

## Evaluation Of Right Ventricular Dysfunction By Tapse In Patients Of Chronic Valvular Heart Disease

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### ABSTRACT

**Background:** The way the right ventricle (RV) functions is key to the outcome of patients with chronic valvular heart disease (VHD). Although obtaining TAPSE by echocardiography is simple, current research linking TAPSE to clinical results in mixed VHD patients is scant, especially in low- and middle-income regions.

**Methods:** We did a study in a hospital on 50 patients over 1 year with well-established chronic valvular heart disease seen at S. N. Medical College, Agra (April 2023 – March 2025). The patient was examined, given an NYHA grade and had echocardiography performed. According to the American Society of Echocardiography guidelines, I measured TAPSE, PASP, LA diameter and LVEF. The assessment of RV dysfunction was separated from how well global 2-D/colour and Doppler criteria were met.

**Results:** Mean age of the participants was 50.8 years, with 58% identifying as male. Among all cases, MS and mixed MS+MR together made up the highest numbers (34 % MS and 38 % mixed MS+MR). The overall result was that 56 % of patients saw a decline in their TAPSE (below 17 mm). The Mean TAPSE decreased with each increase in NYHA class (II  $17.2 \pm 3.0$  mm; III  $15.7 \pm 3.5$  mm; IV  $15.0 \pm 1.7$  mm;  $p < 0.01$ ). There was a positive link between TAPSE and LVEF ( $r = 0.50$ ,  $p < 0.01$ ) and an inverse link between TAPSE and both LA diameter ( $r = -0.39$ ,  $p = 0.017$ ) and PASP ( $r = -0.45$ ,  $p = 0.010$ ). With an area under the curve of 0.871, using a cut-off of less than 15 mm allowed accurate prediction of severe RV dysfunction in 90.9 % of cases and correctly identified those without it in 74.4 % of cases.

**Conclusion:** In chronic VHD, TAPSE falls in parallel with clinical heart-failure severity and correlates with key haemodynamic surrogates. A threshold of  $< 15$  mm robustly identifies severe RV dysfunction, underscoring TAPSE's utility as a rapid, non-invasive screening tool in resource-constrained environments.

**Keywords:** *Measuring the contraction of the tricuspid valve; right ventricle may not function well; there is severe ongoing heart valve disease; the approach uses echocardiography and NYHA class is used to reflect the patient's functional ability.*

### 1. INTRODUCTION

Valvular heart disease (VHD) contributes substantially to global cardiovascular morbidity, with an estimated prevalence of 2.5 % in the general population rising steeply with age [1, 2]. While the left heart has traditionally occupied centre-stage in VHD research and clinical decision-making, an expanding body of evidence highlights the pivotal role of right-ventricular (RV) performance in determining exercise tolerance, peri-operative risk and long-term survival [3, 4]. RV dysfunction portends adverse outcome across diverse cardiac disorders but is particularly germane in VHD, where chronic pressure and/or volume overload, pulmonary hypertension and ventricular–ventricular interactions conspire to impair RV contractile reserve.

Quantifying RV systolic function remains challenging because of the ventricle's complex crescentic geometry. Among the armamentarium of echocardiographic indices, tricuspid-annular-plane systolic excursion (TAPSE) offers an attractive blend of simplicity, reproducibility and prognostic power [5–7]. TAPSE, obtained from a single M-mode tracing of the lateral tricuspid annulus, reflects longitudinal shortening and correlates well with radionuclide or cardiac-MRI derived RV ejection fraction [5]. Thresholds  $< 16$ – $17$  mm are widely accepted as abnormal in adults [8].

Despite guideline endorsement, the incremental value of TAPSE in day-to-day management of chronic VHD—particularly within rheumatic-predominant populations—has not been fully elucidated. Prior series have tended to focus on isolated lesions or peri-operative cohorts, leaving a knowledge gap concerning mixed pathologies and ambulatory patients. Furthermore, data linking TAPSE to easily recognised clinical strata, such as the New York Heart Association (NYHA) functional classification, remain sparse, yet such correlations could greatly enhance bedside risk stratification where advanced imaging is unavailable.

India shoulders one of the world's largest burdens of rheumatic VHD, yet echocardiography resources, especially quantitative RV analysis, are often limited outside major tertiary centres. Against this backdrop, we aimed (a) to characterise RV systolic function using TAPSE in an unselected cohort of chronic VHD patients, and (b) to explore its relationship with clinical severity, echocardiographic surrogates and composite RV dysfunction grading. We hypothesised that TAPSE would fall progressively with worsening NYHA class and demonstrate strong concordance with integrative RV assessment. Establishing such associations could strengthen the evidence base for incorporating TAPSE into routine VHD evaluation pathways and inform timely referral for definitive valve intervention or advanced therapy.

