Plasma Glucose as predictor of Forced Vital Capacity of the lungs in Type 2 Diabetes Mellitus

Dr..Latha.S*.[1], Dr.Sanjay Andrew [2], Dr.Siva Priya .D.V [3]
[1]Assistant professor ,Department of physiology ,Panimalar Medical College Hospital &Research Institute
[2]Professor, Department of Physiology ,Chettinad Medical College Hospital and Research Institute
[3]Professor, Department of Physiology , Panimalar Medical College Hospital &Research Institute

ABSTRACT:

Introduction: Plasma glucose of type 2 Diabetes mellitus is a strong predictor of many complications . The causative factor of complications in the lung due to type 2 diabetes mellitus is not studied .Objectives : To study the association between pulmonary functions and plasma glucose in type2 diabetes mellitus and to predict the causative factors of the pulmonary complications in type 2 diabetes mellitus .Methods: FVC was determined using spirometry and Plasma glucose (PPPG and FPG) were measured for about 125 diabetic participants and 75 normal participants .Chest measurement and waist measurement was recorded. Results: FVC % in diabetic was(68.88 ± 16.44) and nondiabetic (95.53 ± 11.65) P< 0.005.Conclusion: PPPG FPG ,chest circumference and waist circumference were predictors of decreased FVC in type 2 diabetes mellitus .

Key Words:FVC,FPG.PPPG.Chest circumference ,Waist circumference

INTRODUCTION:

Diabetes mellitus is a highly prevalent metabolic disease in India. Diabetes result in microvascular (1) and macrovascular complications even at the initial stage of disorder (2). Complications were largely due to inadequate glycemic control, oxidative stress and advanced glycation end products.(3) Deleterious effects of diabetes in all organs of body were studied extensively, except for lungs. Lungs play an vital role in delivery of oxygen and oxygen is important for glucose homeostasis. Oxygen therapy for OSA(obstructive sleep apnea) improved glycemic status of the patient(4) and chronic intermittent hypoxia as a result of OSA may cause impaired insulin secretion which may led to insulin resistance(5). Decreased lung parameters in spirometry examination of type 2 diabetes mellitus may be a cause of increased incidence of tuberculosis in Indian population (6). Type 2 diabetes mellitus is associated with central obesity. Central obesity means excess of fat above the hips, this is different from having excess fat in hips and thighs. Indians are more prone for central obesity. Central obesity is measured with waist circumference and waist hip ratio, are more in Indians when compared with other population. Fasting serum insulin of diabetes mellitus patients may be related to waist circumference and body weight.(1) In rural population in Australia a study tried to find an association between elevated spirometry values and incidence of metabolic syndrome and diabetes(7) .The relation between plasma glucose values ,chest circumference , waist circumference and forced vital capacity in type 2 diabetes mellitus has to be studied.

METHODS

This cross sectional study was conducted in a tertiary care medical college hospital .The study was initiated after the ethical committee approval. Proper consent was obtained. About 125 participants were type 2 diabetic patients on oral hypoglycemic agents without any other complications of diabetes mellitus . 75 non diabetic participants participated in the study. Plasma collected and plasma glucose estimated.Type 2 diabetes mellitus patients were diagnosed according to American diabetes association recommendation of fasting plasma glucose of 126mg/dl or greater and post prandial glucose of 200mg/dl or greater (8). Participants on oral medicine were included and patients on insulin were excluded from the study . Detailed history was collected and consent form signed. Computerized spirometry was used. Chest measurement was done with an inch tape. Patients were asked to stand erect and all the items from the pocket emptied. Non stretchable measuring tape was placed around the patient's chest at the level of nipple and measurement was recorded in centimeters. Waist measurement Measured with non

stretchable measuring tape, patients were asked to stand erect with feet close to each other. Measuring tape was placed around the waist, at the level of umbilicus and measurement recorded in centimeters. Spirometry calibration was checked every day. Calibration was adjusted for Indian race. Disposable mouth piece was used and filters were also changed for each subject. The Spirometer used was (Chestograph HI-105).Nose clips used. A demonstration was given to the subject regarding the procedure. American thoracic society guidelines followed. The following parameter was recorded FVC(forced vital capacity) . Three readings of pulmonary function tests were done and the best of three readings were considered for assessment . Height and weight recorded. BMI calculated using formulae body weight in Kg/height2 in meter. Software used was SPSS version 17. Continuous variables were compared using student t test and expressed as mean±SD. P<0.05 was taken as level of significance. Continuous variables were compared using student t test

