Correlation between mitral annular peak systolic excursion (MAPSE)by m-mode and peak systolic velocity by tissue Doppler imaging and LV systolic function assessed by biplane Simpson's method

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Introduction

An accurate assessment of left ventricular function is important in the diagnosis and management of several cardiac diseases. The most widely used measurement of left ventricular systolic function is the ejection fraction, which provides important prognostic information in these patients **(John et al., 1997).**

Ejection fraction by definition is

EF=EDV-ESV/EDV in normal individuals it varies 50-70%

Left ventricular ejection fraction (LVEF) is used to provide inclusion criteria for certain medical therapies, such as implantation of a cardiac defibrillator or to begin adjuvant chemotherapy for cancer. Its use is also important in the serial assessment of left ventricular function in many patients for the determination of timing of medical or surgical interventions **(Stuart et al., 2010).**

The imaging modalities which assess LVEF are;

1- Echocardiography:

Echocardiography is the most common & widely spread method for estimation of LVEF because it's almost available at every facility, easy to perform, no side effects, with reliable results &fit for all patient, on the other hands it requires a well trained sonographer, there is interpersonal variability and some people has bad echogenic window especially obese persons, smokers and patients with pervious CABG **(Tuncay et al., 2000).**

2-contrast angiography:

Measurement of left ventricular dimensions by left ventricular angiography was first described during late 1950s but now it's obsolete because it's an invasive method which carries out the risks of strokes, infection, perforation ….etc, in addition to adverse effects of dye used and it's not available in every center. Nowadays it's considered as a historic method **(John et al, 1997).**

3-Radionuclide techniques of blood pool and first pass imaging:

It represents a reliable and quantitative method of measurement of left ventricle EF especially it doesn't depend on LV geometry yet it is not available in many centers, requires well trained personal and has the limitations of radioactive material **(John et al., 1997).**

4-Electron beam computed tomography (EBCT):

EBCT allows quantitative measurement of LV EF based on precise measurement of end systolic &end diastolic dimensions giving an accurate results but it has 2 major drawbacks radiation exposure and use of iodinated contrast media which limits its use **(John et al., 1997).**

5-Cardiac magnetic resonance imaging (MRI):

It's the latest method for measurement of EF, its considered as the gold standard because its most accurate, easier to perform, lack interpersonal variation and has nearly no side effects yet it's not used commonly because it's

costy, can't be used with patients who suffer from claustrophobia or on permanent pacemakers or having some types metal clips (for cerebral aneurysms) or some sort of metal stents **(Tuncay et al., 2000)**

They have all evolved separately and have different normal values for each technique. Studies have shown that these modalities do not provide interchangeable values, supporting the conclusion that the serial assessment of ejection fraction with different techniques should be avoided and the same modality should be used for each follow-up assessment **(Stuart et al., 2010).**

Aim of the Study

To validate the correlation of mitral annular plane systolic excursion (MAPSE) by m-mode and peak systolic velocity by tissue Doppler imaging as surrogates for estimation of LV function in comparison to LV systolic function as assessed by biplane Simpson's method.

Patients and Methods

Patients:

The study will include 100 patients with age ranging between 20–75 years, divided into 2 groups:

- **Group A:**
  This group will include 50 patients with normal ejection fraction as assessed biplane Simpson's method

- **Group B:**
  This group will include 50 patients with sub normal ejection fraction as assessed biplane Simpson's method.

Exclusion criteria:

- Patients with arrhythmia.
- Valvular stenosis.
- Significant valvular regurgitation.
- Regional wall motion abnormality.
- Mitral annular calcification.
- Also patients with poor echogenicity who were difficult to determine their EF with Simpson's biplane method were excluded.

