

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

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Week:03

Lecture:03

Umbilical cord and Fetal membranes (Part - 1)

Welcome students. We are here for yet another session of the NPTEL online certified courses 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 an assistant professor at B.C.Roy Medical College and Research Center, IIT, Kharagpur. Today, our topic of discussion is umbilical cord and fetal membranes. So we have already read about the placenta, the normal as well as the abnormal variants.

Today, we are going to learn about the umbilical cord. Concepts covered in today's class are umbilical cord structure, the fetal membranes, insertion of cord, vasopraevia, single umbilical artery, true knot and false knot and a little bit discussion about cord prolapse. The keywords for the class are as follows, right. Now coming to the class proper.

So umbilical cord, umbilical cord is also called as funi, it is also called as funi, it is attached to the fetal surface of placenta, right. Development it is developed from the connecting stock and coming to the contents. So this is a cross section of the umbilical cord which will be connecting the fetus and the placenta. So from outside, this is a single layer of aminocytes, right. So first is the single layer of aminocytes.

Then inside is the connective tissue or the mucoid degeneration of the mesenchymal tissue which is called as the Wharton's jelly. And in the Wharton's jelly are the umbilical vessels, right. So number one is the layer of amino sites, then the Wharton's jelly and third is the umbilical vessels. We can see here there are two umbilical arteries and one umbilical vein, right. To note here, now to start with there was the cord had four vessels that is two arteries and two vein.

As pregnancy progresses, around 16 weeks of gestation, the left umbilical vein remains or is left behind, right. And the right umbilical vein degenerates, it disappears. So after 16 weeks, it becomes a three vessel cord containing two umbilical arteries and one umbilical vein that is the left umbilical vein, right. Another thing to note here is this allantois. This allantois is nothing but a blind tubular structure which is present at the fetal end of the cord.

Coming to the one liners, so vessels of the cord. Yes, there are two umbilical arteries and one umbilical vein which is nothing but the left umbilical vein after 16 weeks of pregnancy. The umbilical arteries are the branches of internal iliac arteries, right. And after birth, after birth these umbilical artery will form the medial umbilical ligament. After birth these arteries will collapse and ultimately they will form the medial umbilical ligament.

Whereas the umbilical vein after birth it will form ligamentum teres, right. So vein will form the ligamentum teres and artery will form the medial umbilical ligament. Coming to the length of the cord. Now, it is you know told that the length of cord is equal to the length of the fetus, right. So it is approximately 50 centimeters.

We say it in a range it is between 40 to 70 centimeters. If the length of the cord is less than 30 centimeter it is called as short cord whereas, if the length is more than 100 centimeter then it is called as the long cord. Now coming to short cord and long cord. We see here short cord meaning less than 30 centimeter in length. So we see here this is the uterus, the internal os, this is the amniotic membrane and inside is the placenta and this is the umbilical cord, right.

So the cord length is short. What are the difficulties faced with a short cord? Due to the short length of the cord any movement of the fetus is restricted. So during external cephalic version which is nothing but a maneuver we will learn about these things in our later classes. So in external cephalic version we do a maneuver externally from outside on the uterus so as to change the position of the fetus in utero. Normally the fetus should be in longitudinal lie in cephalic presentation for a normal vaginal delivery.

In case of bridge presentation or podalic end it is the buttocks lower down we try to rotate the fetus so that the head which was above goes down. But as the length of the cord is short this movement of the fetus is restricted and there is difficulty in external cephalic version. Number two there might be no sudden pull from the cord is short any movement or any trauma or any sudden traction on this cord can lead to separation of a normally placed placenta which is called as abruption which can lead to antepartum hemorrhage and other complications associated with it. Number three is difficulty in descent. Yes during the onset of labor in the late third trimester when the fetus it is descending into the maternal pelvis this descent is hampered because the length of the cord is short.

So there will be delay in engagement or the fetus cannot engage or come low down into the female mother's pelvis so there is delay in engagement. Number four is fetal malpresentation. Yes due to the movement of the fetus being restricted the position of the fetus will not be normal. No there will be difficulties in cephalic version there will be difficulties in internal rotation, inflexion, position of the fetus and it will result in malpresentation. And lastly it will

lead to fetal distress in labor.

