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Clinical characteristics, management, and outcome of acute pulmonary embolism in Al Zahraa teaching hospital

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Abstract
Background: Acute pulmonary embolism (PE) is a significant medical emergency that demands prompt and specialized intervention. This study evaluates the clinical trajectory and therapeutic approaches for managing PE at a secondary care facility.
Patients and Methods: This retrospective study included all patients diagnosed with acute pulmonary embolism at Al Zahraa Teaching Hospital in Al-Kut City, Iraq, from September 1, 2019, to March 1, 2022. Confirmation of diagnosis was through CT pulmonary angiography. We systematically recorded demographic, clinical, biochemical, and echocardiographic data, along with treatment modalities. Follow-up lasted six months.
Results: A total of 55 patients were enrolled, with a mean age of 46.58 ± 14.36 years; the majority were female. Shortness of breath emerged as the most common symptom, with immobility being the predominant predisposing factor. Most cases were classified as massive or submassive PE. Thrombolytic therapy was administered to 41.8% of the cohort, with all patients receiving anticoagulation therapy. The in-hospital mortality rates were 14.8% overall, 25.0% for massive PE, and 22.7% for submassive PE. Increased mortality was associated with cancer, hypotension, elevated serum troponin levels, and echocardiographic evidence of left and right ventricular dysfunction.
Conclusion: The predominance of massive and submassive PE cases highlights the critical need for aggressive treatment strategies, including the liberal use of thrombolytic therapy, which correlates with the higher mortality observed in these patient groups.

Keywords: Management, pulmonary embolism, Zahraa teaching hospital

Introduction
Pulmonary embolism (PE) represents a severe medical condition characterized by the obstruction of the pulmonary artery or its branches due to embolic materials such as thrombi, which commonly originate from deep vein thrombosis (DVT) within the body. Other emboli, including tumors, air, or fat, can also cause such obstructions. According to the guidelines by the Task Force on Pulmonary Embolism of the European Society of Cardiology, acute PE requires prompt and accurate diagnostic procedures followed by tailored therapeutic management to reduce the risk of mortality and complications (European Society of Cardiology, 2000). The clinical manifestation of PE can range from sudden, severe symptoms in acute cases to gradual onset of dyspnea in chronic conditions, significantly impacting the patient's quality of life and long-term health (Kearon, 2003) [10].
Acute PE is a complex emergency with potentially fatal outcomes if not correctly managed. The severity of acute PE can be classified into three types: massive, submassive, and minor, each associated with different levels of risk and clinical management strategies. Massive PE, which involves substantial hemodynamic instability and can lead to sudden death, is particularly challenging and requires immediate intervention (Coon & Willis, 1959) [6]. Submassive PE, while not immediately life-threatening, involves significant cardiovascular strain and can lead to deterioration if not adequately treated. Patients with minor PE typically present with more stable conditions but still require careful management to prevent further complications (Soloff & Rodman, 1967) [12].

This study aims to delve into the varying clinical outcomes of PE management at Al Zahraa Teaching Hospital in Al-Kut City, Iraq, evaluating how different therapeutic strategies influence recovery and survival rates among patients with distinct classifications of acute PE. By integrating comprehensive treatment guidelines with a deep understanding of the natural history of venous thromboembolism, this research seeks to enhance the overall approach to managing this complex condition, ultimately improving patient outcomes and reducing the burden of this disease on the healthcare system.

Patients and Methods

This study was a comprehensive retrospective cohort analysis, targeting all patients formally diagnosed with acute pulmonary embolism at Al Zahraa Teaching Hospital in Al-Kut City, Iraq, from September 1, 2019, through January 1, 2022. Diagnostic confirmation was rigorously obtained via CT pulmonary angiography, in line with the gold-standard practices for accurate detection of pulmonary embolisms. An extensive dataset was compiled for each participant, capturing a wide range of variables: demographic details (such as age and gender), clinical symptoms, critical biochemical indicators, and detailed echocardiographic assessments. The therapeutic interventions employed were thoroughly recorded, emphasizing the evaluation of treatment efficacy and alignment with the latest clinical guidelines. To ensure a robust analysis of treatment outcomes, each patient was monitored for a follow-up period of six months. This follow-up was designed to track survival rates, monitor for recurrence of embolic episodes, and evaluate any necessary adjustments in therapeutic approaches based on individual patient responses and overall health progression. This longitudinal tracking aimed to provide a nuanced understanding of patient outcomes and the effectiveness of treatment strategies in a real-world clinical setting.

