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Effects of Atrial Fibrillation Cardioversion after Percutaneous Mitral Balloon Valvuloplasty on Echocardiographic Left and Right Atrial Functions

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Abstract

Amongst patients with mitral stenosis (MS), the most common complication is AF.Our study aimed at evaluating the effect of AF cardioversion after Percutaneous Mitral Balloon Valvuloplasty (PMBV) on echocardiographic atrial functions.

The study included 34 patients with MS and AF, presenting to Ain-shams University hospitals, who underwent successful PMBV then randomized into 2 different groups according to AF management strategy. Group-I patients (n=16) received DC cardioversion after amiodarone infusion (within 24 hours post-PMBV) in addition to anticoagulation. Group-II patients (n= 18) were kept on the rate control strategy for AF and anticoagulation. Atrial functions were evaluated by echocardiography before and 48-72 hours after PMBV.

Both groups were homogenous regarding demographic, clinical and echocardiographic data before PMBV. Both groups showed significant improvement in MVA (Group-I: 0.953 ± 0.144cm2 to 2.26 ± 0.463cm2, p=0.000, Group-II: 0.942 ± 0.171cm2 to 1.95 ± 0.40cm2 , p=0.0000), left atrial emptying fraction (Group-I:16.11 ± 6.93% to 26.16 ± 5.51%, p=0.000 , Group-II: 18.49 ± 5.47% to 26.12 ± 7.68%, p=0.002), left atrial function index (Group-I: 4.48 ± 2.32 to 6.84 ± 3.35, p=0.001 , Group-II: 3.34 ± 1.42 to 7.80 ± 4.17, p=0.006) as well as estimated systolic pulmonary artery pressure (Group-I: 49.06 ± 13.86 to 38.25 ± 7.29, p=0.01 , Group-II: 53.44 ± 14.52 to 39.88 ± 10.67, p=0.003). For group-I patients, reduction in left atrial end-diastolic volume was significant (120.84 ± 32.82 mL to 95.31 ± 19.27mL, p=0.012) and TAPSE showed significant improvement (17.57± 4.96 to 21.08 ± 2.52,p=0.018). When percentage improvement in variables was compared between both groups, none of the indices used to evaluate atrial functions showed any significant difference between both groups.

Atrial functions improve post-PMBV. No additional improvement in atrial functions occurs after cardioversion in patients who have already undergone PMBV, at least within 72-hours.

Introduction

Atrial fibrillation is the most common sustained cardiac arrhythmia and its prevalence is ~1–2% of the general population, but higher with increasing age and in patients with concomitant heart disease especially mitral valve diseases.[1] Amongst patients with MS, the most common complication is AF.[2] Despite declining incidence of rheumatic heart disease worldwide, it remains the most common cause of MS.

Mitral stenosis is a disease of plateaus[4] it takes 1 to 2 decades after the onset of rheumatic fever before signs of MS appear, followed by another period of 1 to 2 decades before mild symptoms occur. During this time, the onset of AF may cause further decompensation, beginning of AF is a fundamental moment in MS which is often caused by atrial inflammation and remodeling. AF occurs in 40–75% of patients who are symptomatic for MS, precipitates such symptoms, greatly increases the risk of systemic embolization, and reduces cardiac output and exercise capacity.[5] Systemic embolization most often occurs in patients with AF and MS.

Protection of the sinus rhythm in patients with MS is very important for reduction the risk of cerebral embolism, conservation of cardiac output and exercise capacity, and reduction of symptoms.[3]

On reviewing the literature, we didn't find any study that evaluated atrial functions by echocardiography in patients cardioverted to sinus rhythm after PMBV. In this study, we aimed at evaluating the effect of AF cardioversion post-PMBV on echocardiographic atrial functions.

Patients and Methods

The study included 34 patients with MS and AF who all underwent a successful PMBV (from November 2011 to December 2013) then randomized into 2 different groups according to the AF management strategy:

1. Group-I patients (n=16) received DC cardioversion after amiodarone infusion (within 24 hours post-PMBV) in addition to anticoagulation.

Key Words:
Mitral Stenosis, Atrial Fibrillation , Cardioversion.

Disclosures:
None.

