Pulmonary computed tomography angiography in the diagnosis of acute pulmonary embolism: an assessment of prevalence and use

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Principal location of audit
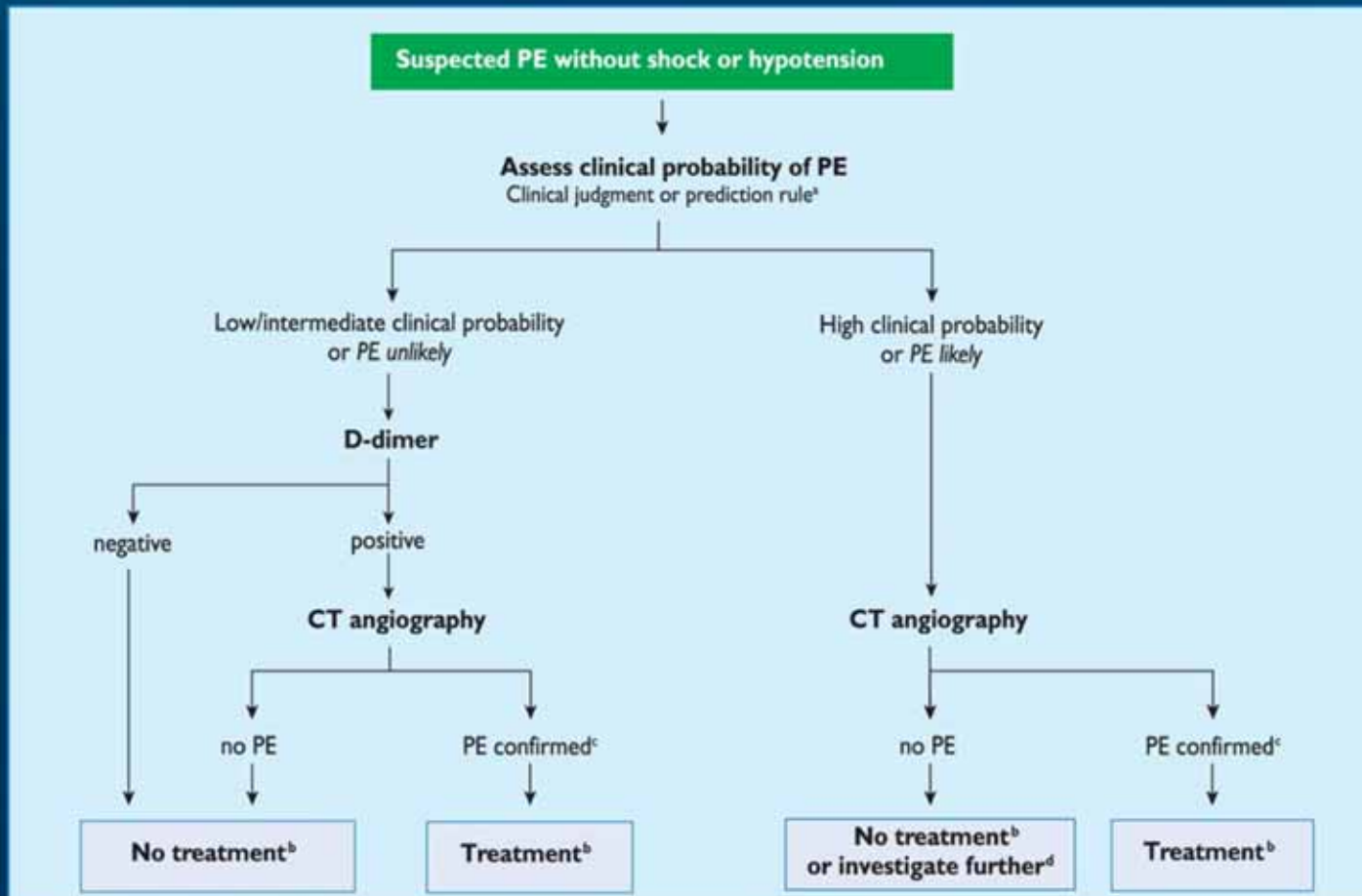
- University-based practice

Introduction
Background

- Pulmonary embolism is the third most frequent cardiovascular event
  - Case fatality rate ad 30% if not treated promptly
- Nonspecific signs and symptoms
- Pretest probability calculated using Wells scoring system

