Int J Biol Med Res. 2012; 3(4): 2429-2432

BioMedSciDirect Publications

Contents lists available at BioMedSciDirect Publications

International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original Article

A Comparative Study of Haematological Parameters in Type I Diabetes mellitus Patients & healthy Young Adolescents.

Ruchi Kothari*, Pradeep Bokariya**

** Assistant Professor, Dept. of Physiology, MGIMS, Sevagram, Wardha (Maharashtra)*
*** Assistant Professor, Dept. of Anatomy, MGIMS, Sevagram, Wardha (Maharashtra)*

ARTICLE INFO

Keywords:
Type 1 diabetes mellitus
Anemia
Healthy adolescents

ABSTRACT

Aims: The present study was undertaken to evaluate and compare the haematological parameters related to the erythrocytes in a cross-section of type 1 diabetic patients with those of the healthy young adolescents of Jodhpur region.Material & Methods: A total of 30 normal young adolescents in the control group and 28 type1 diabetes mellitus patients in experimental group of age 8-15 years were examined for total RBC count, Haemoglobin concentration, Packed cell volume and MCHC (Mean Corpuscular Haemoglobin Concentration). All hematologic variables were fitted into normal distributions, and parametric analysis using mean, Standard deviation (S.D.), Standard Error (S.E.) was done. For validation of observations, Student's "t" test has been employed. Results: The mean Total RBC count in the control group was found to be 4.77 million per cubic mm whereas it came out to be 3.94 million per cubic mm in the experimental group. The average Hb concentration in control group was 12.86 g/dl and that in diabetic subjects was 11.45 g/dl. The value of PCV in both categories was 41.56 % and 40.07 % respectively. Similarly the MCHC was taken out to be 31.24% for the controls and 28.45 % for the experimental group. Conclusion: The mean values of TRBC, Hb, PCV, MCHC for the diabetic patients were found to be lower than the values of control group, indicating the presence of anemia in the former group. Since anemia has been known to be a risk factor for cardiovascular disease in diabetic patients with chronic kidney disorder, it is therefore an important observation that development of anemia in type 1 diabetes may predate an abnormality in renal function. Furthermore, understanding the mechanism by which this occurs may provide the opportunity to develop therapeutic options that may improve patient outcomes.

1. Introduction

Diabetes mellitus has been traditionally looked upon as a disease of adults (except Type I diabetes), however it can affect individuals of any age. Given the peculiarities and problems that it carries, diabetes in children and adolescents poses special challenges to the entire society. Diabetes is the second commonest chronic disease occurring in 1 in every 1500 children by age 5 and in 1 in 350 children by age 8 [1].

* Corresponding Author : RUCHI KOTHARI
Assistant Professor,
Department of Physiology,
Mahatma Gandhi Institute of Medical Sciences,
SEVAGRAM, Wardha (Maharashtra) - 442102
Email id- prachi1810@yahoo.com
Phone no.- 09730216884
drsumitgiri@gmail.com

Type 1 diabetes, which we commonly relate with children, tends to be more common in Caucasians. Although the incidence of type 1 diabetes in the young in India [2] has been shown to be low i.e. 3.8 per 100,000 persons but the burden of diabetes is great due to massive population in our country. Also there is 4% increase in incidence trend in Asia.[3] Therefore as the incidence increases, the probability of complication associated with Type1 Diabetes mellitus (T1DM) will also increase.

The etiology of childhood onset diabetes mellitus (DM) varies between regions and races, and its long-term outcome is affected by social and economic factors. There are scanty data on the erythrocyte related parameters of T1DM from developing countries. Only a few Indian studies have reported vascular complications, clinical, biochemical, haematological & etiological

profile associated with T1DM [4-7] and such a study was lacking as yet in the western part of the country where lies the Thar desert. Therefore the present study was undertaken to evaluate and compare the haematological parameters related to the erythrocytes in the type 1 diabetic patients and the normal healthy individuals of Jodhpur region (western Rajasthan).

The presence of anemia in diabetic patients with undetected renal dysfunction may be particularly dangerous especially at the primary care setting where routine laboratory investigations are infrequent and haematological tests not usually included as part of the laboratory tests for the patients' management. In this regard, the present study is aimed to assess the value of haematological profile in a cross-section of type 1 diabetic patients of Jodhpur region.

2. Material & Methods

A total of 30 normal subjects in control group and 28 type1 diabetes mellitus patients in experimental group were examined for various parameters which included total RBC count, Haemoglobin concentration, Packed cell volume and MCHC (Mean Corpuscular Haemoglobin Concentration).The subjects were asked to answer a self coding questionnaire. Their particulars regarding age, dietetic habits, past illness, general health, structure of household whether housebound, catering arrangements, socio economic status of family etc. were entered in a proforma. An informed consent was taken prior to the investigations by each of the subjects. All estimates were done on venous blood.

