ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 15, Issue, 05, pp.24520-24524, May, 2023
DOI: https://doi.org/10.24941/ijcr.45263.05.2023

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

TO STUDY VARIOUS INFLAMMATORY MARKERS IN TYPE 2 DIABETES MELLITUS

Mahesh Dave[1], Anuj Goyal[2,*] and Manasvin Sareen[3]

[1]Senior Professor and Unit Head, Department of General Medicine, RNT Medical College, Udaipur, Rajasthan, India
[2,]Resident Doctor, Department of General Medicine, RNT Medical College, Udaipur, Rajasthan, India
[3,]Senior Resident Doctor, Department of General Medicine, RNT Medical College, Udaipur, Rajasthan, India

ARTICLE INFO

Article History:
Received 14th February, 2023
Received in revised form
10th March, 2023
Accepted 16th April, 2023
Published online 15th May, 2023

Key words:

CRP, Diabetes Mellitus,
Dyslipidemia, Inflammatory Markers.

**Corresponding Author:*
Anuj Goyal

ABSTRACT

Introduction*:* Diabetes Mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Impaired glucose tolerance and hyperglycemia are the main clinical and diagnostic features and the result of an absolute or relative insulin deficiency or resistance to its action. ***Aims and Objectives***: To study various inflammatory markers such as ESR, CRP, Serum albumin and Ferritin and their correlation in type 2 Diabetes Mellitus patients. ***Material and Methods****:* The present study was carried out in 50 Diabetes Mellitus type 2 patients (cases) and 50 age and gender matched individuals (control) in MBGH hospital and RNT Medical College, Udaipur over the period of 12 months. ***Results:*** Mean age of patients was 59.50 ± 11.06 years. Females out numbered males 1.5:1. Patients of case group had dyslipidemia, total cholesterol (257.70 ± 49.49), triglycerides (203.52 ± 83.62), LDL was 124.30 ± 29.99 and HDL was 35.67 ± 7.62. Serum ferritin was found to be very high (511.09 ±390.37) in patients with diabetes mellitus as compared to control group (106.60 ± 30.19), the difference was statistically highly significant. Same was the case with ESR and CRP levels. This showed strong association of increased inflammatory markers with diabetes mellitus. Also, serum albumin was decreased in cases as compared to controls; which was statistically significant. There was a positive correlation between duration of Diabetes Mellitus type 2 with inflammatory markers (Ferritin, albumin). Also, inflammatory markers like ESR, CRP and albumin had coorelation with HbA1c values. ***Conclusion:*** Diabetes Mellitus type 2 has a close association with inflammatory markers and dyslipidemia such as raised ESR, CRP, Ferritin and decreased albumin. These markers are associated with uncontrolled hyperglycemia and increased risk of various complications ; thus , they can serve as a prognostic marker

Citation: ***Mahesh Dave, Anuj Goyal and Manasvin Sareen.*** **2023.** "To study various inflammatory markers in type 2 diabetes mellitus*". International Journal of Current Research*, 15, (05), 24520-24524.

INTRODUCTION

Diabetes Mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Diabetes is a multifaceted metabolic disorder affecting the glucose status of the human body. Impaired glucose tolerance and hyperglycaemia are the main clinical and diagnostic features and the result of an absolute or relative insulin deficiency or resistance to its action. Chronic hyperglycaemia associated with diabetes can result in end organ dysfunction and failure which can involve the retina, kidneys, nerves, heart and blood vessels.[1] Chronic systemic subclinical inflammation has also been identified as a driving force for insulin resistance. The process of inflammation induces hepatic synthesis of various acute phase reactants. Acute phase reactants are proteins that respond to acute stress such as infection, trauma, surgery and tissue necrosis. Some of these agents are ESR, CRP and ferritin. CRP is produced by liver cells and could activate complement system and T and B Lymphocytes.

ESR is a type of blood test that measures how quickly erythrocytes settle at the bottom of a test tube that contains blood sample. Ferritin is a complex globular protein that stores iron as soluble and non-toxic component. In oxidative stress, Fe^{+2} enters to cells and then changes to Fe^{+3}, linked to ferritin and then protect cells from oxidative stress.[2]Albumin is one of the major proteins synthesized in liver. Several studies have reported that lower concentrations of serum albumin are associated with an increased risk of coronary heart disease and cardiovascular mortality. This may be due to the anti inflammatory properties of serum albumin.[3] Since inflammation has a significant role in the pathogenesis of type 2 diabetes mellitus , therefore ,we planned the current study to determine the relation between various inflammatory markers and type 2 diabetes mellitus.

