Section: Pathology

Original Research Article

CLINICAL UTILITY OF SERUM LDH AND URIC ACID IN THE EVALUATION OF ACUTE LEUKEMIAS

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ABSTRACT

Background: Acute leukemias are aggressive hematological malignancies characterized by rapid proliferation of immature hematopoietic cells, leading to increased cellular turnover and metabolic disturbances. In resource-limited settings, simple and readily available biochemical markers such as serum lactate dehydrogenase (LDH) and uric acid may serve as useful adjuncts in disease evaluation and risk stratification. The objective is to assess the clinical utility of serum LDH and uric acid levels in adult patients with acute leukemia and to evaluate their relationship with total leukocyte count (TLC) and leukemia subtype.

Materials and Methods: A cross-sectional study was conducted on 60 newly diagnosed adult patients with acute leukemia. Serum LDH, uric acid, and TLC were measured at diagnosis. Patients were classified as acute myeloid leukemia (AML) or acute lymphoblastic leukemia (ALL). Statistical comparisons and Pearson's correlation analysis were performed.

Results: The mean age was 38.6 ± 14.2 years with male predominance (1.7:1). AML accounted for 56.7% and ALL for 43.3% of cases. Markedly elevated LDH levels were observed in 60% of patients, while 23.3% had significant hyperuricemia. Mean serum LDH and uric acid levels were significantly higher in AML compared to ALL ($p = 0.041$ and $p = 0.048$, respectively). Serum LDH showed a strong positive correlation with TLC ($r = 0.62$, $p < 0.001$), and uric acid showed a moderate correlation ($r = 0.51$, $p < 0.001$).

Conclusion: Serum LDH and uric acid levels are frequently elevated in newly diagnosed acute leukemia patients, particularly in AML, and correlate significantly with total leukocyte count. These findings support the role of LDH and uric acid as simple, cost-effective biomarkers reflecting tumor burden and disease activity, with potential utility in the initial evaluation and risk assessment of acute leukemia.

Keywords: Acute leukemia, Lactate dehydrogenase, Uric acid, Total leukocyte count, Acute myeloid leukemia, Acute lymphoblastic leukemia.

INTRODUCTION

Acute leukemias constitute a heterogeneous group of hematological malignancies characterized by clonal proliferation of immature hematopoietic precursors within the bone marrow and peripheral blood. They are broadly classified into acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML), each exhibiting distinct clinical behaviors, cytogenetic abnormalities, and therapeutic responses. Early diagnosis and risk stratification remain essential to improving survival outcomes, particularly in low- and middle-income settings where delayed diagnosis and limited access to advanced diagnostics persist. [1,2]

Serum biomarkers that reflect tumor burden, cellular turnover, and organ involvement have gained relevance in recent years as adjunctive tools in the evaluation of acute leukemias. Among these, lactate dehydrogenase (LDH) and uric acid are commonly utilized due to their biochemical relationship to cell lysis, metabolic activity, and proliferation rates. LDH, an intracellular enzyme released during cell

turnover and tissue breakdown, is frequently elevated in leukemic patients and correlates with disease aggressiveness, total leukocyte counts, and cytogenetic risk groups. Elevated serum LDH has also been associated with shorter event-free survival and greater risk of tumor lysis syndrome (TLS). [3-5]
Similarly, uric acid, the final product of purine metabolism, increases in conditions involving rapid cell breakdown. Hyperuricemia is a classical feature of acute leukemias and is an important predictor of TLS, renal dysfunction, and morbidity during induction chemotherapy. As both biomarkers are routinely available, cost-effective, and rapidly measurable, they hold potential as accessible prognostic indicators, especially in resource-limited environments. [6-8]
Although previous studies have demonstrated associations between LDH, uric acid, and disease severity in leukemia, variations in demographic profile, hematological parameters, and treatment practices across populations necessitate region-specific evidence. Therefore, this study was undertaken to evaluate the clinical utility of serum LDH and uric acid levels in adults diagnosed with acute leukemias, and to examine their relationship with hematological parameter- Total Leucocyte Count (TLC), and subtype classification.

MATERIALS AND METHODS

A hospital-based observational cross-sectional study was conducted in the Department of Pathology, D Y Patil Medical College, Kolhapur, India over a period of 12 months. A total of 60 newly diagnosed patients with acute leukemia were included.

Inclusion Criteria

- Patients aged ≥ 18 years
- Newly diagnosed cases of AML or ALL confirmed by bone marrow examination
- No prior chemotherapy or cytotoxic treatment

Exclusion Criteria

- Chronic leukemias and other hematological malignancies
- Pre-existing renal or hepatic disease
- Patients receiving drugs affecting uric acid metabolism

After obtaining informed consent, venous blood samples were collected at diagnosis prior to initiation of therapy to measure serum LDH, serum uric acid and TLC.

