STUDY OF CORRELATION OF PULSE PRESSURE WITH FRS IN TYPE 2 DIABETES MELLITUS AT A TERTIARY CARE CENTRE IN BANGALORE

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ABSTRACT

BACKGROUND

Pulse pressure (PP) is the difference between systolic blood pressure and diastolic blood pressure. It is easy to measure and has been established as a surrogate marker of arterial stiffness. Studies have been done to determine its significance as a better predictor of coronary heart disease (CHD) risk than systolic blood pressure (SBP) or diastolic blood pressure (DBP) in patients over 50 years of age. Our goal was to study its significance in diabetic patients as a single parameter as surrogate marker to correlate cardiovascular risk in 10 years obtained with the help of multiparametric Framingham risk score calculation.

METHODS

This is a cross sectional study conducted in the outpatient department of a tertiary care center. Patients were distributed into three groups based on blood sugar control. Group 1 (control group), Group 2 (moderately controlled blood sugar), and group 3 (uncontrolled blood sugar). Age and sex were appropriately matched with the controls. Pulse pressure and Framingham risk score were calculated and correlated for each group.

RESULTS

Pulse pressure showed good correlation with systolic blood pressure and Framingham risk score in patients with poorly controlled diabetes. ($r = 0.862$, $p < 0.001$) and ($r = 0.537$, $p =< 0.001$). Statistically significant differences in mean value were found amongst 3 groups of patients for FBS, PP, TG, RS. 'F' ranged from 144-8.49, $p = 0.001$ for all groups. The other two parameters namely diastolic blood pressure and fasting blood sugar did not reveal statistical significance.

CONCLUSIONS

Pulse pressure can be used as a surrogate marker to predict risk for coronary artery disease in diabetics with uncontrolled sugar levels. We hence intend to remind our fellow physicians of the importance of pulse pressure measurement in daily practice.

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BACKGROUND

On April 12, 1945 president Franklin Roosevelt died of a massive heart attack; in response to this event president Truman signed the national heart act and the intensive study of heart disease began on October 11, 1948 through the Framingham heart study.[1,2] At that point of time we knew very little of the epidemiology of heart disease. Since then to 2019 we have gone through 71 years of intensive research and this period has given us sufficient information to understand and predict the epidemiology of heart disease. Although there are various calculators to measure cardiovascular risk in asymptomatic patients one of the most reliable risk calculators is the one derived from information obtained from the Framingham Cohort study which has been used for over 10 years to optimally predict cardiovascular risk.[3,4] Cardiovascular disease is extremely common and we need a suitable instantaneous method to be able to predict cardiovascular risk.[5] Pulse pressure was shown to be a good predictor of cardiovascular risk in type 2 diabetics.[6] Although the Framingham risk calculator requires multiparametric information to predict risk we wanted to investigate if a simple single parameter such as pulse pressure would corelate with the risk score obtained from the Framingham risk score calculator. Diabetic patients without any previous history of a myocardial infarction have an equally high risk of developing a myocardial infarction as a nondiabetic patient who has suffered from a previous myocardial infarction.[7]

The risk of cardiovascular disease is indeterminate in the aspect of quantitative control of blood sugar levels.

We attempt to investigate the correlation of cardiovascular risk in diabetics based on the degree of control of blood sugar levels with the help of the Framingham risk score and further correlate this to pulse pressure measurement.

Surprisingly most studies have not been able to establish any relationship with glycaemic control and cardiovascular risk, and the risk has been attributed to nonglycemic factors seen in diabetes.[8] Moreover, recent data indicate that aortic stiffness is an independent predictor of mortality in patients

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with diabetes and we wanted to correlate if pulse pressure could be an efficient surrogate marker to correlate with Framingham risk score to predict cardiovascular risk.

METHODS

Study Area

M S Ramaiah medical college is a well-known tertiary care center in North Bangalore. All data was collected from the outpatient department of General Medicine at Ramaiah Medical College Hospital.