AIMS AND OBJECTIVES

- To study various inflammatory markers such as ESR, CRP, Serum albumin and Ferritin in type 2 Diabetes Mellitus patients.
- To study correlation between various inflammatory markers such as ESR, CRP, Serum albumin and Ferritin with complications of type 2 diabetes Mellitus.

MATERIAL AND METHODS

STUDY SITE: Patients attending O.P.D. of Medicine and Endocrinology and admitted to various medical wards of M.B. Govt. Hospital.

STUDY DESIGN: Hospital based randomized prospective case-control study, 50 in each group.

STUDY POPULATION AND PERIOD: Patients of Type 2 diabetes mellitus admitted in various medical wards and attending Medicine and Endocrine OPD in M. B. Govt. Hospital, Udaipur diagnosed with Type 2 Diabetes Mellitus (based on ADA Criteria of Diabetes Mellitus) were enrolled between the period of December 2019 to November 2020.

Inclusion Criteria

- Patients ready to participate in study and sign informed consent.
- Age >18 years
- Patient is a known case of type 2 diabetes or newly diagnosed type 2 Diabetes Mellitus.

Exclusion Criteria

- Patients with acute or chronic infections, active inflammatory disease or treatment with anti-inflammatory drugs.
- Patients with auto immune disorders and various connective tissue disorders like Rheumatoid Arthritis, SLE, Sjogrens syndrome etc.
- Malignancies like Multiple Myeloma, Leukemias, Lymphomas that increase ESR.
- Pregnancy.
- Patients of Type-I diabetes mellitus.
- Unwillingness to participate in study.

STUDY METHOD

After an informed consent, all subjects were thoroughly assessed at presentation, investigated and treated according to the protocol. Their detailed clinical history regarding type-2 diabetes mellitus and complications such as neuropathy, nephropathy, retinopathy and cardiovascular diseases, demographic profile and socio-economic status were recorded. Address and contact number of patients were taken for further communication. General physical examination as well as complete systemic examination which includes cardiovascular, peripheral vascular and neurological examination was done. A diagnosis of Diabetes Mellitus was made based on the American Diabetes Association (ADA) criteria. ADA Criteria for the diagnosis of Diabetes Mellitus

- Symptoms of diabetes plus random blood glucose concentration >11.1mmol/L (200 mg/dL) or
- Fasting plasma glucose >7.0 mmol/L (126 mg/dL) or
- Hemoglobin A1c > 6.5% or
- 2-h plasma glucose >11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test.

The diagnosis requires 2 abnormal tests from the same sample or in 2 separate test samples. Different inflammatory markers like ESR, CRP, Ferritin, Albumin were measured according to standard protocol among both cases i.e. Diabetes Mellitus patients and age & sex matched controls. Fasting plasma glucose (FPG) was measured with blood venous sample under sterile conditions obtained after overnight fasting for at least 8 hours. Oral Glucose Tolerance was performed using a glucose load containing the equivalent of 75 grams anhydrous glucose dissolved in water and then measured with blood venous sample under sterile conditions after 2 hours. Random Blood Glucose is defined as without regard to time since the last meal. The A1C test was performed using a method that is certified by the NGSP (www.ngsp.org) and standardized or traceable to the Diabetes Control and Complications Trial (DCCT) reference assay. The sample for CRP was taken at the time of admission and analyzed by qualitative rapid latex slide tests, based on the immunologic reaction between CRP as an antigen and latex particles coated with monospecific anti-human CRP. Routine blood investigations (Complete hemogram, Liver function test, Kidney function test, Auto-Immune profile), urine routine as well as HIV testing was done. The Mean levels were compared among the cases and controls. All the information was recorded in predesigned proforma formed in Microsoft excel for final analysis.

STATISTICAL ANALYSIS

Summary statistics was done by Proportion, Mean, Median and Standard Deviation. The inferential statistics was done by ANOVA and Pearson's correlation. All measurements were done using SPSS version 21.0. 'p' value <0.05 was considered statistically significant.

