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Original Research Article

Correlation of C-Reactive Protein Levels with Glycemic Control in Diabetic Foot Patients and it's Outcome at RNT Medical College, Udaipur

Bheru Singh Hariyawat[1], Krishna Gopal Sharma[2], Vaibhav Kumar[3], Jamil Mohammad[4]

[1]Associate Professor, Department of General Surgery, RNT Medical College, Udaipur
[2]Associate Professor, Department of General Surgery, RNT Medical College, Udaipur
[3]Resident, Department of General Surgery, RNT Medical College, Udaipur
[4]Associate Professor, Department of Biochemistry, RNT Medical College, Udaipur

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Corresponding author: Dr Jamil Mohammad
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Abstract

Diabetic foot complications are major sequelae of diabetes and contribute to most causes of non-traumatic lower-extremity amputations worldwide. For clinicians, if the risk stratification of DFU can be obtained earlier in diabetic patients, the hospitalization, disability and mortality rate will be reduced. The objectives were to evaluate the association between blood glucose levels and serum CRP levels in type 2 Diabetes mellitus patients presenting with diabetic foot and to correlate the level of CRP with outcome of diabetic foot in the study population. This prospective observational study carried out for a period of one year. Total 64 patients who were admitted with diabetic foot in the Department of General Surgery, MB Govt. Hospital at Udaipur were studied. The proportion of subjects with higher fasting blood sugar and post-prandial blood sugar showed increasing trend with increasing level of CRP level. 9 out of 22 patients with elevated CRP level more than 40 mg/dl went for amputation. Rest 13 patients had slow rate of wound healing. We concluded that poor glycemic control and CRP has definitive correlation with outcome.

Keywords: Diabetes mellitus, diabetic foot ulcer (DFU), CRP, Blood sugar, amputation

Introduction

Diabetes mellitus (DM) is a metabolic disease characterized by chronic hyperglycemia, caused by defects in insulin secretion and/or utilization, or both. [1] Until now, diabetes treatment drugs can only control blood glucose levels but cannot completely cure the disease. DM may lead to chronic complications due to improper control. Various complications usually present at the time of diagnosis of DM. Usually 15–25 % of diabetic patients suffer from diabetic foot ulcer (DFU). DFU and amputation are the main causes of morbidity and mortality in DM. The prevalence of new chronic DFU increased from 20.7 to 33.1 per 1000 people from 2003 to recent time. However, its prevalence varies in different countries and regions. [2-3] Since DM is associated with long-term complications of microvascular and macrovasculars, it is necessary to detect the complications early. If the risk

stratification of DFU can be done earlier in diabetic patients, the hospitalization, disability and mortality rate can be reduced. Even with appropriate treatment, some patients need to undergo major amputation or a limb salvage operation. [4] These operations are not only a huge emotional and social burden to the patients due to physical impairment, but also a financial burden. [5]

High sensitivity C-reactive protein (CRP) is an acute-phase response protein that is considered a marker of inflammation as well as an independent predictor of cardiovascular disease (CVD), including myocardial infarction, stroke, peripheral arterial disease, and sudden cardiac death in apparently healthy people. [6-8] Growing evidence indicates that diabetic individuals have higher concentrations of CRP than non-diabetic individuals, suggesting an increased role of inflammation in the accelerated atherosclerosis seen in these patients. [9-12] The prolonged hyperglycemia can initiate active micro inflammation systemically as indicated by a rising in CRP levels and such inflammation might be associated with the various complications of the diabetic foot.

The objectives of the study were to evaluate the association between blood glucose levels and serum CRP levels in patients with type 2 Diabetes mellitus presenting with diabetic foot and to correlate the level of CRP with outcome of diabetic foot in the study population of tribal area.

Materials and Methods:

This study was a prospective observational study conducted from January 2021 to December 2021 at Hospitals associated with RNT medical college. The study was undertaken after approval from ethical committee and obtaining Informed consent from patients. The inclusion criteria were type 2 DM patients of age more than 18 years with ongoing treatment and having diabetic foot of both genders. Patients with any other systemic diseases leading to sepsis other than diabetic foot, Patients with active auto immune disease (RA, SLE, systemic sclerosis etc) and Patients giving no consent for the study were excluded from the study. The patients fulfilling selection criteria were informed in detail about the risks and benefits of the procedure and a written informed consent was taken before enrolment. At admission blood sugar values and CRP estimation were carried out by standard protocol. Grading of diabetic foot was done as per Wagner classification. By employing the standard protocol, all patients were treated with medical and surgical care available at MBGH, Udaipur. Blood Sugar values and CRP values were correlated with the grade of diabetic foot and treatment outcome by using suitable statistical analysis.

Statistical Analysis:

Descriptive statistics of the findings in terms of amputation and wound healed were analyzed in terms of percentage. All the data were entered in MS-Excel and analyzed using SPSS Ver.18.0 and Fishers exact test was applied to find the association between the variables.

Observation and Results:

For a period of one year, a total of 64 patients who was admitted with diabetic foot in the Department of General Surgery, MB Govt. Hospital at Udaipur were studied. After admission routine blood investigations and radiological evaluation done. Wound swab culture and sensitivity, Blood sugar (fasting and postprandial) and C reactive protein tests were performed in all patients. Both oral and intravenous antibiotics were prescribed according to the pus culture and sensitivity report. The surgical debridement was done followed by daily dressings when required. The maximum numbers of patients belong to age group 70-82. The maximum age was 88 years and minimum 34 years.