Methods:

All the patients included in the study will be subjected to:

- **Thorough history taking.**
- **Thorough clinical examination (general and local).**
- **Echocardiography:**
  - By using ultrasound system (vivid 7,GE, USA) and a 1–5 MHz phasedarray transducer, images

will be acquired with the subject in the left lateral decubitus position, at end expiration for a minimum of four consecutive cardiac cycles,
2D images were obtained in the parasternal long axis, parasternal short axis (mid-level), apical two and four chamber views. Optimization was performed using harmonic imaging, gain, dynamic range, frequency, sector width and focus to improve signal-to-noise ratio and provide optimal endocardial definition. Images were acquired ensuring the largest cavity lengths, and with less than 20% difference between apical four and two chamber views**.**

- **Biplane modified Simpson's method:** The biplane Simpson's software on the GE vivid-7 ultrasound system utilized a template system mapping the LV cavity allowed adjustments to be made to fit the map to the endocardial boundaries. This was performed for apical four- images at both end-diastole and systole. End-diastole was taken by identifying the frame with the largest LV cavity, end-systole was selected by identifying the frame with smallest LV cavity cross-sectional area in both apical views prior to mitral valve opening. End-diastolic and end-systolic volumes, ejection fraction, were calculated according to modified Simpson’s method.

- **MAPSE (mitral annulus plane systolic excursion):**

  By the same concept of using TAPSE (tricuspid annulus plane systolic excursion) as indicator of RV systolic performance which comes from the fact RV contraction is characterized by predominant longitudinal shortening and that decreases in TAPSE correlates with progressive decrease in RV function. Similarly, the value of MAPSE is obtained using M-mode echocardiography. It is the difference between end systolic and end diastolic distance from the mitral annulus to the apex. This is obtained by placing the cursor on the lateral and medial aspects of the mitral annulus (P. Ballo, et al., 2008).

- **Mitral annular Peak systolic velocity by Tissue Doppler imaging (TDI):**

  Pulsed TD imaging of systolic annular velocity will be performed from The apical 4-chamber view by placing a 5-mm sample volume at the junction between basal lateral myocardium and lateral mitral annulus, Tissue Doppler Imaging (TDI) provides information on systolic function through its systolic mitral annulus velocity Wave (Sm), reflecting the peak velocity of shortening of the myocardial fibers oriented in the longitudinal direction.

The data collected will be analyzed using SPSS (Statistical Package for Social Science). It will be presented using the Mean and Standard deviation .

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Abbreviations

AUC: area under the curve

ARVC: arrhythmogenic right ventricular Cardiomyopathy

ATP: adenosine triphosphate

AV: arteriovenous

CAD: coronary artery disease

CMR: cardiac magnetic resonance

DCM: dilated Cardiomyopathy

DD: diastolic dysfunction

DM: diabetes mellitus

EBCT: electron beam computed tomography

EDRVOTD: end-diastolic RV outflow tract diameter

EF: ejection fraction

ESRVOTD: end-systolic RV outflow tract diameter

Fig: figure

FS: Fractional shortening

HCM: Hypertrophic Cardiomyopathy

HF: heart failure

HFpEF: heart failure with preserved ejection fraction

HTN: hypertension

Lat: lateral

LV: left ventricle

LVEF: left ventricular ejection fraction

MAPSE: mitral annular peak systolic excursion

MDCT: multi-detector computed tomography

Med: medial

MLCV: maximal longitudinal contraction velocity

MRI: magnetic resonance imaging

mm: millimeter

ms: millisecond

mSv: Millisievert

NO: number

PSV: peak systolic velocity

PW: pulsed wave

ROC: Receiver operating characteristic

RV: right ventricle

RVEDA: Right ventricular end diastolic area

RVFAC: Right ventricular fractional area change

RVOT-SF: Right ventricular outflow tract shortening fraction

RVESA: RV end systolic area

SERCA: sarcoendoplasmic reticulum Ca2+-ATPase

SPECT: single photon emission computed tomography

SR: sarcoplasmic reticulum

TDI: tissue Doppler imaging

TAPSE: Tricuspid annular peak systolic excursion

Yrs: years

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