Weill Cornell Medicine

POCUS Conference

Place for POCUS in the diagnosis and management of Pulmonary Embolism

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Case

30-year-old woman admitted with chest pain with a past medical history of sickle cell disease. Patient describes 2 days of chest pain described as midsternal and constant; but not consistent with her vaso-occlusive pain crisis. Patient saw her PMD who did an EKG but advised her to go to the emergency room.

Case

- **Past surgical and medical history:**
  - **Sickle cell disease**
  - **Cholecystectomy**
  - **Scoliosis surgery**

- **Family and social history:**
  - **Works as a nurse's aide on 4 N.**
  - **Does not smoke occasional alcohol**
  - **Single**

Case

Tc: 36.6 Tmax: 36.8
HR: 77 (7 - 77)
BP: 107/67 (95/57 - 118/68)
Room Air, , SpO2: 97% (95 - 99), RR: 16 (16 - 73)

- **Awake and Alert, Orient to person, place and time.**
- **EOMI**
- **No JVD**
- **No overt skin lesions.**
- **No significant adenopathy.**
- **Normal S1 and S2 no murmurs rubs, thrills or gallops.**
- **Lungs are clear to ascultation, no crackles, rhonchi or wheezes.**
- **Abdomen is soft, non-tender and not distended. No organomegaly. Bowel sounds are present.**
- **Neuro exam is non-focal/without clear deficits**

