



## Research Article

# A Study to Find Out the Proportion of Patients with Deep Vein Thrombosis among Those Evaluated For Suspected Pulmonary Embolism

Authors

**Dr Agnes Thomas<sup>1</sup>, Dr Mathew George<sup>2\*</sup>**

<sup>1,2</sup>Department of Radiodiagnosis, Pushpagiri Institute of Medical Sciences & Research Centre, Thiruvalla, Kerala

\*Corresponding Author

**Dr Mathew George**

Assistant Professor, Pushpagiri Institute of Medical Sciences & Research Centre, Thiruvalla, Kerala, India

## Abstract

**Background:** Venous thromboembolism is a disorder including both deep venous thrombosis, the most common form of venous thromboembolism and pulmonary thromboembolism which is the most life-threatening manifestation of venous thromboembolism. The imaging evaluation of the venous thromboembolism ideally should include both deep veins of lower limbs and pulmonary arterial system<sup>1</sup>. Recent advances in the imaging techniques have made possible to evaluate the spectrum of imaging findings in venous thromboembolism, the most common and the evolving one being CT pulmonary angiography with indirect venography.

**Objectives:** 1.To calculate the proportion of patients having DVT as diagnosed using indirect venography in clinically suspected cases of pulmonary embolism. 2.To determine the proportion of patients with venous thromboembolism, i.e., concomitant DVT and PE, DVT alone and pulmonary embolism alone.

**Materials and Methods:** Patients who were clinically suspected to have pulmonary embolism underwent CT pulmonary angiography along with indirect venography. Clinical symptoms, signs and echo findings of these patients were collected using pre-prepared proforma, and the prevalence was calculated. Also, the prevalence of venous thromboembolism (combined pulmonary embolism and deep venous thrombosis), pulmonary embolism alone and deep venous thrombosis alone were evaluated using with SPSS, version 22.

**Results:** The study population comprised of 66 patients; The prevalence of venous thromboembolism in our study population was 37.87%, i.e., 25 patients with venous thromboembolism out of 66 suspected cases of pulmonary embolism. Prevalence of pulmonary embolism was 19(28.78%), and deep venous thrombosis was 19(28.78%). Out of the 25 patients with venous thromboembolism, 13 (19.7% of all patients and 52% of patients with venous thromboembolism) had both pulmonary embolism and deep venous thrombosis. Isolated pulmonary embolism and isolated deep venous thrombosis was seen in 6 (9.09% of all patients and 24% of patients with venous thromboembolism) patients each.

**Conclusion:** We conclude that, the proportion of patients with venous thromboembolism was 37.8 %; with concomitant PE and DVT in 19.7 % patients, isolated DVT and isolated PE each in 9.0 % patients. Our study also showed that there was isolated occurrence of pulmonary embolism and isolated deep venous thrombosis which emphasizes the need to screen for DVT during the evaluation of any suspected cases of pulmonary embolism.

**Keywords:** VTE: Venous thromboembolism, DVT: Deep venous thrombosis, PE: Pulmonary embolism, CT: Computed Tomography.

## Introduction

Venous thromboembolism encompasses both deep venous thrombosis and pulmonary embolism and is defined as pathological thrombosis occurring in venous circulation. Imaging of DVT has evolved from conventional contrast venography and duplex sonography to CT direct/indirect venography and MR venography. Ultrasonography has become the most widely used noninvasive diagnostic modality, for the diagnosis and exclusion of acute DVT<sup>2</sup>. However, sonography has its limitations like operator dependency, limited utility above the inguinal ligament, below the knee, and occasionally in the adductor canal; and is less accurate in asymptomatic patients. Also, sonographic identification of complex anatomy such as duplicated veins can be difficult, and only limited evaluation possible in obese persons<sup>3</sup>.

With the advent of CT pulmonary angiography which can non-invasively depict thrombi in central as well as second to fourth division pulmonary arteries, along with some other ancillary findings is now considered the first line investigation for pulmonary embolism<sup>4</sup>.

Studies done worldwide have shown that patients with symptomatic DVT may have a concomitant silent pulmonary embolism and also asymptomatic DVT may be present in patients with pulmonary embolism<sup>5</sup>. Therefore ideally, the investigation for venous thromboembolism should include evaluation of the venous system of the lower extremities and the pulmonary arterial system<sup>1</sup>.

Combined indirect CT venography and pulmonary angiography is a new diagnostic examination by which radiologists can check both the pulmonary arteries for pulmonary embolism and the deep vein for thrombosis without administering additional contrast in a single study<sup>6</sup>.

