

**Course Name :An Overview on Maternal Health Antenatal, Intranatal and Postnatal Care**

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**Lecture:01**

**Physiological changes in pregnancy (part 1)**

Hello students. Welcome to the next session for the NPTEL online certified course on the topic and overview on maternal health, the antenatal, intranatal and postnatal care. I am Dr. Barnali Ghosh, obstetrician and gynecologist working as assistant professor at B.C.Roy Medical College and Research Center IIT, Kharagpur. Today our topic of discussion is the maternal physiological changes occurring during pregnancy. So we have already dealt with the basics of reproduction, now starting from gametogenesis, fertilization, implantation, formation of placenta and the umbilical cord and also the fetus as a whole regarding its circulation and its physiology.

Today we will be dealing with the mother. The changes occurring in the mother's body during pregnancy or the maternal adaptations during the period of pregnancy. We will be discussing the individual systems right starting right from the reproductive tract changes then coming to the hematological changes, the respiratory system changes, changes in skin and breast, cardiovascular changes, changes in the blood coagulation profile, the liver, gallbladder and most importantly the changes occurring in the kidney. So the keywords for today's class are as follows.

Now coming into the discussion proper starting with the changes in the reproductive tract we know that the most important organ undergoing maximum change during the period of pregnancy is the uterus right. It will increase in size, it will increase in volume, it will increase in muscle mass so as to enlarge and accommodate the growing fetus inside the mother's womb. So what happens? So we can see from here you know this is the uterus in non-pregnant state right. This is non-pregnant uterus. We have already discussed the dimensions of the uterus you know in the previous class.

I will again repeat it for you. So this is the uterus in the non-pregnant state and we have already seen that the distance from the fundus to the external oss, this length is 8 cm right. Whole length from the fundus to the external oss is 8 cm. Now we have this formula 3 into 2 into 1 inches. This is for uterus.

Similarly we have also told that for ovary the dimensions are 3 into 2 into 1 cm right. Easy to remember. Now converting this inch into cm we have to multiply with 2.5 right. So it will be 7.

5. We will round it around 8. So 8 into 5 into 2.5 cm. This is the dimensions of a non-pregnant uterus. Length 8 cm, breadth or the intercornual distance.

This is 5 cm and the thickness is 2.5 cm right. So length is 8 cm out of which the cervical length will be around 2.5 cm. Next the isthmus.

This isthmus is 0.5 cm right. So cervix is 2.5 cm, isthmus is 0.5 cm.

Now this length from the fundus to the isthmus, this length will be the rest 5 cm right out of which the fundus this does not have the cavity. The fundus thickness is 1.5 cm. So the rest you know the uterine cavity proper, the length of the uterine cavity proper will be thus 3.5 cm right.

So this is how we calculate or we need to know the length of the uterus in the non-pregnant state. What happens during pregnancy? There is you know enlargement of the uterus and it increases in length and it becomes at term pregnancy this uterus will become you know approximately 36 cm. So 8 cm will increase to 36 cm in some books it is given as 35 cm right. So this is pregnancy at term. What we need to know here that during clinical examination we we when we examine a patient we know that the uterus first was a pelvic organ in the female pelvis and it will slowly increase in size as pregnancy progresses.

Starting from 12 weeks the uterus you know after 12 weeks it will enter the abdomen and will become an abdominal organ and from then onwards you know it can be palpated by the examining doctor by per abdomen examination right. So at 12 weeks the uterus is at the level of symphysis pubis. From 12 weeks onwards it will you know grow grow and grow into the abdomen and we have divided this you know say here is the umbilicus and this total length has been divided into segments. First the length between the umbilicus and the symphysis pubis this can be divided into three segments four fingers each of four fingers breadth right. And the at 12 weeks the uterine height or the fundal height of the uterus is at the symphysis pubis then it increases and at one third this segment has been divided into three segments first will be 16 weeks then will be 20 weeks and when the uterine fundus is palpated at the umbilicus it corresponds to 24 weeks of pregnancy right.

