. This study describes the clinical profile and hematological parameters of confirmed KFD cases in a tertiary care center in Goa.

Methods: A retrospective observational study was conducted at Goa Medical College, from June 2016 to June 2017. Medical records of adult patients with reverse transcription polymerase chain reaction (RT-PCR)-confirmed KFD were reviewed. Demographic data, clinical features, and laboratory parameters were analyzed descriptively. Patients with incomplete medical records or non-confirmed diagnoses were excluded.

Results: A total of 57 patients were enrolled, with female predominance 36 (63.2%) and a mean age of 41.6±15.7 years. Fever was universal, with gastrointestinal and myalgia symptoms. Bleeding occurred in 10 (17.5%), and neurological involvement developed in 30% by day 5–6. Leucopenia was documented in 52 (91.2%), neutropenia in 48 (84.2%), and thrombocytopenia in 40 (70.2%). Transaminitis was observed in 51 (90.2%), while hyperbilirubinemia and renal dysfunction were rare. Most patients recovered by day 7; one death occurred due to pneumonia-related complications.

Conclusion: KFD is characterized by early cytopenias and hepatic involvement following a predictable temporal pattern. Early diagnosis and phase-specific monitoring are essential to optimize outcomes.

Keywords: Kyasanur forest disease, Hematological parameters, Viral hemorrhagic fever, Thrombocytopenia, Goa

INTRODUCTION

KFD is an acute viral hemorrhagic fever endemic to the southern part of India, first identified in the Kyasanur Forest region of Karnataka in 1957. The disease is caused by the Kyasanur forest disease virus (KFDV), a member of the Flaviviridae family, genus Flavivirus, and is primarily transmitted to humans through the bite of infected *Haemaphysalis* ticks.¹ The transmission cycle of KFDV is maintained in forested ecosystems involving small mammals such as rodents, and shrews, which act as amplifying hosts. Monkeys, particularly *Semnopithecus* and *Macaca radiata*, are highly susceptible and often die

following infection, serving sentinel species for outbreak detection.¹ KFD displays a seasonal pattern, with most cases occurring from December to May, coinciding with peak nymphal tick activity.² The clinical spectrum includes the sudden onset of high-grade fever, chills, headache, myalgia, vomiting, and gastrointestinal symptoms. In some cases, a biphasic illness may occur, with neurological manifestations such as mental confusion, tremors, and rarely, hemorrhagic features.³ Laboratory abnormalities frequently observed in KFD include leukopenia, thrombocytopenia, elevated liver enzymes, and mild renal dysfunction, but data on these parameters remain limited, particularly at the time of

admission. Although KFD has historically been confined to Karnataka, the emergence of cases in neighboring states such as Kerala, Tamil Nadu, and Goa in recent years indicates an expanding geographic range.⁴ Goa reported its first laboratory-confirmed cases in 2015, raising public health concerns about the spread of the disease beyond traditional endemic areas.⁵ Early identification and characterization of clinical and hematological features at admission are essential for timely diagnosis, risk stratification, and supportive management of affected patients. The present study aimed to describe the clinical profile and hematological parameters of laboratory-confirmed KFD cases at the time of hospital admission in a tertiary care center in Goa.

METHODS

Study design and setting

This hospital-based observational retrospective study was conducted in the Department of Medicine at Goa Medical College, Goa, India, over a period of one year from June 2016 to June 2017. Approval for the study was obtained from the Goa Medical College, Institutional Ethics Committee, bearing approval number GMC/IEC/Sept-17/13, prior to data collection. Informed consent was waived given the retrospective nature of the study.

Study population and eligibility criteria

Medical records and laboratory reports of adult patients (aged ≥ 18 years) admitted during the study period with a confirmed diagnosis of KFD were reviewed. Patients with incomplete medical records or a non-confirmed diagnosis were excluded from the study. Confirmation of KFD was based on the detection of KFDV RNA by RT-PCR or real-time RT-PCR performed on blood or tissue samples. The case definition used for KFD included any patient presenting with acute febrile illness, headache, and myalgia, along with a history of tick exposure, travel to forested regions, or residence in a KFD-endemic area—particularly the forested areas of Karnataka—with laboratory confirmation of KFDV RNA by RT-PCR.⁶

Sample size

As this was a retrospective study reviewing all available confirmed KFD cases admitted during the one-year study period at a single tertiary center, no formal sample size calculation was performed. All 57 eligible cases identified during the study period were included in the analysis.

