PRACE KAZUISTYCZNE
położnictwo

Pulmonary CT angiography in the diagnosis of pulmonary embolism in pregnancy – a case report

Angiografia naczyń płucnych w diagnostyce zatorowości płucnej w ciąży – opis przypadku

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Abstract

This paper describe the case of pulmonary thromboembolism (PTE) in pregnancy diagnosed by angio CT. The clinical diagnosis of PTE in normal population is difficult. In pregnancy is even more complicated, because physiologic changes of pregnancy can mimic signs and symptoms of PTE. Our patient presented dyspnoea, breathing effort and cyanosis of the mouth at admission. In the check-up there was a distinct murmur just under the heart and tachycardia 115 bpm. The Doppler examination of the venous vessels of the lower extremities was normal. Echocardiography revealed features of right ventricular failure. Due to increased level of D-dimers and echocardiographic features of right-ventricular overload, the suspicion of pneumonic embolism was made. Therefore, in order to verify the initial diagnosis the decision of pulmonary CT angiography was made with the radiological protection of the fetus. This study revealed pulmonary embolism in the form of numerous defects in the contrast fillings of the pulmonary arteries. CT pulmonary angiography is the first imaging test of choice in general population who is suspected to have PTE. However, there is no consensus what should be preferred during pregnancy. In this paper the diagnostic concepts and an evidence-based guidelines were discussed in case of PTE in pregnancy as well as its side effects including teratogenicity and oncogenicity. In each case, the risks and benefits must be compared before a decision is taken. In case of thrombosis symptoms in the lower extremities, ultrasound should be taken as the next step, otherwise chest X-ray must be performed. In patients with normal chest X-ray, the next step should be scintigraphy, but if chest X-ray is abnormal, angio CT is preferred.

Key words: **pulmonary thromboembolism** / **diagnosis** / **pregnancy** /

Streszczenie

W artykule opisano przypadek zatorowości płucnej (PTE) w ciąży rozpoznany dzięki zastosowaniu angiografii naczyń płucnych w tomografii komputerowej (angio CT). Rozpoznanie PTE w normalnej populacji jest trudne. W ciąży jest jeszcze bardziej skomplikowane, ponieważ zmiany fizjologiczne w ciąży mogą naśladować objawy PTE.

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Nasza pacjentka w momencie przyjęcia do szpitala prezentowała duszność, wysiłek oddechowy i sinicę okolicy jamy ustnej. W badaniu stwierdzano wyraźny szmer tuż pod sercem oraz tachykardię ok. 115 ud/min . Badanie dopplerowskie naczyń żylnych kończyn dolnych było prawidłowe. Badanie echokardiograficzne ujawniło cechy niewydolności prawokomorowej. Z powodu podwyższonego poziomu D-dimerów i echokardiograficznych cech przeciążenia prawej komory serca postawiono podejrzenie zatorowości płucnej. Dlatego też, w celu weryfikacji wstępnego rozpoznania zadecydowano o wykonaniu angio CT z zachowaniem ochrony radiologicznej płodu. Badanie to wykazało zatorowość płucną w postaci licznych ubytków cienia kontrastu w tętnicach płucnych. Angiografia naczyń płucnych w tomografii komputerowej jest pierwszym testem z wyboru w przypadku podejrzenia PTE. Jednakże żadne rekomendacje nie wskazują w sposób jednoznaczny, które badanie jest badaniem z wyboru w czasie ciąży. W pracy przedstawione obecne stanowisko dotyczące diagnostyki, zastosowanie angio CT w ciąży oraz potencjalne działania niepożądane, w tym działanie teratogenne i onkogenne. W każdym przypadku, należy rozważyć potencjalne ryzyko i korzyści zanim podjęta zostanie właściwa decyzja, zwłaszcza jeśli ryzyko zgonu znacznie przeważa ryzyko napromieniowania. Jeśli pacjent prezentuje objawy zakrzepicy w obrębie kończyn dolnych, sugeruje się, że badanie USG powinno być kolejnym krokiem. W innych przypadkach metodą z wyboru jest RTG klatki piersiowej . U pacjentów z prawidłowym obrazem klatki piersiowej w badaniu radiologicznym, zaleca się wykonanie scyntygrafii, natomiast, jeśli RTG klatki piersiowej jest nieprawidłowe, korzystniejsze jest wykonanie angio CT .

Słowa kluczowe: **zatorowość płucna** / **diagnostyka** / **ciąża** /

Introduction

Pulmonary thromboembolism (PTE) is among the most common causes of maternal death during pregnancy and puerperium worldwide and is the leading cause of maternal mortality in developed countries [1].