Now going above this is the xiphisternum, this distance from xiphisternum to umbilicus is again divided into three segments. So then the next level is at 28 weeks then 32 weeks and at the you know level of xiphisternum this is the corresponding to 36 weeks of pregnancy so when it is at the level of the xiphisternum when the uterus has you know increased in height and it is corresponding to 36 weeks of pregnancy. To note here that after 36 weeks of pregnancy the

uterus will you know then to a progressing towards 40 weeks the fundal height will somewhat decrease and at 40 weeks it will come down at the level of 32 weeks right. So why this happens this is because the fetus the fetus will be entering the maternal pelvis you know there will be engagement it will enter into the maternal pelvis during the late third trimester and it will go down and thus the fundal height will also somewhat come down at you know at the level of 32 weeks. So how to differentiate that whether it is a 40 weeks uterus or a 32 weeks uterus at 40 weeks the fetus goes down into the maternal pelvis and the flanks of the mother will be full right so there will be fullness fullness of the flanks and this is called as shelving sign right.

So this is seen in case of 40 weeks size uterus which will be absent at 32 weeks. So this way we can determine whether you know the different weeks of pregnancy from the fundal height right. So this was about the length of the uterus. Coming to the next is your volume of the uterus right. So coming to the volume of the uterus so this we know that in non-pregnant state the volume of uterus is 10 ml and this increases pregnancy at term the volume will increase and it will increase you know as much as 5 liters this is pregnancy at term so the 10 ml of uterine volume increases to 5 liters.

To note here that this 5 liters can increase much more it has a capacity to increase much more in cases of polyhydramnios in case of triplets or quadruplets it can increase up to 20 liters right. So this is about the volume. Coming to the weight of uterus we know in non-pregnant state the weight of uterus is approximately 60 to 80 grams which increases at term pregnancy to 1000 grams right. Next coming to the blood supply so the blood supply of the uterus in non-pregnant state is this is the uterine artery it is supplying the uterus in non-pregnant state it is around 70 ml sorry 50 ml it is 50 ml per minute and this comprises approximately 2 percent of cardiac output which will increase at term pregnancy and become approximately it will increase there is increased vascularity increased circulation and increases to 750 ml per minute just putting a 7 in front of 50 that is how you remember. So 750 ml per unit per minute will comprise approximately 15 percent of the cardiac output right.

So this is regarding the vascularity increased vascularity increased size increased volume of the uterus. Now coming to the uterine musculature, uterine musculature now we know that the uterus muscles are in three different layers right. So we have already talked about them during the anatomy outer is the longitudinal muscle layers the longitudinal muscle layers will be you know traversing longitudinally in the anterior and posterior walls of the uterus and they will intermingle at the fundus and will surround the uterus as a hood right. The innermost muscle which are encircling the uterine cavity are the circular muscle layers right. So innermost is the circular muscle layer say this is the innermost encircling the uterine cavity these are the circular muscle layers and in between are the crisscross layer of muscle right.

So this is the middle layer or the crisscross layer where in between the muscle layers which are

arranged in crisscross fashion are the spiral arterioles and when these muscles contract so during delivery you know there is hypertrophy as well as hyperplasia of all these three muscle layers and point to be noted is the maximum hypertrophy occurs in the middle this is the crisscross muscle layer. So this undergoes maximum hypertrophy in pregnancy as a whole the muscles will undergo both hypertrophy and hyperplasia but hypertrophy will be more hypertrophy will be more than hyperplasia right. Another thing to note is in prime gravida who are prime gravida they those women who are becoming pregnant for the first time right and multi gravida is you know starting from birth order two or more that is they have one previous at least one previous pregnancy right. So in prime gravida hypertrophy is more pronounced in prime hypertrophy is more compared to multi. So in multi what happens there is mostly stretching of muscles right.

So this has an important clinical application. Prime gravida there is hypertrophy or increase in muscle mass increase in size of the muscle cells but in multi gravida mostly there is stretching of the muscles and all throughout the pregnancy these muscles of the uterus they are stretched after delivery immediately in the postpartum period these overstretched muscles will you know become flabby and they will just be atonic the tone of the muscles is very less and thus these multi gravida are more prone to bleeding or postpartum hemorrhage right. So this is about the muscle layers of muscle layer undergoing both hypertrophy and hyperplasia and we have known that these three muscle layers immediately following the delivery after the separation of the placenta they will contract the longitudinal layers will contract as a hood and it will decrease the length of the uterus the circular muscles will contract and try to obliterate the cavity thereby you know compressing the anterior and posterior walls thereby decreasing the bleeding and the crisscross layer they will be compressing or obliterating the open ends of the spiral arterioles and they will decrease also the bleeding after delivery this layer they will you know act as a living ligature they obstruct or you know compress the blood vessels like figure of 8 stitch right. So they are called as living ligature and the most important is this muscle layer which undergoes maximum hypertrophy during pregnancy. So we have discussed the muscle layers right.

