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Analysis of Homocysteine Level in Patient with Acute Kidney Injury

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ABSTRACT

Background: Homocysteine (Hcy) contributes to oxidative stress and renal injury by generating reactive oxygen species and reducing heme oxygenase-1 levels. Elevated Hcy (Hhcy) may worsen outcomes after acute renal failure(ARF), promoting fibrosis and progression to chronic kidney disease (CKD). This study investigates the association between Hcy levels and ARF in patients at Tribhuvan University Teaching Hospital.

Methods: This study was an analytical cross sectional single center study that was carried out in Tribhuvan University Teaching Hospital. Specimens were processed as per the guidelines of Standard Operating Procedure (SOP) of Biochemistry laboratory of Tribhuvan University Teaching Hospital.

Results: Participants had a mean age of 54.2 years. Mean homocysteine was (13.7±10.36) µmol/L and creatinine was (148.7±18.03) µmol/L. Homocysteine levels showed no significant association with age, sex, residence, or disease type. A weak but significant positive correlation was found between homocysteine and creatinine($r = 0.186$, $p = 0.029$). Potassium correlated moderately with creatinine ($r = 0.383$, $p < 0.001$).

Conclusions: Homocysteine levels showed no significant association with age, gender, residence, or comorbid conditions. A weak but significant correlation was observed between homocysteine and creatinine, suggesting a potential link with renal function.

Keywords: Creatinine; homocysteine; potassium; renal failure.

INTRODUCTION

Homocysteine (Hcy) is a sulfur-containing amino acid produced during the conversion of methionine to cysteine.[1] It contains a reactive sulfhydryl group and can undergo rapid auto-oxidation in the presence of oxygen and metal ions, leading to the production of reactive oxygen species (ROS) such as superoxide and hydrogen peroxide.[2] Elevated homocysteine levels, or hyperhomocysteinemia (Hhcy), contribute to oxidative stress in renal injury by reducing levels of heme oxygenase-1 (HO-1). Studies have shown that inducing HO-1 with cobalt protoporphyrin (CoPP) significantly reduces ROS production in Hhcy models.[3]

Hhcy may also worsen renal outcomes after acute kidney injury (AKI) by promoting fibrosis and excessive extracellular matrix deposition, which can accelerate the transition from AKI to chronic kidney disease (CKD). Therefore, Hhcy may be a novel risk factor in AKI-to-CKD progression. Lowering Hcy levels or inducing HO-1 may offer potential therapeutic strategies.[3]

This study aims to explore the relationship between Hcy levels and AKI patients admitted to Tribhuvan University Teaching Hospital.

METHODS

The study was an analytical cross-sectional study carried out in Tribhuvan University Teaching Hospital with 138 participants. Patients was diagnosed with Acute Kidney Injury admitted to the Department of Emergency of TUTH were taken as study participants. Non-probability

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sampling method was used for data collection after ethical clearance being taken from IRC Ref No (213080/081). Patients diagnosed with anuria, pregnancy, organ transplant recipient, myocardial infarction, deep vein thrombosis, genetic disease related to thrombus formation were excluded. Data were collected using questionnaire following informed written and verbal consent. Venous sample of Homocysteine, sodium, potassium and creatinine were taken in gel tube vial during the time of admission. In laboratory sodium and potassium were estimated by ion selective electrode method. Homocysteine was estimated by chemiluminoessence method along with creatinine by Jaff enzymatic method. Calibration and quality control of analytes were done routinely to get precise and accurate results.

The variable required for the study were noted in pro-forma and were entered in the MS excel and analyzed using SPSS version 26. Descriptive statistics of various parameters with mean, median and standard deviation were calculated. The level of confidence was set to be at 95% with the level of significance of less or equal to 0.05. Chi-square, fisher exact and co-relation test were applied to the variable to get the result.

RESULTS

The study included participants with a mean age of (54.23 ± 15.53) years (range: 25-88). Mean values for key biochemical parameters were as follows: creatinine (148.72 ± 18.03) µmol/L, sodium (Na^+)(139.42 ± 2.99)mEq/L, potassium (K^+)(4.37 ± 0.48)mEq/L, and homocysteine(13.68 ± 10.36) µmol/L.

Table 1. Summary statistics of the age of the patients and biochemical measures.

	Mean	Std.Deviation	Minimum	Maximum
Age goup (yrs)	54.23	15.53	25	88
Creatinineumol/L	148.72	18.03	112	190
NA Meq/l	139.42	2.99	130	146
K Meq/l	4.37	0.48	3.5	5.7
Homocysteine	13.68	10.36	0.6	56.0

No statistically significant associations were observed between homocysteine levels and age group (p = 0.305), sex (p = 0.33), residence (rural vs urban, p = 0.191), or underlying disease category (p = 0.341).

Table 2. Distribution of Homocysteine Levels of the patients by Age, Sex, Residence, and Systemic Involvement.

