

## **The Short of Breath Pregnant Woman**

The following section is entitled “**The Short of Breath Pregnant Woman**”. This section deals with some of the basic concepts important in caring for women with respiratory illness during pregnancy. The section begins with a *learner handout* with space for the learner to make their own notes. The *learner handout* is followed by the *teaching script* for the educator. Relevant cases for discussion and a bibliography of related articles complete this section.

# SHORTNESS OF BREATH IN PREGNANCY

## SHORTNESS OF BREATH IN PREGNANCY

### Physiology

- The normal value for PaO<sub>2</sub> in pregnancy is 100 mmHg and for PaCO<sub>2</sub> is 28-32 mmHg.
- The increased maternal PaO<sub>2</sub> and decreased PaCO<sub>2</sub> is achieved through an increase in minute ventilation without an increase in respiratory rate.

### Physiology

- The fetus requires a maternal PaO<sub>2</sub> > 70 mmHG for health, and therefore, a maternal oxygen saturation should be kept greater than 95%.
- Chest X-rays should be done in pregnant women for the same indication as in nonpregnant individuals.

## SHORTNESS OF BREATH IN PREGNANCY

### Asthma

- The management of asthma in pregnancy is basically unchanged from that of nonpregnant individuals.
- The course of asthma is not clearly affected by pregnancy.

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### Asthma

- Inhaled Beta agonists, inhaled steroids, PO and IV steroids and cromolyn sodium have all been used safely in pregnancy.
- Stress dose steroids in labor are required by all pregnant women who have received greater than two weeks of steroid therapy in the previous year.

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### Asthma

- Common reasons for exacerbation of asthma in pregnancy include noncompliance with medications, sinusitis and gastroesophageal reflux disease.

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## SHORTNESS OF BREATH IN PREGNANCY

### **Pulmonary Embolism**

- **The presentation of pulmonary embolism in pregnancy is often more subtle than in the general medical population.**
- **The diagnostic evaluation for pulmonary embolism is the same in pregnancy as it is in nonpregnant individuals.**

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### **Pulmonary Edema**

- **Pregnant women are predisposed towards developing pulmonary edema because of a decrease in serum oncotic pressure that normally occurs in pregnancy.**
- **Pyelonephritis, tocolytics (medications used to stop preterm labor), and preeclampsia are some of the common causes of pulmonary edema in pregnancy.**

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### **Pulmonary Edema**

- **Pregnancy associated pulmonary edema often responds dramatically to treatment of the underlying cause and a small dose of a diuretic.**

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## SHORTNESS OF BREATH IN PREGNANCY

### Dyspnea of Pregnancy

- **Dyspnea of pregnancy is a common entity characterized by an often dramatic increase in a patient's perceived shortness of breath during pregnancy without any abnormalities found on evaluation.**

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### Cardiac Disease

- **Heart disease (especially mitral stenosis) can present for the first time during pregnancy as unexplained dyspnea in the third trimester when the increased blood volume of pregnancy reaches its maximum..**

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### Amniotic Fluid Embolism

- **Amniotic fluid embolism is a rare and often fatal entity that usually occurs at the time of delivery and is characterized by a rapid and progerssive respiratory failure associated with hemodynamic instability and disseminated intravascular coagulopathy (DIC).**
- **Treatment is supportive.**

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# SHORTNESS OF BREATH IN PREGNANCY

## *Teaching Script*

### **Changes in Respiratory Physiology with Pregnancy**

There are several important physiologic principles that need to be known when evaluating the pregnant woman with dyspnea.

Pregnant women have an increase in minute ventilation that is caused by the effects of progesterone on the respiratory center. The increase in minute ventilation is due to an increase in tidal volume, not by an increase in respiratory rate. This physiologic hyperventilation leads to a change in the normal values for blood gases in pregnancy. The average PaO<sub>2</sub> in pregnancy is 100 mm Hg at sea level and average PaCO<sub>2</sub> is 28 to 32 mm Hg. Therefore, a blood gas with a PaO<sub>2</sub> of 80 and a PaCO<sub>2</sub> of 40 mm Hg in a pregnant woman is markedly abnormal and can even represent impending respiratory failure. The other consequence of the increase in tidal volume is a decrease in residual volume and expiratory reserve volume in pregnancy. For this reason, pregnant women have less reserve if they become hypoxic.

For optimal health the fetus requires that maternal PaO<sub>2</sub> remain greater than 70 mm Hg. Below this level, fetal hemoglobin may have trouble picking up the needed oxygen molecules and delivering them to fetal tissue. This is because fetal hemoglobin has a very different oxygen dissociation curve from adult hemoglobin. We therefore try to maintain maternal oxygen saturation greater than 95% at all times, thereby keeping the maternal PaO<sub>2</sub> well above the level at which any compromise to fetal well being may occur.