Data collection and study parameters

Data extracted from the records included demographic details (age, sex), clinical features at the time of

presentation, duration of illness, and complications during hospitalization. Laboratory parameters assessed at admission (Day 1) and on Days 3, 5, and 7 of illness included complete blood count (CBC)—hemoglobin (Hb), total leukocyte count (TLC), differential leukocyte count, and platelet count; liver function tests (LFTs)—serum glutamic-oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), alkaline phosphatase (ALP), and total and direct bilirubin; and renal function tests (RFTs)—serum creatinine. Leucopenia was defined as TLC < 4000 cells/mm³, neutropenia as absolute neutrophil count < 1800 cells/mm³, thrombocytopenia as platelet count $< 150,000$ /mm³, and anemia as hemoglobin < 12 g/dl for females or < 13 g/dl for males.

Statistical analysis

All collected data were compiled in a structured format and analyzed using SPSS software (V24). Continuous variables are expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables are expressed as frequencies and percentages. Day-wise trends in hematological parameters were analyzed descriptively.

RESULTS

A total of 57 confirmed cases of KFD were enrolled in this study. Among these, 36 (63.2%) were females and 21 (36.8%) were males, with a male-to-female ratio of 0.58:1. The age of patients ranged from 15 to 79 years, with a mean age of 41.56 ± 15.68 years. The majority of cases were in the 30 to 40 years age group 17 (29.8%). The baseline demographic characteristics are summarized in Table 1.

Fever was present in all 57 (100%) patients at admission, with an average duration of 4.29 days. Other prominent symptoms included myalgia, vomiting, diarrhea, abdominal pain, and headache. Rash was observed in 4 (7%) of cases, conjunctival congestion in 3 (5.2%), and bleeding manifestation in 10 (17.5%). Respiratory findings included cough in 11 (19.2%) patients by Day 4 and coarse crepitations in 11 (20%).

Pneumonia developed in 5 (8.8%) patients around Day 5 of illness. Neurological involvement became evident by Day 5 or 6, with altered sensorium of 10 (17.5%) patients, meningoencephalitis in 5 (8.8%), seizures in 2 (3.5%), and other manifestations such as coarse tremors, quadriparesis, and cerebellitis in the remainder, affecting approximately 17 (30%) patients overall. Hypertension and shock occurred in 8 (14%) of patients. Hepatomegaly was seen in 4 (7%), splenomegaly in 3 (5.2%), tachycardia in 6 (10%), and relative bradycardia in 3 (5.2%) patients. Acute kidney injury developed in 1 (1.8%) patient during the hospital stay.

Table 1: Baseline characteristics of Kyasanur forest disease patients (n=57).

Characteristics		Number	%
Age (in years)	<21	7	12.28
	21 - 30	10	17.54
	31-40	17	29.82
	41-50	9	15.79
	51-60	8	14.04
	>60	6	10.53
Sex	Males	21	36.84
	Females	36	63.16

Table 2: Day-wise distribution of total leukocyte counts categories in patients with Kyasanur forest disease (n=57).

Total leukocyte count (cells/mm ³)	Day 1	Day 3	Day 5	Day 7
>4000	3	2	3	5
3000-4000	5	2	5	8
2000-3000	14	11	7	13
1000-2000	29	30	28	13
<1000	2	5	4	1
Data unavailable	4	7	10	17

Table 3: Biochemical profile and clinical interpretation of KFD patients on day 1 of illness.

Parameter	Mean±SD	Median (IQR)
Total bilirubin (mg/dl)	0.44±0.21	0.4 (0.3-0.6)
Direct bilirubin (mg/dl)	0.47±1.64	0.2 (0.1-0.3)
SGOT (U/l)	334.35±400.77	155 (58.5-439)
SGPT (U/l)	145±182.44	87 (25-195.5)
Alkaline phosphatase (U/l)	78.85±45.84	64 (50.5-83.5)

Hematological analysis revealed dynamic day-wise trends over the first week of illness. Hemoglobin levels showed minimal variation over the first week, starting at approximately 12.5 g/dl on day 1, with a slight dip on day 3 followed by stabilization through day 5 and day 7 (Figure 1). In contrast, total leukocyte counts (TLC) displayed a biphasic trend. The mean TLC was low on day 1 (2025.85 cells/mm³), further decreased by Day 3 (1851.44 cells/mm³), recovered modestly on Day 5 (2041.66 cells/mm³), and then showed a marked increase by Day 7 (2967.23 cells/mm³) (Figure 2).