Pulmonary thromboembolism mostly affects segmental branches of lower lobes than upper lobes and mostly this can be bilateral. If thrombus is large, mostly it occludes main, right and left pulmonary arteries, whereas smaller emboli

mostly lodge in peripheral aspect of segmental or subsegmental branches.<sup>7</sup> Pulmonary thromboembolism can be classified into four clinical types-a) Acute minor pulmonary embolism, b) Acute massive pulmonary embolism, c) Subacute massive pulmonary embolism and d) Chronic pulmonary thromboembolism.

**Acute minor pulmonary embolism:** This occurs when thrombus occludes less than 50% of pulmonary circulation. Mostly this will be asymptomatic or present with dyspnea or pleuritic type of chest pain with 10-30% developing signs and imaging features of pulmonary infarction. However no obvious right ventricular dilatation or failure occurs.

**Acute massive pulmonary embolism:** If thrombus occludes more than 50% of pulmonary circulation, it can result in acute massive pulmonary embolism characterized by increase in right ventricular afterload, right ventricular dilatation, tricuspid regurgitation, compromise of left ventricular filling, syncope, hypotension and in severe cases death occurs. Patient can present with severe respiratory distress, chest pain and syncopal attacks. On examination there will be tachypnea, cyanosis with signs of right ventricular strain like elevated jugular venous pressure, gallop rhythm and widely split second heart sound.

**Subacute massive pulmonary embolism:** When embolization to pulmonary vasculature is multiple which is small or moderately sized and occurs over several weeks, this constitutes subacute massive pulmonary embolism. Here right ventricle gets adequate time to adapt to undergo hypertrophy. So the rise in right ventricular and atrial pressure will be less severe than acute massive pulmonary embolism. Clinically patient presents with worsening dyspnea, dry cough and decreasing exercise tolerance. The jugular venous pressure may be elevated with gallop rhythm and loud pulmonary component of S2.

**Chronic pulmonary thromboembolism:** In most of the patients with pulmonary thromboembolism, thrombus often resolves by mechanical fragmentation and endogenous fibrinolysis with

replacement of normal hemodynamics within one month after the start of treatment. But in few patient's clot may persist which later on get organized and attaches to the wall of pulmonary vessels. This fibrosed residual thrombotic material may impair pulmonary blood flow resulting in chronic thromboembolic pulmonary hypertension<sup>8</sup>.

Radiological diagnosis of venous thromboembolism is essential to initiate treatment for the same as clinical signs and symptoms of venous thromboembolism are unreliable and screening test such as D-dimer has low specificity<sup>9</sup>. Imaging is not only used for diagnosing thromboembolism, but also needed for localizing the site of venous thromboembolism (whether in deep veins of lower limbs / pulmonary arteries and their branches or both) and in assessing the response to treatment. Imaging evaluation of venous thromboembolism has evolved from conventional venography for deep venous thrombosis and conventional pulmonary angiography for pulmonary embolism to ultrasound and CT Pulmonary Angiography respective<sup>10,11</sup>.

#### **CT venography- Direct and Indirect**

CT venography is an imaging modality which can provide accurate delineation of the entire venous system of the lower limbs. Also evaluation of varicose veins and venous malformations including their anatomic origin, course and relations is possible. Two types of CT venography are available-Direct and Indirect venography. Direct venography includes injection of diluted contrast into subcutaneous veins of feet. Contrast is injected via a 22 gauge needle at a rate of 1.5ml/kg with contrast volume ranging from 10 to 20 ml and scanning will be done via bolus tracking method from distal to proximal aspect of lower limb when contrast material reached femoral vein by automatic triggering. Advantages include faster acquisition of images, easy to perform, higher spatial resolution, can be used in obese patients to detect DVT where ultrasound is less sensitive and for evaluation of proximal veins

like pelvic veins and inferior venacava. Also assessment of anatomical variations like aplasia, hypoplasia, duplication and fenestration is possible. However radiation exposure and contrast reactions are the disadvantages with direct venography<sup>12</sup>.

Indirect CT venography is now one of the well-known imaging evaluation technique used for detection of deep venous thrombosis which was first described by Loud et al in 1998. For any patients suspected to have pulmonary embolism CT pulmonary angiography is the investigation of choice. In indirect venography technique, CT pulmonary angiography will be combined with CT venography without any additional use of contrast agent so that detection of pulmonary embolism and deep venous thrombosis i.e. venous thromboembolic disorder as whole is possible by a single examination<sup>13</sup>. In clinical practice indirect venography is more performed than direct CT venography. For this combined technique 100-120ml of non-ionic contrast material will be injected via an 18 gauge needle through a cubital vein at a rate of 3ml/second. Patient will be requested to hyperventilate for five times and then hold his breath, during which angiographic images of pulmonary arteries will be acquired from diaphragm up to the level of apex of lung by bolus tracking technique when the average HU(Hounsfield units) value in pulmonary arteries comes around 120 HU.

