



ORIGINAL RESEARCH ARTICLE

ASSOCIATION OF HYPERTENSION AND ISCHAEMIC ECG CHANGES IN TYPE II DIABETES MELLITUS

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is one of the most common metabolic disorders to the current generation. It usually leads to multi-systemic complications such as cardiovascular diseases, proteinuria, micro albuminuria, retinopathy, hypertension, ischaemic changes and chronic kidney disease. These complications increase the morbidity and mortality of patients. The prolonged hyperglycemia leads to vascular damage. It causes insufficient blood flow to the cardiac muscles which may cause myocardial or cardiac ischaemia. The aim of this study was to find out the prevalence of hypertension and ischaemic ECG changes in T2DM patients attending Kathmandu Medical College.

Methods: Total 360 type 2 diabetic patients were included. Blood pressure was measured and electrocardiogram (ECG) was recorded by 12 leads ECG. Statistical analysis was done using SPSS version 16. $p < 0.05$ was considered to be statistically significant.

Results: The mean age of the patients was 66.88 ± 1.52 years, age ranging from 40 – 95 years. In this study 168 patients (46.66%) had systolic hypertension, 204 patients (56.67%) had diastolic hypertension and 126 (35%) had both systolic and diastolic hypertension. About 103 (28.61%) showed ECG changes in hypertensive patients. Only 4 (1.11%) non-hypertensive had ECG changes. This study showed statistically significant relation of hypertension and ischaemic ECG changes in type 2 diabetes mellitus cases with p -value 0.03.

Conclusions: There is a high prevalence of hypertension among T2DM patients. In these patients, there is a statistically significant association between hypertension and ischaemic ECG changes.

INTRODUCTION

Type II Diabetes mellitus (T2DM) or non-insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes is a metabolic disorder that results in hyperglycemia. The symptoms include excess thirst, frequent urination and constant hunger. T2DM is more prevalent than T1DM.¹

The number of people with diabetes and hypertension is increasing globally. Diabetes with hypertension fall among the top 10 leading causes of death in the world.²

This lethal combination of diabetes with hypertension is in increasing order in Nepal as well.³

The incidence rate of diabetes have increased markedly. About 424.9 million people were found diabetic worldwide in 2017 with an estimate of a 48% increase to 628.6 million people for the year 2045.⁴

A study in US population showed, hypertension occurs in approximately in 50% to 80% of patients with type 2 diabetes. Hypertension and diabetes share common pathway. These two diseases frequently occur together. Behavioral changes and physical activity plays an important protective role in both con-

dition. Knowing the common causes, disease mechanisms and complications provides a more effective approach in their prevention and treatment.⁵

According to Joint National Committee (JNC) 8, systolic blood pressure more than 140 mm of Hg and diastolic more than 90 mm of Hg is considered as hypertension with diabetes.⁶

The main purpose of identification and treatment of diabetic with hypertension patients is reduction of cardiovascular morbidity and mortality. Hypertension and T2DM are two commodities condition.⁷

METHODS

A cross-sectional study was conducted from March 2017 to April 2018. Ethical clearance was obtained from the Institutional Review Committee (IRC) of Kathmandu Medical College (Ref No. 17032017). Sample size was calculated by using formula, $n = 4pq / E^2$ the result was 360. Previously diagnosed type 2 diabetes cases were taken from OPD of Kathmandu Medical College and Teaching Hospital, Duwakot, Bhaktapur. Patients having fasting blood glucose level more than 110 mg/dl and post prandial level more than 140 mg/dl were considered as diabetes case. Patients having normal blood glucose level but history of diabetes with medication were also considered as diabetic. Total 360 type 2 diabetic patients with age more than 40 years were included. Type I diabetic patients, patients with chronic diseases, malignancy and pregnant women were excluded from the study

Patients' name, age, gender, address, contact no. were recorded as patient's information which was confidentially maintained. Blood pressure was measured manually by using sphygmomanometer and stethoscope for three times. It was measured after complete rest with 10 minutes interval then mean was calculated. The systolic blood pressure up to or more than 140 mm of Hg and diastolic more than 90 mm of Hg were considered as hypertension. The subject already diagnosed as a hypertensive was also considered as hypertensive regardless of their current blood pressure. ECG (Electrocardiogram) was recorded by 12 leads Schiller electrocardiograph. The ST segment changes from baseline and changes in amplitude of T wave were utilized for defining ischaemic ECG changes. Elevation of ST segment more than 0.1 mv (millivolt) and depression up

to or more than 0.5 mv was considered as ischaemic changes. Flat T wave, inversion of T wave more than 0.1 mv and marked increase in T wave were also considered as ischaemic ECG changes.

Data was collected, compiled and analyzed by using Statistical Package of Social Science (SPSS) software version 16. The data were expressed as mean \pm SD or median (minimum-maximum) as appropriate. Frequency of hypertension and ischaemic ECG changes were calculated. The association of hypertension and ischaemic ECG changes were analyzed by chi-square test. p-value of < 0.05 was considered to be statistically significant.

