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Case Report of S1Q3T3 Electrocardiographic Abnormality in a Pregnant Asthmatic Patient During Acute Bronchospasm

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Patient: Female, 33
Final Diagnosis: S1Q3T3 electrocardiographic abnormality in a pregnant asthmatic during acute bronchospasm
Symptoms: Cough • shortness of breath
Medication: —
Clinical Procedure: EKG
Specialty: Pulmonology

Objective: Rare co-existance of disease or pathology

Background: Asthma is the most common chronic pulmonary disease during pregnancy. Several previous reports have documented reversible electrocardiographic changes during severe acute asthma attacks, including tachycardia, P pulmonale, right bundle branch block, right axis deviation, and ST segment and T wave abnormalities.

Case Report: We present the case of a pregnant patient with asthma exacerbation in which acute bronchospasm caused S1Q3T3 abnormality on an electrocardiogram (ECG). The complete workup of ECG findings of S1Q3T3 was negative and correlated with bronchospasm. The S1Q3T3 electrocardiographic abnormality can be seen in acute bronchospasm in pregnant women. The other causes like pulmonary embolism, pneumothorax, acute lung disease, cor pulmonale, and left posterior fascicular block were excluded.

Conclusions: Asthma exacerbations are of considerable concern during pregnancy due to their adverse effect on the fetus, and optimization of asthma treatment during pregnancy is vital for achieving good outcomes. Prompt recognition of electrocardiographic abnormality and early treatment can prevent adverse perinatal outcomes.

MeSH Keywords: Asthma • Bronchial Spasm • Electrocardiography • Pregnancy

ECG – electrocardiogram; **BA** – bronchial asthma

Full-text PDF: http://www.amjcaserep.com/abstract/index/idArt/901661

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Background

Asthma is a chronic inflammatory disease of the airway, characterized by hyper-responsiveness of the tracheobronchial tree to stimuli, and is the most common chronic pulmonary disease during pregnancy [1]. In the United States, mortality rates for asthma are approximately 2.1 per 100,000 people [2]. Women with mild asthma rarely have complications compared to women with severe asthma. Severe or poorly controlled asthma during pregnancy is associated with various adverse perinatal outcomes such as preterm labor, premature birth, congenital anomalies, low birth weight, preeclampsia, pregnancy-induced hypertension, uterine bleeding, and fetal growth retardation [3].

Several electrocardiographic abnormalities have been reported in asthmatic patients, including tachycardia, P pulmonale, right bundle branch block, right axis deviation, and ST segment and T wave abnormalities [4]. Acute cor pulmonale can result in an S1Q3T3 pattern on an ECG, regardless of the cause, which includes acute bronchospasm, pulmonary embolism, pneumothorax, acute lung disease, and left posterior fascicular block [5].

Case Report

A 33-year-old, gravida3para2, pregnant (19 weeks) woman with a medical history of asthma presented to the emergency department (ED) with complaints of progressively worsening dry cough, wheezing, shortness of breath, and chest tightness over a one-week period. The patient had developed flu-like symptoms one month prior to her presentation at the ED; she later developed an intermittent cough and was treated for laryngitis in an outside facility with some improvement in her symptoms. She denied any fever, sick contacts, abdominal pain, or vaginal bleeding. There was no history of recent travel, smoking, or illicit drug use, but the patient did have a history of asthma since childhood and utilized an albuterol inhaler as needed. Review of the patient's systems was negative except as noted above.

Upon physical examination, the patient appeared to be in mild distress. She was tachycardic with a heart rate of 112 beats per minute, an oxygen saturation of 92% on a 2-liter nasal cannula, and was afebrile. The patient was using accessory muscles of respiration, but palpation of the chest did not elicit any tenderness. On auscultation, breath sounds were distant and end expiratory wheezes were present bilaterally. The remainder of the physical examination was unremarkable.

A transvaginal ultrasound revealed a single viable intrauterine pregnancy. Initially, the patient declined a chest radiograph. The patient's pertinent blood gas values were: pH 7.45 and pCO_2 27.8. Although the patient was initially admitted for acute exacerbation of bronchial asthma (BA), her symptoms worsened and she was transferred to the intensive care unit for asthma exacerbation; an ECG revealed an S1Q3T3 pattern (Figure 1).

