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Original Research Article

Haematological profile of diabetes and non-diabetes patients in rural tertiary centre

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ABSTRACT

Background: Anemia is a common haematological finding in diabetic patients. Many research studies have reported that anemia mostly occurs in patients with diabetes who also have renal insufficiency. A few other studies have also reported an incidence of anemia in diabetics prior to evidence of renal impairment. Anemia occurs earlier and at a greater degree in patients presenting with diabetic nephropathy than those presenting with other causes of renal failure. The objective of this study is to determine the haematological profile among type 2 Diabetes mellitus in comparison with non-diabetic controls.

Methods: Hospital based case control study was conducted in a rural tertiary care centre for a period of 1 year (May 2016 to April 2017) among type 2 diabetic patients and equal proportion of controls without diabetes. 70 diabetics and non-diabetics as controlled were enrolled for the study. Pretested and structured questionnaire was used to collect the data from subjects. For laboratory investigation 5 ml of blood was drawn from the patient and analysed in the automated cell counter for haematological parameters. Data was analysed using SPSS 22 version, Chi-square test and independent t test was the test of significance for qualitative and quantitative data respectively. P value of <0.05 was considered to be statistically significant.

Results: Mean age of diabetics was 55.7±3.6 years and non-diabetics was 56.2±3.5 years. Majority of subjects in both the groups were females. In diabetics mean haemoglobin, RBCs, PCV, and MCV was significantly lower than in non-diabetics. Whereas mean MCHC, WBCs and lymphocytes was significantly higher in diabetics compared to non-diabetics. No difference was observed for MCH, neutrophils and platelets between two groups. This shows that diabetics are prone for anemia, leucocytosis and lymphocytosis.

Conclusions: Haematological profile in diabetes patients in deranged and diabetics are more prone for anemia, leucocytosis and lymphocytosis. Hence routine and regular screening for haematological profile is recommended in diabetic patients to initiate early prevention strategies and to reduce the morbidity related to it.

Keywords: Case control study, Hematological profile, Type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) is a non-communicable disease with increasing prevalence worldwide.[1] Poorly controlled diabetes leads to various complications such as nephropathy, retinopathy, neuropathy and oxidative stress causing oxidative damage to tissues and cells.[2] India is the known to be diabetic capital of the world. By 2030, about 80 to 87 million people of India will be diabetic and 438 million people (7.8%) of the adult population are expected to have diabetes worldwide.[3] Anemia is a common hematological finding in diabetic patients. Anemia is defined as a reduction in the haemoglobin concentration of blood, which consequently reduces the oxygen-carrying capacity of red blood cells such that they are unable to meet the body's physiological needs.

Many research studies have reported that anemia mostly occurs in patients with diabetes who also have renal insufficiency.[4] A few other studies have also reported an incidence of anemia in diabetics prior to evidence of renal impairment.[5] Anemia occurs earlier and at a greater degree in patients presenting with diabetic nephropathy than those presenting with other causes of renal failure.[6] Anemia in diabetic male is an added morbidity and it affects the quality of life.[6] Routine measurement of haematological parameters is done in diabetic patients. In literature, it has been showed that white blood cell (WBCs) count and PCV (Packed cell volume), have been associated with insulin resistance and T2DM.[7] Positive correlation has been observed between PCV and hyperinsulinemia, high blood pressure, elevated serum triglycerides, low HDL cholesterol, and central obesity, suggesting relationship to insulin resistance.[8,9] Chronic inflammation plays an important role in the pathogenesis of T2DM. Various epidemiological studies has demonstrated an association between total WBCs or leukocyte count, a non-specific marker of inflammation, and diabetes risk.[8,9] The ojective of this study is to determine the hematological profile among type 2 Diabetes mellitus in comparison with non-diabetic controls.

