

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

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**Week:10**

**Lecture:02**

### **Intrapartum Fetal Monitoring – Cardiotocography (CTG)**

Good morning students. I welcome you all to today's 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, an obstetrician and gynecologist working as assistant professor at B.C.Roy Multispeciality Hospital and Medical Research Centre, IIT, Kharagpur. Today, we are going to discuss about intrapartum fetal monitoring and the method or the technique used for this monitoring is cardiotocography, right. So, we have already discussed the antepartum fetal surveillance in our previous class which includes non-stress test, right and the amniotic fluid volume or together we can call as the biophysical profile or the modified biophysical profile and there we have come across the Manning score, right.

The scoring system and depending upon the score assigned to the fetus in the antepartum period, we assess the fetal well-being. So, what is the difference? It is antenatal that means, the mother is not in labour, right and it is mostly the antepartum fetal surveillance is done in the later stages of third trimester. Today, our topic of discussion is intrapartum that means, when the mother is in labour, the labour onset has already started and we are in active phase of first stage of labour. During this stage, we need to assess or monitor the fetal as well as maternal well-being during the process of labour.

So, we have discussed partogram in our previous class which gives an idea regarding the progress of labour also. Now, it includes the cervical dilatation, the gradual cervical increase in cervical dilatation as well as the fetal descent, right and mostly it is the monitoring of the active stage of first stage of labour. The delivery or the second stage is not included in the partograph, but we can assess the progress of labour through the active phase. Now, today is the class on CTG that is cardiotocography which is also called as continuous electronic fetal monitoring. So, the concepts to be covered in today's class are intrapartum fetal monitoring that is by cardiotocography as well as you know this cardiotocography is actually the monitoring of the fetus as well as the mother.

So, the keywords are as given, right. So, coming to the discussion proper. So, this is the

cardiotocographic machine. So, here you can see this is the cardio this is the pictorial representation of the cardiotocographic machine. So, it has two probes it has two probes one is for FHR fetal heart rate tracing and this is placed on the uterine fundus, right.

So, it is placed on the fundus of the pregnant uterus of the mother and this probe this is actually the toco, toco meaning uterine pressure, right. So, sorry. So, this is for the pressure this is for the uterine pressure tracing, right. So, this is on the uterine fundus and this probe. So, this toco is actually involves the uterine pressure and cardio meaning fetal heart rate.

So, this is placed on the FHR tracing in lower uterine segment, right. So, there are two probes and this is present in the hand of the mother she will press this knob whenever she feels or perceives a fetal movement. So, these three are the probes and that is to be kept over the mother's abdomen this is on the upper abdomen this is on the lower abdomen and this is held by the hand of the mother. Now, this is the monitor this is the monitor on this we can get the vitals of the mother in the form of pulse, respiratory rate, SPO<sub>2</sub>, right. Then your temperature everything not temperature you have to measure manually, but this is the monitor and this is the paper.

This paper will have the tracing two tracing. Now, this is the FHR tracing the fetal heart rate tracing and this is the uterine contraction, right. So, this is the whole machine in a nutshell and from this we will get an idea about the FHR pattern, the changes in the fetal heart rate and also in relation to the uterine contraction that are going on during the process of labour. Now, coming to the definition what is CTG? It is continuous electronic record of the fetal heart rate obtained via an ultrasound transducer placed on the mother's abdomen, right. So, it is a continuous there is no role of intermittent CTG.

If you start a CTG during the process of labour say there are some indications or abnormalities which have led to continuous fetal heart rate monitoring. You need to continue the monitoring throughout the labour till the delivery, right. So, this is also called as continuous, continuous electronic fetal monitoring or CTG. Now, coming to the principle behind it. So, every uterine contraction that occurs during the process of labour is a stress for the fetus because with every uterine contraction there is decrease in the uteroplacental blood flow, right.

