Original Research Article

Kawasaki Disease in PICU: Clinico-Epidemiological Profile and Inflammatory Markers - Experience from a Tertiary Care Centre in Eastern India

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ABSTRACT

Kawasaki disease in children is the commonest acquired heart disease inchildren. It still remains an enigma and poses a diagnostic dilemma especially in incomplete oratypical cases and in critically ill children.This study was done to evaluate the clinico-epidemiological spectrum, inflammatory markers, and outcomes of children with Kawasaki Disease (KD) admitted in PICU, identify the factors associated with severity and outcome of of these children and compare clinical and Lab parameters of children with KD in PICU and those in ward and didn't require ICU care.

Methods: This was a prospective observational study conducted over 18 months in the pediatric intensive care unit (PICU) of a tertiary care hospital in Eastern India. Children diagnosed with KD were divided into two groups: those requiring PICU admission and those managed in wards. Demographic data, clinical features, laboratory parameters, echocardiographic findings, treatment, and outcomes were analyzed.

Results: A total of 45 KD patients were studied, of whom 15 required PICU admission and 30 were managed in wards. Mean age was comparable (3.66 ± 3.51 vs. 2.99 ± 2.50 years, p = NS). PICU patients had significantly higher leukocyte counts (20,663 vs. 16,080/mm³, p = 0.004), lower platelet counts (2.47 vs. 3.03 lakh/mm³, p = 0.009), and significantly elevated inflammatory markers—CRP (91.4 vs. 30.7 mg/dL, p < 0.0001), ESR (64.9 vs. 32.2 mm/hr, p < 0.0001), ferritin (1044 vs. 333 ng/mL, p < 0.0001), LDH (1352 vs. 457 U/mL, p < 0.0001), NT-proBNP (25,293 vs. 2580 pg/mL, p < 0.0001). Echocardiography revealed coronary dilatation in all PICU patients, with left ventricular dysfunction in 73.3% and pericardial effusion in 20%.

Two patients (13%) died, both with markedly elevated NT-proBNP and LDH levels. (diagnosed as KD followed by HLHS progressing to multiorgan dysfunction) 7(47%) were diagnosed as KD shock syndrome (KDSS), 6 (40%) with myocarditis (of which one had SVT).

Conclusion: Elevated CRP, ESR, ferritin, LDH, and NT-proBNP are associated with severe KD requiring PICU care. NT-proBNP and LDH levels also correlated with mortality. Early recognition of these markers may guide timely interventions in resource-limited settings.

Keywords: Kawasaki disease, pediatric intensive care, NT-proBNP, inflammatory markers, coronary dilatation

INTRODUCTION

Kawasaki disease (KD) is an acute, self-limiting vasculitis of childhood, primarily affecting children under 5 years of age, though adolescents and adults may also be affected [1]. It is now recognized as the leading cause of acquired heart disease in children in developed nations [2]. The estimated incidence in India is 8.89 per 100,000 children, though many cases remain undiagnosed due to overlapping clinical features and atypical presentations [3].

Typical manifestations include fever, conjunctivitis, mucocutaneous changes, and extremity involvement. However, incomplete or atypical KD poses diagnostic challenges [4]. Standard treatment includes intravenous immunoglobulin (IVIG) and aspirin, though 10–20% of patients are IVIG-resistant, requiring additional therapies such as repeat IVIG or infliximab [5,6].

Recent studies suggest that inflammatory markers and biomarkers (CRP, ESR, ferritin, NT-proBNP) and echocardiographic findings may aid in identifying patients at risk of severe disease and coronary complications [7–9].

Aims and Objectives:

1. To get an overview of spectrum of presentation and biochemical profile in children with Kawasaki disease admitted in PICU
2. To identify the factors associated with severity and outcome of these children.
3. Comparison of clinical and Lab parameters of children with KD in PICU and those who were in ward and didn't require ICU care.

