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D-dimer testing versus multislice computed tomography in the diagnosis of postpartum pulmonary embolism in symptomatic high-risk women

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Postpartum pulmonary embolism (PE) is a challenging diagnosis because physiologic changes during pregnancy can yield benign symptoms that mimic or mask the condition. All PE tests have limitations, and diagnosis is confirmed only in approximately one-third of high-risk symptomatic women [1].

Because it yields nonspecific results—which can be related to pregnancy events, cancer, and infections [1]—D-dimer testing has not significantly impacted the diagnosis of PE and is used only as an exclusion tool. In high-risk patients, imaging should be performed instead of D-dimer testing [2]. Multislice computed tomography (MSCT) creates thinner sections and involves shorter scanning times and clearer visualization of segmental and subsegmental vessels than other types of computed tomography (CT). In cases of suspected PE that have been shown to be negative, MSCT use has prevented unnecessary treatment [3]. The aim of the present study was to compare D-dimer testing with spiral MSCT plus contrast agent in the diagnosis of postpartum PE in symptomatic women.

The present study took place at Sohag University Hospital, Sohag, Egypt. In total, 2359 women experiencing different postpartum (i.e. within 42 days after delivery or abortion) symptoms and signs of PE were evaluated. The study was approved by the institutional Ethics Committee and informed consent was obtained from all participants.

Histories included age, presenting symptoms, and signs of PE such as shortness of breath, chest pain, hemoptysis, wheezy chest, palpitations, and cyanosis. The women were given follow-up cards and encouraged to report any symptoms to the emergency unit or to phone the study investigators to be booked for follow-up. Risk factors for thromboembolism included age over 35 years; parity of 3 or more; body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) of 30 or more; past or family history of deep vein thrombosis and/or PE; past history of contraceptive pill use; and recent history of trauma, surgery, bed rest, malignancy, and/or autoimmune disorders. A positive Homans' sign was noted if discomfort was elicited in the upper calf during forced dorsiflexion of the ankle joint. Leg swelling was considered to be significant if there was a 2-cm difference in calf and ankle measurements (at the widest point of each) between legs.

Vital signs were reported and general, chest, and heart examinations were undertaken. Imaging included plain chest X-ray in the posterior–anterior view, electrocardiography, echocardiography, and MSCT scan (Multidetector 6 Philips; Koninklijke Philips Electronics, Amsterdam, Netherlands) plus contrast agent. Normal renal function was confirmed before contrast injection. Laboratory tests included D-dimer testing via enzyme-linked immunosorbent assay using an immunochemical automated analyzer (Abbott AxSYM; Abbott Laboratories, Chicago, IL, USA). In the present study, 500 IU/mL or less of fibrinogen was considered negative for PE and 1500 IU/mL or more was considered to be highly suggestive of PE.

Caudocranial thoracic images were acquired via MSCT scan (Brilliance 6 CT Scanner; Koninklijke Philips Electronics, Amsterdam, Netherlands). To gain an intravenous view, an 18–20-gauge catheter with a 100–125-mL injection (adjusted for weight) of iodinated contrast agent (350 mg I/mL) was introduced at 4 mL/second into an antecubital vein. Images were obtained via a standard algorithm and viewed using imaging software (IMPAX 4.1; AGFA, Teterboro, NJ, USA). They were displayed with 3 different grayscales, enabling lung window-specific (window width/level, 1500/600 HU), mediastinal window-specific (400/40 HU), and PE-specific (700/100 HU) settings.

Reformatted images enabled differentiation between true PE and a variety of patient-related, technical, anatomic, and/or pathologic factors that can mimic PE. Contrast material-enhanced spiral CT of the veins of the lower extremities was performed with the same contrast material bolus used for chest CT. Images of the iliac, femoral, and popliteal veins were obtained 4 minutes after the onset of enhancement from the initial contrast material injection. Women diagnosed with PE via spiral CT were treated immediately according to department protocol; treatment lasted for 6 months in total.

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Table 1
Characteristics of women with clinical parameters highly suggestive of PE (n = 60).[a]

Characteristic	
Past history of thrombosis (DVT and/or PE)	5 (8.3)
Family history of thrombosis (DVT and/or PE)	8 (13.3)
Past history of contraceptive pill use	20 (33.3)
BMI ≥ 25	31 (51.7)
Shortness of breath	51 (85.0)
Chest pain	10 (16.7)
Hemoptysis	16 (26.7)
Echocardiography changes	7 (11.7)
Wheezy chest	12 (20.0)
Cyanosis	5 (8.3)
Tachycardia >120 beats/min	8 (13.3)
Tachypnea	33 (55.0)
Electrocardiography changes	17 (28.3)
Chest X-ray abnormality	13 (21.7)
Positive D-dimer test results (fibrinogen >500 IU/mL)	60 (100.0)
Positive MSCT findings	4 (6.7)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); DVT, deep vein thrombosis; MSCT, multislice computed tomography; PE, pulmonary embolism.
[a] Values are given as number (percentage).

