



Tricuspid Annular Plane Systolic Excursion/Pulmonary Arterial Systolic Pressure Ratio as a Predictor of Mortality in Heart Failure Patients

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: We aimed to investigate the prognostic value of the tricuspid annular plane systolic excursion (TAPSE)/ pulmonary arterial systolic pressure (PASP) ratio in Moroccan patients with heart Failure (HF).

Study Design: A retrospective study was conducted in The Cardiology Department of Ibn Rochd Hospital of Casablanca in Morocco. The study was conducted in the period between March 2012 to March 2016 with a follow-up until December 2022.

Methods: data were evaluated from the HF register patients and their relatives were contacted by phone. Patients with reduced LVEF were included, patients with pulmonary embolism, and patients with HFpEF were excluded. The endpoint of the study was mortality.

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Results: 128 patients were enrolled Over an average follow-up of 58 months. 51(41.4%) patients died at the end of the follow-up, the median value of left ventricular ejection fraction was $35.2 \pm 2.2\%$. Patients were stratified according to the TAPSE/PASP ratio (low <0.32 mm/mmHg; high: >0.32 mm/mmHg). Kaplan-Meier survival analysis showed that ten-year all-cause mortality was significantly higher in patients with TAPSE/PASP ≤ 0.32 mm/mmHg than in patients with TAPSE/PASP > 0.32 mm/mmHg (log-rank 7.8, $p = 0.008$) Cox regression analysis revealed that lower LVEF ($p = 0.04$), and a ratio of TAPSE/PASP < 0.32 ($p = 0.02$) were associated to an increase in all-cause mortality.

Conclusion: Correlating right ventricular function to loading conditions may be more accurate in assessing its real contractility and predicting patients' outcomes. Our study showed that TAPSE/PASP appears as a novel prognostic predictor in patients with Heart failure.

Keywords: TAPSE; PASP; Chronic heart failure; Morocco; predictors; mortality.

1. INTRODUCTION

Heart failure is a global public health concern affecting millions of people and poses an important social and economic burden more pronounced in developing countries [1]. HF is defined by The American Heart Association as a complex clinical syndrome with symptoms and signs that result from any structural or functional impairment of ventricular filling or ejection of blood [2]. Even though this definition applies to both the right and left ventricle, the left ventricle has always been the primary focus for physicians.

RV is far more important than being a simple conduit. Its importance is already known in terms of prognosis [3]. Nevertheless, its complex anatomy, trabeculations, and dependence on load conditions make its assessment more complicated in echocardiography [4].

The ratio between a tricuspid annular plane systolic excursion (TAPSE) and pulmonary artery systolic pressure (PASP) TAPSE/PASP is a good marker of RV-PA coupling and has proved its relevance in terms of Prognosis in Heart failure and pulmonary hypertensive patients [5].

The present study aims to determine the prognostic value of TAPSE/PASP in patients with chronic heart failure in Morocco.

2. METHODS

This single-center, retrospective study was conducted in the cardiology department of IBN ROCHD hospital in Casablanca in the period between March 2012 and March 2016 with a follow-up until December 2022 data was collected from the Heart Failure Registry; by contacting patients and their relatives by phone.

128 patients were enrolled over an average follow-up of 55 ± 12 months. Examinations used Vivid 7 (General Electrics) echocardiography. Simpson's method was used to estimate Left ventricular ejection fraction (LVEF), PASP was estimated based on tricuspid regurgitation velocity and the estimated central venous pressure, While TAPSE estimation used 2D echo M mode, the Ratio TAPSE/PASP was calculated after. Patients with HfrEF or HfmEF were included, patients with a history of pulmonary embolism, HfpEF, and with missing data were excluded.

2.1 Statistical Analysis

The continuous variables were reported in means \pm standard deviation and compared using an independent sample t-test. The remaining variables were expressed in percentages and compared using the Chi-square tests with the primary endpoint of the analysis being death. Kaplan-Meier was used for the calculation of survival over time, The differences in mortality between subgroups were tested using the log-rank test. The Cox proportional hazard regression model was used to investigate the association between the survival time of patients and the variables. All analyses were conducted using the IBM SPSS Statistics 23 version.