MATERIALS & METHODS

Study Design and Setting

A prospective observational study was conducted at a tertiary care centre. Kolkata, between January2024 and July2025. Ethical approval was obtained from the Institutional Ethics Committee (BCH/ME/PR/1010). Written informed consent was taken from parents/guardians.

Inclusion Criteria

Children diagnosed with KD based on the American Heart Association (AHA) criteria [10] were included. The total cohort of patients have been divided into 2 groups, those who requires PICU admission for serious condition and other who were managed in wards.

Data Collection

Demographic details, clinical features, investigations, management, and outcomes were recorded. Laboratory tests included complete blood count, CRP, ESR, liver function tests, electrolytes, procalcitonin, ferritin, LDH, troponin-I, and NT-proBNP. Echocardiography was performed by a pediatric cardiologist.

STATISTICAL ANALYSIS

Data was analyzed using SPSS v24. Continuous variables were expressed as mean ± SD and compared using t-test/Mann-Whitney U test. Categorical variables were analyzed using Chi-square test. A p-value <0.05 was considered statistically significant

RESULT

A total of 45 children with KD were included; 15 (33.3%) required PICU admission and 30 (66.7%) were managed in wards. The Mean age was 3.66 ± 3.51 years (PICU) vs. 2.99 ± 2.50 years (wards), p = NS. In clinical features, there was no significant difference induration of fever in both groups . Loose stools were noted in 73% of PICU patients. Two patients (13.3%) died, both presenting with diarrhea.

Total leukocyte count was significantly high in PICU group (p=0.004) (Table1)

Table 1: Distribution of complete hemogram among 2 groups (PICU stay and non PICU stay)*

Parameters	Requirement of PICU stay	Mean	s.d.	t-value	p-value
Hb	Yes	8.48	1.75	1.555	0.134
	No	9.27	1.29		
TLC	Yes	20663.33	5143.44	3.405	0.004

	No	16080.00	1199.54		
N	Yes	74.13	11.34	0.173	0.865
	No	73.60	5.26		
L	Yes	18.33	9.50	0.356	0.726
	No	19.27	5.06		
PLT	Yes	2.47	1.03	1.708	0.099
	No	3.03	1.05		

Continuous variables were expressed as mean ± standard deviation and compared between groups using the unpaired student's t-test. A p-value < 0.05 was considered statistically significant. The TLC was significantly higher in those with PICU stay.
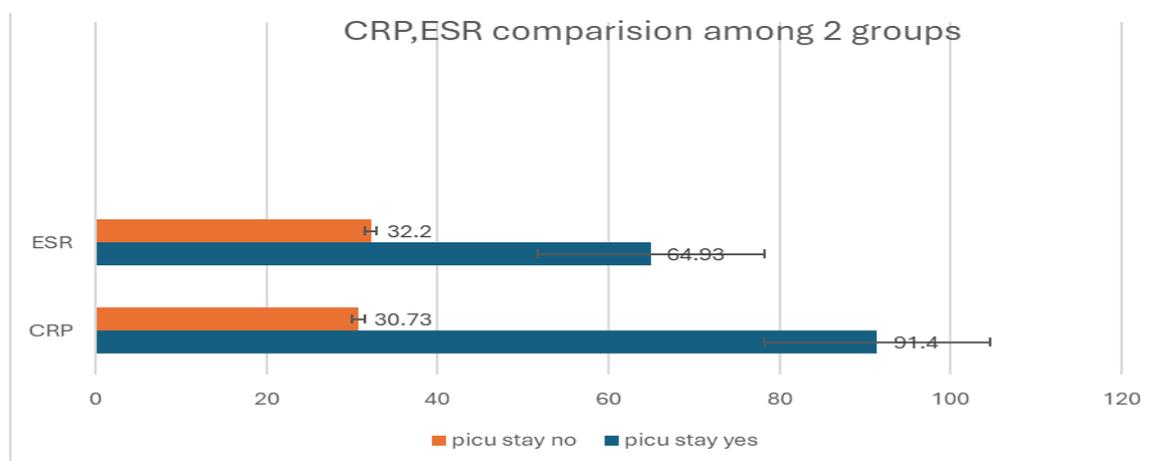
PICU patients had significantly higher CRP, ESR, ferritin, LDH, NT-proBNP, and procalcitonin (p < 0.01 for all). (Table2, Fig 1a, b, c, d). Concomitant infections were ruled out using appropriate tests. There was no significant difference in Liver function test, electrolytes, urea and creatinine between the two groups in the initial period.

