Short Communication

Assessment of Galectin-3 with Biochemical Changes in Patients with Chronic Kidney Disease

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Abstract

The existence of renal impairment or an estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 mt^2, regardless of the etiology, that lasts for three months or more is referred to as chronic kidney disease (CKD). The 30 kDa lectin known as galectin-3, or Gal-3, is linked to several pathophysiological processes, including fibrosis and kidney injury. Gal-3 uses its carbohydrate recognition domain to bind β-galactoside. assessing the relationship between glomerular filtration rate (GFR) and plasma Gal-3 content in hemodialysis patients with CKD. This study included 90 patients in a case–control design, 45 of whom had been diagnosed with chronic renal disease and 45 of whom appeared to be in good condition. To quantify Gal-3, blood samples were obtained. Age and BMI were among the other characteristics that were measured. The diagnostic accuracy of Gal-3 was assessed using statistical methods, such as receiver operating characteristic (ROC)-curve analysis. The present investigation discovered a statistically significant increase in Gal-3 concentration in the control group at *P* value significant ($P < 0.05$). Moreover, the Gal-3 ROC yielded an area under the curve of 77%. The findings highlight the critical function that Gal-3 plays in chronic renal disease.

Keywords: Chronic kidney disease, galectin-3, patients

Introduction

An important public health problem in Babylon City these days is chronic kidney disease (CKD). Given the increasing frequency of its related risk factors, it is acknowledged as a deadly disorder that has reached epidemic proportions.[1] Renal replacement therapy, such as dialysis or kidney transplantation, is required when kidney function steadily diminishes due to this disorder. Urine sediment abnormalities, higher urine albumin excretion rates, and pathologic abnormalities shown by renal biopsy or imaging investigations are all regarded as signs of kidney disease.[2,3]

According to the Iraqi Ministry of Health, CKD is one of the top five fatal illnesses in the country.[4] As the condition progresses, individuals with CKD encounter both structural and functional alterations in the kidneys, which can result in damage to the glomeruli, tubules, and blood vessels. Retinal fibrosis arises due to oxidative stress, hypoxia, and chronic inflammation, all of which are characteristics of the disease's progression stage.[5,6]

A class of proteins known as lectins may bind to β-galactoside sugars through N- or O-linked glycosylation via their carbohydrate recognition domains. Galectin-3 (Gal-3) uses methods that are not dependent on carbohydrates to control a wide range of biological activities through its carbohydrate recognition domain. Gal-3 is mostly found in the cytoplasm and has the ability to go into the nucleus as well as be released extracellularly.[7]

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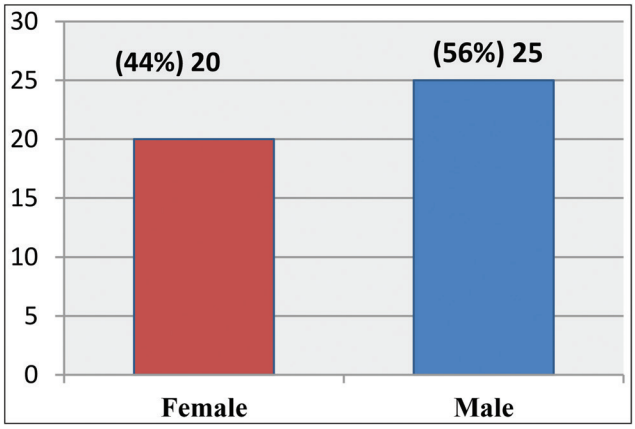

Figure 1: Sex distribution of patients and controls

Extracellular Gal-3 contributes to the formation of collecting ducts during embryonic development and regulates key connections between extracellular matrix (ECM) and epithelial cells.[8] On the other hand, intranuclear Gal-3 encourages cell growth, while intracellular Gal-3 is crucial for cell survival because it can obstruct the intrinsic apoptotic pathway.[9]

Gal-3 has been linked to fibrosis, heart failure, obesity, poor glucose metabolism, and cancer in a number of clinical and experimental studies.[8] Infections, autoimmune and inflammatory diseases, and the pathophysiology of ventricular remodeling have all been linked tolectin-3. Gal-3, for example, controls cell development, proliferation, differentiation, and inflammation in response to acute tissue injury and is essential to the host's defense against pathogens such *Streptococcus pneumonia* [Figure 1].[10] Expression and function Gal-3 are expressed by a variety of cells and organs, including fibroblasts, endothelium, muscle or tumor cells, lung, spleen, stomach, colon, adrenal glands, uterine, ovary, and kidney. This results in distinct functions in a range of pathophysiological circumstances.[8]

Materials and Methods

In this 90-person case–control study, 45 people (females, 20 with 25 men) had chronic renal illness, while 45 participants (females, 20 with 25 males) seemed to be in excellent condition. Every sample was taken between August and October of 2023. Samples were collected from the dialysis units of the Imam Al-Sadiq and Marjan Teaching Hospitals in Babylon, Iraq.

