



ROLE OF CTPA IN PULMONARY EMBOLISM IN PATIENTS WITH LOWER LIMB FRACTURES

Radiology

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ABSTRACT

This research will provide valuable insights into the role of CTPA in the early detection and management of pulmonary embolism in patients with lower limb fractures. By highlighting the incidence of PTE and its approximate time frame from trauma and surgery, this study aims to contribute to the development of more effective diagnostic and treatment strategies, ultimately improving patient care and reducing mortality rates associated with PE. This was observational cross sectional study carried over a period of 24 months at department of Radiodiagnosis, tertiary care center after obtaining clearance from our Institutional Ethics Committee. Total 50 patients enrolled in the study with 60% were male & 16% had pulmonary embolism. There is no significant difference in incidence of PTE according to age of patient & presence of co-morbidity ($p > 0.05$). Majority of the adults studied were of the middle-aged group & majority of the patients had no significant comorbidities. There was a statistically non significant difference seen for the frequencies between the groups ($p > 0.05$) of patients with DVT and those with high clinical suspicion of thromboembolism. There is no strong evidence to suggest a significant difference in the presence of thrombus across different days since trauma. Out of the 50 patients 30 had undergone surgery. The most frequently encountered finding was infective changes involving the lung parenchyma. This study highlights incidence of pulmonary embolism in patients with lower limb fractures was found to be 16 % with majority comprising femoral followed by tibial fractures. There was no correlation between incidence of pulmonary embolism and other factors like age, gender or comorbidities.

KEYWORDS

CTPA, Pulmonary Embolism, DVT

INTRODUCTION:

Lower limb fractures are one of the most common presenting complaints in orthopaedic casualties and trauma centres. The most common cause is usually road and traffic accidents, with other causes including accidental falls, pathological fractures and insufficiency fractures. Patient with lower limb fractures require prompt and intensive inpatient care as many of these fractures are associated with complications.

Although mortality exclusively due to lower limb fractures is low, it causes significant morbidity and prolonged hospital stay. Mortality in patients with lower limb fractures are usually due to other associated injuries in polytrauma patients, vascular injuries or pulmonary thromboembolism. Mortality rates after lower limb fractures vary depending on type and location of fracture. Hip fractures in particular are associated with higher mortality rates of 15-20 %. Other fractures of lower limb have much lower rates.

Pulmonary thromboembolism is a significant and potentially life-threatening complication that can arise from lower limb fractures. Prompt and accurate diagnosis is crucial to manage and mitigate the associated risks. Patients with lower limb fractures are at increased risk for venous thromboembolism (VTE), which can lead to PE if not promptly diagnosed and treated. PE can occur any time following trauma. It may occur as early as within 1st 24 hours or may show delayed presentation months after trauma. PE may also occur during or following surgery for lower limb fractures. Prolonged immobility following fracture is also another potential cause for PE. PE carries a significant risk of mortality and can be as high as 30%. Although many centres administer Low molecular weight heparin following major lower limb fractures and its surgeries, routine prophylaxis with LMWH following isolated lower limb fractures distal to knee is not recommended.

Traditional diagnostic methods, including clinical assessment and D-dimer testing, often fall short in terms of accuracy and reliability. Consequently, CTPA offers a more definitive diagnostic approach,

allowing for timely intervention and management. Understanding the effectiveness and limitations of CTPA in this specific patient cohort is essential for improving clinical outcomes and optimizing treatment protocols.

CTPA has emerged as a gold standard diagnostic tool for detecting pulmonary embolisms due to its high sensitivity and specificity. It is also easily accessible, affordable and gives quick results. This dissertation examines the critical role of CTPA in diagnosing PE in patients who have sustained lower limb fractures.

However, there is a dearth of adequate studies regarding incidence of pulmonary thromboembolism in lower limb fractures and associated morbidity and mortality. Resources pointing towards peak incidence of thromboembolism following lower limb fractures is inadequate to suggest the time frame following surgery or trauma when incidence is maximum. At present routine screening of patients for PTE with CTPA lacks evidence and is not recommended.