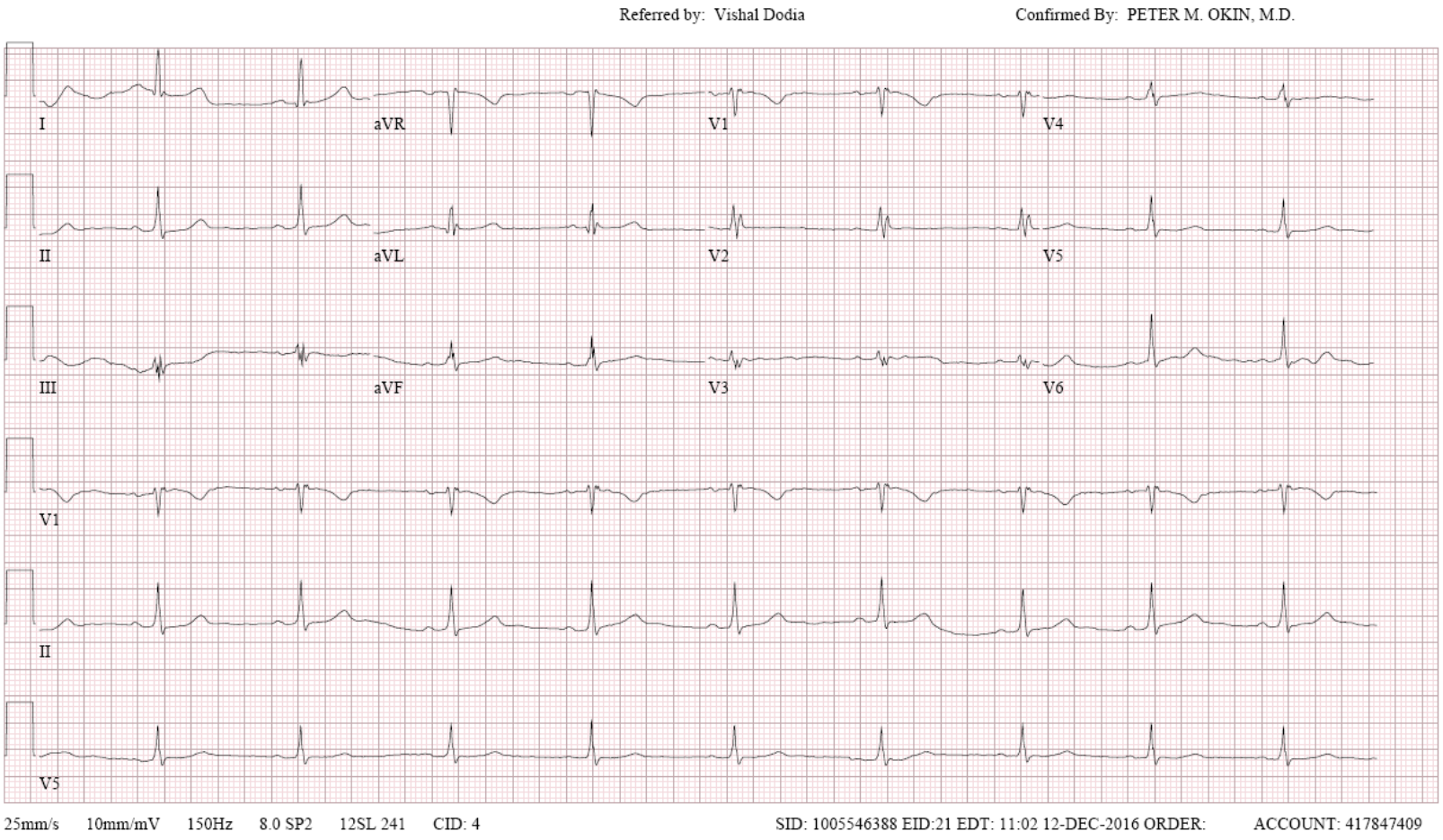
Labs

↑	14.4
↓	7.9
↓	22.7
	394
*	97.9
↑	34.2
	34.9
↑	21.9
	8.4
↓	2.32

139
4.5
104
24
9
0.55
91
9.4

	7.1
	4.2
	2.9
	30
	25
	46
↑	2.5
	0.5
↑	2.0

ECG 1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Confirmed By: PETER M. OKIN, M.D.