Say for instance this mother with short cord goes into labor during the process of labor as the fetus goes down as there is more descent, more flexion, more internal rotation these all can lead to firstly abruption or separation premature separation of the placenta. And number two it can lead to cord compression thereby you know compressing the fetal blood vessels, decreasing in fetal blood supply leading to fetal hypoxia and fetal distress. So these are about short cord. Coming to long cord we know long cord meaning it is more than 100 centimeter. So this is a case of long cord.

So in long cord you know it in utero when the fetus is inside you know inside the mother's womb due to the long cord it may so happen that the cord passes down ahead of the fetal parts right. So the cord will be low down and it will be covering the internal os with the membranes intact. So this you know this type of situation where the cord is covering the internal os it is overlying the internal os below the fetal parts and you know with the membranes intact it is called as cord presentation. It is an antenatal finding right. The mother is still not in labor but the cord is lying low down below the fetal parts just above the internal os.

So it can form or present as cord presentation. Then as the length is more there will be more coiling there is chance of formation of true knots within the cord then it can lead to coiling of the cord around the fetal neck which is called as cord entanglement and sometimes following rupture of membranes the cord may pass down along with the amniotic fluid and come outside the internal os into the vagina leading to cord prolapse. So these are the complications arising from long cord. Now coming to the diameter. Diameter of the cord it is ranging from 1 to 2.

5 centimeters. So on an average we take it to be 1.5 centimeters. Connective tissue of the cord yes we have just read it is called as Wharton's jelly which is nothing but the mucoid degeneration of the mesenchymal you know tissue. Another thing to note is the folds of Hoboken. Folds of Hoboken these are also found in the umbilical cord they are actually the folds of tunica media right in of the umbilical arteries.

So these umbilical arteries which are carrying blood from the placenta to the fetus in utero immediately after birth they will collapse right and they will obliterate and this folds of Hoboken which are present in the umbilical artery these will help in you know closure of these umbilical arteries after birth. So these are also present in umbilical cord right. Now coming to funicitis we know umbilical cord is also called as funis. So funicitis is nothing but inflammation of the cord and the choroidal plate it is called as funicitis. Cordic presentation is another name for cord presentation.

Cord is overlying the internal os it is present in the lower uterine segment and is you know

low down below the fetal parts overlying the internal os with the membranes intact that situation is called as the cord presentation. Now coming to HYRTL anastomosis right so this type of anastomosis is present in between the two umbilical arteries near the fetal end of the cord right. So this type of anastomosis is called as the HYRTL anastomosis. Next coming to a very important concept the umbilical coiling index. Now in recent times it is of very importance is an USG feature which we can detect antenatally.

So it is defined as the number of complete coils per centimeter of cord length. So you know we can see here this is the umbilical cord and you see that there are coils along the length of the cord. So number of coils complete coils mind it per centimeter of cord length. So why is the cord you know coiling this coiling is from left to right the twisting of the coil is from left to right right from left to right and why is it there is such coils in the cord because the blood vessels passing through the cord they are longer than the length of the cord. So there is coiling of the cord normal umbilical coiling index is 0.

3 right this is normal if it is less than 0.3 then it is called as hypocoiling and more than 0.3 meaning it is hypercoiling both are dangerous hypo hyper both are dangerous hypo being more dangerous for the fetus because it will lead if there is less coiling it will lead to you know fetal growth retardation right it can lead to fetal distress or meconium aspiration syndrome right and it can so happen that it may lead to intrauterine fetal death. So these are the complications of umbilical coiling index when you get it is less than 0.

3. So this is very important and it can be assessed antenatally by sonography. Coming to the fetal membranes they are of four types amnion, chorion, yolk sac and allantois. So chorion we know it is formed by the cytotrophoblast and it is the outermost fetal membrane developing by day 8 of fertilization. Amnion it is formed by the fetal ectodermal cells and it does not have any blood vessels that means it is avascular it has no nerve supply no lymphatics and it maintains the tensile strength of the fetal membranes this is very important the amniotic fluid right is present in the amniotic sac say this is the maternal abdomen and uterus with the internal os and these are the amniotic membrane. Inside the amniotic membrane is the fetus with the placenta right.

