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Study of In-Hospital Prognostic Value of TAPSE/SPAP Ratio in Patients with Acute Heart Failure

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ABSTRACT

Background: Acute heart failure (AHF) is associated with high morbidity and mortality. TAPSE/SPAP ratio is a non-invasive echocardiographic marker reflecting right ventricular-pulmonary artery (RV-PA) coupling. To determine the predictive value of TAPSE/SPAP for in-hospital mortality and to assess its association with ICU admission, inotropic support, ventilator support, and ICU stay duration.

Methods: This prospective observational study included 50 patients admitted with acute heart failure. TAPSE/SPAP was calculated from echocardiography performed during admission. Outcomes including mortality, ICU admission, inotropic support, ventilator support, and ICU stay duration were analyzed. Chi-square test, Pearson correlation, and ROC curve analysis were performed.

Results: The mean age of the study population was 56.8 ± 13.3 years, with males comprising 68.0% of participants. Overall in-hospital mortality was 7/50 (14.0%). Patients with a low TAPSE/SPAP ratio (<0.40) had significantly higher rates of mortality (46.7%), ICU admission (100%), inotropic support (100%), and ventilator support (100%) compared with those having a TAPSE/SPAP ratio ≥0.40 (all $p < 0.001$). TAPSE/SPAP demonstrated significant negative correlations with mortality, ICU admission, inotropic requirement, ventilator support, and ICU stay duration. ROC analysis showed excellent predictive performance, with AUC values of 0.922 for mortality, 0.958 for ICU admission, 0.977 for inotropic support, and 0.948 for ventilator support.

Conclusion: TAPSE/SPAP is a simple, non-invasive, and clinically useful predictor of mortality and critical care outcomes in patients with acute heart failure.

Key-words: TAPSE/SPAP; Acute heart failure; RV-PA coupling; Mortality; ICU admission; Inotropes; Ventilator support; ROC curve

INTRODUCTION

Acute heart failure (AHF) is one of the leading causes of emergency department visits and hospital admissions worldwide and continues to be associated with substantial morbidity, mortality, frequent rehospitalization, and high healthcare expenditure despite advances in medical therapy and critical care management.

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Early identification of high-risk patients is essential to facilitate timely intensive monitoring, appropriate escalation of therapy, and improved clinical outcomes [1,2]. Although left ventricular dysfunction has traditionally been the primary focus in heart failure assessment, increasing evidence indicates that right ventricular (RV) dysfunction is an equally important determinant of prognosis across the spectrum of preserved and reduced left ventricular ejection fraction [3-7]. Acute heart failure remains a common cause of emergency admission and is associated with substantial in-hospital and post-discharge mortality [1,2]. Early bedside risk stratification is important because high-risk patients may require intensive monitoring, ventilatory support, inotropic therapy, and rapid escalation of care.

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Right ventricular dysfunction is increasingly recognised as an important determinant of prognosis in heart failure across the spectrum of left ventricular ejection fraction [3-7]. However, right ventricular performance is highly dependent on pulmonary vascular load. Therefore, RV function should not be interpreted in isolation, but in relation to pulmonary artery pressure and afterload [8-10]. The functional performance of the right ventricle is closely influenced by pulmonary arterial afterload; therefore, assessment of RV function alone may not accurately reflect overall RV performance. RV–pulmonary artery (RV-PA) coupling has emerged as a valuable physiological concept integrating RV contractility with pulmonary vascular load [8-10]. The tricuspid annular plane systolic excursion to systolic pulmonary artery pressure (TAPSE/SPAP) ratio is a simple, reproducible, non-invasive echocardiographic surrogate of RV-PA coupling that can be readily measured at the bedside [10-12]. Recent studies have demonstrated that a reduced TAPSE/SPAP ratio is independently associated with increased mortality, major adverse cardiovascular events, and worse clinical outcomes in patients with acute heart failure. However, evidence regarding its utility in predicting the need for intensive care, inotropic support, ventilatory support, and in-hospital mortality in emergency department patients remains limited. Therefore, the present study aimed to evaluate the prognostic value of the TAPSE/SPAP ratio for predicting adverse in-hospital outcomes in patients presenting with acute heart failure.