Pregnancy could be considered as an example of Virchow's triad: hypercoagulability, venous stasis, and vascular damage. The clinical diagnosis of PTE in normal population is usually difficult, but it is even more complicated in pregnant patients. The reason is that physiologic changes of pregnancy can mimic signs and symptoms of pulmonary embolism confusing clinicians to make decision that in which situation they must pursue a diagnosis of pulmonary embolism and request imaging modalities [2].

The diagnostics of PTE in pregnancy is difficult. Pregnant women may present such symptoms as dyspnoea, fatigability and oedema of lower limbs, and these symptoms are often noticed in normal pregnancy [2, 3]. In comparison to non-pregnant women, Pregnant women suffer from 4–5 higher risk of thrombotic complications due to anatomic and physiologic alterations when compared to non-pregnant women. The thrombotic complications in 80% are related to the venous system and are responsible for 1.1 over 100000 deaths of women which gives 9% perinatal deaths of mothers in USA [4].

At present, there have been no randomized trials or prospective studies in detection of PTE in pregnancy. That is why there is currently no specific diagnostic algorithm for suspected PTE in pregnant population [5]. However, different methods and recommended algorithm are discussed.

Case

Up to now healthy, 19-year-old patient in 29th week of pregnancy was admitted to a regional hospital due to sudden deterioration of dyspnoea. In the patient's history the dyspnoea had been notified for three weeks, and had intensified for several hours. The denominating symptoms at admission were dyspnoea, breathing effort and cyanosis of the mouth. In the check-up there was a distinct murmur just under the heart and tachycardia 115 bpm.

The USG and CTG of the fetus were performed as well as Doppler examination of the venous vessels of the lower extremities. These results were normal. Echocardiography revealed features of right ventricular failure. Due to increased level of D-dimers (577 ng/L) and echocardiographic features of right-ventricular overload – the suspicion of pneumonic embolism was made. The treatment with low-molecular weight heparin and next with non-fractionated heparin was applied, giving 5000 units in bolus, and next 1000 units/h in intravenous infusion under the periodic APTT control (lengthening 1.5 times) and oxygen treatment allowed to achieve a partial improvement of patient's status. Due to increased CRP values, an intravenous antibiotic therapy with cefuroksym was implemented. According to reference system of hospitals, after initial supply, with intravenous infusion of heparin, the patient was delivered to a third level referral hospital in Poznań. On admission the state of the patient was relatively balanced, conscious, respiratory and circulatory efficient. The assessment of the fetal well-being included: CTG (FHR about 140bpm, with accelerations, no decelerations, without uterine contractions) and ultrasound screening with Doppler measurements (the fetus presented breech presentation, normal growth dynamics – 1540g, normal fetal anatomy and Doppler blood flow velocimetry). The maintaining tachycardia 115 bpm and recurring dyspnoea were the reasons to transfer the patient to the Department of Cardiology.

On admission to the Department of Cardiology the patient presented: arterial pressure of 90/40, cardiac rhythm 111bpm, silent systolic murmur in the third intercostal space on the left side of the sternum. No lower limbs oedema was seen. In the laboratory tests elevated levels of: D-dimers 2057ng/ml (N<500ng/ml), pro BNP – 3640 pg/ml (N<125 pg/ml), Troponin I-0.092 ng/ml (N<0.056), CRP – 49.6 mg (N<9.6 mg/L) were found. Moreover, the anaemia (Hb – 6.10 mmmol/L) and decreased pO2 – 78 mmHg (N>80 mmHg) were diagnosed. The electrocardiogram revealed normal sinus rhythm about 111bpm. Additionally, Q wave in III, aVF, the complex rSr `in V 1, negative T wave in V1 and V2, V3 and flat in V3 i III were found. The echocardiography revealed features of right ventricular overload:

dilated right ventricle – 33mm, shorter ACT (activated clotting time) in pulmonary artery – 67 ms, increased systolic pressure in the right ventricle RVSP – 50-55 mmHg with asynchronous movement of ventricular septum at the time of contraction toward the left.

The strong suspicion of pulmonary embolism was considered. So, an intravenous unfractionated heparin under the control of the APTT was administered. Further management included Doppler ultrasound of the leg veins and transesophageal echocardiography. But none of these studies did not confirm the presence of embolic material. Therefore, in order to verify the initial diagnosis the decision of pulmonary CT angiography was made with the radiological protection of the fetus. This study revealed pulmonary embolism in the form of numerous defects in the contrast fillings of the pulmonary arteries: on the right side - in the intermediate artery, lower lobar artery, segmental and subsegmental arteries to the lower lobe, on the left side - on the level of left pulmonary artery division, lower lobar artery, segmental arteries to the lower lobe.