RESULTS

Table 1:Pulmonary function parameters of diabetic and Non diabetic subjects

Parameters	Diabetic	Non-Diabetic	Significance P<0.005
Age	46.82 ± 7.06	46.72 ± 7.03	.094
BMI	26.60 ± 4.84	23.93 ± 3.71	.000
Chest Measurement	91.29 ± 9.23	85.86 ± 8.24	.000
Waist Measurement	94.27 ± 12.37	82.26 ± 8.54	.000
FPG	214.00 ±87.79	124.56±22.91	.000
PPPG	317.00 ±119.22	172.44±33.47	.000
FVC %	68.88 ± 16.44	95.53 ± 11.65	.000

All the data given are mean ± SD.. level of significance (P<0.05).* - denotes significant difference.BMI-Body mass Index in kg/m^2-FPG- Fasting plasma glucose g/dlPPPG-Ppost Prandial Plasma glucose -FVC-Forced Vital Capacity in %

The number of diabetic subjects participated in the study were 125. About 75 age matched controls without complications of diabetes were included in the study .The age and height of both the groups were almost identical .The BMI of diabetic participants were 26.60 and that of non diabetic was 23.93 .Many participants in the diabetic group were obese with BMI greater than 30 compared with nondiabetic participants. The cheat circumference and waist circumference in type 2 diabetes mellitus were of a greater value when compared with nondiabetic participants and it was statistically significant. Fasting and post prandial plasma glucose was in diabetic range in diabetic patients and it was a significant difference when compared with non diabetic .FVC of diabetic subjects was 68.88% .The non diabetic FVC was 95.53% and it was statistically significant p<0.005. The mean FVC value of diabetic subjects was less compared with non-diabetic subjects as in table1.The mean waist measurement of diabetic patients was higher than non diabetic participants as described in table 1. Among the 125 diabetic patients, those with BMI 25< had waist circumference of 87.29, those with BMI 25-29 had waist circumference of 95.70 and those with BMI 30< had waist circumference of 103.35.Results from the study show waist circumference (.004) and chest circumference (.011) were strong predictors of FVC values and fasting plasma glucose (.505) and Post prandial plasma glucose(.910) were also predictors of FVC values.

DISCUSSION

The forced vital capacity was reduced in diabetic participants when compared with non diabetic participants . Reduction in FVC in diabetic participants compared with nondiabetic was described by dennis et al(9-11) and

aparna et al (12). FVC reduction was associated with insulin resistance and diabetes incidence as shown in study done by Lawlor et al(13). In a study by Lange et al, there was an accelerated decline in FVC among diabetic patients using insulin than patients on oral drugs (14). In a cross sectional study by RJ Dennis et al, it was found that the FVC values decreased with inadequate glycemic control(9) while some studies proved FVC decline was independent of glycemic control(15-17) .In the present study a decrease in FVC value was documented and plasma glucose was found to be predictor of decreased FVC value.In diabetic participants Hughes k.et al it was proved the same . The Asians had central obesity when compared with other ethnic races like Chinese and Europeans. Waist measurement was comparatively high in diabetic participants than nondiabetic participants in the present study. The central obesity was an important factor associated with insulin resistance.Present study proved waist circumference as a predictor of decreased FVC ,Yeh et al proved in his study that factors like obesity and inflammation was associated with impaired lung function (17). Waist circumference was an important factor for pulmonary function derangement than BMI (18).Waist circumference was associated with glucose intolerance (19). Asians with high waist circumference were associated with increased incidence of diabetes (20). Asians with high waist circumference were associated with more incidence of diabetes(20). The Waist circumference showed increased association with FVC than FEV1 according to a study (21).This study proves that diabetic subjects with high BMI have a positives correlation with plasma glucose and BMI was positively correlated with insulin resistance(19) . Chest circumference is a strong predictor decreased FVC value, it was demonstrated by Sandler et al that elastic recoil of lung will be reduced in diabetic patients and that it is due to the glycosylation of tissue proteins(22)Diabetes mellitus is associated with decreased lung elastic recoil and volume and Matsubara et al contributed to the thickened basal lamina of capillaries and alveolus(23).Decreased FVC may be caused due to diabetic neuropathy(24) Ramierz et al proved that good glycemic control was associated with prevention of pulmonary complicationss(25). In a study by chance et al, it is proved that glycemic control was not associated with decrease in pulmonary function parameters (26) But our study show that lung mechanical abnormalities is more dependent on the factors like hyperglycemia, chest circumference and waist circumference