So this was the picture I have already drawn it for you. So in non-pregnant state the uterus had these dimensions and ultimately pregnancy at term pregnancy it will reach to 36 you know to be more precise 35 centimeters of length volume increases from 10 ml to 5 ml. Next the uterine supply yes I have told 750 ml per minute at term pregnancy and these are the muscle layers the innermost the innermost are the circular then the intermediate and these are the intermediate or living ligature and these are the outermost longitudinal layer there is hypertrophy as well as hyperplasia, but hypertrophy of muscles is more pronounced right. Now in a nutshell the changes in the reproductive tract or specially in the uterus length becoming a changing from 8 centimeter to 36 centimeter volume increasing from 10 ml to 5 liters, vascularity increasing from 50 ml per minute to 750 ml per minute and weight increasing from you know round about 70 grams to 1000 grams in at term pregnancy right. Now another important thing is the Braxton Hicks contraction.

So these uterine muscles sometimes there is you know spasms spasmodic contraction and after a period of time you know in few minutes they will go away. So this is you know known as Braxton Hicks contraction right. So in earlier days you know on per vaginal examination as early as 4 weeks the examining doctor can palpate or feel these contractions during her during the per vaginal examination and this is called as Palmer's sign. So this was a you know method for diagnosis of intrauterine pregnancy, but in today's time we rarely go for per vaginal examination during first trimester because we have a magic tool with us that is the ultrasound which will detect the intrauterine pregnancy as well as calculate the gestational age right. Now these contractions these will be felt by the mother a little late you know starting from the second trimester the mother tells the doctor I feel like tightening of the abdomen lower abdominal muscles it gets tightened and then it goes away right.

So you need to reassure the mother that no no they are all normal it is you know a physiological phenomenon and no need to worry. These Braxton Hicks contractions are you know they are irregular they are sporadic they are unpredictable and you know they are I mean they are painless and just they can be palpated by putting the hand on the abdomen right. You feel the uterus gets tightened and then after some few minutes it will go away right. And so in this picture you have you are saying that yes it is being felt from the second trimester and they are mostly painless and the mother should be reassured that they are normal during pregnancy. So, that was you know that is all written from 4 weeks it can be palpated parvaginally by the examining doctor called as the Palmer sign and they are irregular they are painless, sporadic, non rhythmic, palpated by one hand on the abdomen or on the uterus right.

And the intensity and frequency both increases as the pregnancy progresses and it will get converted to false labour pain during the late third trimester. Intensity very important intensity varies between 5 to 25 millimeter not more than that right which you know in stark comparison with the intensity of uterine contraction during labour which is as high as 100 millimeter of Hg right. So, these are very of low intensity of 5 to 25 millimeter of Hg right. So, that was about Braxton Hicks contraction. Now, coming to the changes there are 2 types of changes number 1 there is softening the reproductive tract starting from the cervix, the isthmus, the uterus, the fundus and the body all get softened right because due to number 1 the progesterone which increases during pregnancy and number 2 accumulation of water right.

For these 2 the different you know the cervix get softened there is the sign called as goodell sign, the isthmus get softened that is called as Hager sign, the lateral wall at the site of implantation of the placenta that will get softened and there is asymmetrical enlargement from the outside that is called as piskacek's sign, the fundal region gets softened and it is called as the von braun fernwald sign. We will go through these signs in the later lectures and they help to diagnose the pregnancy and you know also the gestational age. Increased vascularity yes we

know there is more blood supply and thus there is change in color of the vaginal mucosa as well as the cervical mucosa which becomes you know bluish or purplish in color that also has a name it is called as Jacquemier's or Chadwick sign right. So, these are the changes occurring in the uterus. Now, coming to the cervix changes in the cervix yes in the cervix also there is increased vascularity giving the cervical epithelium a bluish or purplish hue due to the underlying blood vessels right and also the endometrial I mean the endocervical glands there are increase in number of the glands and increase in mucus secretion and ultimately you know it forms a mucus plug and this mucus plug will obstruct the cervical canal throughout pregnancy and this mucus plug is a protective barrier right.