The categorical distribution of TLC across days is detailed in Table 2. The majority of patients clustered in the 1000-3000 cells/mm³ range during the early phase; by day 7, there was a visible shift toward higher leukocyte categories, with an increase in patients having TLC >3000 cells/mm³ and a reduction in those with counts <2000 cells/mm³ illustrating a characteristic early leukopenic phase followed by gradual hematological recovery over time. Differential count patterns showed declining neutrophils (mean 56.5% on day 1 to 39.7% on day 7), while lymphocyte percentages increased from a mean of 34.17% on day 1 to 43.38% on day 5, with sustained elevation on day 7 (40.08%). Monocyte counts

also increased progressively from a mean of 7.82% on Day 1 to 17.4% by day 7.

Platelet counts showed a rapid rise in the early phase from a mean of 18.46×10⁹/l on Day 1 to 28.90×10⁹/l by Day 3, then trended downward through day 5 (26.31×10⁹/l) and day 7 (23.30×10⁹/l). Despite this decrease, platelet levels remained above critical thresholds in most cases after the initial days (Figure 3).

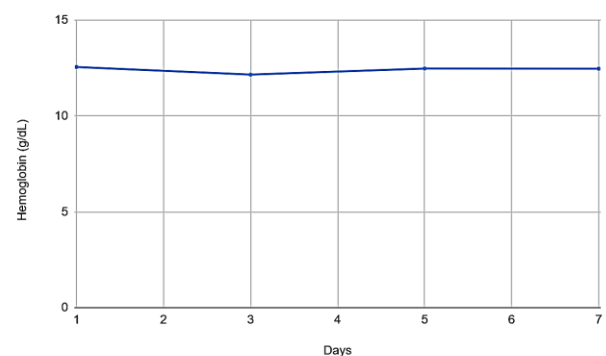


Figure 1: Hemoglobin trends in KFD patients over the first week of illness.

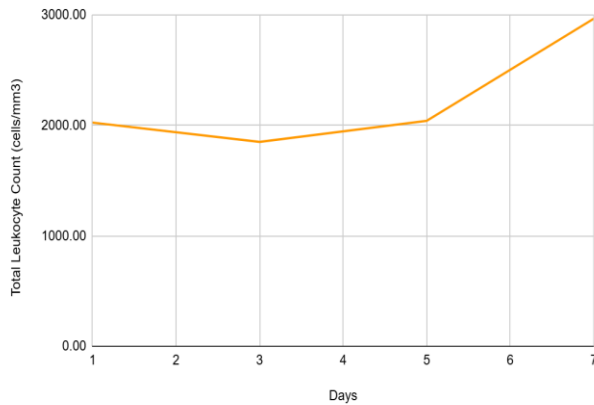


Figure 2: Mean total leukocyte count in KFD patients during the first week.

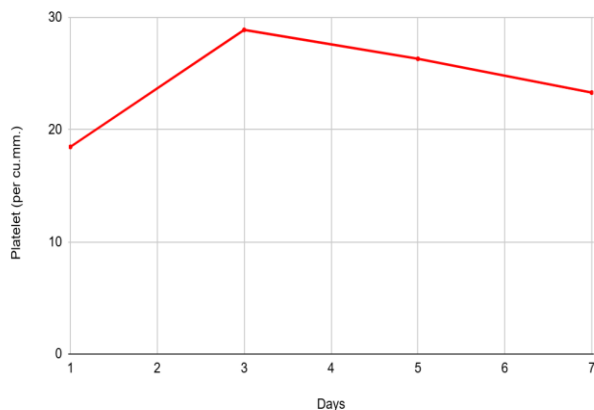


Figure 3: Mean platelet count in KFD patients over the first seven days.