RESULTS

Table 1. Demographic profile

Characterstics	No. of cases (n = 50)	Percentage (%)
Age		
31-40	3	6.00%
41-50	8	16.00%
51-60	14	28.00%
61-70	19	38.00%
71-80	5	10.00%
81-90	1	2.00%
Sex		
Female	30	60.00%
Male	20	40.00%
Residence		
Urban	47	94.00%
Rural	3	6.00%
Personal History of smoking		
Smoker	25	50.00%
Non- smoker	25	50.00%
Family history of type 2 DM		
Present	24	48.00%
Absent	26	52.00%
BMI wise distribution(Kg/m^2)		
<18.5 (underweight)	1	2.00%
18.5-24.9 (normal)	16	32.00%
25-29.9 (overweight)	33	66.00%
>30 (obesity)	1	2.00%

Table no. 1 shows that majority of patients 19 (38%) were of the age group 61-70 years, followed by 14 (28%) of 51-60 years, 8 (16%) of 41-50 years and 5 (10%) of 71-80 years of age. Mean age of patients was 59.50 ± 11.06 years. Females out numbered males in our study 1.5:1. Almost all 47 (94%) of patients were of urban residence in our study. Only 3 (6%) of patients belonged to rural background. There were equal number of patients 25 (50%) in smokers as well as non smokers. Family history of diabetes mellitus was present in 24 (48%) of patients. Also, majority of patients had BMI of 25-29.9 Kg/m^2, i.e. overweight and obese people are more prone to have diabetes mellitus. 16 (32%) had normal (18.5 – 24.9 Kg/m^2) BMI. Only one underweight patient reported with diabetes.

Table 2. Lipid Profile, Blood sugar and Inflammatory markers Examination

	Case		Control		
	Mean	**SD**	**Mean**	**SD**	**P VALUE**
LIPID PROFILE					
Triglycerides	203.52	83.62	97.18	22.08	<0.001
Total Cholesterol	257.70	49.49	101.70	25.09	<0.001
HDL	35.67	7.62	46.14	5.47	<0.001
LDL	124.30	29.99	71.02	16.25	<0.001
BLOOD SUGAR					
Random Blood Sugar	267.64	107.18	107.80	15.75	<0.001
Fasting Blood Sugar	162.50	44.83	82.28	9.64	<0.001
2 hour Post prandial Sugar	273.02	67.73	118.02	12.15	<0.001
HbA1c	9.84	2.77	4.93	0.34	<0.001
INFLAMMATORY MARKERS					
Serum Ferritin	511.09	390.37	106.60	30.19	<0.001
Serum Albumin	2.96	0.61	3.99	0.38	<0.001
ESR	27.28	4.80	14.20	2.19	<0.001
CRP	30.40	20.35	3.84	0.62	<0.001

Table no. 2 reflects that patients with case group had dyslipidemia with elevated levels of total cholesterol (257.70 ± 49.49), triglycerides (203.52 ± 83.62), LDL (124.30 ± 29.99) and decreased levels of HDL (35.67 ± 7.62). In controls all the lipid parameters were well within the normal range. This shows that in patients with diabetes the lipid levels are also significantly altered. Also , blood sugar levels in patients were significantly higher than control cases.
Random blood sugar levels were 267.64 ± 107.18, fasting plasma sugar was 162.50 ± 44.83,2 hour PP glucose was 273.02 ± 67.73 and HbA1c was 9.84 ±2.77 in cases. In controls all the blood sugar parameters were well within the normal limits. When inflammatory markers were examined, Serum ferritin was found to be very high (511.09 ±390.37) in patients with diabetes mellitus as compared to control group (106.60 ± 30.19), the difference was statistically highly significant. Same was the case with ESR and CRP levels. This showed strong association of increased inflammatory markers with diabetes mellitus. Also , serum albumin was decreased in cases as compared to controls; which was statistically significant.

