Correlation of CRP Level with Glycaemic Control in Diabetic Foot Patients and its Sequelae

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Abstract

Background: C-reactive protein (CRP) is a sensitive physiological biomarker of sub-clinical inflammation associated with hyperglycemia, insulin resistance and type 2 diabetic patients. The present study conducted to study correlation of CRP with glycemic control in diabetic foot patients and sequelae of diabetic foot in the study population.

Methods: A observational study among 100 patients with Type 2 Diabetes mellitus with diabetic foot attending outpatient department of Medical College was done during1st January 2021 and 31st June 2021. Each subject selected underwent a medical history and history regarding diabetes. The collected data was fed into an excel spreadsheet and then tabulated. SPSS for Windows version 22 software was used for statistical analysis.

Results: The association of diabetic foot outcome and CRP levels showed that, patients with higher CRP levels had more chance of amputation as compared to normal CRP levels with statistical significance. The blood sugar levels showed significant positive correlation with CRP levels with statistical significance.

Conclusion: There is a strong positive association between poor blood sugar control and elevated CRP levels These data can support a possible role of inflammatory biomarker in diabetogenesis.

Keywords: Correlation, CRP, Glycemic Control, diabetic foot

Introduction

Diabetes mellitus (DM) consists of a group of metabolic disorders that share common phenotype of hyperglycemia. India has the highest prevalence of people with diabetes in the world which is predicted to increase to 120.9 million by 2030. [1]

Diabetic foot is the common complication in lower extremity with 13–18% of patients will develop diabetic ulcer in foot over a period of time. [2] Autonomic neuropathy, poor glycemic control, high pressure in soles are the factors which contributes to development of ulcer and one of the causes of non-traumatic amputation of lower limb. [3]

Chronic, systemic subclinical inflammation has also been identified as a driving force for insulin resistance, metabolic syndrome, and type 2 DM. C-reactive protein (CRP) is a sensitive physiological biomarker of sub-clinical inflammation associated with hyperglycemia, insulin resistance and type 2 diabetic patients. Small increases in CRP predict the likelihood of developing

cardiovascular events both in diabetic and nondiabetic populations. [4]

In addition, in apparently healthy subjects, increased levels of CRP predict the risk of developing type 2 diabetes. There is some evidence that CRP, besides its predictive role in determining cardiovascular risk, may represent an active participant in atherogenesis. [5]

Diabetic foot cause considerable disability and often the reason for lower limb amputation. Even with appropriate treatment, some patients must undergo major amputation or a limb salvage operation. [6] These operations are not only a huge emotional and social burden to the patients due to physical impairment, but also a financial burden. [7]

The objectives of the present study was to find correlation of CRP with glycemic control in diabetic foot patients and sequelae of diabetic foot in the study population.

Objectives:

i. To study association between glycemic control and serum CRP levels in patients with type 2 Diabetes mellitus presenting with diabetic foot
ii. To correlate the level of CRP with sequelae of diabetic foot

Methodology:

The present observational study was carried out in the department of General Medicine, Medical College Hospital. The study was carried out between 1st January 2021 and 31st June 2021 and included 100 patients with Type 2 Diabetes mellitus with diabetic foot. A adequate required sample size was estimated based on prevalence of disease and using formula, n = z2pq / d2, where; n=sample size, z=1.96(considering 0.05 alpha, 95% confidence limits and 80% beta), p = assumed probability of occurrence or concordance of results, q = 1 – p and d = marginal error (precession). The International Diabetes Federation has reported that the prevalence of diabetes in adults in India is 7.1% and marginal error was taken as 5% which gives our stated sample size for the study.[1] Target population were all the patients with diabetic foot of age above 21 years coming to OPD and wards of the department of medicine in medical college and hospital. Subject fulfilling inclusion criteria were selected for the study. Each subject selected underwent a medical history and history regarding diabetes, its duration and medical treatment, general examination including body mass index (BMI), blood pressure, systemic examinations, investigations like Fasting plasma glucose, HbA1C, CRP levels. Emphasis on history and examination pertinent for diabetic foot were taken and relevant investigations to look for same were undertaken. Wagner grading for diabetic foot was used. After a written informed consent cases were enrolled in the study satisfying our inclusion criteria The collected data was fed into an excel spreadsheet and then tabulated. SPSS for Windows version 22 software was used for statistical analysis. Chi2 or Fisher's exact test was applied to compare frequency distribution.

Results:

Table 1: Demographic variables among patients:

Variables		No. of Patients (n=100)	Percentage
Age group (years)	≤40	02	02.00
	41-50	11	11.00
	51-60	31	31.00
	61-70	38	38.00
	>70	18	18.00
Gender	Male	62	62.00

Female	38	38.00

The table no. 1 shows that among 100 patients, majority were in age group 61-70 years (38%) with mean age of 62.29 ± 8.21 years. Majority of the patients were male (62%) as compared to females. (38%)

Table 2: Wagner grading for diabetic foot among patients:

Wagner's Grade	No. of Patients	Percentage
Grade I	42	42
Grade II	34	34
Grade III	13	13
Grade IV	8	8
Grade V	3	3
Total	100	100

The Wagner grading for diabetic foot among patients shows majority belong to Grade I (42%) followed by Grade II (34%).

Table 3: Blood sugar levels among patients:

Blood sugar levels	Mean ±SD	Range
Fasting (mg/dl)	208.12± 58.33	90-310
Post-prandial	278.51 ± 72.91	175—450
HbA1c (%)	8.08 ±2.18	5.9—12.6

The mean fasting blood sugar levels among patients was 208.12± 58.33 mg/dl with range of 90-310 mg/dl. The mean post-prandial blood sugar level among patient was 278.51 ± 72.91 mg/dl with range of 90-310 mg/dl. The mean HbA1c level among patient was 8.08 ±2.18 % with range of 5.9—12.6 %.

