AMERICAN JOURNAL OF DIAGNOSTIC IMAGING
2026; 12(2): 77-86
10.5455/ajdi.20260131084128

WisdomGale

ORIGINAL ARTICLE

Open Access

Computed tomography pulmonary angiography features as predictors of short-term outcomes among patients with pulmonary embolism at a Zonal Referral Hospital in Northeastern Tanzania from Jan 2022-Dec 2024

Robhi Marwa Mokeha[1], Felister Gerald Uisso[1], Nyasatu Godfrey Chamba[2], Adnan Mehboob Sadiq[1]

[1]Department of Radiology and Medical Imaging, School of Medicine, KCMC University, Moshi, Tanzania

[2]Department of Internal Medicine, School of Medicine, KCMC University, Moshi, Tanzania

ABSTRACT

Background: Pulmonary embolism (PE) is a major cause of cardiovascular morbidity and mortality. Computed tomography pulmonary angiography (CTPA) is the diagnostic standard and provides imaging markers of right ventricular (RV) dysfunction and clot burden that may aid prognostication. However, evidence on the prognostic value of CTPA-derived parameters in sub-Saharan African populations remains limited.

Methods: In this retrospective cohort study, patients with CTPA-confirmed PE at Kilimanjaro Christian Medical Centre between January 2022 and December 2024 were included. Demographic, clinical, and imaging variables—including RV-to-left ventricular (LV) ratio, septal deviation, inferior vena cava (IVC)/hepatic contrast reflux, pulmonary artery diameter, pleural effusion, and Qanadil obstruction index—were collected. The simplified Pulmonary Embolism Severity Index (sPESI) was used for clinical risk stratification. Associations with 30-day mortality and intensive care unit (ICU) admission were analyzed using multivariable regression models.

Results: Fifty patients were analyzed (mean age 58.8 ± 20.2 years, 78% female). Thirty-day mortality was 26%, and 62% required ICU admission. RV/LV ratio ≥1 (72%) and septal deviation (64%) were frequent indicators of RV strain. IVC/hepatic contrast reflux was significantly associated with high-risk sPESI classification and independently predicted ICU admission (adjusted prevalence ratio 2.59, 95% CI: 1.33–5.02). No CTPA-derived parameter independently predicted 30-day mortality after adjustment.

Conclusion: CTPA markers of RV dysfunction correlate with disease severity and ICU requirement but did not independently predict short-term mortality. These findings highlight the complementary role of imaging alongside clinical risk scores in PE risk stratification in resource-limited settings.

ARTICLE HISTORY

Received February 06, 2026
Revised March 13, 2026
Accepted April 12, 2026
Published June 07, 2026

KEYWORDS

CTPA; PE; short-term outcomes; sPESI; Tanzania

Introduction

Pulmonary embolism (PE), a thromboembolism obstructing pulmonary arteries, ranks as the third leading acute cardiovascular syndrome globally after myocardial infarction and stroke, with high mortality (40%–61.5%) in African settings, including Tanzania [1–5].

The exact incidence of PE in the general population is estimated at 0.5–2 cases per 1,000 person-years in high-income settings [6]. In East Africa, a study from Kenya reported an incidence of approximately 0.032% [2].

Computed tomography pulmonary angiography (CTPA) provides excellent diagnostic accuracy and can also offer prognostic information through imaging markers such as the right-to- left ventricular (RV/LV) ratio, pulmonary artery obstruction index, and contrast reflux, which may complement clinical risk stratification tools such as the Wells score,

Contact Robhi Marwa Mokeha robhi88@gmail.com Department of Radiology and Medical Imaging, School of Medicine, KCMC University, Moshi, Tanzania.

© The Author(s) 2026. Open Access. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY). http://creativecommons.org/licenses/by/4.0/.

Geneva score, and Pulmonary Embolism Severity Index (PESI) [7–9].

Specifically, the Wells and Geneva scores assess pretest probability of pulmonary embolism, while the PESI is used for prognostic stratification, particularly 30-day mortality. While these tools rely primarily on clinical variables, imaging markers from CTPA may provide additional prognostic information by directly assessing thrombus burden and RV dysfunction [10]. Management of PE requires integration of radiological findings with clinical parameters [11,12].

Most evidence regarding the prognostic value of CTPA-derived imaging parameters in PE originates from high-income countries. Consequently, limited data exist from resource-limited settings, particularly in East Africa, where differences in patient characteristics, healthcare infrastructure, and treatment availability may influence outcomes. Therefore, evaluating the prognostic significance of CTPA findings in this setting is important to inform locally relevant clinical decision-making [8,13,14].

This evidence gap, together with the rising utilization of CTPA (from 138 examinations in 2023 to 292 in 2024) at Kilimanjaro Christian Medical Centre (KCMC), highlights the need for region-specific data to inform prognostication and clinical decision-making in East Africa, particularly regarding the application of CTPA-derived parameters.