Table 2. Comparison of various inflammatory markers and acute phase reactant (NT-proBNP, trop I, procalcitonin, ferritin, LDH, CRP and ESR) among the 2 groups; PICU stay and no PICU stay) *

Parameters	Requirement of PICU stay	Mean	s.d.	t-value	p-value
CRP (mg/dl)	Yes	91.40	35.50	6.523	<0.0001 S
	No	30.73	8.63		
ESR (mm/hr)	Yes	64.93	20.26	6.153	<0.0001 S
	No	32.20	5.33		
Ferritin(ng/ml)	Yes	1044.00	504.79	5.281	<0.0001 S
	No	333.20	183.89		
LDH(u/ml)	Yes	1351.93	510.21	6.642	<0.0001 S
	No	457.13	154.30		
TROP I(ng/L)	Yes	49.95	67.41	2.628	0.02
	No	4.19	2.16		
NT PROBNP (pg/ml)	Yes	25293.33	5719.82	15.251	<0.0001 S
	No	2580.00	1053.23		
PROCAL (ng/ml)	Yes	14.61	17.77	2.99	0.01
	No	0.89	0.34		

*** Unpaired student's t-test. A p-value < 0.05 was considered statistically significant. PICU patients had significantly higher CRP, ESR, ferritin, LDH, NT-proBNP, and procalcitonin*

CRP,ESR comparision among 2 groups

ESR: 32.2 (picu stay no), 64.93 (picu stay yes)
CRP: 30.73 (picu stay no), 91.4 (picu stay yes)

