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Original Research Article

The ECG changes in various comorbidities with hypertension and without hypertension

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ABSTRACT

Background: Hypertension is the commonest cardiovascular disorder posing a challenge to the societies in socioeconomic and epidemiologic transition. In India, Cardiovascular Diseases (CVDs) are estimated to be responsible for 1.5 million deaths annually. Indeed, it is estimated that by 2020, CVDs will be the largest cause of mortality and morbidity in India. To present study is designed to evaluate the variation of blood pressure and ECG wave forms among people hypertension with co morbidities (study group) and controls.
Methods: The study included 50 people comorbidities with hypertension and 50 controls, each between ages 30-40 years from general population, and also from Medicine outpatient department, KIMS and RF Amalapuram. Detailed history from subjects, blood pressure (sitting position) and electrocardiogram was recorded during resting state in supine position. The ECG results were evaluated for various parameters like heart rate, P wave, PR interval, QRS complex etc.
Results: There was significant increase in heart rate, systolic blood pressure as well as diastolic blood pressure in study group when compared to controls. Decrease in PR interval, decrease in QT interval, decrease in QTc interval, decrease in QRS axis in smokers when compared to controls.
Conclusions: There was significant increase in heart rate in study group (smokers, diabetic) when compared to controls. There was significant increase in systolic blood pressure as well as diastolic blood pressure in study group (smokers, diabetics) when compared to controls. There was significant decrease in PR interval in smokers when compared to controls. There was significant decrease in QT and QTc interval in smokers when compared to controls.

Keywords: Diabetes, ECG, Hypertension, Smoker

INTRODUCTION

Health vitality and long life are desirable goals of every individual. But many of habits of modern life style and sedentary living have become a serious threat to our health by significantly increasing the incidence of chronic diseases like hypertension, diabetes, atherosclerosis, coronary artery diseases, stroke and cancer.[1] Hypertension is the commonest cardiovascular disorder posing a challenge to the societies in socioeconomic and epidemiologic transition.[2] Hypertension affects nearly 26 per cent of the adult population worldwide.[3] Hypertension as a most important risk factor for death in industrialized countries.[4] India, the world's largest democracy, is undergoing a rapid economic growth. This growth has been accompanied by demographic, lifestyle and cultural changes which have had a large impact on the health profile of India's citizens and placed a

significant strain on the country's healthcare system.[5-7] Whilst such changes may be most obvious in major cities, such as Delhi and Mumbai, they are also likely to impact those living in the rural areas. Over 70% of India's population live in rural areas, yet access to government healthcare is much poorer than in urban areas, with twice the number of hospital beds available to urban dwellers per head of population.[8] In India, cardiovascular diseases (CVDs) are estimated to be responsible for 1.5 million deaths annually.[9] Indeed, it is estimated that by 2020, CVDs will be the largest cause of mortality and morbidity in India.[10]

METHODS

This is a prospective, observational study conducted in the department of general medicine Konaseema institute of medical science Amalapuram from July 2018 to December 2019.

Patients were enrolled in this based on exclusion and inclusion criteria.

They are grouped into two controls and study groups. Each group consists of 50 subjects between ages 30-40 years were selected from general population, and also from Medicine outpatient department, KIMS and RF Amalapuram.

Inclusion criteria

- Male Individuals age group 30-40 years
- Smoker
- Diabetic (FBS ≥126 mg/dl, RBS ≥200 mg/dl.)

Exclusion criteria

- The male individuals aged <30 and >40 yrs,
- Patients on Anti-hypertensive medications
- Patients with coronary artery disease
- Females
- Acute illness

This study is approved by institutional ethics committee, A written informed consent was obtained from all patients before enrolment for this study.

Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level.