The TAPSE/SPAP ratio combines tricuspid annular plane systolic excursion, a marker of RV longitudinal systolic function, with systolic pulmonary artery pressure, a marker of RV afterload. It has emerged as a practical non-invasive echocardiographic surrogate of RV-PA coupling [10-12]. In a prospective multicentre study, TAPSE/SPAP <0.40 mm/mmHg was independently associated with in-hospital major adverse cardiovascular events in acute heart failure [2]. The present study evaluates TAPSE/SPAP for prediction of mortality and organ-support requirements in an emergency/critical care setting.

MATERIALS AND METHODS

Study design- This prospective observational study was conducted in the Department of Emergency Medicine of a tertiary care teaching hospital. Fifty consecutive adult patients (≥18 years) with a clinical diagnosis of acute heart failure were enrolled after obtaining written informed consent. Patients with poor echocardiographic windows, significant pulmonary disease, congenital heart disease, prior valvular surgery, or pregnancy were excluded. Detailed demographic and clinical information, including age, sex, presenting symptoms, comorbidities, vital signs, laboratory investigations, diagnosis type, and echocardiographic parameters, were recorded using a structured data collection form. Transthoracic echocardiography was performed within the first 24 hours of admission by an experienced cardiologist/echocardiography-trained physician using standard imaging protocols. Tricuspid annular plane systolic excursion (TAPSE) was measured in the apical four-chamber view using M-mode echocardiography, while systolic pulmonary artery pressure (SPAP) was estimated from peak tricuspid regurgitation velocity using the modified Bernoulli equation with estimated right atrial pressure. The TAPSE/SPAP ratio was calculated by dividing TAPSE by SPAP, and patients were categorized as TAPSE/SPAP <0.40 or ≥0.40 based on published evidence [2]. Following echocardiographic assessment, all patients received standard treatment according to institutional protocols and were monitored for predefined clinical outcomes, including ICU admission, inotropic support, ventilator support, ICU stay duration, total hospital stay, and in-hospital mortality.

Inclusion Criteria

1. Patients aged 18 years and above.
2. Patients diagnosed with acute heart failure based on clinical evaluation and supporting investigations.
3. Patients willing to provide written informed consent for participation.

Exclusion Criteria

1. Patients with poor echocardiographic windows preventing accurate measurement of TAPSE or SPAP.
2. Patients with significant chronic pulmonary diseases such as severe COPD, interstitial lung disease, or pulmonary fibrosis.
3. Patients with congenital heart disease.
4. Patients with a history of previous valvular heart surgery or prosthetic heart valves.
5. Pregnant women and patients who declined to provide informed consent.

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Statistical Analysis- Continuous variables were summarized as mean ± standard deviation. Categorical variables were summarized as frequency and percentage. Chi-square test assessed associations between TAPSE/SPAP category and clinical outcomes. Pearson correlation assessed linear association between TAPSE/SPAP and outcomes/ICU stay duration. ROC curve analysis evaluated discrimination for mortality and organ-support outcomes. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1 summarizes the baseline demographic and clinical characteristics of the study population. A total of 50 patients with acute heart failure were included in the study. The mean age was 56.8 ± 13.3 years, while the median age was 55 years (range: 25–82 years), indicating a predominantly middle-aged to elderly population. Males constituted the majority of the cohort (34 patients, 68.0%), whereas 16 patients (32.0%) were female. During hospitalization, 7 patients (14.0%) died, while 43 patients (86.0%) survived. The overall mean TAPSE/SPAP ratio was 0.570 ± 0.285, reflecting the average right ventricular–pulmonary arterial coupling in the study population. Based on the predefined cut-off value, 15 patients (30.0%) had a TAPSE/SPAP ratio <0.40, suggestive of impaired right ventricular–pulmonary arterial coupling, whereas 35 patients (70.0%) had a TAPSE/SPAP ratio ≥0.40, indicating relatively preserved right ventricular function.

