Should TAPSE Score be in the Forefront Following the Tricuspid Valve Replacement?

Triküspid Kapak Replasmanı Takiplerinde TAPSE Skoru Ön Planda Olmalı mı?

Triküspid Kapak Cerrahisinde TAPSE Skoru / TAPSE Score in Tricuspid Valve Surgery

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Özet

Amaç: Triküspid kapak hastalıkları sıklıkla romatizmal hastalıklardan etkilenmekte ve yetmezlik ile karşımıza çıkmaktadır. Çalışmamızda, Triküspid kapak replasmanı yapılan hastaların takiplerinde Tricuspid Annular Plane Systolic Excursion (TAPSE) skorunun yeri ve önemini araştırmak istedik. Gereç ve Yöntem: 2011-2013 yılları arasında Triküspid kapak replasmanı yapılan hastalar retrospektif olarak değerlendirildi. Çalışma grubumuzu reoperasyonlar ve ilk kez ameliyat olan hastalar oluşturuyordu. Hastaların hepsi operasyon sonrası farklı zamanlarda kontrollere çağrıldı. TAPSE skoru, New York Heart Association (NYHA) fonksiyonel sınıflaması, Mean Pulmonary Artery Pressure (MPAP), ejeksiyon fraksiyonu, ekokardiyografik diğer ölçüm parametreleri bakılarak klinik durum ile korelasyonları değerlendirildi. Bulgular: Operasyon sonrası takiplerde NYHA fonksiyonel kapasitesi (operasyon öncesi 3,31±0,63, 1,83±0,83), TAPSE skoru (operasyon öncesi 17,38±3,15 mm; 12,53±4,8mm) ve MPAP (operasyon öncesi 35,53±14,72 mmHg; 30.3±11.2 mmHg) değerlerine bakıldı. NYHA ve MPAP değerlerinde kliniğe paralel belirgin bir iyileşme saptanırken, TAPSE skorunda klinik ve diğer parametrelerin tersine gerileme olduğu görüldü. Tartışma: TAPSE skoru, operasyon öncesi mortalite ve morbiditeyi belirlemede önemli olmasına rağmen Triküspid kapak replasmanı yapılan hastaların takiplerinde çok etkili olmadığını gördük. Triküspid kapak replasmanı yapılan hastaların takiplerinde klinik durum ve diğer parametrelerin daha ön plana çıkması, skorun ise daha geri planda değerlendirilmesi gerektiğini düşünüyoruz.

Anahtar Kelimeler

Triküspit Anüler Plan Sistolik Sapması; Sağ Ventriküler Fonksiyon; Triküspit Yetmezliği; Ekokardiyografi

Abstract

Aim: Tricuspid valve diseases are generally affected from rheumatismal diseases and it emerges by regurgitation. In our study, we aimed to search both the situation and importance of Tricuspid Annular Plane Systolic Excursion (TAPSE) score during the follow-up of patients who had undergone tricuspid valve replacement. Material and Method: Between the years of 2011-2013, the patients who were done tricuspid valve replacement have been evaluated retrospectively. Our group was made up of re-operated patients and the ones that were operated for the first time. TAPSE score, clinical classification of New York Heart Association (NYHA), Mean Pulmonary Artery Pressure (MPAP), ejection fractions, echocardiographic measure parameters were checked and their correlations with clinical conditions, were evaluated. Results: During the follow-up of these patients post operatively, functional capacity (before the operation 3.31±0.63; 1.83±0.83), TAPSE score (pre-operation 17.38±3.15mm; 12.53±4.8mm), MPAP (pre-operation 35,53±14,72 mmHg; 30.3±11.2 mmHg) values were evaluated. In the values of NYHA and MPAP, marked clinical improvement was detected in parallel with clinical situation; the decline in score of TAPSE was observed contrary to clinical and the other parameters. Discussion: Although the TAPSE score is important in defining the mortality and morbidity before the operation, we observed that it is no such of an importance in the follow-up of patients who had tricuspid valve replacement. We think that, for the follow-up of these patients who had tricuspid valve replacement, clinic condition and other parameters should be in the forefront, however the score should be evaluated in the background.

