Ultrasound in Diagnostics of Strangulation with Umbilical Cord

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SUMMARY
Introduction: Having in mind the significance of its function, umbilical cord represents one of the predictors of pregnancy outcome, delivery and vitality of the newborn. Umbilical cord is the only connection between fetus and source of oxygen and nutritional components, and ultrasound (especially color Doppler, pulsating Doppler and 3D) provide us with an insight into organic and functional changes in umbilical cord. Material and methods: We have analyzed medical histories of women who delivered in 2007, as well as their CTG records typical for complications with umbilical cord, ways of delivery and vitality of newborns. Results: Out of 3550 deliveries, in 801 changes which indicated complications with umbilical cord on CTG record were evident. Most commonly, we were dealing with short term compression of the convolute of cord loop(s) around neck, shoulder or body of the fetus or extension of short umbilical cord in the phase of expulsion. There were 27 urgent Cesarean sections which were performed due to acute and prolonged asphyxia which was caused by strangulation of the neck with umbilical cord and 2 cases of fetus mortus in utero – one case of term pregnancy with 5 loops around the neck and one case of 28 weeks pregnancy with 4 loops around fetal neck. Conclusion: Most commonly, strangulation with umbilical cord does not represent a significant obstetrical problem, but in some cases (intensive fetal activity, beginning of contractions) can lead to acute catastrophic conditions. According to the available literature, percentage of cases of strangulation with umbilical cord is around 24,6% in newborns, out of which 21% is with a single loop, 3,5% with 2 or three loops and 0,1 % with four or more loops. The maximum reported number of loops is nine. Frequency of loops depends on the length of the cord – with short cords (35cm) the incidence is 14%, with normal length cords 2,3% and with cords longer than 89cm -53%. Cord loops around fetal neck can easily be presented with 6 mode and color Doppler.

Keywords: umbilical cord, nuchal cord, ultrasound, color Doppler

1. INTRODUCTION
Umbilical cord is the only connection between fetus and source of oxygen and nutritional components. Many umbilical cord abnormalities can be detected by sonography (B-mode, color and power Doppler, 3D and 4D US imaging) and have important prognostic implications for perinatal morbidity and mortality. The base of umbilical cord occurs during the creation of extra-embryonic mesoderm, between 11th and 12th day of embryonic development.

Around middle of the third week, from mesenchymal cells of chorion, connecting stalk and the wall of yolk sac, through the process of angiogenesis, blood vessels are created.

Through proliferation and development of extra-embryonic blood vessels and villi, a contact with intra-embryonic blood vessels is established; that is how placental circulation is established (1). At the end of third month, allantois and blood vessels is established; that is how placental circulation through the process of angiogenesis, blood vessels are created. Extra-umbilical mesenchyme, it is rich with water, mucopolysaccharides and does not contain blood vessels. That gelatinous connective tissue helps protect the umbilical vessels from compression. Arteries have a thick muscle wall and a lot of elastic fibers which contribute to fast contractions after umbilical cord is tied. These are unique blood vessels because they don’t have adrenergic (alpha and beta) receptors so that arteries and their chorionic branches do not react to changes of concentration of pH, CO2 and catecholamines.

This shows that there is a great permeability for the blood rich with CO2 and other degradation fetal products.

2. ROLE OF ULTRASOUND AND COLOR DOPPLER IN DETECTION OF THE UMBILICAL CORD
The umbilical cord is first visualized by US at 8 weeks as a straight, thick structure. The length of the umbilical cord is approximately equal to the crown-rump length. The length of umbilical cord varies and at the end of pregnancy ranges from 50 to 55 cm.

Extreme lengths of umbilical cord vary from acordia to the length of 3 meters. The weight is about 100 grams and the diameter of umbilical cord is normally less than 2 cm (2). The umbilical cord develops up to 40 spiral turns as it elongates during gestation, and it twists toward the left more frequently than to the right.

Coiling is thought to aid in protecting the cord by resisting compression of the vessels. Umbilical coiling index (UCI) is measured when total number of coils per one segment (2 arteries and 1 vein) is divided by the length of umbilical cord (in cm).

Increased coiling (more than 0,3 coils per one cm) or reduced coiling (less than 0,3 coils per one cm) carries an increased fetal risk (IUGR, chromosomopathies, disorders in FHR, more frequent intrapartum interventions and sudden fetal death). Normally, the umbilical cord contains two arteries and one vein.

