International Journal of Medical Studies
Available online at www.ijmsonline.in

INTERNATIONAL JOURNAL OF MEDICAL STUDIES
ESTD 2015

IJMS 7(5), 8-14 (2022)
Print ISSN 2542-2766

Echocardiographic evaluation of left atrial performance by using left atrial appendage flow velocity

Thirumurugan E[1], Subha C[2], Gomathi K[3], Swathy[4], Syed Ali Afrin[5],

[1]*Research Scholar, Srinivas University, India and Lecturer, College of Allied Health Science, DR MGR Educational and Research Institute, ACS Medical College, Chennai, Tamil Nadu.*

[2]*Faculty, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu.*

[3]*Faculty, College of Allied Health Science, DR MGR Educational and Research Institute, ACS Medical College, Chennai, Tamil Nadu.*

[4]*Faculty, College of Allied Health Science, DR MGR Educational and Research Institute, ACS Medical College, Chennai, Tamil Nadu.*

[5]*Faculty, College of Allied Health Science, DR MGR Educational and Research Institute, ACS Medical College, Chennai, Tamil Nadu.*

Corresponding author: *Thirumurugan E, Research Scholar, Srinivas University, India and Lecturer, College of Allied Health Science, DR MGR Educational and Research Institute, ACS Medical College, Chennai, Tamil Nadu.*

Article history
Received 10 March 2022
Received in revised form 22 April 2022
Accepted 19 May 2022
Available online 30 May 2022

ABSTRACT

Background: Left atrial (LA) functional Study has a traditional role in evaluation of left ventricular diastolic function. The widely accepted echocardiographic parameters used in routine clinical practice to assess left ventricular diastolic function include pulsed-wave doppler mitral inflow analysis, tissue doppler imaging measurements, and LA dimension estimation. Left atrial appendage doppler studies using early diastolic emptying velocity, late diastolic emptying velocity and LAA filling velocity imaging to assess LA function were validated in patients with valvular atrial fibrillation (AF). Currently, there is no evidence regarding the Left atrial appendage doppler studies used in identifying the performance of left atrium and diastolic function in patients with Normal Sinus Rhythm.

Objectives: This study aimed to identify the performance of left atrial function in patients with normal sinus rhythm using Left atrial appendage doppler studies.

Methods: In a study population of 63 patients aged >18 years old who undergone routine echocardiographic study for Cardiac evaluation between Jan 2017 to Jan 2018, among which 40 (64%) were males and 23 (36%) were females. For those Patient's, left atrial appendage flow velocity and diastolic doppler parameters are noted from G E echocardiography machine by the single observer.

Results: The Mean Left Atrial Appendage (late-diastolic emptying velocity) in diastolic dysfunction patients (39.74) associated with impaired left atrial function, when compared with the mean Left Atrial Appendage (late-diastolic emptying velocity) in patients without diastolic dysfunction (54.76) respectively.

Conclusion: In this study, we founded that Patient with diastolic dysfunction had an impaired left atrial function that was measured by left atrial appendage flow velocity.

Keywords: Diastolic Dysfunction, Left Atrial Appendage Flow Velocity, Left Atrial Function.

This article reviewed by Dr. D.K Sharma, Dr. Ram. Edited by Dr. Pradeep J., Dr. S Gaur. Available online 30 May 2022.

INTRODUCTION

The left atrium is one of the four chambers of the heart, located on the left posterior side. Its primary duties are to act as a holding chamber for blood returning from the lungs and to act as a pump to transport blood to other parts of the heart [1]. The Left atrial appendage begins to develop during the 3rd week of gestational life. It arise from the embryonic left atrium, however the remaining portion of the left atrium is originated from the branches of the primordial pulmonary veins. It is a finger-like projection from the main body of the left atrium. There are considerable variations in its size, shape, and relationship with adjacent cardiac and extra cardiac structures, which can be extremely relevant when interventional procedures are, performed [2].

The function of the LA appendage is mostly noticeable in AF and thrombo-embolic stroke. Low flow velocities, spontaneous echo contrast, and thrombus have been identified in the LA appendages among those who sustained thrombo-embolic stroke [3]. Ventricular emptying and filling are complex interdependent processes with the cardiac cycle conceptually divided into systole and diastole to allow clinical measurements of disease severity. Diastolic ventricular dysfunction plays a key role in the clinical manifestations of disease in patients with a wide range of cardiac disorders [4]. Diastolic dysfunction also may be an early sign of cardiac disease. Echocardiographic techniques allow evaluation of right and left Ventricular diastolic filling patterns, the velocity of myocardial motions and right and left atrial filling patterns [5].

METHODS

In this prospective, single-center trial, 63 patients aged >18 years old who undergone routine echocardiographic study for cardiac evaluation between Jan 2017 to Jan 2018, among which 40 (63%) were males and 23 (36%) were females. Patients with Atrial fibrillation, Mitral stenosis, Aortic stenosis, Mitral regurgitation, Aortic regurgitation and patients with Poor echo acoustic windows were excluded. Subjects aged 18 years old or older with sinus rhythm were eligible. The study protocol was approved by the Institutional Review Board, Ramachandra Hospital, Porur, Tamil Nadu and all patients provided informed consent.

