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**ORIGINAL ARTICLE**

# Pulmonary Venous Flow Pattern due to Left Ventricular Diastolic Dysfunction among Impaired Glucose Tolerance Patients

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## Abstract

**Background:** The pattern of pulmonary venous flow due to left ventricular diastolic dysfunction is important among impaired glucose tolerance patients. **Objectives:** The purpose of the present study was to observe the pulmonary venous flow pattern due to left ventricular diastolic dysfunction among impaired glucose tolerance patients. **Methodology:** This cross sectional study was carried out in the Department of Cardiology at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from July 2005 to June 2007. Impaired glucose tolerance (IGT) patients attending Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders, Dhaka, Bangladesh were included in this study as group A. The apparently healthy persons without cardiovascular disease were taken as group B. All the study subjects underwent 2D and M-mode echocardiography. **Result:** Doppler pulmonary inflow parameters of group A and group B showed no statistically' significant difference in peak S-wave (46.42+10.06 vs 51.20±8.34 cm/s, P>0.05), peak D-wave (34.86±8.01 vs 40.48±5.77 cm/s, P>0.05) and S/D, ratio (1.35±0.21 vs 1.20±0.13, P>0.05). Doppler pulmonary inflow parameters were compared between left ventricular diastolic dysfunction present and absent in group A which showed no statistically significant differences in peak S-wave (p>0.01), peak D-wave (p>0.50), S/D ratio (p>0.05). **Conclusion:** In conclusion the pulmonary venous flow pattern is significantly difference due to left ventricular diastolic dysfunction among impaired glucose tolerance patients. [*Journal of Current and Advance Medical Research January 2020;7(1):3-6*]

**Keywords:** Pulmonary venous flow; left ventricular diastolic dysfunction; impaired glucose tolerance

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## Introduction

Pulmonary and systemic venous congestion develops due to diastolic dysfunction[1]. Thus, the sign and symptoms of pulmonary and/or systemic venous congestion are not only the result of systolic dysfunction, rather they are also related to alteration in the diastolic properties of LV chamber[2]. In a small group of patients, abnormalities in diastolic function occur in absence of significant systolic dysfunction[3]. But diastolic dysfunction and diastolic heart failure emerge as a separate clinical entity for the last 10 to 12 years[4]. Diastolic heart failure of left and right ventricle often leads to all signs and symptoms of systolic dysfunction. But, therapeutic approach varies for this condition[5].

Common causes of diastolic dysfunction are ischaemic heart disease (IHD), hypertension, cardiomyopathy, pericardial disease, valvular heart disease (VHD) and diabetes mellitus[6]. Framingham Heart Study has shown that increased incidence of CHF in diabetic subjects irrespective of coronary artery disease (CAD) and hypertension[7]. In the study of left ventricular diastolic dysfunction (SOLVD) trail and registry, diabetic and IGT were found to have an independent risk factor for morbidity and mortality in both symptomatic and asymptomatic heart failure[8].

Birmingham Diabetes Survey Working Party in their 5-years and 10-years follow-up of Birmingham population showed that most of those who converted to florid diabetes case from IGT group[9]. Of the IGT group, 21.4% became florid diabetes over 5 years and 45.2% over a period of 10 years[10]. Diabetic registry of BIRDEM have showed an increasing trend. Epidemiological evidence supports hyperinsulinemia as a marker for CAD risk, though an aetiologic role has not been demonstrated[11].

Clinical, epidemiological and pathological studies showed the increased occurrence of clinical CHF in IGT subjects attribute to diabetic cardiomyopathy, which take the form of systolic and/or diastolic left ventricular dysfunction. Left ventricular diastolic dysfunction may represent the first stage of diabetic cardiomyopathy[12].

This present study was undertaken to observe the pulmonary venous flow pattern due to left ventricular diastolic dysfunction among impaired glucose tolerance patients.

