Original Article

The Relationship Between Pentraxin-3, Procalcitonin and Glycemic Control in Diabetic Foot Infections

Ekhlas Hatem AL-Asadi[1], Hawraa Hamid Hussein[1] and Hawraa M. Kadhim[2]

ABSTRACT

Objective: To evaluate the relative importance of pentraxin-3, procalcitonin, C-reactive protein, glycated hemoglobin and body mass index as well as identify any correlations between these parameters.

Study Design: Case-control study

Place and Duration of Study: This study was conducted at the University of Babylon, College of Medicine, Iraq from 18th June to 24th September 2024.

Methods: Fifty participants with diabetic foot infection and fifty healthy individuals were among the one hundred people whose Pen-3, procalcitonin, C-reactive and glycated hemoglobin levels were estimated. The age range of patients and control subjects is 38 to 69 years. The sandwich-enzyme-linked immunosorbent assay kit and the colomeric technique were used to test the levels of pentraxin-3, procalcitonin and C-reactive protein in serum. The glycated hemoglobin kit was also used.

Results: There was a substantial rise in serum levels of pentraxin-3, procalcitonin and C-reactive protein as well as a significantly elevated glycated hemoglobin ($p<0.001$). However, glycated hemoglobin was a major relationship between pentraxin-3 and procalcitonin.

Conclusion: There is a substantial link between diabetic foot and variability, pentraxin-3 and procalcitonin among patients with diabetes.

Key Words: Glycated hemoglobin (HbA1c), C-reactive protein (CRP), Procalcitonin

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INTRODUCTION

Diabetic foot it is considered one of complications of besides disturbing problems of diabetes, defined by way of a foot usual by ulceration that is consistent with neuropathy and peripheral arterial disease of the minor associate in diabetes patient. The vascular complications of DM can be pretentious by some microangiopathy or macroangiopathy.[1] The macroangiopathy in T2DM is a form of earlier atherosclerosis worrying carotid, coronary in adding to peripheral arteries. This cause big vessels growth of diabetic foot ulcer in DM patient.[2] Diabetic foot is the important cause of lower end amputation in diabetic patient, known to stretch a poor prognosis to the patient.[3] Wound healing a procedure that arises subsequent rupture of the skin wall and usually eased by cytokines and growth factors out by particular cell stimulate through immuneresponse, counting fibroblasts, endothelial cell, keratinocytes and platelets. Cytokines and growth factors are significant group of the molecular method complex in make cutaneous wound healing probable.[4]

An adequate technique of analysis, treatment of the illness to prevent recurrence, and the amputation of affected limbs are all strategies that have been researched and put into practice in an effort to reduce the number of persons diagnosed with DF. A major consideration in allocating resources and deciding on treatment procedures is the accurate assessment of DF severity.[5] Additional indicators of illness severity are required to reestablish clinical choices since infection symptoms in diabetics might be hard to identify and the disease can advance quickly. Pentraxin-3 (PTX-3), C-reactive protein (CRP), and procalcitonin (PCT) are the most appropriate inflammatory indicators for this purpose out of the many that have been researched extensively.[6]

Several cells at the site of inflammation, including as adipocytes, endothelial cells, fibroblast granulosa, mesangial cells, and mono-nuclear phagocytes, generate PTX-3, a soluble gratitude receptor. After that

[1.] Department of Physiology, University of Babylon, College of Medicine, Iraq.
[2.] Department of Physiology, University of Al-Ameed, College of Medicine, Iraq.