## 2. MATERIALS AND METHODS

### Study design and setting

This study was carried out at S. N. Medical College, Agra, in the Department of Medicine from April 2023 to March 2025. Everyone who took part gave written consent.

### Participants

Consecutive adults ( $\geq 18$  years) with echocardiographically confirmed chronic VHD attending outpatient clinics or admitted to medical wards were screened. Inclusion criteria were (i) established chronic valvular lesion(s) of rheumatic or degenerative aetiology, and (ii) clinical or echocardiographic evidence of RV involvement. Exclusion criteria comprised acute ischaemic aetiologies (e.g., papillary-muscle rupture post-myocardial infarction), primary pulmonary disorders (COPD, pneumonia), pulmonary embolism, RV infarction, constrictive pericarditis, right-sided cardiomyopathies, infiltrative diseases and significant congenital heart disease. A sample size of 50 was calculated using the formula  $n = z^2 p(1 - p)/d^2$  assuming a 2.5 % VHD prevalence [1], 95 % confidence and 5 % precision.

### Clinical assessment

Demographic data, symptom duration, past rheumatic fever and medication history were recorded. Detailed cardiovascular examination was performed and functional limitation graded by NYHA criteria.

### Echocardiography

The echocardiography exams were created using a Philips iE33 product with a 2.5–3.5 MHz array transducer. All images were stored digitally and studied on a computer without knowledge of the patients' medical data by an offline level-III echocardiographer, following the American Society of Echocardiography rules [5, 8]. TAPSE (tricuspid-annular-plane systolic excursion) within the apical four-chamber view with an M-mode cursor was used to indicate right-ventricular function; measurements  $< 17$  mm indicated that the ventricle had less ability to contract. PASP was established by measuring the highest tricuspid regurgitant jet velocity with continuous wave Doppler, then correcting it for estimated right-atrial pressure. In our study, we measured the LA size by its parasternal long-axis end-systole diameter and LVEF was determined by using the Simpson biplane approach. Using a combined method, overall RV systolic function was assessed as being mild, moderate or severe dysfunction based on TAPSE, tissue-Doppler S' velocity, RV fractional-area change and a visual assessment.

### Statistical analysis

Data were tabulated in Microsoft Excel 2021 and analysed with SPSS v26. Categorical variables are reported as frequency (%), continuous data as mean  $\pm$  SD. Between-group comparisons used  $\chi^2$  tests for proportions, and one-way ANOVA or Mann–Whitney *U* for continuous predictors as appropriate. Pearson correlation explored associations between TAPSE and echocardiographic parameters. Receiver-operating-characteristic (ROC) analysis determined the optimal TAPSE cut-off predicting severe RV dysfunction. A two-tailed  $p < 0.05$  denoted statistical significance.

## 3. RESULTS

### Patient characteristics

Fifty patients were studied (Table 1). Mean age was 50.8 years; two-thirds were 51–70 years. Males predominated (58 %). Mitral stenosis with regurgitation was the commonest lesion (38 %), followed by isolated MS (34 %). Forty per cent presented in NYHA II, 60 % in NYHA III–IV (Table 2).

**Figure 1** (see above) illustrates that 56 % of participants exhibited reduced TAPSE, underscoring the high burden of

subclinical RV compromise.

#### Relationship between TAPSE and clinical severity

Mean TAPSE declined progressively across NYHA strata (NYHA II  $17.2 \pm 3.0$  mm, III  $15.7 \pm 3.5$  mm, IV  $15.0 \pm 1.7$  mm;  $p < 0.01$ ; Table 3). The trend is depicted in **Figure 2**.

#### Correlates of TAPSE

TAPSE demonstrated a moderate positive correlation with LVEF ( $r = 0.50$ ,  $p < 0.01$ ) and inverse correlations with LA diameter ( $r = -0.39$ ,  $p = 0.017$ ) and PASP ( $r = -0.45$ ,  $p = 0.010$ ) (Table 4). No significant differences in mean TAPSE were observed between isolated mitral and aortic lesions ( $p = 0.57$ ).

#### Diagnostic accuracy

ROC analysis yielded an AUC of 0.871 (95 % CI 0.77–0.97). A TAPSE threshold  $< 15$  mm predicted severe RV dysfunction with 90.9 % sensitivity and 74.4 % specificity.