The venous blood for all samples collected for the study was drawn between 8:30 a.m. to 12 noon and following estimations were done-

I) Total R.B.C. Count

This was done by Hemocytometry method using an Improved Neubauer's Double counting chamber.

II) Haemoglobin- It was done by -"Cyanmeth Hb Method"

III) Packed Cell Volume - It was done by "Wintrobe's (Macro) Method"

IV) Mean Corpuscular Haemoglobin Concentration – was calculated by the following formula-

$$\frac{\text{(M.C.H.C.) = Hb. in g/dl X 100}}{\text{P.C.V. per 100 ml blood}}$$

Criteria of selection of subjects-

Control Group:

a) The subjects were of the age group 8-15 years.

b) They were primarily children who were brought by their parents for routine medical checkup in the Pediatric department of Govt. Hospital of Jodhpur.

c) The subjects were clinically healthy and were not taking any medications.

d) The selected persons were invited to have a blood test and samples were drawn only after having their consent.

Experimental Group:

a) The subjects were of the age group 8-15 years

b) The subjects diagnosed as the cases of type 1 diabetes mellitus by the Medicine department of Govt. Hospital were included for the present study.

c) Their height & body weight was taken with the subjects wearing light weight clothes without shoes. Body mass index (BMI) was also estimated.

d) Blood glucose was measured using colorimetric test.

e) HbA1C was measured using HPLC method.

f) Blood samples were collected in fasting state and were analysed for Blood sugar levels, TC, TG, HDL, using specific enzymatic methods in auto-analysers.

g) Serum creatinine, urinary proteins/albumin were also measured.

Statistics:

All hematologic variables were fitted into normal distributions, and parametric analysis using mean, Standard deviation (S.D.), Standard Error (S.E.) was done. For validation of observations, Student's "t" test has been employed.

Observations:

The mean Total RBC count among the control group was found to be 4.77 million per cubic mm whereas it came out to be 3.94 million per cubic mm in the experimental group. The average Hb concentration in the control group was 12.86 g/dl and that in diabetic subjects was 11.45 g/dl. The value of PCV in both categories was 41.56 % and 40.07 % respectively. Similarly the MCHC was taken out to be 31.24% for the controls and 28.45 % for the experimental group.

These values corroborate well with the findings of Ezenwaka et al (2008) [8] in Caribbean diabetic population where they found Hb. level of 12.9 ± 0.2 g/dl in diabetic population as compared to 14.6 ± 0.3 g/dl of control group, Hematocrit (%) for diabetic was 39.4 ± 0.5 & for non-diabetics was 44.2 ± 0.7. Red Blood Cell ($\times 10^6$/L) for diabetics was 4.6 ± 0.1 and for controls was 5.1 ± 0.1. The minor variation observed may be due to difference in the sample size studied or might be due to ethnic differences that exist among the population studied.

Table No.1 Total RBC Count

	No. of subjects	Mean	Standard Deviation	Standard Error
Control Group	30	4.77	0.60	0.11
Experimental Group	28	3.94	0.50	0.10

(P value <0.001), Highly Significant

Table No.2 Haemoglobin

	No. of subjects	Mean	Standard Deviation	Standard Error
Control Group	30	12.86	1.36	0.24
Experimental Group	28	11.45	1.08	0.20

(P value <0.001), Highly Significant

Table No.3 Packed Cell Volume

	No. of subjects	Mean	Standard Deviation	Standard Error
Control Group	30	41.56	4.95	0.90
Experimental Group	28	40.07	3.87	0.73

(P value >0.05), Non Significant

Table No.4
Mean Corpuscular Haemoglobin Concentration (MCHC)

	No. of subjects	Mean	Standard Deviation	Standard Error
Control Group	30	31.24	2.79	0.51
Experimental Group	28	28.44	2.33	0.44

(P value <0.001), Highly Significant

5.Discussion

It has been recently recognized that anemia is a common complication of diabetes and represents a significant and under recognized burden in patients with type 1 diabetes.

Recent studies have also highlighted an association between anemia and the development and progression of diabetic nephropathy. There is also a high cardiovascular risk in patients with diabetic nephropathy and a clear association between anemia and abnormal cardiac function[8].

In a cross-sectional survey of patients with diabetes in a single clinic, Thomas et al (2002) [9] found that nearly a quarter of all outpatients had anemia. This is in accordance with the significantly low values of total RBC and Hematocrit obtained in our experimental group thus implying the presence of anemia in the type 1 diabetic patients.

