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Original Research Article

Study of hypertensive subjects with diabetes as co-morbidity

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ABSTRACT

Background: Combined presence of diabetes and hypertension increases the chances of various complications manifold than individually. Together, they accelerate the development of left ventricular hypertrophy, coronary artery disease, renal dysfunction, diabetic retinopathy and cerebrovascular diseases.
Methods: After ethical considerations this observational study was carried out to identify the clinical, laboratory and end-organ profile of Hypertensive subjects who also had Diabetes; this cohort was also compared with subjects who had hypertension only.
Results: The prevalence of hypertensive subjects with diabetes as co-morbidity was 10.26%. 26.4% subjects had family history of diabetes and 20.4% had family history of hypertension. The mean diastolic blood pressure (83.66±12.0) was significantly higher in hypertensive diabetes group, than the subjects with hypertension only (76.98±6.46) and the difference was statistically significant (p <0.0001). 51.9% of hypertensive females with diabetes had significantly higher (p 0.0003) central obesity. Macrovascular damage was slightly more common in females and microvascular damage was common in male hypertensive diabetic subjects. Out of 102 patients having end organ damage 37.25% had single organ involvement and 62.75% had multiple organ involvement. Retinopathy (33.2%) was commonest followed by renal (27.6%), cardiovascular (16.2%) and cerebrovascular (14.8%). Hypertensive diabetic patients had higher occurrence of end organ damage reflecting the impact of diabetes-hypertension co-morbidity on target organs.
Conclusions: Given the increasing rates of coronary artery disease among Indians, especially at a younger age, 5understanding and successfully managing this deadly duo may hold the key to reducing cardiovascular mortality in India.

Keywords: Co-morbidities, Diabetes, Hypertension

INTRODUCTION

Diabetes and hypertension, two of the major global risk for mortality, are interrelated diseases that strongly predispose an individual to atherosclerotic disease.[1]

The combined presence of hypertension and diabetes in an individual concomitantly accelerates the development of left ventricular hypertrophy, coronary artery disease, renal dysfunction, diabetic retinopathy and cerebro-vascular diseases.[2,3] Diabetic nephropathy often leads to hypertension; hence hypertension occurs more commonly in individuals with known diabetes than vice-versa. The prevalence of hypertension is 1.5-2.0 times more in those with diabetes than in those without diabetes, whereas almost one-third of the patients with hypertension develop diabetes later.[4] Many studies are available in literature about hypertension developing in diabetic subjects; however there are fewer studies on hypertension with diabetes as co-morbidity. Given the increasing rates of coronary artery disease among Indians, especially at a younger age, understanding and successfully managing this deadly duo may hold the key to reducing cardiovascular mortality in India.[5]

This study was conducted with an aim to understand the clinical profile, laboratory characteristics, and susceptibility to end-organ damage in hypertensive subjects with diabetes, compared with those without. Additionally, we also intended to study the temporal elements that influenced the disease course and outcome in subject vis-à-vis the onset of hypertension or diabetes.

METHODS

After ethical considerations, this cross-sectional observational study was conducted over a period of one year (2013-2014) in the specialty hypertension clinic of a tertiary teaching hospital in Mumbai. Two hundred and fifty (250) hypertensive patients with type 2 diabetes as co-morbidity were enrolled in the study arm and one hundred and twenty two (122) subjects with Hypertension alone were enrolled in the comparison arm. Pregnant females, type-1 diabetics and those with secondary hypertension were excluded from the study group. Eligible patients were divided into various groups as per gender, presence of diabetes, type of end organ damage, and the time of diagnosis of hypertension and diabetes. Historical details were sought about hypertension, diabetes, personal habits, occupation and symptoms of target organ damage. Detailed physical examination was carried out and recorded in the validated proforma. The results of tests those are mandatory for all hypertensive patients with diabetes as co-morbidity (as per JNC 7 recommendation) were also recorded.