Blood sample collection: A total of 5 mL of venous blood was collected from a suitable vein in the antecubital fossa, preferably the median cubital vein, with the patient in a comfortable position.

Serum LDH estimation: carried out using a standard enzymatic UV-kinetic method with reference value of 140–280 IU/L.

Serum uric acid estimation: carried out using the uricase-peroxidase colorimetric method with reference value of 3.5–7.2 mg/dL.

TLC estimation: Complete blood count was done from which TLC data was taken. 4-10 ×10⁹/L was the reference value.

Data was collected and analyzed using Microsoft Excel software. Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between acute myeloid leukemia and acute lymphoblastic leukemia groups were performed using the independent t-test. The relationship between biochemical parameters and total leukocyte count was evaluated using Pearson's correlation coefficient (r). p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 newly diagnosed patients with acute leukemia were included in the study. The age of the study population ranged from 18 to 68 years, with a mean age of 38.6 ± 14.2 years. The highest proportion of cases was observed in the 21–40-year age group, accounting for 41.7% of patients, indicating a predominance of acute leukemia in young and middle-aged adults. A male predominance was noted, with 38 (63.3%) male and 22 (36.7%) female patients, yielding a male-to-female ratio of 1.7:1.

Based on detailed morphological assessment of peripheral blood smears and bone marrow aspirates, supported by appropriate cytochemical staining, the study population was classified into two major subtypes of acute leukemia. Acute myeloid leukemia (AML) was the predominant diagnosis, accounting for 34 cases (56.7%), while acute lymphoblastic leukemia (ALL) was identified in 26 cases (43.3%) [Figure 1].

Figure 1: Distribution of sample according to type of leukemia

Analysis of serum LDH levels showed that only 11 patients (18.3%) had values within the normal reference range (≤280 IU/L). Moderate elevation (281–560 IU/L) was observed in 13 patients (21.7%), while a majority of the study population, 36 patients (60.0%), demonstrated markedly elevated LDH levels (>560 IU/L), indicating a high prevalence of significant LDH elevation among the participants [Figure 2].

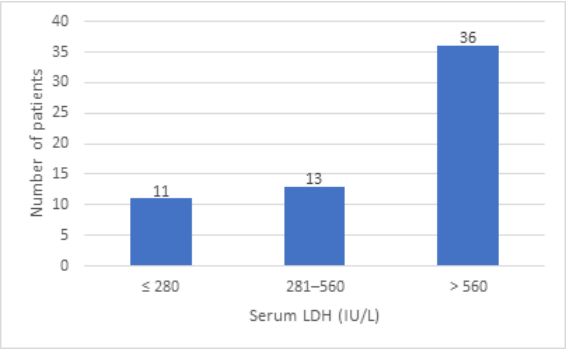

Figure 2: Distribution of sample according to serum LDH levels (n=60)

With respect to serum uric acid levels, 27 patients (45.0%) had values within the normal range (≤7.2 mg/dL). Moderate elevation (7.2–10.0 mg/dL) was detected in 19 patients (31.7%), whereas 14 patients (23.3%) showed markedly elevated uric acid levels (>10.0 mg/dL) [Figure 3].

A comparative analysis of serum LDH and uric acid levels was performed between patients with AML and ALL. The mean serum LDH level in patients with AML (742 ± 328 IU/L) was significantly higher than that observed in patients with ALL (604 ± 281 IU/L), with the difference reaching statistical significance (p = 0.041). Similarly, the mean serum uric acid level was higher in the AML group (8.1 ± 2.5 mg/dL) compared to the ALL group (6.9 ± 2.1 mg/dL), and this difference was also found to be statistically significant (p = 0.048) [Table 1].

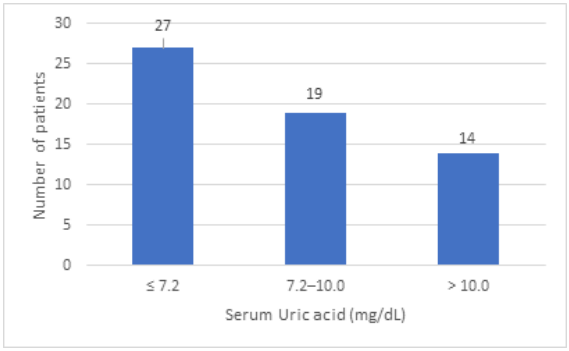

Figure 3: Distribution of sample according to serum uric acid levels (n=60)

Table 1: Comparison of Serum LDH and Uric Acid Levels Between AML and ALL

Biomarker	Type of acute leukemia		p value
	AML (n=34) Mean ± SD	ALL (n=26) Mean ± SD	
Serum LDH (IU/L)	742 ± 328	604 ± 281	0.041
Serum Uric acid (mg/dL)	8.1 ± 2.5	6.9 ± 2.1	0.048

The mean total leukocyte count of the study population was markedly elevated above the normal reference range, with an overall mean of 52.4 ± 36.8 ×10⁹/L. When analyzed by leukemia subtype, patients with AML had a higher mean TLC (58.6 ± 39.2 ×10⁹/L) compared to those with ALL (44.1 ± 31.6 ×10⁹/L).