So, as the blood flow decreases during the contraction there is more compromise on the part of the fetus, right. So, you know there are various mechanisms that are operating on the fetal level to compensate or to survive this stressful condition of labour. So, we can know in a nutshell if you say that fetus has an autonomic nervous system. The autonomic nervous system has two parts the sympathetic and the parasympathetic. There is always a synchrony between these two systems the sympathetic nervous system and the parasympathetic nervous system because the sympathetic will increase the fetal heart rate and parasympathetic will decrease the fetal heart

rate.

So, system, right. Number two are the baroreceptors which will assess the blood pressure. So, in case the arterial blood pressure of the mother increases it will decrease if the arterial blood pressure is high what will happen the parasympathetic system is activated and that will decrease the fetal heart rate, right. The chemoreceptors they will sense the acidosis or hypoxia, right hypoxia or acidosis will be sensed by the chemoreceptors, right. So, all these features all these sympathetic system, parasympathetic system, the baroreceptors, the chemoreceptors come into play in the fetus to combat this stressful condition.

And also you know how to overcome for the fetus as the fetus matures it can survive these stressful situations because of the presence of hemoglobin F which has higher affinity for oxygen. So, even in lesser concentration of oxygen the fetal hemoglobin is able to extract the oxygen from the maternal blood also there may result in no anaerobic respiration leading to acidosis. So, lactic acidosis can sometimes result in case of hypoxia in the fetus, right. And number three is your due to this activation of this chemoreceptors, activation of the baroreceptors or activation of the sympathetic nervous system it will increase the fetal heart rate by the sympathetic system activity, right. So, all these three together is the result of on the fetus during this stressful condition and all these are plotted on the graph paper in a CTG and thereby we can assess the fetal condition.

Now, coming to the purpose of CTG actually what is CTG doing it is recording the fetal heart sound or fetal heart rate to be precise fetal heart rate continuously. So, it helps to you know prevent unnecessary cesarean section. Number one it prevents unnecessary cesarean section and number two it helps to identify any abnormality earlier. You know we detect or identify any abnormality earlier and so, we can proceed in you know in that direction or we can intervene timely. So, it in it helps to monitor the FHR continuously, it helps to check the uterine activity whether it is adequate or not, it helps to detect fetal distress at a earlier stage and we can gain information about the rate, the fetal heart rate, the rhythm right and also about the fetal movement which is you know through the hand held probe present with the mother, right.

So, all these you know information we get from a CTG and now what is WHO saying that whether every woman needs to go for a CTG on admission? No, it does not support the use of admission CTG in low risk pregnancy, right. It is not recommended in low risk in pregnancy which are uncomplicated without any maternal or fetal adversities we need not go for CTG. In that case only intermittent auscultation is enough. So, CTG is done only for high risk pregnancies, right. Now how to you know categorize? Categorize mother into low risk and high risk, right.

So, in case of low risk I have told that yes CTG is not required here we go for intermittent

auscultation. Now, what is this intermittent auscultation? We have already seen that in the first stage we have to monitor FHR fetal heart rate in active phase of first stage of labour. At what interval? At an interval of 30 minutes sorry 15 minutes extremely sorry. So, every 15 minutes you need to monitor the FHR for that mother, right. And say if you know the mother goes to the second stage second stage of labour then FHR is to be monitored every 5 minutes.

So, this is in case of intermittent auscultation, right. And how intermittent auscultation is done? It can be done by this is Pinard's Fetoscope any of the three you can use the Pinard's Fetoscope, you can use the Bell of the Stethoscope or you can use the handheld Doppler. With any of the three placed on the mother's abdomen you know here or you auscultate the fetal heart rate which is at the interval of 15 minutes in active first stage of labour and in second stage it has to be monitored every 5 minutes, right. And you know this monitoring this FHR should be done at the end of uterine contraction. So, when you palpate a uterine contraction by putting your hand on the mother's abdomen just at the end of that uterine contraction you need to monitor the FHR.

