Research Article

A Study on Association of Diabetes Mellitus and Hypertension with Their Demographics and Blood Parameters – A Pilot Study

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Abstract

Introduction:

Haematologists have always had a keen interest in researching the pathophysiology and clinical relevance of hematological parameters in various populations. Factors that may affect haematological and serum

biochemical parameters might include Gender, Age and disorders like Diabetes mellitus, Hypertension or both.

Aim:

To determine the correlation of hemoglobin, red blood cell count, white blood cell count and platelets with the age, gender, disorders like Diabetes mellitus, Hypertension or both.

Materials & Method:

We have selected record of 349 patients were randomly selected from the daily record register data, who came to the hematology section of the department in the regular OPD services. The record of selected patients were catagorised into 4 groups from Group A to Group D. Group A – (Control group) Subjects with no morbidity, Group B – Patients with Diabetes mellitus, Group C – Patients with Hypertension and Group D – Patients with both Diabetes mellitus & Hypertension. Blood parameters (Hb, Red blood cell count, White blood cell count and Platelets count) of each were noted and analyzed in Department of Oral Pathology and Microbiology.

Results & Discussion:

The mean age of participants having both diabetes & hypertension was found to be significantly more than that of the subjects having diabetes alone, which was further significantly more than those who did not have any morbidity. The results showed more prevalence of occurance ot these disorders among males than females. However, the mean Hb level, RBC count, WBC count and Platelet count did not differ significantly among subjects having different types of morbidities like Diabetes mellitus, Hypertension and both.

Conclusion:

We found a significant positive correlation between age among diabetic and hypertensive men and women. Poor lifestyle and lack of awareness on diabetes and hypertension might be the possible causes.

Keywords: Hematological parameters, Diabetes mellitus, Hypertension, Auto analyzer.

1. Introduction

Diabetes mellitus (DM) is defined as the group of metabolic diseases indicated by abnormal glucose levels in the blood over a long period of time. Approximately 415 million people (about 8.3% of the world's population) had diabetes worldwide in 2015, with 90% of the cases classified as Type 2 DM, which is caused by insulin resistance that arises mostly from being overweight and from a lack of exercise.

There are three types of DM: Type 1 DM is characterized by the loss of insulin-producing beta cells in the pancreas; it is traditionally termed a juvenile disease, as the majority of these cases are children and the disease is often inherited. Type 2 DM is indicated more by a poor responsiveness of the body tissues to insulin than by poor insulin

secretion by the pancreas. This often occurs after middle age and is mostly caused by lifestyle choices, such as being overweight, eating an unbalanced diet, and having poor physical exercise habits. In addition, gestational diabetes occurs during pregnancy and is often resolved after childbirth. Out of these three, 90% of the 415 million DM patients fall under Type 2. Long-term, uncontrolled diabetes has been associated with Alzheimer's disease and this is sometimes referred to as Type 3 DM [1].

An interaction between environmental and genetic factors is responsible for the development of type 2 DM. Type 2 diabetes mellitus patients have two-four folds increase in risk of atherosclerosis. Akinsegun A et al 2014 also documented an increased risk of coronary artery disease and cerebrovascular disease as a result of accelerated atherosclerosis in DM [2].

The long-term complications that result from poor glycemic control contribute substantially to the morbidity, mortality, and economic burden of diabetes. Diabetes is the main cause of blindness and end stage renal disease in adults [3].

Also, worldwide high blood pressure or hypertension is regarded as one of the most important underlying causes of cardiovascular disease. Normal BP: <120/80 mmHg [4]. It has been reported that 54% of the stroke cases and 47 % of the ischemic heart disease cases could be attributed to high blood pressure. [5]

Hypertension is defined as blood pressure more than 140/90 mm Hg. The prevalence of hypertension in India is 23.10 % among men and 26.60% among women. Prevalence of hypertension in South India was found to be 20% according to the CURES 2007 study. Overweight and obesity are the two most important key determinants of health that leads to adverse metabolic changes including increase in blood pressure. Obesity and weight gain are independent risk factors for hypertension. Also 60-70% of hypertension in adults may be directly attributable to adiposity [4].

All the above disorders are strongly related to hematological parameters like Hemoglobin, red blood cell count, white blood cell count and platelet count, etc.
Anemia is a common condition that is defined as hemoglobin level of <13 g/dL in men and <12 g/dL in women [6]. As the amount of hemoglobin represents the oxygen carrying capacity of cells, anemia is considered as a risk factor for microvascular complications, including retinopathy, nephropathy, and neuropathy in diabetic patients. Although the pathogenic mechanisms remain unclear, several studies have suggested that anemia, hemoglobin levels and RBC count may be linked to the development and progression of many disorders [7]. Hemoglobin in carried by red blood cells.