Correspondence: Ekhlas Hatem AL-Asadi, Assistant Professor, Department of Physiology, University of Babylon, College of Medicine, Iraq.
Contact No: +9647801889672
Email: ekhlasasa@uobabylon.edu.iq

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point, it may be able to directly reproduce a more advanced form of vascular inflammation. Angiogenesis and restenosis are inhibited by PTX-3, an endothelial controller in ischemic vascular disease and thrombosis that binds to angiogenic fibroblast growth factor-2.[7] One of the acute-phase reactants linked to CRP is PTX-3. Their family tree is quite similar to that of PTX-3. The antimicrobial response is greatly impacted by PTX-3, in addition to its function in cell debris clearance.[8] Emerging from the body's natural inflammatory response and infection defense systems, PTX-3 may be an improved biomarker for DFU compared to other systemic indicators.[9] Cancer, cardiovascular disease, asthma, sepsis, and PTX-3 are just a few of the illnesses and disorders linked to improved health and longer life expectancy. Scientists have looked at the PTX-3 DFU.[10] Understanding the role of PTX-3 as a biomarker for DF infection, limb amputation level prognosis, and patient survival was the main goal of this study. In connection to the diagnosis of DF, the secondary aims are to assess Hba1c, C-reactive protein, procalcitonin, and duration of diabetes.[11]

A 116-amino-acid biomarker that has recently gained popularity for application in infection detection is polypeptide C-reactive tissue (PCT), which is released by thyroid C-cells, lung, liver, and kidney parenchymal cells. An influential person in this field is the brains behind PCT. If you're looking for an indicator of bacterial infection, it may be more dependable than C-reactive protein (CRP), according to some writers.[12] Virus infection and non-specific inflammatory disorders are associated with relatively modest PCT residues. This research evaluated PCT's diagnostic accuracy in respect to other inflammatory markers, such as C-reactive protein.[13]

A important indicator of diabetes mellitus is an elevated HbA1c. Instead than only checking blood sugar levels at one point in time, it alerts you to the possibility of persistent glycaemia. 50% of HbA1c is finished in the month before to sample, with 25% completed in the month before[14], and it gives a combined measure of glycaemia over the whole 120-day lifetime of the red blood cell. However, during this 120-day period, fresh glycaemia has the major influence on the HbA1c score. The purpose of this research was to examine the relationship between and variations in Pentraxin-3 level, PCT, CRP, and HbA1c in individuals diagnosed with DFI.

METHODS

This case-control study was conducted at University of Babylon, College of Medicine, Iraq from 18th June to 24th September 2024 vide letter No. 4545/QM/Approval/3FG533 dated March 01, 2024. The equation for the Daniel sample size technique was used to determine the sample size. One hundred Iraqi subjects participated in this review; fifty of them had diabetic foot ulcers. All patients had their medical histories taken, which included information on where they lived, how old they were, whether or not they smoked, any relevant family history, and any treatments that may have an impact on the outcomes. Fifty healthy subjects were used as a control group. The participants' ages ranged from 38 to 69. The modification did not include individuals with type 1 diabetes mellitus, any accompanying acute or chronic inflammatory disorders, or cancer.

Immediate analysis of serum concentrations of Pentraxin-3, PCT, and CRP using the sandwich-ELIZA kit. The micro-ELIZA plate in this kit (from Bioassay Technology Laboratory) was pre-coated with an antibody that specifically targets the Pentraxin-3 level, Procalcitonin. ROCK's COBAS INTEGR is a fully automated analyzer that assessed glycated hemoglobin A1c (HbA1c). Meters squared divided by kilos of body weight are the formula for a person's body mass index (BMI). Body mass index = Weight (kg)/Square Height (m^2). For the statistical analysis, SPSS-20 was used. P values were considered significant when they were less than 0.05.

RESULTS

The age distribution of the control and DF groups did not vary significantly (P=0.59). The removal of disparities in the findings of the analyzed parameters that were caused by large variation in age is facilitated by the similarity in age.

