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Serum ferritin level in type 2 diabetic patients with renal dysfunction

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Abstract

Background and objective: Nephropathy is the major cause of end-stage renal disease (ESRD) in type 2 diabetes mellitus (T2DM). Delay in identification and management of nephropathy in T2DM may cause development of ESRD. An increased level of serum ferritin plays a role in the pathogenesis of chronic kidney disease (CKD) in T2DM. Hence, the present study intended to assess the level of serum ferritin in renal dysfunction in patients with T2DM**.**

Material and methods: This was a retrospective study with 81 T2DM patients with and without nephropathy. They were categorized into two groups. Group-1 consisted of 46 T2DM cases without nephropathy and remaining 35 with nephropathy. The clinical and biochemical parameters such as blood glucose, urea, creatinine, iron, ferritin, transferrin, total iron binding capacity (TIBC), and haemoglobin were measured by standard methods, and estimated glomerular filtration rate (eGFR) by MDRD formula.

Results: Significantly ($p<0.05$) elevated level of serum ferritin along with urea and creatinine was found in patients with T2DM with nephropathy. A significant positive correlation ($r = 0.37$) of serum ferritin and negative correlation ($r = - 0.852$) of eGFR with creatinine were found. It indicated that ferritin could be a good marker to monitor kidney function in T2DM.

Conclusion: Apart from eGFR and serum creatinine, raised serum ferritin level was a good indicator of renal dysfunction in T2DM patients and might play an important role in renal dysfunction in early stage diabetic nephropathy.

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Introduction

Chronic kidney disease (CKD) is a global health problem. Patients with type 2 diabetes mellitus (T2DM) are in increased risk of developing chronic kidney disease. Globally, the prevalence of CKD among T2DM patients varied from 6.0% to 39.3% [1-3]. Also, diabetes-related chronic kidney disease (CKD) is the leading cause of end-stage kidney disease (ESKD) in T2DM patients worldwide [4,5].

Ferritin is an evolutionarily preserved intracellular iron storage protein that control iron metabolism [6]. Serum ferritin is considered as a malignancy marker, namely in neuroblastoma, renal cell carcinoma, or Hodgkin's lymphoma. Hyperferritinemia is also related with hepatic dysfunction, usually because liver is the main organ to eliminate moving ferritin molecules. In addition, T2DM is often related with increased levels of serum ferritin. A relation

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between concentration of high serum ferritin, insulin resistance and glucose intolerance in healthy individuals has also been reported [7]. Moreover, a reduction in glucose resistance has been recognized after depletion of iron in T2DM subjects [8]. High levels of ferritin have been observed in subjects who had CKD with proteinuria and glomerular disease [9]. The present study was carried out to find whether serum ferritin can be an independent marker of kidney dysfunction in patients with T2DM.

Materials and methods

This study was conducted at the Clinical Biochemistry laboratory of Chalmeda Anand Rao Institute of Medical Sciences & Hospital, Karimnagar, Telangana, India.

The study comprised of two groups aged between 34 to 53 years. Group-1 participants consisted of T2DM patients without CKD (n = 46) while Group-2 comprised of T2DM patients with chronic kidney dysfunction (n = 35). T2DM patients having the serum creatinine higher than 1.4 mg/dl levels were considered to have chronic kidney dysfunction. T2DM patients with serum creatinine less than 1.4 mg/dl were considered to have normal kidney function. Data of the patients were collected from the records of Clinical Biochemistry laboratory from September 2020 to December 2020. The requirement of written informed consent was waived owing to the retrospective nature of the study. Blood glucose, urea, creatinine, hemoglonin, iron, transferrin, ferritin, total iron binding capacity (TIBC) were analysed in Randox Imola auto-analyser. eGFR was estimated based on serum creatinine using online MDRD (modification of Diet in Renal Disease) formula.

The mean value and standard deviation were measured for each parameter. Mean values were compared by independent t test. Pearson's correlation coefficient test was used to measure association between variables. The analysis was carried out by using Sigma Plot 13 (Systat software USA).

Results

A total of 81 T2DM patients were included in the study of which 46 had T2DM without CKD (Group-1) while 35 had T2DM with CKD (Group-2). Table-1 shows the detail characteristics of the Group-1 and Group-2 study population. The mean age of the Group-1 study population (35.50±1.1 years) was significantly (p<0.001) less than that of Group-2 cases (49.29±4.15 years). In gender wise distribution, Group-1 had 28 males and 18 females, while Group-2 had 26 males and 9 females. The biochemical parameters like urea, creatinine and serum ferritin values were significantly (p<0.001)

