Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14,Issue.33s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Copeptin Level as a Biomarker of Diabetic Nephropathy: A Major Microvascular complication in Children and Adolescents with Type 1 Diabetes Mellitus

Sohayla Abdelrahman Anwar Deghady [1]*, Radwa Mahmoud Elsharaby [2], Shaymaa Mohamed Elrifaey [1], Shereen Abdelghaffar Taha [3], Adel Ali Erfan [1]

[1] Pediatrics Department, Faculty of Medicine, Tanta University, Tanta, Egypt

[2] Clinical Pathology Department, Faculty of Medicine, Tanta University, Tanta, Egypt

[3] Pediatrics Department, Faculty of Medicine, Cairo University, Cairo, Egypt

***Corresponding Author:**

Sohayla Abdelrahman Anwar Deghady

Affiliation: Pediatric Deparment, Faculty of Medicine, Tanta University, Tanta, Egypt

Email ID : sohayla.deghady1@gmail.com

ORCID iD: 0009-0005-0630-4376

Cite this paper as Sohayla Abdelrahman Anwar Deghady , Radwa Mahmoud Elsharaby , Shaymaa Mohamed Elrifaey , Shereen Abdelghaffar Taha , Adel Ali Erfan (2025) Copeptin Level as a Biomarker of Diabetic Nephropathy: A Major Microvascular complication in Children and Adolescents with Type 1 Diabetes Mellitus .Journal of Neonatal Surgery, 14.(33s) 276-284

ABSTRACT

Background: Diabetic nephropathy (DN) is a major microvascular complication of Type 1 diabetes mellitus (T1DM) that may lead to end-stage renal disease. Early biomarkers like copeptin, reflecting kidney dysfunction and vasopressin activity, may improve risk prediction and serve as therapeutic targets. The aim of this work was to evaluate serum copeptin as a biomarker for DN in children and adolescents with T1DM.

Methods: This analytical cross-sectional study was carried out on 70 children and adolescents aged from 11 years to 18 years who have 2 to 5 years diabetes duration, both sexes, with T1DM and 20 healthy individuals as control. All patients were subjected to serum copeptin level measurement.

Results: In diabetic patients, serum copeptin levels did not differ significantly between sexes ($P = 0.649$). Serum copeptin levels were higher in patients with elevated blood pressure ($P < 0.001$) and in those with diabetic neuropathy. Additionally, copeptin levels increased significantly with recurrent DKA episodes, with the highest levels observed in patients with >3 episodes, followed by ≤3 episodes, and no recurrence. No significant association was observed between copeptin levels and family history of diabetes or type of initial presentation. Serum copeptin levels showed significant association with multiple metabolic and renal parameters in diabetic patients. Serum copeptin levels were positively correlated with fasting and postprandial glucose, HbA1c values, LDL, total cholesterol, serum creatinine, and A/C ratio, and negatively correlated with HDL and eGFR. Serum copeptin level showed no significant correlation with hemoglobin, leukocyte count, liver enzymes, thyroid hormones, urea, BUN, anthropometric measures, or insulin dose.

Conclusions: There is evidence of increased level of serum copeptin level in patients with type 1 DM especially in long standing diabetes with poor glycemic control.

Keywords: *Serum Copeptin, Diabetic Nephropathy, Adolescents, Children, Biomarkers.*

1. INTRODUCTION

Diabetes mellitus is a serious, long-term condition with a major impact on the lives and well-being of individuals, families, and societies worldwide (1).

Type 1 diabetes mellitus (T1DM) is one of the two major forms of this disease which, in contrast to type 2 DM is characterized by a childhood onset. T1DM occurs due to autoimmune destruction of pancreatic beta cells resulting in progressive failure of insulin production (2).

.

Type 1 DM has various macro- and micro-vascular complications. One of its serious microvascular complications is diabetic nephropathy (DN), also known as diabetic kidney disease, that can eventually progress to end-stage renal disease (ESRD) (3).

The poor outcome of DN is related to the complex and poorly understood pathogenesis, inadequate markers for its early diagnosis, monitoring of the disease progression, and lack of specific curative treatments (3).

Many markers of renal dysfunction, either glomerular or tubular, can appear before detection of microalbuminuria, which only appears after occurrence of significant kidney damage (4).

Circulating levels of vasopressin are found to be increased in both T1DM and T2DM (5).

