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THE IMPACT OF HYPERURICEMIA ON RENAL FUNCTION TESTS IN PATIENTS WITH HEMATOLOGICAL MALIGNANCY

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Abstract

Background: Patients with hematological malignancies have a high prevalence of hyperuricemia and uric acid crystals, inflammation and oxidative stress may play a role in causing renal impairment in these patients. Cancer treatment outcomes, quality of life and survival are negatively impacted by renal dysfunction.

Objective: To determine the frequency of hyperuricemia in patients with hematological malignancy and to compare the mean renal function tests in patients with and without hyperuricemia among patients with hematological malignancy.

Methods: The cross-sectional study was carried out at the Department of Medicine, Jinnah Hospital Lahore during July 2025 and October 2025. The patients, aged 18-75 years, were diagnosed with hematological malignancies such as leukemia, lymphomas and multiple myeloma and were selected by non-probability consecutive sampling method (100 patients). At the time of presentation, serum uric acid, serum creatinine and estimated glomerular filtration rate (eGFR) were measured. Hyperuricemia was considered as serum uric acid >7.5 mg/dl. Data were analyzed statistically with SPSS 25. Independent sample t-test was used to compare renal function parameters of hyperuricemia and non-hyperuricemia groups.

Results: Hyperuricemia was found in 21% of the cases. Hyperuricemic patients had significantly greater mean serum creatinine levels than normouricemic patients (1.28±0.34 vs 0.89±0.21 mg/dl; $p<0.001$). Similarly, mean eGFR was significantly lower in patients with hyperuricemia (58.7±14.2 vs 82.4±16.8 mL/min/1.73m^2; $p<0.001$). Among patients with Hematological malignancies, hyperuricemia was significantly associated with impaired renal function.

Conclusion: Patients with hematological malignancies are often hyperuricemic and have significant association of deranged renal function tests. Timely management of elevated serum uric acid could be beneficial for reducing renal complication and the clinical outcome of this high risk group in terms of early screening.

Keywords: Hyperuricemia, Hematological malignancy, Renal function tests, Serum creatinine, eGFR, Acute kidney injury, Leukemia, Lymphoma.

1. INTRODUCTION

Acute kidney injury (AKI) is a life-threatening and serious complication which can happen in patients with hematological malignancies, especially during chemotherapy and other intensive treatment schedules. The negative consequences of AKI are higher morbidity and mortality within hospital settings, length of hospital stay, higher healthcare cost, impaired long-term renal function, inability to provide best cancer care and worse survival rates [1].

Hyperuricemia is now known to be an important risk factor for renal dysfunction and is a potentially modifiable factor that has attracted attention as a potential cause of kidney injury [2]. Increased serum uric acid has been proposed to play a role in the pathogenesis of both chronic and acute kidney diseases through inflammatory, oxidative stress, endothelial dysfunction, and activation of the innate immune system mechanism [3]. Hyperuricemia has also been linked to vascular changes which can also play a role in the worsening of renal failure [4].

Patients with hematological malignancies are especially vulnerable to hyperuricemia due to the fast proliferation and destruction of the malignant cells either naturally or as a result of chemotherapy. The release of intracellular nucleic acids during cell lysis leads to their conversion to hypoxanthine and xanthine and then to uric acid by the enzyme xanthine oxidase [1]. Humans cannot further break down uric acid, and its production can lead to high blood uric acid levels and supersaturation. This can result in uric acid crystals precipitating in the renal tubules and blockage of the tubules, inflammation, renal impairment and ultimately AKI [3].

Previous studies have shown that AKI can occur under a variety of clinical circumstances and be affected by a number of environmental and biological factors [5]. Experimental studies have also revealed that inflammatory and oxidative pathways are also crucial in the pathogenesis and progression of renal injury [6]. Recent studies also underscore the increasing clinical relevance of hyperuricemia and the management of hyperuricemia in clinical practice [7].

In addition to its association with AKI, high levels of uric acid have been associated with various long-term health effects. The systemic inflammation associated with hyperuricemia could have negative consequences in musculoskeletal, metabolic, and immunological functions [8]. Furthermore, reduction in uric acid serum levels has been demonstrated to improve cardiovascular parameters like blood pressure, and possibly also decrease the risk of progressive renal damage [9].