Table 2
Final diagnoses of women with positive D-dimer test results compared with those of women with positive MSCT findings (n = 60).[a]

Final diagnoses	Women with positive D-dimer test results	Women with positive MSCT findings
Anemia	9 (15.0)	0 (0.0)
Rheumatic heart	5 (8.3)	0 (0.0)
Cardiomyopathy	2 (3.3)	0 (0.0)
Bronchial asthma	6 (10.0)	0 (0.0)
Pneumonia	6 (10.0)	0 (0.0)
Tracheobronchitis	10 (16.7)	0 (0.0)
Musculoskeletal pain	5 (8.3)	0 (0.0)
Sighing respiration	13 (21.7)	0 (0.0)
Pulmonary embolism	4 (6.7)	4 (6.7)
Total	60 (100.0)	4 (6.7)

Abbreviation: MSCT, multislice computed tomography.
[a] Values are given as number (percentage).

Of the 2359 women, 60 (2.5%) had clinical parameters that were highly suggestive of PE. All of these women—who were initially diagnosed with postpartum PE within the first week after delivery—had positive D-dimer test results; therefore, MSCT was carried out to confirm the diagnoses. The ages of the 60 patients were as follows: younger than 20 years (n = 16 [26.7%]); 21–26 years (n = 13 [21.7%]); 27–31 years (n = 14 [23.3%]); and 32–37 years (n = 17 [28.3%]). The parity of the women was as follows: 0 (n = 9 [15.0%]); 1–4 (n = 45 [75.0%]); and 5 or more (n = 6 [10.0%]). Social class and education were listed as follows: illiterate (n = 8 [13.3%]); high-school education (n = 25 [41.7%]); and university education (n = 27 [45.0%]).

The clinical characteristics of all 60 women were noted (Table 1), and the final diagnoses of women with positive D-dimer test results were compared with those of women with positive MSCT findings (Table 2). A final diagnosis of postpartum PE was confirmed via MSCT in 4 (6.7%) cases. In total, 35 (58.3%) women delivered vaginally, whereas 25 (41.7%) underwent cesarean delivery. Of the women with a final diagnosis of PE, 1 delivered vaginally and 3 delivered via cesarean. D-dimer test results and MSCT findings were also compared (Table 3). The number needed to screen (NNS, indicating the number of patients with positive D-dimer test results required to diagnose 1 case of PE) was defined as the ratio of positive D-dimer test results to positive MSCT findings. In the present study, the NNS was 15 (60/4).

Table 3
Comparison of D-dimer test results and PE-related MSCT findings (n = 60).[a]

D-dimer result [b]	MSCT finding		Total
	Negative	Positive	
Negative	0 (0.0)	0 (0.0)	0 (0.0)
Positive	56 (93.3)	4 (6.7)	60 (100.0)
Total	56 (93.3)	4 (6.7)	60 (100.0)

Abbreviations: MSCT, multislice computed tomography; PE, pulmonary embolism.
[a] Values are given as number (percentage).
[b] Sensitivity of D-dimer testing was 4/4 = 100.0%; specificity was 0/(0 + 56) = 0.0%; negative predictive value was (0/56) × 100 = 0.0%; positive predictive value was (4/60) × 100 = 6.7%; compatibility rate was (0 + 4)/60 × 100 = 6.7%.

The sensitivity of D-dimer testing among postpartum women with symptoms suggestive of PE was 100.0% (Table 3). Although D-dimer testing was 100% sensitive for PE, 56 (93.3%) of the 60 women with positive D-dimer test results were proved via MSCT to be negative for the condition. This equates to a 6.7% positive predictive value for D-dimer testing, making it an unsuitable exclusion test but a strong screening tool. D-dimer testing required 15 patients to diagnose 1 case of PE. These characteristics make it an unsuitable test in busy low-resource settings, where diagnostic tools with high specificity and negative predictive values are of paramount importance. D-dimer testing is nonspecific and cannot support treatment decisions [1].

As indicated by the results of the present study, the immediate postpartum period after cesarean is the time of greatest risk for PE. In all 4 confirmed cases, PE occurred in the first week. A specific clinical presentation conferring significant risk for subsequent diagnosis of PE was not identified.

The limitations of the present study included the relatively small patient cohort. Further studies with larger numbers of patients are required before the present findings can be applied to similar settings.

Although D-dimer testing is a good screening tool for excluding PE in high-risk postpartum cases, MSCT with contrast agent is required to confirm diagnoses when test results are positive. Raising the negative cut-off level of D-dimer testing could help to improve its specificity.

Conflict of interest

The authors have no conflicts of interest.

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