Results

Table 1: Frequency of symptoms and signs in patients with pulmonary embolism

Symptoms and Signs	Number of Patients	Percentage (%)
Symptoms		
Shortness of breath	38	69.1
Palpitation	30	54.5
Chest pain	23	41.8
Syncope	8	14.5
Hemoptysis	6	10.9
Wheeze	3	5.5
Signs		
Tachypnea	28	50.9
Tachycardia	25	45.5
Fever	3	5.5
Arterial hypotension	12	21.8
O2 desaturation	26	47.3

Table 1 provides a detailed overview of the clinical manifestations of pulmonary embolism in 55 patients, illustrating that shortness of breath (69.1%) and tachypnea (50.9%) are the most frequent symptoms and signs, reflecting the primary respiratory impact of the condition. Notably, over half of the patients experienced palpitations and approximately half reported O2 desaturation, indicating significant cardiopulmonary involvement. Less common but critical symptoms like syncope (14.5%) and signs like arterial hypotension (21.8%) point to the potential severity of pulmonary embolism, underscoring the importance of prompt recognition and management in affected individuals. This diversity in clinical presentation highlights the variable impact of PE on patients, necessitating a vigilant and comprehensive approach to diagnosis and treatment.

Table 2: Frequency of predisposing factors for pulmonary embolism

Predisposing Factor	Number of Patients	Percentage (%)
Immobility	17	30.9
Previous DVT (Deep Venous Thrombosis)	11	20.0
OCP (Oral Contraceptive Pills)	7	12.7
Cancer	2	3.6
Unknown	17	30.9

The data from Table 2 identifies several key predisposing factors for pulmonary embolism among patients at Al Zahraa Teaching Hospital, with immobility and unknown causes each accounting for 30.9% of cases, emphasizing the significant impact of reduced mobility due to chronic conditions and highlighting areas for further research into unidentified risk factors. Previous deep venous thrombosis was present in 20% of the cases, underscoring its known linkage to pulmonary embolism, while 12.7% of the patients were taking oral contraceptive pills, pointing to the thrombotic risks associated with hormonal therapy. Additionally, a smaller proportion of patients (3.6%) had cancer, indicating the diverse nature of cancer-related thrombotic risks. Collectively, these findings stress the importance of comprehensive risk assessments and targeted prevention strategies in managing pulmonary embolism across varied patient demographics.

Table 3: Frequency of electrocardiographic changes in study group

Electrocardiographic Changes	Number of Patients	Percentage (%)
Sinus Tachycardia	25	45.5
T Wave Inversion in V1, V2, V3	17	30.9
Right Bundle Branch Block (RBBB)	10	18.1
S1 Q3 T3 Pattern	7	12.7
Atrial Fibrillation	2	3.6

The table you provided lists various electrocardiographic (ECG) changes observed in patients, along with the number of patients affected and the percentage of the total observed cases:

1. **Sinus Tachycardia (45.5%):** This is the most common electrocardiographic finding in the data provided, affecting nearly half of the patients (25 out of 55). Sinus tachycardia is a condition where the heart rate is elevated beyond the normal range but follows a normal heart rhythm. It's often a response to physiological stress, dehydration, fever, or could be due to conditions like pulmonary embolism.
2. **T Wave Inversion in Leads V1, V2, V3 (30.9%):** Found in 17 patients, this change involves the inversion of T waves specifically in the anterior leads of the ECG. This can indicate issues such as myocardial ischemia, particularly affecting the anterior part of the heart, or could be due to pulmonary embolism, especially if correlated with other symptoms and findings.

3. **Right Bundle Branch Block (RBBB) (18.1%):** Present in 10 patients, RBBB is a block in the electrical conduction pathway of the right bundle branch of the heart. This causes a delay in the electrical impulse to the right ventricle, which can be seen as a specific pattern on an ECG. It might be indicative of various cardiac issues, including chronic lung disease or heart damage.
4. **S1 Q3 T3 Pattern (12.7%):** This specific ECG pattern, seen in 7 patients, is often associated with acute right heart strain and is considered a classic sign of pulmonary embolism, although not very sensitive or specific. It's characterized by a deep S wave in lead I, a Q wave in lead III, and an inverted T wave in lead III.
5. **Atrial Fibrillation (3.6%):** Seen in the least number of patients (2), atrial fibrillation is an irregular and often rapid heart rate that can increase the risk of strokes, heart failure, and other heart-related complications. Its low occurrence in this cohort suggests it is not a primary concern but still significant given its implications.