Measures

It was a cross sectional observational study conducted during the period of two years. Pulse pressure was measured manually using a sphygmomanometer. Blood pressure recordings were done according to the norms prescribe by ACC 2017 Guidelines as published in JACC.

Waist and hip circumference were calculated using a measuring tape. Fasting blood sugar, Cholesterol and triglycerides were analysed by NABH accredited laboratory part of Ramaiah teaching hospital. A total of 105 participants were studied. Framingham Risk Score was calculated using an app in an android software phone

Rationality of Sample Size

A pilot study was undertaken to evaluate the relationship between pulse pressure and FRS amongst population of poorly controlled diabetes in the hospital in the absence of any published literature for estimating sample size. The findings of study revealed the significant correlation of 0.768 between two parameters. Assuming that population correlation coefficient to be 0.91 with the power of 80% and alpha error of 5%, the sample size was found to be 33. However, in the present study 35 subjects were included for the study in each 3 groups

Inclusion Criteria

Diabetic patients with no past history of cardiovascular disease.

Exclusion Criteria

All patients that could have a pathological cause of increase in pulse pressure that could interfere with data collection and tabulation were excluded such as Thyrotoxicosis, increased intracranial hypertension, anaemia, beriberi, or established cardiovascular disease which would interfere with pulse pressure measurement.

Ethical Approval

Research was approved by the ethical committee, Ramaiah Medical College, Bangalore.

Analysis

Data from the questionnaire was entered in SPSS (Statistical Package for the Social Sciences) version 19 for analysis and the results were compared. All the quantitative parameters such as SBP, DBP, FBS, pulse pressure, Triglycerides and Framingham Risk score were expressed as mean with Standard deviations for all three groups and subjects.

The difference in mean values amongst the three groups in control subjects (Group I), T2DM (Controlled) (Group II) and T2DM (Uncontrolled) (Group III) were tested for statistical significance by employing analysis of variance.

Further Bonferroni test and significance was employed for post hoc statistical significance. Further to evaluate the relationship of pulse pressure with SBP, DBP, FBS and FRS Pearson correlation coefficient was computed along with the significance levels.

RESULTS

Various clinical parameters such as systolic (SBP), diastolic blood pressure (DBP), fasting blood sugar (FBS), pulse pressure (PP), triglycerides and risk stratification (FRS) for the various groups namely Group 1 (Controlled blood sugar subjects) Group 2 (Moderately controlled subjects) and Group 3 (Uncontrolled blood sugars) are presented in Table 1.

	Group 1	Group 2	Group 3	F	p
Systolic BP (mmHg)	129.3 ± 16.8	136.3 ± 18.8	133.7 ± 19.6	1.297	0.278
Diastolic BP (mmHg)	82.3 ± 9.8	84.5 ± 10.8	84.5 ± 9.76	0.606	0.548
FBS	89.3 ± 10.35	122.97 ± 23.25	171.1 ± 24.1	144.49	0.001
Triglycerides Total (mg/dl)	47.3 ± 30.63	136.9 ± 47.94	195.7 ± 78.45	30.217	0.001
PP	90.9 ± 2.77	51.1 ± 11.28	48.9 ± 13.92	213.32	0.001
Risk Stratification	2.6 ± 30.63	4.5 ± 4.5	7.7 ± 7.16	8.49	0.001