Table 1: Distribution of patients in relation to fasting sugar

Fasting blood sugar	No. of patients (N=64)	Percentage
126-146 mg/dl	1	1.56 %
147-166 mg/dl	11	17.20 %
167-186 mg/dl	24	37.50 %
187-206 mg/dl	21	32.80 %
>206 mg/dl	7	10.90 %

The fasting blood sugar value ranges from 135 to 225 mg/dl. Minimum value is presentation 135 mg/dl and the maximum value 225 mg/dl. Patients were categorized into five groups to find the distribution. The 37.5 % patients fallen in range 167-186 mg/dl followed by 32.8 % in range 187-206 mg/dl. (Table-1)

Table 2: Distribution of pateints in relation to post-prandial sugar

Post-prandial blood sugar	No. of patients (N=64)	Percentage
<200 mg/dl	1	1.60 %
200-240 mg/dl	3	4.70 %
241-280 mg/dl	29	45.30 %
281-320 mg/dl	23	35.90 %
321-360 mg/dl	6	9.40 %
>360 mg/dl	2	3.10 %

Patients were classified into six groups based on the postprandial blood sugar values. Lowest value 165 mg/dl and highest sugar level 368 mg/dl. The 45.30 % patients fallen in range 241-280 mg/dl followed by 35.90 % in range 281-320 mg/dl. (Table-2)

Table 3: Distribution of patients according to wagner's grading

Wagner's grading	No. of patients (N=64)	Percentage
GRADE 1	8	12.5 %
GRADE 2	21	32.8 %
GRADE 3	25	39.1 %
GRADE 4	9	14.1 %
GRADE 5	1	1.6 %

Based on Wagner's grading which describes the depth of wound, patients are categorized in 5 grades. The proportion of subjects with Wagner's grade 1, 2, 3, 4 and 5 ulcers were 12.5 %, 32.8 %, 39.1 %, 14.1 % and 1.6 % respectively. (Table-3)

Out of 11 patients who went in for amputation 9 patients fall under Wagner's grade 4 and 1 patient in Wagner's grade 5 and 1 in grade 3. Out of 64 patients 11 got amputated and in 53 patients wound healed without complications.

Table 4: Distribution of patients according to crp level (n=64)

CRP value	No. of patients	Percentage
< 40 mg/dl	42	65.62 %
>40 mg/dl	22	34.38 %

Out of 64 patients 22 patients have got CRP value greater than 40 mg/dl and 42 patients have got CRP value less than 40 mg/dl. (Table-4)

Table 5: Distribution of patients according to crp level and outcome (n=64)

CRP values	Amputated	Healed	Total no of patients	Percentage of amputated patients
>40 mg/dl	9	13	22	40.9 %
<40 mg/dl	2	40	42	4.76 %

Patients in which CRP levels were below 40 mg/dl only 2 had to undergo amputation and rest 40 healed with conservative management. (Table-5) The outcome in 9 patients out of 22 patients whose CRP values greater than 40 mg/dl got amputated and 13 patients healed with conservative management (wound granulated and healed after adequate wound debridement and slough excision). On using Fischer exact test for the above values, the p-value comes out to be 0.001 which is statistically significant.

Discussion

Based on several studies and results so far conducted, it has been clearly stated that glycemic control in terms of fasting and postprandial plays a pivotal role in the outcome of diabetic foot patient. Patients who had persistently elevated fasting and post-prandial have gone for amputation, our study too concludes the same. In patients with consistently elevated fasting and postprandial blood sugar the response to treatment was poor with antibiotics and there was no improvement in Wagner's grading since the wound healing was slow, the time taken for granulation tissue to appear was prolonged, when compared to patients with good glycemic control. They also had elevated CRP level above 40 mg/dl and had higher chances to be treated by amputation.

So in our current study, it is highlighted that there is a strong correlation between glycemic control and outcome in terms of amputation and wound healing in patients with diabetic foot. After analyzing the results drawn from 64 patients it has been clearly stated that CRP level assumes significance in relation to outcome in patients with diabetic foot.

After analyzing the results drawn by Lin C W et al [13] and Baris Akinci [14] it was concluded that values < 45 -50 mg indicates good prognosis in diabetic foot in terms of outcome which may be amputation or healing. [15]

In our study 22 patients out of 64 patients has elevated CRP levels higher than 40 mg/dl. Out of these 22 patients 9 patients were amputated either by above and below knee amputation and remaining patients healing of wound was observed. It is interesting to note that patients who had elevated CRP higher than 40 mg/dl also had extensive gross level of infection when compared to rest of patients. This was assessed using Wagner's grading which graded the patients into 5 subgroups based on depth of tissue involvement. Out of 11 patients who went in for amputation 9 patients fall under Wagner's grade 4 and 1 patient in Wagner's grade 5 and 1 in grade 3. By several studies and research conducted so far, it has been concluded that the patients in higher end of grading have ultimately gone for amputation which was similar to that of results drawn in our study.

Out of 22 patients with elevated CRP level more than 40 mg/dl, 9 of total patients went in for amputation and in 13 patients wound healed. So, the chance of having the risk of amputation when the CRP level is greater than 40 mg/dl is 40.9%. It is also observed from our study that the patients have got elevated CRP but not went in for amputation have sustained slower rate of wound healing, whereas in those patients who have got CRP less than 40 mg/dl had good response to treatment with quick recovery and wound healing and only 2 patients had to undergo amputation.

Study limitations:

We performed study on 64 patients only; need to be involve more patients to make study more relevant and generalizable.

Conclusions

In our study 40.90 % (9 patients out of 22) patients with elevated CRP above the critical value of 40 mg/dl have went for amputation and rest 13 patients wound healed with regular dressing and local debridement. 42 patients fall under the category of CRP levels below 40 mg/dl

and out of which 2 patients had to undergo amputation and rest 40 wound healed with regular dressing and local debridement.

From our study we concluded that glycemic control and CRP has definitive correlation with outcome which is proved by patients with persistently elevated blood sugar levels and CRP went in for amputation in our study.

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