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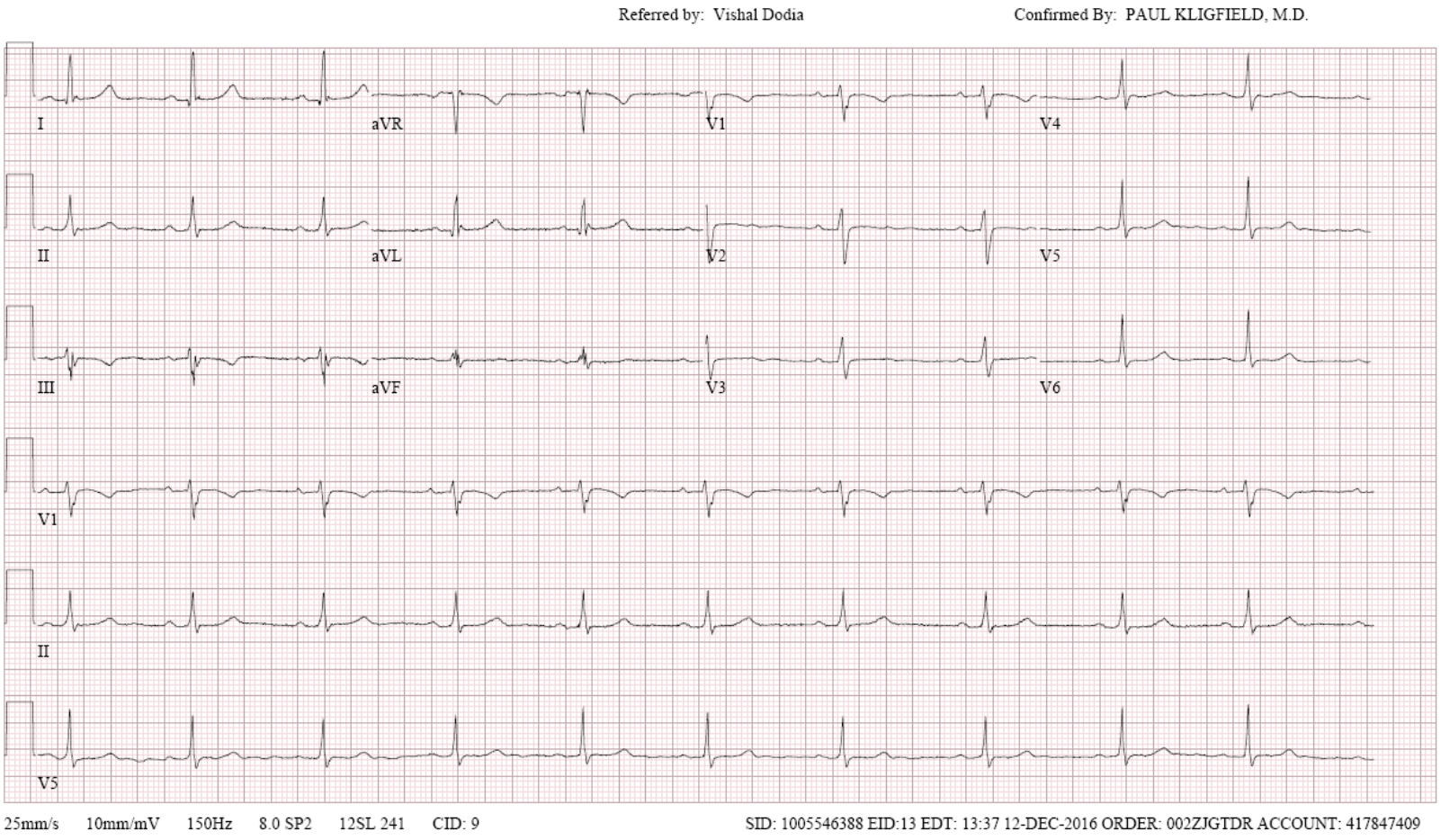
ECG 2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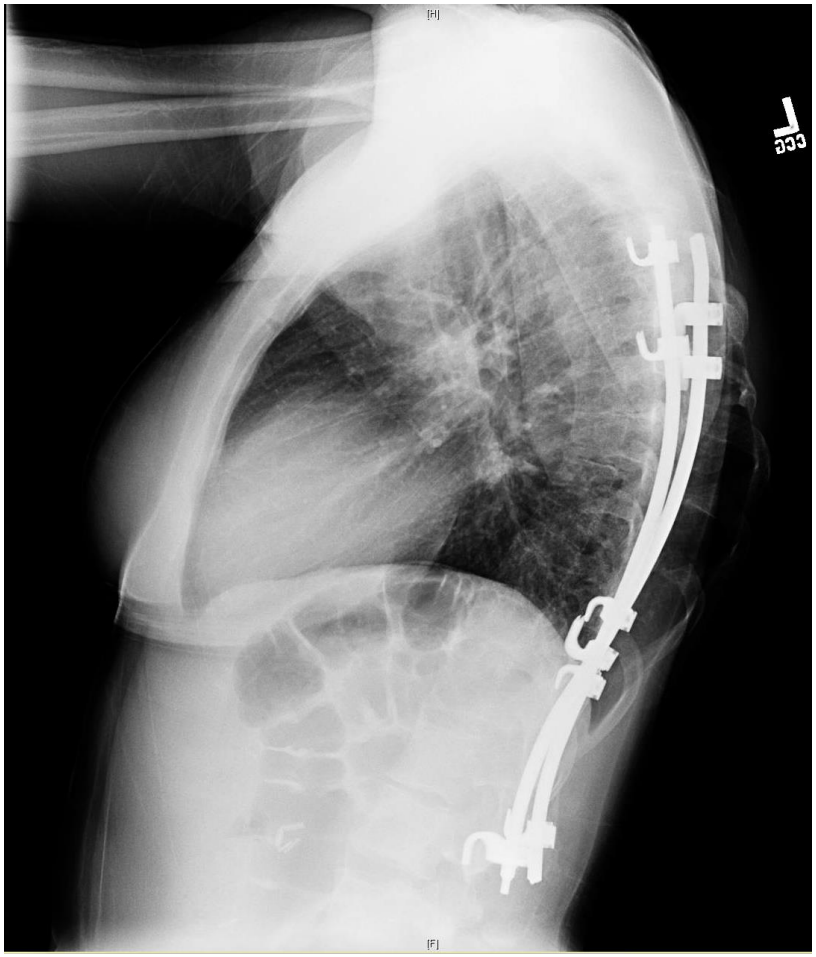
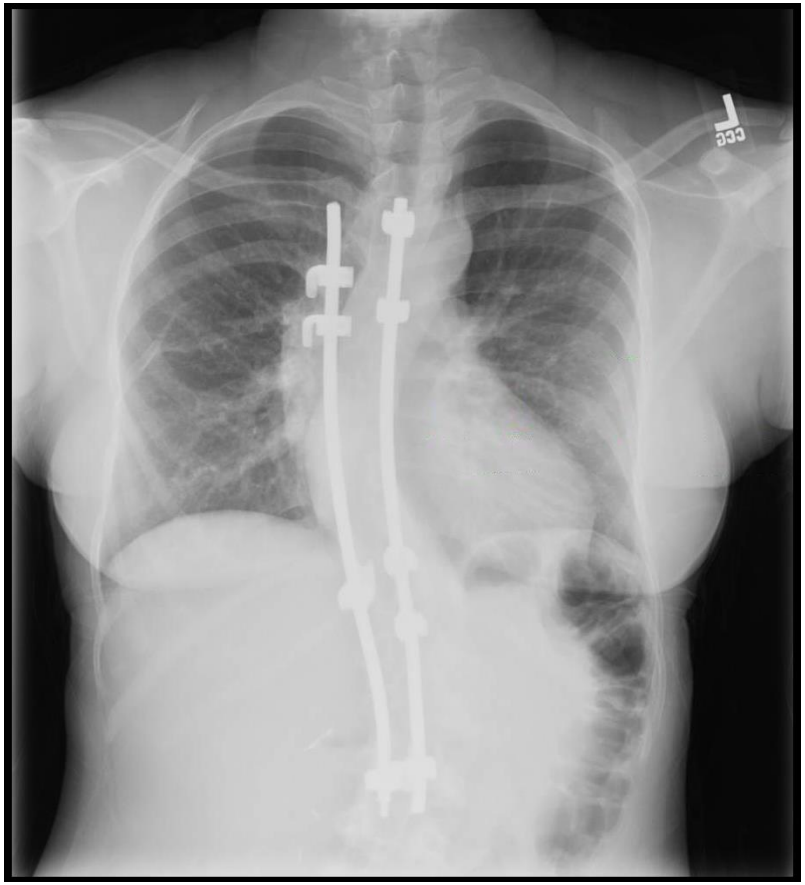
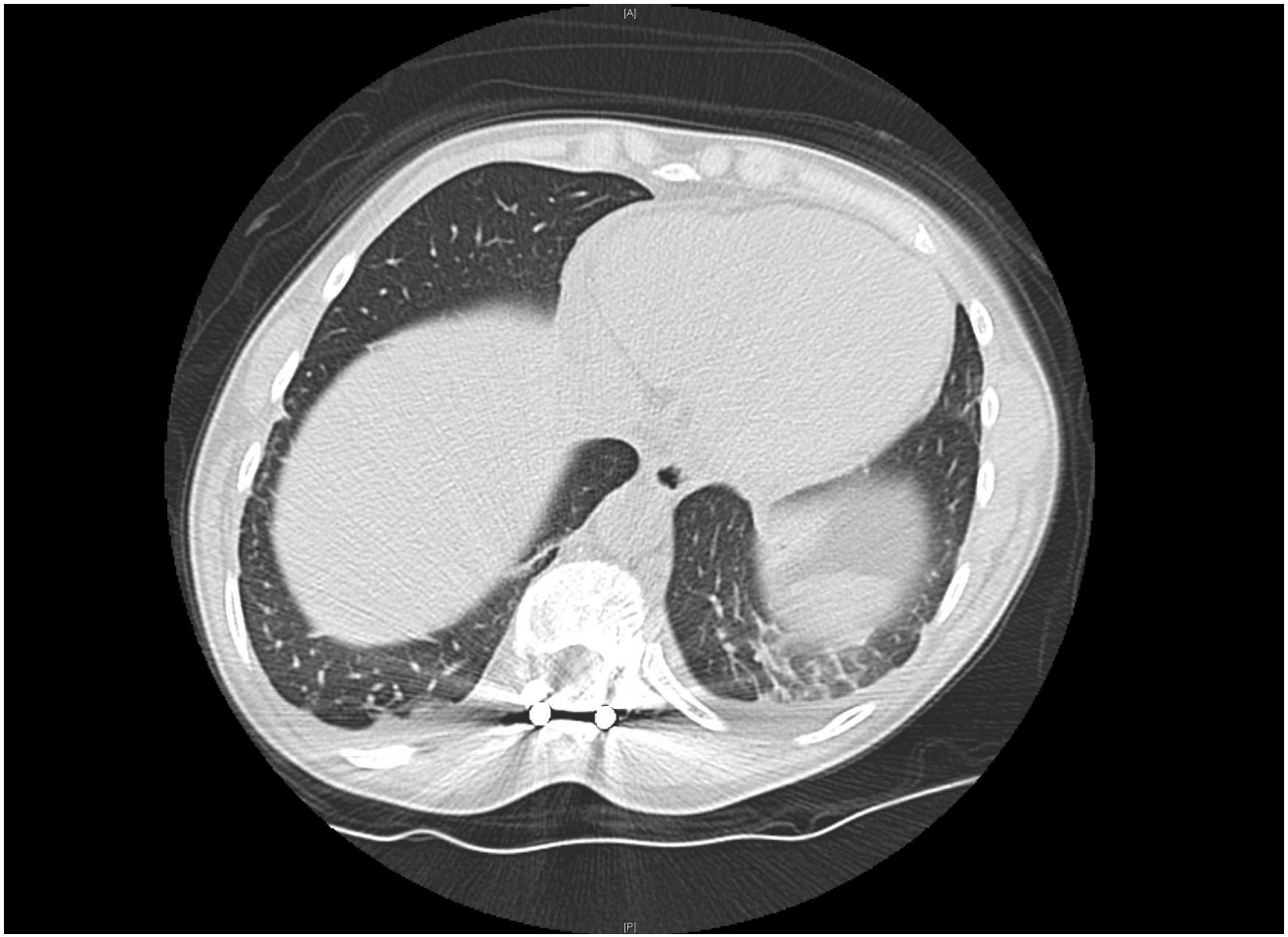