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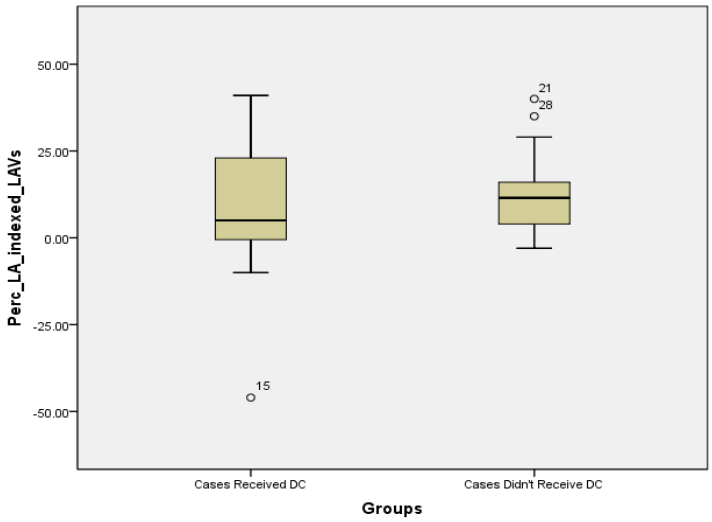

Figure 1: Comparing Percentage Change in LAFI between both groups

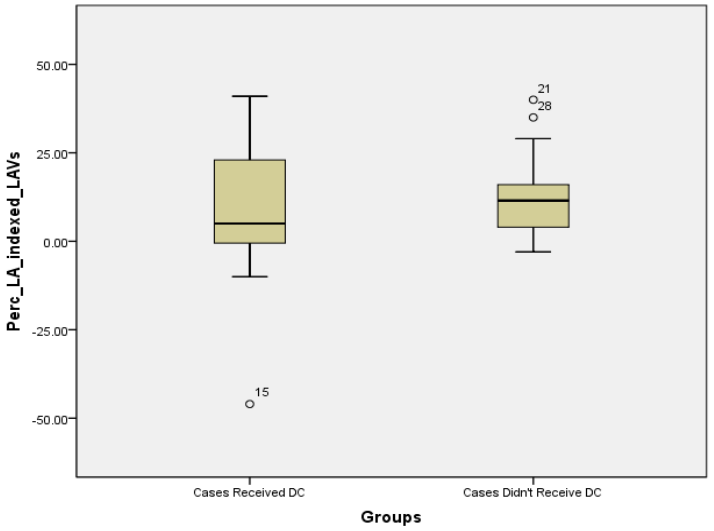

Figure 2: Comparing Percentage Change in indexed LAVs between both groups

2. Group-II patients (n= 18) were kept on the rate control strategy for AF as well as anticoagulation. Atrial functions were evaluated by echocardiography before and 48-72 hours after PMBV.

All Patients Were Subjected To The Following

- Proper history taking, thorough clinical examination.
- Routine laboratory investigations including INR, as well as an ECG.
- Conventional 2D Echocardiography: was performed using GE Vivid S5 machine. It was done before and 48-72 hours after PMBV (and DC for group-I). it included:

Thorough assessment of MVA, mean PG, Wilkin's score, presence and degree of other valvular lesions especially mitral regurgitation, tricuspid regurgitation.[6]

Thorough assessment of left atrial (LA) and right atrial (RA) volumes (end-systolic volume "ESV" and end-diastolic volume "EDV")[7] and emptying fraction (EF). For left atrium, a rhythm-independent index was calculated; the left atrial function index (LAFI) as below:[8]

Statistical Analysis

All data were gathered, statistically analyzed and tabulated. All numerical variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as percentage (%). Changes in continuous variables were evaluated with the paired t-test or Mann Whitney test. For all analysis a P value of < 0.05 was considered statistically significant.

Results

Both groups were homogenous regarding demographic, clinical and echocardiographic data before PMBV with no significant differences that might have confounded the results post-PMBV.

There were significant changes in some variables some within the same group following PMBV. Both groups showed significant improvement in MVA (Group-I: 0.953 ± 0.144cm2 to 2.26 ± 0.463cm2, p=0.000, Group-II: 0.942 ± 0.171cm2 to 1.95 ± 0.40cm2 , p=0.0000) , left atrial emptying fraction (Group-I: 16.11 ± 6.93% to 26.16 ± 5.51%, p=0.000 , Group-II: 18.49 ± 5.47% to 26.12 ± 7.68%, p=0.002), left atrial function index (Group-I: 4.48 ± 2.32 to 6.84 ± 3.35, p=0.001 , Group-II: 3.34 ± 1.42 to 7.80 ± 4.17, p=0.006) as well as estimated systolic pulmonary artery pressure (Group-I: 49.06 ± 13.86 to 38.25 ± 7.29, p=0.01 , Group-II: 53.44 ± 14.52 to 39.88 ± 10.67, p=0.003).