Persistent high levels of vasopressin in diabetes aggravate hyperglycemia, induce insulin resistance and may be deleterious to renal function (6).

Vasopressin is cosecreted with copeptin, the c-terminal part of vasopressin precursor, into the blood in an equimolar ratio. In contrast to vasopressin, copeptin is stable for days, easily measured and mimics fluctuations in vasopressin concentration (7)..

The vasopressin may be a potential therapeutic target for the prevention and treatment of diabetic complications, notably DN. Copeptin is an adequate surrogate marker of vasopressin (8).

The aim of this work was to evaluate serum copeptin as a biomarker for DN in children and adolescents with T1DM.

Patients and Methods:

This analytical cross-sectional study was carried out on 70 children and adolescents aged from 11 years to 18 years who have 2 to 5 years diabetes duration, both sexes, with T1DM and 20 healthy individuals as control. The study was done from August 2022 to August 2024 after approval from Ethical Committee Tanta university Hospitals, Tanta, Egypt. (approval code 35508/5/22). An informed written consent was obtained from the patients.

Exclusion criteria were patients with associated congenital or acquired kidney disease, thyroid dysfunction, history of recent infection, history of recent diabetic ketoacidosis and who received nephrotoxic drugs or glucocorticoids.

All patients were subjected to complete history taking, clinical examination and laboratory examination [Complete blood count (CBC), liver and renal function tests, lipid profile: total cholesterol, low density lipoproteins (LDL), high density lipoproteins (HDL), and triglycerides (TG), fasting blood glucose level and 2 hours post prandial (by using Automatic biochemical analyzer), glycosylated Hemoglobin (HbA1c %), plasma protein and albumin levels, complete urine analysis and culture, thyroid function tests , Anti GAD and anti-islet cell antibodies].

Specific Investigations:

Renal ultrasound to exclude renal congenital anomalies , estimated glomerular filtration rate (eGFR; mL/min/1.73 m2) was calculated using updated Schwartz formula: (Schwartz GJ et al. (9) eGFR-Cr = 0.413*height (cm)/Serum Cr (mg/dL), urine albumin/creatinine ratio (UACR), first-voided morning urine sample was taken. It is the preferred time to avoid the known diurnal variation in albumin excretion and postural effects, the samples were collected after excluding urinary tract infections, kidney diseases, marked hyperglycemia, menstrual bleeding and fever, and also instructions were given to avoid strenuous exercise, heat stress, and excess protein intake before sample collection to exclude other causes of proteinuria, and serum copeptin level.

Serum Copeptin level:

Human copeptin ELISA Kit was used to assay the level of copeptin in human serum by using a double-antibody sandwich enzyme-linked immunosorbent assay (ELISA), kits supplied by Develop, Chinese Canadian company. Catalog number DL-CPP-Hu.

Assay procedure:

Determine wells for diluted standard, blank and sample. Prepare 7 wells for the standards, 1 well for blank. Add 100µL each of dilutions of standard (read Reagent Preparation), blank, and samples into the appropriate wells. Cover with the Plate sealer. Incubate for 2 hours at 37ºC, remove the liquid from each well, do not wash, add 100µL of Detection Reagent A working solution to each well. Incubate for 1 hour at 37˚C after covering it with the Plate sealer, aspirate the solution and wash with 300µL of 1× Wash Solution to each well using a squirt bottle, multi-channel pipette, manifold dispenser or auto-washer, and let it sit for 1-2 minutes. Remove the remaining liquid from all wells completely by tapping the plate onto absorbent paper. Wash thoroughly 3 times. After the last wash, remove any remaining Wash Buffer by aspirating or decanting. Invert the plate and blot it against absorbent paper, add 100µL of Detection Reagent B working solution to each well. Incubate for 1 hour at 37ºC after covering it with the Plate sealer, repeat the aspiration/wash process for a total of 5 times as conducted in step 4, add 90µL of Substrate Solution to each well. Cover with a new Plate sealer. Incubate for 15-25 minutes at 37ºC (Do not exceed 30 minutes). Protect from light. The liquid will turn blue with the addition of the Substrate Solution, add 50µL of Stop Solution to each well. The liquid will turn yellow with the addition of the Stop solution. Mix the

liquid by tapping the side of the plate. If the color change does not appear uniform, gently tap the plate to ensure thorough mixing, remove any drops of water and fingerprints on the bottom of the plate and confirm there are no bubbles on the surface of the liquid. Run the microplate reader and take measurements at 450 nm immediately.