The study included 50 people comorbidities with hypertension and 50 controls, each between ages 30-40 years from general population, and also from Medicine outpatient department, KIMS and RF Amalapuram. Detailed history from subjects, blood pressure (sitting position) and electrocardiogram was recorded during resting state in supine position. The ECG results were evaluated for various parameters like heart rate, P wave, PR interval, QRS complex etc. Hypertension is a major risk factor for CVDs, including stroke and myocardial infarction. Patients with high blood pressure frequently have abnormalities of cardiac structure and function including left ventricular hypertrophy, systolic and diastolic dysfunction and in extreme cases overt heart failure. Using a cut-off of 140 mmHg or greater systolic Blood Pressure (BP), or 90 mmHg or greater diastolic BP people with hypertension have: increased dietary salt intake, smoking and long term drinking, family history of hypertension, overweight and obese, too much psychological stress, diabetes and insulin resistance. Hence the present study is undertaken ECG changes in people comorbidities with hypertension and thereby creating awareness among people. Physical examination included measuring height in centimeters, weight in kilograms, recording resting pulse rate by palpating radial artery and blood pressure recording with a mercury sphygmomanometer. Clinical examination of cardiovascular and respiratory systems was done in detail. The subjects were screened using the inclusion and exclusion criteria and taken up for the study. Following detailed assessment of the subject, a 12-lead electrocardiogram was recorded during the resting state.

RESULTS

In present study 50 people co morbidities with hypertension and 50 controls, each between ages 30-40 years from general population were evaluated as per study protocol.

Table 1: Age-wise distribution of study subject.

Age in years	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
30-34	18	72.0	3	12.0	22	44.0
35-39	7	28.0	10	40.0	16	32.0
40-44	0	0.0	12	48.0	12	24.0
Total	25	100.0	25	100.0	50	100.0
Mean±sd	32.80±2.10		37.80±3.32		35.24±3.76	

Diabetic patients had higher mean age with p<0.001**

Among study group Smokers, highest percentage of study subjects were in the age group of 30-34 years and whereas among Diabetics and controls subjects were in 30-34, 35-39 and 40-44 yrs. There is a difference in age distribution between study group and controls and it was significant in Diabetics (p-value 0.001) (Table 1).

Out of 25 smokers 1 subject is in BMI of 23-30 kg/m^2 and 24 subjects in BMI of 18.5-23 kg/m^2 and 25 diabetics, 3 were in 18.5-23 kg/m^2 and 22 were 23-30 kg/m2 and in controls of 50,35 in 18.5-23 kg/m^2 and 15 in 23-30 kg/m^2 (Table 2).

Table 2: BMI distribution of study subjects.

BMI (kg/m^2)	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
18.5-23.0	24	96.0	3	12.0	35	70.0
23.0-30.0	1	4.0	22	88.0	15	30.0
>30.0	0	0.0	0	0.0	0	0.0
Total	25	100.0	25	100.0	50	100.0

Table 3: Comparison of Anthropometric measurements b/w study group and controls.

	Smokers	Diabetics	Controls	p value
Height (cm)	1.63±0.05	1.60±0.09	1.61±0.07	0.358
Weight (kg)	53.16±4.09	62.76±6.66	57.98±5.66	<0.001**
BMI (kg/m^2)	20.14±1.01	24.69±1.74	22.22±2.07	<0.001**

Weight (mean) was more among diabetics (62.76 kgs), controls (57.98 kgs) compared to smokers (53.16 kgs) and this difference was statistically significant. BMI (mean) was comparatively more among diabetics (24.69 kg/m^2) and smokers (20.14 kg/m^2), controls (22.22 kg/m^2) and this difference was found significant (Table 3).

Table 4: Comparison of heart rate b/w study group and controls.

HR(BPM)	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
<70	0	0.0	3	12.0	16	32.0
71-80	3	12.0	12	48.0	32	64.0
81-90	16	64.0	6	24.0	1	2.0
>90	6	24.0	4	16.0	1	2.0
Total	25	100.0	25	100.0	50	100.0

Out of 25 smokers 16 (64%) are with heart rate 81-90 and 6 (24%) are with heart rate greater than 90 and 3 (12%) are with heart rate 71-80.out of 25 diabetics 12 (48%) are in heart rate 71-80, 6 (24%) are with heart rate 81-90, 4 (16%) are with heart rate greater than 90, 3 (12%) are with heart rate less than 70 (Table 4).

Out of 25 smokers 24 (96%) are with greater than 120 mm of Hg of SBP and less than 120 mm of Hg in 1 (4%) and diabetics 21 (84%) are with SBP greater than 120mm of Hg and 4 (16%) with SBP less than 120 mm of Hg (Table 5).There 25 smokers are having DBP greater than 80 mm of Hg and out of diabetics 25,20 (80%) are having DBP greater than 80 mm of Hg and 5 (20%) are having DBP LESS THAN 80 mm of Hg (Table 6).