After acquiring pulmonary angiographic images, around 120 to 180 seconds after the initial contrast administration, scanning of pelvis and lower extremity up to the popliteal fossa is done to get 5mm thick axial venogram images. This delay would bring satisfactory enhancement of lower limb deep veins. Primary diagnostic criteria for acute deep venous thrombosis by venography include filling defect or non-opacification of the lumen of veins with or without dilatation of veins. Presence of calcified thrombi, small caliber of the veins, thickened walls, recanalization and presence of collaterals would indicate chronic deep venous thrombosis. Advantages of indirect

venography are similar to direct venography with added benefit of detecting pulmonary embolism and deep venous thrombosis in single test with no extra contrast usage. It is particularly beneficial in detecting deep venous thrombosis in asymptomatic patients and thereby helping in increasing the diagnosis of venous thromboembolic disorder. Major disadvantages for indirect venography includes radiation exposure, contrast reaction, poor venous enhancement due to individual differences in circulation time of contrast medium reaching the limbs and need of more contrast agents for critically ill patients due to underlying renal or cardiac co-morbidities<sup>14,15</sup>

Combined direct and indirect venography is a modified technique where the disadvantage of one technique is nullified by the other. Poor enhancement of the deep veins with resultant decreased contrast between background and veins is the major disadvantage of indirect venography whereas artefacts are the leading problem encountered in direct venography. By combining both techniques, veins will be displayed as a combination of both systemic (indirect) and local enhancement (direct) by which the disadvantages of both techniques could be neutralized. Combined venography doesn't contribute to additional radiation as no extra scanning techniques are done. Non-ionic contrast is used, which is given as two steps, firstly 80ml of contrast is given via cubital vein at rate of 4ml/sec. Later 60ml of suspension containing contrast and normal saline is given by dorsal vein of lower limb at a rate of 1.5ml/sec. One minute after this second injection scanning of lower limb and pelvis done by dual energy scanning protocol. Images are subjected to several post processing techniques including 3D imaging of the entire lower limb which is advantageous in term of pre surgical mapping<sup>16</sup>. This combined technique has high sensitivity and accuracy and usually recommended as a higher option for complicated cases.

## Materials and Methods

**Study Design:** Prospective, cross sectional study.

**Study Setting:** The study was done in Pushpagiri Institute of Medical Sciences & Research Centre, Thiruvalla, involving the Department of Radiodiagnosis and various other departments from where patients with clinically suspected pulmonary embolism were referred to the department of radiology.

**Study Period:** January 2017 to June 2018 (18 months).

**Study Participants:** Patients who are clinically suspected to have pulmonary embolism, referred to our department and willing to undergo indirect venography after CT pulmonary angiography was included in the study.

**Sample Size:** Assuming that 60% of patients with suspected pulmonary embolism will have an associated DVT, along with a relative precision of 20% and an alpha error of 5%, the sample size was 66.

**Sampling Method:** A consecutive, non-random sampling was done. All patients clinically suspected to have pulmonary embolism and who falls under the inclusion criteria were studied until the end of the study period.

**Ethical Clearance:** Obtained from Institutional Ethical Committee, Pushpagiri Medical College Hospital, Thiruvalla.

**Inclusion Criteria:** All patients who presented with symptoms and signs suspicious for pulmonary embolism to the various clinical departments of Pushpagiri Institute of Medical Sciences and Research Centre, who were referred to the department of Radiology for CT pulmonary angiography were included in the study.

**Exclusion Criteria:** Patients who are not willing or have a contraindication to undergo CT pulmonary angiography. Patients who underwent CT pulmonary angiography alone without undergoing indirect CT venography.

**Data Sources:** Data for the study will be collected by pre-prepared case proforma (Annexure I) which will include the complete clinical history of patients which includes age,

sex, clinical symptoms, clinical features and echo findings.

### Study Procedure

After explaining the purpose, procedure, benefits and risks of the study, informed written consent was obtained from the patient/attender (attached as Annexure IV).

Preparation of patient for scan: Serum Creatinine was checked for normal range. Patient was kept for 4 hour fasting prior to the test. In case of emergency situation serum creatinine or fasting was not mandatory.