Statistical analysis

Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS), version 21. The data were presented as numbers and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution. Chi-square test (X^2) was used in the comparison between two groups with qualitative data while independent t-test was used in the comparison between two groups with quantitative data and parametric distribution. Univariate parametric analysis of variance was used for comparison between more than two means of more than two different groups (F) value of analysis of variance (ANOVA). Significance was adopted at $p < 0.05$ for interpretation of results of tests of significance. Spearman correlation coefficients were used to assess the significant relation between two quantitative parameters in the same group.

Results:

There was no significant difference between both groups regarding age, sex, family history, tanner staging of puberty, number of girls got menarche, anthropometric measurements and vital signs. FBG, 2 Hr PP BG, Last HbA1C, average HbA1C last year, LDL, triglycerides, total cholesterol, serum creatinine, estimated GFR, serum copeptin level, and A/C ratio were significantly different between both groups while other parameters without significant difference. **Table 1**

Table 1: Age and gender, family history, tanner staging of puberty, number of girls got menarche, anthropometric measurements, vitals signs, and laboratory data of diabetic patients and controls

		Patients (n=70)	**Controls (n=20)**	**Test** f sig,	**P**
Age (Years)		13.71 ± 1.77	13.73 ± 1.69	t=-0.045	0.964
Sex	**Male**	33 (47.14%)	9 (45.00%)	X^2=0.029	0.865
	Female	37 (52.86%)	11 (55.00%)		
Family history of DM		16 (22.86%)	7 (35.00%)	X^2=1.206	0.272
Tanner staging	**Prepubertal**	7 (10.00%)	3 (15.00%)	**X^2=0.394**	0.530
	Pubertal	63 (90.00%)	17 (85.00%)		
Girls with menarche		16 (43.24%)	5 (45.45%)	**X^2=0.017**	0.897
Anthropometric measurements					
Weight (kg)		52.83 ± 11.22	54.80 ± 10.84	t=−0.698	0.487
Weight Z-Score		1.10 ± 1.53	1.46 ± 1.60	t=−0.897	0.372
Height (cm)		158.66 ± 8.92	157.65 ± 7.90	t=0.459	0.647
Height Z-Score		0.59 ± 1.27	0.47 ± 1.35	t=0.354	0.724
BMI (kg/m²)		20.62 ± 3.55	21.85 ± 3.31	t=−1.386	0.169
BMI Z-Score		0.12 ± 1.25	0.61 ± 1.15	t=−1.549	0.125
Waist circumference (cm)		71.14 ± 12.39	75.50 ± 10.46	t=−1.432	0.156
Hip circumference (cm)		84.99 ± 12.17	89.80 ± 10.63	t=−1.602	0.113
Waist/Hip ratio		0.83 ± 0.04	0.84 ± 0.04	t=−0.479	0.633
Vitals signs					
Systolic BP	**50th–90th**	55 (78.57%)	18 (90.00%)	X^2=1.508	0.471
	90th–95th	13 (18.57%)	2 (10.00%)		
	> 95th	2 (2.86%)	0 (0.00%)		
Diastolic BP	**50th–90th**	54 (77.14%)	17 (85.00%)	X^2=0.899	0.638