So during this amniotic membrane this green amniotic membrane they are maintaining the tensile strength so as pregnancy progresses the amniotic sac will increase in size but it will not rupture due to the tensile strength of the amniotic membrane and it will help in continuation of pregnancy. Then during labor in the third trimester there is the fetus going descending into the maternal pelvis and then ultimately there will be onset of labor and during labor sometimes it may so happen that know the cervical os opens a little and through the os this amnion will bulge down this is called as bag of membranes. It will bulge down forming a bag of membrane which will help in further cervical dilatation and effacement of the cervix thereby you know helping in smooth progression of labor. So this is a you know important episode due occurring during the

process of labor helping in its progress right and this amnion as it is a closed sac closed membrane it will also prevent ascent of infection from the maternal vagina into the amniotic fluid thereby into the fetus. So it is a protective barrier for the fetus and it is formed after chorion by day 10 of fertilization.

Now coming to the yolk sac, yolk sac is the first site of hematopoiesis in fetus. So by second week there is production of you know first production of hemoglobin in fetus occurs in the yolk sac and they are Portland hemoglobin, Goers hemoglobin I and II these are the you know types of hemoglobin which are produced in fetus in very early periods of gestation and it also you know helps in secretion of alpha-fetoprotein right. We know alpha-fetoprotein it is also secreted by liver and GI tract of the fetus. Coming to the allantois it is nothing but a diverticulum connecting the hind cart to the connecting stalk. Now all these fetal membranes you know they are rich in prostaglandins and specifically prostaglandin E2 right.

So this can be a question fetal membranes are rich in prostaglandin E2. Now coming to the types of insertion of cord. Normally cord is inserted at the center. It is inserted at the center of the placenta and on the fetal surface the glistening shiny fetal surface of the placenta which is covered by the amnion and we have already discussed this amnion can be separated from the underlying placenta you know from the periphery we can pick the amnion up we can peel it off, but except at the center of the insertion of the cord at this place the amnion is continuous with the underlying structures. So normal insertion is on the fetal side surface of the placenta mostly at its center.

It can so happen that sometimes there can be marginal insertion of the cord where the cord is attached at the margin of the placenta which is also called as battle dore placenta. So cord is attached at the margin and sometimes it can so happen that the cord ends before the placenta and then it forms a membrane. This membrane they are attaching the cord the umbilical cord with the placenta right. So this is called as filamentous insertion of the cord.

We will come to them one by one. Marginal insertion of the cord here is the picture this cord is attached at the margin or within 2 centimeter of the placental edge. So cord insertion is at the margin or within 2 centimeter of placental edge and what are the complications in this case? Number one complication is you know during the delivery of placenta after the delivery of the fetus the placenta will be delivered and that period is called as the third stage of labor right. Now sorry yes third stage where there is delivery of the placenta. So during the delivery of placenta we go for active management of third stage where we do controlled cord traction. We hold the you know the artery forceps which we have used for clamping the cord.

The fetus is you know the newborn or the baby which has been born. So it will be separated from the cord and we have cut the cord we have handed over the baby to the pediatrician and

now the placental end of the cord that is containing the artery forceps we hold the artery forceps and we give a traction controlled traction to the cord so as to help in placental separation. In case of marginal insertion of the cord during this controlled cord traction there can be tear in the cord right. So it can result in cord avulsion. So the cord will get torn from the placenta due to this traction and this may result in retained placenta which gets retained inside the uterus and ultimately leading to bleeding called as postpartum hemorrhage.

So this is one of the complication. Number two complication is in the antenatal period during the progression of pregnancy it may so happen that with fetal movement or with the growth of the fetus this cord may get you know torn from a normally situated placenta that is called as placental abruption leading to fetal distress in utero. Number three which is IUGR why there is IUGR because you know this placenta it is attached at the margin and it is liable to kinking or compression of the cord by the fetal parts and this compression or kinking of the cord will lead to compression of the fetal blood vessels underneath thereby decrease in fetal blood supply, decrease in fetal oxygenation causing fetal hypoxia and decrease in fetal growth that is IUGR. So that was about the marginal insertion of the cord and it is present in case of battle neck placenta. Coming to velamentous insertion of the cord. So what happens in velamentous insertion? This is the umbilical cord and this umbilical cord has ended before placenta and this portion is containing only the fetal membranes without the Wharton's jelly right.