Overall, leucopenia was documented in 52 (91.2%) of patients at admission, with 30 (52.6%) having TLC <2000/mm³, including 8 (14%) with values <1000/mm³. Absolute neutropenia occurred in 48 (84.2%) of patients, lymphocytosis in 18 (31.5%), and thrombocytopenia in 40 (70.2%), with 15 (26.3%) exhibiting platelet counts <100,000/mm³. Anemia was found in 15 (26.3%) of cases, including 4 (7%) patients with hemoglobin <10g/dl. Transaminitis was present in 51 (90.2%) of patients, predominantly due to SGOT elevation. The biochemical profile on day 1 of illness is summarized in Table 3. Bilirubin levels showed minimal deviation from normal values, with total bilirubin median of 0.4 mg/dl, and raised creatinine was rare. Most patients improved clinically with normalization of hematological and biochemical parameters by day 7. One (1.8%) patient died due to pneumonia-related complications.

DISCUSSION

Our cohort of 57 RT-PCR-confirmed KFD cases from Goa, a region that has emerged as an extension of the traditional endemic belt along the Western Ghats. The

cohort was characterized by female predominance 36 (63.2%), with a male-to-female ratio of 0.58:1, and a mean age of 41.56±15.68 years, with nearly 46% of patients clustered between 31 and 50 years of age. This demographic profile is comparable to recent data from Kerala, where Gladson et al reported female predominance (73%) with a mean age of 38±13.5 years, suggesting similar exposure patterns in emerging endemic regions.⁷ In contrast, larger cohorts from Karnataka have reported male predominance; Gupta et al in a 192-patient series, noted 57% males with a mean age of 46.2±15.6 years, reflecting regional differences in occupational exposure, particularly forest-based agricultural activities, and healthcare-seeking behaviour.⁸ The female predominance observed in our cohort and in Kerala may reflect greater involvement of women in forest-adjacent livelihood activities in these regions.

Clinically, all patients in our cohort presented with fever, with a mean duration of 4.29 days at admission, closely aligning with the median duration of 4-5 days reported in Karnataka studies.⁸ Gastrointestinal symptoms and myalgia were common early features, while bleeding manifestations were observed in 10 (17.5%) of patients, a proportion that lies between the lower rates reported in Karnataka (8.3%) and the higher rates noted in the Kerala and Shivamogga Karnataka cohorts (20% and 40%, respectively).⁷⁻⁹ Neurological involvement in our study became apparent later in the course of illness, typically around day 5-6, affecting approximately 17 (30%) of patients in various forms, including altered sensorium, meningoencephalitis, and seizures. These timings and frequencies are consistent with the biphasic pattern described in prior studies, where neurological complications are more frequently documented during the later phase of illness.^{8,10}

The most striking findings in the study relate to the dynamic changes in hematological parameters over the first week of illness. Leucopenia was present in 91.2% of patients at admission, with over half having counts below 2000/mm³, a frequency higher than that reported by Gupta et al. (80.2%) and comparable to the near-universal leucopenia described in early-phase presentations in Manipal cohorts. The mean total leukocyte count declined further from 2025.9 cells/mm³ on day 1 to a nadir of 1851.4 cells/mm³ by day 3, before showing gradual recovery by day 5 and a more marked rise to 2967.2 cells/mm³ by day 7.

This pattern is attributed to transient bone marrow suppression during peak viremia, compounded by cytokine-mediated apoptosis of circulating leukocytes. As viral replication declines, marrow function recovers and leukocyte counts rise, often accompanied by a relative lymphocyte and monocyte predominance, reflecting a shift from innate to adaptive immune responses. Phase-specific studies have further shown that this leukopenia phase may transition to leukocytosis during the second phase, particularly among patients with neurological

involvement.¹⁰ The concordance of these patterns across studies supports the interpretation that leukocyte trends in KFD reflect viral replication kinetics and marrow suppression early in illness.

Comparing with Kerala cohort, Gladson et al documented early leukopenia with median TLCs of 2,100–2,600 cells/ μ l, platelet counts of 110,000–162,000/ μ l, and largely preserved hemoglobin levels of 10.5–13.1 g/dl during the first two days of illness.⁷ The findings closely parallel this early hematological pattern, with a low mean TLC of 2,025.85 cells/mm³ on Day 1 and stable hemoglobin around 12.56 g/dl, supporting early bone marrow suppression without significant hemolysis or bleeding. However, platelet counts in our cohort were markedly lower in the early phase (mean 18.46×10^9 /l), suggesting later presentation, referral bias, or a higher proportion of severe disease compared with earlier cohort studies.