Table 1: Demographic characteristics

Characteristic	Value
Total patients	50
Mean age ± SD	56.8 ± 13.3 years
Median age (range)	55 (25-82) years
Male	34 (68%)
Female	16 (32%)
Deaths	7 (14%)
Survivors	43 (86%)
Mean TAPSE/SPAP ± SD	0.570 ± 0.285
TAPSE/SPAP <0.40	15 (30%)
TAPSE/SPAP ≥0.40	35 (70%)

Table 2 presents the association between TAPSE/SPAP categories and major in-hospital outcomes. Patients with a TAPSE/SPAP ratio <0.40 had significantly poorer outcomes than those with a ratio ≥0.40. Mortality was observed in 46.7% of patients with a TAPSE/SPAP ratio <0.40, while no deaths occurred in the ≥0.40 group (p < 0.001). Similarly, ICU admission, inotropic support, and ventilator requirement were significantly more frequent in patients with a reduced TAPSE/SPAP ratio (all p < 0.001). Overall, a low TAPSE/SPAP ratio was strongly associated with adverse in-hospital outcomes and identified patients at high risk of clinical deterioration.

Table 2: Association of TAPSE/SPAP category with outcomes

Outcome	≥0.40 total	≥0.40 events	≥0.40 event rate	<0.40 total	<0.40 events	<0.40 event rate	χ^2	df	p-value
Mortality	35	0	0.0%	15	7	46.7%	15.31	1	<0.001
ICU admission	35	15	42.9%	15	15	100.0%	12.00	1	<0.001
Inotropic support	35	7	20.0%	15	15	100.0%	24.12	1	<0.001
Ventilator support	35	8	22.9%	15	15	100.0%	22.15	1	<0.001

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Table 3 presents the correlation between the TAPSE/SPAP ratio and major clinical outcomes. Pearson's correlation analysis demonstrated significant negative correlations between TAPSE/SPAP and all adverse outcomes, indicating that lower TAPSE/SPAP values were associated with greater disease severity and poorer in-hospital prognosis. The strongest negative correlation was observed with inotropic support ($r = -0.835$, $p < 0.001$), followed by ventilator support ($r = -0.785$, $p < 0.001$), ICU admission ($r = -0.780$, $p < 0.001$), and ICU stay duration ($r = -0.716$, $p < 0.001$). A moderate but significant negative correlation was also found with in-hospital mortality ($r = -0.533$, $p < 0.001$). Overall, lower TAPSE/SPAP ratios were consistently associated with higher mortality, greater need for intensive care, inotropic and ventilator support, and prolonged ICU stay, supporting the TAPSE/SPAP ratio as a reliable echocardiographic marker for risk stratification in acute heart failure.

Table 3: Correlation of TAPSE/SPAP with clinical outcomes

Variable correlated with TAPSE/SPAP	Pearson r	p-value
Mortality	-0.533	<0.001
ICU admission	-0.780	<0.001
Inotropic support	-0.835	<0.001
Ventilator support	-0.785	<0.001
ICU stay duration	-0.716	<0.001

Fig. 1 illustrates the ROC curves of the TAPSE/SPAP ratio for predicting in-hospital mortality, ICU admission, inotropic support, and ventilator support. All ROC curves were located near the upper-left corner, indicating excellent diagnostic performance. The AUC was highest for inotropic support (0.977), followed by ICU admission (0.958), ventilator support (0.948), and mortality (0.922), demonstrating consistently high predictive accuracy. All curves were well above the reference diagonal, confirming that the TAPSE/SPAP ratio accurately identifies patients at risk of adverse outcomes. These findings support the TAPSE/SPAP ratio as a reliable, non-invasive echocardiographic marker for early prognostic assessment and clinical decision-making in acute heart failure.

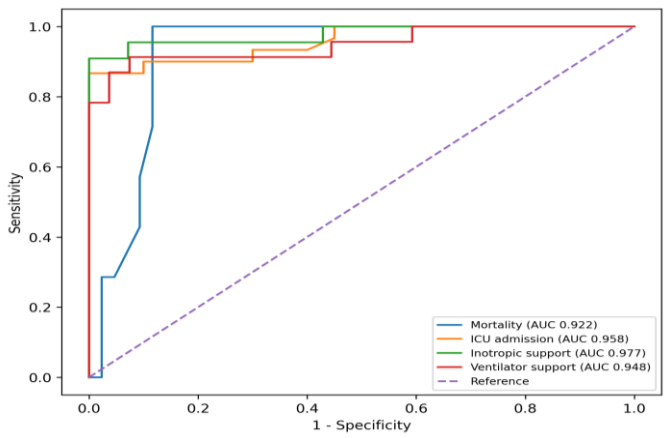

Fig 1: ROC curve analysis

DISCUSSION

This study demonstrates that TAPSE/SPAP is strongly associated with mortality and organ-support requirements in patients with acute heart failure. Mortality occurred only in the low TAPSE/SPAP group, and chi-square testing confirmed a statistically significant association between TAPSE/SPAP category and death. ROC curve analysis showed good discrimination for mortality and excellent-to-outstanding discrimination for ICU admission, inotropic support, and ventilator support [11-14].