3. RESULTS

We included 128 patients during ten years of follow-up. Table 1 summarizes the informations available for patients included in the study. 57.7% of patients were men. The mean age observed was 58 ± 15.8 years. The prevalence of diabetes and hypertension observed for all patients were 39.8% and 46.8 % respectively.

The median value of the left ventricular ejection fraction was 35.2%. 51(41.4%) of patients have died at the end of the follow-up.

Univariate Cox regression analysis revealed that both LVEF (HR, 0.82; 95% CI, 0.75–0.93) $p= 0.04$ and a ratio of TAPSE/PASP <0.32 (HR, 0.9; 95% CI, 0.82–0.98 $p= 0.02$ were associated with an increase in all-cause mortality. The other parameters of assessing RV function: TAPSE and tricuspid lateral

annular systolic velocity (S') were both not correlated to the primary outcome as reported in Table 2 .

3.1 Time-To-Event Analysis

The overall survival curve is shown in Fig. 1. patients with a ratio of TAPSE/PASP inferior to 0.32 had a worse prognosis this was demonstrated after a period of 4 years with log rank of 0.08 as demonstrated in Chart. 1 .

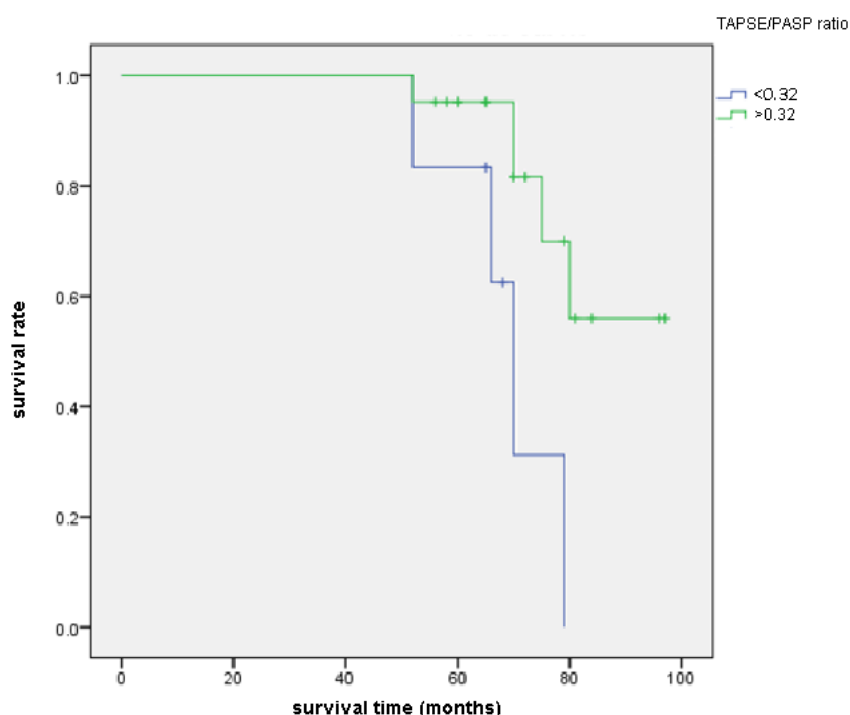


Fig. 1. Survival rate in patients with HF depending of TAPSE/PASP ratio

Table 1. Characteristics of the studied population

	Survivors N=72	Non survivors N=51	P value
Age (y)	58 ± 15.8	60 ± 15.8	0.34
Gender (M), n (%)	43 (59)	28 (54.9)	0.52
SBP (mmHG)	128.2 ± 13.8	130 ± 12	0.6
DBP (mmHG)	74 ± 10.5	77 ± 12	0.76
HR (bpm)	78 ± 9	76 ± 9	
Hypertension N (%)	32(44)	28 (50)	0.37
Diabetes N (%)	28(38)	21(41)	0.6
LVEF (%),	36.2 ± 2.3	34 ± 2.5	0.02
PASP (mmHG)	36.34 ± 17	39.55 ± 18	0.2
TAPSE (mm)	18.46 ± 4	18.73 ± 4	0.23
TAPSE/PASP	0.62 ± 0.3	0.47 ± 0.2	<0.001
0.32 >	17 (23)	23(45)	
0.32 <	55(76)	28 (55)	

