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INCIDENTAL PULMONARY EMBOLISM IN CANCER PATIENTS UNDERGOING ROUTINE CT CHEST

Dr. Namrah Khalid[*1], Dr. Rashid Nazir[2], Dr. Amna Mehboob[3], Dr. Ranam Akhtar[4], Dr. Nasir Khan[5], Dr Tariq Mahmood[6]

*[*1,3,4,5]PGR Radiology, Shifa International Hospital*
[2]Consultant Radiology, MBBS FCPS, Shifa International hospital Islamabad
[6]Consultant Oncology, MBBS, FCPS, MCPS, FRC Path, DRC Path, Shifa International hospital Islamabad

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Corresponding Author: *
Dr Namrah Khalid

Abstract
Objective:
To determine frequency of incidental pulmonary embolism in cancer patients undergoing routine CT chest.
Study Design: *Cross-Sectional Study.*
Study Setting: *Department of Radiology, Shifa International Hospital, Islamabad.*
Duration of Study: *Five months (Jan to May 2025).*
Data Collection: *This cross-sectional study included 650 adult cancer patients aged 18–60 years who underwent contrast-enhanced CT chest for diagnostic evaluation, treatment response assessment, or routine surveillance. Patients with suspected or previously diagnosed pulmonary embolism were excluded. Incidental pulmonary embolism was defined as an intraluminal filling defect within pulmonary arterial vasculature detected on CT performed for indications unrelated to pulmonary embolism. All scans were interpreted by an experienced consultant radiologist.*
Results: *Incidental pulmonary embolism was detected in 20 patients, yielding a frequency of 3.1%. Although a higher proportion of pulmonary embolism was observed in patients aged 31–60 years and in males, no statistically significant association was found with age or gender. Similarly, incidental pulmonary embolism showed no significant association with cancer type, disease stage, or treatment modality.*
Conclusion: *Incidental pulmonary embolism was identified in a small but clinically important proportion of cancer patients undergoing routine CT chest. Given its potential prognostic implications, careful radiological evaluation and appropriate clinical management of incidental pulmonary embolism are essential to reduce morbidity and mortality in oncology patients.*

INTRODUCTION

Venous thromboembolism (VTE) is a known risk factor for both cancer and cancer treatment. Cancer patients have been shown to have a significantly higher risk of VTE than general population. Nearly twenty percent of all new VTE occurrences in community are caused by actively progressing cancer. Patients with malignant brain tumors and adenocarcinoma of ovary, pancreatic,

colon, stomach, lung, or prostate have an exceptionally high risk of developing a VTE.1

In spite of high frequency, best care of accidental PE has not been investigated in clinical studies and continues to be a contentious topic of discussion.2

Although CT scans have not been performed with a specific PE technique and have poor contrast enhancement, identification of incidental PE has been proven to be accurate up to segmental and subsegmental arteries.3

diagnosis of pulmonary embolism is made by accident in patients who are diagnosed with cancer during routine imaging tests. It is not understood what clinical relevance of distant clots in incidental pulmonary embolism is or what most effective treatment is for them. most common types of cancer, according to a survey, were colorectal cancer (21%) and lung cancer (15%). Significant bleeding and recurrent venous thromboembolism occurred in 6% of patients each, and 283 individuals passed away, or 43% of total. risk of recurrent venous thromboembolism is considerable in patients with cancer who have experienced an accidental pulmonary embolism, despite fact that anticoagulant therapy is being administered..4

A population-based case control study carried out in year 2002 was to assess potential impact of controlling risk factors on incidence of venous thromboembolism and attributable risks were calculated. Apart from multiple other causes for incidental pulmonary embolism established in this study including institutionalization, trauma, congestive heart failure, common neurological diseases with extremity paralysis and varicose veins; it was established that about 18% of incident venous thromboembolism cases were attributable to active malignant neoplasms with or without chemotherapy. Larger population (12%) was attributable to malignant neoplasm without chemotherapy with lesser percent (6%) was found in cases with malignancy with chemotherapy.5

It is imperative that occurrence of symptoms in cancer patients who have experienced accidental PE not be disregarded, as these symptoms may be linked to several significant consequences, including mortality.6. natural development of an unintentional pulmonary embolism is likely to be comparable to that of a symptomatic pulmonary embolism in terms of chance of recurrent venous thrombotic disease and death, according to research that is based on observations carried out by medical professionals. It is noteworthy to note that there has been an increase in rate of accidental subsegmental PE along with increased adoption of more advanced CT techniques. This is something that has occurred. general assumption is that treatment for incidental PE is same as treatment for symptomatic PE. This is despite fact that there is a dearth of clinical trials and observational data are limited to cancer-associated incidental PE. This include selection of drug class that is most successful, utilization of outpatient treatment, and overall duration of treatment..7

rationale of this study is that as early detection of incidental pulmonary embolism is critical for reduction of morbidity and mortality among cancer patients, and limited local data is available regarding incidence of incidental pulmonary embolism in cancer patients undergoing routine CT chest. Triage of cancer patients for suspicion of pulmonary embolism along with symptoms of VTE can help in early diagnosis and management of these patients. I have designed this study to determine burden of incidental pulmonary embolism in cancer patients undergoing routine CT chest.