Hb levels in our study are similar to those described in a cohort of type 1 diabetic patients in a more recently published study by Thomas et al (2004) [10]. They found that 15% of female and 13% of male patients with type 1 diabetes had Hb levels less than 11 g/dl (110 g/liter) denoting the threshold for intervention in patients with renal disease as it is now well established that reduced hemoglobin (Hb) levels, even to a limited degree, identify patients at increased risk of progressive renal disease [11,12]

It is therefore an important observation that the development of anemia in diabetes may predate any abnormality in renal function. Furthermore, understanding the mechanism by which this occurs may provide the opportunity to develop therapeutic options that may improve patient outcomes.

In a recent study Ezenwaka & his associates (2008) have shown that anaemia was more prevalent in diabetic than non-diabetic subjects irrespective of gender, and diabetic patients with anaemia had the lowest kidney function compared with patients without anaemia or non-diabetic subjects with anaemia.

To clarify the contribution and differing roles of diabetes and nephropathy in the development of anemia in diabetic patients, Craig et al (2005) had examined the hematologic and hematinic parameters of diabetic patients without nephropathy. They postulated that anemia associated with nephropathy results from Erythropoeitin deficiency, which seems to develop in patients with type 1 diabetes who have even relatively normal levels of serum creatinine [13].

However, patients with diabetes are still able to mount an appropriate response to acute hypoxia [14], suggesting that the renal cells that produce erythropoietin are not simply lost in the process of interstitial damage that characterize diabetic renal disease. It seems likely that the anemia-sensing (rather than secretory) mechanisms are dysfunctional in the anemia of diabetes. Although the mechanism of this remains to be established, it is conceivable that thickening of the endothelial basement membrane and changes in regional blood flow mediated through up-regulation of the local renin angiotensin system may directly contribute to anemia. It has also been suggested that autonomic degeneration as a result of diabetes may diminish erythropoietin release [15]. Because autonomic neuropathy is closely correlated with renal injury, it is difficult to assess its independent influence. However, denervated kidneys used for transplantation appear to release erythropoietin normally [16].

There are many pathophysiologic reasons why the presence of anaemia may lead to adverse cardiovascular consequences especially in diabetic patients. For instance, it has been demonstrated that patients with chronic anaemia had a high cardiac output and a low systemic vascular resistance.

Certainly, anemia has direct mitogenic and fibrogenic effects on the kidney and the heart, associated with expression of growth factors, hormones, and vasoactive reagents, many of which are also

implicated in the diabetic microvascular disease [17]. Anemia is also correlated with oxidative stress, because erythrocytes represent a major antioxidant component of the blood [18]. Increased susceptibility to oxidative stress alongwith decreased antioxidant defense which may be due to poor glycemic control in patients with type 1 diabetes has been recently reported [19].

The limitation in our study is that the study was not designed to determine the type of anaemia the patients had, though iron-deficiency anaemia is the commonest type in most of the developing countries as has been reported in some studies lately. Thus, diabetic children and adolescents with limited food choices, would be more vulnerable to iron-deficiency anaemia.

The findings in the present study have implications for diabetes management in that they appear to indicate a need for routine full blood counts in T1DM management. Inadequate or absence of laboratory facilities in many developing countries is a major limitation in routine laboratory assessment of diabetic patients. We believe that early detection and management of anaemia in diabetic patients at the primary care setting would be cost effective in so far as it would reduce hospital admissions and maintain optimum health. This could be achieved through the provision of adequate laboratory facilities and expansion of the scope of laboratory investigations used in the management of diabetic patients. Therefore, it is suggested that all diagnostic laboratories in developing countries and elsewhere should include complete blood count as one of the routine laboratory tests required in the management of diabetic patients.

6.Result

The mean values of TRBC, Hb, PCV, MCHC for the diabetic patients were found to be lower than the values of control group the indicating the presence of anemia in the former group. Since a significant probability of anemia was identified in this group of type 1 diabetic patients therefore it is recommended that diagnostic laboratories in developing countries and elsewhere should include complete blood count in routine laboratory investigations in the management of diabetic patients. This study should encourage heightened awareness of the unrecognized burden of anemia in patients with type 1 diabetes.

7. Conclusion

The ground reality is that in a country like India, life expectancy of children with Type 1 diabetes is still quite low because of late diagnosis, poor affordability and difficult access for modern treatment and low awareness level in society leading to stigmatization. The time has come for the Indian society to arouse to the reality of diabetes in the young and make all possible efforts to reduce its prevalence and ensure that each tender bud blooms to its fullest ability without missing out on the joys and excitement of this important phase of life.