## **Radiologic Investigations in Pregnancy**

When evaluating pregnant patients with respiratory illness, chest x-rays should be done for the same indications that they would be in nonpregnant individuals. The abdomen is shielded to help protect the fetus and the amount of radiation involved in a routine chest x-ray is greatly below the minimal dose associated with any documented fetal effects. It is recommended that total radiation dosages during pregnancy be kept below 5 rads. Below this level of radiation there is no significant teratogenic or leukemogenic effect on the fetus. The average chest x-ray with modern equipment delivers less than 0.01 rad of radiation to the maternal pelvis.

## **Asthma in Pregnancy**

The most common chronic respiratory illness that we see during pregnancy is asthma. Fortunately the management of asthma in pregnancy is basically unchanged from that of the nonpregnant individual. Inhaled beta agonists, inhaled steroids, systemic steroids (both oral and intravenous) and cromolyn sodium have all been used safely in pregnancy. The new leukotriene antagonists have been released with an FDA category B suggesting that there have been no ill effects on the fetus identified in animal studies. There is, however, presently no human data regarding their use in pregnancy. The only asthma medication to be avoided in pregnancy is subcutaneous epinephrine, which has been associated with placental ischemia.

Overall, there is no evidence to suggest that the course of asthma is affected by pregnancy. However, there may be individuals who have improvement or deterioration of their disease while pregnant. Common causes of asthma exacerbation in pregnancy include noncompliance with medications, sinusitis and gastroesophageal reflux disease. It has been our experience that it often takes longer for asthma exacerbations in pregnancy to resolve and for maternal oxygenation to normalize.

It should be remembered that any asthmatic woman who has received steroids for greater than two weeks in the past year should be given stress dose steroids at the time of labor or cesarean section as would be done for any other perioperative patient.

### **Thromboembolism in Pregnancy**

Pulmonary thromboembolism is the leading nonobstetric cause of maternal mortality in the US, Canada and the UK. Pregnancy is an important risk factor for thromboembolic disease in young women.

Unfortunately, its presentation is often more subtle in pregnant women than it is in the general medical population. This is likely because pregnant women are generally healthy with greater cardiopulmonary reserve than the general medical population, which tends to be older with comorbid medical conditions. As well, symptoms that suggest thromboembolism such as dyspnea, palpitations and leg edema are often part of normal pregnancy. At our institution, we have found that less than half of the pregnant women with a documented pulmonary embolism had a widened arterial-alveolar gradient of oxygen, and none of them had heart rates greater than 100 beats per minute. Therefore, a high degree of suspicion about pulmonary embolism is required in pregnancy.

The diagnostic evaluation and investigation for pulmonary embolism in pregnancy are the same as it is for the nonpregnant individual. Chest x-rays, ventilation perfusion scans and pulmonary angiograms all involve radiation levels that are well below accepted upper limits for the gravid woman.

## **Pulmonary Edema in Pregnancy**

Pregnant women have an increased propensity for pulmonary edema, a fact that comes as a surprise to many internists. Pregnant women are predisposed toward developing pulmonary edema because of the decrease in serum oncotic pressure that normally occurs in pregnancy. This decrease in serum oncotic pressure occurs because the 50% increase in blood volume that occurs in pregnancy is predominantly achieved through an increase in plasma free water. This has a dilutional effect on the blood and is manifested by the significant drop in serum albumin levels that is seen during gestation. The conditions that can precipitate pulmonary edema in pregnant women include pyelonephritis, tocolytics (medications which are used to stop preterm labor such as terbutaline) and preeclampsia. Although the pulmonary edema seen in pregnancy can be very severe in its clinical and radiologic presentation, it is important to remember that it often responds dramatically to withdrawal of the underlying cause combined with a small dose of diuretic.

## **Dyspnea of Pregnancy**

Dyspnea of pregnancy is a specific entity that is quite common and characterized by an often dramatic increase in a patient's perceived shortness of breath during pregnancy. It usually begins sometime in the middle of gestation and can be very frightening for the patient. Investigations of these patients reveal a completely normal physical examination, oxygenation, chest x-ray, and pulmonary function testing. Once underlying pathology has been ruled out, reassurance is the mainstay of treatment. Surprisingly, dyspnea of pregnancy may occur in women who have had other pregnancies not complicated by this clinical entity. The explanation for this condition is not established, but is believed to be some central (i.e., CNS) misperception of the normal increase in minute ventilation that occurs in pregnancy.

## **Cardiac Disease as a Cause of Dyspnea in Pregnancy**

Because of the increased cardiac work associated with pregnancy, heart disease can present for the first time during pregnancy as unexplained dyspnea. Typically, this will occur at 24 to 28 weeks gestation when blood volume reaches its maximum. A classic example of this is mitral stenosis, which often presents for the first time in young, reproductive age women. In fact, up to 25% of cases of mitral stenosis will present for the first time during pregnancy.