Table 4: Echocardiographic features

Echocardiographic Finding	Number	Percentage
LV dysfunction (Depressed LV systolic function)	4	7.3%
Dilated RV	16	29.1%
TAPSE < 1.7	13	23.6%
mPASP > 25 mmHg (Elevated PASP)	21	38.2%

Abbreviations

- **LV:** Left Ventricular
- **RV:** Right Ventricular
- **TAPSE:** Tricuspid Annular Plane Systolic Excursion
- **mPASP:** Mean Pulmonary Artery Systolic Pressure

The table provides data on various echocardiographic findings in patients, indicating the presence of different types of heart dysfunctions

LV Dysfunction (Depressed LV Systolic Function) (7.3%): Affects 4 patients and involves decreased pumping capacity of the left ventricle, which is crucial for pumping oxygenated blood throughout the body. This lower percentage suggests it is less common in the studied group but indicates significant cardiac impairment where it does occur.

Dilated RV (Right Ventricular) (29.1%): Found in 16 patients, this condition involves the enlargement of the right ventricle, which can be a sign of right ventricular strain or failure, often due to conditions such as pulmonary hypertension or chronic lung diseases. The relatively high percentage indicates it's a common issue in the observed patient cohort**.**

TAPSE < 1.7 (Tricuspid Annular Plane Systolic Excursion): (23.6%) - Present in 13 patients, a low TAPSE value indicates reduced right ventricular systolic function. This metric is a significant indicator of right ventricular dysfunction and can be associated with poorer outcomes in patients with conditions like heart failure or pulmonary hypertension.

mPASP > 25 mmHg (Mean Pulmonary Artery Systolic Pressure) (38.2%): The most common finding, affecting 21 patients, indicates elevated pulmonary artery pressure. This is a key sign of pulmonary hypertension, which can be secondary to numerous conditions including lung diseases, left heart diseases, and chronic thromboembolic diseases.

Table 5: Classification of pulmonary embolism

Category	Total	Percentage of Total
Massive PE	12	21.8%
Submassive PE	22	40.0%
Mild-moderate PE	21	38.2%

The table presents the classification of pulmonary embolism (PE) among a cohort of patients, broken down into three categories: Massive PE, Submassive PE, and Mild-moderate PE. Here's an interpretation:

1. **Massive PE (21.8%):** Represents 12 patients out of the total group. Massive PE is the most severe form, often characterized by significant hemodynamic instability, such as systemic hypotension or cardiogenic shock. It requires immediate and aggressive treatment, including considerations for thrombolytic therapy due to its high mortality risk.
2. **Submassive PE (40.0%):** Includes 22 patients and makes up the largest category. Submassive PE refers to cases where there is right ventricular dysfunction or myocardial necrosis, but without systemic hypotension. These patients are at risk for becoming hemodynamically unstable and often require close monitoring and potentially more aggressive treatment than mild-moderate PE, but less than what is required for massive PE.
3. **Mild-moderate PE (38.2%):** Accounts for 21 patients. This category involves patients with PE who do not exhibit signs of right ventricular dysfunction or myocardial injury, and who maintain stable hemodynamics. Treatment typically includes anticoagulation and less aggressive interventions compared to the more severe categories.

Table 6: Distribution of treatment

Treatment	Number of Patients	Percentage (%)
Unfractionated Heparin (UH)	38	69.1
Low Molecular Weight Heparin (LMWH)	17	30.9
Warfarin	53	96.3
Dabigatran	2	3.6
Thrombolytic	23	41.8
Embolectomy	3	5.5

Abbreviations

- **UH:** Unfractionated Heparin
- **LMWH:** Low Molecular Weight Heparin

The table you provided outlines the distribution of various treatments used for patients with pulmonary embolism, indicating both the number of patients treated and the percentage of the total cohort:

1. **Unfractionated Heparin (UH) - 69.1%**
   - This treatment was administered to 38 patients, making it the most commonly used initial anticoagulant. Unfractionated heparin is often preferred in the acute setting due to its rapid onset, ease of reversing its

effects, and the ability to closely monitor its anticoagulant effect.

2. **Low Molecular Weight Heparin (LMWH) - 30.9%**
- Used in 17 patients, LMWH is also favored for its ease of use (subcutaneous administration) and predictable pharmacokinetics, which don't typically require monitoring. Its use here reflects a substantial portion but is less than UH, likely due to specific clinical scenarios or patient characteristics that make LMWH more suitable.

3. **Warfarin - 96.3%**
- Administered to 53 patients, warfarin is the mainstay treatment for long-term anticoagulation in pulmonary embolism management. The high percentage indicates that almost all patients transitioned to warfarin after initial stabilization with heparin.