conclusion

REFRENCES

1. Hughes K, Aw TC, Kuperan P, Choo M. Central obesity, insulin resistance, syndrome X, lipoprotein(a), and cardiovascular risk in Indians, Malays, and Chinese in Singapore. Journal of epidemiology and community health. 1997;51(4):394-9. Epub 1997/08/01.
2. Sosale A, Prasanna Kumar KM, Sadikot SM, Nigam A, Bajaj S, Zargar AH, et al. Chronic complications in newly diagnosed patients with Type 2 diabetes mellitus in India. Indian journal of endocrinology and metabolism. 2014;18(3):355-60. Epub 2014/06/20.
3. Rojas A, Morales MA. Advanced glycation and endothelial functions: a link towards vascular complications in diabetes. Life sciences. 2004;76(7):715-30. Epub 2004/12/08.
4. Dawson A, Abel SL, Loving RT, Dailey G, Shadan FF, Cronin JW, et al. CPAP therapy of obstructive sleep apnea in type 2 diabetics improves glycemic control during sleep. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine. 2008;4(6):538-42. Epub 2008/12/30.
5. Wang N, Khan SA, Prabhakar NR, Nanduri J. Impairment of pancreatic beta-cell function by chronic intermittent hypoxia. Experimental physiology. 2013;98(9):1376-85. Epub 2013/05/28.
6. Viswanathan AA, Gawde NC. Effect of type II diabetes mellitus on treatment outcomes of tuberculosis. Lung India : official organ of Indian Chest Society. 2014;31(3):244-8. Epub 2014/08/16.
7. Yu D, Simmons D. Association between lung capacity measurements and abnormal glucose metabolism: findings from the Crossroads study. (1464-5491 (Electronic)).
8. Genuth S, Alberti KG, Bennett P, Buse J, Defronzo R, Kahn R, et al. Follow-up report on the diagnosis of diabetes mellitus. Diabetes care. 2003;26(11):3160-7. Epub 2003/10/28.
9. Dennis RJ, Maldonado D, Rojas MX, Aschner P, Rondón M, Charry L, et al. Inadequate glucose control in type 2 diabetes is associated with impaired lung function and systemic inflammation: a cross-sectional study. BMC Pulmonary Medicine. 2010;10(1):38.
10. S A Fau - S M, S M Fau - P G, P G Fau - C R, C R, Tabit Ce Fau - Chung WB, Chung Wb Fau - Hamburg NM, et al. Alveolar Gas Exchange and Pulmonary Functions in Patients with Type II Diabetes Mellitus

Endothelial dysfunction in diabetes mellitus: Molecular mechanisms and clinical implications

Cross-Sectional and Prospective Study of Lung Function in Adults with Type 2 Diabetes Mellitus: The Atherosclerosis Risk in Communities (ARIC) Study

Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement

Endothelial dysfunction in diabetes mellitus

Diabetes Is an Independent Risk Factor for Severe Nocturnal Hypoxemia in Obese Patients. A Case-Control Study. LID - e4692

Pulmonary functions in patients with diabetes mellitus

Impact of Diabetes Mellitus on Treatment Outcomes of Patients with Active Tuberculosis