## **Amniotic Fluid Embolism**

A dreaded cause of shortness of breath that is unique to pregnancy is amniotic fluid embolism. It is rare and often fatal. It has been reported to occur at anytime during the third trimester, but usually occurs at the time of delivery. It is characterized by a rapid and progressive respiratory failure that is associated with hemodynamic instability and the rapid onset of disseminated intravascular coagulation (D.I.C.). There is reason to believe that at least a portion of the manifestation of this condition is related to some allergic or immunologic response to the fetal tissue present in the amniotic fluid. This is because some women who have had pulmonary artery catheters inserted during labor have been found to have fetal tissue in their circulation without any of the clinical manifestations of amniotic fluid embolism. It is unclear why some women present with such dramatic symptoms while others are asymptomatic. Treatment is supportive. Blood products and factor replacements should be given if the patient is bleeding. Mechanical ventilation and hemodynamic support with cardiac inotropes and vasopressors is often also necessary.

# SHORTNESS OF BREATH IN PREGNANCY

## *Case Discussion*

### **Case #1**

A 28 year old G<sub>4</sub>P<sub>3</sub> woman at 31 weeks gestation presents with complaints of painful uterine contractions occurring every four minutes. Her obstetrical history is unremarkable with three previous deliveries at term. Regular uterine contractions are noted upon monitoring, but the fetal heart tracing looks good and the cervix is unchanged on exam.

Physical examination reveals a pulse of 132 and a temperature of 104°F. Her blood pressure is 100/60 and her respiratory rate is 10 per minute. The only positive finding on exam is marked right CVA tenderness.

Laboratory evaluation reveals a WBC of 14 with a left shift, a hemoglobin of 10, and a platelet count of 180. Her creatinine is 1.8 mg/dL (159  $\mu$ mol/L) and BUN is 40 mg/dL (14.2 mmol/L). Examination of her urine shows WBC's that are too numerous to count, positive nitrates and clumps of bacteria.

She is admitted to the hospital with a diagnosis of pyelonephritis and preterm labor.

***What do you think of the patient's CBC?***

***What do you think of her creatinine?***

Her urine and blood are cultured and she is started on ampicillin 2g IV q6h and gentamicin 100mg IV q8h. Her contractions continue so she is placed on subcutaneous terbutaline as a tocolytic.

Her next 36 hours in the hospital are marked by slow and steady improvement. She becomes afebrile and her back pain improves. Her contractions cease and her tachycardia resolves. Urine cultures are positive for E. coli sensitive to ampicillin.

However, 48 hours after her initial hospitalization, the nurse notes that the patient is coughing and that her respiratory rate has gradually increased overnight to 34 per minute. The patient says she is "having difficulty getting enough air," but denies any chest pain. An arterial blood gas done on room air is as follows: pH=7.55, PaCO<sub>2</sub>=22, PaO<sub>2</sub>=65, HCO<sub>3</sub>=20.

***What do you think of this blood gas?***

The patient is placed on 100% O<sub>2</sub> by mask and is able to maintain adequate oxygenation. She is monitored with a pulse oximeter.

***What is your goal for oxygenation in a pregnant woman?***

***What are the possible etiologies of this patient's respiratory failure?***

You order a chest x-ray, but she refuses because she does not want to expose her fetus to radiation.

***What do you tell her?***

After your discussion, she consents to the chest x-ray.

***What do you think her x-ray will show?***

The chest x-ray shows dramatic changes of pulmonary edema with bilateral increased interstitial markings and fluid in the fissures.

***What are the possible etiologies for this x-ray picture?***

***What would you have done if the chest x-ray was normal?***

***How would you treat this patient acutely?***

***What are the risks of giving diuretics in pregnancy? What dose would you use?***

***Is central hemodynamic monitoring necessary at this point?***

***What normal physiological factors predispose the pregnant woman to developing pulmonary edema?***

***What are the common inciting events that precipitate pulmonary edema in pregnant women?***

*How would you investigate this patient for the etiology of her pulmonary edema?*

*Could this complication have been prevented?*

*If you needed to intubate this patient, are there any special concerns in pregnancy that need to be considered?*

*If you chose to institute hemodynamic monitoring of this patient, what values would you expect to find?*

*How do the normal physiologic changes in pregnancy affect the interpretation of the CVP and PCWP?*

*Why might you expect the patient's oxygenation to improve rapidly after intubation, even before a diuresis is achieved?*

*How might this piece of information affect decisions about the timing of extubation?*

The patient responds very well to furosemide 10mg IV (with a diuresis of 1600 mL over 2 hours) and the discontinuation of her terbutaline. Her oxygenation continues to improve and after 48 hours she no longer requires supplemental oxygen. She goes home on oral antibiotics. Follow up echocardiogram is completely normal. She delivers a healthy baby boy 4 weeks later.