It will prevent ascent of infection from the lower down vagina into the uterine cavity and you know just and after you know the mother goes into labor there is onset of labor with the dilatation of the cervical canal this mucus plug along with a slight amount of bleeding gets expelled out through the vagina and this is called a show which marks the onset of true labor right. So, that is it is written vascularity increases cervical glands proliferate at term in the glands occupy approximately 50 percent of the entire cervical mass forming a mucus plug right and there is another phenomenon it is called the endocervical epithelium columnar epithelium they you know they will they they moves outward into the ectocervix and this is called as ectopy or ectropion. Here is the picture this is an ectopy or ectropion you can see the epithelium of or the columnar epithelium the red colored epithelium it has come outside into the ectocervix and this is called as ectopy or ectropion which is also a normal phenomenon in pregnancy and you know just you know just trivial trauma to the cervix line in case of per vaginal bleeding or a pap smear taken during pregnancy can lead to bleeding from the cervix presenting as antepartum hemorrhage. So, you need to be very you know careful during the procedures right.

So, that was the changes in cervix. Now, coming to the changes in vagina, vaginal epithelium we know they are three layers number one is the superficial layer which are spherical cells with sharp borders with abundant cytoplasm and these cytoplasm contains glycogen right. So, they will they are rich in glycogen and they are under the influence of estrogen. The basal cells which are basophilic round with large nuclei they are present in absence of estrogen or progesterone right and the intermediate which are intermediate between the superficial and the basal cells these are the intermediate cells which are neither fully spherical they are no nor oval intermediate without sharp borders and have a vesicular nuclei or a boat shaped nuclei at the periphery they are under the influence of progesterone. So, during pregnancy both these two layers of epithelial cells increase in number and mostly the intermediate cells increase because there is more secretion of progesterone. Now, what happens the glycogen superficial layer having glycogen and lactobacilli or the Döderlein's bacilli also increase in the vaginal canal right.

So, these will act upon the glycogen converting it to lactic acid right and this lactic acid will

convert the vaginal pH acidic. So, acidic pH of vagina which decreases in the reproductive years we have known that the pH of vagina is around 4.5 in pregnancy it decreases further and becomes around 4 or less than 4 right. So, pH of vagina decreases increased Döderlein's bacilli or lactobacilli in the vagina more glycogen on the superficial cells under the influence of estrogen they are getting converted to lactic acid which will decrease the vaginal pH and what is the benefits of this it acts as a defense to prevent infection. Infection is the main cause for preterm labor and this infection is prevented by the acidic pH of vagina right.

So, this is a pictorial just representation of what I have already told lactic acid formation leading to acidic pH right. Now, only one condition right infection increases during pregnancy and that is candidiasis. Candida can thrive in acidic pH. So, vaginal candidiasis increases particularly in the second and third trimester and it is the most common cause of vaginitis in pregnancy. So, we have done with the reproductive tract changes.

So, now, coming to the hematological changes the whole blood volume increases in pregnancy right blood volume meaning the plasma volume will also increase the RBC volume will also increase right, but to note that the plasma volume increase is more compared to the RBC volume right. So, there is a hemodilution this is physiological hemodilution occurring during pregnancy the plasma volume increases by 40 to 50 percent right. So, it increases by 40 to 50 percent, but the RBC volume increase by 18 to 20 percent. So, this disparity in increase this will lead to physiological hemodilution right. So, what are the advantages and disadvantages of physiological hemodilution? The plus points are this there is physiological hemodilution causing the blood less viscous thereby more blood flow to the uterus, more blood flow to the utero placental circulation and thus more blood supply to the fetus helping in fetal growth and development.

So, you know it helps in fetal growth. Number 2 the increase in blood volume or increase in blood plasma in comparison to the RBC volume this you know there is more increase. So, per ml of blood will be containing less gram of hemoglobin or hemoglobin concentration decreases. So, this you know this compensates to some extent the blood loss that will be occurring during the period of delivery right. So, these are the advantages coming to the disadvantages yes there is decreased in hemoglobin concentration and it will lead to physiological anemia and if there is already pre-existing anemia in mother it will get aggravated during pregnancy right. So, talking about the blood cells RBC volume increase by 18 to 20 percent WBC total WBC count or total leukocyte count will also increase right and this increase is also normal.

In normally the TLC is we know the upper limit is 11000 in pregnancy it can increase to 15000 and in the postpartum or in puerperium period it can increase to up to 25000. So, blood picture show a in a first postpartum day it shows leukocytosis or 25000 total leukocyte count it does not diagnose a case of sepsis right. We will not start antibiotics because it is a normal phenomenon

and it will decrease in the subsequent days right. Now, coming to the differential leukocyte count both the neutrophils and the lymphocytes they increase out of which T lymphocytes will increase, but there will be no change in B lymphocytes and CD4 is to CD8 ratio right these 2 will remain unchanged. Coming to the platelets mostly there is no change in the platelet count sometimes there can be slight decrease in platelet count approximately 15 percent decrease and this is also benign this you know this is benign and this does not need any further investigation it is called as benign gestational thrombocytopenia this occurs due to you know more destruction of platelets in the spleen due to hypersplenism or it can be due to consumption of platelets in the micro thrombi formation during pregnancy or it can be due to the hemodilution right.