Material and Methods

Patients

This retrospective cohort study at KCMC Hospital (Jan 2022–Dec 2024) included all patients diagnosed with PE by CTPA, with data extracted on demographics, clinical presentation, imaging features (RV/LV ratio, septal deviation, inferior vena cava (IVC)/hepatic reflux, obstruction index), management, and 30-day outcomes [mortality, intensive care unit (ICU) admission]; patients <18 years, with missing data, suboptimal imaging, or inadequate follow-up were excluded. All eligible patients who met the inclusion criteria during the study period were included. No formal sample size calculation was performed due to the relatively low incidence of confirmed PE cases and the retrospective nature of the study, yielding 50 cases from 61 confirmed PE diagnoses among 338 suspected. Several imaging parameters were categorized using clinically relevant thresholds (e.g., RV/LV ratio ≥1) to facilitate interpretation and comparison with prior literature.

ICU admission protocol

ICU admission decisions were based on the clinical judgment of the treating physicians and institutional protocols, considering hemodynamic instability, respiratory failure, or need for advanced monitoring and supportive care. However, ICU availability and local resource constraints may also have influenced admission decisions. Clinical decision-making incorporated both simplified Pulmonary Embolism Severity Index (sPESI) and CTPA findings; however, patient clinical status remained the primary determinant for ICU admission, given the limited independent prognostic value of imaging parameters.

Data collection

Patient identifiers were retrieved from the radiology registry and linked to the Electronic Health Management System, from which demographic and clinical variables, including age, sex, presenting symptoms, comorbidities, treatment modality, and 30-day outcomes (mortality and ICU admission), were extracted. The sPESI was calculated for each patient to assess the clinical risk of short-term mortality. The score is based on six clinical variables: age greater than 80 years, history of cancer, history of chronic cardiopulmonary disease, heart rate ≥110 beats per minute, systolic blood pressure <100 mmHg, and oxygen saturation <90%. Each variable is assigned one point when present, resulting in a total score ranging from 0 to 6. Patients with a score of 0 were classified as low risk, whereas those with a score ≥1 were categorized as high risk for 30-day mortality [15].

CTPA images acquisition and image interpretation

CTPA images were acquired using a 128-slice multidetector scanner with a standard protocol (40 mm detector, 0.625 mm slices, 0.4 seconds rotation, 120 kVp/380 mAs), 60–100 ml of contrast administered at 5 ml/s (weight-adjusted), and a 10–20 seconds delay; no Electrocardiogram gating was applied. Images were independently reviewed by the principal investigator and a senior radiologist, assessing Qanadil obstruction index (mild ≤40%, severe ≥41%) [16], RV/LV ratio (≥1.0), main pulmonary artery diameter (>30 mm), septal deviation, IVC/hepatic reflux, pleural effusion, and pulmonary infarction [1,17].

Interobserver agreement

CTPA images were independently reviewed by the principal investigator and a senior radiologist. In cases of disagreement, a consensus interpretation

was reached through joint review. Formal interobserver agreement statistics were not calculated, which represents a limitation of the study.

Statistical analysis

Data were analysed using STATA version 17. Categorical variables were summarized using frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. Associations between CTPA features and sPESI risk groups were assessed using Chi-square or Fisher's exact tests, as appropriate. Predictors of 30-day mortality were evaluated using classical logistic regression. Predictors of ICU admission were analysed using modified Poisson regression with robust standard errors to directly estimate adjusted prevalence ratios (APRs). Variables with clinical relevance or $p < 0.20$ in univariable analysis were entered into multivariable models. Statistical significance was defined as $p < 0.05$.

Results

Baseline demographic and clinical characteristics

A total of 50 patients with CTPA-confirmed PE were included in the analysis. The mean age was 58.8 ± 20.2 years, with a predominance of female patients (n = 39, 78%). Most participants were aged ≥65 years. The most common presenting symptom was dyspnoea (68%), followed by chest pain (20%), cough (8%), and haemoptysis (4%). Hypertension was the most prevalent comorbidity (36%), followed by diabetes mellitus (20%), malignancy (6%), and chronic obstructive pulmonary disease (4%). Regarding treatment, 86% of patients received anticoagulation alone, while 14% received thrombolytic therapy with or without anticoagulation. Baseline demographic and clinical characteristics are summarized in Table 1.

Table 1. Demographic and clinical characteristics of patients with PE attended KCMC hospital (N = 50).

Variable	Frequency	Percentage
Age		
22–34	8	16
35–64	19	38
>=65	23	46
Mean(sd)	58.8	20.2
Sex		
Female	39	78
Male	11	22
Clinical presentation		
Chest pain	10	20
Cough	4	8
Dyspnea	34	68
Hemoptysis	2	4
Treatment received		
Anticoagulants	43	86
Thrombolytics	7	14
Comorbidities		
Diabetes	10	20
Hypertension	18	36
COPD*	2	4
Cancer	3	6

*Key: COPD, Chronic Obstructive Pulmonary Disease.