Table No. 1: Comparison of demographic and biochemical data of study and control groups

Variable	Control groups (n=50)	DF Group (n=50)	P value
Age (years)	49±15.22	51±10.77	>0.071
BMI (kg/m^2)	25.14±1.91	26.63±2.52	>0.063
HbA1c	5.6±0.3	7.2±0.412	<0.03
CRP (mg/dl)	33.34±20.1	125.7±88.3	<0.04
PCT (ng/ml)	0.41±0.03	1.13±0.3	<0.032
Pentraxin-3 (Pg/ml)	1130.7±730.4	3150.8±1530.9	<0.049

$p<0.05$ (Significant)

Table No. 2: Correlation coefficient between different parameter in diabetic foot groups

Variables	Diabetic Foot Group	
	r	P
Pentraxin-3 vs HbA1c	0.71	0.05
Pentraxin-3 vs CRP	0.52	0.01
Procalcitonin vs HbA1c	0.83	0.05
Procalcitonin vs CRP	0.77	0.03

Correlation is significant at $p< 0.05$

There was no statistically significant difference in body mass index (BMI) between the control group and the DF (P=0.63). The increase concentration of HbA1c, CRP, PCT and Pentraxin-3 levels, and in DF patients related with control with significant ($p<0.05$) mean changes among them (Table 1).

A significant positive relationship was detected between Pentraxin-3, PCT and HbA1c concentration. On the other hand, Pentraxin-3 level, PCT, and CRP have also significant correlation in DF patients (Table 2).

DISCUSSION

The general concept of diabetes mellitus is associated with chronic high blood sugar and also with a group of metabolic disorders. The condition worsens when complications of the disease occur. These contain large vascular difficulties e.g. cardio-vascular disease besides cerebrovascular disease. As for micro- vascular complications, they are, nephropathy retinopathy as well as neuropathy, especially distal peripheral neuropathy and complications of blood vessels in the foot that main to diabetic foot ulcers diabetic foot ulcers.[15] Health care costs, patient satisfaction, and the need for lower limb amputations are all negatively impacted. In addition to potentially leading to mortality, diabetic foot infection (DFI) often necessitates hospitalization of the patient.[16] Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Streptococcus spp., and Enterococcus spp. were the most often reported bacteria found in patients with DFI. The identification of the causative agent has a pivotal role in surgical management including the avoidance of amputation and the prevention of infection spread.[17] Unique regulations pertaining to the structure of DFI were accessible last year. The management of diabetic foot infections was helped by these strategies.[18] In reaction to inflammation and infection, especially bacterial infections, the acute-phase protein C-reactive protein (CRP) increases. Compared to healthy subjects, diabetes individuals have a higher CRP level.[19] Recently PCT has gained interest as a diagnostic tool for infected DF. In response to infection or inflammation, the thyroid C cell, liver, lungs, and kidneys stimulate the production of this peptide.[20] While clinical findings are the primary basis for an IDFU diagnosis, evaluation of inflammatory markers like C-reactive protein (CRP) and, more recently, positron emission tomography (PET) may aid in the diagnosis of infection when clinical signs are inadequate. Currently, there are only a small number of studies that have examined PCT's usefulness in diagnosing both systemic and contained bacterial infections.[21]

PTX-3 was intended to be a death and re-operation rate analyzer in DFU patients. That might be because PTX3 is already known to be an indicator of metabolic syndrome and vascular disease, both of which are prevalent in diabetic individuals. Pentraxin-3 showed a statistically significant alteration among DF besides control this might groups due to the overall inflammatory state of people through diabetes besides could be related through infection besides following sepsis in certain DF patients, Previous study , originate lesser level of PTX3 a analyst for infection besides amputation related toward control.[22]

Patients with DF had significantly higher levels of Pentraxin-3, PCT, CRP, and HbA1c compared to the control group in this research. The current research on diabetic foot found a strong association between glycosylated hemoglobin (HbA1c) and serum Pentraxin-3 and PCT. Serum pentraxin-3 and PCT were also shown to be strongly linked with C-reactive protein.

CONCLUSION

Changes in the levels of pentraxin-3, procalcitonin, C-reactive protein, and glycated hemoglobin in patients with diabetic foot infections may suggest a strong association between the two conditions.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ekhlas Hatem AL-Asadi, Hawraa Hamid Hussein
Drafting or Revising Critically:	Ekhlas Hatem AL-Asadi, Hawraa M. Kadhim
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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