Table-1: *Clinical parameters of Group-1and Gruup-2 study population (n = 81)*

Parameters	Group-1 (n = 46) Mean±SD	Group-2 (n = 35) Mean±SD	p-value
Age (Years)	35.50±1.1	49.29±4.15	<0.001
RBG (mg/dl)	132.08±6.8	133.08±58.9	0.480
Urea (mg/dl)	25.0 ±4.57	114.0±60.9	<0.001
Creatinine (mg/dl)	0.85±0.19	7.61±4.24	<0.001
Ferritin (ng/ml)	480.5± 81.6	510.5± 6.1	0.033
Iron (mcg/dl)	74.56±7.09	72.9±53.7	0.282
TIBC (mcg/dl)	248.6±103.2	225.0±9.8	0.381
Transferrin (mg/dl)	175.3±71.7	157.1±9.1	0.293
Haemoglobin (gm/dl)	8.09±2.27	7.90±2.22	0.888
eGFR (mL/min/1.73 m^2)	92.06±27.88	6.97±4.40	<0.001

Note: Group-1: serum creatinine <1.4 mg/dl; Group-2: serum creatinine >1.4 mg/dl.
RBS: random blood glucose, TIBC: total iron-binding capacity, eGFR: estimated glomerular filtration rate, SD: standard deviation.

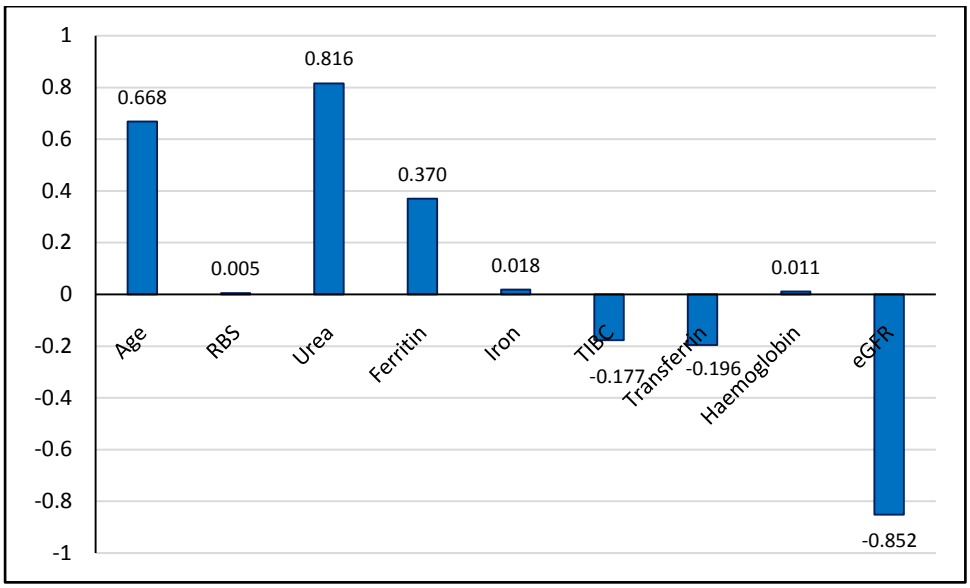

Figure-1: *Correlation of creatinine with other parameters in all study subjects. RBS: Random blood glucose, TIBC: Total iron binding capacity, eGFR: estimated glomerular filtration rate.*

elevated in diabetic subjects with renal dysfunction compared to diabetic subjects without renal dysfunction**.** However, no significant difference was observed in the level of iron, TIBC, transferrin and haemoglobin between the two study groups**.**

Figure-1 illustrates that serum creatinine had significant positive correlation with age (r = 0.668), urea (r = 0.816) and serum ferritin (r = 0.37) in all study subjects**.** In addition to that creatinine was negatively correlated with TIBC and transferrin, but statistically insignificant**.** However, no significant correlation of creatinine with RBG, iron and haemoglobin was found in the study subjects**.**

Discussion

Creatinine, urea and eGFR are clinically established diagnostic markers for renal disease. The anhydrous form of creatinine gets filtered by the glomerulus and thus serum creatinine is considered as an indirect estimation of glomerular filtration capacity. The diminished glomerular filtration rate leads to rise in creatinine and urea levels in the serum [10,11]. Furthermore, estimation of albuminuria, serum creatinine and eGFR are predictors of renal disease progression in T2DM [12]. In the present study significant positive co-relation of creatinine was found with raised serum ferritin level in study population. Serum iron, TIBC, transferrin and haemoglobin levels were though higher in diabetic patients with no kidney dysfunction but the differences were not statistically significant than those with CKD. Overall, we found that TIBC, transferrin, haemoglobin and eGFR were negatively correlated with creatinine. Recently it has been reported that raised levels of serum ferritin may play a role in the pathogenesis leading to the development of CKD in T2DM [13]. Also, serum ferritin level has been found as a prognostic marker for predicting renal recovery in acute kidney injury [14].

Therefore, elevated serum ferritin may be considered as a marker for kidney dysfunction in patients with T2DM. The serum ferritin could be used as laboratory parameter for the diagnosis of kidney dysfunction because of its easy availability and low cost. For clinical practice, serum ferritin marker may also be one of the recommended assays for identifying and monitoring the chronic kidney dysfunction in patient with T2DM.

Conflict of interest

The authors declare that they have no conflict of interest for this study.

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