Why? Because immediately after uterine contraction you need to assess whether there is you know a fall in fetal heart rate. So, that can be done when fetal heart rate is monitored at the end. So, at the peak of the uterine contraction this at the peak of the uterine contraction you will not auscultate you will auscultate after the uterine contraction has ended, right. So, this is about intermittent monitoring and you know what is the inference, how to get the inference from this fetal heart rate and another thing is you have to auscultate over a period of 1 minutes. So, you know if sometimes we think that yes we auscultate for 30 seconds or say 15 seconds and multiply it by 4 or auscultate for 30 seconds and then multiply it by 2.

No that is not the rule you have to auscultate over a period of 1 minute and then you calculate the FHR and if it is within 110 to 160 beats per minute then it is normal. If less than 110 or more than 160 that is fetal bradycardia or tachycardia over a period of 10 minutes this is also important over a period of 10 minutes it remains as less than 110 or more than 160 then from intermittent auscultation we need to go for continuous electronic fetal monitoring or CTG. Any abnormality during the course we need to convert to continuous fetal heart rate monitoring. So, that was for low risk now coming to the high risk. So, what who are the high risk women, right.

Who are the high risk this is what I have already told that yes intermittent auscultation should be done for all pregnancies of low risk category that is without any complication on the part of mother or fetus. But once you know these happens when the fetal baseline fetal heart rate is either less than 110 or more than 160 or there you perceive or you auscultate any drop in fetal heart rate after the uterine contraction in the form of deceleration or any intrapartum risk factors develop on the part of the mother or the fetus then we convert the intermittent auscultation to continuous electronic fetal monitoring. Now coming to the indications of CTG. So, these are

the high risk high risk group. So, high risk meaning they have some complication in the form of medical or obstetric.

So, what are the medical complications in case the mother is having gestational diabetes, right gestational diabetes or pregestational diabetes not controlled, right. So, everything every complication when it is not controlled in pregnancy hypertension PIH, BP not controlled in case of chronic kidney disease, chronic liver disease these are you know with some complications in the form say there is raised creatinine, raised bilirubin you know jaundice in the mother or say any liver cirrhosis you know these type of complication on the part of the mother in the form of medical complication. Now coming to the obstetrical complication it can be so, that it is a post dated or post term pregnancy. In case of preterm also less than 32 weeks we go for CTG. So, you are going for a cesarean section and you are going for a trial of labor by you know vaginal you are trying for vaginal birth after cesarean section I U G R.

Now we call it as FGR that is fetal growth retardation in the uterus, right and you know in any type of malformation on the part of the fetus oligohydramnios very important, right. So, in gross oligohydramnios we are actually not going for labor or vaginal delivery in that case we will directly go for cesarean section gross oligohydramnios with say abnormal doppler you need to deliver it you know expedite the delivery and you need to go for cesarean section, but mild oligohydramnios you can go for vaginal delivery, right. But in that case you need a continuous cardiotocography monitoring PROM, PROM meaning pre labor rupture of membranes third trimester bleeding in any form in case of abruption in case of say placenta you know not placenta period because in that case also you will have to go for cesarean section. So, in case of abruption or oxytocin induction oxytocin used for induction or augmentation of labor.

So, this is important. So, in any labor process or in any mother where you are giving oxytocin infusion it is mandatory for CTG monitoring for that patient, right. Other complications like preeclampsia, meconium stent like you need to go for continuous CTG stress. So, that was about the mothers who need continuous CTG monitoring. Now see this is the CTG machine which I was talking about it has two probes, right. One probe over the uterine fundus that will be measuring the uterine pressure, right and know the increase in uterine pressure during uterine contraction and this probe over the lower uterine segment it is placed just you know against the fetal heart where you auscultate the fetal heart rate by your stethoscope there you place this probe and this picks up the fetal heart rate tracing.