Keywords

Tricuspid Annular Plane Systolic Excursion; Right Ventricular Function; Tricuspid Incompetence; Echocardiography

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Introduction

Tricuspid heart valves are mainly affected by rheumatic illnesses and co-occur with mitral valve involvement. It is discernible that 62% of patients with mitral valve disease have functional tricuspid valve dysfunction. It is very rare that the stenosis is seen isolated and generally it is collocated with insufficiency.

Decrement of the afterload of right ventricle, functional tricuspid regurgitation (TR) and some improvement in right ventricule (RV) function occur in parallel with decrease of the pulmonary artery pressure although tricuspid valve is not intervened during mitral valve surgery. However, during mitral valve surgery, in that of necessary surgical intervention applied to tricuspid valve, it was reported that improvement of TR and RV functions are much better [1].

Such questions like; "When and how should tricuspid valve intervened? What are the factors conditioning the mortality and morbidity?" are still valid and under discussion today.

Due to RV's anatomical and complex structure, it is quite hard to evaluate the ejection fraction in a non-invasive way. In detaining the RV systolic function, the acceleration during isovolumetric contraction, the right ventricle myocardial performance, the changes in ventricle fraction area, three dimensional right ventricle ejection fraction, tissue Doppler-derived tricuspid lateral annular systolic velocity (Tri S), Tricuspid Annular Plane Systolic Excursion (TAPSE) can be effectively used [2].

TAPSE is a scoring system which is measured with non-invasive doppler echocardiography and is used in determining right ventricle function. This scoring system has been found in a relation with mortality and bad fractional classification [3].

• The place of TAPSE score in evaluating the right ventricle functions in patients who had tricuspid valve replacement (TVR)

• Is TAPSE score efficient in evaluations and follow-ups of patients undergone TVR and does it show any correlation with patient's clinic? We have searched for the answers to these questions.

Material and Method

In between the years January 2011-March 2013, in our clinic, thirteen patients undergone TVR operation were evaluated retrospectively and were included in our study. As routine TAPSE score was not followed before the year 2011, TVR operations done before that year were not taken into consideration. Our patient group that evaluated retrospectively is composed of the patients that were operated before due to rheumatismal valve disease (Aort and/or mitral) and the ones that will be operated for the first time. The operations were performed by inserting cross clamp with the accompany of right thoracotomy or else, median sternotomy with cardiopulmonary bypass. For TVR, bioprosthesis and mechanical heart valves were performed. None of the patients were applied tricuspid valve reconstruction. Post-operative inotropic agent needs, the duration of intensive care unit stays, discharging from hospital times, the presence of ascites during pre and post operation, functional capacity, cardiac rhythm, MPAP (mean pulmonary artery pressure), TAPSE score and ejection fractions (EF %) were observed and the patients were evaluated in terms of clinical and measurement parameters (Table 1). Different patients of early-middle-late periods were invited for controls at different times. TAPSE score of patients, MPAP and their functional capacities were evaluated in accordance with New York Heart Association (NYHA), moreover their effects on mortality and morbidity were surveyed. In addition, the correlation of TAPSE with other parameters and clinical conditions were examined.

Table 1. Pre operative and post operative parameters of patients.

	Pre operative value	Post operative value	P value
Post operative inotropic agent need (%)	46.2	91.7	<0.05
The duration of intensive unit stay (day)		8.9±11.5	
Presence of AF (%)	92.3	92.3	>0.05
Presence of nodal rhythm (%)	0	7.7	<0.05
Discharging from hospital time (day)		17.6±12.3	
Presence of ascite (%)	92.3	16.7	<0.05
NYHA functional capacity	3.31±0.6	1.83±0.8	>0.05
MPAP (mmHg)	35.5±14.7	30.3±11.3	>0.05
TAPSE score (mean)	17.4±3.2	12.5±4.8	<0.05
EF(%)	49.6±8	51±6	>0.05

AF: Atrial Fibrillation, EF: Ejection Fraction, MPAP: Mean Pulmonary Artery Pressure, NYHA: New York Heart Association, TAPSE: Tricuspid Annular Plane Systolic Excursion.