Introduction
Investigation algorithms

Suspected PE without shock or hypotension

↓

Assess clinical probability of PE
Clinical judgment or prediction rule[a]

Low/intermediate clinical probability
or *PE unlikely*

High clinical probability
or *PE likely*

↓

D-dimer

negative → positive → **CT angiography**

CT angiography

no PE → PE confirmed[c]

no PE → PE confirmed[c]

No treatment[b] | **Treatment[b]** | **No treatment[b] or investigate further[d]** | **Treatment[b]**

Introduction
Clinical revelance

- Low positive yield rate of PCTA (10%) (Table 1)

- Significant increase of the use of PCTA (23% to 45%) (Table 2), suggesting overuse

Table 1. Positive yield rates reported		
Author	Year	Pos. yield rate
Alhassan	2016	7.4%
Perelas	2015	9.4%
Yin	2011	1.8%
Hall	2009	9%
Sarojini	2009	11%
Costantino	2008	9.57%
Mamlouk	2006	9.84%
Prologo	2004	12%

Introduction
Clinical revelance

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- Significant increase of the use of PCTA (23% to 45%) (Table 2), suggesting overuse

Table 2. Prevalences of PCTA use reported		
Author	Year	Prevalence of use
Yin	2011	46.8%
DeMonaco	2001	45.18%
DeMonaco	1997	23.23%

Introduction
Clinical revelance

- Increase of the incidence rate of PE by 80% from 1998 to 2006, but no significant change in mortality rate (Wiener, 2013), suggesting overdiagnosis

- Concern about use of PCTA as screening tool rather than as a diagnostic tool

Introduction
Overuse vs overdiagnosis

- Overuse: excessive use of a diagnostic test, i.e. when not indicated
  - ↑Frequence of use of test, ↓positive yield rate
- Overdiagnosis: intrinsic property of an overly sensitive test, resulting in positive diagnoses of a large number of clinically insignificant cases of a disease
  - ↑incidence rate of disease, ↓case fatality, ↔mortality rate associated with disease

Objective – Clinical audit

- To evaluate the frequency of use and the positive yield rate of PCTA at a university-based medical center

Audit target

- No current consensus on target positive yield rate and prevalence of use

Materials and methods
Study design

- Cross-sectional retrospective study, completion time around 2 months

- Population: all patients from the university-based medical center suspected of having acute PE from Jan. 1st to Dec. 31st 2015

- How patients were identified:
  - Model 1: all patients having undergone at least one of the following tests: D-dimer testing, PCTA, ventilation-perfusion scintigraphy
  - Model 2: same as model 1, but with patients having undergone venous doppler of lower limbs removed from the D-dimer group

Materials and methods
Data acquisition

- 64- to 256-slice scanners

- Data gathered from hospital's electronic medical records system
  - Age, sex, department of patient, specialty of prescribing MD, scan result, location of most proximal embolus
  - Clinical information written in scan requests (hemoptysis, dyspnea, chest pain, syncope, desaturation, signs of right-sided heart failure)

Materials and methods
Statistical analysis

- Descriptive statistics:
  - Positive yield rate: number of positive scans/total number of scans
  - Prevalence of use: total number of scans/number of patients suspected of having PE
- Statistical analyses:
  - Comparisons of positive yield rate and prevalence of use with other studies: one sample z-test
  - Multivariate logistic regression of the positive yield rate according to age, sex, departement of patient, and specialty of prescribing MD

Results

- From 5296 (model 2) to 5565 (model 1) patients investigated for acute PE in the year 2015

- 1331 PCTA scans requested

  - Prevalence of use of PCTA: **23.9%** (model 1) to **25.1%** (model 2)

Table 4. Patient clinical data	
Number of PCTA scans	1331
Age (yrs)	60.2 ± 16.6
Male sex (*n*)	575 (43.2)
Hemoptysis (*n*)	61 (45.9)
Dyspnea (*n*)	390 (29.3)
Chest pain (*n*)	417 (31.4)
Syncope (*n*)	34 (25.6)
Desaturation (*n*)	147 (11.1)
Signs of right-sided heart failure (*n*)	16 (1.20)

