EXPLORING THE RELATIONSHIP BETWEEN CYSTATIN C LEVELS AND GLYCATED HEMOGLOBIN IN DIABETIC NEPHROPATHY PATIENTS

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Introduction

Diabetic nephropathy (DN) is a severe complication of diabetes mellitus, characterized by progressive kidney damage due to prolonged hyperglycemia. Early detection and monitoring of kidney function are crucial for managing DN and preventing further renal deterioration. Traditionally, serum creatinine has been used to assess renal function; however, it has limitations, particularly in detecting early stages of kidney dysfunction.

Cystatin C has emerged as a promising biomarker for more accurately assessing glomerular filtration rate (GFR) and overall renal function, as it is less influenced by muscle mass and other factors that affect creatinine levels. Additionally, cystatin C[1] has been found to correlate with diabetic complications, making it a relevant marker in DN.

This study aimed to explore the relationship between cystatin C levels and glycated hemoglobin (HbA1c) in diabetic nephropathy patients, with a focus on patients categorized based on their GFR, calculated using a combined creatinine-cystatin C formula.

Key words: Cystatin C, glycated hemoglobin, diabetic nephropathy, glomerular filtration rate, kidney dysfunction.

Methods

Blood samples were collected from a control group (n=20) and diabetic nephropathy patients (n=120). Kidney functional activity was calculated using the GFR formula based on creatinine-cystatin C levels. Diabetic nephropathy patients were then divided into two groups, CKD C2 and CKD C3a, based on their GFR. The relationship between cystatin C levels and glycated hemoglobin was analyzed in both groups.

Data Collection

- Cystatin C levels: Measured using enzyme-linked immunosorbent assay (ELISA).

- Glycated hemoglobin (HbA1c): Measured using high-performance liquid chromatography (HPLC), providing a long-term indicator of blood glucose control.

- GFR: Calculated using the combined creatinine-cystatin C formula, which is

considered more accurate than GFR calculated with creatinine alone.

Statistical Analysis

The relationship between cystatin C levels and glycated hemoglobin was analyzed using Pearson or Spearman correlation, depending on data distribution. Comparative analysis between the two CKD groups was conducted using t-tests or Mann-Whitney U tests, with a significance level set at $p < 0.05$.

Results

In the CKD C2 group, characterized by relatively preserved kidney function, the mean glycated hemoglobin level was 9.35 ± 2.6%, while cystatin C levels in blood were 1171.2 ± 119.4 pg/ml. Conversely, in the CKD C3a group, indicative of moderate kidney dysfunction, the mean glycated hemoglobin level was higher at 10.7 ± 1.9%, accompanied by elevated cystatin C levels of 1342.2 ± 169.02 pg/ml.

Discussion

The findings of this study suggest a potential association between cystatin C[4,5] levels, glycated hemoglobin, and renal function in diabetic nephropathy patients. Elevated cystatin C levels were observed in diabetic nephropathy patients with moderate kidney dysfunction (CKD C3a), along with higher glycated hemoglobin levels, indicating poorer glycemic control. This implies that deteriorating kidney function may contribute to poorer glucose regulation in diabetic nephropathy[2]. Monitoring cystatin C levels alongside glycated hemoglobin could serve as an additional tool for assessing kidney function and glycemic control in diabetic nephropathy patients[3].

Potential Mechanisms

Several mechanisms could explain the association between elevated cystatin C, declining renal function, and higher HbA1c levels:

1. Hyperglycemia and Kidney Function: Poor glycemic control, as indicated by higher HbA1c levels, exacerbates kidney damage by promoting glomerular hyperfiltration, inflammation, and fibrosis. As kidney function declines, cystatin C accumulates in the blood, reflecting reduced GFR.

2. Cystatin C as a Marker of Diabetic Complications: Beyond its role in estimating GFR, cystatin C has been linked to systemic inflammation and oxidative stress, both of which are heightened in diabetes and contribute to the progression of nephropathy.

3. Glycemic Control and Renal Outcomes: The higher HbA1c levels in the CKD C3a group suggest that poor glycemic control may be both a cause and a consequence of declining kidney function. As kidney function deteriorates, insulin clearance is reduced, leading to insulin resistance and further exacerbating hyperglycemia.

Clinical Implications

The findings suggest that monitoring cystatin C levels[6,7], in conjunction with

HbA1c, could provide valuable insights into both kidney function and glycemic control in diabetic nephropathy patients. Elevated cystatin C levels, particularly in conjunction with high HbA1c, may indicate worsening renal function and the need for more aggressive interventions to prevent further kidney damage[8].

Additionally, cystatin C could be integrated into routine clinical assessments as an early marker for kidney dysfunction, offering an advantage over creatinine-based measures, especially in patients with early DN or those with confounding factors affecting creatinine levels (e.g., low muscle mass).

Conclusion

This study highlights the relationship between cystatin C levels, glycated hemoglobin, and kidney function in diabetic nephropathy patients. Elevated cystatin C levels were associated with poorer renal function and higher HbA1c levels, suggesting a link between kidney dysfunction and glycemic control. Incorporating cystatin C measurements into routine clinical assessments may aid in the early detection and management of diabetic nephropathy and its complications.

Further studies are warranted to explore the underlying mechanisms of this relationship and validate these findings in larger cohorts. Longitudinal studies would be particularly valuable in assessing how changes in cystatin C levels correlate with disease progression and treatment outcomes in diabetic nephropathy.

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