Imaging: All the scans of pulmonary angiography with indirect venography in this study were performed using GE Optima 660, 128 slice Multidetector CT machine.

### CT PULMONARY ANGIOGRAPHY WITH INDIRECT VENOGRAPHY PROTOCOL

- a. A lateral scout film was acquired with patient in supine position.
- b. The venous access was gained through antecubital vein with an 18-gauge cannula. About 100 – 120 ml of non-ionic iodinated contrast i.e., Ultravist 370 mOsm (Bayer Pharma) was injected at a rate of 4.5 ml/sec using a power injector.
- c. Axial sections were acquired for pulmonary angiography, inferiorly from the level below diaphragm extending superiorly to the level of neck.
- d. Multidetector CT was used for the study with three phases of volume helical shuttle lasting for 10.5 sec was performed after a scan delay of 8 seconds from the onset of contrast injection.
- e. After a delay of 120 to 180 seconds axial images were acquired from the level of iliac crest to bilateral knee to obtain images for indirect venography.
- f. The study was performed in Auto mA settings, mA ranging from 200 to 500 and with kVp of 120 with rotation time of 0.5 sec.
- g. The images were displayed in mediastinal window (window width of 350 HU and window level of 40 HU), and pulmonary

embolism-specific window (window width of 700 HU and window level of 100 HU) settings.

**Study Tools:** All the findings of the cases were studied, and relevant findings required for analysis were tabulated using Microsoft Excel. This is depicted in the master chart which has been added in the (Annexure III).

### Statistical Analysis

The data was collected and entered in Microsoft Excel. Statistical analysis of all data sets was performed with SPSS, software version 22 (IBM, ARMONK, and New York: IBM Corp). Baseline socio-demographic correlates were tabulated. Continuous Variables (Age) are expressed in mean and standard deviation. Categorical Variables (Occurrence of pulmonary embolism and deep venous thrombosis) are expressed in frequencies and percentages. Chi- Square test was applied as test of association for two nominal variables and p-value of less than 0.05 was considered significant.

## Results

### Inferential statistics

- i. Prevalence of clinical symptoms and significance of association with pulmonary embolism and deep venous thrombosis.
- ii. Prevalence of clinical signs and significance of association with pulmonary embolism and deep venous thrombosis.
- iii. Cross tabulation between pulmonary embolism and deep venous thrombosis.

Our study population had dyspnea as the most prevalent clinical symptom. Around 55 (83.3%) patients had dyspnea as presenting complaint, followed by 24 (36.3%) had chest pain, 10 (15.1%) had cough and 5 (7.5%) patients had syncope. Hemoptysis was the least prevalent clinical symptom and was seen in only 2 (3%) patients.

In study population of 66 patients, 44 (66.6%) patients had tachypnea and 43 (65.1%) had tachycardia which were the most prevalent clinical signs. Other clinical signs like hypoxia was

present in 13(19.6%) patients, tricuspid regurgitation murmur in 8 (12.1%), hypotension/shock in 4 (6%), elevated JVP and gallop rhythm in 3 (4.5%) patients and the least prevalent clinical sign was wide split S2 in 1 (1.5%) patient.

Out of 66 patients in our study population, 25 patients had venous thromboembolism with 19 having pulmonary embolism. Among these 19 patients with PE, 13 patients had both pulmonary embolism and deep venous thrombosis and 6 had pulmonary embolism alone. Deep venous thrombosis was found in 19 (28.78%) out of 66 patients. 13 (19.69%) patients had both pulmonary embolism and deep venous thrombosis and 6 (9.09%) had deep venous thrombosis alone .

In study population of 66 patients, 25 (37.87%) patients had venous thromboembolism. Out of this 25 patients with venous thromboembolism, 13 (19.69 % of all patients and 52% of patients who were diagnosed as thromboembolic disease) had both pulmonary embolism and deep venous thrombosis. Isolated pulmonary embolism and isolated deep venous thrombosis was seen in 6 patients each (9.09 % of all patients and 24% of patients who were diagnosed as thromboembolic disease). Pie chart 2 demonstrates the frequency of isolated pulmonary embolism and isolated deep vein thrombosis. .

There is statistically significant association between the prevalence of pulmonary embolism and deep venous thrombosis with p-value <0.001. However our study showed that there was isolated occurrence of pulmonary embolism in 6 patients and isolated deep venous thrombosis in 6 patients.

