**NAME: UWAOGU KELECHI OYINDAMOLA**

**DEPARTMENT: NURSING**

**MATRIC NUMBER: 18/MHS02/192**

**COURSECODE: PHS212**

**COURSE** TITLE**: PHYSIOLOGY**

QUESTION:

Physiological adaptations of the female to pregnancy

# PHYSIOLOGICAL RESPIRATORY CHANGES

## Anatomic Changes

Mucosal edema and hyperemia secondary to capillary engorgement are common findings in the nasopharynx and the tracheal bronchial tract. In fact the majority of pregnant women have redness and swelling of the lungs that at times can produce changes in the voice. Changes also occur in chest circumference (6 to 7 cm.), vertical diameter (4 to 5 cm.), and the substernal angle (from 70 to 105 degrees). The increase in chest circumference compensates for the elevation of the diaphragm, so that essentially there is no change in the overall volume of the thoracic cavity.

## Pulmonary Ventilation

During normal pregnancy the patients are in a state of hyperventilation. The arterial CO2 declines and the maternal arterial blood pH remains unchanged by compensatory increase in renal excretion of bicarbonate, which decreases to 21 mEq/L from 27 mEq/L. This hyperventilation of pregnancy seems to be related to the direct action of progesterone on the respiratory center. This effect with the lowering of the CO2 in the blood facilitates removal of CO2 from fetal cells and produces a CO2 tension in the fetus similar to what will be found in the newborn. During the labor process the hyperventilation process is augmented and the patients' ventilation peak values can reach as high as 40 liters per minute as compared to the 12 liters per minute prior to labor.

This is most likely attributable to the painful uterine contractions that lead to a spontaneous hyperventilation.The oxygen consumption increases as pregnancy advances. The increase in oxygen consumption relates to the additional energy requirements of the fetus as well as the other metabolic alterations that happen to the body of the pregnant woman. The total increment in basal oxygen consumption has been estimated at approximately 50 ml per minute. During labor, oxygen consumption rises during each uterine contraction from about 250 ml per minute to 750 ml per minute. The average oxygen consumption, which includes that during and between contractions, increases progressively and in the second stage approaches twice that of the term pregnant woman before the onset of labor.

During pregnancy the functional residual capacity of the lungs is decreased. The reduction has been attributed to the elevation of the diaphragm from the enlarging uterus. This effect is counterbalanced by a proportional increase in inspiratory capacity that results in an unchanged vital capacity. Overall the respiratory changes in pregnancy reflect a tendency to assure plenty oxygen supply to the fetus and able opportunity to eliminate waste.

## RENAL PHYSIOLOGICAL CHANGES

The changes in renal function during pregnancy are profound and are surpassed only by those of the cardiovascular system.

### Anatomic Changes

The kidney size increases only slightly during normal pregnancy. However, the more striking in structural changes are those of the ureters, calyces, and renal pelvis. These changes are readily seen as early as the third month of gestation and remain until approximately the fourth month postpartum. Since these changes appear long before the gravid uterus is large enough to cause mechanical compression of the ureters, a hormonal effect is postulated. Progesterone, a smooth muscle relaxant, is produced in large concentrations even early in pregnancy, and is most likely the cause of the dilatation and decrease in peristaltic activity. Later in pregnancy, mechanical compression must certainly play a role. Interestingly, the dilatation of the upper urinary tract is greater on the right than on the left. The explanation given by some for this phenomenon is that the colon acts as a cushion to protect the left ureter, where as the right ureter is more exposed.

### Functional Changes

Of all functional renal changes that accompany pregnancy, the most striking is that of glomerular filtration rate (GFR), which increases by approximately 50 percent. Renal plasma flow on the other hand increases by approximately 25 percent. Both begin to change early in the second trimester of pregnancy and in lateral recumbency are maintained at these elevated levels to term. The factors responsible for these changes remain conjectural, but the following have been suggested;

- The growth hormone-like effect of the hormone human placental lactogen,
- The increased production and plasma concentration of free cortisol,
- The increase in blood volume,
- The hemodilution and hydremia resulting in decreased colloid osmotic pressure.