picu stay no / picu stay yes

Figure 1a; Bar diagram of CRP, ESR value among 2 group, PICU stay Kawasaki and non-PICU stay Kawasaki patients (the former group had significantly (p<0.01) higher ESR and CRP)
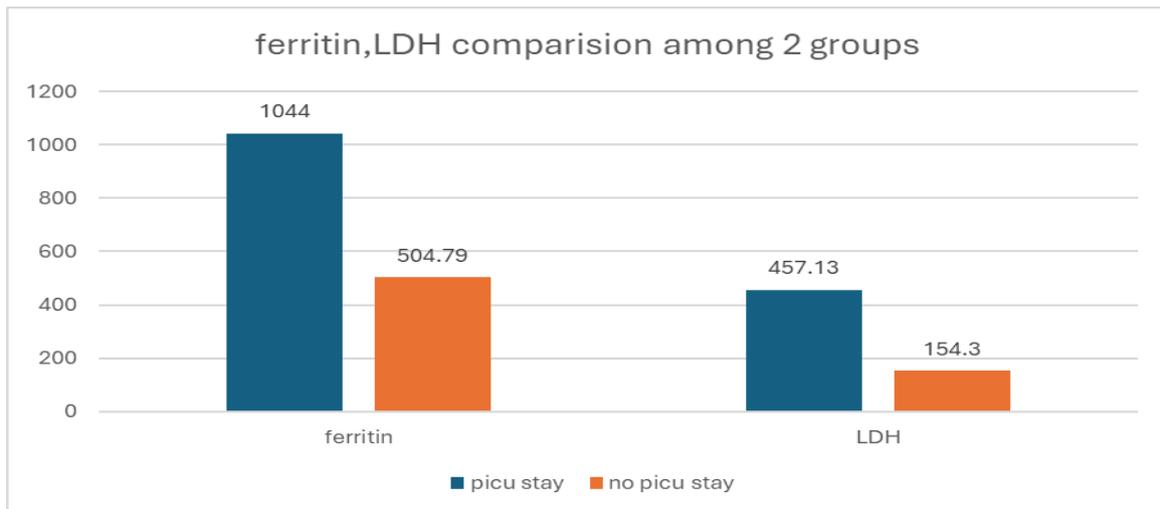
Figure 1b; Bar diagram of ferritin, LDH value among 2 groups PICU group having significantly higher values than non PICU group (p < 0.01)
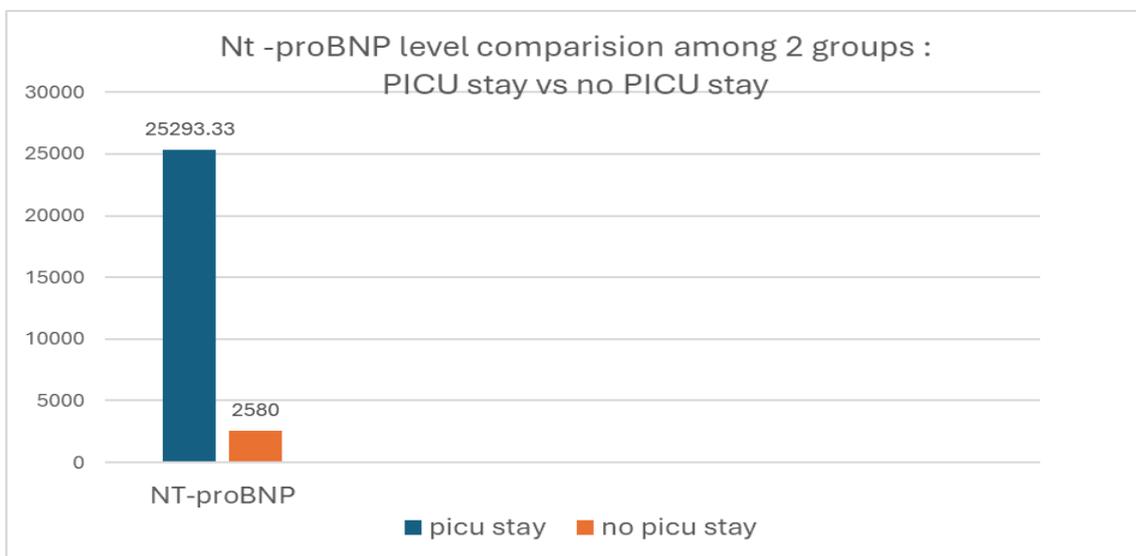

Figure 1c; Bar diagram of Nt-proBNP value among 2 groups, PICU stay Kawasaki and non PICU stay Kawasaki, higher values corresponding to PICU group (p=0.0002).
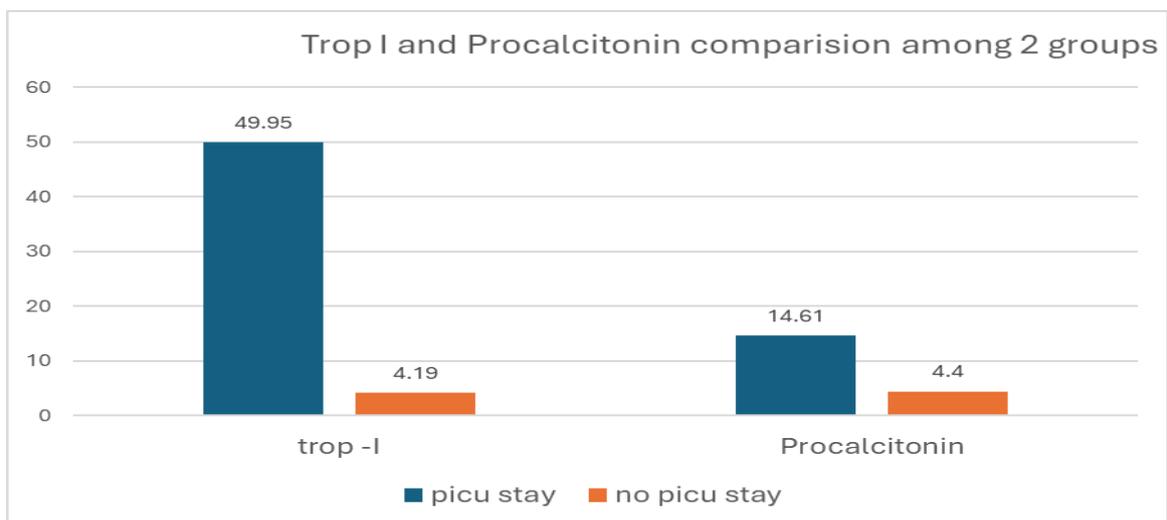