Case




[A]
[P]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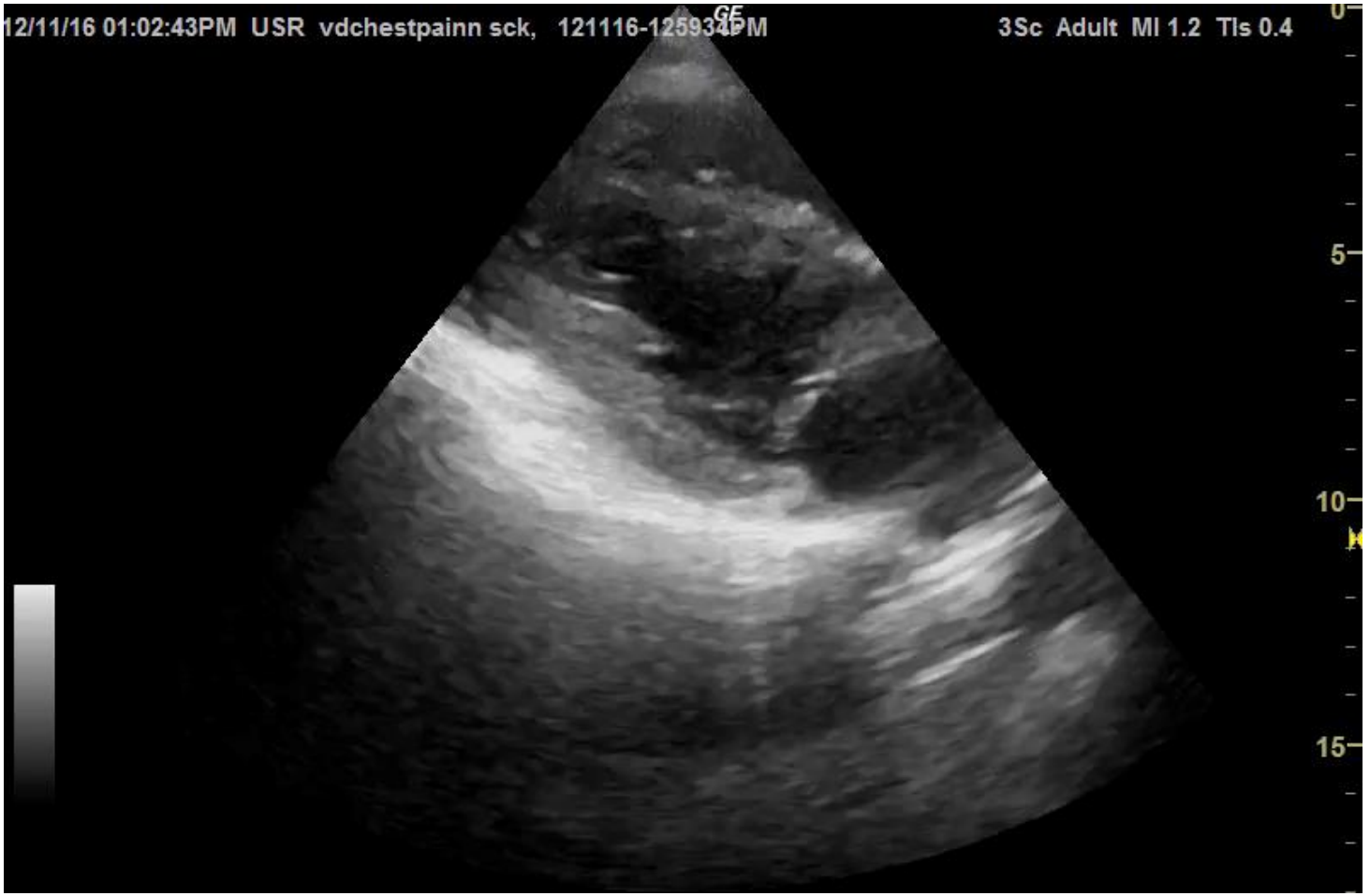
0
5
10
15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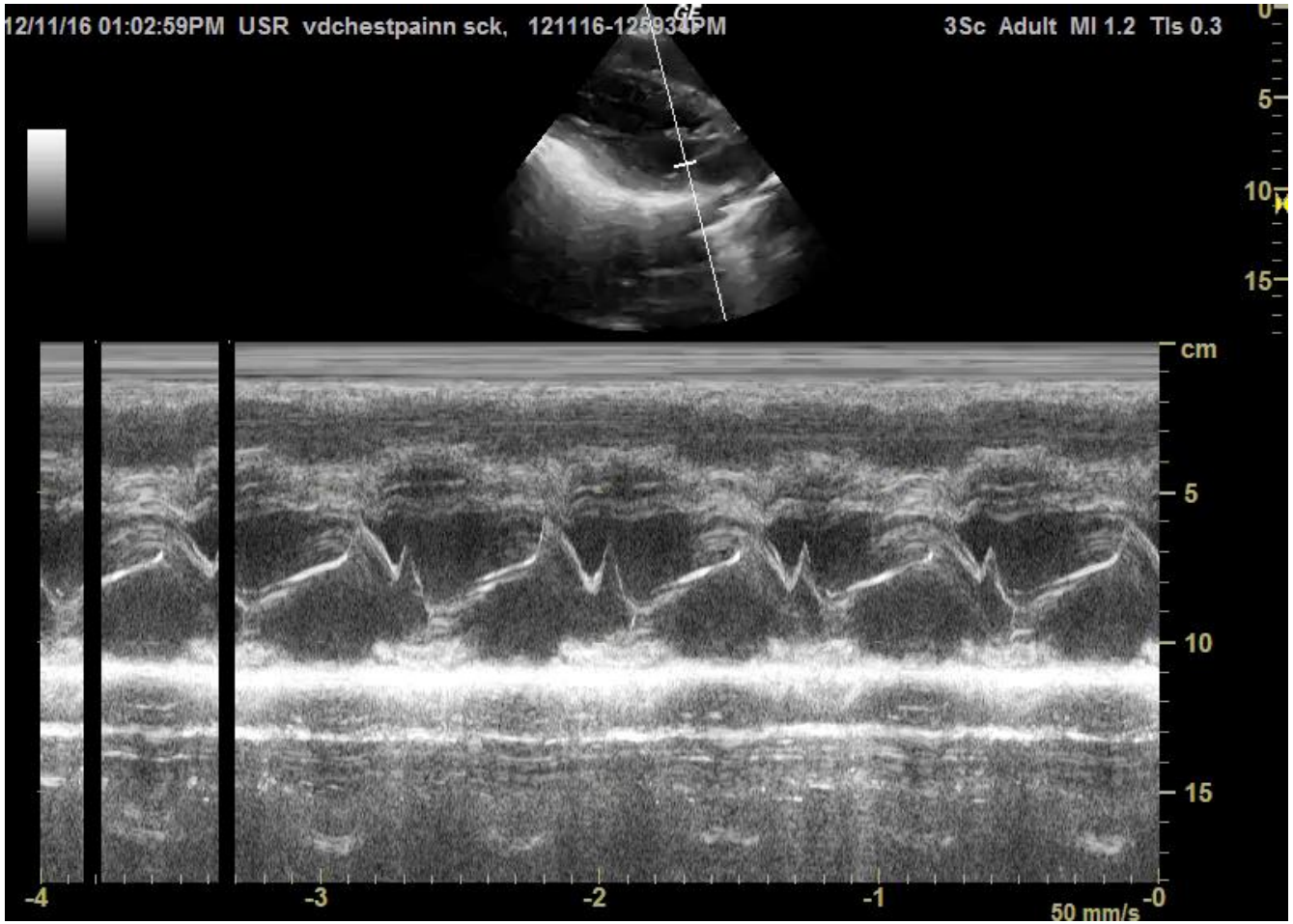
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cm
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10
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-4
-3
-2
-1
-0
50 mm/s