A major function of the red blood cells, erythrocyte, is to carry oxygen to all the tissues from the lungs. The RBC is a count of the number of red blood cells per cubic millimeter of blood. This measurement is made with a microscope and a specially ruled chamber (hemacytometer). Counting RBC in this way is costly and time consuming. The RBC

is recorded as millions of cells per cubic millimeter (Normal Ranges: males, 5.4 ± 0.8; females, 4.8 ± 0.6) [8].

The white blood cells (WBC) are a heterogeneous group of nucleated cells that can be found in circulation for at least a period of their life. Their normal concentration in blood varies between 4000 and 11,000 per microliter [9]. They play a most important role in phagocytosis and immunity and therefore in defense against infection. The white blood cell (WBC) count is marker of systemic inflammation. It is determined routinely by means of well-standardized automated methods at low cost and with high precision. Consequently, the WBC count is often included in routine clinical checkups. Data from multiple observational studies have demonstrated that WBC count has an independent ability to predict all-cause mortality, cancer mortality and cardiovascular diseases and mortality [10].

The platelets also play significant roles in the integrity of normal homeostasis and atherosclerosis process. Normal count of plateles ranges from 1.5-4 lakhs per microliter of blood. Platelets are also closely associated with cardiovascular events [11]. The Mean platelet volume and platelet counts are indicators of thrombotic potentials, and risk factors for microvascular complications. All the above disorders may lead to alterations of von Willebrand factor (vWF). vWF acts as an important adhesive protein for both platelet adhesion and aggregation. Because platelets play a dominant pathogenetic role in the development and outcome of cardiovascular diseases, and platelet function strongly dependent on vWF, elevated vWF levels due to hyperthyroidism may lead to increased platelet plug formation and consecutively to an increased cardiovascular risk [2].

As the above mentioned disorders may affect the Hb, RBC count, WBC count and platelet count, the present study was conducted to investigate the possible correlations of DM, Hypertension, and Hyperthyroidism with their hematological parameters through a cross-sectional study.

2. Aims & Objectives

The aim of the present study is to evaluate the pathophysiology of hematological parameters in various populations affected by Diabetes Mellitus, Hypertension or their combined occurance. Therefore the objectives of the present study are:

1. To correlate the age and gender of the subjects with the prevalence of the morbidities like Diabetes mellitus, Hypertension, and both.
2. To compare the values of hemoglobin, red blood cell count, white blood cell count and platelets count in patients with Diabetes mellitus with that of Control group in reference to age & gender.
3. To compare the values of hemoglobin, red blood cell count, white blood cell count and platelets count in patients with Hypertension with that of Control group in reference to age & gender.
4. To compare the values of hemoglobin, red blood cell count, white blood cell count and platelets count in patients with both Diabetes mellitus & Hypertension with that of Control group in reference to age & gender.

5. To inter-compare the values of hemoglobin, red blood cell count, white blood cell count and platelets count among patients with Diabetes mellitus, Hypertension, and both.

3. Materials & Method

It is a Cross sectional study, in which a minimum of total 349 patients randomly who came to the hematology section of the department in the regular OPD services and taking 95% Confidence Interval with 5 % Error. After taking ethical approval by the institutional review board for the protocol, KG Medical University, record of 349 patients were randomly selected from the daily record register data, who came to the hematology section of the department in the regular OPD services. The record of selected patients were catagorised into 4 groups from Group A to Group D. Group A – (Control group) Subjects with no morbidity, Group B – Patients with Diabetes mellitus, Group C – Patients with Hypertension and Group D – Patients with both Diabetes mellitus & Hypertension. Blood parameters (Hb, Red blood cell count, White blood cell count and Platelets count) of each were noted. Analysis of the record was done in Department of Oral Pathology and Microbiology. The record of any patient revealing presence of clinical evidence of any haemorrhage, , Fe & Folate, Vit B12 deficiency, systemic infection, any blood disorder or who has donated blood within 6 months from date, were excluded from the study.