Hyperuricemia-chronic kidney disease (CKD) relationship has been studied in depth. Hyperuricemia has been reported to be an adverse factor for deteriorating kidney function, and uric acid-lowering treatment is suggested as a treatment strategy for slowing CKD progression [10]. Moreover, elevated uric acid levels in blood, hyperuricosuria and acidic urine are well known risk factors for uric acid nephrolithiasis which can further impair renal function and thereby may exacerbate the development of chronic kidney disease [11].

Many previous studies have confirmed a strong relationship between hyperuricemia and renal dysfunction. Of the patients who had hematological malignancies, 18.5% were hyperuricemic. Moreover, the mean serum creatinine level was significantly higher in the hyperuricemia group as compared to the normal uric acid group (1.0 ± 0.2 mg/dL versus 0.8 ± 0.2 mg/dL; $p < 0.001$), indicating that elevated uric acid levels were associated with decreased renal function [12].

The present study was designed to assess renal function in patients with hematological malignancies, and to compare renal function parameters between these patients with raised and normal serum uric acid level. There are some reports in the literature indicating the possible link between hyperuricemia and renal function but limited data for the local population. To our knowledge, there has not been a local study that has thoroughly examined this relationship. This study could be useful as a local evidence for early diagnosis, monitoring and management of hyperuricemia in patients with haemato-oncological diseases. Early intervention can bring about better disease management, fewer complications, better quality of life and better overall survival outcomes, and prevent kidney damage [1,10].

2. Objective:

To determine the frequency of hyperuricemia in patients with hematological malignancy and to compare the mean renal function tests in patients with and without hyperuricemia among patients with hematological malignancy.

3. METHODOLOGY

This was a cross-sectional study done at department of Medicine, Jinnah Hospital Lahore from July 2025 to October 2025. The patients were 100 cases of hematological malignancies (leukemia, lymphoma and multiple myeloma), consecutively taken using non-probability sampling. The study included patients who were 18-75 years old and of both sexes. A structured proforma was used to record detailed demographic and clinical details such as age, gender, body mass index (BMI), duration of malignancy, socioeconomic status, residency and treatment history. Blood samples were taken for measuring the serum uric acid, serum creatinine and estimated glomerular filtration rate (eGFR). Hyperuricemia was defined as serum uric acid level >7.5 mg/dl. Hyperuricemic group and normouricemic group were compared with renal function tests to assess the effect of high uric acid levels on renal function.

3.1 Inclusion Criteria

Patients 18–75 years of age, both gender, who had been diagnosed with hematological malignancies (leukaemia, lymphoma, and multiple myeloma), as confirmed in their medical records, were included.

3.2 Exclusion Criteria

Pregnant females, patients with metastatic disease, chronic kidney disease on dialysis, and patients who were taking uric acid lowering agents within the last 3 months before enrollment on medical records was excluded.

3.3 Data Collection Procedure

Patients who visited the Department of Medicine were enrolled consecutively after approval from the ethical review committee. All participants signed informed consent forms prior to participation in the study. The demographic and clinical information such as age, gender, BMI, residence, socioeconomic status, type and duration of malignancy, treatment modalities were recorded on a predesigned proforma. A venous blood sample was taken under sterile conditions, and the serum uric acid, serum creatinine and eGFR were measured in a hospital laboratory. The patients were classified into hyperuricemia group and normouricemia group by levels of serum uric acid. Careful recording of all laboratory findings and the patients received standard management following the hospital protocol. Patient data was kept confidential during the study.

3.4 Data Analysis

All the data were entered and analyzed using SPSS version 25. All of the quantitative variables (age, BMI, duration of malignancy, serum creatinine, serum uric acid, eGFR) were presented as mean ± SD and the qualitative variables (gender, type of malignancy, place of residence, socioeconomic status, treatment modalities) were presented as frequencies and percentages. The Shapiro-Wilk test was used to check the normality of data distribution. The mean renal function parameters for Hyperuricemic group and Normouricemic group were compared with Independent sample t-test. Chi square test was used to test the association between categorical variables. Effect modifiers such as age, gender, BMI, type of malignancy, treatment modality and disease duration were stratified. The p-value of ≤0.05 was considered statistically significant and was used throughout the analysis.