Statistical analysis

For parametric numerical data unpaired t test was used for comparison between two groups and ANOVA test was used for comparison between more than two groups. For Non-parametric numerical data Mann-Whitney test was used for comparison between two groups and Kruskal-Wallis test was used for comparison between more than two groups. Post-hoc test was used for multiple group comparison. For parametric categorical data chi square test and Fishers exact test were used for comparison between two or more groups.

RESULTS

We analysed the data pertaining to clinical features, anthropometry, laboratory parameters, and end organ damage as per the following cohorts:

- Hypertensive patients with diabetes.
- Hypertensive patients without diabetes.
- Hypertension-Diabetes group classified as per time of diagnosis as

a) Hypertension diagnosed prior to diabetes (Hypertension precedes)
b) Diabetes diagnosed prior to hypertension (Diabetes precedes)
c) Both Hypertension and diabetes diagnosed simultaneously.

Hypertensive subjects with diabetes

Demographic profile

Prevalence: From September 2013 to August 2014, a total of 2436 (584 new cases, 1852 follow-up cases) patients visited our hypertension clinic. Out of these patients, 250 patients were having both hypertension as well as diabetes. The prevalence of hypertensive subjects with diabetes as co-morbidity attending hypertension clinic was 10.26%.

Age: In present study mean age of hypertensive patients with diabetes as co-morbidity was a 57.88±10.72 year. Mean age in males was 57.95±10.76 years and in females, 57.82±10.72 years. There was no statistical difference between age of male and female subjects in study population (p-0.92).

Gender: In present study, out of 250 hypertensive diabetic subjects, 131 (52%) were females and 119 (48%) were males

Addictions: In present study, smoking (8%), tobacco (26%), alcohol (9%) and mixed addictions were in 15.2% patients. 29% females had addiction, predominantly of Tobacco use.

Presenting complaints: Although 41% subjects were asymptomatic, giddiness was the commonest symptom found in remaining 30% subjects followed by headache in 11% subjects. 6% of patients presented with chest pain and 10% patients complained of sweating.

Disease duration: In present study, mean duration of diabetes was 5.13±1.35 years. Males had mean duration of diabetes as 5.8±1.85 years and females had 5.52±1.8 years. The mean duration of hypertension was 6.55±2.17 years and there was no significant difference between the duration in males and females.

Family History: 25.95% of females and 26.8% of males had family history of diabetes mellitus. Family history of hypertension was present in 20.60% of females and 20.16% of males. Thus one fourth of study subjects had family history of diabetes and one fifth had family history of hypertension.

Blood pressure measurements

Mean systolic blood pressure in hypertensive subjects with diabetes as co morbidity was 132.69±17.60 mm Hg and mean diastolic blood pressure was 83.66±12.01mm Hg. There was no significant difference found on comparing mean systolic (p 0.60) and diastolic Blood pressure (p 0.45) of male with female hypertensive subjects with diabetes as co morbidity. The mean systolic blood pressure was higher by 2mm Hg in hypertensive diabetes patients (132.69±17.60) when compared with patients having hypertension without diabetes

(130.52±12.98) (p 0.09), however the mean diastolic blood pressure (83.66±12.0) was significantly higher in hypertensive diabetes group, than the subjects with hypertension only (76.98±6.46) and the difference was statistically significant (p <0.0001). It was also noted that both systolic BP (137.39±19.01) and diastolic BP (87.30±11.48) was higher in subjects in whom diabetes was diagnosed earlier than hypertension, though not statistically significant (p 0.31 for systolic BP and P 0.24 for diastolic BP).

Anthropometry

In our study, mean weight of hypertensive males with diabetes was 68.48±10.78 and that of hypertensive females with diabetes was 64.24±22.13. The difference was statistically significant (p<0.0001). However, 51.9% of hypertensive females with diabetes had abnormal Waist Circumference as compared to only 28.5% of hypertensive males with diabetes (p 0.0003), thus reflecting significantly higher central obesity in hypertensive female patients with diabetes. The mean Waist to Height ratio in these hypertensive females (0.608±0.06) was significantly higher (p<0.0001) as compared to the hypertensive males (0.56±0.06).