Results

- 211 positive scans
  - Positive yield rate **15.9%** ($p < 0.000\ 1$)
- 847 (63.9%) requests from Emergency dept.
- 409 (30.8%) requests by general practitioners
- Positive yield rate higher in ICU (OR = 4.210) et when prescribed by medical internists (OR = 2.201)

Table 3. Pulmonary emboli by location	
Most proximal embolus	Number of scans
Main pulmonary artery	23 (11.1)
Lobar	44 (21.1)
Segmental	98 (46.9)
Sub-segmental	44 (21.1)

Results

	Negative	Positive	Doubt	Non-dx	Total	Pos. rate	OR	95% CI	p-value
Sex									
Male	583 (77.4)	118 (15.7)	48 (6.4)	4 (0.5)	753 (56.8)	15.7%	—	—	—
Female	407 (71.2)	93 (16.3)	65 (11.4)	7 (1.2)	572 (43.2)	16.3%	0.963	[0.705—1.316]	0.813
Age	—	—	—	—	—	—	**1.011**	**[1.002—1.021]**	**0.019**
Department									
Emergency department	646 (76.3)	128 (15.1)	65 (7.7)	8 (0.9)	847 (63.9)	15.1%	—	—	—
Other (Inpatient)	132 (70.6)	34 (18.2)	20 (10.7)	1 (0.5)	187 (14.1)	18.2%	1.016	[0.615—1.677]	0.951
Other (Outpatient)	78 (83.0)	11 (11.7)	4 (4.3)	1 (1.1)	94 (7.1)	11.7%	0.651[†]	[0.319—1.326]	0.237
Surgery	60 (69.0)	12 (13.8)	14 (16.1)	1 (1.1)	87 (6.6)	13.8%	0.728[†]	[0.353—1.498]	0.388
Gynecology	39 (67.2)	11 (19.0)	8 (13.8)	0 (0.0)	58 (4.4)	19.0%	0.935[†]	[0.386—2.261]	0.881
Intensive care unit	**35 (67.3)**	**15 (28.8)**	**2 (3.8)**	**0 (0.0)**	**52 (3.9)**	**28.8%**	**4.210[†]**	**[1.630—10.871]**	**0.003**
Specialty									
Family medicine	308 (75.3)	61 (14.9)	35 (8.6)	5 (1.2)	409 (30.9)	14.9%	1.040	[0.647—1.671]	0.871
Emergency medicine	165 (78.6)	30 (14.3)	14 (6.7)	1 (0.5)	210 (15.8)	14.3%	—	—	—
Other	130 (68.8)	34 (18.0)	24 (12.7)	1 (0.5)	189 (14.3)	18.0%	1.309[‡]	[0.695—2.465]	0.405
Pulmonology	105 (77.8)	17 (12.6)	11 (8.1)	2 (1.5)	135 (10.2)	12.6%	0.814[‡]	[0.416—1.594]	0.549
Internal medicine	**63 (66.3)**	**25 (26.3)**	**7 (7.4)**	**0 (0.0)**	**95 (7.2)**	**26.3%**	**2.201[‡]**	**[1.138—4.256]**	**0.019**
Cardiology	71 (79.8)	11 (12.4)	6 (6.7)	1 (1.1)	89 (6.7)	12.4%	0.786[‡]	[0.361—1.708]	0.543
Hematology	60 (75.0)	12 (15.0)	8 (10.0)	0 (0.0)	80 (6.0)	15.0%	1.264[‡]	[0.580—2.755]	0.556
Gynecology	43 (69.4)	13 (21.0)	6 (9.7)	0 (0.0)	62 (4.7)	21.0%	1.860[‡]	[0.754—4.591]	0.178
Intensive care	45 (80.4)	8 (14.3)	2 (3.6)	1 (0.0)	56 (4.2)	14.3%	0.344[‡]	[0.106—1.118]	0.076
Total	990 (74.7)	211 (15.9)	113 (8.5)	11 (0.8)	1325	15.9%	—	—	—

Conclusion

- At our university-based medical center, there is less evidence of overuse of PCTA than the general consensus (low prevalence of use, higher positive yield rate)

- Audit successful, but improvements possible

Action plan

- Presentation at Emergency department
- Possibility of implementing Clinical Decision Support (CDS) systems to assist physicians
  - Main barriers to implementation: cost of software and infrastructure, reluctance of clinicians to adopt CDS

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