### Frequency of clinical symptoms in suspected cases of pulmonary embolism

Clinical symptoms	Prevalence (Number)	Frequency (Percentage)
Dyspnea	55	83.3
Cough	10	15.1
Chest pain	24	36.3
Hemoptysis	2	3
Syncope	5	7.5

### Frequency of clinical signs in suspected cases of pulmonary embolism

Clinical Signs	Prevalence (Number)	Frequency (Percentage)
Tachypnea	44	66.6
Tachycardia	43	65.1
Hypoxia	13	19.6
Elevated JVP	3	4.5
Gallop rhythm	3	4.5
Wide split S2	1	1.5
TR murmur	8	12.1
Hypotension/Shock	4	6.0

### Frequency of location of deep venous thrombosis

Deep Vein Involved	Prevalence (Number)	Frequency (Percentage)
Inferior venacava	4	21
Common iliac vein	5	26.3
External iliac vein	7	36.8
Internal iliac vein	1	5.2
Common femoral vein	8	42.1
Superficial femoral vein	9	47.3
Popliteal vein	7	36.8

### Frequency of isolated pulmonary embolism and isolated deep venous thrombosis

Isolated Involvement	Prevalence (Number)	Frequency (Percentage)
Pulmonary embolism alone	6	24
Deep venous thrombosis alone	6	24

### Prevalence of clinical symptoms and significance of association with pulmonary embolism and deep venous thrombosis

	Pulmonary Embolism		Deep venous thrombosis		p*	p <sup>#</sup>
	Absent	Present	Absent	Present		
<b>Dyspnea</b>					0.39	0.11
Absent	9	2	10	1		
Present	38	17	37	18		
<b>Cough</b>					0.15	0.15
Absent	38	18	38	18		
Present	9	1	9	1		
<b>Chest pain</b>					<b>0.004</b>	0.08
Absent	35	7	33	9		
Present	12	12	14	10		
<b>Hemoptysis</b>					0.50	0.36
Absent	46	18	45	19		
Present	1	1	2	0		
<b>Syncope</b>					0.13	0.13
Absent	42	19	42	19		
Present	5	0	5	0		

p\* : p value for association between clinical symptoms and pulmonary embolism.

p<sup>#</sup> : p value for association between clinical symptoms and deep venous thrombosis.

### Prevalence of clinical signs and significance of association with pulmonary embolism and deep venous thrombosis

	Pulmonary Embolism		Deep venous thrombosis		p*	p <sup>#</sup>
	Absent	Present	Absent	Present		
<b>Tachypnea</b>					0.17	0.44
Absent	18	4	17	5		
Present	29	15	30	14		
<b>Tachycardia</b>					0.35	0.13
Absent	18	5	19	4		
Present	29	14	28	15		
<b>Hypoxia</b>					0.06	0.23
Absent	35	18	36	17		
Present	12	1	11	2		
<b>Elevated JVP</b>					0.13	<b>0.005</b>
Absent	46	17	47	16		
Present	1	2	0	3		
<b>Gallop rhythm</b>					0.13	0.85
Absent	46	17	45	18		
Present	1	2	2	1		
<b>Widely split S2</b>					0.52	0.52
Absent	46	19	46	19		
Present	1	0	1	0		
<b>Tricuspid regurgitation murmur</b>					0.56	0.56
Absent	42	16	42	16		
Present	5	3	5	3		
<b>Hypotension/shock</b>					0.86	0.86
Absent	44	18	44	18		
Present	3	1	3	1		

p\* : p-value for association between clinical signs and pulmonary embolism

p<sup>#</sup> : p-value for association between clinical signs and deep venous thrombosis

### Cross tabulation between pulmonary embolism and deep venous thrombosis

DVT	PE		p value
	Absent	Present	
Absent	41	6	<0.001
Present	6	13	

DVT= Deep venous thrombosis, PE- Pulmonary embolism

### Discussion

The study population comprised of 66 patients; out of whom 29 were males (44%) and 37 were females (56%). The prevalence of clinical symptoms in suspected cases of pulmonary embolism was as follows: 55 (83.3%) patients had dyspnea as the most prevalent symptom, followed by 24 (36.3%) with chest pain, 10 (15.1%) with cough and 5 (7.5%) with syncope. Hemoptysis was the least prevalent clinical symptom and was seen only in 2 (3%) patients. In a study by **Miniati et al.** on clinical presentation of acute pulmonary embolism in 800 patients; sudden onset of dyspnea was the most frequent symptom, followed by chest pain. The prevalence of clinical complaints in our study is comparable to previously published literature.