Regardless of etiology, these functional alterations force us to redefine normal values of renal function during pregnancy. The normal serum creatinine in pregnancy drops to 0.46 mg. % as compared with the non-pregnant value of 0.67 mg. %. The BUN decreases to 8.2 mg.% from a non-pregnant value of 13 mg.%. Uric acid also declines to a value of 3.1 mg.% from approximately 4.5 mg.%. The upper-normal uric acid level in pregnancy is 5 mg.% and levels higher than that should raise suspicion of preeclampsia. Creatinine clearance values increase to 150 - 200 ml/min as compared with values of 65 to 145 ml/min in the non-pregnant patient.

Although a glomerular tubular balance exists for sodium during pregnancy, this is not the case for glucose or amino acids. The increased glomerular filtration rate leads to a significant glucose excretion that exceeds the tubular maximum for glucose reabsorption leading to glucosuria in many normal patients. A similar aminoaciduria is frequently seen in pregnancy. In compensation for the hyperventilation and hypocarbia that occur with pregnancy, there is an increase in bicarbonate excretion by the kidney. This results in an elevation of urine ph. During pregnancy there is a reversal of the usual non-pregnant diurnal pattern of urinary flow. When pregnant women go to bed at night third spaced fluid is mobilized and returns into the cardiovascular system leading to rather dilute urine in the morning, which is unusual according to non-pregnant standards. When tubular function tests are to be contacted in pregnant women, these effects should be taken in account and it may be best to collect urine from women for this test in the evening hours.

Posture and Renal Function in Pregnancy

In non-pregnant individuals the up-right posture causes extra cellular fluid to shift to the legs, resulting in a relative decrease in central blood volume. This response is exaggerated during pregnancy and a similar response also occurs when the supine position is assumed. The extent of the change is a 50 to 60 percent decrease in urine flow and sodium excretion in supine recumbency versus lateral recumbency, accompanied by 20 percent decrease in renal plasma flow and glomerular filtration. The underlying patho-physiology is likely to be inferior vena caval obstruction, resulting in pulling of blood in the dilated veins of the lower extremities, dependent edema, decreased venous return, decreased central blood volume, increased aldosterone production, and ultimately decreased urinary excretion of sodium and water.

## Hormonal

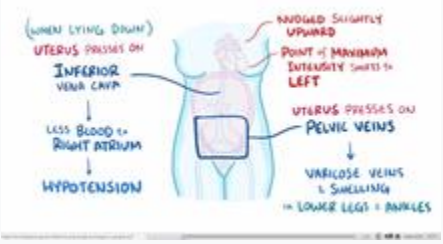
Pregnant women experience numerous adjustments in their endocrine system that help support the developing fetus. The fetal-placental unit secretes steroid hormones and proteins that alter the function of various maternal endocrine glands. Sometimes, the changes in certain hormone levels and their effects on their target organs can lead to gestational diabetes and gestational hypertension.

## Cardiovascular

The heart adapts to the increased cardiac demand that occurs during pregnancy in many ways.

- Cardiac output (Lit./Min.): 6.26
- Stoke Volume (Ml.): 75
- Heart Rate (Per min.): 85
- Blood Pressure: Unaffected

Cardiac output increases throughout early pregnancy, and peaks in the third trimester, usually to 30-50% above baseline. Estrogen mediates this rise in cardiac output by increasing the pre-load and stroke volume, mainly via a higher overall blood volume (which increases by 40–50%). The heart rate increases, but generally not above 100 beats/ minute. Total systematic vascular resistance decreases by 20% secondary to the vasodilatory effect of progesterone. Overall, the systolic and diastolic blood pressure drops 10–15 mm Hg in the first trimester and then returns to baseline in the second half of pregnancy. All of these cardiovascular adaptations can lead to common complaints, such as palpitations, decreased exercise tolerance, and dizziness.




Uterine Compression of IVC and Pelvic Veins. Displacement of PMI by Uterus