Table 3. Relationship of inflammatory markers with duration of type 2 DM

Duration of Type 2 DM (yrs)		Mean	SD	P value
ESR	0-5	25.67	4.13	>0.05
	5-10	26.92	5.98	(NS)
	>10	25.27	3.85	
Serum Ferritin	0-5	423.79	339.17	<0.001
	5-10	505.16	342.60	(HS)
	>10	556.26	299.67	
Serum Albumin	0-5	3.11	0.46	<0.05
	5-10	2.95	0.66	(S)
	>10	2.82	0.50	
CRP	0-5	31.31	25.50	>0.05
	5-10	27.47	19.95	(NS)
	>10	31.23	13.87	

In table no. 3, when relationship of serum parameters with duration of type 2 diabetes mellitus was assessed, we found that serum albumin significantly decreases in patients with increase in time duration of diabetes mellitus. Similarly serum ferritin levels significantly increases in patients with increase in time duration of diabetes mellitus. ESR and CRP though increase initially but do not vary with time duration of diabetes mellitus.

Table 4. Relationship of inflammatory markers with HbA1c values of type 2 DM patients

		HbA1c (mean ± SD)		
		Mean	SD	P value
ESR	Normal 0-20	8.5	2.7	0.013 (S)
	High >20	10.5	2.54	
Serum Ferritin	Normal 0-400	9.24	2.56	0.076
	High >400	10.67	2.91	(NS)
Serum Albumin	Normal >3.4	10.42	2.76	0.024 (S)
	Low <0-3.4	8.61	2.45	
CRP	Normal ≤5	-	-	-
	High >5	9.84	2.77	

In Table no. 4,we assessed the relationship between serum parameters with HbA1c in diabetic patients, the HbA1c was found to be elevated in patients in whom ESR was elevated (10.5 ± 2.54) when compared with normal ESR levels (8.5 ± 2.7), this difference was statistically highly significant. The HbA1c was found to be elevated in patients in whom serum ferritin was elevated (10.67 ± 2.91) when compared with normal ferritin levels (9.24 ± 2.56), however this difference was statistically non significant. The HbA1c was found to be elevated in all patients with elevated CRP levels (9.84 ± 2.77), which shows CRP levels are strongly affected with diabetes mellitus. The HbA1c was found to be elevated in diabetics with low serum albumin (8.61±2.45) when compared with normal albumin levels (10.42±2.76), and this difference was found statistically significant.

Table no. 5. Relationship of Inflammatory markers with Cholesterol Levels of Type 2 DM patients

		Cholesterol (mean ± SD)		
		Mean	SD	P value
ESR	Normal 0-20	215.67	65.31	0.009 (S)
	High >20	260.38	47.96	
S. Ferritin	Normal 0-400	255.90	49.80	0.76 (NS)
	High >400	260.19	50.17	
Serum Albumin	Normal >3.4	259.18	50.20	0.74 (NS)
	Low <0-3.4	254.56	49.39	
CRP	Normal ≤5	-	-	NA
	High >5	257.70	49.49	

Table no.5 shows the relationship of serum parameters with cholesterol levels in patients of type 2 diabetes mellitus. As ESR levels increased the cholesterol level also significantly increases. Serum ferritin, albumin and CRP levels didn't show any effect on cholesterol levels.