8. References

[1] Sperling MA- Diabetes mellitus. In: Sperling MA, editor. Pediatric Endocrinology. Philadelphia: Saunders, 2002:323-66

[2] Prasanna Kumar KM, Krishna P, Reddy SC, Gurappa M, Aravind SR, Munichoodappa C- Incidence of type 1 diabetes mellitus and associated complications among children and young adults: results from Karnataka Diabetes Registry 1995-2008. J Indian Med Assoc 2008; 106: 708-711.

[3] Diamond Project Group – Incidence and trends of childhood type 1 diabetes worldwide 1990-1999. Diabet Med 2006; 23: 857-66.

[4] Ramchandran A, Snehalatha C, Sasikala R, Satyavani K, Vijay V – Vascular complications in young Asian Indian patients with type 1 diabetes mellitus. Diabetes Res Clin Pract 2000; 48 : 51-6

[5] Zargar AH, Bhat MH, Laway BA, Masoodi SR – Clinical and etiological profile of early onset diabetes mellitus: data from a tertiary care centre in the Indian subcontinent. J Postgrad Med 2001; 47: 27-32

[6] Jyotsna VP, Singh SK, Gopal D, Unnikrishnan AG, Agrawal NK, Singh SK et al – Clinical and biochemical profiles of young diabetics in North-Eastern India. J Assoc Physicians India. 2002; 50 : 1130-4

[7] Bhatia V, Arya V, Dabadghao P, Balasubramanian K, Sharma K, Verghese N et al – Etiology and outcome of childhood and adolescent diabetes mellitus in North India. J Pediatr Endocrinol Metab 2004: 17: 993-9

[8] Chidum E Ezenwaka, Altheia Jones-LeCointe, Emeka Nwagbara, Dawn Seales, Fidelis Okali - Anaemia and kidney dysfunction in Caribbean Type 2 diabetic patients. Cardiovascular Diabetology 2008; 7:25

[9] Thomas MC, MacIsaac RJ, Tsalamandris C, Power D, Jerums G- Unrecognized anemia in patients with diabetes. Diabetes Care 2002; 24:1164–1169

[10] Thomas MC, MacIsaac RJ, Tsalamandris C, Molyneaux L, Goubina I, Fulcher G, Yue D, Jerums G- Anemia in patients with type 1 diabetes. J Clin Endocrinol Metab 2004; 89:4359–4363.

[11] Keane WF, Lyle PA- Recent advances in management of type 2 diabetes and nephropathy: lessons from the RENAAL study. Am J Kidney Dis 2003; 41(3 Suppl 1): S22–S25

[12] Ueda H, Ishimura E, Shoji T, Emoto M, Morioka T, Matsumoko N, Fukumoto S, Miki T, Inaba M, Nishizawa Y- Factors affecting progression of renal failures in patients with type 2 diabetes. Diabetes Care 2003; 26:1530–1534

[13] Craig KJ, Williams JD, Riley SG, Smith H, Owens DR, Worthing D, Cavill I, Phillips AO - Anemia and Diabetes in the Absence of Nephropathy. Diabetes Care 2005; 28:1118–1123.

[14] Bosman DR, Winker AS, Marsden JT, MacDougall IC, Watkins PJ- Anemia with erythropoietin deficiency occurs early in diabetic nephropathy. Diabetes Care 2002; 24:495–499

[15] Jeffrey RF, Kendall RG, Prabhu P, Norfolk DR, Will EJ, Davison AM- Re-establishment of erythropoietin responsiveness in end-stage renal failure following renal transplantation. Clin Nephrol 1995; 44:241–247

[16] Hsu CY, McCulloch CE, Curhan GC- Epidemiology of anemia associated with chronic renal insufficiency among adults in the United States: results from the Third National Health and Nutrition Examination Survey. J Am Soc Nephrol 2002; 13: 504–510

[17] Fine LG, Bandyopadhay D, Norman JT- Is there a common mechanism for the progression of different types of renal diseases other than proteinuria? Towards the unifying theme of chronic hypoxia. Kidney Int 2000; 57(Suppl 75):S22–S26

[18] Grune T, Sommerburg O, Siems WG- Oxidative stress in anemia. Clin Nephrol 2000; 53(Suppl 1):S18–S22

[19] Firoozrai M, Nourbakhsh M, Razzaghy-Azar M- Erythrocyte susceptibility to oxidative stress and antioxidant status in patients with type 1 diabetes. Diabetes Res Clin Pract. 2007 Sep;77(3):427-32