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10
15


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15


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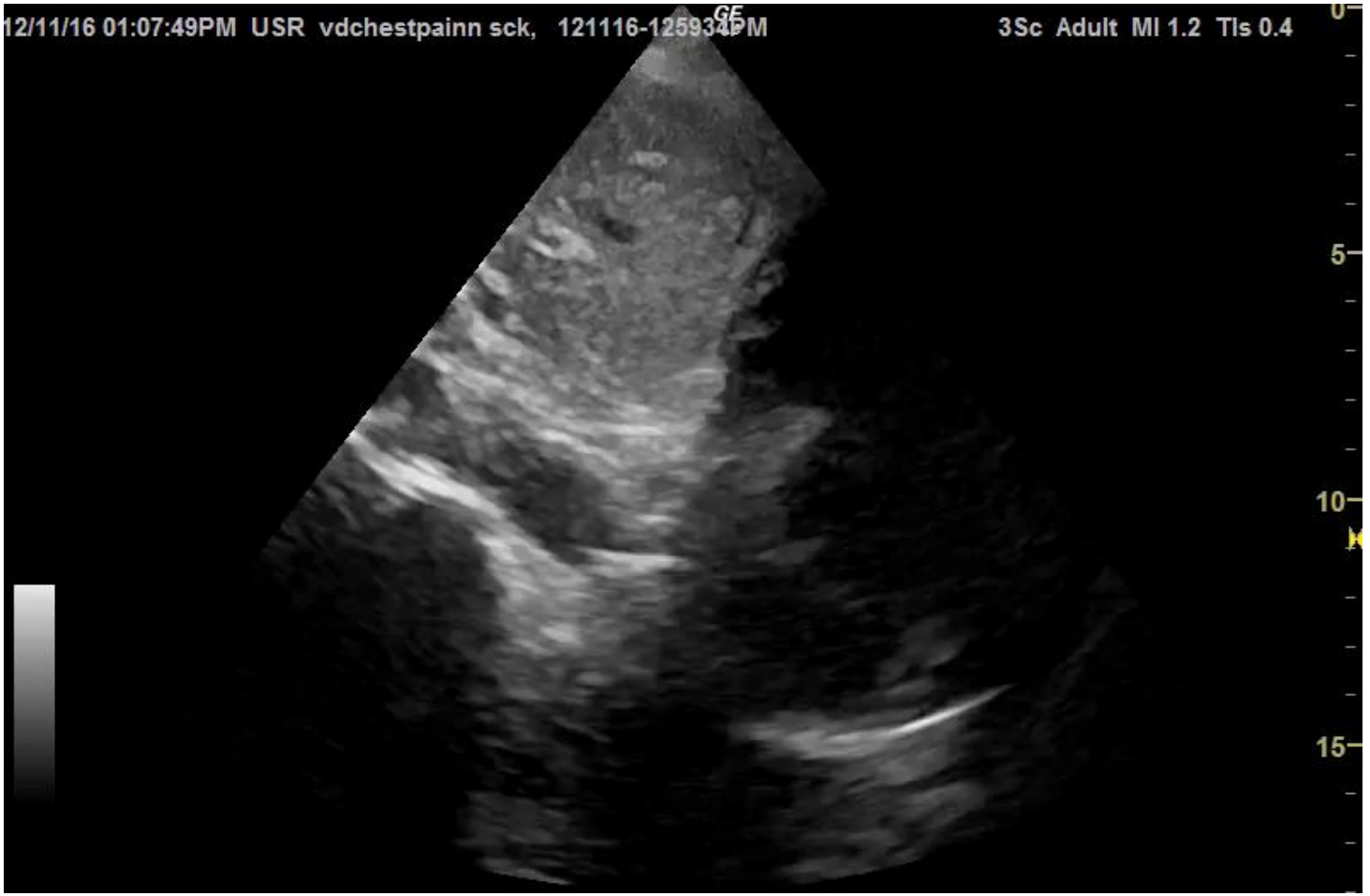
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3Sc Adult MI 1.2 Tls 0.4
0
5
10
15

TTE

Interpretation Summary

- **The left atrium is moderately dilated.**
- **The left ventricle is normal in internal dimension, wall thicknesses and wall motion.**
- **Global left ventricular function is normal.**
- **The right ventricle is mildly dilated.**
- **There is 1+ (mild) tricuspid regurgitation.**
- **There is mild pulmonary hypertension.**
- **Tissue Doppler imaging of the mitral anulus is consistent with normal left ventricular relaxation.**
- **Compared to prior study on 10/17/2013, mild pulmonary hypertension and right ventricular enlargement have developed.**

One of the most difficult diagnoses to make in medicine today is that of pulmonary embolic disease. In a study done in the early 1970s,[1] evidence of pulmonary embolism at autopsy correlated poorly to antemortem diagnosis of pulmonary embolic disease; in only one third of cases were emboli correctly identified. A batting average of .333 may be terrific for a professional baseball player, but for a physician attempting to make a diagnosis of a potentially lethal disease, such a statistic is unsatisfactory.

