Chest ultrasound in the diagnosis of pulmonary embolism in a pregnant patient — a case report

Abstract

Pregnancy is a risk factor for both pulmonary embolism (PE), and an incorrect diagnostic assessment in cases of suspected PE with potentially dangerous consequences for the mother and foetus. The major concern is ionising radiation utilized by diagnostic tests and its potential negative effect on foetal safety. This paper presents diagnostic difficulties encountered in a 31-year-old patient at 20 weeks of gestation who was admitted to hospital with non-specific chest pain and suspected PE as a complication of right lower limb venous thrombosis. The case study reminds of chest ultrasound as a useful tool in the diagnosis of PE. The official clinical practice guidelines do not recommend the use of chest ultrasound for diagnosing of PE due to lack of a sufficient number of published studies. This case report may encourage further, prospective studies in the hope to define whether and when chest ultrasound might find its place in the diagnostic strategy of PE, especially in pregnant women.

Key words: deep vein thrombosis, pulmonary embolism, ultrasound, chest, pregnancy, diagnosis


Introduction

The contemporary practice guidelines in pulmonary embolism (PE) recommend diagnostic algorithms, whose efficacy and safety have been verified in prospective clinical studies [1]. The recommended diagnostic methods include: determination of D-dimer, angio-CT, pulmonary scintigraphy, pulmonary arteriography, venous ultrasound and, in some cases, echocardiography. The selection of diagnostic methods depends, among other factors, on the clinical likelihood of PE, the actual availability of a specific test and the clinical context.

Ultrasonographic assessment of the chest has been suggested as a potentially useful tool in the differential diagnosis of dyspnoea in patients with COPD [2] and heart failure [3]. In patients with COPD, the sensitivity of ultrasound in detecting pneumothorax is 100% with a specificity of 84%, although it does not replace other diagnostic methods. Pleural ultrasound is also used in evaluating the nature of pleural effusion [4, 5]. In the case of pleural effusion, the sensitivity of ultrasonography in detecting cancer is 73% with a specificity of 100%, positive predictive value (PPV) of 100% and negative predictive value (NPV) of 79%. Pleural
thickening of > 10 mm, its nodular outline and diaphragmatic thickening of > 7 mm are all suggestive of cancer. Some authors reported usefulness of this diagnostic method in the diagnostic assessment of PE [6] by visualising lesions consistent with distal postembolic foci in the pulmonary parenchyma [7–9]. The knowledge about the sensitivity and specificity of this method is scarce and mainly based on reports inspired by one team of researchers [8]. It is unclear whether this is due to the lack of other studies or to their discouraging results making publications difficult (the so-called publication bias).

We therefore decided to improve our own experience using chest ultrasound in the diagnostic assessment of PE. In the case of favourable outcomes, the method might be particularly useful in pregnant women, expanding the panel of diagnostic tests based on the emission of ultrasounds rather than ionising energy [10].

This paper presents the first case of a pregnant woman with a suspected PE, in which a comprehensive ultrasound assessment of the chest was performed and the images were compared with those described in the available literature.

**Case report**

A 31-year-old woman at 20 weeks of gestation was admitted emergently with right lower limb venous thrombosis. The symptoms developed on 11 September 2008 in the form of lower leg pain accompanied by a slight oedema. The diagnosis was made in the outpatient setting by compression ultrasound of the veins (Fig. 1). Two weeks before these events the patient experienced “pain in her spine” and left-sided chest pain. The patient gave a history of deep vein thrombosis in the left lower limb seven years before, following the use of hormonal contraceptives. She had been receiving anticoagulant treatment for a short period, but could not remember the names of the medications or the details of treatment. No diagnostic evaluation for thrombophilia had been performed at that time. The patient also gave a history of recurrent lower limb venous thrombosis suffered by her father.

During pregnancy the patient was under constant care of an obstetrician and gynaecologist and had been taking intravaginal progesterone until she was hospitalised. She was also under constant care of an endocrinologist due to hyperthyreosis in the course of Graves disease diagnosed in 2004.

Laboratory tests following admission to the ward revealed, among others: HGB 10.72 g/dl, HCT 31.5%, RBC 3.64 × 10^9/l, PLT 334 × 10^6/l, D-dimer 2027 µg/l, APTT 31 s, INR 0.92, antithrombin III 86%, fibrinogen 6.47 g/l, TSH 0.005 µIU/ml, FT4 17.9 pmol/l. Blood gas analysis (arterialised blood) revealed PaO2 96 mm Hg, pH 7.45, pCO2 35 mm Hg. ECG revealed no significant abnormalities. We considered indications for extending the diagnostic assessment to include the possibility of PE due to the respiration-dependent chest pain and dyspnoea, in light of the preserved hemodynamic stability, normal systolic blood pressure and no manifestations of shock, a suspicion of non-high-risk PE was raised. We considered indications for extending the diagnostic assessment to include...
de chest imaging. Due to the pregnancy, good overall condition of the patient and the pleural nature of the pain we started the diagnostic investigation with a chest ultrasound and a detailed assessment of the prognostic risk markers.

The ultrasound scan revealed no changes in the left pleura. In the right pleura a small amount of effusion was detected, over three intercostal spaces. Behind the effusion, we visualised a lung with poorer aeration and slightly reduced volume. In its lower portion, we observed at least three subpleural hypoechoic areas in the shape of a triangle with the base facing the pleura. The largest of the three areas had a base of 37.5 mm and a height of 18 mm. The dimensions of the smaller lesions were up to 22 mm in base and up to about 15 mm in height. Between the lung and the chest, at the site of the greatest accumulation of effusion, the thickness of the layers was up to 22 mm. The parietal pleura was slightly thickened (Fig. 2).