Figure 1d, Bar diagram of trop I, procalcitonin value among 2 groups, PICU stay Kawasaki and non PICU stay Kawasaki, higher values in PICU group (p<0.05).

In cardiac findings, Coronary dilatation was found in all PICU patients (4 giant aneurysms (Fig 3), 8 moderate and 3 small aneurysms). LV dysfunction found in in 5 (33%), pericardial effusion in 3(20%).

Mean PICU stay was 5.7 ± 1.1 days. The 15 patients in PICU due to their serious condition at the time of presentation, required some form of ventilatory support and inotropic support during their PICU stay. Mean duration of PICU stay was 5.73+/-1.1 days, INV (invasive mechanical ventilation) and NIV (non-invasive ventilation) requirement mean duration were 2+/-1.18 days and 2.38+/-0.96 days respectively.

13(87%) required inotropes mainly dobutamine infusion and 6(40%) required additional adrenaline or noradrenaline infusion at any point during their PICU stay. Along with coronary dilatation which is noticed in all those 15 patients,11 patients (73.3%) had significant left ventricular dysfunction and 3 patients (20%) had mild pericardial effusion at the time of presentation.

The reason for PICU admission were depicted in figure 2. Among these 15 patients, 7 (47%) were diagnosed as KD shock syndrome with hypotension and shock at presentation and responded to fluids and inotropes. 5 (33%) heart failure and one had SVT. 2 (13%) had multiorgan dysfunction and unfortunately succumbed to death (diagnosed as HLH following KD).
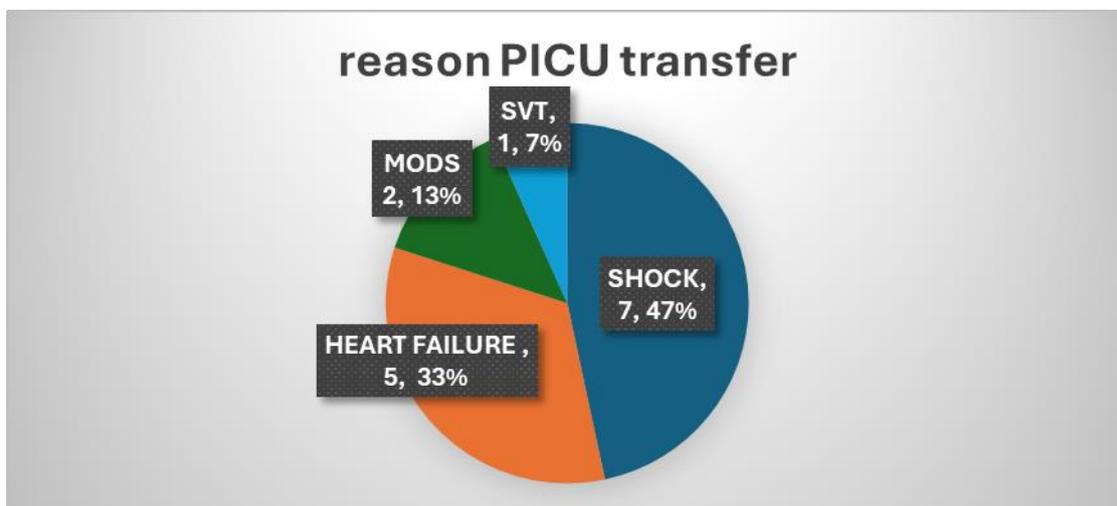