Table 1

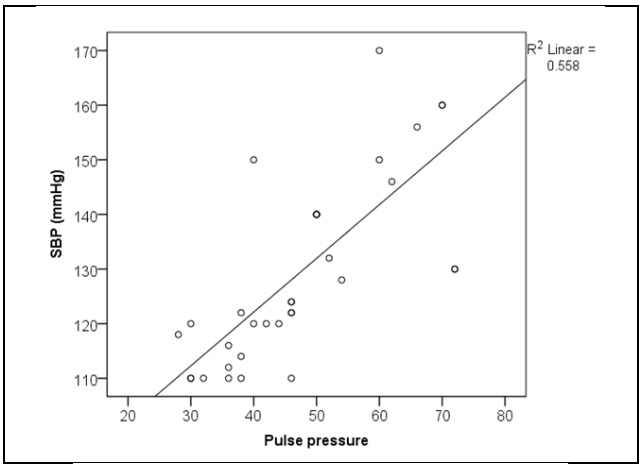
	Group 1		Group 2		Group 3	
	r	p	r	p	r	p
SBP	0.747	0.001	0.822	0.001	0.862	0.001
DBP	0.60	0.731	0.336	0.48	0.302	0.078
FBS	-0.63	0.717	-2.51	0.145	0.325	0.571
FRS	-1.32	0.456	0.241	0.163	0.537	0.001

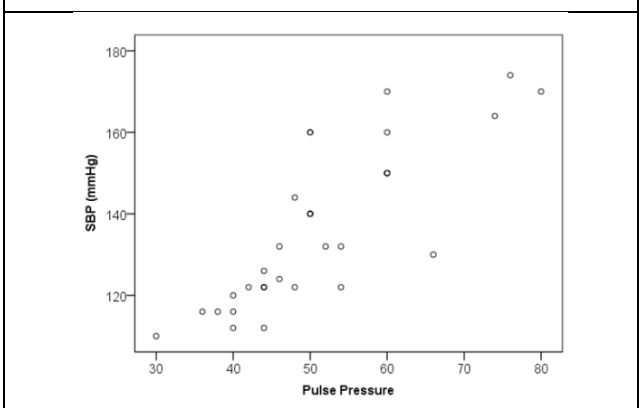
Table 2. Correlation

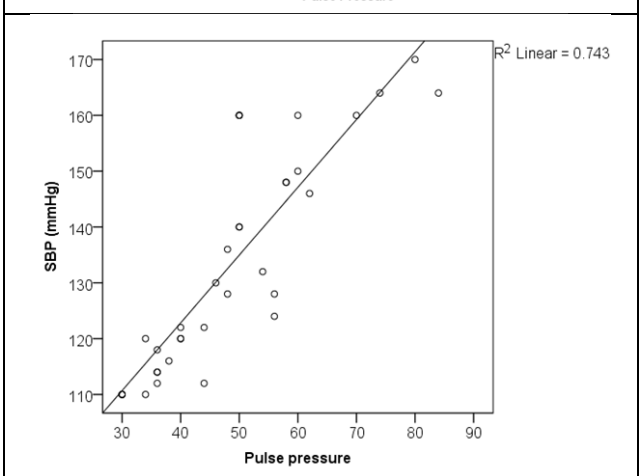
Table II IN TABLE II, the difference in the various parameters such as PP, SBP and DBP amongst the three groups were not found to be statistically significant. 'P Value' ranged from 0.278 to 0.548. However, the correlation between Pulse pressure value and Framingham Risk Score was found to be highest (mean 7.7, SD: 7.167) in group 3 (T2DM– uncontrolled) and showed statistical correlation only in group 3 as compared to the other two groups. The difference in mean FRS scores in group 1, group 2 and group 3 were found to be statistically significant.

Although the correlation of Framingham risk score and pulse pressure was seen to statically significant only in group 3. The correlation analysis of pulse pressure with the various parameters such as SBP, DBP, FBS and FRS revealed that amongst the control subjects a significant correlation was noted between PP and SBP and other factors did not reveal significant correlation.

In group 2 pulse pressure reveals a statistical significance with SBP, DBP ($r = 0.822$) and ($r = 0.336$) respectively, $p = 0.00$ and 10.0048. However, the other two parameters FBS and FRS did not reveal statistical significance at 5 % level of significance ($r = 0.302$, $p = 0.78$) and ($r = 0.325$, $p = 0.57$).







Scatter Plots: Group I, II. III.