Echocardiography

Doppler color echocardiography was performed using a GE Vivid 7 console. Right ventricular function was assessed using TAPSE measured by M-mode in the trans-apical four chamber view. Right ventricular systolic dysfunction was defined as TAPSE <15 mm.

Statistical analysis

The data were presented as mean and standard deviations, and percentage, where appropriate. Chi square test and paired-t test were used to compare the test values where necessary. Probability (p) values below 0.05 were considered significant. Confidence intervals (CI) were calculated at the 95% level.

Results

7.7% of our patients (n=13) who had gone under TVR operation were men (N=1, age=35 years) and 92.3% was women (N=12, mean age=56±8.76 years). 84.6% of the study patients who had 3rd degree (23.1%) and 4th degree (76.9%) tricuspid valve insufficiency had been operated before for various reasons; but 15.4% were made up of the ones who were going to have an operation for the first time (Figure 1A). Operations were performed with the approach of right thoracotomy (46.2%) or median sternotomy (53.8%). The preoperative diagnoses are described in figure 1A and the surgical operations types are shown in figure 1B. Mechanical heart valves were used in 38.5% and bioprosthetic valves were used in 61,5% of TVR. In all our patients, preoperation and postoperation rhythms were atrial fibrilation and no patient had an extra intervention on rhythm.

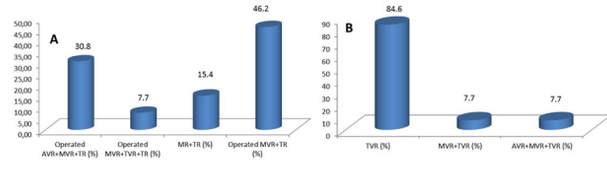

Figure 1. Preoperative diagnoses (A), Distribution of the operation (B).

Ascites was 92.3% before the operation and after the operation was 15.4%. Throughout follow-ups, pre and post operational presence of, NYHA classification, MPAP, EF and TAPSE scores were evaluated (Figure 2). TAPSE scores and MPAP values were measured in different patient groups who came for check-ups at different time levels. Their approximate stay in intensive care unit was 8.91±11.56 days. Only one patient became exitus (7.7%). While two of our patients still stay in our hospital for treatment, rest of the ten patients were released from the hospital in good health.

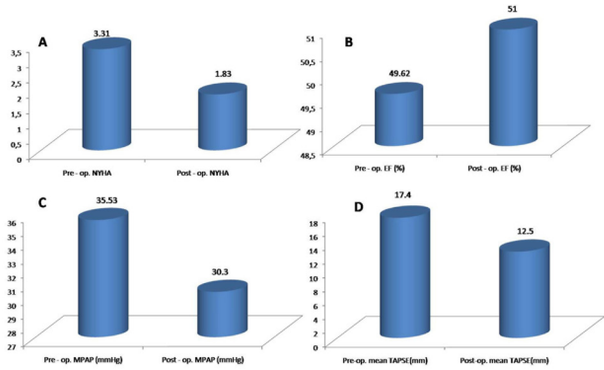

Figure 2. Mean NYHA functional classification scores before and after operation (P<0.05) (A), Mean EF values before and after operation (P>0.05) (B), MPAP values before and after operation (P>0.05) (C), Preoperative and postoperative mean TAPSE scores (P<0.05) (D).