Table 2. CTPA features among patients with PE attended at KCMC hospital (N = 50).

Variable	Frequency	Percentage
Main pulmonary trunk size		
>30 mm	19	38
<=30 mm	**31**	**62**
RV/LV ratio		
<1	14	28
>=1	**36**	**72**
Obstructive index		
Mild	21	42
Severe	**29**	**58**
Septal deviation	32	64
IVC/hepatic contrast reflux	24	48
Pleural effusion	20	40
Pulmonary infarction	13	26

Bold values indicate most frequently observed CTPA features in our study

CTPA imaging characteristics

Key CTPA findings are summarized in Table 2.

An RV/LV ratio ≥1 was observed in 72% of patients, while septal deviation was present in 64%. Inferior vena cava (IVC)/hepatic contrast reflux was identified in 48% of participants. Main pulmonary artery diameter >30 mm was noted in 38% of cases. Pleural effusion and pulmonary infarction were detected in 40% and 26% of patients, respectively.

Association between CTPA features and sPESI risk stratification

A significant association was observed between IVC/hepatic contrast reflux and high-risk sPESI classification. Among patients with reflux, 83.3% were categorized as high risk compared to 57.7% without reflux. Pleural effusion demonstrated a clinically relevant trend toward association with

Table 3. CTPA features comparing high and low risk sPESI (clinical prognostic scoring system) among study participants (*N* = 50).

	sPESI		*p*-value
Variable	**High risk**	**Low risk**	
Main pulmonary trunk size			0.849
>30 mm	13 (68.4)	6 (31.6)	
<=30 mm	22 (71.0)	9 (29.0)	
RV diameter (mm)	45.3 (9.2)	45.5 (9.9)	0.939
RV/LV ratio			0.582
<1	9 (64.3)	5 (35.7)	
>=1	26 (72.2)	10 (27.8)	
Septal deviation			0.700
Yes	23 (71.9)	9 (28.1)	
No	12 (66.7)	6 (33.3)	
IVC/hepatic contrast reflux			**0.048***
Yes	20 (83.3)	4 (16.7)	
No	15 (57.7)	11 (42.3)	
Pleural effusion			**0.055***
Yes	17 (85.0)	3 (15.0)	
No	18 (60.0)	12 (40.0)	
Pulmonary infarction			0.527
Yes	10 (76.9)	3 (23.1)	
No	25 (67.6)	12 (32.4)	
Obstructive index			0.662
Mild	14 (66.7)	7 (33.3)	
Severe	21 (72.4)	8 (27.6)	

Key; * *p* value <0.05.

high-risk classification, with 85% of affected patients classified as high risk compared to 60% without effusion. Detailed comparisons are presented in Table 3.

Predictors of 30-day mortality

Thirteen patients (26%) died within 30 days of diagnosis. In univariable analysis, IVC/hepatic contrast reflux was associated with increased mortality risk (APR: 3.61; 95% CI: 1.11–11.71). However, this association did not remain statistically significant after multivariable adjustment.

In the adjusted model, male sex was associated with increased odds of 30-day mortality (APR: 3.94; 95% CI: 1.50–10.38; $p = 0.005$). Hypertension demonstrated a borderline association with mortality (APR: 3.01; 95% CI: 0.95–9.57; $p = 0.062$).

No CTPA-derived imaging parameter remained independently associated with mortality after adjustment. Results are presented in Table 4.

Predictors of ICU admission

Thirty-one patients (62%) required ICU admission during hospitalization. In univariable analysis, IVC/hepatic contrast reflux was significantly associated with ICU admission (CPR: 2.28; 95% CI: 1.36–3.81; $p = 0.002$). An RV/LV ratio ≥1 showed a borderline association (CPR: 2.02; 95% CI: 0.96–4.23; $p = 0.062$). After multivariable adjustment, IVC/hepatic contrast reflux remained independently associated with ICU admission (APR: 2.59; 95% CI: 1.33–5.02; $p = 0.005$). No other imaging variable demonstrated an independent association. Adjusted results are shown in Table 5.

Discussion

This study evaluated the prognostic significance of CTPA-derived imaging parameters in patients with acute PE at a tertiary referral center in Tanzania. First, several CTPA features of RV strain, including increased RV/LV ratio, septal deviation, and IVC/hepatic contrast reflux, were frequently observed among patients with confirmed PE. Second, (IVC)/hepatic contrast reflux was independently associated with ICU admission, while no CTPA parameter independently predicted short-term mortality after multivariable adjustment. These findings suggest that CTPA markers may reflect disease severity and the need for escalation of care, but may not independently predict mortality when clinical variables are considered.

To the best of our knowledge, this is among the few studies evaluating CTPA prognostic parameters in PE within an East African tertiary care setting.