In our study population, common clinical signs were tachypnea and tachycardia which were present in 44(66.6%) and 43(65.1%) patients respectively. Other clinical signs included, hypoxia in 13(19.6%) patients, tricuspid regurgitation in 8(12.1%), hypotension/ shock in 4(6%), elevated JVP and gallop rhythm, both in 3 (4.5%) patients with the least prevalent clinical sign being wide split S2 in 1(1.5%) patient. **Stein et al.** in their PIOPED II study, evaluated the clinical characteristics in patients with acute pulmonary embolism and found that tachypnea (54%), was the most prevalent clinical sign followed by lung findings and tachycardia in 29% and 24% patients respectively. The results of their study were similar to our study except for lung findings which werenot assessed in our study. Among our study population, the most prevalent echo finding was dilated right atrium in 23 (34.8%) patients followed by dilated right ventricle in 17 (25.7%) patients and hypokinesia of right ventricle in 11(16.6%) patients.

The prevalence of venous thromboembolism in our study population was 37.8%,i.e. 25 patients with venous thromboembolism out of 66 patients suspected to have pulmonary embolism. There were 19 (28.7 %) patients with pulmonary embolism and 19 (28.7 %) patients with deep venous thrombosis in our study population. Out of the 25 patients with venous thromboembolism, 13 (19.7% of all patients and 52% of patients with venous thromboembolism) had both pulmonary embolism and deep venous thrombosis. Isolated pulmonary embolism and isolated deep venous thrombosis were seen in 6patients each (9% of all patients and 24% of patients with venous thromboembolism). **Nasaroglu et al.** reported a prevalence of venous thromboembolic disease in 29.1%, acute PE in 25.2% and acute DVT in 18.0% of patients, in their study in assessing the role of MDCT pulmonary angiography and CT indirect venography in diagnosing thromboembolic disease. On the assessment of 306 patients with the suspected thromboembolic disease, 43 (14.1%) patients had both PE and DVT with isolated sub segmental PE in 2 patients (0.7% of all patients and 2.2% of patients with thromboembolism).Isolated DVT was seen in 12 patients (3.9% of all patients and 13.5% of patients with venous thromboembolism). The prevalence of venous thromboembolism (including PE, DVT and combined PE with DVT), isolated PE and isolated DVT was comparable to previous studies with a slightly higher prevalence in our study. This higher prevalence could be due to the meticulous clinical selection criteria for selecting the patients who need to undergo CT pulmonary angiography and could also be attributed to the use of Multi detector (128 slice) computed tomography which enables submillimeter sections along with increased temporal and spatial resolution. Our study indicated that performance of indirect CT venography following CT pulmonary angiography increased the detection rate of venous thromboembolic disease further by detecting isolated DVT which also requires prompt

anticoagulation. Patients with DVT and pulmonary embolism involving subsegmental arteries can be asymptomatic and hemodynamically stable. Identification of such patients with embolism involving subsegmental arteries could be difficult, mainly due to suboptimal study or due to artifacts. These patients are potential candidates to develop hemodynamically unstable recurrent pulmonary embolism due to the persistence of DVT. In such patients, the inclusion of indirect venography following CT pulmonary angiography can detect the associated DVT earlier and can help in initiating anticoagulation which would prevent a further episode of hemodynamically unstable recurrent pulmonary embolism and post-thrombotic syndrome.

Deep venous thrombosis was found in 19 (28.78%) out of 66 patients. Assessment of the location of DVT showed superficial femoral vein as the most prevalent site. 9 (47.3%) patients had deep venous thrombosis in superficial femoral vein followed by 8(42.1%) in common femoral vein, popliteal and external iliac veins in 7(36.8%) patients, 5(26.3%) in common iliac vein and inferior venacava in 4(21%) patients. The internal iliac vein was the least involved, only in 1(5.2%) patient. In a study done by **Nchimi et al.** on incidence and distribution of lower extremity deep venous thrombosis using indirect CT venography in patients suspected of pulmonary embolism, the prevalence of DVT was more in popliteal vein in 102(39.4%) patients, followed by superficial femoral vein in 75(29%) patients, common femoral vein in 56 (21.6%), common and external iliac vein in 19 (7.3) and IVC in 12 (4.6%) patients. Popliteal vein was most common site of deep venous thrombosis in the study by Nchimi et al., whereas the superficial femoral vein was the most prevalent site in our study. The prevalence of venous thrombosis involving rest of the deep veins in our study was comparable to previous literature.