Discussion

Tricuspid heart valves are often affected by rheumatic diseases. There can be observed stenosis or regurgitation, however it mostly appears in regurgitation. In mitral valve disease, the geometry of right ventricle changes, papillar muscles relatively change places, the shape and size of tricuspid annulus change, causing functional tricuspid regurgitation.

During the five years of patient follow-ups, who were operated because of mitral insufficiency, it was observed serious tricuspid regurgitation and mortality amount was 50%, on the other hand, the ones with medium level insufficiency weren't observed to have any mortality related to tricuspid valve. In our study, where tricuspid operation was done with fifteen patients series due to rheumatic causes, operative mortality was found as 20%. Within the same study, the half of survived patients were set to be in class III – IV according to NYHA functional classification. While in the study we prepared, our mortality rate was found as %7.7, in thirteen patients series, NYHA classification in survived patients was found as 3.31±0.63 before the operation and as 1.83±0.83 after the operation.

It was shown that functional tricuspid valve regurgitation decreased after mitral valve replacement (without insufficiency level before operation being considered). In the same study, it was shown that there was a bit of recession at first in the ones who are over grade 2, and in 3 years time, TR continued in Grade 2 and over [1]. It was observed that the recovery in TR was temporary. In the course of mitral valve intervention, effective tricuspid valve repair or replacement enable a permanent recovery [1]. In the group whose TR grade is between 0-1, RV function was normal and over grade 2 group degenerated RV function was determined. In time, insufficiency in tricuspid valve was progressing, deterioration the patient's clinic [4]. Most part of the patients in our serial were made up of re-operated individuals whose tricuspid heart valves weren't intervened during the first operation. Our results are concordant with literature. In the course of first operation, the risk of mortality and morbidity increased as a result of insufficient intervention to tricuspid heart valve, thus leading to a probability of patients who have the predicament of surgical operations.

Either in adult or congenital heart diseases; afterload, preload and contractility play an important role on right ventricle systolic performance [5]. The right ventricle systolic function is determined by; ventricle free wall movement, apical basal shortening during contractions and the movement of interventricular septum which develops as a connection of two ventricles. RV function is dependent on both ventricles so, it is harder to determine RV function non-invasively compared to the one on the left. Determining the systolic performance, non-invasive methods are more useful and practical than other invasive methods. Evaluating TAPSE score is easy, cheap and more advantageous owing to its repeatability.

Right ventricle dilatation determines mortality and morbidity and is of a very high-importance prognostic factor [3]. There was observed a strong correlation between right atrial pressure elevation and mortality [6,7].

For right heart disease; high pulmonary artery pressure, the presence of pericardial effusion, right atrial area index, right ventricular Tie index [8] and TAPSE [9] are the factors which determine the prognosis.

Pulmonary hypertension is a hemodynamic and pathophysiological clinic course which progress on average pulmonary artery pressure of 25mmHg and over [6]. In defining the mortality, the cut off value of PAP is 70 mmHg. PAP above 70 mmHg is significantly related with the renal and hepatic complications, prolonged mechanical support, pericardial effusion [3]. According to one study, it has been concluded that, there is no relationship between the ones having mitral valve disease with MPAP ≥ 50 mmHg and mortality after operation [10]. In the patients who are followed up for pulmonary artery hypertension and whose average pulmonary artery pressure are alike, TAPSE value of ≥2.0 cm have better prognosis than the ones with ≤2.0 cm. There is a negative correlation between TAPSE score and PAP. It was observed that the score decreases in patients with high PAP [11]. In our study, MPAP values decreased in post-operation follow ups and this has been parallel to clinical recovery. There hasn't been observed any correlation between TAPSE score and MPAP due to problems about score measure, which will be discussed later in another argument.