Real Reason

73-year-old man admitted with dyspnea with a past medical history of diabetes, hypertension and a recent discovery of a large lung mass consistent with lung cancer.

- **Patient is reported approximately a 1 day history of shortness of breath and dyspnea as well as right-sided chest pain. He traveled approximately 14 hours in a plane, during the plane trip he complained several times of shortness of breath partially relieved by supplemental oxygen.**

Case

- **3 months prior to admission, he developed a cough and flulike syndrome, which progressed to requiring hospitalization. He was found to have a large right apical mass. He was scheduled to obtain a biopsy but was deferred because of his elevated INR.**

Case

- **In the emergency room he was tachycardic to 130, given IV fluids and morphine. He was mildly hypertensive with systolics in the 150s and hypoxic requiring 4 L nasal cannula to saturate around 93%.**
- **He was found to have an elevated creatinine 2.03 as well as an INR of 1.9.**
- **Because of his elevated creatinine a ventilation perfusion scan was ordered which was <u>intermediate</u> probability for pulmonary embolism.**

Case

- **Anticoagulation was not initiated**
- **Reason given, lack of evidence of right heart strain on bedside echocardiogram as well as an elevated INR with no confirmation of a PE.**
- **The emergency room physicians also were concerned about the possibility of an intracranial mass causing a bleed. The patient's neurologic examination was nonfocal.**
- **The medical residents ordered an ultrasound of the lower extremities held off on anticoagulation although there are clinical suspicion was exceedingly high.**

Case

- **Around 14 hours after his initial arrival in the emergency room he developed an episode of pulselessness and was pronounced dead after unsuccessful attempt at resuscitation.**

TTE for PE

Diagnostic strategy	Study Grade			No of patients	Heterogeneity			Pooled random negative likelihood ratio (95% CI)
	A	B	C		Cochran's Q	P value	I^2 (%)	
Echocardiography[22 23]	0	1	1	148	0.15	0.70	0	0.59 (0.41 to 0.86)

Miniati, M et al. Value of transtho- racic echocardiography in the diagnosis of pulmonary embolism: results of a prospective study in unselected patients. Am J Med 2001;110:528-35. [SEP]

Bova C, et al. Diagnostic utility of echocardiography in patients with suspected pulmonary embolism. Am J Emerg Med 2003;21:180-3

Lung US for PE

Study	TP	FP	FN	TN	Sensitivity	Specificity
Kroschel 1991	28	1	3	1	0.90 [0.74, 0.98]	0.50 [0.01, 0.99]
Leichleitner 1998	18	15	3	31	0.86 [0.64, 0.97]	0.67 [0.52, 0.80]
Leichleitner 2002	29	1	7	18	0.81 [0.64, 0.92]	0.95 [0.74, 1.00]
Mathis 1990	27	2	1	3	0.96 [0.82, 1.00]	0.60 [0.15, 0.95]
Mathis 1993	41	4	1	8	0.98 [0.87, 1.00]	0.67 [0.35, 0.90]
Mathis 1999	66	6	4	41	0.94 [0.86, 0.98]	0.87 [0.74, 0.95]
Mathis 2005	144	8	50	150	0.74 [0.67, 0.80]	0.95 [0.90, 0.98]
Mohn 2003	22	10	9	33	0.71 [0.52, 0.86]	0.77 [0.61, 0.88]
Pfeil 2010	7	7	3	16	0.70 [0.35, 0.93]	0.70 [0.47, 0.87]
Reissig 2001	35	2	9	23	0.80 [0.65, 0.90]	0.92 [0.74, 0.99]

CHEST

Original Research

PULMONARY PROCEDURES

Accuracy of Point-of-Care Multiorgan Ultrasonography for the Diagnosis of Pulmonary Embolism

Peiman Nazerian, MD; Simone Vanni, MD, PhD; Giovanni Volpicelli, MD, FCCP; Chiara Gigli, MD; Maurizio Zanobetti, MD; Maurizio Bartolucci, MD; Antonio Ciavattone, MD; Alessandro Lamorte, MD; Andrea Veltri, MD; Andrea Fabbri, MD; and Stefano Grifoni, MD

- **MCTPA has high costs, is not feasible in unstable patients, is not available 24 h a day in all institutions, and should be used with caution in some patient groups, such as patients with renal failure and pregnant women.**

- **The diagnostic role of ultrasonography in patients with suspected PE, focusing on subpleural infarcts investigated by lung ultrasonography, right ventricular dilatation by heart ultrasonography, and DVT by leg vein ultra- sonography. However, due to the relatively low sensitivity, not one of these ultrasonographic methods can be safely used to rule out PE as a standalone test**