CTPA characteristics in PE patients at KCMC

In this study, most patients demonstrated CTPA features of right heart strain and increased PE severity, including an RV/LV ratio ≥1, septal deviation, and frequent IVC/hepatic contrast reflux. Pleural effusion and pulmonary infarction were also observed, with some patients showing an enlarged main pulmonary artery diameter. These findings are consistent with previous studies reporting similar radiologic indicators of PE severity and RV strain [1,9,18,19].

Table 4. Predictors of mortality among patients with PE who attended KCMC hospital (*N* = 50).

Variable	CPR (CI)	*p*-value	APR (CI)	*p*-value
Age	1.02 (0.99,1.04)	0.160	1.00 (0.97,1.03)	0.921
Sex				
Female	1	1	1	1
Male	1.58 (0.59,4.19)	0.363	3.94 (1.50,10.38)	**0.005***
Diabetes				
No	1			
Yes	0.73 (0.19,2.81)	0.644	0.29 (0.06,1.30)	0.105
Hypertension				
No	1			
Yes	2.07 (0.81,528)	0.126	3.01 (0.95,9.57)	**0.062**
Main pulmonary trunk size				
<=30 mm	1	1	1	1
>30 mm	1.39 (0.54,3.57)	0.484	1.15 (0.38,3.47)	0.801
RV/LV ratio				
<1	1	1	1	1
>=1	4.67 (0.65,33.27)	0.124	1.86 (0.16,21.09)	0.915
Septal deviation				
No	1	1	1	1
Yes	3.09 (0.76,12.62)	0.115	0.71 (0.10,5.14)	0.738
IVC/hepatic contrast reflux				
No	1	1	1	1
Yes	3.61 (1.11,11.71)	0.032	3.16 (0.53,18.89)	0.208
Pleural effusion				
No	1	1	1	1
Yes	1.75 (0.68,4.49)	0.244	1.68 (0.68,3.94)	0.270
Pulmonary infarction				
No	1	1	1	1
Yes	0.85 (0.27,2.66)	0.785	1.22 (0.28,5.34)	0.769
Obstructive index	1.49 (0.87,2.56)	0.150	1.22 (0.59,2.54)	0.579

Key * *p* value <0.05, APR; Adjusted prevalence ration CPR; Crude prevalence ratio.

Using the Qanadil obstruction index, more than half of the participants had severe obstruction scores, suggesting a high clot burden. Higher obstruction scores were associated with increased RV/LV ratio and IVC/hepatic reflux, supporting the established pathophysiological relationship between clot burden, elevated pulmonary vascular resistance, and RV strain [20].

CTPA features and short-term outcome

The overall 30-day mortality rate was relatively high (26%), which may reflect delayed presentation, referral bias toward more severe cases, and limited access to advanced therapeutic interventions in resource-constrained settings [2,9,13,14,21]. Additionally, some patients may have had significant underlying comorbidities contributing to poorer outcomes.

Prior studies have reported heterogeneous findings regarding the prognostic value of CTPA-derived parameters in acute PE. Some studies have demonstrated independent associations between markers of RV straining and an increased RV/LV ratio or IVC contrast reflux, and short-term mortality, while others have shown that these associations diminish after adjustment for clinical variables, as shown in Table 6.

Our findings align with the latter observations, as none of the evaluated CTPA features independently predicted short-term mortality. Although IVC/hepatic contrast reflux was observed more frequently among patients who died, this association

Table 5. Predictors of ICU admission among patients with PE attended KCMC hospital (*N* = 50).

Variable	CPR (CI)	*p*-value	APR (CI)	*p*-value
Age	1.00 (0.99,1.01)	0.937	1.00 (0.99,1.02)	0.740
Sex				
Female	1	1	1	1
Male	0.68 (0.34,1.36)	0.278	0.93 (0.50,1.74)	0.824
Diabetes				
No	1			
Yes	0.59 (0.27,1.31)	0.198	0.58 (0.31,1.10)	0.094
Hypertension				
No				
Yes	0.85 (0.52,1.38)	0.504	0.75 (0.50,1.13)	0.168
Main pulmonary trunk size				
<=30 mm	1	1	1	1
>30 mm	1.03 (0.66,1.61)	0.895	1.41 (0.54,2.41)	0.729
RV/LV ratio				
<1	1	1	1	1
>=1	2.02 (0.96,4.23)	0.062	1.71 (0.71,4.09)	0.229
Septal deviation				
No	1	1	1	1
Yes	1.37 (0.82,2.32)	0.233	0.65 (0.31,1.37)	0.255
IVC/Hepatic contrast reflux				
No	1	1	1	1
Yes	2.28 (1.36,3.81)	0.002*	2.59 (1.33,5.02)	**0.005***
Pleural effusion				
No	1	1	1	1
Yes	0.95 (0.60,1.49)	0.816	0.86 (0.55,1.33)	0.499
Pulmonary infarction				
No	1	1	1	1
Yes	1.16 (0.74,1.83)	0.511	0.88 (0.52,1.47)	0.618
Obstructive index	1.22 (0.98,1.52)	0.080	0.98 (0.79,1.20)	0.819

Key; * *p* value <0.05 APR; Adjusted prevalence ration CPR; Crude prevalence.

did not remain statistically significant after adjustment, consistent with [9,22]. This suggests that while imaging markers may reflect hemodynamic compromise, mortality in PE is multifactorial and influenced by clinical factors such as comorbidities, physiological reserve, and systemic complications [23–25].

