



**ORIGINAL RESEARCH PAPER**

**Radiodiagnosis**

**ROLE OF CT PULMONARY ANGIOGRAPHY IN THE SEVERITY GRADING OF PULMONARY EMBOLISM USING THE MASTORA CLOT LOAD SCORE WITH D – DIMER CORRELATION**

**KEY WORDS:** Pulmonary Embolism, CT Pulmonary Angiography, D-Dimer, Mastora Score

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**ABSTRACT**

Pulmonary embolism (PE) is a potentially fatal disease, whose severity varies from uncomplicated cases to life-threatening massive embolism. A high clot burden, as determined by the pulmonary artery obstruction index in CT Pulmonary Angiography is associated with the extent and therefore severity of PE. This dictates therapeutic practices. However, repeated CTPA is not always practiced for follow up of a patient due to high cost and radiation exposure risk. Therefore, it is necessary to review if PE patients can be monitored and followed up the basis of successive D-dimer values which is relatively less costly and easy to carry out in an outpatient setting. We conducted a prospective observational study of 30 patients referred with a high pre-test probability and clinical suspicion of acute pulmonary embolism, to determine whether there lies any significant association between the radiological parameters conventionally used to assess and grade severity of a pulmonary embolism (namely, the Mastora Score on CTPA) with the patients' evaluated D-Dimer levels and found positive linear correlation amongst the said variables.

**INTRODUCTION**

Pulmonary embolism is a potentially lethal disease, the severity of which varies from relatively uncomplicated cases to fatal massive embolism, with high mortality. Recurrence of pulmonary embolism is the leading cause of death, with a mortality rate of approximately 30% in untreated patients. These patients may develop chronic thromboembolic pulmonary hypertension, which leads to higher rates of morbidity and mortality.

Therefore, definitive diagnosis and regular follow up is essential, to avoid complications. The gold standard for diagnosing pulmonary embolism is CT Pulmonary Angiography. Other radiological investigations such as X-Ray Chest and CT Chest (Plain) do not confer the same sensitivity and specificity as a pulmonary Angiogram study. Adjunctive diagnostic tests include echocardiography, lower limb doppler ultrasonography, V/Q scanning, and D-Dimer lab investigation.

Assessing the severity of pulmonary embolism is a two-step procedure. This is because, it has been accepted that the clinical impact and subsequent mortality after a pulmonary embolic event, depends on both, the size of the embolus and on the underlying cardiopulmonary status.

Clot burden scores include the Miller, Walsh, Qanadli and Mastora scores. Mastora score remains the most reliable of these since it is one of the newer scores to be employed of the four, and it takes into account segmental arteries as the most distal branches to be evaluated and has shown higher correlation with markers of right ventricular dysfunction. Usually, an obstruction index of 40---60% is associated with high-risk recurrent pulmonary embolism.

D-Dimer is a simple biochemical parameter, which in itself shows high positive predictive value for pulmonary embolism, but is not necessarily used for follow up.

The usual management strategy on a long term basis includes a 3-6 month follow up after initial anticoagulation, which includes a clinical evaluation for dyspnoea or any functional deficit. This is an incomplete method of follow up evaluation, for a lethal disease and must be supplemented with other diagnostic tests.

Repeated CT Pulmonary Angiographies are not always practiced for follow up of a patient owing to their high cost, and radiation and contrast associated risks. Therefore, it is necessary to review if PE patients can be followed up the basis of successive D-dimer values, which will be more patient friendly.

**OBJECTIVES**

To determine whether a significant association exists between the radiological severity index (Mastora Score) on CT Pulmonary Angiography and the patient's D-dimer levels.

**REVIEW OF LITERATURE**

Pulmonary embolism is an underdiagnosed and potentially lethal entity.

In the (ICOPER) International Cooperative Pulmonary Embolism Registry, the estimated three month mortality data for all pulmonary embolism patients is calculated at 17.4%. (1). According to the (MAPPET) Management Strategies and Determinants of Outcome in Acute Pulmonary Embolism Trial, this 13% rose to 31% in IPD patients showing signs of hemodynamic instability (2).

In severe cases, 2/3rds of those patients die within one hour of presentation and massive PE usually accounts for only a half of such deaths, the rest being due to smaller, submassive and/or recurrent emboli. The outcome from PE is a direct function of both, the size of the embolus as well as the underlying cardiopulmonary function (3). The clinical symptoms and signs of acute pulmonary embolism are very non-specific. In maximum cases, pulmonary embolism is suspected in patients with dyspnoea, pain in chest, syncope, and/or haemoptysis (4).

Plasma D-dimer measurement using a highly sensitive assay is recommended in all emergency department patients, those that are unlikely to have pulmonary embolism (5). This is done to reduce the need for unnecessary imaging and the associated risk of radiation. The quantitative (ELISA) enzyme-linked immunosorbent assay has a diagnostic sensitivity of 95% & can be used to completely exclude PE in such patients.

