

Pathophysiology of Respiratory Diseases in the First Trimester of Pregnancy

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Abstract: The physiological adaptational changes that the body undergoes during pregnancy can affect the respiratory system. First-trimester alterations encompass increased minute ventilation, increased tidal volume, and a rise in respiratory rate. Hormonal and metabolic changes can lead to pathophysiologic alterations in respiratory diseases.

Keywords: respiratory changes , pregnancy , mechanical and hormonal factors, ventilation , tidal volume , bronchial hyperreactivity , chronic inflammatory disease , asthma, pneumonia, sleep apnea , cystic fibrosis, metabolic disorders , COPD , progesterone ,uterus enlargement gastroesophageal reflux.

Changes in Respiration During the First Trimester :-

- **More minute ventilation:-** The amount of air inhaled in a minute known as minute ventilation, increases 40-50% in the first trimester. The rise is due to raises in tidal volume and respiratory rate
- **Elevated tidal volume :** - Tidal volume is the amount of air breathed, in or out, in a single tidal breath, this increases 20–30 % in the first trimester. This rise occurs due to reduced airway resistance and increased lung compliance.
- **Increased Respiratory Rate:-** The respiratory rate is the number of breaths taken per minute, which rises about 10–15% in the first trimester. This is due to the loss of sensitivity of the respiratory centre to carbon dioxide.

These changes in respiration influence respiratory disease pathophysiology in a multitude of ways.

Asthma :-

Asthma is a long-term inflammatory disease of the airways. Higher minute ventilation and tidal volume during the first trimester may worsen asthma severity . That's because increased

air flow could make the airways more prone to constriction. Then again, the increased rate of respiration can produce an added obstacle to getting the skin from asthma patients.

COPD :-

Chronic obstructive pulmonary disease (COPD) is a condition that leads to airflow obstruction. Changes in minute ventilation and tidal volume during the first trimester may benefit patients with COPD as they may increase airflow. And this is because the greater amount of air can help to expel mucous from the airways. In fact, COPD patients may find it even harder to breathe due to the faster respiratory rate.

Pneumonia :-

Pneumonia is a type of lung infection. In the first trimester, enhanced minute ventilation and tidal volume may compensate for hypoxemia in cases of pneumonia [17]. This is due to the ability of increased airflow to help clear out fluid and bacteria from the lungs. But this compensatory drive to breathe faster may lead pneumonia patients to work harder to breathe.

Other Respiratory Diseases:-

The increased minute ventilation, tidal volume, and respiratory rate that sets the stage for these changes in the first trimester can also change the pathophysiology of other respiratory diseases, such as:

- Sleep apnea: The increased air flow can cause sleep apnea sufferers to have a harder time keeping their air way open.
- Cystic fibrosis:- The increased air flow may aid in clearing mucus from the airways but increased respiratory rate may make breathing more difficult for cystic fibrosis patients.

The other aspect that may impact pulmonary hypertension provides benefit through increased airflow, which can improve oxygenation, but as due the increased respiratory rate, airflow may be lost and we can have more difficult in pulmonary hypertension.

REVIEW OF MANAGEMENT OF RESPIRATORY DISEASES IN THE FIRST TRIMESTER

Management of respiratory disorders in the first trimester should be a collaborative effort among a patient, a provider, and a respiratory therapist. Goals of management and its process are as follows:

- Managing symptoms:- This can include the use of medications, such as inhaled corticosteroids or bronchodilators, to decrease inflammation and increase airflow.
- Avoiding complications:- This may include staying away from smoke or dust trigger, and exercising regularly to maintain lung function.
- Patient education:- This can include teaching the patient about the disease process, how to control symptoms, and how to prevent complications.

Hormonal and metabolic factors:-

Hormonal and metabolic adaptations drive the respiratory changes during the first trimester of pregnancy. These factors include:

- Progesterone- Progesterone is a hormone made by the ovaries during pregnancy. Because progesterone relaxes and dilates the airways, we see an increase in tidal volume and minute ventilation.
- Estrogen:- Another hormone secreted by the ovaries during pregnancy. It is known that estrogen enhances surfactant production, a substance that helps to maintain the patency of the alveoli. This is an increase in the lung compliance due to increased surfactant production during the first trimester.
- hCG:- hCG stands for human chorionic gonadotropin, it is a hormone that early in pregnancy is produced by the placenta. The release of hCG, for instance, causes both progesterone and estrogen production; it also has a direct action on the respiratory tract. It is said that hCG relaxes and dilates the airways and increases respiratory rate.
- Higher metabolism:- The metabolic rate rises in pregnancy, and so does carbon dioxide production. More carbon dioxide is produced, stimulating the respiratory centre, which increases the respiratory rate.