Heart rate (mean) was high among smokers (87.76 bpm), diabetics (79.40 bpm) compared to controls (73.48 bpm) and this difference was found to be statistically significant. Systolic BP (mean) was more among smokers (123.36 mm Hg), diabetics (123.12 mm Hg) Compared to controls (117.95 mm Hg) and this difference was statistically significant. Similarly, Diastolic BP (mean) was more among smokers (81.20 mm Hg), diabetics (80.08 mm Hg) compared to controls (79.52 mmHg) and this difference was significant (Table 7).

Table 5: Comparison of SBP b/w study group and controls.

SBP (MM HG)	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
<120	1	4.0	4	16.0	43	86.0
>120	24	96.0	21	84.0	7	14.0
Total	25	100.0	25	100.0	50	100.0

Table 6: Comparison of DBP b/w study groups and control.

DBP (MM HG)	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
<80	0	0.0	5	20.0	42	84.0
>80	25	100.0	20	80.0	8	16.0
Total	25	100.0	25	100.0	50	100.0

Table 7: Comparison of vitals (BP, HR) b/w study groups and controls.

Vital parameters	Smokers	Diabetics	Controls	p value
HR (BPM)	87.76±4.56	79.40±9.39	73.48±4.19	<0.001**
SBP (mm Hg)	123.36±2.75	123.12±4.73	117.95±2.98	<0.001**
DBP (mm Hg)	81.20±1.53	80.08±3.81	79.52±2.57	0.040*

Table 8: Comparison of p wave b/w study groups and controls.

Measurements (p wave)	Smokers	Diabetics	Controls	Significance		
				Smokers-diabetics	Smokers-controls	Diabetics-controls
Duration (s)	0.08±0.01	0.07±0.01	0.075±0.009	0.177	0.271	0.863
Amplitude (mm)	1.02±0.07	0.92±0.31	0.96±0.134	0.124	0.344	0.656

There was not much difference in duration (mean) of P wave between smokers (0.08 sec), diabetic (0.07 sec) and controls (0.075 sec) and it was not significant. And amplitude (mean) was slightly high among smokers (1.02), controls (0.96) compared to diabetics (0.92) which was statistically not significant (Table 8).

Table 9: Comparison of ECG parameters b/w study groups and controls.

Measurements	Smokers	Diabetics	Controls	Significance		
				Smokers-diabetics	Smokers-controls	Diabetics-controls
PR Interval	0.14±0.02	0.15±0.02	0.155±0.013	0.790	0.020*	0.122
QRS Interval	0.08±0.02	0.08±0.02	0.077±0.011	0.806	0.999	0.732
QT Interval	0.35±0.04	0.40±0.03	0.39±0.023	<0.001**	<0.001**	0.505
QT_C Interval	0.38±0.06	0.44±0.04	0.43±0.039	<0.001**	0.001**	0.464
QRS Axis	41.32±13.93	52.68±10.73	55.80±10.51	0.002**	<0.002**	0.512

QT interval (mean) was less among smokers (0.35 sec) compared to controls (0.39 sec) and this was statistically significant. QT interval (mean) was slight difference among diabetics compared to controls and this difference was statistically not significant. QTc interval was less among smokers (0.38 sec) compared to controls (0.43 sec) and this difference was statistically significant. QTc interval no much difference between diabetics (0.44 sec) and controls. QRS axis (mean) was very high among controls (55.800) compared to smokers (41.320) and it was statistically significant (Table 9).

Table 10: Comparison of T wave b/w study groups and controls.

T wave	Smokers		Diabetics		Controls	
	No	%	No	%	No	%
Normal	25	100.0	25	100.0	50	100.0
Abnormal	0	0.0	0	0.0	0	0.0
Total	25	100.0	25	100.0	50	100.0

As per table 10, out of 25 smokers there are 100% normal t wave and 25 diabetics 100% are of having normal t wave. There was no abnormal T wave in any group.

DISCUSSION

In this study Blood pressure and ECG changes compared between hypertension with comorbidities and age matched controls. Age is important risk factor for development of hypertension. Isolated systolic hypertension is strongly age dependent. This age depended pattern of increasing rates of ISH is observed in Framingham Heart Study.