DBP : Diastolic Blood Pressure , LVEF : Left Ventricular Ejection Fraction , SBP : Systolic Blood Pressure
PASP: Pulmonary Arterial Systolic Pressure , TAPSE : Tricuspid Annular Plane Systolic Excursion

Table 2. Univariate cox proportional hazard regression

	B	E.S.	Wald	ddl	Signif.	Exp(B)	95.0% IC pour Exp(B)	
							Inf	Sup
TAPSE\PASP	-.105	.047	5.037	1	.025	.900	.821	.987
TAPSE	.555	.402	1.904	1	.168	1.742	.792	3.831
SVD	-.779	.581	1.798	1	.180	.459	.147	1.433

Chart 1. Global comparison

	Chi-squarre	ddl	Sig.
Log Rank (Mantel-Cox)	7.087	1	.008
Breslow (Generalized Wilcoxon)	5.040	1	.025
Tarone-Ware	6.118	1	.013

4. DISCUSSION

Right ventricle assessment has been a challenge to cardiologists even with the advent of 2-dimensional echocardiography. In contrast, left ventricular ejection fraction is relatively easy to calculate and is correlated to cardiovascular outcomes. LV contractility is indeed more complicated to evaluate and LVEF may have limits in this regard. However, it is still an accurate and reproducible parameter. As mentioned before this difference is due to RV geometry and extreme loading dependence [6].

RV to PA coupling is considered a valuable prognostic predictor in patients with pulmonary hypertension and Heart failure [7] with TAPSE\PASP being the most noninvasive parameter studied in the last decade [8–10]

The main finding of this study is that when combined with echocardiographic estimation of pulmonary arterial pressure, tricuspid annular plane systolic excursion was strongly associated with mortality in patients with reduced or mildly reduced ejection fraction. A recent Italian study emphasizes the importance of interpreting RV function in the context of RV load, they found a strong correlation between TAPSE, RV strain, and survival when considering pulmonary pressure in patients with chronic heart failure [11]

Patients with lower LVEF experienced more cardiovascular events and mortality, this is already reported in the literature and many studies proved that LVEF is a strong and independent predictor of mortality in patients with chronic heart failure [12-13] There may occasionally be a clear pathophysiological cause for mortality in patients with HF and reduced LVEF: such as a myocardial infarction, an

increase in catecholamines, or electrolyte abnormalities. Generally, Harmful left ventricular remodeling and fibrosis generate a substrate that is incredibly weak and exceedingly vulnerable; Causing ventricular arrhythmia and sudden cardiac death [14].

While our study failed to prove a correlation between pulmonary pressure and TAPSE with mortality separately it is believed that each of these parameters is strongly correlated with heart failure rehospitalization and mortality [15,16] this may be due to the limited population of our study and the long period of the follow up.

These findings highlight the importance of assessing RV function in the light of loading conditions: TAPSE\PASP is a noninvasive, simple, and reproducible parameter to assess the prognosis of patients with Heart failure, it may be beneficial to include this parameter in the echocardiography report of all patients. The variation of this parameter may be beneficial in assessing the efficacy of guideline-directed medical therapy GDMT and we hope that future studies will test this hypothesis.

5. LIMITATIONS

This study has several limitations. We excluded 30% of the population and couldn't analyze mean pulmonary artery pressure due to missing data, Despite the limited number of the study population (123 patients) a strong correlation was found between mortality and TAPSE/PASP ratio, Cardiovascular deaths couldn't be determined.

6. CONCLUSION

Correlating right ventricular function to loading conditions may be more accurate in assessing RV contractility and predicting patients

outcomes. Our study showed that TAPSE/PASP appears as a novel prognostic predictor in patients with Chronic Heart failure.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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