## Methodology

This present cross sectional study was carried out in the Department of Cardiology at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from July 2005 to June 2007 for a period of two (02) years. Patients with impaired glucose tolerance (IGT) patients attending Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Dhaka, Bangladesh and fulfilled selection criteria were included in this study. Patients with the age group of 18 to 60 years, fasting blood sugar less than 7 mmol/L and 2 hours after 75 gm glucose 7.8 to 11.0 mmol/L with blood pressure of systolic less than 140 mmHg and diastolic less than 90 mmHg, sinus rhythm and negative ETT were selected as study population. Any evidence of pericardial, myocardial or endocardial disease, valvular heart disease, congenital heart disease, known or suspected coronary artery disease, diabetes mellitus patients, atrial fibrillation, renal impairment, pregnant women or patients with poor echocardiography window were excluded from this study. The apparently healthy persons without cardiovascular disease were taken as group B. Informed consents were taken from each subject. History and clinical examination findings were recorded in predesigned data collection sheet. ECG, chest X-ray, blood sugar (fasting and 2 hours after 75 gm glucose); fasting lipid profile and serum creatinine; urine for microalbumin level were analyzed and findings documented. Exercise tolerance test (ETT) was done in every case and positive cases were excluded. Echocardiography including Doppler with colour flow imaging study were done by cardiologists. Each study subjects underwent standardized 12-lead electrocardiographic evaluation. Echocardiography for this study was done by Siemens Acuson CV70 and ALOX-A Colour Doppler SSD-1000, Japan, ultrasound imaging system using 2.5 MHz array phased transducer with ECG gating. All the study subjects underwent 2D and M-mode echocardiography for chamber enlargement, ventricular hypertrophy and ventricular systolic function according to recommendation of American Society of Echocardiography. Doppler examination was performed with the study subjects at the left lateral decubitus position. Flow patterns across the pulmonary inflow, i.e. S- and D-wave velocities, S/D ratio, atrial reversal (AR) and duration of AR (ARD) were measured. AD/ARD ratio was calculated. Normal values for the Doppler parameters are mentioned above. Different stages of

LVDD as absent, abnormal relaxation, pseudonormalization and restrictive pattern values were recorded. Collected data were compiled and statistical analyses were done using computer based software, Statistical Package for Social Science (SPSS). To arrive at statistical significance, Chi-square test and unpaired Student's 't' test were applied. P value < 0.05 was taken as minimum level of significance.

## Result

The present prospective study was carried out in the Department of Cardiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from July 2005 to June 2007. Fifty consecutive cases of IGT patients who attended BIRDEM hospital and fifty age, sex matched non-IGT subjects, who fulfilled the selection criteria were included in this study. The mean age of group A and B were 49.92±8.96 and 40.42±9.31 years. The difference between the group A and B was not statistically significant (p=0.785) (Table 1).

**Table 1: Mean Age of the study subjects**

| Group | Mean Age± SD | P value |
|---|---|---|
| Group A | 40.92±8.96 | 0.785 |
| Group B | 40.42±9.31 | |

Unpaired Student's 't' test

Doppler pulmonary inflow parameters of case and control groups shows that there is no statistically' significant difference in peak S-wave (46.42+10.06 vs 51.20±8.34 cm/s, P>0.05), peak D-wave (34.86±8.01 vs 40.48±5.77 cm/s, P>0.05) and S/D,ratio (1.35±0.21 vs 1.20±0.13, P>0.05), but peak AR velocity (25.62±2.01 vs 22.14±3.10 cm/s, P<0.001) was statistically significantly higher in case group than control group (Table 2).

**Table 2: Pulmonary venous flow pattern by Doppler echocardiography in the study subjects**

| Variables (cm/s) | Group A | Group B | P value |
|---|---|---|---|
| Peak S-wave | 46.4±10.06 | 51.20±8.34 | 0.054 |
| Peak D-wave | 34.9±8.01 | 40.48±5.77 | 0.051 |
| S/D ratio | 1.3±0.21 | 1.20±0.13 | 0.073 |
| Peak AR velocity | 25.6±2.01 | 22.14±3.10 | 0.0001 |

AR=Atrial reversal; Unpaired Student's 't' test

Doppler pulmonary inflow parameters were compared between left ventricular diastolic dysfunction present and absent groups in cases which shows that there was no statistically significant differences in peak S-wave (47.04±12.21 vs 44.65±7.28 cm/s, p>0.01), peak D-wave (34.19±9.59 vs 34.02±6.87 cm/s, p>0.50), S/D ratio (1.44±0.24 vs 1.24±0.19, p>0.05) and peak AR velocity (26.50±2.76 vs 25.58±2.78 cm/s, p>0.10) (Table 3).