The findings are biologically plausible because a low TAPSE/SPAP ratio reflects impaired RV systolic reserve relative to pulmonary artery afterload, indicating RV-PA uncoupling [8-12]. RV-PA uncoupling may contribute to reduced forward flow, systemic venous congestion, impaired oxygen delivery, and hemodynamic instability. These mechanisms explain its association with ICU admission, inotropic requirement, ventilator support, and mortality [15-17].

The present findings are consistent with Fauvel *et al.*, who reported that TAPSE/SPAP <0.40 was independently associated with in-hospital major adverse cardiovascular events in acute heart failure and improved model discrimination beyond traditional risk factors [2]. Similar work has shown that RV dysfunction and RV-PA

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uncoupling have prognostic significance in heart failure with preserved and reduced ejection fraction [3-7,10-12].

Compared with more complex hemodynamic assessments, TAPSE/SPAP is rapid, non-invasive, and obtainable from bedside echocardiography. It may therefore be useful in emergency units for early triage, identification of high-risk AHF patients, and decision-making regarding ICU monitoring and organ support [18,19].

This study has several limitations that should be acknowledged. The sample size was relatively small, comprising only 50 patients, which may limit the generalizability of the findings. Furthermore, the study was conducted at a single center using an observational design, potentially introducing selection bias and limiting external validity. The results may also have been influenced by confounding factors, including variations in patient comorbidities and treatment strategies. In addition, multivariable regression analysis was not performed to adjust for potential confounders, and external validation of the findings was not undertaken [20]. The follow-up period was restricted to in-hospital outcomes, preventing assessment of the long-term prognostic significance of the TAPSE/SPAP ratio.

Future research should focus on larger prospective multicenter studies to validate the prognostic utility of the TAPSE/SPAP ratio in diverse patient populations. Serial monitoring of TAPSE/SPAP during treatment should be evaluated to determine its value in tracking disease progression and therapeutic response. Moreover, integrating the TAPSE/SPAP ratio with established biomarkers and clinical severity scoring systems may enhance risk stratification and prognostic accuracy. Future studies should also employ multivariable models to assess the independent prognostic value of TAPSE/SPAP after adjusting for relevant clinical and demographic confounders.

CONCLUSIONS

TAPSE/SPAP is a simple, non-invasive, and reliable predictor of mortality and severity in acute heart failure. In this 50-patient cohort, TAPSE/SPAP <0.40 was significantly associated with mortality, ICU admission, inotropic support, and ventilator support. ROC analysis demonstrated good-to-outstanding discrimination across outcomes, supporting its role as a bedside risk-stratification tool. Furthermore, the TAPSE/SPAP ratio demonstrated strong correlations with the need for advanced critical care interventions and prolonged ICU stay, highlighting its clinical relevance beyond mortality prediction. As a readily obtainable echocardiographic parameter, it can assist clinicians in early risk stratification, identification of high-risk patients, and timely decision-making regarding intensive monitoring and therapeutic escalation. Larger multicenter studies are warranted to validate these findings and establish TAPSE/SPAP as a routine prognostic marker in acute heart failure management.

CONTRIBUTION OF AUTHORS

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REFERENCES

[1] McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J., 2021; 42: 3599–26.
[2] Fauvel C, Dillinger JG, Rossanaly Vasram R, Bouleti C, Logeart D, et al. In-hospital prognostic value of TAPSE/sPAP in patients hospitalized for acute heart failure. Eur Heart J Cardiovasc Imaging., 2024; 25(8): 1099–108.
[3] Ghio S, Guazzi M, Scardovi AB, Klersy C, Clemenza F, et al. Different correlates but similar prognostic implications for right ventricular dysfunction in heart failure patients with reduced or preserved ejection fraction. Eur J Heart Fail., 2017; 19: 873–79.

doi: 10.21276/SSR-IIJLS.2026.12.4.30

[4] Bosch L, Lam CSP, Gong L, Chan SP, Sim D, et al. Right ventricular dysfunction in left-sided heart failure with preserved versus reduced ejection fraction. Eur J Heart Fail., 2017; 19: 1664–71.