Table 4: CRP levels among patients:

CRP levels	No. of Patients	Percentage
Normal (<0.8 mg/dl)	39	29
Abnormal (≥0.8 mg/dl)	61	71
Total	100	100
Mean ±SD (mg/dl)	2.18 ±1.31	Range (0.2-4.5)

The majority of patients showed abnormal CRP levels (71%) with mean CRP level among patient was 2.18 ±1.31 mg/dl with range of 0.2—4.5 mg/dl.

Table 5: Outcome (sequelae) of diabetic foot among patients:

Outcome	No. of Patients	Percentage
Amputation done	11	11
Healed	89	89
Total	100	100

The outcome among patients showed that, the majority of patients healed by treatment (89%) while amputation had to be done in 11% patients.

Table 6: Association of outcome (sequelae) of diabetic foot and CRP levels:

Outcome	CRP levels		Total	P value
	Normal (<0.8 mg/dl)	Abnormal (≥0.8 mg/dl)		
Amputation done	1	10	11	Chi square value=4.64, P=0.034 (Significant)
Healed	38	51	89	
Total	39	61	100	

The association of diabetic foot outcome and CRP levels showed that, patients with higher CRP levels had more chance of amputation as compared to normal CRP levels with statistical significance. (P=0.034)

Table 7: Correlation of blood sugar levels and CRP levels:

Correlation	r	P value
FBS vs CRP	0.278	0.01
PPBS vs CRP	0.293	0.003
HbA1c vs CRP	0.322	0.002

The correlation of blood sugar levels and CRP levels showed significant positive correlation with statistical significance. (P<0.05)

Discussion:

Diabetes is a huge and growing problem, and the costs to society are high and escalating. Diabetic foot cause considerable disability and often the reason for lower limb amputation. Diabetes is a challenging disease to be managed successfully. It requires frequent Self-Monitoring of Blood Glucose (SMBG), dietary modifications, exercise, and administration of medications as per schedule. [3]

The present observational study was conducted to study correlation of CRP with glycemic control in diabetic foot patients and sequelae of diabetic foot in the study population.

In the present study, among 100 patients, majority were in age group 61-70 years (38%) with mean age of 62.29 ± 8.21 years. Majority of the patients were male (62%) as compared to females. (38%) (Table 1) Bandyopadhyay et al [8] in a study on C Reactive Protein in Type 2 Diabetes observed mean of patients as

47.4± 11.7 years with majority of patients were males. (58.75%)

The Wagner grading for diabetic foot among patients shows majority belong to Grade I (42%) followed by Grade II (34%). (Table 2) Similar findings were seen in study by Anand A et al [9] where majority of patients with diabetic foot belongs to Grade I. (48%)

The mean fasting blood sugar levels among patients was 208.12± 58.33 mg/dl with range of 90-310 mg/dl. The mean post-prandial blood sugar level among patient was 278.51 ± 72.91 mg/dl with range of 90-310 mg/dl. The mean HbA1c level among patient was 8.08 ±2.18 % with range of 5.9—12.6 %. (Table 3) The majority of patients showed abnormal CRP levels (71%) with mean CRP level among patient was 2.18 ±1.31 mg/dl with range of 0.2—4.5 mg/dl. (Table 4) Bandyopadhyay et al 8 in a study on C Reactive Protein in Type 2 Diabetes found that blood CRP varied between 0.22 to 4.4 mg/dl.

The outcome among patients showed that, the majority of patients healed by

treatment (89%) while amputation had to be done in 11% patients. (Table 5) The association of diabetic foot outcome and CRP levels showed that, patients with higher CRP levels had more chance of amputation as compared to normal CRP levels with statistical significance. (P=0.034) (Table 6)

Similar findings were seen in study by Anand A et al [9] where patients with higher CRP levels had more chance of amputation as compared to normal CRP levels with statistical significance. Lin C W et al. [10] in a study indicates good prognosis in diabetic foot patients and concluded that reduced c reactive protein level <50 mg/l indicates good prognosis in diabetic foot patients. Baris A kinci, et al [11] observed among 165 diabetic ulcer patients and concluded that post treatment CRP values were strongly related to amputations.

The correlation of blood sugar levels and CRP levels showed significant positive correlation with statistical significance. (P<0.05) (Table 7)

Bandyopadhyay et al [8] found significant correlation of CRP levels with HbA1C. In other studies, by Ladeia et al [12] similar associations have been recorded.

CRP is now established as an important risk marker in diabetes. It is associated with the degree of glycemic control and also the different complications of diabetes. [13] In a study from USA, they have found significant association of CRP and various diabetic complications. [14] CRP and other inflammatory markers like PAI-1 or IL 6 are markers of endothelial dysfunction and monocyte activation. [15] This inflammatory milieu promotes deregulated lipid metabolism to generate various toxic metabolites which leads to insulin resistance. [15] This also leads to accelerated atherosclerosis and the microvascualr complications. [16]

The present study had limitations like small number of subjects, the cross-sectional nature of the study, lack of measurement of other markers like fibrinogen and lack of measurement of hsCRP. A larger prospective multi-centre study can actually find the role of CRP in Indian patients and its inclusion in daily clinical practice as a cost-effective risk marker.

Conclusion:

The study concludes that there is a strong positive association between poor blood sugar control and elevated CRP levels in the study population. The study has also documented a positive association between higher CRP levels and amputation.

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