There is a close relation between RV average TAPSE score and mortality and morbidity. In accordance with the study of TAPSE on age and body surface area (BSA), the score has a stronger relationship with age and a weaker relationship with BSA [12]. While it has been set that the score has reached its peak value at the age of 18, there has been detected no difference between sexes [12]. Tachycardia, high grade TR after operation, the wideness of left atrial systolic area, low left ventricle EF were found in relation with TAPSE's value being low [1]. The very close relation of TAPSE score with right ventricle function was shown in studies done with radionuclide EF [13], magnetic reso-

nance [14]. While the ones with average score 12.23 ± 4.83 mm had more mortality, in 18.49 ± 5.8 mm ones, there were seen meaningfully less [3]. TAPSE being <2.0cm shows that the left or right ventricle starts to lose its function, however >2.0cm value means ventricle function is normal. There has been observed very important difference within Intra-inter observers in measuring the TAPSE score [15]. It was shown that, for patients with TAPSE < 2cm, RV ejection fraction is <40% [16]. TAPSE is an essential definer for cardiac index. TAPSE being <1.3 cm shows 76% specificity and sensitivity for left ventricle EF decrease.

Related to left and right ventricle EF, there has been detected a crucial correlation between TAPSE and left ventricle dysfunction [17]. TAPSE score gives more important information and shows high sensitivity and specificity rather than RV systolic and diastolic function in terms of ventricle echocardiographic parameters [18]. It hasn't been shown that the maximum velocity rate of tricuspid valve during early diastole and atrium contraction doesn't define RV systolic and diastolic function, alone [19].

At the same time, maximum velocity rate of tricuspid valve was seen that it is relationship to left ventricle systolic and diastolic function [19]. It was pointed out that TAPSE score has a relationship with EF measured with echocardiography [20,21]. TAPSE score was found less effective in determining right ventricle functions in the group that was applied Mitrale valve replacement solely, than in the group applied TVR [1]. There are other studies as well which support that TAPSE score does not confirm its relevance in measuring RV function after the operation [22].

There has been observed a meaningful decrease in TAPSE score during TVR follow ups among our patients. Although there has been a very important clinic recovery during late period follow ups, it was observed that TAPSE score had increased most to the pre-operation value. Clinical recovery, loss of ascite, the precious decrease in the score despite advanced recovery in functional classification remind us of the relation between valve ring occupancy within TVR operated patients. By the reason of restriction within after-TVR mechanic and bioprosthesis valve ring's annulus movements, TAPSE score was found low, which has no correlation between patient's clinic and NYHA functional classification. Even though there has been a clinic recovery in all our patients, detection of decrease in TAPSE score confirms this very idea of ours. While in TVR planned patients, pre-operation TAPSE score defines mortality and morbidity during the course of post-operative follow ups, functional classification, clinic parameters and MPAP stand in the front.

The recovery in right ventricle after the intervention on tricuspid valve increases slowly in the course of time and become permanent. The acceleration in TAPSE score during early period after TVR (good prognosis) is not very clear. Among the ones with functional TR secondary to mitral valve disease, the decompositions in RV right after TVR have been recovery quite fast, however, this hasn't reflected on TAPSE score.

Either in congenital or right ventricle related mature heart diseases, it has become more of an issue to present right ventricle functions in a quantitative way. TAPSE value right ventricle function is an important parameter that determines cardiac index. Among the group undergone TVR, TAPSE score is low due to the restrictions in the annulus movements related to valve in the early period and this disables us to no observe clinical condition, mortality and morbidity. We consider that in evaluating cardiac functions among the TVR done patients, of course clinical and other parameters should be more in the front.

The Restrictions of the Study

The importance of TAPSE score in determining the right ventricle function has been lately discovered. For that reason, the number of patients has been less as the score is being considered for such a short period of time. The patients were invited for follow ups at different times and their scores were measured. In order to measure and evaluate their TAPSE scores, some patients were invited at early period while others were called out during middle and late periods. Our aim for the future is to homogenize our patients' follow up durations and to better introduce the efficiency of TAPSE score on TVR applied patients' follow ups. For this reason, newly TVR applied patients and TAPSE scores have been added in the group. We would like to share our early period results with you.

Conflict of interest

The Authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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