So that is having the fetal membranes the amnion and chorion without the Wharton's jelly and over the fetal membranes there are the fetal blood vessels traversing right. So this portion is the velamentous insertion. So cord ends before placenta fetal blood vessels from the cord traverse on the fetal membranes without the Wharton's jelly towards the placenta and as a whole it is liable to kinking. These blood vessels can be you know they can be you know they are liable to kinking or compression by the fetal parts right. So it may also decrease fetal circulation causing fetal hypoxia and fetal growth retardation.

So they are a cause of IUGR right. But sometimes it may so happen that this part will be overlying the internal os. Not always sometimes it can over lie the internal os and will be called as vasapraevia type 1 right. So we will read about that and most commonly these velamentous insertion are found in monochorionic twins and placenta previa. So what I was telling that yes this is a velamentous insertion, this is the membrane part and the cord you know is attached to the placenta through this fetal membranes which have the fetal blood vessels you know traversing through it. So this is you know plain velamentous insertion of the cord, but in some cases where these fetal membranes with the fetal you know blood vessels they over lie the internal os.

This is called as you know that is the membranes with the fetal blood vessels they are forming the presenting part. So this situation is called as vasapraevia and it is type 1 right. So same

picture this is normal insertion, this is the cord attached to the placenta at its center and this is a case of velamentous insertion where you know it is the cord is attached to the placenta with an intervening membrane. And when this membrane with the fetal blood vessels they form the presenting part it is called as vasa praevia. So this is a case of velamentous insertion of the cord with vasa praevia.

So point to be noted all velamentous cord insertion are not vasa praevia and vice versa that means all vasa praevia are not due to velamentous insertion of the cord. There are some other causes also. Now coming to the complication yes I have told that there can be compression or kinking of the blood vessels which are traversing the fetal membranes there is no what instantly no protective covering to the fetal blood vessels. So they can be compressed causing less blood supply to the fetus causing growth retardation in the fetus called as IUGR less blood supply to the fetus, less blood supply to the fetal kidneys, less urine production leading to oligohydramnios and you know ultimately fetal hypoxia leading to fetal distress. And second is type 1 vasa praevia where these fetal membranes with the fetal blood vessels they form the presenting part and it needs to be you know diagnosed antenatally.

This prenatal diagnosis with USG and Doppler study is essential. So whenever we see a case of velamentous insertion of the cord we should always go for Doppler study to exclude the possibility of vasa praevia. Vasa praevia is a very obstetrical emergency and it is associated with high fetal loss no there is increased perinatal mortality around 60 percent if it is diagnosed in labour. So it should be diagnosed antenatally before the onset of labour which will increase the survival of the fetus to 95 percent and can be done with USG with a Doppler study right.

So this is about vasa praevia. Vasa Praevia yes we know what is the definition of vasa praevia. The fetal membranes with the fetal blood vessels they form the presenting part. The presenting part is formed of fetal membranes with fetal blood vessels very important to note because you know these blood vessels are carrying fetal blood right. So any trauma any trauma or any bleeding from the vagina any bleeding per vaginal bleeding or antepartum hemorrhage. Antepartum hemorrhage in a case of vasa praevia is you know it signifies that blood loss is of fetal origin that is the fetus is losing its blood.

There is fetal exsanguination fetus is losing blood and ultimately fetal death will occur. So increase in perinatal mortality nothing to do with the mother. There is no increased mortality of the mother. Mother is not at danger but the fetus is at danger. It is an emergency obstetrical emergency and we need to intervene very very fast.

Incidence is 1 in 2000 to 1 in 6000 and in IPF pregnancy its incidence increases to 1 in 300. There are types 3 types. Type 1 we have already known this is due to the velamentous insertion of the cord right. So this is the placenta, this is the cord and in between is the membrane with the

fetal blood vessels which are overlying the internal os and called as velamentous insertion of the cord which is type 1 vasapraevia. What is type 2? Type 2 means that this is one placental lobe you know or another is this placenta.