METHODS

Hospital based case control study was conducted in a rural tertiary care centre for a period of 1 year (May 2016 to April 2017) among type 2 diabetic patients and equal proportion of controls without diabetes. Age and gender matching was done to eliminate selection bias. Ethical clearance was obtained from the Institutional Ethics Committee and written informed consent was obtained from the study participants prior to the start of the study.

Inclusion criteria was type 2 diabetic patients on treatment with duration of disease >5years and exclusion criteria was type I Diabetes mellitus, cases with haematological disease.

Sample size was estimated based on mean difference in PCV between diabetics and controls from the study by Al-Ali et al.[10] PCV in type 2 diabetics was 30.40±2.70 and in controls was 31.80±2.90. Using these values in MedCal® version 12.7.0.0 sample size calculator, sample size of 64 was obtained in each group. With 10% non-response rate sample size of 70 was obtained in each group. Pretested and structured questionnaire was used to collect the data from subjects. Detailed clinical history was taken. For laboratory investigation 5 ml of blood was drawn from the patient and analysed in the automated cell counter for haematological parameters like Hb (haemoglobin), TC (total count), DC (differential count), PCV (packed cell volume), MCV (mean red cell corpuscular volume) and Leishman staining was used for peripheral smear findings were studied. Anemia was graded as mild, moderate and severe based on the WHO guidelines.[11] Data was analysed using SPSS 22 version, Chi-square test was the test of significance for qualitative data between two groups and independent t test was the test of significance for quantitative variables between two groups. P value of <0.05 was considered to be statistically significant.

RESULTS

In the study, 70 type 2 diabetes subjects and non-diabetic subjects (controls) were included. Mean age of diabetics was 55.7±3.6 years and non-diabetics was 56.2±3.5 years.

Table 1: Profile of subjects in the study.

		Type 2 diabetics (n=70)	Non-diabetics (n=70)	P value
Age (Mean±SD) years		55.7±3.6	56.2±3.5	0.406
Gender	Male	30 (42.8%)	34 (48.5%)	0.497
	Female	40 (57.2%)	36 (51.5%)	
Domicile	Urban	45 (64.2%)	40 (57.2%)	0.388
	Rural	25 (35.8%)	30 (42.8%)	
Socio economic status	Upper class	21 (30%)	18 (25.7%)	0.495
	Upper middle	15 (21.4%)	20 (28.6%)	
	Middle	20 (28.6%)	18 (25.7%)	
	Lower	10 (14.3%)	6 (8.6%)	
	Poor	4 (5.7%)	8 (11.4%)	
Education	Illiterate	12 (17.1%)	15 (21.4%)	0.851
	Primary	28 (40%)	25 (35.7%)	
	Secondary	18 (25.7%)	20 (28.6%)	
	Higher education	12 (17.1%)	10 (14.3%)	
Duration of Diabetes (years)		7.2±2.6	-	-

Majority of subjects in both the groups were females. There was no significant difference in age and gender distribution between two groups. Mean duration of diabetes in diabetics was 7.2±2.6 years. No significant difference was observed in socio economic status and education between two groups (Table 1). In diabetics mean hemoglobin was 11.17±4.42 (g/dl) and in non-diabetics 14.11±3.46 (g/dl). Similarly, other haematological parameters are shown in Table 2. In diabetics mean haemoglobin, RBCs, PCV and MCV was significantly lower than in non-diabetics. Whereas mean MCHC, WBCs and lymphocytes was significantly higher in diabetics compared to non-diabetics. No difference was observed for MCH, neutrophils and platelets between two groups. This shows that diabetics are prone for anemia, leukocytosis and lymphocytosis.

Table 2: Haematological profile comparison between two groups.