The patients were diagnosed after the patient groups were selected based on selection criteria and exclusion criteria, which included individuals under the age of 18, smokers, and those with hyperglycemia, hypertension (HT), pregnancy, liver, cardiovascular disease, obesity, and autoimmune illness.

Each participant had a blood sample drawn from their vein at the prehemodialysis period. The blood was then gently pushed into a gel tube and allowed to clot for 10 to 15 min at room temperature before being centrifuged at 3000 × *g* for 10 min. Serum Gal-3 was measured after the serum was extracted and placed in Eppendorf tubes. The enzyme-linked immunosorbent assay (ELISA) technique was utilized to assess Gal-3. The Bioassay Technology Laboratory (China) human Gal-3 ELISA kit was utilized.

The remaining serum portion was utilized to assess the results of many biochemical tests, one of which measured serum creatinine. The research equation for isotope dilution mass spectrometry-traceable modification of diet in renal disease was utilized to compute the glomerular filtration rate (GFR). Serum albumin levels are ascertained by measuring the protein's bind to 3,3′,5,5′-tetrabromo-m cresol sulphonephthalein, an indication of bromocresol green (BCG). The complex's absorbance and the sample's albumin content are directly connected. The maximum albumin-BCG absorption happens at 578 nm. This parameter's value was determined using an instrument made by a UV–VIS Spectrophotometric in Germany. The Albumin Kit, made by RANDOX (UK), was the one utilized.

Statistical analysis

For the statistical analysis, Statistical Package for the Social Sciences (IBM Corp., Armonk, NY, USA) version 25 was employed. Variable categories were represented using both frequencies and percentages. For continuous variables, the format was (Mean ± SD). The Student *t* test was used to compare the mean of the two groups. The paired *t* test was used to compare the mean of the two paired readings. A *P* value of less than 0.05 was deemed significant. A receiver operating characteristic (ROC) curve was used to evaluate the CKD diagnosis accuracy.

Ethics approval

All research participants were notified prior to sample collection and given the opportunity to provide verbal consent and a permission form using the document number (IRB: 5-25, August 8, 2023).

Results

The study subject's demographic characteristics

In the current comparative study of the patient and healthy groups, the mean difference between the CKD and healthy groups, as well as the correlation between the different patient parameters, was statistically computed using the *t* test. The study had 10 participants in total, divided into two groups of 45 healthy individuals each. Based on demographic data, the 45 patient group's ages ranged from 21 to 61 years old. Table 1 displays the group's outcomes.

Age

The results showed a difference in *P* value (0.548) that was not statistically significant. Table 1 displays the age distribution of the rate of illness. The mean for patients is 42.1 ± 11.22, whereas the mean for the healthy control group is 41.07 ± 9.42, with a *P* value of 0.498.

BMI

1 As Table 1 illustrates, body mass index (BMI) was substantially higher in the control group ($P < 0.05$); the mean and SD were (25.81 ± 2.06) compared to the patients with CKD (23.91 ± 2.11).

Sex

Forty five CKD patients receiving hemodialysis made up the study groups; 25 (56%) of them were men and 20 (44%) were women. This gender distribution matched that of the controls, with the findings shown in Figure 1.

Table 2 presents the diagnostic accuracy of Gal-3. Overall, Table 2 provides valuable insights into the variables being studied and their relevance to the patient population. Figure 2 shows the correlation between galactin-3 and glomerular filtration rate while Table 3 shows Receiver operating characteristic (ROC)-curve analyses of Gal-3 to predict patients with (CKD).

Variable	AUC	Sensitivity	Specificity	*P* value	Cutoff point
Gal-3	0.773	72%	91.00%	0.00	66.8

AUC = area under the curve

Table 1: The demographic characteristics of the study groups

Variable	Patients (Mean ± SD)	Control (Mean ± SD)	*P* value
Age (years)	42.1 ± 11.22	41.07 ± 9.42	0.498 NS
BMI (kg/m^2)	23.91 ± 2.11	25.81 ± 2.06	0.001*
Number	45	45	

NS = Non-significant,
*($P \leq 0.05$)

Discussion

In this study, CKD patients looked into estimating the Gal-3 evaluation. The patients' elevated levels of Gal-3 were the study's main discovery. Increased Gal-3 concentrations may be linked to the development of CKD, suggesting new pathways involving Gal-3 expression that might hasten the disease's course.[11] Furthermore, Gal-3 is reported to play a pivotal role in renal interstitial fibrosis and the progression of CKD.[12]