In contrast to mortality outcomes, IVC/hepatic contrast reflux remained independently associated with ICU admission in our cohort. This finding likely reflects underlying RV dysfunction and elevated right atrial pressure resulting from acute pulmonary vascular obstruction. Similar associations have been reported in prior studies, demonstrating that imaging indicators of RV strain correlate with clinical deterioration and the need for intensive monitoring (Table 6).

These findings highlight the potential clinical value of CTPA markers in identifying patients who may require higher levels of care. In resource-limited settings, early identification of patients at risk for deterioration may assist clinicians in prioritizing monitoring and allocating critical care resources.

CTPA findings and clinical severity

Risk stratification in acute PE is commonly guided by validated clinical tools such as the sPESI. In our study, IVC/hepatic reflux was significantly associated with high-risk sPESI classification, suggesting

Table 6. CTPA imaging parameters and their associations with clinical severity and short-term outcomes in PE.

Study (Ref)	CTPA parameters	Key findings (Mortality/ICU, sPESI)	Relevance to present study
Germany [7]	RV/LV ratio, obstruction index	RV/LV≥1 OR 2.5 (1.8–3.5) for mortality	Supports univariable RV strain associations seen here.
USA, Italy, Egypt [12,25,26]	RV/LV, IVC reflux, PA diameter, obstructive index	IVC reflux, RV/LV, obstructive index independently predicted 30-day death (HR 3.2)	Contrasts with our null multivariable mortality findings
USA, Egypt [9,12,25]	RV/LV, IVC reflux, Obstructive index	IVC reflux predicted ICU (OR 3.2); mortality trend	Matches our IVC reflux ICU association (APR 2.59)
Thailand [11]	RV strain, obstruction	CTPA + clinical improved AUC 0.79→0.85	Aligns with our multimodal recommendation
Germany [18]	RV/LV, septal bow, reflux	Obstruction index univariable only (lost significance)	Mirrors our adjustment effects on imaging predictors
Ireland [19]	IVC reflux, RV/LV, RV strain	Reflux OR 2.8 for 28-day mortality	Most RV strain markers not predictive except obstructive index
USA [20]	CT versus echo RV strain	CT RV/LV correlated with echo (r = 0.68)	Validates our CT-based RV strain assessment, associations lost after adjustment for clinical variables
Germany [24,27]	RV/LV, central clot	No independent CTPA mortality predictors	Clinical variables outperformed CTPA features in mortality prediction
Present Study Tanzania	IVC/hepatic reflux; RV/LV ratio; obstruction index; pleural effusion	No CTPA mortality predictors; IVC ICU APR 2.59 (1.33–5.02)	CTPA markers reflected severity but did not independently determine mortality
Present study	IVC/hepatic reflux	Significant association with high-risk sPESI status	Supports role as complementary risk stratification feature
USA [28]	IVC/hepatic contrast reflux	Yes	Reflux reflects elevated right atrial pressures and RV strain
Iran, Ireland [1,19]	IVC reflux	Yes	Marker of right heart dysfunction and poor prognosis
Present study	Pleural effusion	Trend toward association (clinically significant)	Suggests potential severity marker but requires further validation
Germany, China [18,29,30]	Pleural effusion	Uncertain/variable	Studies report mixed prognostic significance
Turkey, Spain [31,32]	Pleural effusion	Yes	Positive association with severity (cohort-specific differences)

concordance between imaging evidence of RV strain and established clinical severity assessment, as shown in Table 6.

These findings support the concept that CTPA parameters provide complementary structural and hemodynamic information that may enhance risk stratification when interpreted alongside validated clinical scoring systems.

Furthermore, pleural effusion showed a trend toward association with the clinical severity scoring system, suggesting it may represent a clinically meaningful marker of disease severity.

These findings suggest that CTPA-derived markers provide complementary structural and hemodynamic insights, which may enhance risk stratification when integrated with established clinical evaluation.

Possible explanations for lack of independent mortality prediction

Several factors may explain the absence of independent imaging predictors of mortality in this study. First, the relatively small sample size and limited number of mortality events may have reduced statistical power and limited the ability to detect independent associations. Second, mortality in PE is multifactorial and influenced by clinical variables beyond imaging findings alone. Finally, differences in patient characteristics, treatment strategies, and health-care resources across settings may also contribute to variations in prognostic performance of imaging markers.