METHODOLOGY

This cross-sectional study was conducted in Department of Radiology, Shifa International Hospital, Islamabad. (January to June '25) following approval from CPSP and Institutional Review Board (IRB#485-24, Dated: 05-11-2024). study aimed to determine frequency of incidental pulmonary embolism detected on routine contrast-enhanced CT chest examinations performed for indications unrelated to suspected pulmonary embolism. sample size was calculated using World Health Organization (WHO) sample size calculator, assuming a 95% confidence level, an absolute precision of 3.65%, and an anticipated prevalence of incidental pulmonary embolism of 7.3%8 among cancer patients undergoing routine CT chest imaging, as reported

in previous literature. Based on these parameters, a total of 650 patients were required. A non-probability consecutive sampling technique was employed to recruit eligible participants.
Adult patients aged 18 to 60 years with a confirmed diagnosis of malignant carcinoma who were referred for contrast-enhanced CT chest for diagnostic evaluation, treatment response assessment, or routine surveillance were included in study. Patients with a prior diagnosis of pulmonary embolism, known primary hypercoagulable disorders, or documented deep venous thrombosis within 72 hours prior to CT examination were excluded. Incidental pulmonary embolism was operationally defined as radiological detection of pulmonary embolus on contrast-enhanced CT chest performed for indications other than suspicion, confirmation, or exclusion of pulmonary embolism. Radiologically, pulmonary embolism was identified as an intraluminal filling defect within pulmonary arterial vasculature. Emboli were categorized as occlusive or non-occlusive, with non-occlusive emboli characterized by a thin peripheral streak of contrast adjacent to thrombus. Acute emboli typically formed acute angles with vessel wall, whereas chronic emboli demonstrated obtuse angles. All CT scans were interpreted by an experienced consultant radiologist.
After ethical approval, eligible patients presenting to radiology department for routine CT chest examinations were enrolled following written informed consent obtained from patient or their legal attendant. Demographic and clinical data, including age, gender, type of malignancy, cancer stage, and type of anti-cancer therapy, were recorded using a structured proforma. CT imaging was performed using either a Toshiba Aquilion ONE 320-slice scanner or a Siemens Somatom Definition Edge 128-slice scanner with a slice thickness of 2.0 mm. Intravenous contrast material was administered at a dose of 1.5 mL/kg body weight at an injection rate of 3.0 mL per second. All scans were acquired in supine position from cranial to caudal direction during end-inspiration. Image interpretation was carried out independently by a consultant radiologist who was blinded to patients' clinical information to minimize reporting bias. All collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 23. Quantitative variables such as age were expressed as mean ± standard deviation, while qualitative variables including gender, type and stage of cancer, anti-cancer therapy, and presence of incidental pulmonary embolism were presented as frequencies and percentages.

RESULTS

Table 1 presents characteristics of 650 cancer patients who were first examined in experiment. mean age of participants was 39.43 years, accompanied by a standard deviation of 12.19 years. Seventy-two point five percent of participants were aged between 31 and 60 years, whilst twenty-eight point five percent were aged between 18 and 30 years. participant demographic exhibited a little male predominance, comprising 54.9% males and 45.1% females.Breast cancer (26.6%) was predominant malignancy, succeeded by colorectal cancer (20.2%) and lung cancer (17.5%). Stage III cancer represented highest percentage at 41.1%, followed by Stage II at 29.8% and Stage IV at 29.1%. Chemotherapy was predominant treatment modality, provided to 45.5% of patients, while 10.9% were under surveillance.Table 2 presents incidence of accidental pulmonary embolism identified by standard CT chest scans. Incidental pulmonary embolism was detected in 20 patients (3.1%), whereas 96.9% of patients exhibited no signs of pulmonary embolism.Table 3 illustrates correlation between incidental pulmonary embolism, age group, and gender. A greater incidence of pulmonary embolism was noted in patients aged 31–60 years (3.9%) relative to those aged 18–30 years (1.1%); yet, this disparity did not achieve statistical significance ($p = 0.063$). Incidental pulmonary embolism occurred more frequently in males (3.6%) than in females (2.4%); nevertheless, no statistically significant correlation with gender was identified ($p = 0.358$).Table 4 depicts correlation between incidental pulmonary embolism and oncological variables.