So in case of placenta bilobata or bilobed placenta right bilobata or in case of succenturiate placenta where it has a accessory lobe in these conditions these lobes of the placenta these are the no placental lobes they are connected they are connected through this membrane and this membrane will be having the fetal blood vessels and it may so happen that this intervening membrane comes down and it forms the presenting part it is overlying the internal os. So, this type of vasapraevia is called as type 2 vasapraevia and type 3 vasapraevia is associated with placenta previa. So, see this is a case of placenta previa which is low lying this is the placenta and sometimes it happens that this a part of this placenta gets you know degenerated a part gets degenerated and that will form a membrane this is the main placenta and say this part gets you know degenerated and it forms a membrane and it has the blood vessels overlying the membrane and that will be covering the internal os. So, this is a case of type 3 placenta. So, this also can be detected by trans vaginal sonography with Doppler.

So, all cases of placenta previa need to be investigated with TVS with Doppler to exclude you know the presence of vasapraevia. Now, what is the management? Yes, vasapraevia is a complication fetal complication and these blood vessels traversing the you know the fetal membrane they are more prone to compression more prone to kinking leading to decrease fetal circulation causing fetal growth retardation. So, we need to antenatal we need for fetal monitoring from the antenatal period right from 32 weeks of pregnancy we need to monitor the fetus by non stress test and biophysical scoring done weekly these we will again read in fetal monitoring chapter and these are antenatal test done from 32 weeks. So, first is antenatal next we will also monitor the fetus intranatal period. In intranatal period we will you know go for continuous fetal heart rate monitoring by CTG cardiotocography and you know cord compression in CTG is depicted or detected by variable deceleration.

We will read about them in the subsequent classes on CTG these are important we need to know that whether there is any cord compression during the process of labor and this can be detected on a simple CTG tracing. We will see the CTG tracing and we can say that yes there is variable deceleration that means, there is you know cord compression going underneath inside the uterus during this labor and we cannot allow normal vaginal delivery for this pregnancy there will be fetal distress and we lose the fetus right. Now Vasa previa mostly delivery is by a lower segment caesarean section between 34 to 36 weeks of pregnancy and why this period because we do not want the mother to go into labor because during labor there will be more rupture of membranes leading to fetal vessel rupture leading to fetal blood loss and we may lose the fetus. So, we do not want the mother to go into labor and before rupture of membranes we will have to deliver the baby by caesarean section. Now what is the diagnosis of antepartum

bleeding whether it is fetal or maternal we need to differentiate antepartum hemorrhage having a patient coming with per vaginal bleeding she comes to the doctor and she says that yes doctor I am having per vaginal bleeding and I am also having decreased fetal movement.

Now we need to detect whether it is you know of maternal origin or fetal origin how by Singer's Alkali Denaturation Test. It is a simple test we collect the per vaginal blood we add 1 percent NOH or KOH and when if the color of the blood changes to brown that means, there is hemolysis then it says that yes this blood is of maternal origin right. So, under the action of alkali the blood has hemolyzed, but in case of fetal origin the blood is of fetal origin and fetal hemoglobin is resistant to acid or alkali. So, it will not undergo hemolysis and the blood will remain red in color right. So, this is a qualitative test just differentiating the fetal and maternal blood.

Coming to the next test which is called as Kleihauer-Betkey test this is a quantitative test and here we can assess the amount of fetal blood loss present right. So, this is a quantitative test and it is you know helpful for detecting the amount of fetal hemorrhage right. So, this is about the Vasa Praevia. Now coming to the knots in the umbilical cord. True knot they are actually caused by fetal movements incidence is very less 1 percent it is more common in monochorionic twins and if true knots are associated with singleton pregnancy right.

So, in that case yes it is right that the steel birth rate is increased to 2 to 10 folds right. So, with singleton pregnancy if true knots are present then the risk of steel birth is increased. False knot false knot are nothing, but you know sudden swellings these are just knobs protruding from the cord surface and they are due to the accumulation of the Wharton's jelly or due to swelling of the blood vessels underneath and they have no clinical significance and there is nothing to worry with the false knots right. So, these are about the knots on the umbilical cord. So, with this we end this class and the next portion of the umbilical cord will be continued in the next class. Thank you.