4. **Dabigatran - 3.6%**
- Only 2 patients received dabigatran, a direct oral anticoagulant (DOAC), suggesting it might be used in specific cases where warfarin is contraindicated or in patients preferring a DOAC for reasons such as convenience or side effect profiles.

5. **Thrombolytic Therapy - 41.8%**
- Applied to 23 patients, this treatment is significant for those with massive or submassive PE, where rapid clot resolution can be life-saving. Its use in a substantial fraction indicates a significant number of patients presented with severe embolism.

6. **Embolectomy - 5.5%**
- Surgical removal of the embolus was performed in 3 patients, indicating a very selective approach used only in critically ill patients where other thrombolytic strategies are unsuitable or have failed.

Table 7: Factors associated with 30-day mortality

Factor	Total (% of total)	Alive (% within the group)	Dead (% within the group)	P value
Class of PE: Mild-moderate	21 (38.2%)	21 (100%)	0 (0.00%)	0.016
Class of PE: Submassive	22 (40.0%)	17 (77.3%)	5 (22.7%)	0.160
Class of PE: Massive	12 (21.8%)	9 (75.0%)	3 (25.0%)	0.260
Cancer	2 (3.6%)	0 (0.00%)	2 (100%)	0.002
Hypotension	12 (21.8%)	7 (58.3%)	5 (41.7%)	0.003
Fever	3 (5.5%)	3 (100%)	0 (0.00%)	0.404
Tachycardia	25 (45.5%)	21 (84.3%)	4 (16.0%)	0.552
O2 Desaturation	26 (47.4%)	21 (80.8%)	5 (19.2%)	0.351
+ve S.troponin	9 (16.4%)	5 (55.6%)	4 (44.4%)	0.005
D dimer	29 (52.7%)	26 (89.7%)	3 (10.3%)	0.161
S. Creatinine	5 (9.1%)	3 (60.0%)	2 (40.0%)	0.090
LV Dysfunction	4 (7.3%)	2 (50.0%)	2 (50.0%)	0.037
Dilated RV	16 (29.1%)	10 (62.5%)	6 (37.5%)	0.002
TAPSE < 1.6	13 (23.6%)	7 (53.8%)	6 (46.2%)	0.000
mPASP > 25 mmHg	21 (38.2%)	13 (61.9%)	8 (38.1%)	0.000
Thrombolytic Treatment	23 (43.6%)	23 (100%)	0 (0.00%)	0.009
Embolectomy Treatment	3 (5.5%)	3 (100%)	0 (0.00%)	0.462

The table on factors associated with 30-day mortality in patients with pulmonary embolism provides valuable insights into how different clinical, biochemical, and echocardiographic parameters influence survival outcomes. Here's a breakdown of the key findings:

1. **Class of Pulmonary Embolism (PE)**
- **Mild-moderate PE:** All patients (100%) survived, indicating that mild to moderate cases generally have favorable outcomes.
- **Submassive PE:** 77.3% survived, while 22.7% succumbed, reflecting a more severe condition with a substantial risk but still a predominant survival rate.
- **Massive PE:** Had a lower survival rate of 75%, with 25% mortality, underscoring the high risk associated with this category.

2. **Clinical Parameters**
- **Cancer:** Both patients with cancer (100%) died, demonstrating that comorbid conditions like cancer significantly worsen prognosis.
- **Hypotension:** More than 40% of patients with hypotension died, highlighting its significance as an indicator of poor outcome.
- **Fever and Tachycardia:** Patients with these symptoms had better survival rates, suggesting that these might be less predictive of mortality compared to other factors.

3. **Biochemical Parameters**
- **Positive S.troponin** and **Serum Creatinine:** Showed significant associations with higher mortality rates, indicating cardiac injury and renal impairment as critical factors in patient outcomes.
- **D-dimer:** High survival rate in patients, aligning with its role in diagnosing PE but not necessarily predicting mortality.

4. **Echocardiographic Parameters**
- **LV Dysfunction and Dilated RV:** Both showed a significant correlation with mortality, reflecting the impact of cardiac stress and dysfunction on survival.
- **TAPSE and mPASP:** Lower TAPSE and higher mPASP values were strongly associated with mortality, indicating severe right ventricular dysfunction and pulmonary hypertension as poor prognostic factors.

5. **Treatment**
- **Thrombolytic Therapy and Embolectomy:** 100% survival rate in those receiving these interventions, suggesting effective management strategies in severe cases can lead to favorable outcomes.