And another probe is there with the mother with the mother it is you know mother is asked to press that knob whenever she perceives a fetal movement. And here is the graph coming out and you need to see the graph you know over a period of 20 minutes. So, it is coming out continuously and you can read the fetal heart rate tracing over that period of time, right. So, that is about the method.

Now coming to documentation. So, apart from only fetal heart rate monitoring you need to document also the patient particulars, right. So, you need to document also the various patient particulars. So, I will just write it down you need to document the name, age, identification number of the mother, identification number meaning the hospital admission number and also the pulse BP of the mother. So, these are the maternal vitals which you document and very importantly the date and time of CTG tracing. This is very important from what time the CTG is being traced, right that has to be written on that paper.

And that is all regarding documentation apart from these your heart rate and contraction tracing. And another thing is in any intervention is done. Any intervention meaning in the form of any drugs or epidural analgesia or say you have gone for a per vaginal examination or there is change of posture of mother or say you have done an ARM or the Liquor color if you seen all these are also to be documented on that CTG paper. And in case there is any confusion between the CTG tracing of fetal heart rate or no maternal pulse rate say you know you are seeing the fetal heart rate and you are confused whether it is maternal heart pulse or fetal heart rate then you should always differentiate by a bedside ultrasound, right. Now coming to the interpretation of CTG, we are actually concerned with the fetal heart rate monitoring and we have four criteria.

Number 1 is the fetal heart rate the baseline fetal heart rate, number 2 is the baseline fetal heart rate variability, number 3 the presence of any acceleration in the fetal heart rate in the CTG tracing or whether there is any presence of deceleration in the fetal heart rate in that tracing, right. So, this is the paper here this is the tracing for the fetal heart rate and low down is the tracing for uterine activity, right. So, like this you have the uterine activity tracing which you know shows that these are different uterine contractions and the speed of the paper is 1 centimeter per minute, right. So, these are 1 centimeter square, right. So, this is the speed this is the paper speed and this is the fetal heart rate stressing it will come like this say like this.

So, there will be some accelerations, there may be some decelerations and these are the fetal heart rate. So, from this you can see what is the baseline fetal heart rate. Baseline fetal heart rate is taken that segment which is devoid of say any acceleration or deceleration I will take this part. So, here we have no acceleration or deceleration.

So, here if you draw in the midpoint. So, this is the fetal heart rate which corresponds to 120 beats per minute and also there is variability beat to beat variability see. So, this single your this is 130, 140. So, 1 square is 10. So, see this is going 1 square above and half a square below.

So, above it is 10 and below it is 5. So, FHR variability is 10 plus 5 variability baseline variability this is 10 plus 5 that is 15 beats per minute, right. This is FHR variability and

number 3 is presence of acceleration, but acceleration we will we will discuss what is acceleration, what will be deceleration, but acceleration may or may not be present in a intrapartum monitoring. I have already spoken about antepartum monitoring where acceleration was a sure sign of fetal you know well being, but here in the intrapartum period during the process of labour acceleration may or may not be present, right. So, the presence of deceleration and what type of deceleration is important to note from this stressing.

So, coming to one by one baseline fetal heart rate. So, baseline fetal heart rate when it is stable excluding the acceleration and deceleration it is the mean level of fetal heart rate and it has to be determined over a period of 5 to 10 minutes mostly 10 minutes it is expressed in the form of beats per minute, right. So, here you can see this is the so, if this segment if you take this segment say this is without any acceleration or deceleration. So, I will use so, you take this segment. So, here you see this is the mean baseline, right. Above there is some variation below there is some variation.

So, the mean baseline over this period is of 120 beats per minute. So, here the baseline fetal heart rate is 120 beats per minute. Now coming to the values what is the normal value you know 110 to 160 beats per minute. What is bradycardia? If it is less than 110 it is bradycardia. Now you need to know the causes of bradycardia say you are getting fetal bradycardia.