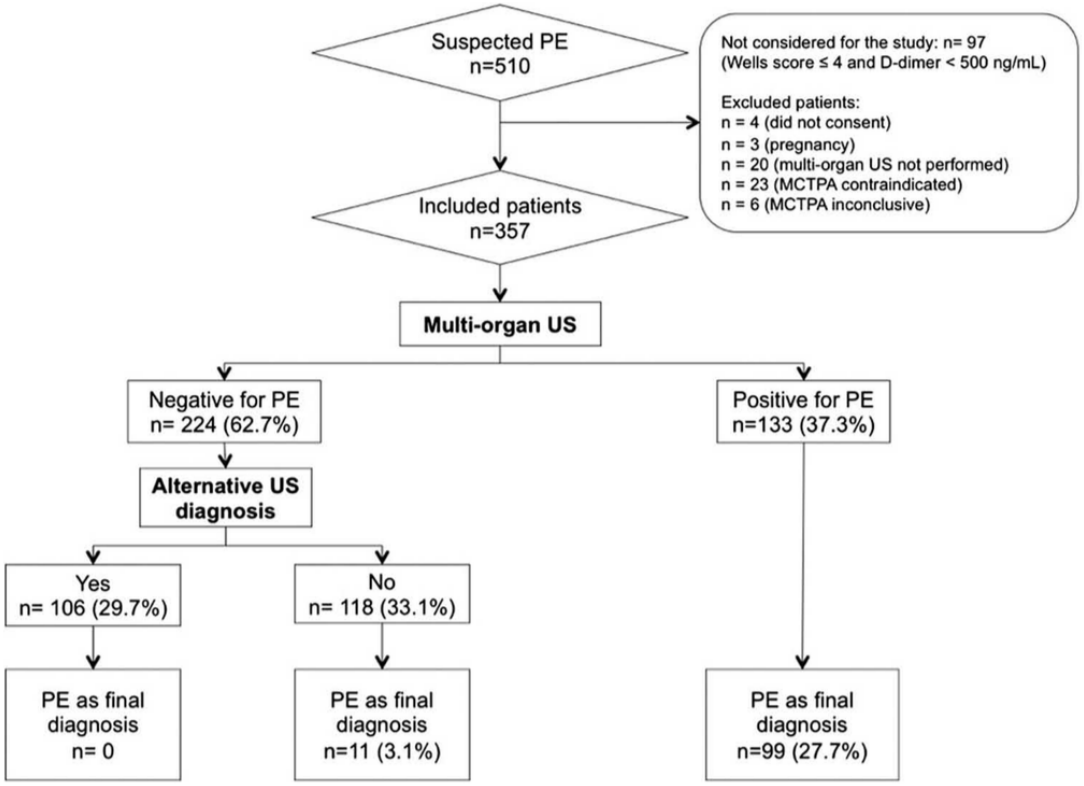


FIGURE 1. Flow diagram of the study and main results. Percentage (%) refers to the 357 included patients. MCTPA = multidetector CT pulmonary angiography; PE = pulmonary embolism; US = ultrasonography.

Table 1—*Final Diagnosis in the Study Patients*

Diagnosis	No. (%)
Pulmonary embolism	110 (30.8)
Pneumonia	84 (23.5)
Heart failure	27 (7.6)
COPD	22 (6.2)
Pleural effusion	17 (4.8)
Syncope	16 (4.5)
Musculoskeletal chest pain	13 (3.6)
Sepsis	13 (3.6)
Acute coronary syndrome	12 (3.4)
Tachyarrhythmia	12 (3.4)
Psychogenic dyspnea	6 (1.7)
Aortic dissection	5 (1.4)
Pulmonary fibrosis	4 (1.1)
Pericardial effusion	3 (0.8)
Miscellaneous	13 (3.6)

Table 2—*Characteristics of the Study Population According to Final Diagnosis*

Characteristic	PE Negative (n = 247)	PE Positive (n = 110)	*P* Value
Age, mean ± SD, y	70.7 ± 14.4	72.7 ± 12.3	.214
Women	123 (49.8)	65 (59.1)	.11
Signs and symptoms of presentation			
Syncope	50 (20.2)	14 (12.7)	.101
Cardiac arrest	2 (0.8)	1 (0.9)	1
Palpitations	25 (10.1)	13 (11.8)	.71
Chest pain			
Total	72 (29.1)	26 (23.6)	.306
Pleuritic	43 (17.4)	18 (16.4)	.88
Dyspnea	152 (61.5)	82 (74.5)	.022
Shock/hypotension	44 (17.8)	11 (10)	.08
Wells score and single items			
Signs and symptoms of DVT	30 (12.1)	54 (49.1)	< .001
PE most likely diagnosis	112 (45.3)	72 (65.5)	.001
HR > 100 bpm	122 (49.4)	46 (41.8)	.207
Immobilization or surgery	65 (26.3)	28 (25.5)	.897
Previous DVT or PE	31 (12.6)	14 (12.7)	1
Hemoptysis	9 (3.6)	1 (0.9)	.185
Malignancy	53 (21.5)	30 (27.3)	.278
Wells score > 4	103 (41.7)	72 (65.4)	< .001
D-dimer			
Positive level, ≥ 500 ng/mL	187 (75.7)	107 (97.3)	< .001

Data are given as No. (%) unless otherwise indicated. bpm = beats/min; HR = heart rate; PE = pulmonary embolism.

Table 3—*Accuracy of Lung, Heart, Veins, and Multiorgan Ultrasonography for the Diagnosis of PE*

Ultrasonography	Sens % (95% CI)	Spec % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	+LR (95% CI)	−LR (95% CI)
Lung	60.9 (51.1-70.1)	95.9 (92.7-98)	87 (77.4-93.6)	84.6 (79.9-88.7)	15 (8-28.1)	0.4 (0.3-0.5)
Heart[a]	32.7 (24.1-42.3)	90.9 (86.6-94.2)	62.1 (48.4-74.5)	74.8 (69.5-79.7)	3.6 (2.2-5.8)	0.7 (0.6-0.8)
Vein	52.7 (43-62.3)	97.6 (94.8-99.1)	90.6 (80.7-96.5)	82.2 (77.4-86.4)	21.7 (9.7-48.8)	0.5 (0.4-0.6)
Multiorgan	90 (82.8-94.9)	86.2 (81.3-90.3)	74.4 (66.1-81.6)	95.1 (91.4-97.5)	6.5 (4.8-8.9)	0.12 (0.07-0.2)
Negative multiorgan, plus alternative diagnosis	100 (96.7-100)	42.9 (36.7-49.3)	43.8 (37.6-50.2)	100 (96.5-100)	1.75 (1.6-1.9)	0

−LR = negative likelihood ratio; NPV = negative predictive value; +LR = positive likelihood ratio; PPV = positive predictive value; Sens = sensibility; Spec = specificity. See Table 2 legend for expansion of other abbreviation.

[a]Calculated in 352 patients with available heart ultrasonography.