DISCUSSION

The present study was a prospective case control study which was done over a period of 1 year (December 2019 to November 2020) on 50 Type 2 Diabetes Mellitus patients and 50 controls who were admitted in various wards of MBGH, Udaipur and attended Medicine OPD. They were compared on basis of demographic profile , lipid profile, blood sugar and inflammatory markers. In this study , we observed majority of patients 19 (38%) were of the age group 61-70 years, followed by 14 (28%) of 51-60 years, 8 (16%) of 41-50 years and 5 (10%) of 71-80 years of age. Mean age of patients was 59.50 ± 11.06 years. In the study by Gupta R et al[4] (2020) ,number of type2 diabetes mellitus patients were highest among the age group 45 - 64 years (N =49, 49%) followed by among +65 years age group (N=32, 32%). Among the non-diabetic healthy control group, the maximum number belongs in the 45-64 years age group (n=48, 48%) followed by among +65 years age group (n=30, 30%). The mean age among cases comes out to be 56.86 ± 12.70 years while among controls it is 53.51 ± 16.18 years. Similarly Ndevahoma Fransina[5] (2021) in their study reported a mean age of 50.16 ± 12.72 years. Momeni et al[2] (2015) also had similar results with mean age of the patients was 56.5 ± 9.7 (30 to 82) years. Zheng et al[6] (2015) and King et al[7] (2003) also observed similar results. In our study females out numbered males (1.5:1) . There were equal number of patients 25 (50%) in smokers as well as non smokers. Family history of diabetes mellitus was present in 24 (48%) of patients. Ndevahoma Fransina[5] (2021) reported a male to female ratio of 0.43 in their study.. Momeni et al[2] (2015) reported 45 (67.2%) patients were females. In our study almost all 47 (94%) of patients were of urban residence in our study. Only 3 (6%) of patients belonged to rural background. Hence, DM-II is a disease primarily seen in females in their 5^{th} – 7^{th} decade and it has an urban preponderance. Majority of patients had BMI of 25-29.9 Kg/m^2, i.e. overweight and obese people are more prone to have diabetes mellitus. 16 (32%) had normal (18.5 – 24.9 Kg/m^2) BMI. Ony one underweight patient reported with diabetes. Similar results were observed by Momeni et al[2] (2015). The mean BMI was 28.5 ± 4 (22 to 42). Zheng et al[6] (2015) and King et al[7] (2003) also observed similar results with BMI 29.12 ± 3.89 and 28.84 ± 4.68 respectively.
In present study patients of case group had dyslipidemia with elevated levels of total cholesterol (257.70 ± 49.49), triglycerides (203.52 ± 83.62), LDL was 124.30 ± 29.99 and HDL was 35.67 ± 7.62. In controls all the lipid parameters were well within the normal range. This shows that in patients with diabetes the lipid levels also significantly rise. Also, blood sugar levels in patients were significantly higher than control cases. Random blood sugar levels were 267.64 ± 107.18, fasting plasma sugar was 162.50 ± 44.83, 2 hour PP glucose was 273.02 ± 67.73 and HbA1c was 9.84 ±2.77 in cases. In controls all the blood sugar parameters were well within the normal limits. When inflammatory markers were examined, Serum ferritin was found to be very high (511.09 ±390.37) in patients with diabetes mellitus as compared to control group (106.60 ± 30.19), the

difference was statistically highly significant. Same was the case with ESR and CRP levels. This showed strong association of increased inflammatory markers with diabetes mellitus.

When relationship of serum parameters with duration of type 2 diabetes mellitus was assessed, we found that serum albumin significantly decreases in patients with increase in time duration of diabetes mellitus. Similarly serum ferritin levels significantly increases in patients with increase in time duration of diabetes mellitus. ESR and CRP though increase initially but do not vary with time duration of diabetes mellitus. We assessed the relationship between serum parameters with HbA1c in diabetic patients, the HbA1c was found to be elevated in patients in whom ESR was elevated (10.5 ± 2.54) when compared with normal ESR levels (8.5 ± 2.7), this difference was statistically highly significant. The HbA1c was found to be elevated in diabetics with low serum albumin (8.61±2.45) when compared with normal albumin levels (10.42±2.76), and this difference was found statistically significant. The HbA1c was found to be elevated in patients in whom serum ferritin was elevated (10.67 ± 2.91) when compared with normal ferritin levels (9.24 ± 2.56), however this difference was statistically non significant. In present study the HbA1c was found to be elevated in patients in all patients with elevated CRP levels (9.84 ± 2.77), which shows CRP levels are strongly affected with diabetes mellitus. In our study when relationship of serum parameters with cholesterol levels in patients of type 2 diabetes mellitus was assessed, as ESR levels increased the cholesterol level also significantly increases. Serum ferritin, albumin and CRP levels didn't show any effect on cholesterol levels. CRP levels were found to be elevated in all diabetics in our study and thus making it an important marker for inflammation in DM-II, although it was unrelated with duration of the disease, thus making it an early marker to rise in the disease, alongside ESR. In a cross sectional study done by King et al[7], it was found that HbA1c was a significant predictor of elevated CRP. It was observed that for every 1% increase in HbA1c , there was a 20% increase in the likelihood of having an elevated CRP. In a study by Gupta R et al[4] (2020) the mean value of hsCRP among diabetic subjects comes out to be 4.06 ±2.59 mg/l, while the mean value of hsCRP among healthy controls is 0.93 ± 0.81 mg/l. There was a statistically significant increase in mean hsCRP levels among cases compared to controls (p-value <0.0001; highly significant). There was a positive correlation between hsCRP and HbA1C and the correlation coefficient between them r = 0.0507, which was statistically significant with p-value <0.0001. When a similar correlation was measured in control there was no correlation found in controls with correlation coefficient r = 0.06 and p-value = 0.5514 which was not statistically significant. The study conducted by Jared P. Reis[8] showed positive linear co relation between hsCRP and duration of DM-II, which was in contrary to our study. In the study conducted by Anubha Mahajan[9], Median hsCRP levels were significantly higher in both diabetic men and women as compared to their non diabetic counterparts (P < 0.0001). In another study conducted by Luciana M. Lima et al, Similar results were obtained.[10] In a study conducted by Valery S et al[11], participants who developed type2 diabetes had higher baseline median hsCRP levels compared with those who did not develop diabetes (3.5 vs. 2.3 mg/L, respectively (P < 0.0001). They also showed a positive correlation between hs-CRP and HbA1c, it has been reported that people with DM with poorer glycaemic control had higher CRP levels. ESR has significantly raised in patients of DM-II and has positive co-orelation with HbA1c. The likely explanation can be Erythrocytes are unique cells because they lose all organelles when mature.