In our study population of 66 patients, isolated deep venous thrombosis was seen in 6 (9.09% of

all patients and 24% of all patients with the thromboembolic disease) patients. **Cham et al.** in their study on DVT detection by using indirect CT venography found that, among 541 patients, 45 patients had DVT. Isolated DVT was found in 16(3% of all patients and 14.9% of all patients with the thromboembolic disease) patients. The prevalence of isolated DVT in indirect venography ranged from 1.1 (in a study by **Slater et al.**) to 6.5%(in a study by **Ghaye et al.** using 16 MDCT) in previous studies which are comparable to our study. This highlights the fact that indirect venography adds to the diagnosis of thromboembolic disease. The frequency of associated CT findings in our study population was 9(47.3%) patients with atelectasis, 7(36.8%) patients with pleural effusion, 5(26.3%) patients with consolidation and 4(21%) patients with mosaic perfusion.

There was a statistically significant association between the prevalence of pulmonary embolism and deep venous thrombosis with p-value <0.001 suggesting an increased likelihood of the occurrence of pulmonary embolism in patients with deep venous thrombosis. The concomitant pulmonary embolism and deep venous thrombosis were seen in 13 (19.7 % of all patients and 52% of patients with venous thromboembolism) patients in our study. **Loudet et al.** in their study on the prevalence of DVT in patients with suspected pulmonary embolism using combined CT venography and pulmonary angiography found that combined occurrence of pulmonary embolism and DVT in 58 (9% of all patients and 58% of patients with venous thromboembolism) out of 650 patients. **Ghaye et al.** reported the prevalence of coexisting DVT in patients with clinically suspected PE to be 83% along with clinically unsuspected PE in patients with DVT to be 61 % respectively. The findings of our study along with previous literature suggest that regardless of clinical condition, pulmonary embolism and DVT frequently co-exist. However, our study also showed that there could be isolated occurrence of pulmonary embolism and deep venous thrombosis

which can be detected only on screening for DVT during the evaluation of suspected cases of pulmonary embolism.

However, our study had a few limitations. First, was a small sample size in comparison to previous published literature. Second, was the absence of venous doppler correlation in diagnosed cases of DVT either due to non performance or due to involvement of sites where ultrasound fails to identify the thrombosis

### Summary

The study population comprised of 66 patients; out of whom 29 were males (44%) and 37 were females (56%). The prevalence of clinical symptoms in suspected cases of pulmonary embolism was as follows: 55 (83.3%) patients had dyspnea as the most prevalent symptom, followed by 24 (36.3%) with chest pain, 10 (15.1%) with cough and 5 (7.5%) patients with syncope. Hemoptysis was the least prevalent clinical symptom and was seen only in 2 (3%) patients.

In our study population, common clinical signs were tachypnea and tachycardia which were present in 44(66.6%) and 43(65.1%) patients respectively. Other clinical signs i.e., hypoxia were present in 13(19.6%) patients, tricuspid regurgitation in 8(12.1%), hypotension/ shock in 4(6%), elevated JVP and gallop rhythm in 3 (4.5%) patients with the least prevalent clinical sign being wide split S2 in 1(1.5%) patient.

The prevalence of venous thromboembolism in our study population was 37.87%, i.e. 25 patients with venous thromboembolism out of 66 suspected cases of pulmonary embolism. Prevalence of pulmonary embolism was 19(28.78%), and deep venous thrombosis was 19(28.78%). Out of the 25 patients with venous thromboembolism, 13 (19.7% of all patients and 52% of patients with venous thromboembolism) had both pulmonary embolism and deep venous thrombosis. Isolated pulmonary embolism and isolated deep venous thrombosis was seen in 6 patients each (9.09% of all patients and 24% of patients with venous thromboembolism).

Deep venous thrombosis was found in 19 (28.78%) out of 66 patients. The prevalence of location for DVT was as follows: 9(47.3%)

There was a statistically significant association between the prevalence of pulmonary embolism and deep venous thrombosis with p-value <0.001. However, our study also showed that there could be isolated occurrence of pulmonary embolism and deep vein thrombosis which highlights the need to screen for DVT in the evaluation of any suspected cases of pulmonary embolism.

### Conclusion

In our study, we evaluated the proportion of patients having DVT in clinically suspected cases of pulmonary embolism and it was found to be 28.78%. We report a statistically significant association of the occurrence of pulmonary embolism with deep venous thrombosis. We conclude that among 66 clinically suspected cases of pulmonary embolism, the proportion of patients with venous thromboembolism was 37.8%; with concomitant PE and DVT in 19.7% patients, isolated DVT and isolated PE in 9.0% patients each. Our study also showed that there was isolated occurrence of pulmonary embolism and isolated deep venous thrombosis which emphasizes the need to screen for DVT during the evaluation of any suspected cases of pulmonary embolism.