Single Umbilical Artery (SUA) is the most common abnormality seen in approximately 1% of pregnancies. Current-
ly, there is no definite correlation between SUA and any specific type or pattern of anomalies. But, evidence of SUA requires cytogenetic prenatal diagnostics with a detailed sonomorphologic examination of fetus, especially neurosonographic and echocardiographic examinations.

The presence of an umbilical cord mass warrants evaluation of flow within the vessels, to assess for vascular compromise resulting from compression or thrombosis.

Early in development, the embryo rotates such that the yolk sac and adjacent connecting stalk are positioned opposite the implantation site. This allows the umbilical cord to insert centrally within the placenta. An exaggerated form of eccentric insertion occurs in 7% of pregnancies with insertion of the cord at the margin of the placenta (battledore placenta).

In 1% of pregnancies, the cord inserts beyond the placental edge into the free membranes of the placenta (velamentous insertion) and may be complicated by rupture and thrombosis of the umbilical vessels because they are not protected by Wharton jelly. Short cords have been reported in association with an increased incidence of: congenital anomalies, in trisomy 21, oligohydramnios, and breech presentation. Shortened umbilical cords may lead to: cord compression, placental abruption or poor fetal descent during delivery. An abnormally long umbilical cord may predispose to: cord knots, nuchal cord, and cord prolapse.

These conditions may lead to cord compression and decreased perfusion secondary to obstruction of venous return.

3. NUCHAL CORDS

Nuchal cords, the term used to describe entanglement of the umbilical cord around the fetal neck, have been reported in approximately 25% of pregnancies, with an incidence ranging between 16% and 30%, but they are rarely associated with perinatal morbidity or mortality and they represent a result of fetal dynamics in 1st and 2nd trimester (3).

Nuchal cords may be recognized on prenatal US as two adjacent loops of cord in cross-section posterior to the neck on sagittal images and by visualizing cord circumferentially around the fetal neck on axial images, best appreciated with color Doppler interrogation.

A single loop umbilical cord seen near the fetal neck is most often an incidental finding (21%) and not associated with fetal risk. But they have been considered worrisome for possible associated fetal injury, particularly when there are two or three loops (3.5%) or four or more tight loops (0.1%) around the fetal neck. According to the available literature, the maximum reported number of loops is nine.

Frequency of loops depends on the length of the cord: with short cords (35 cm) the incidence is 14%; with normal length cords the incidence is 2.3% and with cords longer than 89 cm the incidence is 53%.

The question of whether or not nuchal cords are associated with significantly increased adverse fetal outcome is rather controversial and remains unclear. Some investigators have been suggesting that the observation of nuchal cord is of greater concern when seen in association with other findings, specifically decreased amniotic fluid volume, growth restriction, post dates and, especially, decreased fetal movements. In some cases, that situation need prompt further evaluation with antenatal testing, close surveillance and possible intervention (delivery).

Figure 1. Ultrasound of the foetus and the umbilical cord

Figure 2. Ultrasound of the foetus and the umbilical cord

Figure 3. Ultrasound of the foetus and the umbilical cord
Other investigators have found that: antenatal nuchal cords found by US are rarely associated with perinatal complications, not associated with increased risk of Cesarean section, or poor neonatal outcome and did not alter or influence clinical management at time of delivery.

4. Results
Out of 3,550 deliveries in 2007, in 801 of those changes which indicated complications with umbilical cord on CTG record were evident. Most commonly, we were dealing with short-term compression of the convolute of cord loops around neck, shoulder or body of the fetus, or extension of short umbilical cord in the phase of expulsion. There were 27 urgent Cesarean sections which were performed due to acute and prolonged asphyxia caused by nuchal cords and 2 cases of fetus mortus in utero – one case of term pregnancy with 5 loops around the neck and one case of 28 weeks pregnancy with 4 loops around fetal neck.

5. Conclusion
Most commonly, nuchal cords do not represent a significant obstetrical problem, but in some cases (intensive fetal activity, beginning of contractions) it can lead to acute catastrophic conditions. Knowledge on normal umbilical cord development and anatomy, and awareness of common abnormalities of the cord is therefore important for accurate prenatal diagnosis and assessment. Umbilical cords and their location can clearly be presented by B-mode or, even better, by a color Doppler. Colored Doppler presentations exclude confusion of nuchal cord with dorso-nuchal edema or cystic hygroma of the neck in 1st and 2nd trimester, as well as umbilical knots, false and real ones. It is recommended that, with every routine check-up, morphology of umbilical cord is evaluated; its location should be evaluated by color Doppler and its haemodynamics checked with Doppler sonography.

REFERENCES