Other Factors :-

These include other hormonal and metabolic factors along with changes in respiratory physiology, that may alter the pathophysiology of respiratory diseases in the first trimester:

- Enlargement of the uterus:- The uterus expands while per pregnancy and may press in opposition to the diaphragm and lungs. It can cause you to have trouble inhaling, which may lead to shortness of breath.
- More blood:- The rise in blood volume can cause pulmonary edema (fluid in the lungs) during pregnancy. What makes it harder to be breathed and causes
- Sleep apnea:- In sleep apnea patients, this increased airflow can disrupt the patients ability to maintain an open airway.
- Cystic fibrosis: -The higher flow rates may help to clear mucus from the airways, however, the increased rate of breathing may make it difficult for cystic fibrosis patients to breathe.

In pulmonary hypertension, the increased flow can help with oxygenation, but the increased respiratory rate can be more difficult for the patient.

Men of the Upper half of the Respiratory System difficulties all through the 1st trimester-

How to manage respiratory illnesses in the first trimester is a multi-disciplinary responsibility shared by the patient, the patient care provider, and a respiratory therapist. These include the objectives of management:

- Management of signs:- this can involve medications, such as bronchodilators and inhaled corticosteroids, to reduce irritation and enhance circulation.
- Avoiding complications: — This involves avoiding triggers as much as possible (such as smoke or dust) and exercising to maintain a good lung function
- Education of the patient:- This includes teaching the patient about the illness, the ways to cope with symptoms, and how to prevent complications.

Case Presentation:-

Case A 25-year-old female with a past medical history of asthma presents to the office at 8 weeks gestation. She has been on inhaled corticosteroids and bronchodilators for her asthma but has had worsening symptoms since she became pregnant. She now has symptoms of shortness of breath, wheezing and chest tightness.

Physical Exam:-

On examination the following were noted: Respiratory:- 24 breaths per minute, oxygen saturation is 95% on room air, bilateral wheeze on auscultation

Cardio vascular:- Pulse 120/80 mmHgt, pulse 8 beats per minutes, regular

Abdomen:- Uterus enlarged to a size of grapefruit, fetal heart tones noted

Laboratory Tests:-

CBC:- Normal

X-ray of the chest:- No acute cardiopulmonary disease

Diagnosis:-

Asthma worsening in the first trimester of pregnancy

Pathophysiology:-

The respiratory changes of pregnancy during the 1st trimester likely triggered the patients asthma exaction. In this article, we will cover some basic physiological changes such as increase in minute ventilation, tidal volume and respiratory rate. The airflow changes can contribute to stepped up asthma symptoms since the boosted airflow makes the air passageways more easily inhibited. Also, the higher respiratory rate could also prevent the patient from being able to slow the breathing as easily.

Management:-

Outcomes: The patient's worsening asthma is treated with:

Step up of inhaled corticosteroids: – The step up of inhaled corticosteroids is done in the patient with the aim of reducing the inflammation in the airways.

Short-acting bronchodilators:- The patient is provided with bronchodilators which are short acting bronchodilators which helps to relieve her symptoms.

Oxygen therapy: — The patient is given oxygen therapy so that her oxygen saturation will be improved.

Patient education:-- Patient was educated regarding her asthma and symptomatic management during pregnancy.

Follow-Up:-

She is followed closely by her provider, as well as her respiratory therapist. She improves with treatment for asthma, and goes on to have her pregnancy without further significant complication.

Discussion:-

This case report reminds us of the role of physiopathology of pulmonary affections during pregnancy the first trimester. This knowledge can help us better manage respiratory diseases so that outcomes can be improved for the mother and the baby when we understand what happens to the respiratory system during this period.

Conclusion :-

The respiratory system undergoes important physiological changes during the early pregnancy, which can influence respiratory disease pathophysiology throughout pregnancy. Some of these alterations are: rising in respiratory rate, tidal volume and minute ventilation. Also, increases in airway resistance and decreases in functional residual capacity (FRC) can increase the likelihood of culminating a respiratory infection, as well the airflow limitation (Mason, 2012). In this period the adaptive immune responses may be altered and the level of several hormones may increase, both of which can support the development and progression of respiratory diseases.

Characterization of respiratory system pathology during the first trimester of pregnancy is essential to timely and precise diagnosis, management, and prevention of respiratory diseases in pregnant women.

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