	Type 2 diabetics (n=70)	Non-diabetics (n=70)	P value
Haemoglobin (g/dl)	11.17±4.42	14.11±3.46	<0.001*
RBCs (x106/µl)	4.48±1.64	5.12±1.15	0.008*
PCV (%)	33.69±6.48	37.27±4.53	<0.001*
MCV (fL)	80.29±16.23	86.37±13.18	0.016*
MCH (pg)	30.21±9.43	28.26±7.46	0.177
MCHC (%)	36.28±7.19	32.24±3.27	<0.001*
WBCs (million/mm^3)	9.33±3.86	7.26±2.36	<0.001*
Lymphocytes (%)	34.68±6.46	30.28±4.17	<0.001*
Neutrophils (%)	55.15±13.97	58±3.86	0.102
Platelets (x103/µl)	214.66±22.16	220.24±21.36	0.131

Table 3: Distribution of anemia severity and morphological pattern of anemia between two groups.

		Type 2 diabetics (n=70)	Non-diabetics (n=70)	χ2, df, p value
Grade of anemia	Mild	24 (34.3%)	18 (25.7%)	10.44, 3, 0.015*
	Moderate	20 (28.6%)	12 (17.1%)	
	Severe	6 (8.6%)	2 (2.9%)	
	No anemia	20 (28.6%)	38 (54.3%)	
Morphological type of anemia	Normocytic normochromic anemia	25 (50%)	20 (62.5%)	1.952, 2, 0.376
	Microcytic hypochromic anemia	20 (40%)	8 (25%)	
	Macrocytic anemia	5 (10%)	4 (12.5%)	

Among the diabetics, 34.3% had mild, 28.6% had moderate and 8.6% had severe anemia, in non-diabetics, 25.7% had mild, 17.1% had moderate and 2.9% had severe anemia. This difference in severity of anemia between two groups was statistically significant. Among those with anemia, in diabetic group, 50% had normocytic normochromic anemia, 40% had microcytic hypochromic and 10% had macrocytic anemia, in non-diabetics, 62.5% had normocytic normochromic anemia, 25% had microcytic hypochromic and 12.5% had macrocytic anemia. There was no significant difference in morphological type of anemia between two groups (Table 3).

DISCUSSION

Diabetes prevalence has seen a steady increase globally. Due to its complex multifactorial etiology, leads to progressive deterioration of beta cell function and causes insulin resistance. In the present study 70 type 2 diabetes subjects and non-diabetic subjects (controls) were included. Mean age of diabetics was 55.7±3.6 years and non-diabetics was 56.2±3.5 years. Majority of subjects in both the groups were females. There was no significant difference in age and gender distribution between two groups. Mean duration of diabetes in diabetics was 7.2±2.6 years. No significant difference was observed in socio economic status and education between two groups. Similar demographic profile was observed in the study by Al Salhen KS et al, were in mean age of diabetics was 56±8 years and in controls was 55±6 years. Majority of them were males in both the groups. Patients and controls were well matched for age and gender distribution.[12]

Present study showed that diabetics had mean hemoglobin of 11.17±4.42 (g/dl) and non-diabetics 14.11±3.46 (g/dl). In diabetics mean haemoglobin, RBCs, PCV, and MCV was significantly lower than in non-diabetics. Whereas mean MCHC, WBCs and lymphocytes was significantly higher in diabetics compared to non-diabetics. No difference was observed for MCH, neutrophils and platelets between two groups. This shows that diabetics are prone for anemia, leucocytosis and lymphocytosis. Similar observations

were made by Al Salhen KS et al in T2DM had lower haemoglobin concentrations.[12] In T2DM patient's PCV, whole blood haemoglobin, RBCs and MCV values were significantly lower than in controls with percent differences of 27.7, 19.2, 23.5 and 5.4%, respectively. The mean values for MCHC and MCH were also significantly greater in diabetic patients than healthy controls. Total white blood cell count, lymphocytes and neutrophils counts were significantly higher in the diabetic patients than in the controls. However, no significant differences were observed in platelet counts between patients and controls.