The patient remained persistently tachycardic and hypoxic, requiring noninvasive positive pressure ventilation, intravenous steroids, bronchodilator therapy, and heliox. The patient's symptoms, together with the ECG findings of S1Q3T3, led us to suspect pulmonary embolism, and therefore to request a ventilation and perfusion scan, which showed low probability for pulmonary embolism. A Doppler of the lower extremity was negative for deep vein thrombosis. An echocardiogram showed normal ejection fraction, normal diastolic function, mildly elevated pulmonary artery pressure, and a mildly dilated left atrium. The patient subsequently improved and was transferred out of the intensive care unit. The ECG (Figure 2) showed reversal of S1Q3T3 once acute bronchospasm was resolved in our patient.

Discussion

Asthma is the most common pulmonary disease during pregnancy, occurring in 3–8% of pregnancies [6]. One-third of pregnant women with asthma may develop severe exacerbation

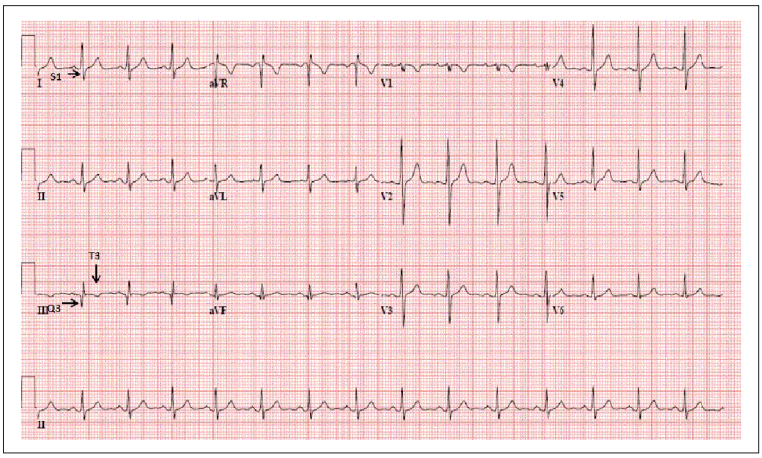

Figure 1. ECG showing S wave in lead I, Q wave, and an inverted T wave in Lead III.

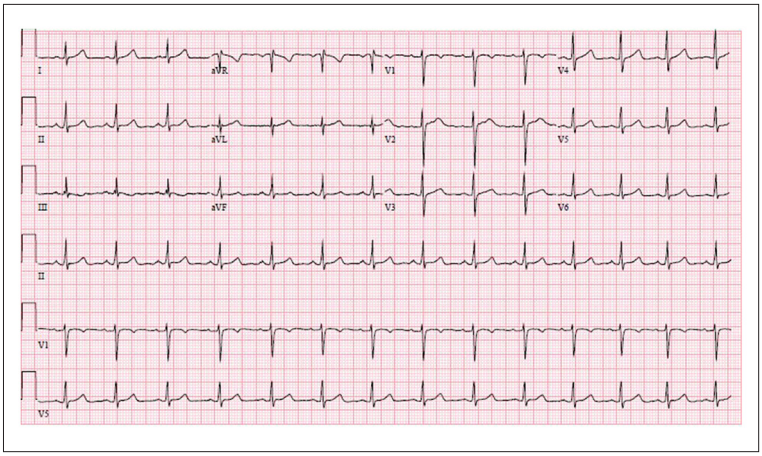

Figure 2. Image shows resolution of ECG finding.

of asthma, and one risk factor for exacerbation is contraction of a respiratory viral infection [7]. Although asthma exacerbation can arise at any stage of pregnancy, it tends to occur in the second trimester [8].

Asthma during pregnancy increased the risk of preeclampsia, complicated labor, perinatal, neonatal mortality, hypertensive disorders, spontaneous abortion and decreased birth weight in infants [9]. Pregnant women with uncontrolled asthma have been shown to have ssignificant asthma-associated immune reactions, such as diminished pregnancy specific regulatory T cell proliferation, increase number of peripheral interferon gamma producing cells and increase in heat shock protein-70. All were associated with fetal growth retardation [10].