Heart rate: In this study Heart rate (mean) was more among smokers (87.76 bpm) compared to controls (73.48 bpm) and it was statistically significant (p value <0.001). The increased in heart rate could be due to stimulation of sympathetic ganglia and discharge of catecholamine's from adrenal medulla.[11] Nicotine causes an increase in heart rate by stimulating release of endogenous adrenergic neurotransmitters.[12] Within minutes of cigarette smoking, nicotine receptors in adrenal medulla are stimulated triggering the release of epinephrine and Norepinephrine. Also, there was significant increase in heart rate (79.40 bpm) was noticed in diabetics compared to controls (73.48 bpm).[13,14] This increase in heart rate can be explained by activation of adrenergic system in diabetic patients. Cardiovascular autonomic neuropathy is common complication of diabetics.

Blood pressure: In this study Systolic BP (mean) was more among smokers (123.36 mmHg) compared to controls (117.95 mmHg) and this difference was statistically significant. Similarly Diastolic BP (mean) was more among smokers (81.20 mmHg) compared to controls (79.52 mmHg) and this difference was statistically significant.[15] Ramon C. Hermida et al, found statistically significant increased diastolic pressure in smokers (p<0.001), ZahiKhoury et al, found increased systolic as well as diastolic blood pressure in smokers. P wave: There was not much difference in duration (mean) of P wave between smokers (0.08 sec) and controls (0.075 sec) and it was statistically not significant. And amplitude (mean) was slightly high among smokers (1.02 mm) compared to controls (0.96 mm) which was statistically not significant.[16,17] S B Sharma et al, and Khan IS et al, also found amplitude was slightly high among smokers compared to controls. But P wave duration and amplitude measurements did not show any statistically significant difference in diabetics when compared to controls PR interval.[15,18] In this study PR interval (mean) was shortened among smokers compared to controls and this difference was statistically significant. This results finding was in agreement with Baden L et al, and Khan IS et al. Cigarette smoking increases the velocity of conduction and shortens the effective refractory period at the AV node.[19] QRS complex: In this study there was no statistical difference in duration of QRS complex (mean) between smokers

(0.08 sec) and controls (0.077 sec). Similar findings noted in Khan IS et al, and Chatterjee S et al. Increased duration of QRS complex noted.[18] It may be because aging affects electrocardiographic wave patterns and aging effect is modified by long term smoking. QRS axis: In this study, QRS axis (mean) showed statistically highly significant decrease in smokers (41.320) when compared to controls (55.800). Venkatesh G and Swamy RM found decreased QRS axis in smokers (42.00) when compared to controls (510) but was not significant. So, these results indicate that aging affects electrocardiographic wave patterns. QT interval: QT interval (mean) was less among smokers (0.35 sec) compared to controls (0.39 sec) and this was statistically significant. Similar findings were reported by Dilaveris P et al. Also, there was slight increase in QT interval was noticed in diabetics (0.40 sec) when compared to controls (0.39 sec). QTc interval: QTc interval was decreased in smokers (0.38sec) compared to controls (0.43sec) and this was not statistically significant. The ventricular repolarization is altered in young male smokers. The differences in the heterogeneity of ventricular repolarization between smokers and controls are mainly due to heart rate differences between the 2 study groups. There was no significant difference in QTc interval among diabetics (0.44 sec) and controls (0.43 sec).Which is supported by the work of Ewing DJ, Boland O et al. 19Twave: In this study, authors noticed normal T waves was seen in study group compared to controls. This finding corroborates with the study of ZahiKhoury, Phillip Comans et al.[17]

CONCLUSION

The following conclusions can be drawn from results of this study. There was significant increase in heart rate in study group (smokers, diabetic) when compared to controls. There was significant increase in systolic blood pressure as well as diastolic blood pressure in study group (smokers, diabetics) when compared to controls. There was significant decrease in PR interval in smokers when compared to controls. There was significant decrease in QT and QTc interval in smokers when compared to controls. There was significant decrease in QRS axis in smokers when compared to controls. The study shows that there were varieties of ECG changes in various comorbidities with hypertension when compared to controls.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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