# SHORTNESS OF BREATH IN PREGNANCY

## *Case Discussion*

### Case #2

A 27 year old G<sub>6</sub>P<sub>5</sub> woman presents at term in well-established labor. Her obstetrical history is uncomplicated and she has no significant medical history.

Her first stage is surprisingly prolonged and requires augmentation with oxytocin. Membranes are ruptured and the amniotic fluid is stained with meconium, but the fetal heart tracing is reassuring. The second stage requires forceps to deliver the baby who looks healthy with Apgars of 7 and 9.

Immediately after delivery, the mother begins coughing and appears agitated. A few minutes later she vomits and her respiratory rate climbs to 40 per minute. Her blood pressure is 80/30 and her temperature is 103°F. She had been afebrile when checked only an hour earlier. There is no evidence of blood loss beyond what would normally be expected for a vaginal delivery. Her oxygen saturation on pulse oximeter is 85% and auscultation of her chest reveals wheezing.

***What is the differential diagnosis at this time?***

***What tests would you order to help with your management and diagnosis?***

***What interventions would you initiate at this time?***

***Is there a role for pulmonary artery catheterization for this patient at this time? What are the risks and benefits of this intervention?***

The patient continues to deteriorate and she requires intubation to maintain oxygenation. Most of her labs are still pending, but her CBC reveals a platelet count of 90.

***How does the platelet count help in your differential diagnosis?***

The nurse alerts you that she the patient's vaginal bleeding is ongoing and becoming severe. The lab calls with the results of her PT and PTT, which are 18 and 52 respectively.

***What treatment options do you have at this point?***

The cardiac monitor shows sinus tachycardia at 150 beats per minute, but the patient's blood pressure drops and she becomes pulseless. CPR is initiated.

***What are the special issues related to CPR in the pregnant woman?***

***How do the ACLS protocols differ for the pregnant woman as compared to the nonpregnant individual?***

Resuscitation with volume, blood, fresh frozen plasma and pressors is attempted. However, after 20 minutes the patient becomes asystolic. Despite attempts to bring back her rhythm, she is eventually declared deceased only 100 minutes after giving birth.

***If this was amniotic fluid embolism, what will the autopsy show?***

***What are the proposed mechanisms by which amniotic fluid enters the maternal circulation?***

***What risk factor for amniotic fluid embolism did this patient have?***

***How would you manage this case if the same series of events occurred when the mother was still in the early second stage of labor?***

# SHORTNESS OF BREATH IN PREGNANCY

## Case Discussion

### Case #3

A 28 year old G<sub>2</sub>P<sub>1</sub> woman at 30 weeks gestation presents to the emergency room complaining of shortness of breath. She has recently had some nasal stuffiness and nocturnal cough, but has otherwise felt well. She denies chest pain or palpitations, but admits she has felt feverish.

On examination, her temperature is 102°F, respiratory rate 38 per minute, heart rate 110 and blood pressure 90/60. The remainder of her physical exam is remarkable only for decreased breath sounds in her lungs bilaterally and occasional wheezing. She has some dullness to percussion at her right base.

While examining her, she complains of dizziness and her blood pressure drops to 70 systolic.

***What are possible causes of her shortness of breath?***

***What should be done emergently?***

***Should she be given epinephrine?***

***What diagnostic tests should be done at this time?***

***What might the fetal monitor show?***

After giving the patient a 500 mL bolus of normal saline, she feels less dizzy and her blood pressure returns to 90/50. She continues to have wheezing and shortness of breath which improves with nebulized albuterol. Her oxygen saturation on pulse oximeter is 93%.

***What do you think of her oxygen saturation? Is it adequate?***

An arterial blood gas reveals a pH of 7.35, PaCO<sub>2</sub> of 37 and PaO<sub>2</sub> of 62. Chest x-ray shows hyperinflated lungs and a right lower lobe infiltrate. Her peak flow is 175.

***What do you think of the blood gas?***

***What further treatment should be instituted?***

She is continued on frequent doses of nebulized albuterol. Intravenous steroids and antibiotics are started. She has an oxygen saturation of 97% with supplemental oxygen by face mask. Her peak flows improve to 250. She is monitored carefully overnight and doesn't require intubation.

The lab calls in the morning to say that blood cultures are growing gram positive cocci.

***What antibiotics could you use to treat her infection. Which ones are contraindicated in pregnancy?***

***What is the risk of this infection and its treatment to the fetus?***

The patient and her fetus do well. She becomes afebrile and her blood gases normalize. She is discharged on hospital day seven.

***What medications should she be discharged on?***

***What special considerations are there for labor and delivery?***

## THE SHORT OF BREATH PREGNANT WOMAN

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