	90th–95th	14 (20.00%)	3 (15.00%)		
	> 95th	2 (2.86%)	0 (0.00%)		
Laboratory data					
FBG (mg/dl)		163.70±60.996	83.25±4.72	t=5.870	**<0.001***
2 Hr PP BG (mg/dl)		217.33±73.91	119.75±0.14	t=5.868	**<0.001***
Last HbA1C (%)		10.36±2.18	4.68±0.46	t=11.566	**<0.001***
Average HbA1C last year (%)		10.62±2.35	4.88±0.41	t=10.828	**<0.001***
Hb (g/dl)		12.75±1.20	12.52±1.12	t=0.776	0.440
TLC (c/mm³)		8.13±1.71	8.31±1.97	t=−0.386	0.700
Platelets (c/mm³)		332.26±107.47	323.05±99.10	t=0.343	0.732
AST (U/L)		29.70±11.31	28.82±11.57	t=0.305	0.761
ALT (U/L)		34.99±12.01	36.98±10.90	t=−0.665	0.508
HDL (mg/dl)		43.73±8.33	46.86±5.65	t=−1.578	0.118
LDL (mg/dl)		88.33± 19.02	68.75±14.09	t=4.273	**<0.001***
Triglycerides (mg/dl)		88.61±20.64	76.80±11.52	t=2.447	**0.016***
Total cholesterol (mg/dl)		117.45±40.77	97.57±32.71	t=2.002	**0.048***
TSH (µIU/ml)		2.51±1.03	2.20±1.07	t=1.165	0.247
FT4 (ng/dl)		1.19±0.21	1.24±0.23	t=−0.878	0.382
FT3 (pg/ml)		2.97±0.58	3.12±0.63	t=−1.036	0.303
Urea (mg/dl)		18.95±4.84	18.97±3.04	−0.020	0.984
Serum creatinine (mg/dl)		0.75±0.13	0.67±0.08	t=2.682	**0.009***
BUN (mg/dl)		11.95±3.10	10.64±3.46	t=1.626	0.108
Estimated GFR (ml/min/1.73m²)		89.77 ± 16.23	98.56 ± 9.49	t=−2.306	**0.023***
Abnormal urine analysis		9 (12.86%)	2(10.00%)	X^2=0.118	0.731
Serum copeptin level (pg/ml)		275.404±126.519	179.450±42.525	t=3.327	**0.001***
A/C ratio (mg alb./gm creat)		18.554±13.949	2.970±1.449	t=4.969	**<0.001***

Data are presented as mean ± SD or frequency (%). * Significant P value <0.05, BMI: Body mass index, BP: Blood pressure, FBG: Fasting blood glucose, PP BG: post prandial blood glucose, HbA1C: Glycated hemoglobin, Hb: hemoglobin, TLC: total leucocytic count, AST: Aspartate Aminotransferase, ALT: Alanine Transaminase, HDL: High density lipoprotein, LDL: Low density lipoprotein, TSH: Thyroid-Stimulating Hormone, BUN: Blood urea nitrogen, **FT3**: **free triiodothyronine, FT4: Free Thyroxine.**

Age of onset of diabetes, duration of the disease, insulin regimen and dose, mode of first clinical presentation and DKA recurrence and diabetic neuropathy in diabetic patients were enumerated at **table 2**

Table 2: Age of onset of diabetes, duration of the disease, insulin regimen and dose, mode of first clinical presentation and DKA recurrence and diabetic neuropathy in diabetic patients

		N=70
Age of DM presentation (Years)		8.12 ± 2.20
Duration of DM (Years)		5.61 ± 2.75
Insulin dose (IU/Kg/d)		1.242 ± 0.295
First presentation symptoms	**DKA**	36 (51.43%)
	Classic	34 (48.57%)
DKA recurrence	**≤ 3**	38 (54.28%)
	> 3	26 (37.14%)

Data are presented as mean ± SD or frequency (%). DM: Diabetes mellitus, DKA: Diabetic ketoacidosis.

In diabetic patients, serum copeptin levels did not differ significantly between sexes (P = 0.649). Serum copeptin levels were higher in patients with elevated blood pressure (P < 0.001) and in those with diabetic neuropathy. Additionally, copeptin levels increased significantly with recurrent DKA episodes, with the highest levels observed in patients with > 3 episodes, followed by ≤ 3 episodes, and no recurrence. No significant association was observed between copeptin levels and family history of diabetes or type of initial presentation. **Table 3**

Table 3: Relation between serum copeptin level and (sex, blood pressure percentiles, family history of diabetes, first presentation symptoms, diabetic neuropathy and DKA recurrence in diabetic patients

Serum copeptin (pg/ml)					
Sex	**Male**	33	282.776±127.469	t = 0.458	**0.649**
	Female	37	268.830±127.056		
Systolic BP percentile	**50th–90th**	55	230.998±80.950	F= 46.623	**<0.001***
	90th–95th	13	400.800±94.508		
	>95th	2	681.500 ± 27.577		
Diastolic BP percentile	**50th–90th**	54	232.406±83.688	F= 38.764	**<0.001***
Family history of DM		16	297.069 ± 91.545	t = 0.778	0.440
First presentation symptoms	**DKA**	36	296.908 ± 130.609	t = 1.476	0.145
	Classic	34	252.635 ± 119.742		
Diabetic neuropathy		16	373.956 ± 174.320	t = 3.895	**<0.001***
DKA recurrence	**≤3 episodes**	38	242.624 ± 112.376	F = 7.898	**0.001***
	>3 episodes	26	343.919 ± 129.064		

Data are presented as mean ± SD. * Significant P Value <0.05, DM: Diabetes mellitus, , DKA: Diabetic ketoacidosis, BP: blood pressure.