The mean BMI of Hypertensive females with diabetes (25.07±4.23) was higher than males (24.90±5.55), but the difference was not statistically significant. On comparing hypertensive subjects with diabetes, with the hypertensive subject without diabetes we found that the mean weight (66.26±17.75 kg), mean waist circumference (93.27±9.49 cms) was significantly higher, p 0.0002 and p 0.0017 respectively. Waist to Height ratio and BMI were comparable in these two groups. In the study subgroups in which diabetes was diagnosed prior to hypertension, mean weight (71.53±34.01 kg) and mean waist circumference (96.16±10.19 cms) were higher, though not statistically significant

Laboratory profile

The mean haemoglobin of female hypertensive diabetics was significantly lower (11.83±8.39 gm%) as compared to males (12.45±2.63 gm%) with p <0.0001. The fasting blood glucose in males and females was comparable, however the post lunch blood sugar in males (217.47±74.98 mg%) was significantly higher than in females (202.89±82.68 mg%), p 0.019 reflecting the need for tight blood sugar control in males. 35.29% of male hypertensive diabetic subjects had microalbuminuria, a strong predictor of diabetic nephropathy, as compared to 20.6% females, this difference was statistically significant (P-0.02).The difference in BUN and S. Creatinine between male and female hypertensive diabetic subject was statistically significant (P<0.0001 in both). Males had higher mean BUN (22.70±24.80 mg/dl) than females (14.20±13.21) Serum Creatinine in males was 1.92±2.23 mg/dl as compared to females, 1.2±0.07 mg/dl. These findings indicate that male hypertensive diabetic subjects have more renal affliction than their female counterparts. The lipid profile components, S. Cholesterol and S. Triglycerides were comparable in both genders in our study population. Male hypertensive diabetic subjects had increased frequency of abnormal ECG (26.89%) as compared to 21.37% in females and significantly higher (P=0.0083) abnormal renal ultrasound findings in males 16.8 % as compared to 6.1% in females.

Comparing the biochemical parameters of hypertensive diabetic group with those with only hypertension, we found that both BUN and S. Creatinine were higher in hypertensive diabetic subjects and S. Cholesterol and S. Triglyceride lower in hypertensive diabetic subjects. Considering the time of diagnosis of hypertension and diabetes in study population, we found that mean fasting blood sugars was high in subjects in whom hypertension and diabetes was diagnosed simultaneously. The post lunch blood sugar was higher in the group in whom diabetes was detected prior to hypertension; however the difference was not statistically significant (p 0.14, 0.49 respectively). The presence of urine abnormalities such as albumin, cast etc. were significantly higher (70%) in diabetes precedes group.

End organ damage

We evaluated four important organ involvements namely brain, heart, retina and kidney in our study subjects, former two reflecting macrovascular damage and latter two microvascular involvement in hypertensive diabetic patients. Out of 250 hypertensive diabetic patients, 148 (59.2%) did not have evidence of end organ involvement. Remaining 102 (40.8%) patients had one or more organ involvement. Out of 102 patients having end organ damage 37.25% had single organ involvement and 62.75% had multiple organ involvement.

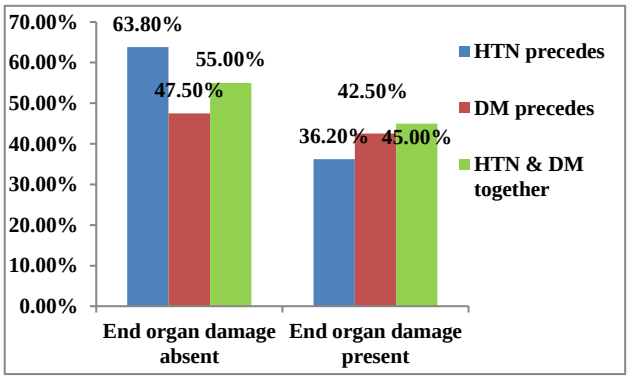

Figure 1: comparison of presence of end organ damage in various groups as per time of diagnosis.