For group-I patients, reduction in left atrial end-diastolic volume was significant (120.84 ± 32.82 mL to 95.31 ± 19.27mL, p=0.012) and also TAPSE showed significant improvement (17.57± 4.96 to 21.08 ± 2.52, p=0.018).

However, when the percentage improvement in variables was compared between both groups, none of the indices used to evaluate atrial functions showed any significant difference between both groups. This might mean that AF cardioversion after PMBV has no additional effect on atrial function, at least within 72 hours. (table1, figures 1,2)

$$\text{Left atrial function Index (LAFI)} = \frac{\text{LA emptying fraction} \times \text{LVOT VTI (cm)}}{\text{LAESV indexed to BSA (cc/m}^2\text{)}}$$

LAFI units = (cm) x (m^2) /cc (ie units cancel out)
LVOT VTI = velocity time integral of the left ventricular outflow tract (cm)
LAESV = maximal left atrial volume in end systole (cc)
BSA = body surface area

LAEF (LA emptying fraction) = [(LAESV-LAEDV)/LAESV] X 100

Discussions

The main objective of our study was to compare between the percentage improvements in atrial functions in both study groups. We aimed at studying the effect of cardioversion of AF on atrial functions in such very high risk group (i.e having moderate to severe MS as well as AF of long duration and thus expected to have the worst atrial functions). Those high risk patients are the most symptomatic patients and the most vulnerable ones who actually need more treatment options. However, none of the indices used to evaluate atrial functions showed any significant difference between both groups. The exact explanation for such results couldn't be fully addressed.

To the best of our interest, no other studies were designed to evaluate atrial functions by echocardiography after AF cardioversion post-PMBV. Nevertheless, there were studies to evaluate atrial functions following each procedure separately, that is, following AF cardioversion or following PMBV alone.

One study[9] included 41 patients with chronic AF (including 7

patients with moderate to severe MS). In the 28 patients who maintained sinus rhythm after 6 months, significant improvements were found in LA and RA volumes and dimensions. The echocardiographic re-assessment in our study was done much earlier, This point may highlight the issue of both the occurrence of atrial stunning (i.e delay in the onset of organized atrial contraction after a successful cardioversion of AF) post-cardioversion as well as the need for time for the occurrence atrial reverse remodeling and hence, improvement in atrial volumes and functions

Reviewing the available literature revealed more or less agreement on the presence a time-course following cardioversion during which gradual improvement of atrial functions occurs before reaching a plateau. The exact time-course varied from a study to another, but ranged from few weeks to few months post-cardioversion. However, the issue of occurrence of atrial stunning and its duration post-cardioversion is still an area of debate in the literature. Whereas some studies highlighted the importance of the hemodynamic effect of atrial stunning, other studies refuted its hemodynamic significance.

Some studies[10] claimed almost complete recovery of atrial functions within 24-hour after cardioversion. However, that study excluded valvular AF and > 50% had AF for less than 4 weeks. Other studies reported significant improvement in LA function immediately after cardioversion, with subsequent further improvement over time, as the case in the cohort of Thomas et al.[8] which adopted and validated the LAFI as a rhythm-independent index for LA function.

On the other hand, other studies showed dissociation of right and left atrial recovery following AF cardioversion. One study[11] found that the right atrium resumed its mechanical function immediately after cardioversion, whereas the left atrium was stunned beyond day 7.

Last and not least, there are studies that suggested that improvement in atrial functions following cardioversion is related to the AF duration pre-cardioversion. One of these studies[12] found that left atrial mechanical function is greater immediately, after 24 hours and after 1 week in patients with brief AF duration compared with those with prolonged AF.

Limitations

• Lack of further serial follow up especially echocardiographic studies that might have limited our ability to study the real effect of AF cardioversion post-PMBV on atrial function.

• It included a single medical center (Ain Shams University hospitals).

• Small number of patients included in the study (34 patients).

Conclusions

• Improvement in atrial function in patients who have undergone AF cardioversion post-PMBV doesn't occur early, at least within the first 72 hours.

• The PMBV per se lead to significant immediate improvement in LAEF, LAFI and systolic PAP.

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