In the present study among the diabetics, 34.3% had mild, 28.6% had moderate and 8.6% had severe anemia, in non-diabetics, 25.7% had mild, 17.1% had moderate and 2.9% had severe anemia. This difference in severity of anemia between two groups was statistically significant. Hence it can be concluded that anemia is relatively common in patients with DM. From various literatures, it is known that low haemoglobin concentration may contribute to complications and progression of diabetes. Low haemoglobin concentration is associated with rapid decline in glomerular filtration rate than that of other kidney diseases.[13] Anemia in patients with diabetes increases susceptibility of the kidney to nephropathy. It is widely accepted that patients with diabetes are more vulnerable to the effects of anemia.[14] Al-Khoury et al observed in their study that for each chronic kidney disease stage, haemoglobin is 1 g/dl lower in patients with diabetes than in the non-diabetic population.[15] In the study decrease in RBCs levels, MCV and PCV levels in the in diabetics with significant increase in MCHC levels when compared with the non-diabetics may be due to hematotoxic effects associated with toxic substances on bone marrow depression caused by damage to multiple classes of hematopoietic cells and a variety of hematopoietic functions.[16] This result was similar to that were previously reported by others.[17] Waggiallah H et al, also observed significant decrease in haemoglobin concentration, RBCs counts, MCHC and MCH value in diabetics compared with controls.[18]

In Type 2 DM lifespan of red blood cells may be decreased due to disturbances in the hematopoietic milieu, such as chronic hyperglycemia and hyperosmolarity.[19,20] These disturbances can lead to increased internal viscosity and increased membrane rigidity in these blood cells, so that the number of red blood cells decreases.[21] The results in the study were in agreement with study by Agrawal R on RBCs deformability and related indices in T2DM.[22]

The present study also showed increased WBCs counts among diabetics and no significant difference was observed in platelet count. Ohshita K et al, in their study showed association between Peripheral WBCs count and insulin resistance, T2DM.[23] Similarly no significant difference was observed in the study by Alexopoulos D anomg Type 2 DM and controls.[24]

CONCLUSION

Hematological profile in Diabetes patients in deranged and diabetics are more prone for anemia, leukocytosis and lymphocytosis. Hence routine and regular screening for hematological profile is recommended in diabetic patients to initiate early prevention strategies and to reduce the morbidity related to it. Secondary prevention in the form of early diagnosis and treatment of anemia in diabetic patients at the primary care setting and rural tertiary care centres would be cost effective and reduces hospital admissions, improves quality of life and also decrease the speed of progression of renal disease. In future therapeutic prevention of anemia in diabetes can retard the progress of diabetic nephropathy and its complications.

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REFERENCES

1. Whiting DR, Guariguata L, Weil C, Shaw J. IDF Diabetes Atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Res Clin Pract. 2011;94(3):311-21.
2. Comazzi S, Spagnolo V, Bonfanti U. Erythrocyte changes in canine diabetes mellitus: in vitro effects of hyperglycaemia and ketoacidosis. J Comp Clin Path. 2004;12(4):199-205.
3. Hoffbrand AV, Moss PAH, Pettit JE. Erythropoiesis and general aspects of anaemia. Essential Haematology. Fifth ed. UK: Blackwell Publishing; 2006:18-20.
4. El-achkar TM, Ohmit SE, Mccullough PA, Crook ED, Brown WW, Grimm R, et al. Higher prevalence of anaemia with diabetes mellitus in moderate kidney insufficiency: The Kidney Early Evaluation Program. Kidney Int. 2005;67(4):1483-8.
5. Bosman DR, Winkler AS, Marsden JT, Macdougall IC, Watkins PJ. Anaemia with erythropoietin deficiency occurs early in diabetic nephropathy. Diabetes Care. 2001;24(3):495-9.
6. Ramachandran A, Snehalatha C. Current scenario of diabetes in India. J Diabetes. 2009;1(1):18-28.
7. Tamariz LJ, Young JH, Pankow JS, Yeh HC, Schmidt MI. Blood viscosity and hematocrit as risk factors for type 2 diabetes mellitus: the atherosclerosis risk in communities (ARIC) study. Am J Epidemiol. 2008;168:1153-60.