The Mastora Scoring system is a 5-point scoring system. It is

calculated for 5 mediastinal branches, 6 lobar branches, and 20 segmental branches of the bilateral pulmonary arteries. The pulmonary vasculature is evaluated according to its' anatomical distribution in a serial-wise systematic manner (6) The higher the score, the graver the prognosis.

**TABLE 1: Mastora Score calculation based on Pulmonary Bed**

Pulmonary bed	Arterial levels considered	Total range of scores	Percentage
Central pulmonary bed	Mediastinal and lobar arteries	25 + 30 = (0 - 55)	x/55 x 100
Peripheral pulmonary bed	Segmental pulmonary arteries	(0 - 100)	x/100 x 100
Global/entire pulmonary bed	Mediastinal, lobar and segmental pulmonary arteries	25 + 30 + 100 = (0 - 155)	x/155 x 100

The value of 'x' is the calculated total CT severity score.

Once a PE is diagnosed, we need to do risk stratification to guide appropriate management. Treatments options include anticoagulation, catheter directed thrombolysis, systemic thrombolysis (ST), reduced dose ST, surgical embolectomy, catheter embolectomy, and mechanical circulatory support like extracorporeal membrane oxygenation.

The primary goal of follow-up clinic is to evaluate the patient for any persistent and/or recurrent symptoms. This helps to decide an appropriate type, duration and dosage of anticoagulation, and also monitor the medication compliance and tolerance. We can stay vigilant for detection of a latent thrombophilia or combine age-appropriate cancer screening, and obviously identify the sequelae of PE like post-PE syndrome and chronic thromboembolic disease (CTED) or CTEPH).

There are no clear guidelines on post-PE imaging however, most physicians agree that repeating lung imaging with a CTA or V/Q scan and repeating echocardiography and/or a 6-minute walk testing are necessary in patients whose symptoms persist. Initial testing is done at 3 months after the original PE diagnosis. Absence of any clear clinical guidelines by the American College of Chest Physicians (ACCP), American Heart Association (AHA), and/or European Society of Cardiology (ESC), or even the PERT consortium causes ambiguity and therefore results in increased mortality primarily due to recurrence of pulmonary embolism that is undetected (7) (8). We propose that D- Dimer values can be assessed in the future publications to serve as an indicator of recurrence.

**RESULTS**

Correlation between D-Dimer and Global Mastora Clot Load Score Using the Pearson correlation coefficient, correlation is significant if >0.01 according to bivariate analysis and the obtained value is 0.802 Hence, there is positive significant correlation.

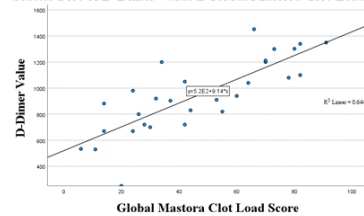
**TABLE 2: Cross Tabulation using bivariate analysis and Pearson's correlation coefficient**

		D-Dimer Value	Global Mastora Clot Load Score
D-Dimer Value	Pearson Correlation	1	.802**
	Sig. (2-tailed)		0.000
	N	30	30
Global Mastora Clot Load Score	Pearson Correlation	.802**	1

	Sig. (2-tailed)	0.000	
	N	30	30

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Scatter Plot of D-Dimer Value x Global Mastora Clot Load Score



**FIGURE 1: Scatter plot diagram to demonstrate the correlation between the D-Dimer value and the global Mastora clot load score.**

**REPRESENTATIVE CASESWITH IMAGES**



**FIGURE 4: CTPA images representing a saddle embolus at the main pulmonary bifurcation**



**FIGURE 5: CTPA axial sections demonstrating a case of central pulmonary embolism with RV dysfunction**

**DISCUSSION**

In the current study, the total sample size is of 30 subjects, the maximum subjects lying in the 50th and 60th decades of life out of which 18 were females and 12 were males.

Two major complaints were evaluated for the purposes of the study, were chest pain and dyspnoea. 19 out of 30 subjects presented with dyspnoea as the chief clinical complaint and 11 out of 30 with chest pain. It was found that out of 30 subjects, 11 had no significant previous history, 10 had previous history of DVT and 9 had previous history of PE.

Out of 30 cases, D-Dimer test was positive for 27/30, which indicates 100% sensitivity of D-Dimer for the incidence of pulmonary embolism, with positive findings on CTPA being considered the gold standard. However, the specificity of D-Dimer as a diagnostic test is considerably lower, measured at 33.3% (1/30 cases). The validity of the data being 100%

The majority of subjects with pulmonary embolism displayed a global clot load Mastora score of 20-30 and / or 70-80. The mean value being 46 of a maximum possible value being 155. In 2007, in an article published by W Ghanima et al, it was seen that a similar study with a population of 100 patients, they concluded that the D-Dimer level is directly related to the severity of pulmonary embolism and it does have potential value as a marker of prognosis in cases with severe pulmonary embolism in the follow up period as well. (9)

## CONCLUSION

There is a significant positive association exists between the radiological severity index (Mastora Score) and the patient's D-Dimer level.

Thus, D-Dimer may serve as a prognostic and severity marker for the follow-up of PE patients, alleviating the need for repeated CTPA exams.

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