So, there will be decrease in platelet count, but the count does never goes below 1 lakh per millimeter very important it will not go below 1 lakh if it goes below 1 lakh right if it goes below 1 lakh then we think of some pathological cause it is not you know just due to gestational thrombocytopenia it can be due to health syndrome or can be due to hemolytic uremic syndrome where there is you know I mean there is more consumption of platelets right or can be due to some autoimmune disorders APLA where their platelets are being consumed in thrombi formation right. So, we need to investigate those cases. Now, coming to the serum proteins, serum proteins they are secreted from the liver and all increase in serum proteins occur during pregnancy starting with transferrin, then copper binding protein ceruloplasmin, globulin they all increase in pregnancy right. So, all types thyroid thyrotropin binding globulin right it will increase then corticotropin binding globulin increase, sex hormone binding globulin all these increase in pregnancy. Albumin which is also being secreted from liver will increase in pregnancy, but due to hemodilution the concentration of the serum proteins decreases right.

Another is albumin globulin ratio normally in non-pregnant state it is 1.7 is to 1 in pregnancy at term it becomes 1 is to 1. Synthesis of globulin is increased or it increases in preference to albumin and ratio becomes 1 is to 1. So, this was with hematological system. Coming to the respiratory system, yes in the respiratory system we know during pregnancy the breaths become more deeper, the inspiration becomes deeper right.

So, there will be more intake of air during the inspiratory phase, but the respiratory rate remains normal in pregnancy. Another thing that occurs is the elevation of the diaphragm. The diaphragm gets elevated right because the uterus in the abdomen will be increasing in height and it will push the diaphragm up and diaphragm it will be elevated thereby decreasing the lung volumes. The lungs will also be pushed up and the residual lung volumes will all be decreased in pregnancy. So, what are the changes? Yes, the subcostal angle this is the subcostal angle, these are the lungs right.

So, you can see this is the subcostal angle. This angle is 70 degree in non-pregnant state. In

pregnancy it will get widened and it becomes 100 degree at term pregnancy. Now, the transverse diameter of the thorax it will increase and its increase is by 2 centimeter. The circumference of the thorax will also increase by 5 to 7 centimeter approximately 6 centimeter on an average and the diaphragm will be elevated above by the uterus below and that elevation is by 4 centimeters. This diaphragm elevation leads to decrease in residual air volumes in the lungs right.

So, this is the diagram the subcostal angle 70 degree becoming 100 degree at 37 weeks pregnancy. The diaphragm this diaphragm will be elevated and by 4 centimeters. The transverse diameter will increase by 2 centimeter and the circumference the thoracic circumference increases by 5 to 7 you know on an average 6 centimeters. Now, coming to the different volumes, if you see that the volumes there is a graph of the different air volumes that are you know goes in and out of the lungs. What are they? This during the period of normal respiration the amount of air going inside and then outside the lungs this is called as the tidal volume right.

So, this is the tidal volume. Now, in case of this is in normal respiration you are taking normal respiration the amount of air going inside and then outside of the lungs is the tidal volume. The amount of air which the person or the female can inhale above the normal respiration in case of forced inspiration. She takes a forced inspiration and the amount of air that goes inside the lungs in excess of the tidal volume this is called as inspiratory reserve volume. And this part this is the summation of the inspiratory reserve volume and the tidal volume this is called as the inspiratory capacity. These are all you know topics related to the physiology of the respiratory system right.

So, this was all the inspiratory volumes. Now, coming to the expiration during normal expiration or normal respiration the volume going in and out is tidal volume. Now, when the person takes you know forced expiration exhales fully to the maximum limit the extra amount of air that is exhaled from the lung this is called as expiratory reserve volume. But there is always some amount of air inside the lungs which cannot be exhaled even after maximum forceful expiration this is called as the residual volume right. And the these two when are added they form the functional residual capacity right. So, that amount of air this amount of air is present in the lungs after a normal expiration right.

So, these are the different terminologies which we have discussed regarding the lung volumes. Now, coming to the changes in the lung volumes see this is the tidal volume this is the tidal volume this part and this tidal volume 450 ml in non pregnant state becomes 600 ml. So, tidal volume increases. Number 2 is the inspiratory reserve volume. Inspiratory reserve volume is the amount of air that can be taken in excess of the tidal volume in a case of forced inspiration and that also increases in pregnancy it increases.