Strengths and limitations

This study provides important data from an underrepresented East African population, where

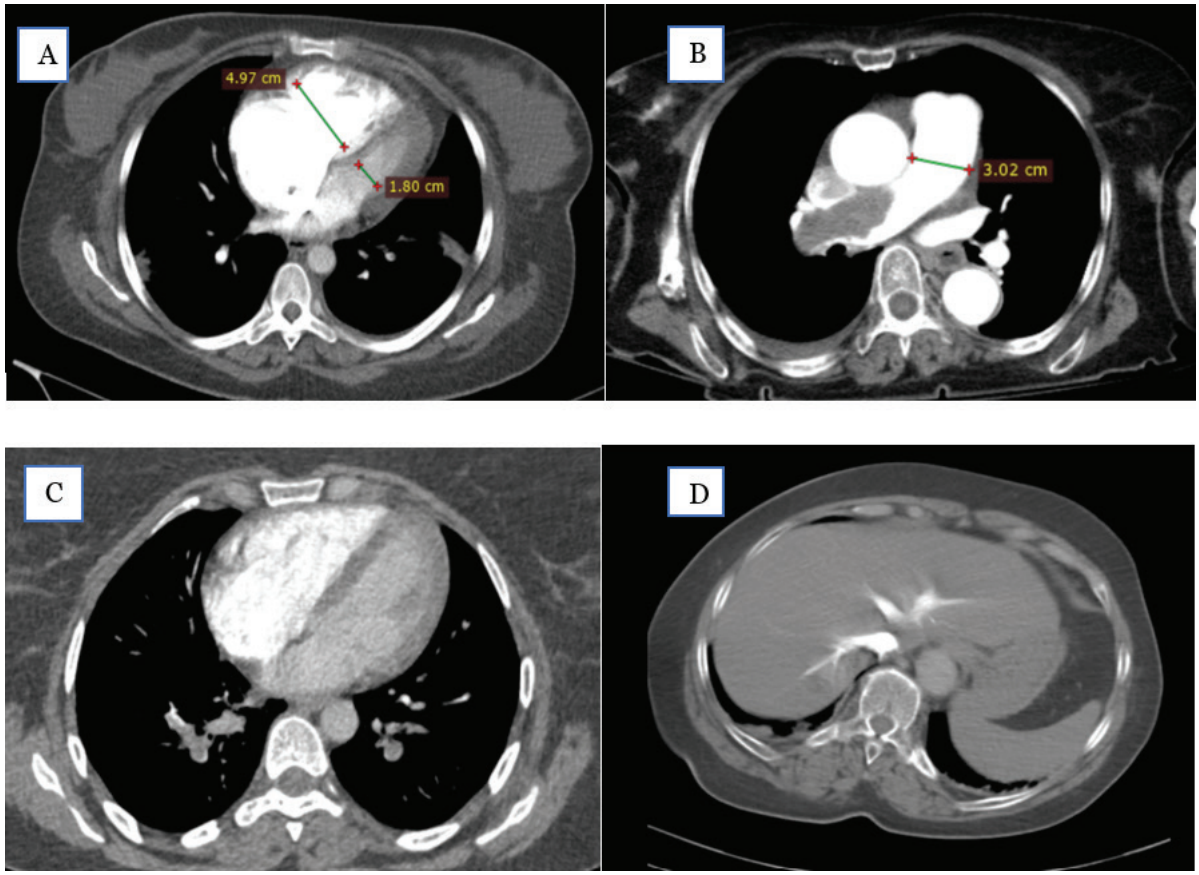


Figure 1. Axial CTPA images demonstrating: (A) Measurement of RV and LV diameters, with calculation of the RV/LV ratio, and associated septal deviation convex toward the left ventricle; (B) An occlusive thrombus in the right main pulmonary artery, with associated pulmonary trunk dilatation and mild right pleural effusion; (C) A flattened interventricular septum; and (D) Reflux of contrast medium into the IVC and hepatic veins, consistent with positive contrast reflux.

evidence regarding imaging-based prognostication in PE remains limited. The inclusion of consecutive CTPA-confirmed cases reflects real-world clinical practice in a tertiary referral setting.

However, several limitations should be considered. The retrospective single-center design limits generalizability. The relatively small sample size (n = 50) and limited number of mortality events may have reduced statistical power and resulted in wide confidence intervals in regression analyses. Additionally, formal interobserver agreement statistics were not calculated, which may affect the reproducibility of imaging measurements. As with any retrospective study, the possibility of selection bias and unmeasured confounding cannot be excluded.

Future multicenter prospective studies with larger cohorts are needed to further clarify the independent prognostic role of CTPA parameters in PE.

Conclusion

This study evaluated the prognostic significance of CTPA findings in patients with PE at a tertiary referral center in Tanzania. While several imaging features reflected disease severity, none independently predicted 30-day mortality after multivariable adjustment. However, IVC/hepatic contrast reflux was significantly associated with ICU admission, suggesting its potential role as an indicator of hemodynamic compromise and need for intensive monitoring.

These findings suggest that CTPA-derived markers may provide complementary information regarding disease severity and escalation of care but should be interpreted alongside established clinical risk stratification tools such as the sPESI. Larger multicenter prospective studies are needed to further clarify the prognostic value of CTPA imaging parameters in patients with PE in resource-limited settings.