RESULTS

A total of 360 diabetic patients (mean age: 66.88 ± 1.52 years, age ranging from 40 – 95 years) were included in the study. There were 168 males (46.6 %) and 192 females (53.4 %) (Figure 1).

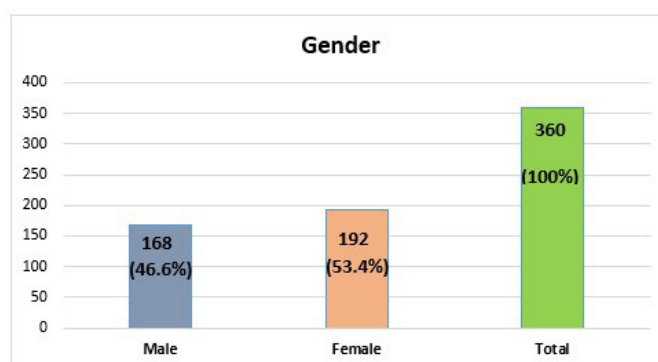


Fig 1: Bar diagram showing the frequency of gender

One hundred sixty eight patients (46.66%) had systolic hypertension. Remaining 192 (53.34%) did not show the condition of systolic hypertension (Table 1).

Table 1: Frequency of systolic hypertension in total (n=360)

Systolic Blood Pressure	Frequency (Percent)
≥ 140 mm of Hg	168 (46.66 %)
≤ 140 mm of Hg	192 (53.34 %)
Total	360 (100 %)

In current study population, 204 patients (56.67%) had diastolic hypertension. Remaining 156 (43.33%) did not show the condition of diastolic hypertension (Table 2).

Table 2: Frequency of diastolic hypertension in total (n=360)

Diastolic Blood Pressure	Frequency (Percent)
≥ 90 mm of Hg	204 (56.67%)
≤ 90 mm of Hg	156 (43.33%)
Total	360 (100%)

In this study, 107 (29.73%) patients were recorded with ischaemic ECG changes and 253 (70.27%) were normal (Table 3).

Table 3: Frequency of ischaemic ECG changes in total (n=360)

ECG Changes	Frequency (Percent)
Yes	107 (29.73%)
No	253 (70.27%)
Total	360 (100%)

In current study, total 103 (28.61%) showed ECG changes in hypertensive patients. Only 4 (1.11%) non-hypertensive had ECG changes. p-value was 0.03 which showed statistically significant relation of hypertension and ischaemic ECG changes in type 2 diabetes mellitus cases (Table 4).

Table 4: Association of ECG changes with hypertension and non-hypertension

	Hypertension with ECG changes	Non Hypertension with ECG changes	Total	p - value
Yes	103 (28.61%)	4 (1.11%)	107 (29.72%)	0.03
No	145 (40.27%)	108 (30%)	253 (70.27%)	
Total	248 (68.88%)	112 (31.11%)	360 (100%)	

DISCUSSION

Type 2 diabetes mellitus is one of the most common metabolic diseases which is associated with many other systemic diseases like cardiovascular diseases, hypertension, retinopathy and micro albuminuria. Similar to our study, a study of Iran showed slightly higher prevalence in female (5.8%) than in males (5.1%).⁸ A contrasting result was observed in a Nigerian study, with high prevalence rate in male 7.7% than in female (5.7%).⁹ Diabetes mellitus has direct

association with obesity and physical activities. It might be due to cultural value, ethnicity and household chores might affect more in female in one region and contrast in other.

A study by Sun D et al. showed a very high prevalence (85.1 %) of hypertension in type 2 diabetes.¹⁰ A study of Morocco showed a high prevalence rate 70.4% of hypertension in diabetes mellitus.¹¹ A study in Czech Republic showed very high prevalence rate of 91.3%.¹² Diabetes mellitus and hypertension had direct correlation with food habit and obesity.

A study done by Gupta S and et.al, showed similar result with current study in ECG changes in diabetes cases. The prevalence of ischaemic ECG changes were found in 26% of diabetic patients. The researcher had included asymptomatic diabetic cases. The current study doesn't differentiate between symptomatic or asymptomatic but result was similar.¹³

Shlomo Stern and Samuel Sclarowsky took the case report of 42 years old, early stage of diabetes case and showed ischaemic ECG changes (ST depression by 2 mm). This case showed diabetic patients are very much vulnerable to develop cardiovascular complications even in early stage of hyperglycemia.¹⁴ A study done by Chiariello M, et.al showed both symptomatic and non-symptomatic changes in ST segment. In total 51 diabetic patients, 18 patients showed symptomatic changes (36 episode) and non-symptomatic (93 episode) changes in ST segment.¹⁵ A study of Bangladesh among 400 hypertensive patients, abnormal electrocardiographic changes were found in 212 (53%) patients. They had categorized the changes in ECG like mild, moderate and severe cases, changes were 38.8% in mild, 65% moderate and 100% in severe. The rate of changes in ECG was in increasing order from mild to moderate and severe form.¹⁶ These studies showed there was strong co-relation of hypertension and type 2 diabetes. But, there was least significance with ECG changes and type 2 diabetic cases. But strong association of hypertension and ischaemic ECG changes in type 2 diabetes.