[5] Melenovsky V, Hwang SJ, Lin G, Redfield MM, Borlaug BA. Right heart dysfunction in heart failure with preserved ejection fraction. Eur Heart J., 2014; 35: 3452–62.

[6] Lam CSP, Roger VL, Rodeheffer RJ, Borlaug BA, Enders FT, et al. Pulmonary hypertension in heart failure with preserved ejection fraction: a community-based study. J Am Coll Cardiol., 2009; 53: 1119–26.

[7] Shah AM, Claggett B, Sweitzer NK, Shah SJ, Anand IS, et al. Cardiac structure and function and prognosis in heart failure with preserved ejection fraction: TOPCAT trial. Circ Heart Fail., 2014; 7: 740–51.

[8] Noordegraaf AV, Chin KM, Haddad F, Hassoun PM, et al. Pathophysiology of the right ventricle and of the pulmonary circulation in pulmonary hypertension: an update. Eur Respir J., 2019; 53: 1801900.

[9] Brener MI, Masoumi A, Ng VG, Tello K, Bastos MB, et al. Invasive right ventricular pressure-volume analysis: basic principles, clinical applications, and practical recommendations. Circ Heart Fail., 2022; 15: e009101.

[10]Guazzi M, Dixon D, Labate V, Beussink-Nelson L, Bandera F, et al. RV contractile function and its coupling to pulmonary circulation in heart failure with preserved ejection fraction. JACC Cardiovasc Imaging., 2017; 10: 1211–21.

[11]Gorter TM, van Veldhuisen DJ, Voors AA, Hummel YM, et al. Right ventricular-vascular coupling in heart failure with preserved ejection fraction and pre- versus post-capillary pulmonary hypertension. Eur Heart J Cardiovasc Imaging., 2018; 19: 425–32.

[12]Tello K, Wan J, Dalmer A, Vanderpool R, Ghofrani HA, et al. Validation of the tricuspid annular plane systolic excursion/systolic pulmonary artery pressure ratio for the assessment of right ventricular-arterial coupling. Eur Respir J., 2019; 53: 1802419.

[13]Haddad F, Doyle R, Murphy DJ, Hunt SA. Right ventricular function in cardiovascular disease, part II. Circulation., 2008; 117: 1717–31.

[14]Haddad F, Hunt SA, Rosenthal DN, Murphy DJ. Right ventricular function in cardiovascular disease, part I. J Am Coll Cardiol., 2008; 52: 1817–25.

[15]Chioncel O, Mebazaa A, Maggioni AP, Harjola VP, Rosano G, et al. Acute heart failure congestion and perfusion status: impact on outcomes. Eur J Heart Fail., 2019; 21: 1338–52.

[16]Miro O, Garcia Sarasola A, Fuenzalida C, Calderon S, Jacob J, et al. Departments involved during the first episode of acute heart failure and subsequent emergency department revisits and rehospitalisations: NOVICA cohort. Eur J Heart Fail., 2019; 21: 1231–44.

[17]Logeart D, Isnard R, Resche-Rigon M, Seronde MF, de Groote P, et al. Current aspects of the spectrum of acute heart failure syndromes in a real-life setting: the OFICA study. Eur J Heart Fail., 2013; 15: 465–76.

[18]Metra M, Teerlink JR. Heart failure. Lancet, 2017; 390: 1981–95.

[19]Santas E, Palau P, Guazzi M, de la Espriella R, Minana G, et al. Usefulness of right ventricular to pulmonary circulation coupling as an indicator of risk in heart failure. J Card Fail., 2018; 24: 418–26.

[20]Kanagawa T, Tatsumi K, Hata J. Prognostic value of right ventricular-pulmonary arterial coupling in patients with heart failure. Heart Vessels, 2020; 35: 1177–87.