8. Bi Y, Wang T, Xu M, Xu Y, Li M. Advanced research on risk factors of type 2 diabetes. Diabetes Metab Res Rev. 2012;28:32-9.
9. Simmons D. Increased red cell count in diabetes and pre-diabetes. Diabetes Res Clin Pract. 2010:90:e50-3.
10. Al-Ali, ZAJ. Some hematological and biochemical parameters in type 2 diabetic patients Missan/ Iraq. Int J Adv Res Biol Sci. 2016;3(4):30-4.
11. WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and mineral information system. Geneva, world health organisation, 2011. Available at http://www.who.int/vmnis/indicators/haemoglobin.pdf.
12. Al Salhen, Khaled S, Mahmoud, Ameerah Y. Hematological profile of patients with type 2 Diabetic mellitus in El-Beida, Libya. Ibnosina J Med Biomed Sci. 2017;9(3):76-80.
13. Rossing K, Christensen PK, Hovind P, Tarnow L, Rossing P, Parving HH. Progression of nephropathy in type 2 diabetic patients. Kidney Int. 2004;66:1596- 605.
14. Thomas MC, MacIsaac RJ, Tsalamandris C, Power D, Jerums G. Unrecognized anemia in patients with diabetes: a crosssectional survey. Diabetes Care. 2003;26:1164-9.
15. Al-Khoury S, Afzali B, Shah N, Covic A, Thomas S, Goldsmith DJ. Anaemia in diabetic patients with chronic kidney disease: prevalence and predictors. Diabetologia. 2006;49:1183-9.
16. Mohammed A, Adelaiye AB, Bakari AG, Mabrouk MA. Antidiabetic and some hematological effects of ethyl acetate and n-butanol fractions of Ganoderma lucidum aqueous extract in alloxan-induced diabetic wistar rats. Intern J Medicine Sci. 2009;1(12):530-5.
17. Edet EE, Akpanabiatu MI, Uboh FE, Edet TE, Eno AE, Itam EH, et al. Gongronema latifolium crude leaf extract reverses alterations in hematological indices and weight loss in diabetic rats. J Pharmacol Toxicol. 2011;6:174-81.
18. Waggiallah H, Alzohairy M. The effect of oxidative stress on human red cells glutathione peroxidase, glutathione reductase level, and prevalence of anemia among diabetics. North Am J Med Sci. 2011;3(7):344-7.
19. Virtue MA, Furne JK, Nuttall FQ, Levitt MD. Relationship between GHb concentration and erythrocyte survival determined from breath carbonmonoxide concentration. J Diabetes Care. 2004;27:931-5.
20. Schmid-Schonbein H, Volger E. Red-cell aggregation and red-cell deformability in diabetes. J Diabetes. 1976;25:897-902.
21. McMillan DE, Utterback NG, La PJ. Reduced erythrocyte deformability in diabetes. J Diabetes. 1978;27:895-901.
22. Agrawal R, Thomas S, João N, Christopher R, Rhythm B, Adnan T, et al. Assessment of red blood cell deformability in type 2 diabetes mellitus and diabetic retinopathy by dual optical tweezers stretching technique. Sci Reports 2016;6:15873.
23. Ohshita K, Yamane K, Hanafusa M, Mori H, Mito K, Okubo M, et al. Elevated white blood cell count in subjects with impaired glucose tolerance. Diabetes Care. 2004;27:491-6.
24. Alexopoulos D, Chrysoula V, Katerina S, Niki V, Angelos P, Ioanna P, et al. Diabetes mellitus and platelet reactivity in patients under prasugrel or ticagrelor treatment: an observational study. Cardiovascular Diabetology. 2015;14:68.

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