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Original Article

Venous Thromboembolism in hospitalized Heart failure patients and its association with right ventricular function

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ABSTRACT

Background and Aim: Venous Thromboembolism (VTE) and Heart Failure (HF) are both vital and related entities. Some studies reported heart failure to be a predisposing factor for VTE. This study aims to assess the association between right ventricular function and VTE in hospitalized HF patients. **Method:** The present study is a cross-sectional one; 60 acute heart failure patients which were diagnosed according to the Framingham criteria were enrolled. Those with a past medical history of pulmonary thromboembolism, cancer, and anticoagulant therapy were excluded. Transthoracic echocardiography was done in 48 hours of admission in all patients and Tricuspid Annular Plane Systolic Excursion (TAPSE) was considered as the right ventricular function parameter. Furthermore, deep vein thrombosis (DVT) was assessed with ultrasound. **Results:** The study investigated 30 left heart failure cases and 30 right and left failure patients. The gender distribution was equal and only 8 patients (13.3%) had DVT. Two patients with left heart failure and six with right and left heart failure had DVT. The differences regarding the presence of DVT did not show any significant difference between the two left heart failure and right and left heart failure ($p=0.254$). Besides, TAPSE, PAP, and FAC showed no notable difference between the two study groups ($p>0.05$). **Conclusion:** There is no significant difference in DVT episodes and right ventricular dysfunction in acute HF patients. Further investigations are needed to decide venoprophylaxis in HF patients.

Keywords: DVT; Heart failure; Right ventricular function

Introduction

Venous Thromboembolism (VTE) is a critical medical condition with high morbidity and mortality. It is classified as Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE). The approximate incidences of VTE in the USA [1] and Europe [2] are 0.14% and 0.11%, respectively. The incidence of both DVT [3] and PE [4] increases in elderly patients and many chronic medical conditions, in which HF has paramount importance, its prevalence is increasing [5, 6] and has a high economic and social burden [7]. It is reported that around 6 to 10 percent of people more than 60 years old have HF [8]. It can be presented as an abnormal cardiac function which results in a congestive state of the lung, volume overload, and even irregular heartbeat and released many inflammatory markers in the bloodstream that can predispose patients to VTE [9]. Moreover, many patients need recurrent hospitalization. It is proposed that the HF hospitalized patients have more venous congestion, inflammatory and hypercoagulable state, and vessel abnormalities [10].

Studies reported that right ventricular dysfunction results in a poor outcome in HF patients as it coincides with progressive HF and predisposes patients to VTE events [10]. Acute and chronic PTE can make RV function worse and put the patient in a vicious cycle [11, 12]. However, the association of right ventricular function with VTE in acute HF patients is not proven yet. It can be an important issue in the decision to Venmo prophylaxis in HF patients.

Method:

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The present study is a cross-sectional one that was done between 2018 and 2019; 60 acute heart failure patients according to the Framingham criteria [13] were included. Patients with a past medical history of PTE, cancer, chronic embolism, acute myocardial infarction, anticoagulant therapy, and immobile bedridden patients were excluded. Consent forms were provided. All stages of the study were confirmed by the Ethics Committee of Mashhad University of Medical Sciences and were in line with Helsinki's declaration.

Demographic features were considered. Transthoracic echocardiography was conducted in 48 hours of admission and left and right ventricular function, diastolic function, pulmonary artery pressure (PAP), tricuspid annular plane systolic excursion (TAPSE), ejection fraction (EF), and fractional area change (FAC) were evaluated. Furthermore, a Doppler ultrasound was done for all patients to assess the DVT [14].

According to the type of failure, the patients were equally grouped into thirty right heart failure cases and thirty right and left failure patients. The frequencies of gender (male and female), age, and DVT were measured. The DVT frequency was compared between the two left heart failure and left and right heart failure groups by chi-square test. The means of PAP and TAPSE were also compared between patients with or without DVT using Mann-Whitney Test. P-values under 0.05 were considered significant.

Results:

Sixty patients were enrolled with no sex preponderance. There were 30 cases with only left heart failure and 30 with right and left heart failure. Only eight cases in the study had DVT. Demographic details have been mentioned in Table 1.

Table 1. Frequency and Percent of Gender, Group, and Presence of DVT

Feature		N (%)
Type of Heart Failure N (%)	Right Heart Failure	30 (50)
	Left and Right Heart Failure	30 (50)
Gender	Male	30 (50)
	Female	30 (50)
DVT	Yes	8 (13.3)
	No	52 (86.7)

DVT: Deep Vein Thrombosis

Two patients with left heart failure and six with right and left heart failure had DVT. The differences regarding the presence of DVT did not show any significant difference between the two left heart failure and right and left heart failure (p=0.254). In addition, four of the DVT cases were male and four were female with no significant difference between the two genders (p>0.999). Furthermore, the mean ages of patients with and without DVT had no significant difference (67.75±4.92 years vs. 65.60±6.44 years; p=0.294). Table 2 shows the details of the above mentioned results.

Table 2. Comparison of Type of Heart Failure, Gender, and Mean Age of the Patients with and without DVT.