So, what can be the cause? Number 1 is post dated pregnancy because I have told in preterm the sympathetic system is more developed, but in post term or post dated there is more maturity of the parasympathetic system which may decrease the fetal heart rate. In case of congenital heart block of the fetus there can be fetal bradycardia. In case of some drug administration to the mother in the form of benzodiazepine or opioids and sometimes fetal bradycardia occurs in acute cord compression. So, all these are the causes which needs to be excluded if you get a scenario of fetal bradycardia. Now coming to fetal tachycardia which is more than 160 beats per minute.

This is fetal tachycardia and this also should be measured over a period of 10 minutes both bradycardia before you say a case of bradycardia or tachycardia you need to see over a period of 10 minutes and what are the causes? This can be fetal cause which can be in case of fetal infection in case of preterm. Preterm meaning less than 32 weeks so, more sympathetic activity more fetal heart rate it can be due to fetal hypoxia very very important needs to be excluded right in case of fetal tachycardia or excessive fetal movements. This can be seen by the probe which is placed in the hand of the mother and some of the maternal causes are there say in case of maternal fever, in case of maternal anxiety, in case of maternal dehydration right. All these can lead to maternal tachycardia which will in turn lead to your fetal tachycardia, in case of you know hypotension due to any you know underlying bleeding right. So, APH or say from placental abruption or placenta previa it leading to hypotension leading to maternal tachycardia

leading to fetal tachycardia, chorioamnionitis right all these infections also increase the fetal heart rate.

So, you need to exclude. So, both these are dangerous it should be in between 110 to 160 beats per minute. Now coming to baseline variability I have told that it is in between 5 to 15 right. Now we say actually less than 5 is reduced variability and more than 25 is you know excessive variability. So, normal is taken to be 5 to 25 right in some books it is 5 to 15, but the to note what is why there is variability because this is a result of the interaction between the nervous system, the sympathetic, the parasympathetic, the chemoreceptors, the baroreceptors and the cardiac receptors. So, all these need to be responsive and when this fetal variability is present that means, the fetus is in well or good condition right.

So, this is the graph for fetal variability normal is you know 10 to 25, but we take it as 5 to 25 less than 5 is reduced variability more than 25 is you know excess both are not normal right. So, here you can assess every I told every vertical point square is 10 right. So, I will clear this because. So, here you see they have already marked. So, here the variability is 20 because it is enclosing 2 squares right 20 here it is 10.

So, on a nutshell you can say the variability is 10 to 20 beats per minute which is normal right. So, that was regarding fetal baseline variability. Now coming to acceleration what is acceleration? Acceleration is you know increase in fetal heart rate by 15 beats per minute. So, if you take this place which is devoid of any acceleration or deceleration here the fetal heart rate is 120. Now in this phase so, it is 120 it has increased and it has gone to 140.

So, increase in heart rate has been by 20 beats per minute right. So, if the increase is more than 15 beats per minute and it stays for 15 seconds then you consider this to be a acceleration right. So, this is an acceleration here this is another acceleration why this is persisting it is more than 15 seconds. So, it is persisting. So, accelerations I have told that yes they are very important in the antepartum fetal monitoring as such acceleration may or may not be present in a intrapartum fetal monitoring. So, accelerations what is the definition it is abrupt increase in fetal heart rate of greater than 15 beats per minute and persisting for 15 seconds.

Presence of acceleration is reassuring right. So, it is reassuring that meaning that yes the fetus is in good condition, but to note that absence of acceleration. Presence of acceleration with an otherwise normal CTG is of uncertain significance. That means, even if it is absent in a CTG stressing then also it is you know we can say yes the fetus is in good condition it is not a necessary to assess the fetal condition in the intrapartum monitoring. So, that was all regarding the up to acceleration. Now, the next part will be the feature deceleration and in case of deceleration if it is present we need to note whether what is the type of deceleration that we will discuss in our subsequent class. So, thank you all for your patient hearing. Thank you.