incidence of pulmonary embolism exhibited slight variation among various cancer types, with highest prevalence noted in breast cancer patients (4.0%); nevertheless, this correlation lacked statistical significance (p = 0.923). No substantial correlation was identified between pulmonary embolism and cancer stage (p = 0.994) or type of anti-cancer treatment (p = 0.817). Incidental pulmonary embolism seemed uniformly distributed among cancer stages and treatment methods

TABLE 1: BASELINE CHARACTERISTICS OF STUDY PARTICIPANTS (N = 650)

Variable	Category	N	%
Age (years)	Mean ± SD	39.43	±12.19
Age group	18–30 years	185	28.5
	31–60 years	465	71.5
Gender	Male	357	54.9
	Female	293	45.1
Cancer type	Breast	173	26.6
	Lung	114	17.5
	Colorectal	131	20.2
	Ovarian	74	11.4
	Prostate	61	9.4
	Others	97	14.9
Cancer stage	Stage II	194	29.8
	Stage III	267	41.1
	Stage IV	189	29.1
Therapy type	Chemotherapy	296	45.5
	Radiotherapy	115	17.7
	Combined therapy	168	25.8
	Surveillance	71	10.9

TABLE 2: FREQUENCY OF INCIDENTAL PULMONARY EMBOLISM

Outcome	n	%
Positive	20	3.1
Negative	630	96.9
Total	**650**	**100**

TABLE 3: ASSOCIATION OF INCIDENTAL PULMONARY EMBOLISM WITH AGE GROUP AND GENDER

Variable	Category	PE Positive n (%)	PE Negative n (%)	p-value
Age group	18–30 years	2 (1.1)	183 (98.9)	0.063
	31–60 years	18 (3.9)	447 (96.1)	
Gender	Male	13 (3.6)	344 (96.4)	0.358
	Female	7 (2.4)	286 (97.6)	

TABLE 4: ASSOCIATION OF INCIDENTAL PULMONARY EMBOLISM WITH CANCER-RELATED FACTORS

Variable	Category	PE Positive n (%)	PE Negative n (%)	p-value
Cancer type	Breast cancer	7 (4.0)	166 (96.0)	0.923
	Lung cancer	4 (3.5)	110 (96.5)	
	Colorectal cancer	4 (3.1)	127 (96.9)	
	Ovarian cancer	2 (2.7)	72 (97.3)	
	Prostate cancer	1 (1.6)	60 (98.4)	
	Others	2 (2.1)	95 (97.9)	
Cancer stage	Stage II	6 (3.1)	188 (96.9)	0.994
	Stage III	8 (3.0)	259 (97.0)	
	Stage IV	6 (3.2)	183 (96.8)	
Therapy type	Chemotherapy	10 (3.4)	286 (96.6)	0.817
	Radiotherapy	2 (1.7)	113 (98.3)	
	Combined therapy	6 (3.6)	162 (96.4)	
	Surveillance / follow-up	2 (2.8)	69 (97.2)	

DISCUSSION:

This cross-sectional study evaluated impact of incidentally detected pulmonary embolism (iPE) on routine contrast-enhanced CT chest scans of cancer patients at a tertiary care radiology facility. primary finding suggested that incidence of incidental pulmonary embolism was 3.1% among individuals who underwent CT chest examinations when needed for reasons other than pulmonary embolism. Furthermore, incidental pulmonary embolism exhibited no significant link with age group, gender, cancer type, cancer stage, or treatment method; however, a non-significant inclination towards greater incidence was observed in individuals aged 31 to 60 years. occurrence of accidental pulmonary embolism in our investigation aligns with previously reported international data. Systematic reviews and meta-analyses of oncologic staging CT scans indicate an overall accidental prevalence of pulmonary embolism (PE) at 3.36, with variations depending on cancer type and scanning techniques.9 This consistency enhances external validity of current study and verifies incidental prevalence of pulmonary embolism as a consistent, if not particularly high, occurrence across diverse oncology patients undergoing routine CT imaging. discrepancies in incidence reported among studies can be attributed to variances in imaging indications, cancer profiles, and institutional diagnostic protocols. In a prospective oncology cohort, overall incidence of pulmonary embolism was reported to be 4.44%, with 1.3% classified as accidental and remainder as symptomatic.10 increased prevalence in these cohorts is likely attributable to fact that patients had CT pulmonary angiography based on clinical suspicion, whereas current analysis focused solely on accidental findings during routine CT chest examinations. issue of under-recognition and under-reporting in routine CT scans significantly affects interpretation of accidental pulmonary embolism data. retrospective analysis of efficacy of elective CT in cancer patients revealed that accidental pulmonary embolism (PE) was identified in approximately 4 percent of scans; however, only 21 percent were documented in radiology reports, despite many being located in segmental or more central arteries.11 This study suggests that true impact of accidental pulmonary embolism may be undervalued in clinical practice and emphasises importance of comprehensive imaging analysis and heightened awareness among radiologists.As a result of its incidental discovery, pulmonary embolism in cancer patients has been shown to have considerable prognostic significance. Population-based cohort studies that accounted for immortal time bias indicated that incidental pulmonary embolism patients exhibited