This research will provide valuable insights into the role of CTPA in the early detection and management of pulmonary embolism in patients with lower limb fractures. By highlighting the incidence of PTE and its approximate time frame from trauma and surgery, this dissertation aims to contribute to the development of more effective diagnostic and treatment strategies, ultimately improving patient care and reducing mortality rates associated with PE.

Methodology:

This was observational cross sectional study carried over a period of 24 months at department of Radiodiagnosis, tertiary care center after obtaining clearance from our Institutional Ethics Committee. All patients with lower limb fractures admit in tertiary care center and referred to radiology department for CTPA were included in the study. The sample size was 50. All cases which satisfy inclusion criteria were included in the study. Informed consent was taken. Detailed clinical history was taken. Clinical examination was done. All patients underwent a CT scan at our department on "SOMATOM AS+" 128

slices. Imaging was done during quiet breathing. The protocol was tailored according to the age, weight of the patient and the clinical situation. The patient was placed in the supine position; arms were extended above the head. Patients were instructed to remove metal clothing before the examination to avoid metallic artifacts. Commonly used contrast for CTPA is Injection Optiscan 350mg/100cc as per body weight dose 1cc/kg intravenously through green peripheral catheter (Gauge size 18). Bolus tracking technique is used. After performing the CTPA the Images were reconstructed with a slice thickness of 1 mm and then images were transferred to a workstation (syngo.via) to run images with inbuilt analysis software. MIP images are used. The D dimer (if available) levels and appropriate X-Rays was recorded. The CTPA findings along with timeframe from trauma and day of surgery was also be recorded and analysed. The outcomes measured were PE and DVT. Patients with PE who had DVT were compared with patients with PE who did not have DVT. Data was fed in MS excel. Data was analysed. The statistical significance of the relationship between independent variables and dependent variables are calculated using Chi-square test ; $p \leq 0.05$ was considered as statistically significant. All calculations were made using the SPSS V26.0 trial version.

RESULTS:

Total 50 patients enrolled in the study with 60% were male & 16% had pulmonary embolism. (Table 1) There is no significant difference in incidence of PTE according to age of patient & presence of comorbidity ($p > 0.05$). Majority of the adults studied were of the middle-aged group & majority of the patients had no significant comorbidities. (Table 2)

The incidence of PTE in patients with femoral fractures was 17% and that for tibial fractures was 16.6 %. There was a statistically non-significant difference seen for the frequencies between the groups ($p > 0.05$) The incidence of DVT is 36% in patients with lower limb fractures. There was a statistically non significant difference seen for the frequencies between the groups ($p > 0.05$) of patients with DVT and those with high clinical suspicion of thromboembolism. In patients with DVT, there was a 20% incidence of PTE, which is slightly more than those without DVT. There is no strong evidence to suggest a significant difference in the presence of thrombus across different days since trauma. Out of the 50 patients 30 had undergone surgery. 6 of the post-surgical patients developed PTE while 2 out of 18 patients who did not undergo surgery developed PTE. However, the p value of the above given data was > 0.05 indicating that there is no statistically significant difference in the incidence of pulmonary embolism in the two groups. (Table 3)

Table 1: Distribution according to demographic parameter

Demographic Parameter		Frequency	Percentage
Gender	Female	20	40
	Male	30	60
Pulmonary embolism	Present	8	16
	Absent	42	84

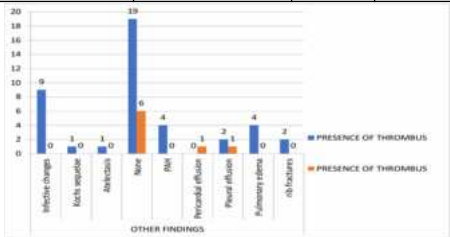
Table 2: Distribution of cases according to presence/absence of PTE