Feature		DVT		p-value
		Yes	No	
Type of Heart Failure N (%)	Right Heart Failure	2 (6.7)	28 (93.3)	0.254
	Left and Right Heart Failure	6 (20)	24 (80)	
Gender N (%)	Male	4 (13.3)	26 (86.7)	>0.999
	Female	4 (13.3)	26 (86.7)	
Age Years (mean ± SD)		67.75±4.92	65.60±6.44	0.294

PAP: Pulmonary Artery Pressure; TAPSE: Tricuspid Annular Plane Systolic Excursion (TAPSE)

Table 3 also demonstrates the comparison between PAP and TAPSE in patients with or without DVT. The mean PAP in DVT patients was 33.75±9.91, and 27.12±13.48 in patients without DVT; however, the difference was not significant (p=0.095). TAPSE was also higher in patients without DVT but the comparison showed no significant difference (1.99±0.08 vs. 1.71±0.19; p=0.555). Moreover, FAC had no significant difference between patients with or without DVT (29.13±7.58 vs. 26.06±8.84; p=0.285).

Table 3. The Comparison of Mean Pulmonary Artery Pressure and Tricuspid Annular Plane Systolic and Fractional Area Change Excursion between Patients with or without DVT

Feature	DVT		p-value
	Yes	No	
PAP	33.75±9.91	27.12±13.48	0.095
TAPSE	1.71±0.19	1.99±0.08	0.555
FAC	29.13±7.58	26.06±8.84	0.285

PAP: Pulmonary Artery Pressure; TAPSE: Tricuspid Annular Plane Systolic Excursion (TAPSE); FAC: Fractional Area Change; DVT: Deep Vein Thrombosis

Discussion:

In this study, we found no significant difference in DVT incidence between patients with only left heart failure and those with right and left heart failure. Our study showed that although PAP was notably higher in patients with DVT compared to those without DVT, it was not statistically significant. TAPSE was lower in patients with DVT, although it was not significant as well.

Piazza et al. [15] reported that patients with heart failure are at greater risk of VTE. This may be explained by the presence of hemostasis and immobility in HF patients which predispose them to VTE. Another study in Japan reported that the severity of heart failure impacts the incidence of VTE. It means that HF patients with higher NYHA classes are more susceptible to VTE. The incidence of DVT in this study was 4.4% for NYHA II, 4.8% for NYHA III, and 25.5% for NYHA IV. The cumulative incidence among different NYHA classes was 11.2 percent [16].

However, the data regarding the presence of VTE along with heart failure are not sufficient in Asian countries. Some studies reported that Asian HF patients have a similar chance just like the western countries for developing VTE [17]. It has been proposed that reduced cardiac function can be an independent factor for VTE [18]. However, controversies have remained and variable relative risks (RR) from (96. – 32.4) as high risk [19] to (1.7 – 2.6) as low risk [20] and even (0.7 – 0.8) with no risk [21] have been reported through literature. However, none of the studies in the literature compared the presence of only right heart failure with right and left failure. Furthermore, all of the studies in the literature assessed chronic cases of HF and none of them assessed the acute cases.

The majority of the underlying pathology of VTE events in patients with HF can be addressed by Virchow's triad. Virchow's triad has three components including endothelial dysfunction, hypercoagulable state, and hemostasis. Patients with chronic heart failure are usually coronary disease cases and thus they have degrees of endothelial damage and dysfunction. Furthermore, reduced cardiac output makes them more susceptible to VTE [22]. It has been shown in a study that exclusion of coronary disease patients lowers the rate of DVT and PE to even 0.5% which is very low [23]. Why there was no difference between patients with left heart failure and right and left heart failure can be described to some extent due to the matter of chronicity as our cases were acute HF cases. Furthermore, acute heart failure cases may be due to other causes than coronary artery disease. It seems that it takes time for HF patients to be at the risk of thromboembolism [24].

It is believed that patients with VTE who have signs of right ventricular dysfunction should pay more attention and even may need critical care. TAPSE is a good measurement for right ventricular dysfunction. Even different studies reported that TAPSE can be used for risk assessment of patients with normal pulmonary pressure [25, 26]. However, these studies assessed patients without underlying heart disease with recurrent pulmonary thromboembolism [26]. Our study focused on only DVT cases with right or right and left heart failure. This means the absence of a significant difference in TAPSE between patients with or without DVT. However, patients without DVT had higher TAPSE in our study with no statistically significant difference.

Some limitations were posed to our study too. Our population was limited to Iranian people and other ethnicities were not assessed. This may be addressed as a strength too; since few studies were conducted in this regard in Asian and Middle Eastern countries [27]. Our study sample number also can be increased for better results. Furthermore, chronic heart failure cases should be compared with acute heart failure patients in case of VTE. Moreover, a majority of the VTE cases may be coronary artery disease patients and it should be investigated that whether thromboembolism is higher in patients with HF due to any reason or only in patients with coronary artery disease.

Conclusion

There was not a significant relation between RV dysfunction and VTE prevalence in acute HF patients in our study. However, our study was confined to only acute HF cases, and chronic cases were excluded. It seems that the presence of other risk factors in HF patients should be considered and scored in the decision to VTE prophylaxis.

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