Figure 2: Reason of PICU transfer of KD patient: Total 15 patients, seven were KDSS, five had heart failure and one had SVT. Two with multiorgan dysfunction and died.
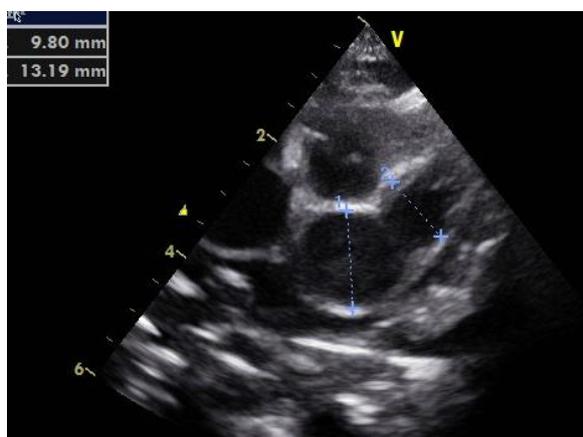

| **Fig 3A** | **Fig 3B** |

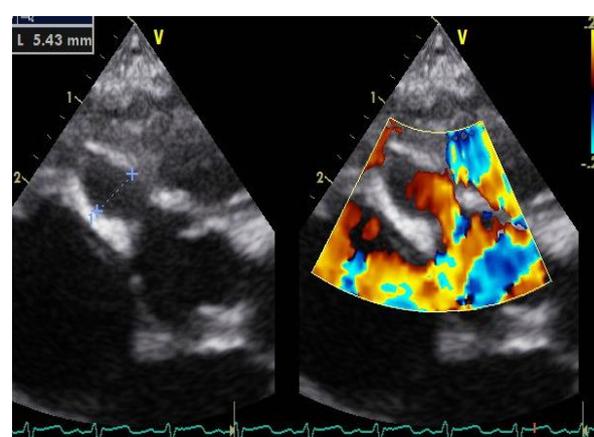**Fig 3 Giant aneurysm of all 3 coronaries in a 2-month-old in PICU. Fig 3A-LMCA (10mm) and LAD (9mm) saccular aneurysm Fig 3B- RCA (5.4 mm) fusiform aneurysm**

Table 3 shows the comparison of demographical, clinical and lab investigations among the dead patient and the successfully discharged patient. The two patients who died had moderate coronary dilatations and LV dysfunction. Both had higher value of inflammatory markers than those have been discharged alive, with LDH (p=0.003) and Nt-Pro BNP level (p=0.0002) being statistically significant.

Table 3: Comparison of demographical, clinical and lab investigations among the dead patient and the successfully discharged patient admitted in PICU.

Parameters	Final outcome	Mean	s.d.	t-value	P-value
Age (Years)	Died during treatment	1.32	1.34	1.899	0.241
	Discharged alive	3.31	2.88		
Body weight (kg)	Died during treatment	11.00	4.24	1.860	0.265
	Discharged alive	16.98	7.55		
Duration of Fever (Days)	Died during treatment	10.00	7.07	0.357	0.781
	Discharged alive	8.21	2.08		
Duration of Loose stool (Days)	Died during treatment	3.50	0.71	0.075	0.947
	Discharged alive	3.45	1.13		
Hb	Died during treatment	10.15	3.89	0.433	0.739
	Discharged alive	8.96	1.38		
TLC	Died during treatment	18450.00	4171.93	0.293	0.816
	Discharged alive	17568.60	3789.95		
PLT	Died during treatment	2.17	0.47	1.910	0.233
	Discharged alive	2.88	1.08		
SGPT	Died during treatment	56.50	20.51	0.004	0.997
	Discharged alive	56.56	21.53		
SGOT	Died during treatment	47.50	2.12	2.714	0.010
	Discharged alive	60.67	30.28		
Albumin	Died during treatment	2.70	0.28	0.773	0.578
	Discharged alive	2.86	0.17		
Ratio of Albumin and Globulin	Died during treatment	0.98	0.32	0.521	0.693
	Discharged alive	1.10	0.13		
Duration of PICU Stay (Days)	Died during treatment	6.50	0.71	1.502	0.278
	Discharged alive	5.62	1.12		
Duration of INV (Days)	Died during treatment	3.50	2.12	1.207	0.433
	Discharged alive	1.67	0.71		
CRP	Died during treatment	56.00	0.00	0.943	0.351
	Discharged alive	50.72	36.70		
ESR	Died during treatment	71.50	9.19	4.167	0.090
	Discharged alive	41.79	19.22		
Ferritin	Died during treatment	1880.00	876.81	2.203	0.268
	Discharged alive	509.21	353.23		
LDH	Died during treatment	2259.00	125.87	14.290	0.003
	Discharged alive	685.47	425.21		
TROP I	Died during treatment	34.35	15.34	1.217	0.351
	Discharged alive	18.75	44.72		
NT PROBNP	Died during treatment	23800.00	989.95	7.745	0.0002
	Discharged alive	9516.28	11189.13		
PROCAL	Died during treatment	3.83	4.42	0.470	0.688
	Discharged alive	5.54	12.23		