**Table 3: Pulmonary venous flow pattern by Doppler echocardiography in cases with left ventricular diastolic dysfunction present and absent**

| Variables (cm/s) | LVD Dysfunction | | P value |
|---|---|---|---|
| | Present | Absent | |
| Peak S-wave | 47.04±12.21 | 44.65±7.28 | 0.45 |
| Peak D-wave | 34.19±9.59 | 34.02±6.87 | 0.84 |
| S/D ratio | 1.44±0.24 | 1.24±0.19 | 0.06 |
| Peak AR velocity | 26.50±2.76 | 25.58±2.78 | 0.35 |

AR=Atrial reversal; Unpaired Student's 't' test

## Discussion

There has been increasing interest comprehension and appreciation regarding the contribution of left ventricular diastolic dysfunction (LVDD) to the signs and symptoms produced by cardiovascular disorders[13]. Abnormal left ventricular diastolic (LVD) performance has been observed both in conjunction with and absence of systolic dysfunction. The advent of Doppler velocity recording has provided a rapid, repeatable, noninvasive method by which LVDD is assessed[14]. Detection of LVDD at the entry point of IGT and diabetes mellitus is very important regarding the initiation of mode of management as appropriate mode of management might arrest or reverse the process[15].

The age range in this study was 18 to 60 years with mean age 49.92±8.96 years. Highest number of patients was 18(36%) in 41 to 50 years group. Next age group was 31 to 40 years. Most of the persons above the age 60 years had LVDD due to aging, for this reason age range was 18-60 years. Bajraktaria et al[2] worked on diastolic dysfunction in normotensive NGT (normal glucose tolerance), type 2 diabetes, age range was 18 to 60 years, they had taken some sample above 60 years which may give a higher frequency of LVDD due to age-related diastolic dysfunction. In this study, out of 26 cases with LVDD, 1(3.8 %) was in age group 18 to 30 years, 5(19.2%) in 31 to 40 years, 17(65.5%) in 41 to 50 years and 3(11.5%) in 51 to 60 years. LVDD was highest among cases belonging to age group 41 to 50 years (65.4%). Therefore, it is shown that

LVDD is common in higher age group. It has been established that ageing is a recognized cause of LVDD which is accentuated by the presence of IGT.

Doppler pulmonary venous parameters between case and control groups did not show any difference. Doppler mitral inflow parameters between LVDD present and absent groups showed that E-wave and E/A ratio were significantly lower in LVDD present group, while A-wave and DT were significantly higher among LVDD present group.

This present study is similar with Karmakar[15], Zahurul[16], and Bajraktaria et al[2]. Furthermore, this present study has showed that LVDD is present in 26(52.0%) subjects of group A, but in group B, only in 5(10.0%) subjects ($p<0.001$) and all of whom have delayed relaxation type of LVDD. None of the subjects is found to have pseudonormal or restrictive filling abnormality.

In all relevant studies, including the present study, have shown that LVDD is present in significant number in IGT cases who are free of clinically detectable heart disease[17].

## Conclusion

In conclusion the pulmonary venous flow pattern is significantly difference due to left ventricular diastolic dysfunction among impaired glucose tolerance patients. Left ventricular diastolic dysfunction (LVDD) present in significant number in patients with impaired glucose tolerance (IGT), who are free of clinically detectable heart disease and can be diagnosed properly by Doppler echocardiography. Therefore, it is our suggestion that all patients of newly diagnosed IGT should be routinely screened for LVDD to detect early phase of diabetic cardiomyopathy, and appropriate therapeutic intervention should be taken to arrest or reverse the process.

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