Asthma exacerbation in women pregnant with a male fetus has been associated with possible perinatal death [11]. Furthermore, severe asthma, use of oral corticosteroids, and exacerbations are linked with preterm delivery due to maternal hypoxia and changes in the uterine muscle function [12]. In pregnancy, cardiac output increases, systemic vascular resistance decreases, maternal oxygen uptake is increased, resting minute ventilation and tidal volume are increased, and the expiratory reserve volume and functional residual capacity are decreased. Plasma volume increases more than red blood cell mass due to neurohormonal changes. Peripheral vascular resistance decreases and there is mild dilatation of all four chambers of the heart [13].

Several electrocardiographic abnormalities have been reported in asthmatic patients; these include tachycardia, P pulmonale, right bundle branch block, right axis deviation, and ST segment and T wave abnormalities [4]. McGinn and White first described the S1Q3T3 pattern in 1935 with the following voltage criteria in acute cor pulmonale due to pulmonary embolism: S wave in lead I and Q wave in lead III, and amplitude of more than 0.15 mV (1.5 mm) associated with inversion of the T wave in lead III [14].

Since the McGinn and White report, there has been extensive data collected regarding the presence of this pattern of ECG changes associated with pulmonary embolism [15]. In the presence of these changes and suggested clinical settings, an early diagnosis of pulmonary embolism can be made [16]. The incidence of S1Q3T3 is reported to be between 12% and 50% in acute pulmonary embolism and is non-specific. This ECG abnormality can occur in the presence or absence of pulmonary embolism [17]. S1Q3T3 has been reported in the presence of right side pneumothorax [18] as well as aortic intramural hematoma with extension to pulmonary artery [19].

In one study, the ECG changes of S1Q3T3 were found in 8.5% of patients with pulmonary embolism versus 3.3% without pulmonary embolism [20]. In addition, Petruzzelli et al. found that the ECG changes of S1Q3T3 were present in 16% of patients with embolic pulmonary embolism and 10% of those with non-embolic pulmonary embolism [21].

Cardiac arrhythmias can occur during pregnancy in the presence or absence of an underlying organic heart disease. The increase in the heart rate could be due to stress, sympathetic stimulation, or hormonal phenomena during pregnancy [22]. Kambire et al. reported a case of right ventricular outflow tract tachycardia that worsened during pregnancy, suggesting that ventricular tachycardia may be exacerbated by pregnancy, with the cause ranging from congenital heart disease to peripartum cardiomyopathy [23].

Chicherina et al. found that diastolic dysfunction of the right ventricle was the earliest finding in BA, and right ventricular hypertrophy and dilation, as well as left ventricular diastolic dysfunction, were seen in severe BA [24]. In a study conducted by Bobrov et al., it was found that left ventricular diastolic relaxation becomes much worse in BA, while left ventricular diastolic filling improved when exacerbation of BA is attenuated [25]. Furthermore, increased volume indices of the heart in patients with BA, and disorders of diastolic and

systolic heart functions, correlate with the degree of asthma severity [26].

Dynamic hyperinflation of the lungs during severe asthma may lead to increased right ventricular afterload and elevated pulmonary artery pressure [27]. These findings can be accentuated secondary to volume overload status during pregnancy. The common causes of elevated pulmonary artery pressures like pulmonary thromboembolism, valvular heart diseases, medications, were excluded. Our patient's left atrial size was 4.09 cm, whereas normal is less than 4 cm. Mild dilatation of cardiac chambers is a normal finding due to pregnancy-related volume overload [28]

There is limited evidence regarding the presence of S1Q3T3 in bronchospasm. Fetal death in pregnant asthmatic patients can be caused by maternal alkalosis [29], and a decrease in fetal oxygenation results in fetal hypoxia, acidosis, and hypercapnia [30]. Other common pathological conditions which can cause S1Q3T3 electrocardiographic abnormality are pneumothorax, pulmonary embolism, cor pulmonale, acute lung disease, and left posterior fascicular block. All of which were excluded in our patient. Therefore, our case is unique as no other cause was found except bronchospasm, and there were reversible electrocardiographic changes.

Conclusions

Asthma exacerbations are of considerable concern during pregnancy due to their adverse effect on the fetus, and optimization of asthma treatment during pregnancy is vital for achieving good outcomes. S1Q3T3 electrocardiographic abnormality can be seen in acute bronchospasm in pregnant women. Current guidelines recommend monthly follow-up with pregnant asthma patients in clinics that have a written asthma action plan.

Statement

None of the authors has a financial relationship with a commercial entity that has an interest in the subject of the manuscript. No financial support was used for this case series.

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