Retinopathy (33.2%) was commonest followed by renal (27.6%), cardiovascular (16.2%) and cerebrovascular (14.8%). Male hypertensive diabetics (42.8%) outnumbered female hypertensive diabetics (38.9%) however the difference was not statistically significant (p

0.61). In contrast to 33.6% of non-diabetic hypertensive subjects having end organ damage, 40.8% of diabetic hypertensive had evidence of end organ damage, reflecting the impact of both the risk factors together. Subjects in whom the diagnosis of hypertension and diabetes was made simultaneously showed higher (45%) involvement of end organ damage (Figure 1).

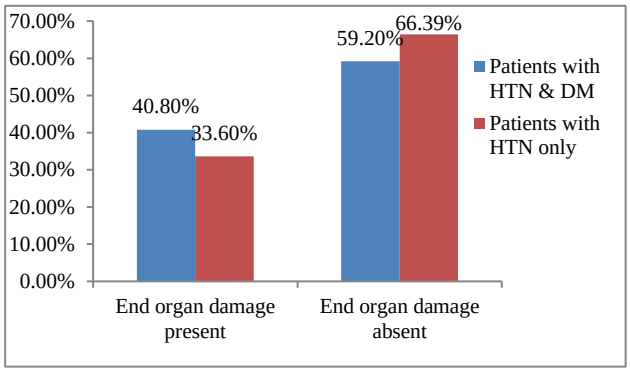

Figure 2: Comparison of end organ damage in hypertensive diabetic subjects with hypertensive subjects.

Relation of gender with individual end organ involvement showed that male hypertensive diabetic had higher involvement of end organs (cerebrovascular 15%, cardio vascular 18.5%, Retinopathy 35.29% and renal 35.29%) (P<0.02%), as compared to female hypertensive diabetic subjects (cerebrovascular 14.5%, cardiovascular 12.2%, Retinopathy 31.29% and Renal 21.37%). On comparing hypertensive diabetic subjects with hypertensive non diabetic subjects, it was noted that the end organ damage is significantly higher when both the metabolic disease exist together (Figure 2).

Hypertensive diabetic patients had significantly higher cerebrovascular 14.8% (p 0.0015), Retinal 33.2% (p<0.0059), Renal 27.6% (p<0.0001) and higher cardiovascular involvement 15.2% (p 0.19). Subjects in whom hypertension and diabetes was diagnosed simultaneously, had higher cerebrovascular involvement 16.3% (p 0.83), cardiovascular involvement 20.4% (p 0.17) and ophthalmic involvement 35.2% (p 0.37). It is interesting to note that the subjects in whom diabetes was diagnosed prior to hypertension, renal involvement was maximum 42.5% (p 0.01) compared to other 2 groups.

Table 1: The characteristics in the three cohorts classified as per time of diabetes diagnosis.

Measures	HTN precedes	DM precedes	HT/DM same time	P value
n (%)	105(42)	47 (18.3)	98 (39.2)	----
Mean Age(years)	58.31±11	56.72±9.84	58.70±10.59	0.58
Mean weight (Kg)	64.73 ± 10.96	71.53±34.01	65.48±21.36	0.42
Mean waist circumference (cm)	93.57±9.32	96.16±10.19	91.92±9.19	0.54
Mean waist:height ratio (cm)	0.59± 0.06	0.59±0.07	0.57±0.06	0.077
BMI (kg/m2)	25.55± 6.32	24.57±3.08	24.58±3.73	0.31
Mean systolic BP(mm/Hg)	131.36±17.7	137.39±19.01	132.3±16.82	0.31
Mean diastolic BP(mm/Hg)	82.62±10.84	87.30±11.48	83.04±13.04	0.24
Fasting blood glucose (mg/dl)	147.69±46.74	158.02±59.53	163.79± 64.7	0.14
Post-prandial blood glucose (mg/dl)	203.80±69.61	232.18±107.08	207.8±74.57	0.49
BUN (mg/dl)	14.23±15.89	28.79±28.79	18.12 ±18.11	<0.0001
Sr.Creatinine (mg/dl)	1.25±1.05	2.42±2.91	1.5 ± 1.46	0.0082
Serum Cholesterol (mg/dl)	158.11±41.03	179.95±48.49	173.08±40.54	0.007
Triglycerides (mg/dl)	124.75±55.95	140.16±64.2	146.04±116.02	0.28
Presence of urine abnormality (%)	47.61	70	55.1	0.048
Presence of EOD (%)	36.2	42.5	45.1	0.13
Cerebrovascular involvement (%)	13.34	14.9	16.3	0.83
Cardiovascular involvement (%)	11.42	12.7	20.4	0.17
Retinal involvement (%)	28.6	34.1	35.2	0.37
Renal involvement (%)	20.3	42.5	29.59	0.01
Macrovascular damage (%)	16.2	21.27	26.5	0.24
Microvascular damage (%)	31.4	44.6	49	0.63