significantly elevated long-term mortality, with an adjusted hazard ratio of 2.26 compared to cancer patients without pulmonary embolism.12 primary cause of mortality in patients was predominantly attributed to characteristics of underlying malignancy, which included metastatic illness. clinical relevance is shown by risk of recurrent venous thromboembolism (VTE) in untreated accidental pulmonary embolism (PE). A matched cohort study of unreported and untreated incidental pulmonary embolism (PE) in cancer patients revealed a significant correlation between embolic burden and increased recurrence risk, with a one-year risk of recurrent venous thromboembolism (VTE) ranging from 52 to 72 events per 100 person-years in patients with multiple subsegmental or more proximal emboli; this risk was not attributable to isolated single subsegmental PE. findings of present study indicated that there is no statistically significant association between incidental pulmonary embolism and demographic characteristics, cancer type, cancer stage, or treatment mode. Recent studies have indicated comparable results, revealing that incidental pulmonary embolism (PE) was uniformly distributed across clinical subgroups without a statistically significant association. This may be attributed to limited occurrences of PE, which restrict statistical power, non-specific categorisation of malignancies, and referral bias, as patients with a clinical suspicion of PE are more likely to undergo dedicated CT pulmonary angiography rather than standard CT chest examination. results of this investigation revealed that there is no statistically significant link between incidental pulmonary embolism and demographic variables, cancer type, cancer stage, or treatment mode. Comparable findings were documented in recent studies, wherein incidental pulmonary embolism (PE) was uniformly distributed across clinical subgroups, exhibiting no statistically significant correlation. This may be ascribed to limited incidence of PE, which constrains statistical power, as well as non-specific categorisation of malignancies and referral bias, given that patients with a clinical suspicion of PE are more likely to undergo dedicated CT pulmonary angiography rather than current CT chest examination.Clinically and radiologically, accumulating evidence suggests that incidental pulmonary embolism in cancer patients should not be treated differently from symptomatic pulmonary embolism. Observational studies and expert consensus reviews have demonstrated comparable perioperative risks of recurrence and mortality, thereby justifying use of anticoagulation, which is effective in most cases and considered following a thorough assessment of bleeding risk and overall prognosis.15This research is characterised by a substantial sample size, utilisation of modern multidetector CT scanners, standardised imaging techniques, and interpretation conducted by seasoned consultant radiologists. Nonetheless, several constraints must be considered. cross-sectional design precluded assessment of outcomes related to recurrence, haemorrhage, and mortality. Furthermore, central venous catheterisation, immobilisation, application of thromboprophylaxis, and metastatic load were not thoroughly investigated as risk factors for thrombosis. Standard CT chest scans, in contrast to PE-specific methods, may exhibit reduced sensitivity to distant emboli, as indicated by prior research.elevenIn summary, incidental pulmonary embolism was identified in 3.1% of cancer patients undergoing routine contrast-enhanced chest CT, aligning with global literature, and is related with a heightened risk of subsequent venous thromboembolism in untreated cancer patients and higher death. introduction of standardised radiological reporting and interdisciplinary care pathways is essential to optimise outcomes in this high-risk population.

CONCLUSION

Incidental pulmonary embolism was identified in 3.1% of cancer patients getting routine contrast-enhanced CT chest scans conducted for reasons other than suspected pulmonary embolism. Despite absence of statistically significant correlations with age, gender, cancer type, disease stage, or treatment modality, occurrence of incidental pulmonary embolism is clinically significant due to its recognised association with heightened risk of recurrent venous

thromboembolism and unfavourable outcomes in oncology cohorts.

CONFLICT OFF INTEREST:
Nil

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