Serum copeptin levels showed significant association with multiple metabolic and renal parameters in diabetic patients. Serum copeptin levels were positively correlated with fasting and postprandial glucose, HbA1c values, LDL, total cholesterol, serum creatinine, and A/C ratio, and negatively correlated with HDL and eGFR. Serum copeptin showed no significant correlation with hemoglobin, leukocyte count, liver enzymes, thyroid hormones, urea, BUN, anthropometric measures, or insulin dose. **Table 4**

Table 4: Correlation coefficient (r) between serum copeptin level and age and anthropometric measurements, age of onset of diabetes, duration of the disease and insulin dose and laboratory parameters in diabetic patients in the diabetic patients

	Serum copeptin level (pg/ml)	
	R	**P**
Age (Years)	0.324	0.116
Weight(kg)	-0.064	0.599
Weight Z-Score	-0.344	0.054
Height(cm)	-0.104	0.390
Height Z-Score	-0.479	0.230
BMI (kg/m^2)	-0.076	0.530
BMI Z-Score	-0.194	0.107
Waist circumference(cm)	-0.062	0.610
Hip circumference(cm)	-0.046	0.705
Waist/Hip ratio	-0.092	0.450
Age of onset of DM (Years)	-0.067	0.584
Duration of DM (Years)	0.266	0.026*
Insulin dose (IU/Kg/d)	0.113	0.351
FBG m(mg/dl)	0.360	**0.002***
2 Hr PP BG (mg/dl)	0.455	**<0.001***
Last HbA1C	0.465	**<0.001***
Average HbA1C last year	0.461	**<0.001***
Hb (gm/dl)	0.149	0.218
TLC (c/mm^3)	-0.069	0.572
Platelets (c/mm^3)	0.058	0.631
AST (U/L)	0.332	0.055
ALT (U/L)	0.211	0.080
HDL (mg/dl)	-0.317	**0.007***
LDL (mg/dl)	0.487	**<0.001***
Triglycerides(mg/dl)	0.426	0.061
Total cholesterol (mg/dl)	0.380	**0.001***
TSH(Uiu/ml)	-0.025	0.837
FT4 (ng/dl)	0.133	0.271
FT3 (pg/ml)	-0.266	0.066
Urea (mg/dl)	0.135	0.265
Serum creatinine (mg/dl)	0.766	**<0.001***
BUN (mg/dl)	0.171	0.157
Estimated GFR (ml/min/1.73m^2)	-0.792	**<0.001***

A/C ratio (mg alb./gm creat)	0.693	**<0.001***

r: Pearson Coefficients, *Significant (P≤0.05), BMI: Body mass index, DM: Diabetes mellitus, FBG: fasting blood glucose, 2Hr PPBG: 2 hour post prandial blood glucose. BUN: Blood urea nitrogen, GFR: Glomerular filtration rate, A/C ratio: Albumin/creatinine ratio, Hb: Hemoglobin, TLC: total leucocytic count, AST: aspartate transaminase, ALT: Alanine transaminase, HDL: High density lipoprotein, LDL: Low density lipoprotein, TSH: Thyroid stimulating hormone, FT4: thyroxine, FT3: triiodothyronine, BUN: Blood urea nitrogen, GFR: Glomerular filtration rate, A/C ratio: Albumin/ creatinine ratio.

Serum copeptin level was significantly elevated in diabetic patients with neuropathy compared to those without neuropathy and healthy controls. Table 5

Table 5: Serum levels of copeptin in diabetic patients with and without neuropathy and controls

	Patients with neuropathy (n=14)	**Patients without neuropathy (n=56)**	**Controls (n=20)**	**ANOVA (F)**	**P-value**
Serum copeptin level (pg/ml)	373.956±174.320	246.204±91.861	179.450±42.522	15.994	**<0.001***

Data are presented as mean ± SD. * Significant P value <0.05.