#### TABLES

**TABLE 1. DEMOGRAPHIC PROFILE (N = 50)**

Age group (yrs)	n (%)	Sex	n (%)
$\leq 30$	1 (2)	Male	29 (58)
31–50	12 (24)	Female	21 (42)
51–70	33 (66)		
$> 70$	4 (8)		
Mean age $\pm$ SD	$50.8 \pm 13.4$ yrs		

**TABLE 2. VALVE PATHOLOGY AND NYHA FUNCTIONAL CLASS**

Lesion	n (%)	NYHA grade	n (%)
MS + MR	19 (38)	II	20 (40)
Isolated MS	17 (34)	III	14 (28)
Isolated MR	7 (14)	IV	16 (32)
AR	5 (10)		
AS	2 (4)		

**TABLE 3. ASSOCIATION OF TAPSE WITH NYHA GRADE**

NYHA grade	n	Mean $\pm$ SD TAPSE (mm)
II	20	$17.2 \pm 3.0$
III	14	$15.7 \pm 3.5$
IV	16	$15.0 \pm 1.7$
ANOVA $p$ -value		$< 0.01$

**TABLE 4. CORRELATION OF TAPSE WITH KEY ECHOCARDIOGRAPHIC INDICES**

Parameter	Pearson $r$	$p$ -value
LVEF (%)	+0.50	$< 0.01$
LA diameter (mm)	–0.39	0.017
PASP (mm Hg)	–0.45	0.010

Figures

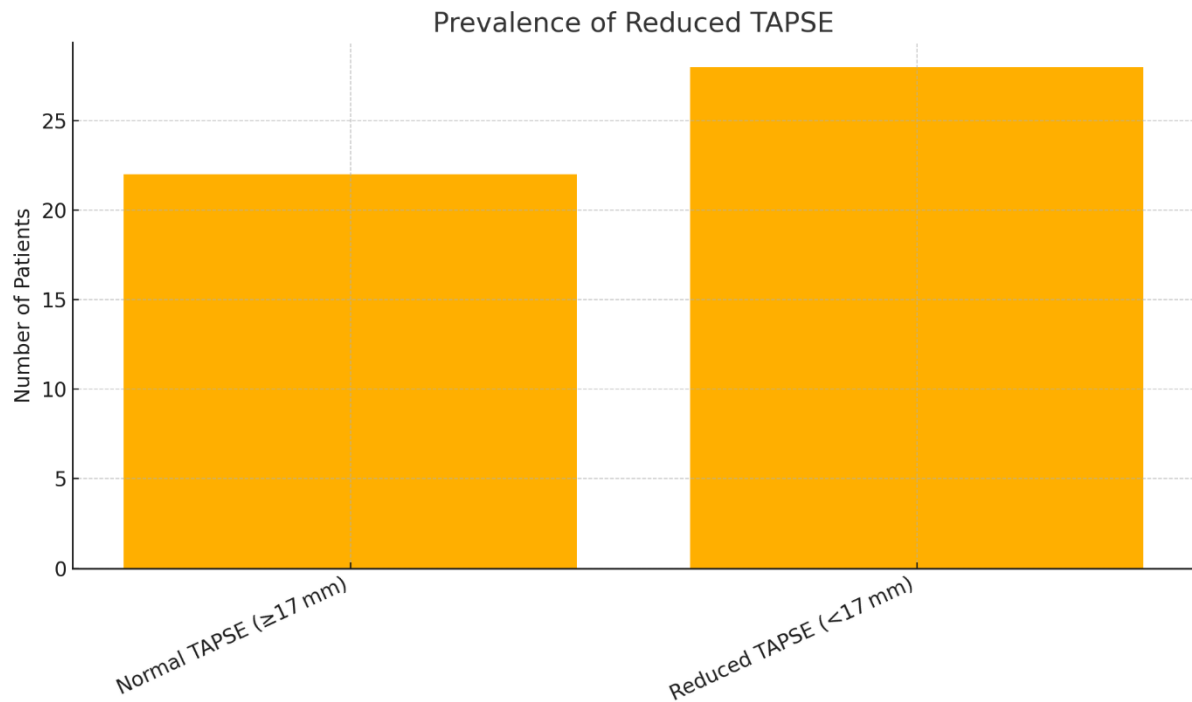


Figure 1. Prevalence of reduced ( < 17 mm) versus normal TAPSE in the study cohort. [Download Figure 1](#)