Now, coming to the inspiratory capacity which is the summation of the tidal volume and the

inspiratory reserve volume this also increases in pregnancy. So, all the inspiratory volumes increase in pregnancy. Coming to the expiratory volumes the expiratory volumes see number 1 is the expiratory reserve volume. So, that is the this is this I will detect as A.

So, expiratory these are the volumes of expiration. Expiratory reserve volume is the volume which can be expelled from the lungs you know in excess of the tidal volume during a forced expiration. So, this will decrease see this will decrease in pregnancy right. Then the next expiratory reserve volume is the residual volume. The residual volume will also that is the amount of air which is present in the lungs even after maximum forceful expiration this is also decrease in pregnancy and the functional residual capacity this will also decrease.

So, expiratory volumes decrease, inspiratory volumes increase. Another important is the total lung capacity. Total lung capacity there is slight decrease in total lung capacity right 4200 becoming 4000 ml and these you know decrease in the expiratory volume is mainly because of the elevation of the diaphragm by the uterus below right. And another point is the vital capacity. The vital capacity remains unchanged in pregnancy it remains unchanged right.

So, these are the changes in the lung volumes occurring during pregnancy. Inspiratory volumes these 3 tidal volume, inspiratory reserve volume and inspiratory capacity increases. Expiratory volumes will decrease due to elevation of the diaphragm right and the total lung capacity there is slight decrease, decrease to the smaller extent from 4200 to approximately 4100 ml. And the things or the parameters which are remain unchanged during pregnancy they are number 1 the vital capacity which will remain unchanged because it is a summation of all these 3. Inspiratory reserve volume, tidal volume and expiratory reserve volume.

So, inspiratory it increases tidal volume increases and expiratory decreases. So, ultimately the summation will be same and the respiratory rate which has also no change right. So, breathing will just be deeper right due to progesterone, but there is no increase in the respiratory rate right. And about the oxygen delivery tidal volume is increasing, air going in and out of the lungs in a normal respiration increasing. So, more oxygen delivery and point to be noted is the maternal arteriovenous oxygen difference it decreases in pregnancy.

So, this was all about the respiratory changes. Now, coming to the skin changes very you know important is the linear nigra you can see in this picture this is the linear nigra extending from the xiphisternum to the symphysis pubis right. Number 2 these are the stria gravida which are present in the flanks and also sometimes in the thigh region these are stria gravidarum right. So, these are nothing, but stretch marks right and they are pink in present pregnancy and you know the stria which was due to a past pregnancy they become silvery white and they are then called as stria albicans right. Another is the chloasma say this is the pigmentation these are the pigmentation around the cheek and also around the eyes. So, these are called as chloasma and it

is also called as pregnancy mask and these are you know all these are due to increase in melanocyte stimulating hormone which is brought about by increase in estrogen right.

Next are the spider navy these are the due to increased vascularity or increased blood in the underlying vessels below the skin they will get engorged and form spider navy and this is palmar erythema or you know erythema over the palms and these are also due to increased estrogen. So, at this point you know the change occurring in the skin due to progesterone is increase in basal body temperature right. So, in pregnancy basal body temperature is nothing, but the temperature of the female just before getting out of bed in the morning and that is increased in pregnancy because of progesterone which is a thermogenic hormone right. So, these are all the skin changes now coming to the breast changes yes breast increases in size it increase in weight there is increase in number of fat which is brought about by the insulin more insulin in mother's blood causing increase in fat of the breast increase in alveoli this is brought mainly by the progesterone and to some extent by estrogen and prolactin and increase in the ducts present in the breast they are brought about by estrogen. So, these three will undergo change there will be more you know increase in size and weight of the breast and also sometimes we see that there is you know this if there is you know more pigmentation these areas will be pigmented pigmentation over the breast hyperpigmentation and sometimes there is a secondary areola formation you know this areola with the nipple this will undergo very hyperpigmentation blackish in color and a zone outer zone outside of you know less pigmentation that is called as the secondary areola right and what are montgomery's tubercles these are present around the areola and they are nothing, but modified sebaceous glands.

So, these are the breast changes in pregnancy. So, this is a very you know I mean theoretical discussion and it involves various parameters and values you need to jot down and in the next class we will continue with the CVS changes and the blood coagulation profile and importantly the renal system changes right. So, thank you.