DISCUSSION

From 1945 to 2019 we have come a long way with our ability to investigate, predict and manage coronary artery disease. Due to in availability of any suitable treatment President Roosevelt was known to move around with a blood pressure of 240/130 mmHg after multiple unsuccessful attempts of phenobarbital and digitalis treatment.[7] Lord Charles Moran, Winston Churchill's personal physician, wrote in his diary "the President appears a very sick man. He has all the symptoms of hardening of the arteries…" and "I give him only a few months to live." [1] At that time there were no reliable calculators to predict cardiovascular risk in patients.

Meanwhile the Whitehall study performed on civil servants, aged 40-64 and the results of the United Kingdom Prospective Diabetes Study (UKPDS) suggested that clinicians should mainly pay attention to systolic blood pressure as the chief risk predictor in heart disease.[9]

Although established that cardiovascular risk was directly related to blood pressure measurement, there has been considerable debate regarding the precise BP component that best predicts cardiovascular risk.[10]

The Framingham Cohort established that in patients below 50 years of age, diastolic blood pressure was the strongest predictor of CHD risk, In Ages 50 to 59 years there was a transition period when all 3 BP indexes were comparable predictors, and from 60 years of age on, DBP was negatively related to CHD risk so that Pulse pressure became superior to systolic blood pressure in predicting CHD risk.[11]

In summary, Pulse Pressure is the best predictor of CHD risk in older subjects with type 2 diabetes mellitus.[6]

Although today there are multiple calculators which enable us to calculate cardiovascular risk. We preferred to use the Framingham risk score from which a 10-year risk score can be derived as a percentage. The risk of developing coronary artery disease is considered as low if the derived percentage obtained is less than 10%, moderate if it ranges between 10% to 19% and high if it is 20% or higher.

The older version of Framingham risk score was able to successfully predict the risk by using the included parameters of age, sex, LDL cholesterol, HDL cholesterol, blood pressure (And also whether the patient is treated or not for his/her hypertension), diabetes, and smoking.

Although the newer modified version of the risk score included dyslipidaemia age range, hypertension treatment, smoking, and total cholesterol, the point of importance is that it excluded diabetes because Type 2 diabetes is considered to be a CHD Risk Equivalent. Type 1 diabetics are considered a separate group altogether with decreased risk as compared to type 2 diabetics.[12]

Though there are no direct studies comparing pulse pressure with Framingham risk score a study done by Nawrot et al it was found that pulse pressure may improve the Framingham risk prediction among middle-aged and older individuals.[13]

In another study by John R. Cockcroft they found that total and HDL-cholesterol were the most important variables associated with PP after age.

In our study it was found that all though an association was found in all three groups between Framingham risk score and pulse pressure a statistical significance was found only in group three. This might be because of the small sample size. One of the main draw backs of the study could be that the Framingham Risk Score could possibly wrongly estimate risk in populations other than the United states population as the score was drafted based on a Cohort study performed in American patients. Another potential draw back could be the in the method of measurement of blood pressure. Also another factor is the choice of artery chosen as peripheral systolic pressure at rest uniformly exceeds the central systolic pressure generated by the same heartbeat; brachial was 109 per cent, radial 112 per cent and femoral 110 per cent of central systolic pressure.[14] Therefore, peripheral pulse pressure does not always provide a reliable measure of central pulse pressure. Furthermore, aortic pulse pressure predicts the incidence of restenosis following coronary angioplasty, independently of peripheral pressure. Since pulse pressure is a surrogate measure of arterial stiffness, such data indicate that arterial stiffness is a key determinant of cardiovascular risk in older subjects. Pulse

pressure rather than diastolic pressure is the best predictor of coronary heart disease risk in older subjects, but the converse is true in younger subjects.[15]

Several studies have investigated the importance of pulse pressure in predicting cardiovascular risk.[16,17]

Moreover, tight BP control reduces the risk of stroke and cardiovascular mortality. The American diabetes association has established that tight regulation of blood glucose is unrelated to cardiovascular risk.[18]

CONCLUSIONS

Though it is a well-known fact that pulse pressure is a useful predictor of future cardiovascular events, in this study we attempted to compare it with Framingham risk score which is also a good predictor of future cardiovascular events but needed many variables including laboratory values to be filled into a risk calculator. A simple measurement of pulse pressure could be a potential surrogate marker for cardiovascular risk. Although we could not obtain a statistically significant correlation in group I and group II, we were able to obtain a correlation which was statistically significant in group III, this might be due to the various drawbacks in our study as discussed previously. Further studies are needed with larger sample size to establish the same. This study emphasizes on the importance of pulse pressure measurement in daily practice which is a simple yet an important measurement.