Parameter		Pulmonary embolism		p Value
		No	Yes	
Age group	20-30	9	4	>0.05
	31-40	12	1	
	41-50	5	1	
	51-60	7	1	
	61-70	7	1	
	>71	2	0	
Co-morbidity	CAD	3	0	>0.05
	CVA	1	0	
	DM	3	0	
	HTN	2	0	
	PTB	1	0	
	RVD	1	0	
	None	31	7	

Table 3 : Association between Presence of thrombus & Different clinical parameter

Clinical Parameter	Presence of Thrombus		p Value
	No	Yes	

Fracture	Clacaneum	1	0	0.962
	Femer	24	5	
	Fibula	1	0	
	Meta-tarsal	1	0	
	Tibia	15	3	
DVT	No	27	15	0.1
	Yes	5	3	
Days Since Trauma	1	3	0	0.129
	2-3	15	1	
	4-7	13	6	
	>7	11	1	
Surgery Thrombus	No	18	24	0.344
	Yes	2	6	



Graph 1: Other associated findings in patients with lower limb fractures and suspicion of PTE.

Table 4: PE in postoperative patients after screening for DVT

Pulmonary embolism	DVT		P Value
	Yes	No	
Present	2	4	>0.05
Absent	7	17	

The most frequently encountered finding was infective changes involving the lung parenchyma. Other findings included pulmonary arterial hypertension, pulmonary edema and pleural effusions. (Graph 1) Out of 30 patients who underwent surgery, 9 (30%) were found to have developed DVT by our screening method. 2 (22 %) patients with DVT were found to have pulmonary embolism. 4 (19 %) of patients who did not have DVT but had high clinical suspicion (by Wells criteria) developed pulmonary embolism. (Table 4)

Table 5: Distribution of PTE in post-surgical patients according to Clinical Parameter

Variables		Pulmonary Thrombus	
		No	Yes
Days Since Trauma	1	4	2
	2-3	12	4
	4-7	4	0
	>7	4	0
Follow Up	Conservative	41	0
	Death	1	2
	Inj SK	0	5
	LMWH	0	1

Post-operatively, all incidences of PTE were within the early postoperative period within 3 days. 2 patients had PTE in immediate postoperative period on day 1. None of the observed patients developed PTE after the third postoperative day. This shows that there is a highly statistically significant ($p \text{ value} < 0.05$) increased incidence in the incidence of PTE in 1st 3 days following surgery. majority of patients with thromboembolism had no other significant chest findings. The most frequently encountered finding was infective changes involving the lung parenchyma. Other findings included pulmonary arterial hypertension, pulmonary edema and pleural effusions. (Table 5)



Fig 1: Figure 1 Axial CTPA image shows complete lumen occluding thrombus of right pulmonary artery. This was a 21 year old male patient who had a femoral fracture and had undergone intramedullary nailing. The patient developed breathlessness on day 5 following trauma. CTPA was done. Patient succumbed soon after the event.



Fig 2: Axial CTPA image shows complete lumen occluding thrombus of left pulmonary artery. This was a 65 year old male with a tibial fracture and managed by external fixator. Patient was found to have DVT on 3rd day post trauma. Patient also had other comorbidities CTPA was done. Patient succumbed soon after.

DISCUSSION:

This study was conducted in the Radiodiagnosis department of a Tertiary care center among 50 patients with lower limb fractures who were either suspected to have pulmonary thromboembolism (PTE) or showed evidence of DVT. The results of this study provide a detailed understanding of the incidence and risk factors associated with pulmonary embolism (PE) in patients with lower limb fractures, an area of significant clinical concern. The discussion integrates these findings with existing literature, offering a comprehensive view of the implications for clinical practice.