They only conserve a few metabolic pathways for obtaining energy and reduce the energy consumption for the key functions they need to fulfil. This makes erythrocytes highly sensitive to any disorder. Glucose metabolism disorders in patients with diabetes profoundly affect the morphological structure and physiological functions of erythrocytes and result in insufficient microcirculation perfusion and hypoxia, promoting the occurrence of diabetic complications and reducing the quality of life of diabetic patients.[12] Serum ferritin levels were significantly increased in patients of DM-II, which also had a relation with duration of the disease. In a study by Momeni et al[2], it was found that in diabetic patients, despite the improvement of diabetic control indices, the amount of serum CRP was not changed; however, serum ferritin level had a relationship with hyperglycemia and its level decreased with lowering of serum blood glucose. There was a significant negative correlation between serum ferritin and duration of diabetes (r = 0.259; P = 0.034). Wrede[13] in a study found a positive correlation between serum ferritin and presence of insulin resistance syndrome in a representative population. In Ashoorapour's study[14], there was a correlation between serum ferritin and FBS, HbA1C, serum insulin. Serum albumin levels were decreased in patients with diabetes as compared to controls. Further, the decrease in serum albumin levels was inversely related to levels of HbA1c levels and duration of DM-II. Insulin resistance is by definition linked to hyperinsulinemia. This compensatory hyperinsulinemia may contribute to this relationship between insulin resistance and serum albumin levels .Insulin has effects on the synthesis rates of liver proteins such as albumin and fibrinogen. In vivo in rats and in rat hepatocytes cultures, insulin increased albumin gene transcription and mRNA synthesis in a dose-dependent manner. In contrast, insulin deficiency decreased both albumin gene transcription and mRNA concentration with a resultant decrease of albumin synthesis. Additionally, in type 1 diabetes patients, insulin withdrawal resulted in a decrease in the albumin synthetic rate, with these changes being reversed by insulin. In diabetic patients, however, plasma albumin concentration has been reported to be inversely related with HbA1c levels, revealing a large proportion of poorly controlled diabetes in patients with lower plasma albumin concentrations. This inverse relationship may also be explained by the fact that poorly controlled type 2 diabetes has been associated with a further decrease in insulin production and secretion by the pancreatic β-cell.

CONCLUSION

From this case control study, we conclude that Diabetes Mellitus type 2 has a close association with inflammatory markers and dyslipidemia such as raised ESR , CRP , Ferritin and decreased albumin.. A further step ahead , it was also observed that there was a close association of HbA1C with high ESR , CRP and low albumin. Also, there is a positive coorelation between duration of Diabetes Mellitus type 2 with inflammatory markers (Ferritin , albumin). The main implication of this finding is that inflammation may not be only a major contributing factor in the development of DM-II but also ongoing levels of hyperglycemia may effect the disease progression and hence higher levels of inflammatory markers were observed with duration of the disease. These markers are associated with uncontrolled hyperglycemia and increased risk of various complications ; thus , they can serve as a prognostic marker. Based on these markers, patients can be stratified on the basis of control of diabetes, risk of complications and future prognosis. Further studies can be done to establish the role of anti inflammatory drugs in DM-II, which can be a huge boost in controlling the disease.