DISCUSSION

This study highlights that children with KD requiring PICU care had significantly elevated inflammatory markers (CRP, ESR, ferritin, LDH, NT-proBNP) compared to those managed in wards. NT-proBNP and LDH also correlated with mortality, underscoring their prognostic role.

In this study we have found that 11 out 15 patients (73%) who required PICU admission had loose stool at presentation and those 2 patients who died had loose stool as

preadmission symptoms. In study done by baker et al,2009 Among 198 Kawasaki patients one or more gastrointestinal symptom (vomiting, diarrhea, or abdominal pain) was present in 120 patients (61%) and 69 patients (35%) had ≥ 1 respiratory symptom (rhinorrhea or cough) (10)

In this study, Kawasaki patients who were admitted to the PICU had significantly higher total leucocyte count (20663.33) with a standard deviation of 5143.44, and a t-value of 3.405 with a p-value of 0.004, suggesting a statistically significant difference in total leucocyte count compared to those who were not admitted to the PICU, whose average total leucocyte count was 16080.00 with a standard deviation of 1199.54. The platelet value (p value=0.09) was not statistically significant in severe and non-severe groups in contrary to the study done by Huang et al, where they had found platelet was raised in KD patient than the other febrile group. (404.64 ± 161.68, *P* = 0.004) (7)

Lee et al had found the mean PCT level in the KD group was significantly lower than that in the bacterial infection group (0.82±1.73 ng/mL vs. 3.11±6.10 ng/mL, P= 0.002) and insignificantly different from that in the viral infection group (0.23±0.34 ng/mL, P= 0.457). The mean erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) level in the KD group were significantly higher than those in the viral and bacterial infection groups (P< 0.001 and P< 0.001 for ESR, P< 0.001 and P= 0.005 for CRP, respectively). The proportion of patients in the KD group with PCT levels of> 1.0 ng/mL was significantly higher in the nonresponders to the initial intravenous immunoglobulin treatment than in the responders (36% vs. 8%, P= 0.01) (8)

in this study, it was found that CRP and ESR levels were significantly higher in patients who required PICU stay compared to those who did not (CRP: 91.40 vs. 30.73 mg/dL, ESR: 64.93 vs. 32.20 mm/hr, both p <0.0001), and PCT levels were also significantly elevated in the PICU group (14.61 vs. 0.89 ng/mL, p = 0.01), suggesting that these inflammatory markers were

associated with the need for intensive care. Study done by Kim et al had found that among 45 KD patients, cTnI were positive in 18 cases (40%) (p value < 0.05). A significant increase in the level of cTnI in the acute stage of KD suggests that acute myocarditis or myocardial cell injury begins in the early phase of the disease (*p* < 0.05) (9).