This study contributes to the limited body of evidence from East Africa regarding the prognostic value of CTPA findings in PE.

Recommendation

CTPA markers of RV dysfunction, particularly IVC/Hepatic reflux, should be considered alongside

clinical parameters to aid early risk stratification and ICU triage in patients with PE. Future multicentre prospective studies with larger cohorts are needed to better define the prognostic value of CTPA features in PE, improve risk stratification, and guide management.

Also, the use of clinical probability scores among medical practitioners is highly recommended to better select suspected PE patients for CTPA, hence avoiding unnecessary exposure to ionizing radiation and contrast.

Emerging research suggests that artificial intelligence and machine learning algorithms may improve the automated detection of PE and quantification of clot burden on CTPA. Future studies integrating AI-based image analysis with clinical risk scores may enhance early risk stratification and prognostic prediction in patients with PE.

Conflict of interest

All authors declared no conflict of interest.

Funding

The principal author provided financial support for this research.

Ethical approval

Ethical approval was obtained from the Kilimanjaro Christian Medical University College Research Ethics Committee on 13th August 2024 (Certificate No. PG 164/2024). Permission was also obtained from the Departments of Radiology and Internal Medicine at KCMC. As this was a retrospective study using anonymized data, the requirement for informed consent was waived.

Availability of data and materials

All study data and related materials are available from the corresponding author upon request.

References

1. Shayganfar A, Hajiahmadi S, Astaraki M, Ebrahimian S. The assessment of acute pulmonary embolism severity using CT angiography features. Int J Emerg Med 2020; 13(1):15.
2. Ogeng'o JA, Obimbo MM, Olabu BO, Gatonga PM, Ong'era D. Pulmonary thromboembolism in an East African tertiary referral hospital. J Thromb Thrombolysis 2011; 32(3):386–91.
3. Tambe J, Moifo B, Fongang E, Guegang E, Juimo AG. Acute pulmonary embolism in the era of multi-detector CT: a reality in sub-Saharan Africa. BMC Med Imag 2012; 12:31.
4. Ramlakhan R, Andronikou S, Rajkumar A. The prevalence and radiological findings of pulmonary embolism in HIV-positive patients referred for computed tomography pulmonary angiography in the Western Cape of South Africa. Cardiovasc J Afr 2017; 28(4):221–8.
5. Marc TB, Michel TP, Florence M, Tousaint M, Serge K, Chadrack B, et al. Hospital survival of patients with pulmonary embolism in a country with limited resources: case of the city of Kinshasa. BMC Cardiovasc Disord 2023; 23(1):1–6.
6. Bulajic B, Welzel T, Vallabh K. Clinical presentation and diagnostic work up of suspected pulmonary embolism in a district hospital emergency centre serving a high HIV/TB burden population [Internet]. Afr J Emerg Med Internet 2019; 9(3):134–9; doi:10.1016/j.afjem.2019.05.003
7. Meinel FG, Nance JW, Schoepf UJ, Hoffmann VS, Thierfelder KM, Costello P, et al. Predictive value of computed tomography in acute pulmonary embolism: systematic review and meta-analysis. Am J Med 2015; 128(7):747–59.
8. Zantonelli G, Cozzi D, Bindi A, Cavigli E, Moroni C, Luvarà S, et al. Acute pulmonary embolism: prognostic role of computed tomography pulmonary angiography (CTPA). Tomography 2022; 8(1):529–39.
9. Ali HI, El-Maadawy SM. Role of multidetector CT in predicting patient outcome in cases of pulmonary embolism: correlation between imaging findings, ICU admissions and mortality rate. Egypt J Radiol Nucl Med 2021; 52; doi:10.1186/s43055-021-00593-z
10. Zhou XY, Ben SQ, Chen HL, Ni SS. The prognostic value of pulmonary embolism severity index in acute pulmonary embolism: a meta-analysis. Respir Res 2012; 13(1):1.
11. Chaosuwannakit N, Soontrapa W, Makarawate P, Sawanyawisuth K. Importance of computed tomography pulmonary angiography for predict 30-day mortality in acute pulmonary embolism patients. Eur J Radiol Open 2021; 8:100340.
12. Khalifa A, Kamel F, Abdel Hafez E, Amer A. Prognostic role of CT pulmonary angiography in acute pulmonary embolism. Ain Shams Med J 2023; 74(2):345–63.
13. Okeke CC, Amadi ES, Ebiliekwe OE, Ekeocha IR, Nnanna Okoro E, Nduji OJ, et al. Risk factors and outcomes of acute pulmonary embolism in african patients: a systematic review. Cureus 2024; 16(11):1–4.
14. Danwang C, Temgoua MN, Agbor VN, Tankeu AT, Noubiap JJ. Epidemiology of venous thromboembolism in Africa: a systematic review [Internet]. J Thromb Haemost Internet 2017; 15(9):1770–81; doi:10.1111/jth.13769
15. Jiménez D. Simplification of the pulmonary embolism severity index for prognostication in patients