Non-Invasive Echocardiographic Measurements

Left atrial appendage flow velocities can be obtained by using pulse wave doppler. The G E echocardiography machine was used for the non-invasive measurements. With patients in the left lateral decubitus position, transthoracic 2-D and doppler echocardiography was performed. In the apical two chamber view the pulse wave doppler placed at one third of left atrial appendage opening. In the apical four chamber view, the pulse wave doppler sample gate was placed across the mitral valve at its tips and the early Trans mitral filling velocity (E) was measured.

Tissue Doppler Imaging (TDI) of the mitral annulus was obtained at a rate of 100-133 color Doppler frames/sec using a velocity range of 0.1-16 cm/sec, by positioning 1-3 mm sample volume at the septal and lateral corners of the mitral annulus in a four-chamber view. Gains were adjusted to eliminate background noise and allow for clear tissue signal. Doppler signals were measured at a paper speed of 100 mm/s. From mitral annular TDI recording systolic (S'), early (E') and late (A'), E/E' diastolic velocities were measured**.**

Sample Size Estimation and Statistical Analysis

The sample size was formulated based on observational data of Diastolic dysfunction parameters during routine echocardiography study performed over a 2 months in our Echocardiography Laboratory. The number of patients needed in each group to achieve a 95% power at the level of significance 0.05 was estimated at 30 (total n = 60).

Baseline Characteristics and Procedural Characteristics were represented using descriptive statistics for continuous variables in form of frequency tables or Percentage (%) for discrete variables. All statistical analysis was performed with SPSS software.

RESULTS

Procedural Characteristics of Patients

A total of 63 patients participated in this study of whom 40 (64%) were males and 23 (36%) were females. The mean age of the participants were 32.51 ± 1.23 years and age ranging between 20 to 80 years.

The major risk factors for diastolic dysfunction identified by participants were high blood pressure (23 %), diabetes (30 %) and others (47%).

Comparison of Left atrial Appendage Flow Velocity versus LA function

The late diastolic emptying velocity is believed to result from active LA contraction and is thus a marker of LAA contractile function. It correlates with LAA ejection fraction, LA size and pressure and is significant predictor of thromboembolic risk.

The Mean Left Atrial Appendage (late-diastolic emptying velocity) in diastolic dysfunction patients (39.74) associated with impaired left atrial function, when compared with the mean Left Atrial Appendage (late-diastolic emptying velocity) in patients without diastolic dysfunction (54.76) respectively. The present study was designed to investigate left atrial appendage echocardiographic variables for patients with diastolic dysfunction to predict Left atrial dysfunction, reflected as reduced LAA late-diastolic emptying velocity.

LV-FILLING PRESSURE (NO.OF PATIENTS)	LEFT ATRIAL APPENDANGE LATE-DIASTOLIC EMPTYING VELOCITY (AVERAGE)	LATE-DIASTOLIC EMPTYING VELOCITY NORMAL RANGE- (50-60)
ELEVATED E/E'(43)	39.74	DECREASED
E/E'(20)	54.76	NORMAL

Table no 1. Table summarising Left atrial appendage flow velocity Versus LA Function in Patients with or without diastolic dysfunction.

DISCUSSION

In the determination of Left Atrial functions, the quantification of LAA velocity is the major method, however in patient with Atrial Fibrillation, quantification of LAA velocity is not feasible because there is no effective contraction in LAA. The impact of LV diastolic dysfunction on LAA Flow velocity is less defined. In this present study LAA emptying velocities were found to be significantly lower in those with LV diastolic dysfunction than those who do not have it.

In the study of Muhammed Bora Demirçelik et al. 2014. The period of study was January 2007 to March 2009. They studied 58 adults patients (non-rheumatic, paroxysmals or persistent AF) referred for transthoracic echocardiography and transesophageal echocardiography within a 30-day period. LAA peak emptying velocity was lower in patients with diastolic dysfunction, and also, in patients with high grade SEC. Accordingly, they

suggest that diastolic dysfunction may confer risk for SEC and stroke in patients with non-valvular AF and preserved LV ejection fraction [6].

Similarly, in our study carried out on 63 patients with Good Ejection fraction at sinus rhythm, in patients with diastolic dysfunction, LAA flow velocity was found to be lower than those who do not have it. In the literature, the impact of LV diastolic dysfunction on LAA velocity is less defined. LAA flow velocity are not well studied especially in Indian population, only few recent studies have been conducted by industries to look for the patients with valvular atrial fibrillation (AF) who sustained thrombo-embolic stroke.

CONCLUSION

In this study, we founded that Patient with diastolic dysfunction had an impaired left atrial function that was measured by left atrial appendage flow velocity.

FUNDING

This study was not supported by any funding.

DECLARATION OF COMPETING INTEREST

All authors declare no conflicts of interest.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

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