Extrapolating these results further we found that when compared to hypertensive subjects, the hypertensive diabetic patients had significantly higher 20.4% Vs. 11.5%; p <0.047) macro vascular damage and significantly higher (40.8% Vs. 29.67%; p <0.0001) microvascular damage.

Female hypertensive diabetic patients had higher (21.37%) macrovascular damage as compared to males (19.3%) p 0.807. Microvascular damage was seen more commonly in male hypertensive diabetic (46.2%) than females (35.8%) p 0.12. Subjects in whom hypertension and diabetes were diagnosed together, macrovascular damage, was seen commonly (26.5%, p 0.24) and also microvascular damage (49%, p 0.63).

'Hypertension-only' group

Hypertensive subjects with diabetes were younger (Mean age - 57.88±10.72 years) as compared to subjects who only had hypertension (Mean age - 63.56±8.79 years) and the difference was statistically significant (p-<0.0001). Anthropometric features were comparable in both groups, so was the systolic blood pressure. Diastolic blood pressure was significantly higher in patients with both hypertension and diabetes than those with hypertension only (p<0.0001). Blood glucose levels and blood urea nitrogen levels were significantly abnormal in the former group. Although the overall incidence of end-organ involvement was higher in the study group, it was not statistically significant. But when studied individually, the incidence of cerebrovascular events, retinopathy and nephropathy was significantly higher in patients with hypertension and diabetes.

Comparison in various groups as per time of diagnosis

Table 1 highlights the characteristics in the three cohorts classified as per time of diabetes diagnosis.

DISCUSSION

In India, as per the 2011 estimates reported by the Indian Council of Medical Research–India Diabetes study, 62.4 and 77.2 million people have diabetes and prediabetes, respectively.[6] This coexistence presents an increased risk and can accelerate vascular complications. Understanding the prevalence of hypertension and diabetes and their associated risk factors (hyperlipidaemia, micro-albuminuria, central obesity, gender) in hypertensive subjects is therefore important especially in urban population. The prevalence of hypertensive subjects with diabetes as co-morbidity attending hypertension clinic was 10.26%.

The available studies from literature are population based studies or studies on patients with metabolic syndrome where hypertension and diabetes co-existed in significant number of cases. We have compared present study results with available Indian studies on subjects with hypertension and diabetes. Screening India's Twin Epidemic (SITE) study by Joshi SR et al in 2009-2010 has reported co-existence of Diabetes and hypertension in 3227 of 15662 (20.6%) patients.[7] The SITE study is a cross-sectional, multicentre, observational clinic based study conducted in 10 states on 15662 subjects. The study further reported that diabetes was prevalent in 34.7% patients and 46.0% subjects had hypertension. Thakur S et al, from Himachal Pradesh reported that in hypertensive patients, 23.7% had impaired fasting glucose.[8] Chi-Neng Hsu et al from Taiwan reported a high prevalence (42.3%) of high fasting glucose or treated diabetes amongst hypertensive subjects.[9] Another study from Jordan, by N Yasein et al on hypertensive subjects reported prevalence of diabetes mellitus as 29.9%.[10] The lower prevalence (10.26%) of hypertensive subjects with diabetes as co-morbidity in our study could be probably due to availability of speciality endocrine OPD and Diabetes clinic in present institution. In present study mean age of hypertensive patients with diabetes as co-morbidity were 57.88±10.72 years. In SITE study by Joshi SR et al mean age in diabetic patients was 54.5±11.5 years and mean age in hypertensive patients was 53.8±12.6 years. In a Japanese study on hypertensive diabetic patients by Eguchi et al, mean age was reported as 67±8.8 years.[11] Chi-Neng Hsu et al from Taiwan reported mean age of 65.3±12.1 years in hypertensive patients with metabolic syndrome.[9] The mean age of hypertensive diabetic subjects in present study is lesser by one decade.