with acute symptomatic pulmonary embolism. Arch Intern Med 2010; 170(15):1383–99.
16. Plasencia-Martínez JM, Carmona-Bayonas A, Calvo-Temprano D, Jiménez-Fonseca P, Fenoy F, Benegas M, et al. Prognostic value of computed tomography pulmonary angiography indices in patients with cancer-related pulmonary embolism: data from a multicenter cohort study. Eur J Radiol 2017; 87:66–75.
17. Chaosuwannakit N, Soontrapa W, Makarawate P, Sawanyawisuth K. Importance of computed tomography pulmonary angiography for predict 30-day mortality in acute pulmonary embolism patients. Eur J Radiol Open 2021; 8:100340.
18. Heyer CM, Lemburg SP, Knoop H, Holland-Letz T, Nicolas V, Roggenland D. Multidetector-CT angiography in pulmonary embolism-can image parameters predict clinical outcome? Eur Radiol 2011; 21(9):1928–37; doi: 10.1007/s00330-011-2125-3
19. Norton L, Cooper G, Sheerins O, Mac A' Bháird K, Roditi G, Adamson M, et al. Clinical and radiological characteristics of acute pulmonary embolus in relation to 28-day and 6-month mortality. PLoS One 2021; 16(12):e0258843; doi: 10.1371/journal.pone.0258843
20. Dudzinski DM, Hariharan P, Parry BA, Chang Y, Kabrhel C. Assessment of right ventricular strain by computed tomography versus echocardiography in acute pulmonary embolism. Acad Emerg Med 2017; 24(3):337–43.
21. Esiéné A, Tochie JN, Metogo JAM, Etoundi PO, Minkande JZ. A comparative analysis of the diagnostic performances of four clinical probability models for acute pulmonary embolism in a sub-Saharan African population: a cross-sectional study. BMC Pulm Med 2019; 19(1):263.
22. Boon GJAM, Jairam PM, Groot GMC, Van Rooden CJ, Ende-Verhaar YM, Beenen LFM, et al. Identification of chronic thromboembolic pulmonary hypertension on CTPAs performed for diagnosing acute pulmonary embolism depending on level of expertise. Eur J Intern Med 2021; 93:64–70.
23. Bailis N, Lerche M, Meyer HJ, Wienke A, Surov A. Contrast reflux into the inferior vena cava on computer tomographic pulmonary angiography is a predictor of 24-hour and 30-day mortality in patients with acute pulmonary embolism. Acta Radiol 2021; 62(1):34–41; doi: 10.1177/0284185120912506
24. Bach AG, Nansalmaa B, Kranz J, Taute BM, Wienke A, Schramm D, et al. CT pulmonary angiography findings that predict 30-day mortality in patients with acute pulmonary embolism. Eur J Radiol 2015; 84(2):332–7.
25. Jradi H. On the circadian pattern of melatonin report. Ann Thorac Med 2017; 13(3):156–62.
26. Zantonelli G, Cozzi D, Bindi A, Cavigli E, Moroni C, Luvarà S, et al. acute pulmonary embolism: prognostic role of computed tomography pulmonary angiography (CTPA) [Internet]. Tomogr (Ann Arbor Mich) 2022; 8(1):529–39; Available via http://www.ncbi.nlm.nih.gov/pubmed/35202207
27. Méan M, Tritschler T, Limacher A, Breault S, Rodondi N, Aujesky D, et al. Association between computed tomography obstruction index and mortality in elderly patients with acute pulmonary embolism: a prospective validation study. PLoS One 2017; 12(6):e0178974.
28. Konstam MA, Kiernan MS, Bernstein D, Bozkurt B, Jacob M, Kapur NK, et al. Evaluation and management of right-sided heart failure: a scientific statement from the American Heart Association. Circulation 2018; 137:578–622.
29. Iestigations C. Clinical relevance of pleural effusion. Investigations C., 2017, pp. 1–8.
30. Zhang J, Zhou H, Aili A, Wang M, Shen Y, Yi Q. Prevalence and clinical significance of pleural effusion in patients with acute pulmonary embolism: a retrospective study. 202113(7)541–51 2021; 13(7):541–51.
31. Olgun Yıldızeli Ş, Kasapoğlu US, Arıkan H, Çimşit C, Çimşit NÇ, Süzer Aslan M, et al. Pleural effusion as an indicator of short term mortality in acute pulmonary embolism. Tuberk Toraks 2018; 66(3):185–96; doi: 10.5578/tt.67203
32. Rodríguez-Núñez N, Gude F, Ferreiro L, Landín-Rey E, Carreiras-Cuiña M, Otero B, et al. Pleural effusion in acute pulmonary embolism: characteristics and relevance. BMJ Open Respir Res 2024; 11(1):e002179; doi: 10.1136/bmjresp-2023-002179