The first 10 days an intravenous unfractionated heparin under the control of the APTT (2-2.5 fold increase), and supplementation of iron and folic quarter due to anemia was carried out. During this time, a gradual resolution of dyspnea, tachycardia (75bpm at rest), the reduction of D-dimer level (1494ng/mL) and normalization of troponin, CRP and blood gas parameters. The significant improvements in echocardiography was noticed - prolongation of the ACT-90 ms, a reduction in RVSP-30 mmHg. Then a therapeutic dose of enoxaparin (1mg/kg twice a day) was applied. After 13 days of hospitalization the patient was discharged from the hospital in good general condition with the recommendation of the continuation of LMWH therapy until the end of pregnancy and further diagnostics of thrombophilia in the postpartum period.

Discussion

The clinical diagnosis of PTE in normal population is difficult. In pregnancy is even more complicated, because physiologic changes of pregnancy can mimic signs and symptoms of pulmonary embolism [2, 3]. It may confuse clinicians to make decision that in which situation they must pursue a diagnosis of pulmonary embolism and request imaging modalities.

D-dimer which is the most frequent laboratory test in normal population with suspected PTE. But its efficacy during pregnancy is not acceptable, because in normal pregnancy D-dimer is usually increased [6]. Neverthesless upper limit of D-dimers still has not been defined for pregnant women. A prospective study revealed that physiologically plasma d-dimer levels increase during pregnancy in about 50% of patients [7]. However, it should be remembered, that the proper value of D-dimers has a high exclusion value to exclude pneumonic embolism also in pregnancy [8].

Lower limb compression ultrasonography (CUS) has been proposed as the first-line imaging modality for pregnant women with suspected pulmonary symptoms, suggesting PTE [9]. Doppler ultrasonography (CUS) of venal system, since a positive result warrants anticoagulation treatment and makes thoracic imaging unnecessary and its sensitivity reaches 70%. Although the benefit of using CUS is potential avoidance of next step radiation-associated tests (in positive cases), only small

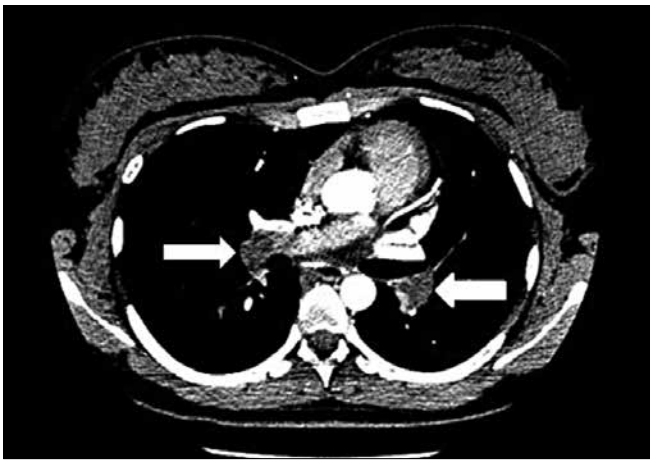

Figure 1. Pulmonary CT angiography revealed pulmonary embolism in the form of numerous defects in the contrast fillings of the pulmonary arteries: on the right side – in the intermediate artery, and lower lobar artery on the left sid.

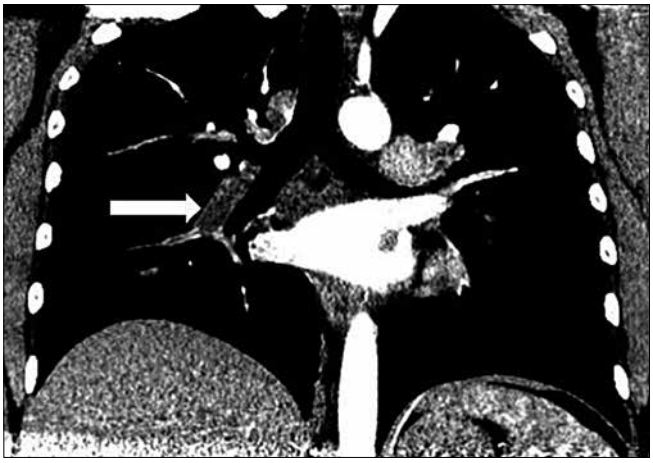

Figure 2. Pulmonary CT angiography – the defect in contrast fillings in the intermediate artery on the right side.