The mean systolic blood pressure was higher by 2 mm Hg in hypertensive diabetes patients when compared with patients having hypertension without diabetes, however the mean diastolic blood pressure was significantly higher in hypertensive diabetes group, than the subjects with hypertension only and the difference was statistically significant. It was also noted that both systolic BP (137.39±19.01) and diastolic BP (87.30±11.48) was higher in subjects in whom diabetes antedated hypertension, though not statistically significant. Thus, longer duration and presence of diabetes in hypertensive subjects has a definite effect on blood pressure, a point to be borne in mind while achieving target blood pressure in these patients. A quarter of our study subjects had family history of diabetes and one fifth had family history of hypertension. Our results are similar to those reported in SITE study by Joshi et al where almost one fourth of the patients had family history of diabetes (24.5%) and hypertension (23.2%).

As mentioned earlier when compared with hypertensive subjects the hypertensive diabetic subjects in present study were significantly over weight (p<0.0002) with central obesity (p 0.0017), having higher systolic BP, significantly higher diastolic BP (p<0.0001), significantly higher BUN (p<0.0001), higher S. Creatinine.

The hypertensive diabetic males had significantly higher addictions (p 0.03), higher mean weight (p<0.0001), higher mean fasting blood sugars, significantly higher post lunch blood sugar (p 0.019), significantly higher microalbuminuria (p 0.02), significantly higher BUN (p<0.0001) and S. Creatinine (p<0.0001). S. Cholesterol and S. Triglycerides were higher in male hypertensive diabetic and they had more frequency of abnormal ECGs

and significantly higher number of male subjects had abnormal renal ultrasound findings (P 0.0088). The female hypertensive diabetics were having significantly lower haemoglobin (P<0.0001) and significantly higher waist circumference (0.0003) and abnormal waist to height ratio (P<0.0001). These findings suggest overall poor nutrition status and sedentary life style of females (mostly housewives) in present study.

The group of subjects in whom diabetes was diagnosed prior to hypertension, amounting to increased duration of diabetes have shown increased weight, increased waist circumferences, higher systolic and diastolic blood pressure, higher post lunch blood sugar significantly higher BUN (p<0.0001) and S. Creatinine (p<0.0082), higher S. Cholesterol (p<0.007) and higher S. Triglycerides, significantly higher urinary abnormalities (p 0.048). On comparing hypertensive subjects with diabetes, with the hypertensive subject without diabetes we found that the mean weight (66.26±17.75 kg), mean waist circumference (93.27±9.49 cms) was significantly higher (p 0.0002 and p 0.0017) respectively. S Thakur et al from Himachal Pradesh reported central obesity in 93.8% hypertensive subjects with metabolic syndrome.[8] Yasein N, et al from Jordan reported high WC in 70.7% of hypertensive subjects with metabolic syndrome.[10] 84.2% of hypertensive females and 51.7% of hypertensive males in this study had high WC. MTA Olinto et al from Brazil reported waist circumference as an independent determinant for hypertension and diabetes in women.[12]

The mean age of hypertensive diabetic subjects in our cohort is almost 10 years younger than the studies reported from Japan and Taiwan, making it all the more imperative to study the impact of hypertension and diabetes on vital organs. Out of 250 hypertensive diabetic patients, 148 (59.2%) did not have evidence of end organ involvement. 102 (40.8%) patients had one or more organ involvement. Out of 102 patients having end organ damage 37.25% had single organ involvement and 62.75% had multiple organ involvement. In contrast to 33.6% of non-diabetic hypertensive subjects having end organ damage, 40.8% of diabetic hypertensive had evidence of end organ damage, reflecting the impact of both the risk factor together.