3.1 Inclusion Criteria:

i. Record of Male & Female subjects visiting the regular hematology OPD of Department of Oral Pathology & Microbiology, KG Medical University, since November 2019 were included in the study.
ii. Age = 20 - 70 years
iii. Record of subjects residing in Plain geographic area

3.2 Exclusion Criteria:

i. Record of the participant with clinical evidence of haemorrhage.
ii. Record of the participant with clinical evidence of any infection.
iii. Record of the participant with clinical evidence of Fe, Folate, Vit B12 deficiency.
iv. Record of the participant who has donated blood within 6 months from date.
v. Record of the participant with clinical evidence of Diabetes mellitus.
vi. Record of the participant with clinical evidence of any blood disorder.
vii. Record of subjects residing in other geographic area except for Plain.

Analysis of the record was done in Department of Oral Pathology and Microbiology, KG Medical University, since November 2019 were included in the study.

Statistical analysis - was done using Chi square test and Post hoc pairwise comparison test.
Source of Funding - Self

Conflict of interest - None

Results

On comparing the total 349 subjects, mean age of males & females did not differ significantly. (Table 1) However, the mean age of participants having both diabetes & hypertension was found to be significantly more than that of the subjects having diabetes alone, which was further significantly more than those who did not have any morbidity. (Table 2) In our study, the results were not found to be significantly different among males & females when the different morbidities were compared gender wise but they shows significant prevalence of occurance in male patients (Table 3). In our study, when results regarding association of different morbidities with hematological parameters were evaluated, the mean Hb level, RBC count, WBC count and Platelet count did not differ significantly among subjects having different types of morbidities like Diabetes mellitus, Hypertension and both. (Table 4, 5, 6, 7)

Table 1: Age wise distribution of subjects

	Gender	N	Mean	Std. Deviation	't', P value
Age	Males	237	39.080	16.5276	1.533, 0.126
	Females	112	36.223	15.6693	

Table 2: Age wise distribution of subjects with different morbidities

Age (years)					
	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
No morbidity	256	31.063	12.1266	29.570	32.555
Diabetes	25	53.360	8.7506	49.748	56.972
Hypertension	32	55.875	7.6189	53.128	58.622
Both diabetes & hypertension	36	62.194	7.4097	59.687	64.702
Total	349	38.146	16.3095	36.429	39.863
F, p value	132.23, <0.001				
Post hoc pairwise comparison	No morbidity < Diabetes < Both diabetes & HT No morbidity < Hypertension				

Table 3: Gender wise distribution of subjects with different morbidities

			Gender		Total
			Males	Females	
Past Medical History	No morbidity	n	170	86	256
		%	66.4%	33.6%	100.0%
	Diabetes	n	16	9	25
		%	64.0%	36.0%	100.0%
	Hypertension	n	25	7	32
		%	78.1%	21.9%	100.0%
	Both diabetes & hypertension	n	26	10	36
		%	72.2%	27.8%	100.0%
Total		n	237	112	349
		%	67.9%	32.1%	100.0%
Chi square, p value			2.28, 0.516		

Table 4: Correlation of Morbities with Hemoglobin

Haemoglobin (grams/dl)					
	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
No morbidity	256	13.529	1.8176	13.305	13.752
Diabetes	25	12.904	1.5834	12.250	13.558
Hypertension	32	13.469	1.5013	12.927	14.010
Both diabetes & hypertension	36	12.719	2.0652	12.021	13.418
Total	349	13.395	1.8170	13.204	13.586
F, p value	2.788, 0.051				
Post hoc pairwise comparison	-				

Table 6: Correlation of Morbities with WBC count

WBC count (X 10^3)					
	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
No morbidity	256	7.085	1.8350	6.859	7.311
Diabetes	25	7.144	1.6220	6.474	7.814
Hypertension	32	6.984	2.0410	6.248	7.720
Both diabetes & hypertension	36	6.819	2.0247	6.134	7.504

Total	349	7.053	1.8546	6.857	7.248
F, p value		0.249, 0.862			
Post hoc pairwise comparison		-			

Table 7: Correlation of Morbities with Platelet count

Platelet count					
	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
No morbidity	256	211.2702	77.70122	201.7065	220.8338
Diabetes	25	211.8400	82.47913	177.7943	245.8857
Hypertension	32	206.4063	82.57894	176.6334	236.1791
Both diabetes & hypertension	36	191.0556	96.39263	158.4410	223.6701
Total	349	208.7798	80.45734	200.3092	217.2504
F, p value		0.684, 0.563			
Post hoc pairwise comparison		-			

Discussion

In our study, out of 349 patients who were randomly selected who came to the hematology section of the department in the regular OPD services, 237 (67.9%) were males and 112 (32.1%) were females. On statistical analysis the mean age of males & females was not found to differ significantly. The finding of gender prevelance in our study was contrary to a study conducted by Enawgaw B et al 2017 in which the percentage of females was more i.e. 67% among 252 subjects [12]. However, in our study the mean age of subjects with diabetes alone was younger and statistically significant (p value < 0.001) than the subjects with both diabetes & hypertension, which was further significantly more than those with no morbidity. The findings of our study were found to be similar to studies conducted by Geldsetzer P et al 2018 and Tsimihodimos V et al 2018 [13]. It is therefore suggested that development of hypertension and diabetes mellitus track each other over time, also the transition from normotension to hypertension is characterized by a sharp increase in BP values, and insulin resistance is one common feature of both prediabetes and prehypertension and an antecedent of progression to both the disease states [14].