Elevated Gal-3 levels may result from renal failure. As CKD worsens, the kidneys' capacity to filter waste products and maintain the proper balance of fluid and electrolytes declines. This causes tissue damage and inflammation, which in turn causes an increase in the synthesis of Gal-3. Tissue fibrosis results from an excessive buildup of ECM proteins in CKD. Gal-3 stimulates the production and deposition of ECM components, which contribute to the promotion of fibrosis.[13]

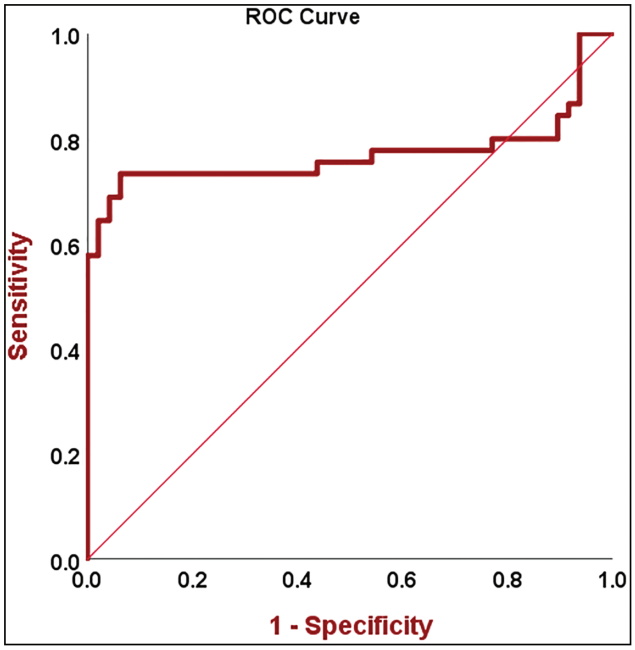

Figure 2: Receiver operating characteristic (ROC)-curve analyses of Gal-3 to predict patients with chronic kidney disease (CKD)

Table 2: Mean difference of galactin-3, albumin, creatinine, glomerular filtration rate (GFR) for the patient and control, respectively

Parameter	Group	*N*	Mean	Std. deviation	*P* value
Albumin	Patient	45	3.58	0.28	0.001
	Control	45	4.53	0.41	
Creatinine	Patient	45	4.18	1.289	0.000
	Control	45	0.89	0.105	
GFR	Patient	45	20.18	1.289	0.000
	Control	45	101.76	10.467	
Galactin-3 pg/mL	Patient	45	227.69	35.782	0.001
	Control	45	175.78	55.914	

Table 3: Correlation between galactin-3 and glomerular filtration rate (GFR)

Parameter	Correlation	No	GFR
Galactin-3 pg/mL	*r*	90	−0.074
	P value		0.04

Furthermore, GFR and plasma Gal-3 levels were observed to be correlated in our study among patients with CKD. Gal-3 may possibly have a role in renal remodeling, which modifies the structure and functionality of the kidneys. Renal function declines as a result of this remodeling, which also makes it more difficult for renal cells to operate normally.[14]

Numerous studies have looked at the relationship between CKD patients' plasma Gal-3 levels and GFR.[15] These studies have produced a range of results: Some have found no significant association at all, some have found a positive correlation, and others have found a negative correlation. For instance, a 2018 research by Smith *et al*.[16] discovered a favorable relationship between GFR and plasma Gal-3 content in CKD patients. They came to the conclusion that reduced renal function was linked to greater Gal-3 levels.

On the other hand, Johnson *et al*.'s[17] 2019 study discovered a negative relationship between CKD patients' GFR and plasma Gal-3 levels. They proposed that higher levels of Gal-3 might indicate more severe renal disease.

In summary, fibrosis, inflammation, and renal failure all have a role in the increased levels of Gal-3 in CKD. This increase in Gal-3 has a deleterious effect on the kidneys, leading to a decrease in renal function through renal remodeling, fibrosis, and inflammation.

In this study, there was no discernible age difference between the groups. By matching the ages of the participants, disparities in the parameter values that may occur from a high age variance are reduced. This concurs with Ranasinghe, Kumara, *et al*.'s[18] earlier research. The age range from 21 to 61 was the most vulnerable.

The BMI of the control was considerably greater than that of CKD patients. Patients receiving hemodialysis who have CKD have a substantial risk of malnutrition.[19]

Present findings from ROC analysis show a fair discriminative value; however, because of the small number of research participants, it cannot be regarded as a biomarker for the diagnosis of patients with chronic renal disease.

Conclusion

According to this study, patients with CKD exhibited higher levels of the protein Gal-3. Additionally, a connection between the GFR and plasma Gal-3 levels was observed in CKD patients.

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Conflicts of interest

There are no conflicts of interest.

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