REFERENCES

1. Harrison's. Ed. 20, vol 2, chapter 396, PP. 2850-53.
2. Momeni A, Behradmanesh MS Kheiri S, Abasi F. 2015. Serum ferritin has correlation with HbAlc in type to 2 diabetic patients. *Adv Biomed Res.,* 4: 74. doi 10.4103/2277-9175.153900.
3. Bae JC, Seo SH, Hur KY, Kim JH, Lee MS, Lee MK, Lee WY, Rhee EJ, Oh KW. 2013. Association between serum albumin, insulin resistance, and incident diabetes in nondiabetic subjects. *Endocrinology and Metabolism*. Mar 1;28(1):26-32.
4. Gupta R, Pamecha H. 2020. To study Relationship of Serum hsCRP with Type 2 Diabetes Mellitus, its Vascular Complications and Non-Diabetics-Case Control Study. *The Journal of the Association of Physicians of India*, Aug 1;68(8):25-9.
5. Ndevahoma F, Nkambule BB, Dludia PV, Mukesi M, Natanael KN, Nyambuya TM. 2021. The effect of underlying inflammation

on iron metabolism, cardiovascular risk and renal function in patients with type 2 diabetes. *E L Haem.,* Aug;2(3):357-65.
6. Zheng Y, Zhang G, Zhilai CH, Qiang ZE. 2015. Relationship between type 2 diabetes and inflammation diseases: cohort study in Chinese Adults. *Iranian journal of public health*. Aug;44(8):1045
7. Caballero AE, Arora S, Saouaf R, Lim SC, Smakowski P, Park JY, King GL, LoGerfo FW, Horton ES, Veves A. 1999. Microvascular and macrovascular reactivity is reduced in subjects at risk for type 2 diabetes. Diabetes. 48:1856-1862
8. Reis JP, Allen NB, Banecks MP, Carr JJ, Lewis CE, Lima JA, Rana JS, Gissing SS, Schreiner PJ. Diabetes Care https://doi.org/10.2337/dc17-2233
9. Mahajan A, Tabassum R, Chavali S, Dwivedi OP, Bharadwaj M, Tandon N, Bharadwaj D. 2009. High-Sensitivity C-Reactive Protein Levels and Type 2 Diabetes in Urban North Indians J Clin Endocrinol Metab, June, 94(^):2123-2127.
10. Luciana M. Lima Maria Das Gracas Carvalho Anna L. 2007. Soares Adriano De P. Sabino Ana P. Fernandes Bethania A. Novelli Marinez O. Sousa. *Arq Bras Endocrinol Metab*., 51/6:956-960.
11. Tutuncu Y, Satman I, Celik S, Dinccag N, Karsidag K, Telci A, GencS, IsseverH, Tuomilehto J, Omer B. 2016. A Comparison of hs-CRP Levels in New Diabetes Groups Diagnosed Based on FPG, 2-Hpg, or HbA1c Criteria. *J Diabetes Res.,* 2016:5827041.
12. Wang X, Bao W, Liu J, Ou Yang YY, Wang D, Rong S, Xiao X, Shan ZL, Zhang Y, Yao P, Liu LG. 2013. Inflammatory markers and risk of type 2 diabetes: a systematic review and meta-analysis. *Diabetes Care.,* Jan 1;36(1):166-75.
13. Wrede CE, Buettner R, Bollheimer LC, Schlomerich J, Palitzsch KD, Hellerbrand C. 2006. Association between serum ferritin and then insulin resistance syndrome in a representative population. *Eur J Endocrinol.,*154:333-40.
14. Ashourpour M, Djalali M, Djazayery A, Eshraghian MR, Taghdir M, Saedisomeolia A. 2010. Relationship between serum ferritin and inflammatory biomarkers with insulin resistance in a Persian population with type 2 diabetes and healthy people. *Int J Food Sci Nutr.,* 61:316-23.

****