Chronic obstructive pulmonary disease and glucose metabolism: a bitter sweet symphony. (2249-782X (Print)).
11. Shah SH, Sonawane P, Nahar P, Vaidya S, Salvi S. Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease. Lung India : official organ of Indian Chest Society. 2013;30(2):108-12. Epub 2013/06/07.
12. Aparna. Pulmonary function tests in type 2 diabetics and non-diabetic people -a comparative study. Journal of clinical and diagnostic research : JCDR. 2013;7(8):1606-8. Epub 2013/10/03.
13. Lawlor DA, Ebrahim S, Smith GD. Associations of measures of lung function with insulin resistance and Type 2 diabetes: findings from the British Women's Heart and Health Study. Diabetologia. 2004;47(2):195-203. Epub 2004/01/06.
14. Lange P, Groth S, Kastrup J, Mortensen J, Appleyard M, Nyboe J, et al. Diabetes mellitus, plasma glucose and lung function in a cross-sectional population study. The European respiratory journal. 1989;2(1):14-9. Epub 1989/01/01.
15. Yeh HC, Punjabi NM, Wang NY, Pankow JS, Duncan BB, Cox CE, et al. Cross-Sectional and Prospective Study of Lung Function in Adults With Type 2 Diabetes: The Atherosclerosis Risk in Communities (ARIC) Study. Diabetes care. 2008;31(4):741-6.
16. Yeh F, Dixon AE, Best LG, Marion SM, Lee ET, Ali T, et al. Lung function and heart disease in American Indian adults with high frequency of metabolic abnormalities (from the Strong Heart Study). The American journal of cardiology. 2014;114(2):312-9. Epub 2014/06/01.
17. Yeh F, Dixon AE, Marion S, Schaefer C, Zhang Y, Best LG, et al. Obesity in adults is associated with reduced lung function in metabolic syndrome and diabetes: the Strong Heart Study. Diabetes care. 2011;34(10):2306-13. Epub 2011/08/20.
18. Saxena Y, Sidhwani G, Upmanyu R. Abdominal obesity and pulmonary functions in young Indian adults: a prospective study. Indian journal of physiology and pharmacology. 2009;53(4):318-26. Epub 2010/06/01.
19. Mohan V, Shanthirani CS, Deepa R. Glucose intolerance (diabetes and IGT) in a selected South Indian population with special reference to family history, obesity and lifestyle factors--the Chennai Urban Population Study (CUPS 14). The Journal of the Association of Physicians of India. 2003;51:771-7. Epub 2003/12/04.
20. Gao H, Salim A, Lee J, Tai ES, van Dam RM. Can body fat distribution, adiponectin levels and inflammation explain differences in insulin resistance between ethnic Chinese, Malays and Asian Indians? International journal of obesity (2005). 2012;36(8):1086-93. Epub 2011/09/29.
21. Chen Y, Rennie D, Cormier Y, Dosman JA. Waist circumference associated with pulmonary function in children. Pediatric pulmonology. 2009;44(3):216-21. Epub 2009/02/11.
22. Sandler M. Is the lung a 'target organ' in diabetes mellitus? Archives of internal medicine. 1990;150(7):1385-8. Epub 1990/07/01.
23. Matsubara T, Hara F. [The pulmonary function and histopathological studies of the lung in diabetes mellitus]. Nihon Ika Daigaku zasshi. 1991;58(5):528-36. Epub 1991/10/01.
24. Gill HK, Yadav SB, Ramesh V, Bhatia E. A prospective study of prevalence and association of peripheral neuropathy in Indian patients with newly diagnosed type 2 diabetes mellitus. Journal of postgraduate medicine. 2014;60(3):270-5. Epub 2014/08/15.

25. Ramirez LC, Dal Nogare A, Hsia C, Arauz C, Butt I, Strowig SM, et al. Relationship between diabetes control and pulmonary function in insulin-dependent diabetes mellitus. The American journal of medicine. 1991;91(4):371-6. Epub 1991/10/01.
26. Chance WW, Rhee C, Yilmaz C, Dane DM, Pruneda ML, Raskin P, et al. Diminished alveolar microvascular reserves in type 2 diabetes reflect systemic microangiopathy. Diabetes care. 2008;31(8):1596-601. Epub 2008/05/22.