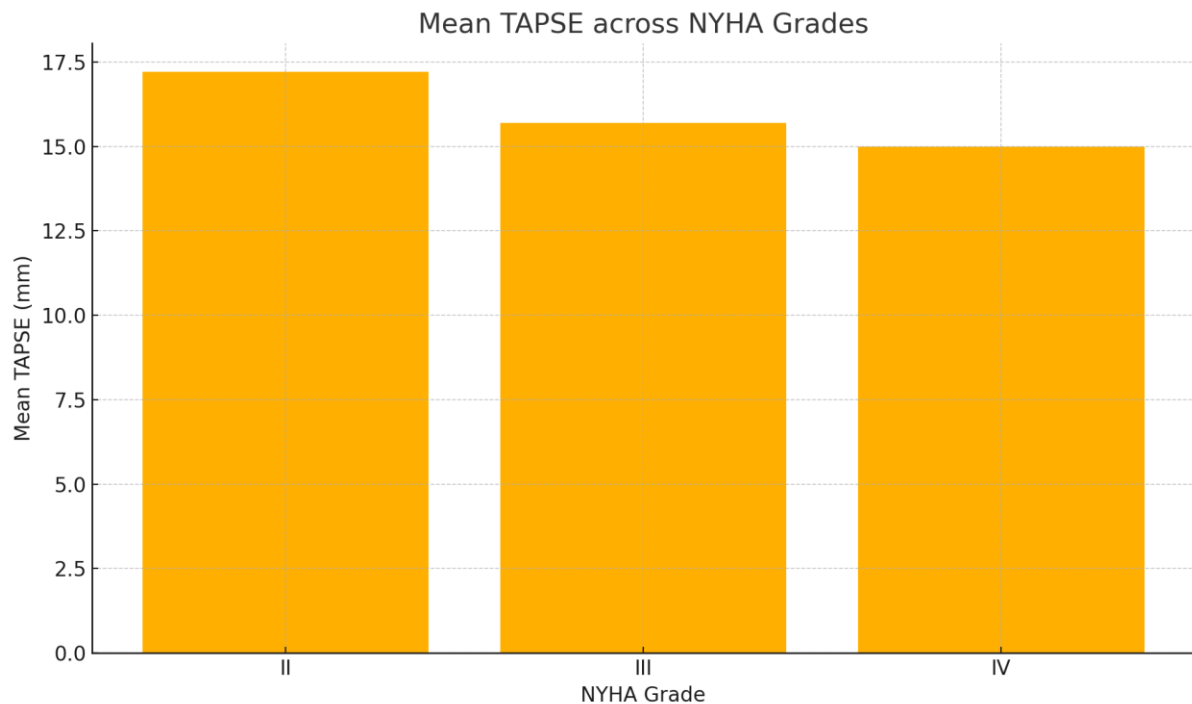


Figure 2. Mean TAPSE values across NYHA functional classes II–IV. [Download Figure 2](#)

4. DISCUSSION

In this unselected cohort of chronic VHD, more than half of patients exhibited reduced TAPSE, echoing data from Western surgical registries yet reflecting the younger epidemiology of rheumatic VHD in India [2, 6]. The graded fall of TAPSE

across NYHA classes mirrors observations from larger heart-failure populations and emphasises the central role of RV reserve in symptom generation [3, 9]. Our finding of a 2.2 mm absolute decrement between NYHA II and III closely parallels the 2-mm cut-off associated with excess mortality after valve surgery reported by Grewal and colleagues [10].

TAPSE correlated positively with LVEF, in keeping with the concept of ventricular interdependence; however, the modest correlation coefficient ( $r = 0.50$ ) underscores that RV dysfunction may be present despite preserved left-sided systolic performance, advocating for routine RV assessment in all VHD patients [11, 12]. The inverse association between TAPSE and PASP aligns with experimental data demonstrating afterload-dependent down-regulation of RV longitudinal fibres [13]. Notably, LA enlargement—an integrator of chronic diastolic burden—also bore an inverse relation to TAPSE, extending prior work linking atrial size to adverse outcomes in rheumatic MS [12].

Our ROC-derived optimal cut-off of  $< 15$  mm for severe RV dysfunction is concordant with a recent meta-analysis pooling over 2 000 subjects (summary AUC 0.85) [14]. While guideline thresholds (16–17 mm) maintain high sensitivity, local calibration may improve specificity where image quality is sub-optimal. Importantly, no significant difference in mean TAPSE was detected among valve-specific subgroups, suggesting that longitudinal impairment is governed more by global haemodynamic load than by lesion anatomy per se, an observation echoed by Kagiya et al. in a degenerative cohort [15].

The study's strengths include uniform imaging protocol, blinded analysis and integration of functional, haemodynamic and structural parameters. Limitations encompass single-centre design, relatively small sample size and lack of longitudinal follow-up or cardiac MRI reference standard. Nevertheless, the internally consistent associations and high diagnostic yield support translation to routine practice.

Future research should explore the prognostic impact of serial TAPSE monitoring pre- and post-intervention, the interplay with RV-free-wall strain and potential thresholds guiding timing of valve surgery or transcatheter therapy [16].

## 5. CONCLUSION

TAPSE is a simple yet powerful echocardiographic marker of RV systolic performance in chronic valvular heart disease. Values decline progressively with worsening NYHA functional status and correlate with left-atrial enlargement, pulmonary pressures and global RV grades. A threshold of  $< 15$  mm discriminates severe RV dysfunction with excellent accuracy. Routine incorporation of TAPSE into standard echocardiographic examinations can facilitate early detection of RV compromise, refine risk stratification and inform timely referral for definitive valve intervention, particularly in resource-limited settings where advanced imaging is not readily available.

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