As the illness progressed to Day 4–5, the Shivamogga cohort reported by Vedachalam et al demonstrated leukocyte of approximately 2,000–2,100 cells/ μ l and platelet counts falling to 58,000/ μ l with other Karnataka outbreaks reporting platelet levels of 100,000–120,000/ μ l.^{8,11} In contrast, our cohort showed a biphasic leukocyte trend, with TLC declining further to 1,851.44 cells/mm³ by day 3 before modest recovery by Day 5 (2,041.66 cells/mm³). Differential counts revealed progressive neutropenia (56.5% on day 1 to 39.7% on day 7) with rising lymphocyte and monocyte proportions, consistent with immune reconstitution in viral hemorrhagic fevers. Absolute neutropenia occurred in 84.2% of patients, a higher frequency than emphasized in prior reports, indicating more profound marrow suppression in our population.

Hepatic involvement in our study closely mirrored established literature, with transaminitis present in 90.2% of patients and a clear predominance of SGOT elevation. SGOT levels (mean 334.35 U/l; median 155 U/l) were comparable to severe ranges reported in Karnataka by Gladson et al outbreaks, where peak values of 180–200 U/l and extremes up to 400–440 U/l have been documented, while SGPT elevation remained relatively modest (median ~87 U/l).⁷ Bilirubin levels showed minimal deviation from normal values, (total bilirubin median 0.4 mg/dl; mean 0.44 mg/dl; direct bilirubin median 0.2 mg/dl), aligning with earlier reports of minimal bilirubin elevation (0.7–0.9 mg/dl) and indicating negligible cholestatic involvement. During recovery, hematological and biochemical parameters improved steadily, with TLC rising to 2,967.23 cells/mm³ by Day 7, hemoglobin stabilizing at 10.5–12 g/dl, and declining transaminases, consistent with published recovery patterns; only one mortality occurred, attributable to pneumonia-related complications rather than direct KFD-related organ failure, reflecting the overall low case fatality rate seen in Goa.⁵

Limitations

The retrospective design relied on medical records, which may have resulted in incomplete data capture, particularly for laboratory parameters at later time points where data were unavailable for a substantial proportion of patients. The single-centre design at a tertiary referral hospital may introduce referral bias, potentially overrepresenting severe cases. The relatively small sample size of 57 patients limits the ability to draw definitive conclusions. The absence of a control group precludes comparative statistical analysis. Additionally, information on prior vaccination status was not systematically recorded and may have influence clinical outcomes. Another limitation is the paucity of published studies evaluating and comparing serial hematological parameters in KFD, which restricts direct comparison of our findings with existing literature. Future multi-centre prospective studies with larger sample sizes are needed to validate these findings and better characterize the hematological evolution of KFD across its full clinical spectrum.

CONCLUSION

This study characterizes distinct phases of KFD illness with clear clinical and management implications. On day 1, patients typically present with leukopenia, early thrombocytopenia, and SGOT-predominant transaminitis, indicating acute viremia and early marrow and hepatic involvement, warranting close baseline assessment and supportive care. By day 5, hematological abnormalities peak, with leukocyte, progressive neutropenia, evolving lymphocyte and monocyte predominance, and persistent thrombocytopenia, emphasizing the need for intensive monitoring for bleeding, secondary infections, and organ complications. By day 7, recovery trends are evident, with rising leukocyte counts, stabilization of hemoglobin, partial platelet recovery, and declining transaminases, allowing gradual de-escalation of monitoring and planning for safe discharge. These dynamic trends underscore the importance of phase-specific surveillance and management to optimize outcomes in KFD. Early recognition of KFD in newly endemic areas such as Goa is essential to reduce morbidity and prevent mortality.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Nayak C, Viegas R, Gomes E. Comparative hematological parameters at admission in Kyasanur forest disease: a single centre study in Goa. *Int J Community Med Public Health* 2026;13:5822-7.