In this study, ferritin and LDH levels are significantly higher in Kawasaki patients who required a stay in the PICU compared to those who did not, with ferritin levels averaging 1044.00 ng/ml (±504.79) for PICU patients versus 333.20 ng/ml (±183.89) for non-PICU patients, and LDH levels averaging 1351.93 U/ml (±510.21) for PICU patients versus 457.13 U/ml (±154.30) for non-PICU patients, both showing statistically significant differences (p < 0.0001), suggesting that elevated ferritin and LDH may be markers for more severe cases requiring intensive care.

Study done in North India by Reddy et al,2016 found that the ProBNP and NT-ProBNP levels were much higher in the acute phase of the KD patients compared to levels in the convalescent phase of KD (*p* = 0.000014) (10). In this study, The NT-proBNP levels were significantly higher in Kawasaki patients who required a PICU stay, with a mean of 25,293.33 pg/ml (±5,719.82) compared to 2,580.00 pg/ml (±1,053.23) in those who did not, and the difference was statistically significant (p < 0.0001), suggesting that elevated NT-proBNP levels were associated with the need for intensive care.

SGPT (p=0.449), SGOT(p=0.916), Albumin(p=0.087) and albumin globulin ratio(p=0.718), serum na(p=0.084) and electrolyte didn't show any statistical significance among two groups of PICU stay and non PICU stay.

Out of the 15 patients, 7 were transferred to the PICU due to shock (46.7%), 5 due to heart failure (33.3%), 2 due to sepsis (13.3%), and 1 due to SVT (6.7%)., mean duration of PICU stay were 5.73+/-1.1 days, INV (invasive mechanical ventilation) and

NIV(non-invasive ventilation) requirement mean duration were 2+/-1.18 days and 2.38+/-0.96 days respectively. 13 patients (86.7%) required adrenaline infusion and 6 patients (40%) required dobutamine infusion during at any point of time during their PICU stay.

Among these 15 patients ,2 (13.3%) had unfortunately succumbed to death. They both had loose stool as a clinical presentation. Those 2 patients who died had higher value of inflammatory markers than those have been discharged alive, with LDH (p=0.003) and Nt-Pro BNP level (p=0.0002) being statistically significant. NT-proBNP levels were significantly higher in patients who died during treatment (23,800.00 pg/ml) compared to those discharged alive (9,516.28 pg/ml), with a p-value of 0.0002, indicating an association with mortality.

Gidding et al,had found that Patients with kawasaki disease in whom coronary aneurysms developed were more likely to have pericardial effusion (p = 0.0006) or mitral regurgitation (MR) (p = 0.014) at initial echocardiographic study than those without aneurysms (13). This study found that along with coronary dilatation in all those 15 patients requiring PICU admission, 5 33.3%) had significant left ventricular dysfunction and 320%) had mild pericardial effusion at the time of presentation.

Our findings align with previous studies [11–13], which identified elevated NT-proBNP and CRP as predictors of severe KD and poor response to IVIG. Echocardiographic abnormalities, particularly LV dysfunction and pericardial effusion, were also more common in PICU patients, consistent with earlier reports [14].

Unlike some studies, platelet count did not significantly differentiate severity in our cohort, though leukocytosis was more prominent in PICU patients.

Limitations
Small sample size, single centered study, not knowing the previous clinical profile or cardiological parameters.

CONCLUSION
KD patients' cases requiring PICU admission constitute a severe clinical spectrum marked by pronounced inflammatory response and cardiovascular dysfunction. Significantly elevated inflammatory and cardiac biomarkers—most notably CRP, ESR, ferritin, LDH, troponin-I, and NT-proBNP—were closely associated with the need for intensive care, while LDH and NT-proBNP showed a strong correlation with mortality. Routine liver function tests and electrolyte parameters were not useful indicators of disease severity. Cardiac involvement, including coronary artery dilatation, left ventricular dysfunction and pericardial effusion, was frequently observed among critically ill patients. Early risk stratification using inflammatory markers and cardiac biomarkers, supported by prompt echocardiographic assessment, is crucial for identifying high-risk patients and optimizing outcomes, particularly in resource-constrained settings.

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