### Bibliography

1. Merli G. Diagnostic assessment of deep vein thrombosis and pulmonary embolism. *Am J Med* 2005; 118[suppl 8A]:3S–12S.
2. Inter societal Accreditation Commission. ICAVL: Essentials and standards for accreditation in noninvasive vascular testing. Part II. Vascular laboratory operations – Peripheral venous testing. ; 2000: 1–8.
3. Fraser JD, Anderson DR. Deep venous thrombosis: recent advances and optimal investigation with US. *Radiology* 1999;

- 211:9–24.  
[www.intersocietal.org/intersocietal.htm](http://www.intersocietal.org/intersocietal.htm).
4. Kohli, D Rajput, M Gomes, S Desai. Review article: Imaging of pulmonary thromboembolism. *Ind J Radiol Img* 2002; Volume 12: 207-212.
  5. Monreal M, Barba R, Tolosa C, Tiberio G, Todolí J, Samperiz AL. RIETE Investigators Deep vein thrombosis and pulmonary embolism: the same disease? *Pathophysiol Haemost Thromb*. 2006;35:133–135. doi: 10.1159/000093555. [PubMed] [Cross Ref].
  6. Bauer AR Jr, Flynn RR. Computed tomography diagnosis of venous thrombosis of the lower extremities and pelvis with contrast material. *Surg Gynecol Obstet* 1988; 167:12–15.
  7. Tarbox AK, Swaroop M. Pulmonary embolism. *Int J Crit Illn Inj Sci*. 2013Jan;3(1):69-72. doi: 10.4103/2229-5151.109427. PubMed PMID: 23724389; PubMedCentral PMCID: PMC3665123.
  8. Riedel M. Acute pulmonary embolism 1: pathophysiology, clinical presentation, and diagnosis. *Heart*. 2001 Feb;85(2):229-40. Review. PubMed PMID: 11156681;PubMed Central PMCID: PMC1729607.
  9. Tovey C, Wyatt S. Diagnosis, investigation, and management of deep vein thrombosis. *BMJ* 2003;326:1180-4.
  10. Goodacre S, Sampson F, Thomas S, van BE, Sutton A. Systematic review and meta-analysis of the diagnostic accuracy of ultrasonography for deep vein thrombosis. *BMC Med Imaging* 2005; 5: 6.
  11. Mos IC, Klok FA, Kroft LJ, DE RA, Dekkers OM, Huisman MV. Safety of ruling out acute pulmonary embolism by normal computed tomography pulmonary angiography in patients with an indication for computed tomography: systematic review and meta-analysis. *J Thromb Haemost* 2009;
  12. Mavili E, Ozturk M, Akcali Y, Donmez H, Yikilmaz A, Tokmak TT, Ozcan N. Direct CT venography for evaluation of the lower extremity venous anomalies of Klippel-Trenaunay Syndrome. *AJR Am J Roentgenol*. 2009 Jun;192(6):W311-6. doi: 10.2214/AJR.08.1151. PubMed PMID: 19457795 1491-8
  13. Cham MD1, Yankelevitz DF, Shaham D, Shah AA, Sherman L, Lewis A, Rademaker J, Pearson G, Choi J, Wolff W, Prabhu PM, Galanski M, Clark RA, Sostman HD, Henschke CI. Deep venous thrombosis: detection by using indirect CT venography. The Pulmonary Angiography-Indirect CT Venography Cooperative Group. *Radiology*. 2000 Sep;216(3):744-51.
  14. Karande GY, Hedgire SS, Sanchez Y, Baliyan V, Mishra V, Ganguli S, Prabhakar AM. Advanced imaging in acute and chronic deep vein thrombosis. *Cardiovasc Diagn Ther*. 2016 Dec;6(6):493-507. doi: 10.21037/cdt.2016.12.06.
  15. Nazaroğlu H, Ozmen CA, Akay HO, Kiliç I, Bilici A. 64-MDCT pulmonaryangiography and CT venography in the diagnosis of thromboembolic disease. *AJR Am J Roentgenol*. 2009 Mar;192(3): 654-61. doi: 10.2214/AJR.07.3939. PubMed PMID:19234261.
  16. Shi WY, Wang LW, Wang SJ, Yin XD, Gu JP. Combined Direct and Indirect CT Venography (Combined CTV) in Detecting Lower Extremity Deep Vein Thrombosis. *Medicine (Baltimore)*. 2016 Mar;95 (11): e3010. doi: 10.1097/MD.0000000000003010. PubMed PMID: 26986113; PubMed Central PMCID: PMC4839894.