Correlation analysis demonstrated a strong positive association between serum LDH levels and total leukocyte count (TLC), with a correlation coefficient of r = 0.62, which was highly statistically significant (p < 0.001). Similarly, serum uric acid levels also showed a moderate positive correlation with TLC (r = 0.51), and this association was likewise statistically significant (p < 0.001) [Table 2].

Table 2: Correlation of Serum LDH and Uric Acid with Total leukocyte count

Biomarker	Total leukocyte count (×10⁹/L)	p value
LDH (r)	0.62	<0.001
Uric acid (r)	0.51	<0.001

DISCUSSION

Acute leukemia is characterized by uncontrolled proliferation of immature hematopoietic cells, leading to increased cellular turnover, tissue infiltration, and metabolic derangements. In the present study, biochemical markers of cell turnover—serum LDH and uric acid—were evaluated in newly diagnosed acute leukemia patients and correlated with disease subtype and TLC.

The demographic profile of the study population showed a predominance of young and middle-aged adults, with a mean age of 38.6 ± 14.2 years, and a clear male predominance (Male: Female = 1.7:1). This finding is consistent with previous studies that have reported a higher incidence of acute leukemia in males and in early to middle adulthood, particularly for AML.[9]

In the present study, AML constituted 56.7% of cases, exceeding ALL (43.3%), which aligns with established epidemiological data indicating that AML is the more common acute leukemia subtype in adults.[10] This predominance provides an appropriate framework for comparing biochemical parameters between AML and ALL.

A striking finding was the high prevalence of elevated serum LDH levels, with 60% of patients showing markedly elevated values (>560 IU/L). LDH is a well-recognized marker of tumor burden, rapid cell turnover, and tissue breakdown, and elevated levels have been consistently associated with aggressive disease and poor prognosis in acute leukemia. [10,11] The predominance of markedly elevated LDH in our cohort underscores the high proliferative activity at diagnosis.

Similarly, serum uric acid levels were elevated in more than half of the patients, with 23.3% demonstrating marked hyperuricemia. Hyperuricemia in acute leukemia results from increased nucleic acid breakdown due to rapid leukemic cell turnover and is a known risk factor for tumor lysis syndrome (TLS).[5] Our findings corroborate earlier reports highlighting the importance of uric acid as a metabolic marker reflecting disease activity and cellular proliferation.[6]

Comparative analysis between leukemia subtypes revealed that patients with AML had significantly higher mean serum LDH and uric acid levels than those with ALL. These findings suggest a greater metabolic and proliferative burden in AML, consistent with observations by Pui et al. (2008) who reported higher LDH levels and metabolic abnormalities in AML compared to ALL.[3] The statistically significant differences observed in the present study further support the role of these biochemical markers in distinguishing disease biology between acute leukemia subtypes.

The total leukocyte count was markedly elevated in the study population, with higher mean TLC values observed in AML than ALL. Importantly, both serum LDH and uric acid demonstrated significant positive correlations with TLC. The strong correlation between LDH and TLC ($r = 0.62$) and the moderate correlation between uric acid and TLC ($r = 0.51$) indicate that rising leukocyte counts are accompanied by increased cellular breakdown and metabolic activity. Similar correlations have been reported by Cairo et al. (2004) and Howard et al. (2011), reinforcing the role of LDH and uric acid as indirect markers of tumor burden. [5,6]

Overall, the findings of this study emphasize that serum LDH and uric acid are simple, cost-effective, and readily available laboratory parameters that reflect disease severity, tumor burden, and biological aggressiveness in acute leukemia. Their strong association with TLC further supports their utility in the initial evaluation and risk stratification of newly diagnosed patients.

CONCLUSION

The present study demonstrates that elevated serum LDH and uric acid levels are common biochemical abnormalities in newly diagnosed acute leukemia patients, with a predominance of markedly elevated LDH levels. Patients with AML exhibit significantly higher serum LDH, uric acid, and total leukocyte counts compared to those with ALL, reflecting greater cellular turnover and metabolic activity. The significant positive correlation of both LDH and uric acid with total leukocyte count highlights their value as surrogate markers of tumor burden.

These findings suggest that serum LDH and uric acid can serve as important adjunctive laboratory markers in the initial assessment of acute leukemia, aiding in disease characterization and potentially identifying patients at higher risk of complications such as tumor lysis syndrome. Incorporation of these parameters into routine diagnostic evaluation may contribute to improved clinical assessment and management of acute leukemia patients.

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