4. RESULT

The effect of hyperuricemia on renal function tests was performed in 100 patients suffering from hematological malignancies. The mean age was 49.6 ± 13.4 years. Most of the respondents were male (58%) and female (42%).

Table 1: Baseline Demographic Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Total Patients	—	100	100%
Age (years)	Mean ± SD	49.6 ± 13.4	—
Gender	Male	58	58%
	Female	42	42%

Table 2: Distribution of Hematological Malignancies

Type of Malignancy	Frequency (n)	Percentage (%)
Leukemia	46	46%
Lymphoma	34	34%
Multiple Myeloma	20	20%

Leukemia was the most common hematological malignancy in the study population.

Table 3: Frequency of Hyperuricemia

Hyperuricemia Status	Frequency (n)	Percentage (%)
Present	21	21%
Absent	79	79%

21% of the patients had hyperuricemia.

Table 4: Comparison of Renal Function Tests Between Groups

Renal Parameter	Hyperuricemia (n = 21) Mean ± SD	Normouricemia (n = 79) Mean ± SD	p-value
Serum Creatinine (mg/dl)	1.28 ± 0.34	0.89 ± 0.21	<0.001
eGFR (mL/min/1.73m²)	58.7 ± 14.2	82.4 ± 16.8	<0.001

Statistically significantly decreased renal function was observed in hyperuricemic patients.

Table 5: Association of Hyperuricemia with Treatment Modality

Treatment Type	Hyperuricemia Present n (%)	Hyperuricemia Absent n (%)	Total
Chemotherapy Alone	7 (10.4%)	60 (89.6%)	67
Radiotherapy Alone	3 (15.0%)	17 (85.0%)	20
Combination Therapy	11 (55.0%)	9 (45.0%)	20

Patients in combination therapy group had statistically significantly higher incidence of hyperuricemia.

Table 6: Stratifications of renal function did not significantly impact the outcomes in the Hyperuricemia Group.

Factor	Effect on Renal Function	Statistical Significance
Age (Older patients)	Lower eGFR, higher creatinine	$p < 0.05$
BMI (Higher BMI)	Worse renal parameters	$p < 0.05$
Duration of disease (Longer)	Progressive renal decline	$p < 0.05$

The poor renal function group was significantly older, more obese and with a longer disease duration than the normal renal function group, and they were those who were hyperuricemic.

21% of the patients with hematological malignancies had hyperuricemia. Serum creatinine levels were significantly higher and eGFR levels were significantly lower in patients with hyperuricemia than in normouricemia ($p < 0.001$). Those with combination chemotherapy and radiotherapy ($p = 0.001$) were more likely to experience this. There was an inverse correlation between renal function and age, BMI and disease duration. Overall, hyperuricemia was significantly associated with renal impairment, and may be regarded as an early marker of renal dysfunction in these patients.

5. DISCUSSION

The present study validated hyperuricemia as one of the common metabolic abnormalities detected in the patients with hematological malignancies and it was found that hyperuricemia is a strong marker of renal dysfunction. Urinary related complications appear to be still important clinical problems in this population and the same distribution reported previously. The patients with high uric acid had higher levels of serum creatinine and lower estimated glomerular filtration rates (eGFR) implying higher uric acid is related to reduced renal function [1]. Furthermore, hyperuricemia was found to be a crucial role player in the activation of the innate immune system and inflammation of the kidneys and was directly related to renal damage [2]. Moreover, uric acid has also been proposed a role in the oxidative stress and inflammatory pathways which cause progressive renal damage, even in the absence of uric acid crystallization [3].

With these experiences in mind, it is now clear that the vascular changes also have a significant role in the progression of kidney diseases where chronic vascular injury and calcification have negative effects on renal perfusion and renal function [4]. Other environmental and metabolic factors including dehydration, oxidative stress and renal autoregulatory failure have also been associated with the development of acute kidney injury [5]. Experimental studies also substantiate the role of inflammatory and oxidative pathways in renal injury and dysfunction [6].