The lesions were compared with typical images characterising various pathologies and were found to meet criteria suggested for PE on chest ultrasonography [8] (Table 1).

In our case, three typical triangular lesions with bases on the pleura would allow us, according to the criteria reported in the literature, to make an unequivocal diagnosis of PE.

We also performed an assessment of risk associated with the possibility of PE: the echocardiogram did not show signs of right ventricular overload, there was no elevation of NT-proBNP (84.3 pg/ml), and troponin T was also negative. Therefore, in accordance with the European Society of Cardiology guidelines on the assessment of risk, we classified the patient as being at a low risk of early death related to PE. Because an unequivocal confirmation of PE in this risk group required treatment identical to the management of venous thrombosis (confirmed by compression ultrasound), we decided not to perform any further imaging studies.

The further course of the treatment was confounded by obstetric complications. On the third day of hospitalisation the patient reported that her water had broken. Following a telephone consultation with a gynaecologist, faced with the risk of premature labour, we decided to transfer the patient to the gynaecology department.

Despite the efforts of the obstetric and gynaecologic team aimed at maintaining the pregnancy in the situation of significant oligohydramnios, the patient eventually miscarried. In the post-procedural period, due to the non-specific chest complaints, the patient underwent a contrast-enhanced CT scan, which finally confirmed the presence of small distal embolic lesions in the segmental arteries of the lower lobe of the right lung (Fig. 3). The patient was discharged home in good overall condition and advised to continue secondary anticoagulant prophylaxis for at least 6 months. Tests for thrombophilia were also ordered.

**Discussion**

Pregnancy, due to its adaptative physiological changes in hormone concentrations, the position of the enlarged uterus in the vicinity of large veins, as well as the physiological alterations in the coagulation system, is a risk factor for thromboembolism. At the same time, PE is the most common cause of death among women in puerperium in developed countries. Symptoms appearing during pregnancy, such as dyspnoea, asymmetric lower limb oedema, and even fainting or hypoxaemia, all resemble symptoms associated with PE [1, 10].

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**Table 1. Criteria recommended in the diagnostic evaluation of PE with the use of chest ultrasonography [8]**

<table>
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<th>Category</th>
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<td>Confirmed PE</td>
<td>$\geq 2$ triangular/round lesions with the base on the pleura</td>
</tr>
<tr>
<td>Probable PE</td>
<td>A single typical lesion in the presence of pleural effusion</td>
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<tr>
<td>Possible PE</td>
<td>A small ($&lt;5$ mm) subpleural lesion or asymmetrical pleural effusion</td>
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Figure 2. Ultrasound of the pleura. A large amount of effusion in the right pleural cavity. Two hypoechoic areas are visible that are consistent with subpleural foci of an early pulmonary parenchymal infarct. These areas are of a shape of the triangle whose base runs along the pleura. They are separated by a slightly uneven border from the remaining parenchyma. The lesions are localised in the right lower lobe, dorsally.
At the same time, pregnancy makes diagnostic testing difficult due to ionising radiation and its negative effect on foetal safety. In fact, depending on the timing of exposure during the prenatal period, irradiation may result in abnormal body habitus, mental retardation or promote the development of malignancies in childhood. This is, however, the case with doses exceeding 500 mSv. The acceptable safe dose for the foetus was defined as < 50 mSv [1]. For comparison, the dose absorbed by the foetus during maternal chest X-ray is < 0.01 mSv, which is equivalent to the dose absorbed during an intercontinental flight. Ionising energy affecting the foetus during an angio-CT scan does not exceed 0.15 mSv being similar to the energy absorbed by the foetus during pulmonary perfusion scintigraphy.

Although the concerns about the adverse influence of imaging studies that utilise ionising radiation are not objectively fully justified and should not significantly hinder diagnostic investigation [1, 10], they remain deeply rooted in the psychological sphere of the patients, their families, and many healthcare providers. At the same time, physiological pregnancy, particularly in the second and third trimesters, leads to non-specific elevation in D-dimers, limiting the usefulness of this parameter in the attempts to rule out PE [11–13]. All those problems promote the use of inadequate diagnostic strategies in pregnant women with suspected PE, which in turn considerably increases the risk of venous thromboembolism and sudden death [14]. A wrong decision to refrain from treatment despite a clinical suspicion of PE may end tragically. On the other hand, a hasty decision to initiate treatment and, as a consequence, long-term secondary anticoagulant prophylaxis may expose the mother and foetus to unnecessary risk of haemorrhagic complications.

For these reasons, confirmation of the reliability of chest ultrasound in the diagnosis of PE in pregnant women would be especially useful.

Mathis et al. were the only researchers who conducted a prospective study in 352 patients to evaluate this method versus angio-CT [8]. In 144 cases the sonographic picture classified as “unequivocal PE” or “probable PE” was subsequently confirmed by CT. In 150 cases PE was not detected using either method. In 8 cases ultrasound detected PE unconfirmed by CT and in 50 cases failed to detect PE found on CT. In total, the sensitivity and specificity of chest ultrasound in diagnosing PE was estimated at 74% and 95%, respectively. The positive and negative predictive values were estimated at 95% and 75%, respectively.

In our case we found identical lesions on chest ultrasound as those presented previously in the literature in cases of PE documented by chest CT. They correlated with the patient’s symptoms and were confirmed several days later by the presence of typical lesions on angio-CT.

We do not consider the reported case as a confirmation of the reliability of the method, but as an incentive for further, prospective studies of its clinical usefulness. It seems that a highly suggestive sonographic picture of the chest, even in the face of a low clinical likelihood of PE, should prompt one to order angio-CT scans in all patient groups, even in pregnant women.

References