Subjects in whom the diagnosis of hypertension and diabetes was made simultaneously showed higher (45%) involvement of end organ damage. Hypertensive diabetic patients had significantly higher cerebrovascular 14.8% (p 0.0015), Retinal 33.2% (p<0.0059), Renal 27.6% (p<0.0001) and higher cardiovascular involvement 15.2% (p 0.19) Subjects in whom hypertension and diabetes was diagnosed at the same time, had higher cerebrovascular involvement 16.3% (p 0.83), cardiovascular involvement 20.4% (p 0.17) and ophthalmic involvement 35.2% (p 0.37). It is interesting to note that the subjects in whom diabetes was diagnosed prior to hypertension, renal involvement was maximum 42.5% (p 0.01) compared to other 2 groups. These observations strongly support the impact of diabetes in hypertensive subjects on the vascular tree and contribution of these two lifestyle disorders in morbidity. The SITE study from India reported previous history of ischemic heart disease (3%), myocardial infarction (1.6%) and stroke (0.8%). 4.4% of diabetic patients and 5% of hypertensive patients had IHD as complications and 1.3% of diabetic patients and 1.3% of hypertensive patients had stroke as complications. The Table 2 compares present study with the Japanese study by Euguchi et al.

Table 2: Comparison of present study with study from Japan by Euguchi et al.[11]

Measures	Study from Japan by Euguchi et al (2003)	Present study (2014)
Total subjects	360	372
HTN with DM	159	250
HTN without DM	201	122
Mean Age(years)	67.0±6.8	5788±10.72
Males	43%	48%
Females	57%	52%
BMI (kg/m^2)	24.4±3.9	24.5±4.76
Mean systolic BP(mm/Hg)	135±17	132.68±17.6
Mean diastolic BP(mm/Hg)	82±10	83.66±12.01
Duration of HTN (years)	8.5±8.6	6.55 ±2.17
Duration of DM (years)	10.7±8.0	5.13 ±1.35
Current smokers	29%	8%
Tobbaco	-	26%
Total Cholesterol (mg/dl)	204.94±34.8	167±43.19
Triglycerides (mg/dl)	141.71 ± 70.85	135.37±86.04
Sr. Creatinine (mg/dl)	0.78 ± 0.36	1.54 ± 1.7
Neurological involvement *	62%	14.8%

* In the study from Japan, neurological involvement was MRI proved multiple silent cerebral infarct. In present study it was clinically evident cerebrovascular events; K. Euguchi from Japan in October 2003 reported that the age, BMI, Prevalence of current smokers, Serum Cholesterol, Serum Creatinine were comparable between the two groups, namely hypertensive patients with diabetes and hypertensive patients without diabetes. The prevalence of male sex, duration of hypertension and serum triglyceride levels was significantly higher in the hypertensive patient with diabetes as co-morbidity than in hypertensive patient without diabetes.

Limitations of present study

This study was conducted in a speciality hypertension clinic of a tertiary care hospital in a metropolitan city,

hence the observation and conclusions of this study cannot be extrapolated to the general population, especially those from rural areas. The sample size need to be larger and the study needs to be continued over several years with follow-up visit analysis which can give further valuable information about the study population.

CONCLUSION

Diabetes and hypertension are manageable health conditions. Understanding the prevalence of diabetes and hypertension and their associated risk factors in larger and more diverse population should be central to any meaningful evaluation of disease epidemiology. With an increasing burden of this twin epidemic in India, public awareness and disease prevention projects need to be undertaken. Our study also emphasizes the need for metabolic screening and evaluation for end organ involvement, in all hypertensive patients at initial diagnosis and thereafter at frequent intervals.

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