The hyperuricaemia may be due to numerous factors in malignant cases of haematological disease. The use of drugs for a long period of time may have adverse effects on uric acid system and renal function [7]. An alteration of uric acid metabolism and kidney function has also been shown to have a metabolic and systemic inflammatory effect [8]. Moreover, uric acid has been associated with vascular dysfunction and hemodynamic abnormalities which may lead to renal dysfunction [9].

The results are corroborative with the many studies that have documented that hyperuricemia may not be entirely the result of a progressive decline in renal function, but rather be a component of the disease process. A few recent reviews have demonstrated that, uric acid lowering therapy could be beneficial in slowing the progression of chronic kidney disease and optimizing renal outcomes [10]. Fever also is known to be associated with renal damage in some clinical situations with uric acid like nephrolithiasis and crystal associated kidney disease [11]. Moreover, it was observed that there was a correlation between the serum uric acid and renal function impairment of non-diabetic hypertension patients [12]. There are also some indications from metaanalytic data that urate-lowering drugs might be renoprotective in some patients [13].

Increasing evidence suggests that hyperuricemia is involved in endothelial dysfunction, oxidative stress and chronic inflammation and these factors are related to the progression of kidney disease [14]. In longitudinal studies significant associations exist between longitudinal uric acid lowering and longitudinal renal function [15]. Also,

hyperuricemia has been associated with higher vascular risk, suggesting another mechanism by which high uric acid can have a negative impact on renal health [16].

Hyperuricemia is particularly associated with haematological malignancies, because of the increased cell turnover, spontaneous tumour lysis and chemotherapy associated tumour lysis syndrome. Excessive purine metabolism and uric acid production are the result of these processes [17]. Oncology patients are prone to experience tumor lysis induced acute kidney failure [18]. Following the acute events due to chronic uric acid toxicity of kidney, loss of nephrons, chronic renal sequelae are possible [19].

In recent years, there have been a number of studies suggesting that hyperuricemia is one of the most important key mechanisms in the pathogenesis of chronic kidney disease (CKD) [20] and this is accepted. There are some clinical trials that have demonstrated improvement in kidney outcome in some patients with urate-lowering therapy [21]. Other reviews have also reported that drugs which lower urate levels have renal protection properties, and have been demonstrated to slow the progression of renal disease [22]. It is also well established in more significant, larger population-based studies that there is a strong association between serum urate and kidney outcomes [23].

In long term, it has been observed that an increased uric acid levels was associated with a high risk of acute kidney failure and/or progression of chronic kidney disease (CKD) [24]. Such benefits from urate-lowering therapy have been well established and some studies have demonstrated that high-risk patients with urate-lowering therapy have a better renal outcome [25]. Besides, hyperuricemia has emerged as a part of the pathogenesis of different cardio-renal diseases, and is demonstrated to be clinically significant in susceptible patients [26].

In the present study it has local significance and provides information about the prevalence of hyperuricemia as well as its correlation with renal dysfunction in the studied population of patient with the diagnosis of hematological malignancies. The prompt identification and treatment of the serum uric acid level can limit renal toxicity, and improve the tolerability of chemotherapy and clinical outcome. The study however, is restricted in terms of sample size and single center study. Further understanding of the causal relationship between hyperuricemia and renal dysfunction will require more comprehensive, multicenter, prospective studies with longer follow-up, and a better evaluation of long-term outcome of early urate-lowering.

6. CONCLUSION

Hyperuricemia is prevalent in patients with hematological malignancies, and is closely related to renal dysfunction tests, including serum creatinine level and estimated glomerular filtration rate. The results of this study indicate that serum uric acid could be a significant factor in renal impairment in leukemia, lymphoma and multiple myeloma patients. Routine screening at the time of diagnosis and when on treatment in hyperuricemic patients could help prevent progression of kidney injury and improve the outcome of the patients. Proper hydration, regular checking of renal parameters and uric acid-lowering therapy can decrease the risk of renal complications and increase the tolerability of treatment with anticancer drugs at the time. The study highlights the need to include routine renal and metabolic surveillance as part of the routine care of all patients with hematological malignancies, especially those in low resource countries where late diagnosis and treatment complications occur.

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