The appearance of ischaemic ECG abnormalities may be an important tool to detect those cases with a higher risk of cardiovascular diseases in future,

in addition to the presence of other risk factors. It could be easy to select populations and prevent the risk.

The study also has some limitations. As the sample was taken from only one place, the results thus obtained cannot be generalized. Larger sample size of various region might have greater value. The patient's detailed history was not included. If the patients were kept under long term follow up which might suggest further risk and its consequences of the condition.

CONCLUSION:

The present study found about fifty percent of prevalence of hypertension among diabetic patients. There was strong association of hypertension and ECG changes in type 2 diabetes mellitus. Diabetic patients have high chances of developing hypertension that has statistically significant association with ischaemic ECG changes. So, developing hypertension in type 2 diabetic cases could be a marker of cardiovascular involvement.

REFERENCES

1. Xu G, Liu B, Sun y, Du Y, Snetselaar LG, Hu FB, Bao W. Prevalence of diagnosed type 1 and type 2 diabetes among US adults in 2016 and 2017: population based study. *BMJ* 2018;362:k1497. [\[DOI\]](#)
2. Kimberly Holland. What Are the 12 Leading Causes of Death in the United States? Healthline: November 2018. [\[LINK\]](#) (3-09-2019)
3. Pandey AR, Karki KB, Mehata S, Aryal KK, Thapa P, Pandit A, Bista B, Dhakal P, Dhimal M. Prevalence and Determinants of Comorbid Diabetes and Hypertension in Nepal: Evidence from NCD Risk Factors STEPS Survey Nepal 2013. *J Nepal Health Res Counc* 2015 Jan - Apr;13(29):20 -50. [\[PDF\]](#)
4. Eberhard S. Global statistics on diabetes. European Society of Cardiology. 01 Apr 2019. [\[LINK\]](#)
5. Cheung BMY, Li . C. Diabetes and Hypertension: Is There a Common Metabolic Pathway? *Curr Atheroscler Rep*. 2012 Apr; 14(2): 160–166. [\[DOI\]](#)
6. Max C. American College of Physicians Ohio/ Air Force Chapters 2018 Scientific Meeting Columbus, OH October 5, 2018. What's In the New Hypertension Guidelines? [Accessed 4-9-2019] [\[PDF\]](#)
7. Petrie JR, Guzik TJ and Touyz RM. Diabetes, Hypertension, and Cardiovascular Disease: Clinical Insights and Vascular Mechanisms. *Can J Cardiol*. 2018 May; 34(5): 575–584. [\[DOI\]](#)
8. Nezhad AM, Mobarhan GM, Parizadeh MR, et.al. Prevalence of type 2 diabetes mellitus in Iran and its relationship with gender, urbanization, education, marital status and occupation. *Singapore Med J* 2008; 49(7): 571. [\[PDF\]](#)
9. Nyenwe EA, Odia OJ, Ihekweba E, Ojule A. Type 2 diabetes in adult Nigerians: a study of its prevalence and risk factors in Port Harcourt, Nigeria. *Diabetes Research and Clinical Practice*. December 2003; Volume 62(3); 177-85. [\[DOI\]](#)
10. Sun D, Zhou T, Heianza Y, Li X, Fan M, Fonseca VA, Qi L. Type 2 Diabetes and Hypertension. A Study on Bidirectional Causality. *Circulation Research*. 2019;124:930–937. [\[DOI\]](#)
11. Berraho M, et al. Hypertension and type 2 diabetes: a cross-sectional study in Morocco (EPIDIAM Study). *The Pan African Medical Journal*. 2012; 11:52. [\[DOI\]](#)
12. Souček M, Widimský J, Lánská V. Control of Hypertension in Patients with Hypertension, Diabetes, and Impaired Fasting Glucose by Czech Primary Care Physicians. *Kidney Blood Press Res* 2006;29:366–372. [\[DOI\]](#)
13. Gupta S, Gupta RK, Shrestha KM, and Chaudhary RR. Evaluation of ECG Abnormalities in Patients with Asymptomatic Type 2 Diabetes Mellitus. *J Clin Diagn Res*. 2017 Apr; 11(4): OC39–OC41. [\[DOI\]](#)
14. Stern S, Sclarowsky S. The ECG in Diabetes Mellitus. *Circulation*. 2009;120:1633–1636. [\[DOI\]](#)

15. Chiariello M, Cindolfi M, Cotecchia R, Sifola C, Romano M, Concorelli M. Asymptomatic transient ST changes during ambulatory ECG monitoring in diabetic patients. *American Heart Journal*; September 1985;110(3):529-534. [\[DOI\]](#)
16. Newaz AR, Huda SQ, Ali MM, Maula MG, Islam MS. Electrocardiographic Changes in Different Grades of Hypertensive Patients: Experience of 400 Cases in Bangladesh. *Journal of Science Foundation*, January 2016; Vol. 14(1):1728-7855. [\[DOI\]](#)