REFERENCES

[1] Mahmood SS, Levy D, Vasan RS, et al. The Framingham Heart Study and the epidemiology of cardiovascular diseases: a historical perspective. Lancet 2014;383(9921):999-1008.

[2] Bruenn HG. Clinical notes on the illness and death of President Franklin D. Roosevelt. Ann Intern Med 1970;72(4):579-91.

[3] Wilson PW, D'Agostino RB, Levy D, et al. Prediction of coronary heart disease using risk factor categories. Circulation 1998;97(18):1837-47.

[4] Eichler K, Puhan MA, Steurer J, et al. Prediction of first coronary events with the Framingham score: a systematic review. Am Heart J 2007;153(5):722-31, 731.e1-8.

[5] Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics--2013 update: a report from the American Heart Association. Circulation 2013;127(1):e6-e245.

[6] Cockcroft JR, Wilkinson IB, Evans M, et al. Pulse pressure predicts cardiovascular risk in patients with type 2 diabetes mellitus. Am J Hypertens 2005;18(11):1463-7, discussion 1468-9.

[7] Haffner SM, Lehto S, Rönnemaa T, et al. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. N Engl J Med 1998;339(4):229-34.

[8] Conget I, Gimenez M. Glucose control and cardiovascular disease: is it important? No. Diabetes Care 2009;32(Suppl 2):S334-S6.

[9] Lichtenstein MJ, Shipley MJ, Rose G. Systolic and diastolic blood pressures as predictors of coronary heart disease mortality in the Whitehall study. Br Med J (Clin Res Ed) 1985;291(6490):243-5.

[10] O'Rourke M, Frohlich ED. Pulse pressure: Is this a clinically useful risk factor? Hypertens 1999;34(3):372-4.

[11] Franklin SS, Larson MG, Khan SA, et al. Does the relation of blood pressure to coronary heart disease risk change with aging? The Framingham Heart Study. Circulation 2001;103(9):1245-9.

[12] National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Circulation 2002;106(25):3143-421.

[13] Nawrot TS, Staessen JA, Thijs L, et al. Should pulse pressure become part of the Framingham risk score? J Hum Hypertens 2004;18(4):279-86.

[14] Kroeker EJ, Wood EH. Comparison of simultaneously recorded central and peripheral arterial pressure pulses during rest, exercise and tilted position in man. Circ Res 1955;3(6):623-32.

[15] Wilkinson IB, Franklin SS, Hall IR, et al. Pressure amplification explains why pulse pressure is unrelated to risk in young subjects. Hypertension 2001;38(6):1461-6.
https://researchers.mq.edu.au/en/publications/pressureamplification-explains-why-pulse-pressure-is-unrelated-t

[16] Madhavan S, Ooi WL, Cohen H, et al. Relation of pulse pressure and blood pressure reduction to the incidence of myocardial infarction. Hypertens 1994;23(3):395-401.

[17] Sesso HD, Stampfer MJ, Rosner B, et al. Systolic and diastolic blood pressure, pulse pressure and mean arterial pressure as predictors of cardiovascular disease risk in Men. Hypertens 2000;36(5):801-7.

[18] Buse JB, Ginsberg HN, Bakris GL, et al. Primary prevention of cardiovascular diseases in people with diabetes mellitus: a scientific statement from the American Heart Association and the American Diabetes Association. Diabetes Care 2007;30(1):162-72.