There was no significant relation between serum copeptin level and Tanner staging of puberty in both diabetic patients and controls **Table 6**

Table 6: Relation between serum copeptin level and Tanner staging in diabetic patients and controls

Serum copeptin level				
Prepubertal	192.014±7.116	164.967±5.944	0.782	0.457
Pubertal	234.670±128.943	182.006±45.491	3.216	**0.052***

Data are presented as mean ± SD. * Significant P value <0.05.

2. DISCUSSION

DM is a complex metabolic disorder characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both (10).

In our study, serum copeptin level mean was 275.404 ± 126.519 pg/ml in diabetic patients compared to 179.450 ± 42.525 pg/ml in control group which was significantly higher in diabetic patients. This comes in agreement with Mustafa HK et al. (11) who found that diabetic children had significant increases in serum copeptin levels compared with healthy children. These finding was also matching with that reported by Bjornstad et al.(7) in their study on adults with T1DM. However, Schiel et al. (12) in their study on children and adolescents with T1DM, found that there was non-significant statistical difference in serum copeptin levels between diabetic group and the healthy group.

In our study, there was no significant correlation between serum copeptin level and age, gender, Tanner staging, weight, weight Z-score, height, height Z-score, BMI, BMI Z-score, waist circumference, hip circumference, waist/hip ratio, hemoglobin, total leucocytic count, platelets, AST, ALT, triglycerides, TSH, FT4 and FT3 in diabetic patients. In concordance with Mustafa HK et al. (11) found that there was no statistical significant correlation between serum copeptin level and height, sex and routine laboratory investigations, but they found a statistically significantly positive correlation between serum copeptin levels and the age in contrast to our study. This could be explained by the different age of the diabetic patients between our study.

In our study, there was positive significant correlation between serum copeptin level and total cholesterol level, LDL in diabetic patients. There was negative significant correlation between serum copeptin level and HDL in diabetic patients. There was no significant correlation between serum copeptin level and triglycerides. Schiel et al., (2016) found positive statistical significant correlation between serum copeptin level and total cholesterol and LDL in patients with T1D.

In our study, there was no significant correlation between serum copeptin level and family history of diabetes, mode of first clinical presentation, age of onset of diabetes and insulin dose in diabetic patients. Noor T et al. (13) found that serum copeptin levels were significantly elevated in subjects with T2D with positive family history of DM. they concluded that the

significant correlation of copeptin with diabetic and renal biomarkers, along with its positive association with family history of DM support its' role as an early and reliable biomarker of DM and its associated nephropathy.

In our study, there was positive significant correlation between serum copeptin level and presence of neuropathy, duration of diabetes, DKA recurrence, fasting blood glucose, 2 hr postprandial blood glucose level, HbA1C and average HbA1C over the last year in diabetic patients. Mustafa HK et al. (11) showed that serum copeptin level significantly correlated with the duration of diabetes, but no significant correlation with HbA1C was found.

In our study, there was no significant correlation between serum copeptin level and urea and BUN in diabetic patients. There was positive significant correlation between serum copeptin level and serum creatinine and albumin/creatinine ratio in diabetic patients. There was negative significant correlation between seum copeptin level and estimated GFR in diabetic patients.

Comparing with our results, Mustafa HK et al. (11) found a positive significant correlation between serum copeptin level and creatinine, albumin/creatinine ratio and BUN, but in contrast to our study they found no statistical significant correlation between copeptin level and eGFR. This could be explained by the different GFR level in their study with mean 125 mL/min per 1.73 m^2 and range (96.5-161 mL/min per 1.73 m^2) compared with GFR mean 89.769 and range (64-127 mL/min per 1.73 m^2) in our study. Schiel et al. (14) found a strong inverse correlation between serum copeptin level and GFR, a finding which is matching with ours, but they found no significant correlation between serum copeptin level and creatinine, this could be explained by the different mean level of serum creatinine (0.58 ± 0.15 mg/dl) in their study and mean level of serum creatinine (0.75 ± 0.132 mg/dl) in our study.

Our study is conceptually matching with the cross sectional case–control study of Bjornstad et al. (15) who reported that copeptin was significantly higher in men with T1DM and albuminuria compared to those with normoalbuminuria. Furthermore, higher copeptin concentrations conferred greater odds of impaired GFR, independent of other important risk factors. Abbasi et al.{Abbasi, 2012 #176}in their study on patients with T2DM, demonstrated that plasma copeptin is a reliable surrogate parameter for the prediction of T2DM mellitus and perhaps for DN. Thus, it can be surmised that the serum copeptin concentration is an independent risk factor for the decline in renal function in patients with T2DM.