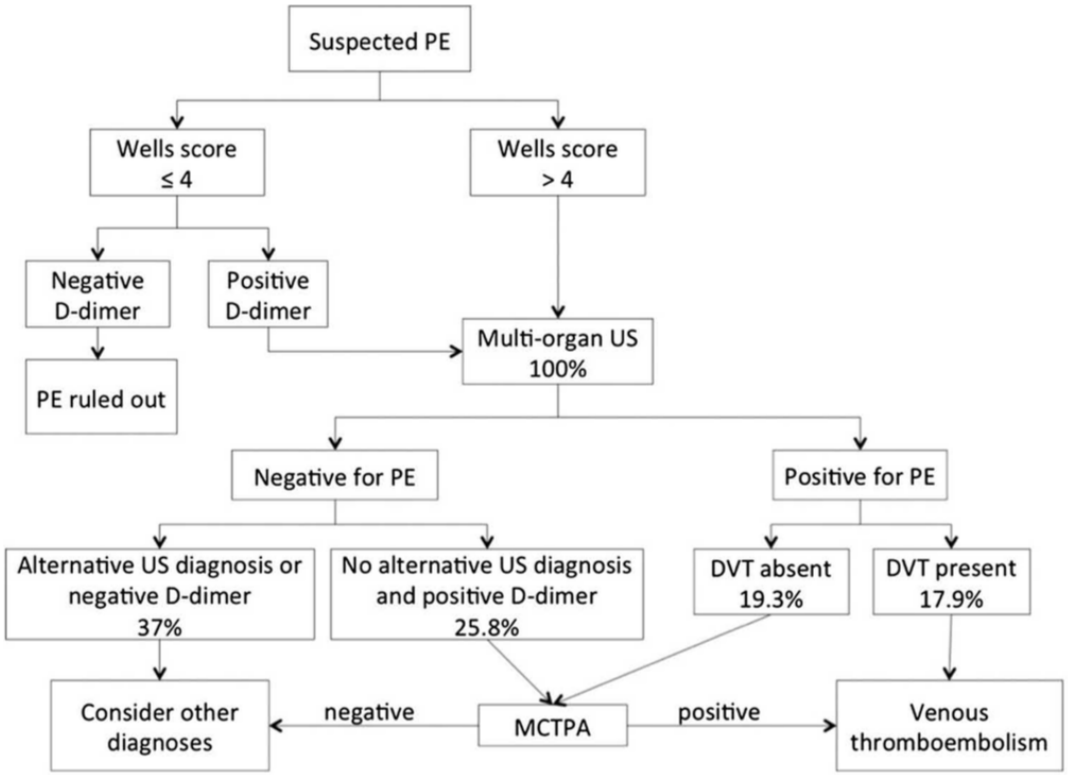
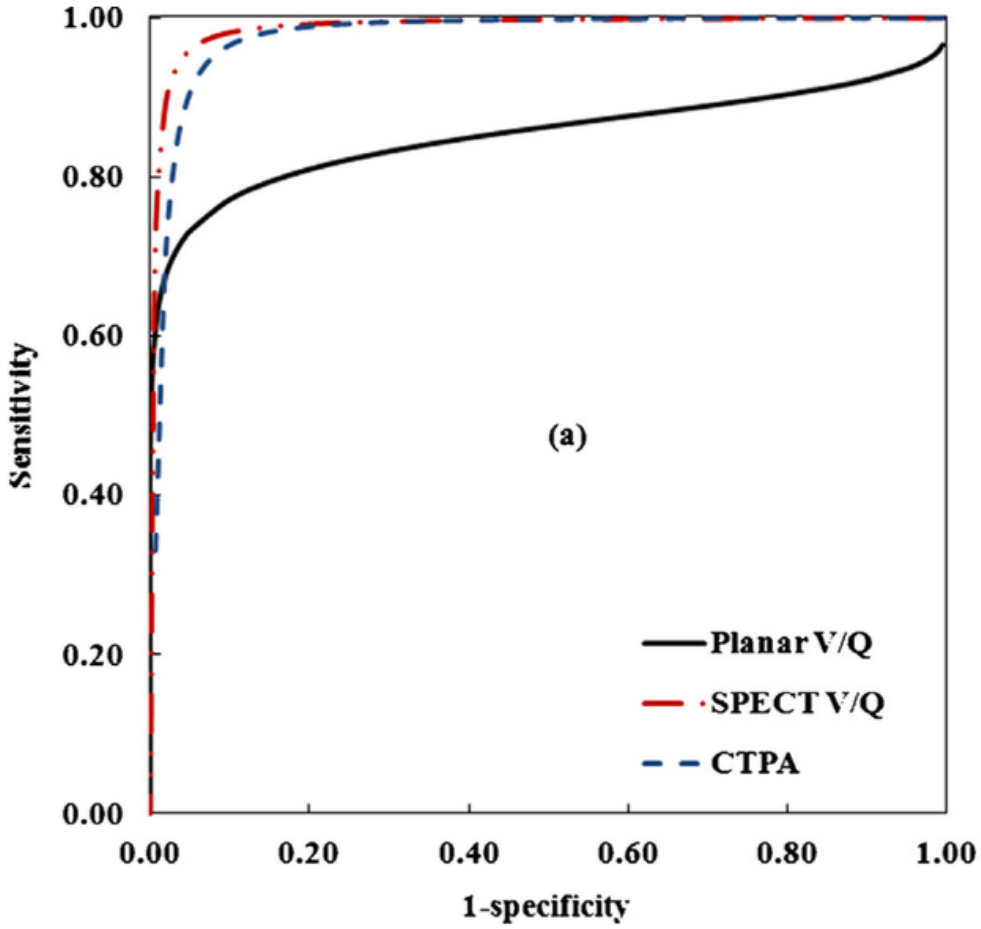


FIGURE 3. Proposed diagnostic algorithm for suspected PE based on Wells score, D-dimer, multiorgan US, and MCTPA. Percentage (%) refers to the 357 included patients. See Figure 1 legend for expansion of abbreviations.


1.00
0.80
0.60
0.40
0.20
0.00
Sensitivity
(a)
Planar V/Q
SPECT V/Q
CTPA
0.00
0.20
0.40
0.60
0.80
1.00
1-specificity

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