Gender wise the distribution of different morbidities were not found to be significantly different among males & females in our study, but then also the number of males (67) affected with morbidities were comparatively more in comparison to females (26). The results were contrary to a study performed by Zuhara NV et al 2019 in which they concluded that the selected diabetics comprised of 46.4% males and 53.6% females. [15] Also, in a study conducted by Ramakrishnan S et al 2019, on 180,335 participants (33.2% women; mean age 40.6 ± 14.9 years) with hypertension, in which overall prevalence of hypertension was 30.7% and that too it was found to be more prevalent

in females. [16] However, in a meta-analysis done by Kumar M et al 2020 which included 300 articles, they also suggested the overall prevalence of diabetes among the male population. However, there can be some variations in the results due to the selection of different age groups, utilizing different diagnostic criteria and cultural factors determining physical activity of individuals in different geographical areas [17].

In our study, on correlation of the morbidities with Hemoglobin, RBC count, WBC count and platelets, the results did not differ significantly among subjects having different types of morbidities. The results of our study were not similar with the studies conducted by Lee MK et al 2018, Yang J et al 2017, Barbiere J et al 2015, Xuan Y et al 2018 in which they concluded that high hemoglobin levels are signifcantly related to a decreased risk of diabetes and hypertension [6, 18, 7]. (Hypertension and hb 1) It is suggested that decreased hemoglobin level was linked with 24-h systolic BPV level independently other risk factors including age, 24-h and systolic blood pressure level [19].

Contrary to the results of our study, RBC count was positively associated with the risk of inadequate glycemic control in a study performed by Jaman MS et al 2018 [20]. Also in a study conducted by Alamri BN et al 2019, hyperglycemia has an imposing effect on RBCs count and its physiological function, which can be normalized effectively with good glycemic control [21]. In a study performed by Wang ZS et al 2013, similar results were obtained, they concluded that a decreased RBC count is associated with microvascular complications in Chinese patients with T2DM. The RBC count is a potential marker to improve further the ability to identify diabetic patients at high risk of microvascular complications [22]. Also in a study performed by Enawgaw B et al 2017, Hypertension has impact on hematological parameters. In this study, the mean and median values of haematological parameters in hypertensive individuals were significantly different compared to apparently healthy normotensive individuals. Hence, hematological parameters can be used to monitor the prognosis of the disease and manage hypertensive related complications, and it is important to assess hematological parameters for hypertensive individuals which may help to prevent complications associated hematological disorders [12].

An elevated leukocyte count even within the normal range was associated with chronic complications in type 2 diabetes and can be used to predict development of micro and macro vascular complications in patients diagnosed with type 2 diabetes, as concluded by Naredi M et al 2017 [3, 23]. Also, Kim DJ et al 2008 in their study suggested that total leukocyte count and all differential leukocyte count examined are independently associated with the presence of Hypertension [24].

The results of our study in relation to platelets were not similar to a study conducted by Chen X et al 2017 as the concluded that there was no relationship between the presence of diabetes with PDW and PLT. However, the MPV was independently associated with the presence of diabetes. [11,2] Also, Gang Li et al 2017 in their study suggested that elevated MPV is associated with increased incidence of hypertension independent of other risk factors, which suggests that platelet activity may play a role in hypertension incidence [25].

Conclusion

We found a significant positive correlation between age among diabetic and hypertensive men and women. Poor

lifestyle and lack of awareness on diabetes and hypertension might be the possible causes. Poor awareness of diabetes and hypertension management and the communication gap with health care providers may be the major contributing factors. Hence, diabetes and hypertension education programs providing guidance in self-care practices especially lifestyle changes are essential for the general community. Future prospective studies with larger sample size are required to determine more precise role of Hematological parameters in diabetic and hypertensive patients as these   may assist in detecting either low or high risk for progression to diabetes and hypertension and may encourage the normal population to be more conscious towards their health by maintaining balanced diet, regular exercise, yoga etc.

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