	Homocystene			Total	P-value
Age (in years)	Normal	high	low		
20-40	20 (64.5%)	9 (29.0%)	2 (6.5%)	31 (100.0%)	0.305
41-60	28 (50.9%)	16 (29.1%)	11 (20.0%)	55 (100.0%)	
Above 60	24 (46.2%)	20 (38.5%)	8 (15.4%)	52 (100.0%)	
Sex					
Female	25 (52.1%)	13 (27.1%)	10 (20.8%)	48 (100.0%)	0.33
Male	47 (52.2%)	32 (35.6%)	11 (12.2%)	90 (100.0%)	
Address					
Rural	56 (56.6%)	28 (28.3%)	15 (15.2%)	99 (100.0%)	0.191
Urban	16 (41.0%)	17 (43.6%)	6 (15.4%)	39 (100.0%)	
Systemic involvement					
Infection	50 (58.80%)	24 (28.20%)	11 (12.90%)	85 (100.0%)	0.341
Cardiac	4 (40.00%)	4 40.00%	2 20.00%	10 100.00%	
Gastrointestinal	18 41.90%	17 39.50%	8 18.60%	43 100.00%	

A weak but statistically significant positive correlation was found between homocysteine and creatinine levels (r = 0.186, *p* = 0.029). Potassium showed a moderate positive correlation with creatinine (r = 0.383, *p*< 0.001). No significant correlations were found between homocysteine and sodium, or between sodium and other parameters.

Table 3. Correlation Matrix among Homocysteine, Creatinine, Sodium, and Potassium levels.

		Homocysteine	Creatinine umol/L	Na Meq/l
Creatinineumol/L	Correlation Coefficient	.186*		
	Sig. (2-tailed)	0.029	.	
NaMeq/l	Correlation Coefficient	0.065	-0.051	
	Sig. (2-tailed)	0.447	0.555	.
K Meq/l	Correlation Coefficient	0.097	.383**	-0.072
	Sig. (2-tailed)	0.256	0.000	0.401
* Correlation is significant at the 0.05 level (2-tailed)				
** Correlation is significant at the 0.01 level (2-tailed).				

DISCUSSION

A total of 138 patients diagnosed with acute kidney injury (AKI) were enrolled in our study, with a mean age of (54 ± 15.53) years. This is quite comparable to findings by Sundar et al., who reported a mean age of (59.77 ± 14) years.[4] The mean serum creatinine level among our patients was (148.72 ± 18.03) µmol/L, which contrasts with the study by Priyambadha et al., where the reported mean creatinine level was significantly higher at 286 µmol/L.[5] In terms of electrolyte levels, our study found mean serum sodium and potassium concentrations to be (139.42 ± 2.99) mEq/L and (4.37 ± 0.48) mEq/L, respectively. These values closely align with those reported by Sundar et al., who found sodium and potassium levels of (130.45 ± 8.31) mEq/L and (4.2 ± 1.06) mEq/L, respectively.[4] Additionally, we observed a mean homocysteine level of (13.68 ± 10.36) µmol/L in our study population, which is relatively similar to the findings of Li et al., who reported a mean level of (16.90 ± 6.95) µmol/L.[6]

Our study showed that there was no significant association of different age group with homocysteine level. Whereas, Xu et al, concluded the homocysteine level was significantly higher in each age range (aged 20-30, aged 30-40, aged 40-50, aged 50-60, aged 60-80, aged over 80) ($p<0.0001$).[7] Sultan et al did not showed any significant association of homocysteine with age. [8] Another non-parametric association of gender with homocysteine in our study showed no significant association whereas Choen et al reported that there was significant association between gender and homocysteine. Average homocysteine concentrations were 12.6 (5.9) and 9.6 (3.2) µmol/L in men and women respectively ($p < 0.001$).[9]

Our study stated that there was no significant association between homocysteine level of people living in urban and rural areas, where as, in a cross-sectional study conducted by Du et al, they have reported higher level of homocysteine in people of Beijing, likely air pollution related.[10] Ganguly and Alam et al stated that, atherosclerosis being the major pathological event, there seems to have clear association between total serum homocysteine level and incidence of cardiovascular disease[11] but our study didn't showed any significant association.

A study stated that, infection induced inflammation being the major pathological process, there seems to have clear association between total serum homocysteine level and incidence of infectious disease. But our study didn't show any significant association.[12]

There was a study conducted by Redeen et al, which reported the occurrence of hyperphomocystenemia in patients with atropic gastritis.[13] Another study conducted by Erzin et al, stated the increased level of homocysteine in patients with IBD[14], but ours study fails to show any association of homocysteine with gastrointestinal diseases.

A weak but significant positive correlation was found between homocysteine and creatinine(r = 0.186, *p* = 0.029). There are studies which supports that Homocysteine has relation with patients of acute renal failure such as Long and Lie et al.[15]

Firstly, it was a single-center study, which may limit the

generalizability of the findings to broader populations. The study was conducted over a limited duration, which may not fully capture variations over time. Additionally, the relatively small sample size of 138 patients may reduce the statistical power to detect more subtle associations. There is also the possibility of unmeasured confounding bias, as certain relevant variables may not have been accounted for. The lack of a control group further limits comparison and interpretation of the observed findings. Moreover, the timing of homocysteine measurement was not standardized across all participants, which could introduce variability in the results.

CONCLUSIONS

Significant associations were not found between homocysteine levels and factors such as age, gender, residence (urban vs. rural), or comorbid gastrointestinal and infectious diseases. However, we found a weak but statistically significant positive correlation between homocysteine and creatinine levels. Overall, our results suggest that while homocysteine may have limited diagnostic or predictive value, its role in AKI and renal pathology warrants further investigation through larger, multicenter studies.

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