Limitations of the study were the number of patients in our study was relatively small and data resulting from this study should be considered as preliminary observations and larger studies with a greater number of patients should be conducted to validate our results.

3. CONCLUSIONS:

There is evidence of increased level of serum copeptin level in patients with type 1 DM especially in long standing diabetes with poor glycemic control, there is evidence of correlation between serum copeptin levels with serum creatinine, albumin/creatinine ratio and eGFR decline in patients with type 1 DM and serum copeptin level is a potential biomarker of DN in children and adolescents with type 1DM.

Financial support and sponsorship: Nil

Conflict of Interest: Nil

REFERENCES

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9(th) edition. Diabetes Res Clin Pract. 2019;157:107843.
2. Roep BO, Thomaidou S, Van Tienhoven R, Zaldumbide A. Type 1 diabetes mellitus as a disease of the β-cell (do not blame the immune system?). Nature Reviews Endocrinology. 2021;17(3):150-61.
3. Salem NAB, El Helaly RM, Ali IM, Ebrahim HAA, Alayooti MM, El Domiaty HA, et al. Urinary Cyclophilin A and serum Cystatin C as biomarkers for diabetic nephropathy in children with type 1 diabetes. Pediatric diabetes. 2020;21(5):846-55.
4. Gudehithlu KP, Hart PD, Vernik J, Sethupathi P, Dunea G, Arruda JAL, et al. Peptiduria: a potential early predictor of diabetic kidney disease. Clin Exp Nephrol. 2019;23(1):56-64.
5. Orchard TJ, Costacou T. Cardiovascular complications of type 1 diabetes: update on the renal link. Acta Diabetol. 2017;54(4):325-34.
6. Rawshani A, Sattar N, Franzén S, Rawshani A, Hattersley AT, Svensson AM, et al. Excess mortality and cardiovascular disease in young adults with type 1 diabetes in relation to age at onset: a nationwide, register-based cohort study. Lancet. 2018;392(10146):477-86.
7. Wiromrat P, Bjornstad P, Vinovskis C, Chung LT, Roncal C, Pyle L, et al. Elevated copeptin, arterial stiffness, and elevated albumin excretion in adolescents with type 1 diabetes. Pediatric diabetes. 2019;20(8):1110-7.

8. Velho G, El Boustany R, Lefèvre G, Mohammedi K, Fumeron F, Potier L, et al. Plasma Copeptin, Kidney Outcomes, Ischemic Heart Disease, and All-Cause Mortality in People With Long-standing Type 1 Diabetes. Diabetes Care. 2016;39(12):2288-95.

9. Schwartz GJ, Haycock GB, Edelmann CM, Jr., Spitzer A. A simple estimate of glomerular filtration rate in children derived from body length and plasma creatinine. Pediatrics. 1976;58(2):259-63.

10. Libman I, Haynes A, Lyons S, Pradeep P, Rwagasor E, Tung JY, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Definition, epidemiology, and classification of diabetes in children and adolescents. Pediatr Diabetes. 2022;23(8):1160-74.

11. Fathalla MS, Kamal HM. Assessment of copeptin levels in children with type 1 diabetes. Zagazig University Medical Journal. 2020;26(3):397-404.

12. Schiel R, Perenthaler TJ, Steveling A, Stein G. Plasma copeptin in children and adolescents with type 1 diabetes mellitus in comparison to healthy controls. Diabetes Res Clin Pract. 2016;118:156-61.

13. Noor T, Hanif F, Kiran Z, Rehman R, Khan MT, Haque Z, et al. Relation of Copeptin with Diabetic and Renal Function Markers Among Patients with Diabetes Mellitus Progressing Towards Diabetic Nephropathy. Arch Med Res. 2020;51(6):548-55.

14. Schiel R, Perenthaler TJ, Steveling A, Stein G. Plasma copeptin in children and adolescents with type 1 diabetes mellitus in comparison to healthy controls. Diabetes Res Clin Pract. 2016;118(12):156-61.

15. Bjornstad P, Maahs DM, Jensen T, Lanaspa MA, Johnson RJ, Rewers M, et al. Elevated copeptin is associated with atherosclerosis and diabetic kidney disease in adults with type 1 diabetes. Journal of Diabetes and its Complications. 2016;30(6):1093-6.