Discussion

This prospective study was conducted on patients presenting to our hospital with acute pulmonary embolism. The mean age for all patients was 46.58±14.36, which is comparable to that mentioned by Anderson and Spencer (2003) [2], slightly younger than reported by Enayat Safavi *et al*. (51.3 years)

from Iran, and older compared to findings by Agarwal *et al*. from India (39±12.1 years). The present study noted a predominance of female patients (54.5%), similar to findings by Enayat Safavi *et al*. (63% females) and slightly higher than the incidence reported by Naess *et al*., who noted a higher incidence of venous thrombosis in females than in males. This contrasts with findings from Agarwal *et al*., who reported a male predominance. Dyspnea was the most common symptom, aligning with observations by Stein *et al*. (1991) [12] and Arcelus *et al*. (2003) [3], and significantly reported by Agarwal *et al*. (91.7%). The most common signs were tachypnea followed by tachycardia, similar to descriptions by Kabrhel *et al*. and Stein *et al*. Arterial hypotension was present in 21.8% of cases, a much higher incidence than the 8% reported by Stein *et al*. The predominant risk factor in our patients was immobility, comparable to Arcelus *et al*. (31%), with previous DVT slightly higher than reported by the same study. The incidence of cancer was much lower, and hormonal therapy usage was higher compared to Arcelus *et al*. A significant proportion (30.9%) had an unknown etiology, highlighting the need for further investigation into potential thrombophilia. ECG changes primarily included sinus tachycardia (45.5%), consistent with findings by Geibel *et al*. (1997) [7] that the ECG commonly reveals sinus tachycardia or normal readings in PE. Right ventricular (RV) dysfunction indicators like dilated RV and TAPSE < 1.7 were found in significant numbers, aligning with findings by Goldhaber (2002) [8] and Casazza *et al*. (2005) [4]. Our study highlighted a higher incidence of massive and submassive PE, which may reflect the acute severity of cases presenting to specialized centers. Treatment predominantly involved unfractionated heparin over LMWH, contrasting with Arcelus *et al*. who reported higher LMWH use. The use of thrombolytic therapy was significantly higher in our study compared to the low rates reported by Arcelus *et al*. (0.8%) but aligned with Wolfgang *et al*. (1997) [14] who reported a 48% rate. The in-hospital mortality rate was 14.8%, with most deaths occurring in the subset of massive and submassive PE. This is consistent with mortality rates reported by Wolfgang *et al*. (1997) [14], indicating a direct relation to the thromboembolic event in most cases. Cancer was the only etiology significantly associated with increased mortality, highlighting its importance as noted in the Pulmonary Embolism Severity Index (Chan, Woods, & Shorr, 2010) [5]. Acute RV dysfunction was a critical determinant of outcomes, consistent with the Pulmonary Embolism Severity Index and clinical trials (Chan *et al*., 2010) [5]. Other biochemical markers like D-dimer and elevated serum creatinine did not show a statistically significant association with mortality, suggesting the need for further studies to explore these relationships.

Conclusion

Our investigation into acute pulmonary embolism (PE) at our hospital reveals critical insights into the epidemiology, clinical presentation, and treatment outcomes of this serious condition. The study identified a mean patient age of 46.58 years, with a notable female predominance, reflecting broader epidemiological trends reported in the literature (Anderson & Spencer, 2003; Naess *et al*., 2007) [2, 11]. Consistent with global findings, dyspnea was the most prevalent symptom, indicating its utility as a key diagnostic indicator (Stein *et al*., 1991) [13]. The data revealed a high occurrence of severe forms, with massive and submassive PE representing a significant proportion of cases. This finding underscores the acute severity of PE presentations at specialized centers and may explain the higher usage of aggressive treatments, such as thrombolytic therapy, which aligned with higher rates observed in comparable studies (Wolfgang *et al*., 1997) [14]. Notably, thrombolytic therapy was associated with a substantial reduction in mortality, emphasizing its effectiveness in managing severe PE cases. Despite the advanced treatments available, the in-hospital mortality rate was 14.8%, with the majority of deaths occurring among patients with massive or submassive PE. This mortality rate reflects the critical nature of PE and is consistent with outcomes reported in other significant studies (Wolfgang *et al*., 1997) [14]. In conclusion, this study underscores the need for heightened clinical vigilance and prompt, aggressive treatment for patients presenting with severe PE. Future research should focus on optimizing diagnostic strategies and treatment protocols to further improve outcomes for this potentially fatal condition.

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