The study's finding that 16% of patients with lower limb fractures developed PE is notably higher than the incidence in the general population, which is approximately 0.1% (1 per 1000). This significant disparity underscores the elevated risk of thromboembolism in patients with orthopedic trauma, particularly those involving lower extremities. Literature on the subject varies, but studies consistently report increased PE risk in trauma patients. The study by Licht et al showed an incidence of 12.8% [1] and that by Constantin et al showed a 9.57% [2]. Whereas study by Velmahos et al [3] showed an incidence of 19%. The p-value obtained (<0.01) indicates a statistically significant difference between the incidence of PE in lower limb fracture patients compared to the general population. This supports the hypothesis that lower limb fractures are a significant risk factor for PE. The clinical implications are profound, suggesting that all patients with such fractures should be considered at high risk for thromboembolism and managed accordingly with preventive interventions such as anticoagulation therapy, mechanical prophylaxis, or both. The study observed a higher number of male patients (60%) compared to female patients (40%), though no significant difference in the incidence of PE was noted between genders. The study found that the majority of patients were middle-aged, yet age did not significantly influence the incidence of PE. This is somewhat surprising, given that older age is generally considered a risk factor for venous thromboembolism (VTE), including PE (Albeseth et al) [4]. The study highlights a significant correlation between DVT and PE, with 20% of patients with DVT developing PE. In patients who were screened on day 1 and then every 3rd day [5] there was a 36% incidence of DVT. In post operative patients, there was no statistically significant difference in incidence of pulmonary embolism in patients screened by DVT and those scanned due to high clinical suspicion. However, 33% more cases of pulmonary embolism were diagnosed by adding routine DVT screening. This finding is consistent with existing literature, which identifies DVT as a major risk factor for PE [6,7]. The high incidence of PE in patients with DVT reinforces the necessity of early detection and management of DVT in patients with lower limb fractures. This finding has critical implications for clinical practice, suggesting that patients with lower limb fractures should be routinely screened for DVT, especially since the absence of DVT has a high negative predictive value for PE. This approach aligns with current guidelines that recommend prophylactic anticoagulation and monitoring for DVT in high-risk trauma patients. Interestingly, the study found that the majority of patients who developed PE did not have significant comorbidities. This finding contrasts with other studies that have identified comorbid conditions such as cardiovascular disease, diabetes, and chronic obstructive pulmonary

disease (COPD) as significant risk factors for PE [8].

The study found that femoral and tibial fractures were most commonly associated with PE, with incidence rates of 17% and 16.6% respectively. However, the differences in PE incidence across various fracture types were not statistically significant. This aligns with some studies that suggest the type of fracture is less important in determining PE risk compared to other factors such as the extent of immobilization and the presence of DVT. The Study conducted by Zhou et al [9] showed an 18.9% incidence of PTE in femoral fractures. However the incidence of PE in tibial fractures was significantly higher in our study compared to some of the other previous studies. In the study by Albeseth et al, there was an average incidence of about 3%. [4] The study showed a significant correlation between the timing of PE development post-trauma and the incidence of PE with maximum incidence following the 1st week of trauma. Literature suggests that the risk of PE is highest in the days immediately following trauma, particularly in the first week (Sing et al and O'Malley et al). [10,11] The study shows that there is a significant mortality rate in patients diagnosed with pulmonary thromboembolism with a mortality rate of 25% in those with imaging confirmed PE. This is in alignment with previous studies indicating increased mortality and morbidity in patients developing pulmonary embolism following lower limb fractures. [12] The study showed a highly statistically significant incidence of thromboembolism in first 3 days following surgery. This is in line with previously described studies as described by Mantilla et al [13] who demonstrated that the maximum cases of PE following surgery occurred in 1st 10 days, especially in the initial post operative 3 days. Bahloul et al [14] also demonstrated that 48.5% of pulmonary embolism occurred in 1st 3 postoperative days. This shows that the early post operative period should be evaluated with special care for the incidence of DVT with proactive screening by lower limb venous doppler and CT pulmonary angiography in patients with suspected pulmonary embolism.

CONCLUSION:

This study highlights incidence of pulmonary embolism in patients with lower limb fractures was found to be 16% with majority comprising femoral followed by tibial fractures. There was no correlation between incidence of pulmonary embolism and other factors like age, gender or comorbidities. By adding routine DVT screening, an additional 33% cases of PE were diagnosed. There was increased incidence of PE in the first week of trauma and the first 3 post operative days directing the need for proactive screening protocols for DVT and PE in the first week following trauma and surgery.

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