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ORIGINAL ARTICLE

Echocardiographic effect of successful balloon mitral valvuloplasty on right ventricular function

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KEYWORDS

Mitral stenosis;
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Abstract *Background:* Rheumatic cardiac disease is an immunologic phenomenon that may affect any of the heart valves and is by far the most common cause of mitral stenosis.
Aim of the work: To evaluate impact of successful percutaneous balloon mitral valvuloplasty on right ventricular function.
Subjects and methods: 30 consecutive patients who underwent balloon mitral valvuloplasty for rheumatic mitral stenosis between September 2010 and July 2011 at Ain Shams University hospital were included.
All patients were subjected to transthoracic echo Doppler study, tissue Doppler imaging and TEE for: (A) Assessment of severity of mitral stenosis. (B) Peak myocardial velocities during systole, early and late diastole. (C) Assessment of RV function by measurement of TAPSE and Tie index.
Results: The study revealed a significant drop in TAPSE (before and 24 h after, *P* 0.008; before and 3 ms after, *P* 0.001) respectively. There was no significant change 24 h and 3 ms after the procedure (*P* 0.220) .There was no significant change in IVC flow before and after 24 h (*P* 0.221). There was no significant drop between before and after 3 ms (*P* 0.062). There was no significant change between 24 h and 3 ms after the procedure (*P* 0.264). There was a significant drop in Tie index (before and 24 h after, *P* 0.008; before and 3 ms after, *P* 0.009) respectively but no significant drop was found 24 h and 3 ms after the procedure (*P* 0.373).
Conclusion: The current study showed a significant improvement in both systolic and diastolic functions of RV as observed by different echocardiographic parameters post BMV in patients without organic TV disease.

1. Introduction

Rheumatic cardiac disease is an immunologic phenomenon that may affect any of the heart valves and the myocardium and is by far the most common cause of mitral stenosis.[1]

Mitral stenosis leads to increase in left atrial pressure which results in a passive rise in pulmonary venous and arterial pressures.[2] It eventually leads to right ventricular dilatation and

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failure. Thus, right ventricular dysfunction is an important indicator to evaluate the severity of mitral stenosis.[3]

The quantitative echocardiographic assessment of right ventricular function is difficult because of the ventricle's complex trapezoidal anatomy and narrow acoustic window.

Two dimensional echocardiography is the mainstay for analysis of RV function, but recently alternative techniques have been proposed, including tissue Doppler imaging (TDI) techniques, three dimensional echocardiography, magnetic resonance imaging (MRI), and even invasive assessment of pressure–volume loops.[4]

The morphologic information provided by echocardiography is important for evaluating potential candidates for percutaneous balloon valvuloplasty.[5]

2. Subjects and methods

Thirty consecutive patients who underwent balloon mitral valvuloplasty for rheumatic mitral stenosis between September 2010 and July 2011 at the Ain Shams University Hospital were included in this study. All patients who were included in the study had formal written consent.

2.1. Inclusion criteria

- Sinus rhythm.
- All the patients were in New York Heart class $\geqslant$II or $\leqslant$IV.
- Moderate to severe MS (i.e., a mitral valve area $\leqslant 1\ cm^2/m^2$ body surface area (BSA) or $< 1.5\ cm^2$ in normal-sized adults.[6]
- Suitable valve morphology by echocardiographic criteria.
- Absence of concomitant cardiovascular disease requiring surgical correction.

2.2. Exclusion criteria

- Atrial fibrillation.
- Systemic hypertension.
- Diabetes mellitus.
- More than mild mitral or aortic regurgitation and/or aortic stenosis.
- Lung diseases.
- Pulmonary valve disease.
- New York Heart Association functional class IV.
- Previous aortic or mitral valve surgery.
- Echocardiographic criteria for contraindications of balloon valvuloplasty e.g. mitral regurgitation grade III or IV, left atrial thrombus, heavily calcified mitral valve annulus, commissural calcification and heavy subvalvular affection).[7]
- Organic tricuspid valve affection.

2.3. Echocardiographic measurement

- All patients were examined in the left lateral decubitus position by M-mode, two-dimensional, Doppler and DTI echocardiography with the use of Vivid 5GE echocardiography device with a 2.5 MHz transducer.
- The Wilkins score was used to assess the suitability of the mitral valve's morphology for balloon mitral valvuloplasty. This scoring system assigns a point value from 1 to 4 for each of: (1) Valve calcification, (2) leaflet mobility, (3) leaflet thickening, and (4) disease of the subvalvular apparatus.[8]

2.4. Severity of mitral stenosis was assessed by

- Mitral valve area was calculated by both the pressure half-time method and planimetry.[6]
- Peak and mean diastolic transmitral gradients were measured by continuous-wave Doppler echocardiography.
- Continuous wave Doppler is used to estimate pulmonary artery systolic and mean diastolic pressure by measuring the peak retrograde pressure drop across the tricuspid valve (Tricuspid regurgitation) and pulmonary valve (Pulmonary regurgitation), respectively. Tricuspid valve velocities can be obtained from parasternal short or long axis projection and apical view whereas pulmonary valve velocities are obtained from the parasternal short axis views (Fig. 1). The pressure drop (gradient) is calculated from the flow velocity using the modified Bernoulli formula ($\Delta P = 4V^2$).[9]
- The maximum peak TR velocity (V) was used to determine right ventricular systolic pressure (RVSP) with the simplified Bernoulli equation which is the sum of the transtricuspid gradient and right atrial pressure (RAP) {RVSP = $4V2$ + RAP}. V is the maximal velocity of the tricuspid regurgitant jet). We further assumed a right atrial mean pressure of 10 mmHg in patients, based on the absence of inferior vena cava dilation greater than 20 mm.[11]

In the absence of a gradient across the pulmonic valve or RVOT, SPAP is equal to RVSP.[12]

2.5. Assessment of RV function

2.5.1. Using M-mode

The tricuspid annular plane systolic excursion (TAPSE) was measured by the level of systolic excursion of the lateral tricuspid valve annulus towards the apex in the four chamber view[4] (see Fig. 2)

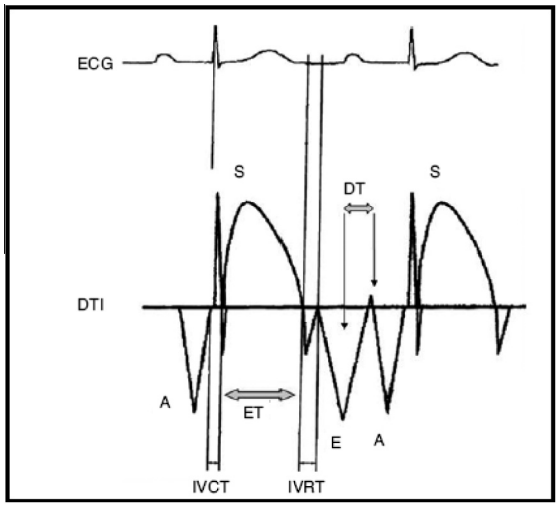

Figure 1 Tissue Doppler echocardiography (DTI) time intervals measured from the tricuspid lateral annulus. ECG: Electrocardiogram; IVCT: isovolumic contraction time; IVRT: isovolumic relaxation time; S: systolic velocity; E\: early diastolic velocity; A\: late diastolic velocity; ET: ejection time; DT: E-wave deceleration time.[10]