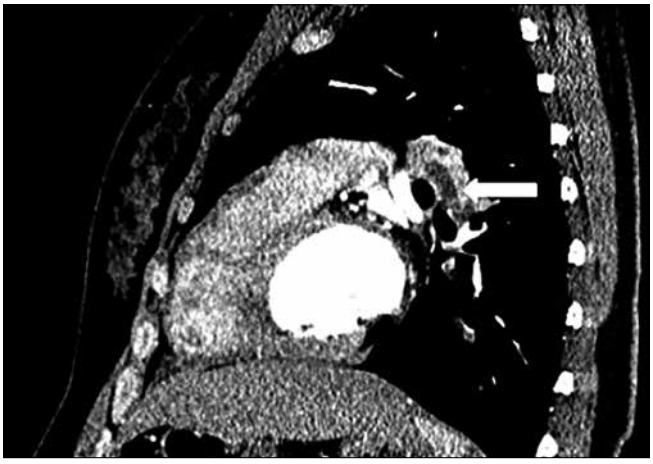

Figure 3. Pulmonary CT angiography – the image presents the emboli on the left side – on the level of left pulmonary artery division.

proportion of CUS studies are positive [10, 11] and it is estimated that the number of women need to do test would likely be several-fold higher, due to lower prevalence of PTE [12]. Furthermore, CUS is problematic in pregnant women due to swollen legs in the absence of deep venous thrombosis (DVT) [13]. According to evidence-based guidelines, using the Grade of Recommendation, Assessment, Development and Evaluation (GRADE) system,it is recommended that in pregnant women with suspected PTE, CUS is performed in the presence of signs and symptoms of DVT, and in absence of signs and symptoms of DVT, CUS would not be first imaging modality [12, 14].

However, European society of cardiology advocate CUS for all pregnant women with suspected PTE and a positive D-dimer test [8]. Second-line radiation-associated imaging begins usually with chest X-ray (CXR), but choosing the next step is more debated. Both Fleischner society and British thoracic society guidelines agree that CT pulmonary angiography (CTPA) is the first imaging test of choice in general population who are suspected to have PTE [2]. However, none of them indicate which technique is preferred in pregnancy [16, 17].

Ridge et al. had noticed considerable number of CTPA in pregnant women which had poor quality resulted in inadequacy of test and repetition of examinations [18]. Cardiac output increases during pregnancy to about 50% above non-pregnant levels and this leads to earlier arrival and stronger dilution of contrast material [19]. Respiratory physiological changes of pregnancy is other point of notice, leading to more artifactual images in pregnant women and contribute to impairment in good arterial opacification, because deep inspiration in pregnant women may increase influx of non-opacified blood via inferior vena cava into the right heart. According to these concepts and evidence-based guidelines, it is recommended to take CXR as the first radiation-associated imaging in the pregnant women with suspected PTE [12]. Then, in the patients who have normal CXR, lung scintigraphy may be recommended as the next imaging test rather than CTPA. Reversely, in the presence of abnormal CXR, CTPA should be next test rather than scintigraphy [2].

In medical imaging like CTPA and lung scintigraphy, deterministic effect is unlikely and the major worry is about stochastic effects including teratogenicity and oncogenicity [20]. Fetal radiation by diagnostic imaging modalities causes no measurably increased prenatal death, malformation, or impaired mental development, but carcinogenesis induced by low-level radiation is more considered, despite no direct evidence supporting it [21]. Fetal dose by CTPA is about 0.03-0.66 mGy and for lung scintigraphy is more (about 0.32-0.74 mGy) [2]. The exposure of the foetus to Roentgen radiation is highly controversial, however, taking into consideration high death rate both in the mother and in the child in the situation, when no proper treatment is applied, is definitely justified. On the other hand it should be remembered that unnecessary anticoagulant treatment exposes the fetus and the mother to the risk of uncontrolled bleeding. The amount of radiation absorbed by the fetus in all radiological tests contains in upper limit with regard to the danger of fetal injury which is 50 mSv (50 000 mGy) [7]. The ESC recommendations favor the chest CT than perfusion lung scintigraphy basing on recent data that had estimated the fetus radiation values in first and second trimester [22]. They claim that CT can be performed safely during pregnancy.

Another problem is the risk of fetal exposure to iodinated contrast media which has not been fully investigated. However, there is no report of their teratogenicity in the literature [23]. Also, in animal studies, there is no teratogenic effect, so they are classified as category B by Federal Drug Administration [24]. The main potential risk might be due to free iodine and possible secondary neonatal hypothyroidism, which leads to this recommendation that these neonates must be evaluated for thyroid function tests in first week after birth [2]. However, in a study by Bourjeily et al. on 344 pregnant women underwent CTPA, there was no abnormal thyroxin level among their neonates [25].

Summarizing, clinical and paraclinical diagnosis of PTE in pregnant women is a challenge. Serious consequences of positive or negative false diagnosis in one hand, against potential risk of radiation and also increased rate of test inadequacy, on the other hand, highlight this challenge. In each case, the risks and benefits must compare to make decision, but if clinician is suspicious, the risk of mortality is far overweight the potential radiation exposure risk. If patient has leg symptoms, CUS will be the next step, otherwise CXR must be taken. In patients with normal CXR, the next recommended modality would be scintigraphy, but if CXR is abnormal, CTPA is preferred. Recommended protocols for improving diagnostic adequacy of these modalities and reducing mother and fetus radiation exposure should also be considered [2].

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