

Fetal distress reflected in umbilical cord features

Ramona Mohora^{1,2},
Decebal Hudita¹,
Silvia-Maria Stoicescu^{1,2}

1. "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania
2. Department of Neonatology, "Alfred Rusescu" Institute for Mother and Child Care, "Polizu" Clinical Hospital of Obstetrics and Gynecology, Romania

Correspondence:
Dr. Ramona Mohora
e-mail: mohoraramona@yahoo.com

Acknowledgements:
This work received financial support through the project entitled „CERO - Career profile: Romanian Researcher”, grant number POSDRU/159/1.5/S/135760, cofinanced by the European Social Fund for Sectoral Operational Programme Human Resources Development 2007-2013.

All authors contributed equally to this work.

Received:
January 20, 2015
Revised:
February 22, 2015
Accepted:
May 14, 2015

Abstract

The management of intrapartum fetal distress is using also the features of umbilical cord. Following progressive in utero hypoxia lead to acidosis and asphyxia by default. Since perinatal asphyxia is approx. 15% of the causes of perinatal morbidity, we intend to study the umbilical cord in infants with fetal distress. The umbilical cord connects the fetus and placenta and its main role is the transport of nutrients and oxygen from the mother to the fetus. Any alteration of the umbilical cord features, such as length- shorter or longer than normal, structural changes like hematoma, ulcers, varicose veins, teratomas, etc., arteriovenous malformations - one artery, can induce perinatal asphyxia witch represents the cause of perinatal morbidity and mortality with long term effects. At the same time changes in the appearance of umbilical cord can be clinical indicators of a disease with intrauterine onset, eg. quantity and color of Wharton jelly, macroscopic appearance of the vessel like turgid or flaccid.

Keywords: umbilical cord, fetal distress, term newborn, transition to extrauterine life

Introduction

Fetal distress is defined as pathological manifestations in the product of conception, occurs during pregnancy and birth due to intrauterine factors changes.

Etiology:

- Maternal factors (e.g. hypertension, decompensated heart disease, chronic lung damage, kidney damage, anemia, respiratory failure, eclamptic last quarter)
- Placental factors (e.g. detachment of the placenta, retroplacental hematoma, inserted below the placenta, placental insufficiency, circulatory disorders, twins)
- Pathology of the umbilical cord and
- Fetal factors⁽¹⁾.

The umbilical cord is mobile, suspended between fetus and placenta and is involved in many processes that affect feto-placental unit⁽¹⁾. At a term newborn umbilical cord has a length of approx. 50-60 cm long, is covered by a single layer of amniotic epithelium, Wharton's jelly contains two arteries and one vein⁽¹⁾.

Amniotic cavity space and cord traction applied during fetal movements determine the length of the cord⁽²⁾. The cord is shorter in twin pregnancy toward unique newborn. Studies have shown that in rat fetuses exposed to alcohol cord is short⁽²⁾. In some dead fetuses *in utero* cord is short due to reduced fetal movements frequency and speed. In polyhydramnios, the umbilical cord is longer⁽²⁾.

Helical path of artery around the vein determine the characteristic structure of the umbilical cord, normally 10-11 spirals with left versus right 7:1, right umbilical artery is usually of higher caliber⁽¹⁾. Coiling of the umbilical cord will be reduced when the smooth muscle of the umbilical vessel walls missing or if the intravascular pressure is decreased. In 30% of cases the condition is corrected during pregnancy⁽²⁾. Coiled cord increases its turgor and makes it resistant to compression⁽²⁾.

This structure is dynamic and morphological depend on amount and composition of amniotic fluid, feto-

placental hemodynamics, gestational age or maternal complications during pregnancy⁽¹⁾.

Case report

We prospectively analyzed the characteristics of umbilical cord in infants with antepartum fetal distress. We present two clinical cases with mentioned pathology, born in PhD, MD. "A. Rusescu" Institute for Mother and Child Care, Clinical Hospital of Obstetrics and Gynecology "Polizu", Department of Neonatology from Romania. The study follows the history of pregnancy, labor, delivery and transition to extrauterine life of the newborn. We used Lubchenco charts for anthropometry and Ballard maturational assessment to determine the gestational age of newborn.

During one year, 2.3% of term infants showed fetal distress. The newborns of pathological pregnancies (arterial hypertension, gestational diabetes, perinatal infections) with intrauterine growth restriction and amniotic fluid changes. Mode of delivery predominantly by cesarean section (>90%). Delayed transition to extrauterine life has accompanied all these cases. The clinical cases we present identified features of umbilical cord which demonstrate intrauterine fetal distress.

Clinical Case 1

Pregnant woman, primiparous, primigesta, 31 weeks gestational age, uninvestigated pregnancy, with arterial hypertension, fetal growth below the 5th percentile, with fetal bradycardia. Reduced fetal movements, ultrasound diagnosed and flows in uterine arteries show uteroplacental insufficiency. She delivered by caesarean section after 24 hours admission a female preterm infant, cranial presentation, weight =1050 g (p<10%), head circumference = 26 cm (p <10%), weight index=1.6 (p<10%), Apgar score 2 to first minute, required resuscitation at birth, hospitalized 46 days, with a diagnosis of respiratory distress syndrome, necrotizing enterocolitis, neonatal anemia. Features of umbilical cord in this case: flaccid, hypocoiled (Figure 1).

Clinical Case 2

Teenage pregnant woman, uninvestigated, II gesta, primiparous (one abortion) is hospitalized for painful uterine contractions. Caesarean section, arterial hypertension, ruptured membranes by approx. 30 hours, meconium stained amniotic liquid, cranial presentation, double nuchal cord. Term newborn, gestational age 40 weeks, weight 3350 g, hospitalized 10 days, diagnosis: meconium-aspiration syndrome, fetal distress, neonatal anemia. Features of umbilical cord in this case: meconium stained - fetal distress for at least one hour (Figure 2).

Discussion

The situations where fetal distress, increased risk of intrapartum fetal heart rate decelerations, or in-

trauterine death have been associated were involved in non-coiled umbilical cords⁽²⁾.

A discrepancy in the size of the umbilical arteries (e.g. 1 mm difference in the diameter of umbilical arteries) is associated with an increase in placental abnormalities (e.g. infarcts) or abnormal placental cord insertions (e.g. marginal and velamentous)⁽²⁾.

Studies have shown that a hypo-coiled umbilical cord may be associated with fetal anomalies, perinatal asphyxia, prematurity, velamentous cord insertion, fetal distress, low birth weight, nuchal cord, meconium amniotic fluid. An hypercoiled cord may be associated with perinatal asphyxia, small for gestational age, trisomy, fetal distress, single umbilical artery or fetal vasculopathy⁽³⁾.



Figure 1. Hypo-coiled umbilical cord



Figure 2. Meconium impregnated umbilical cord

Features of the umbilical cord that may be associated with fetal distress, are as follow:

1. Abnormalities of cord length. The length of the cord is thought to reflect movement of the fetus *in utero*⁽⁴⁾. Short cords are associated with placental abruption, cord rupture, fetal movement disorders, intrauterine constraint, primiparity⁽⁴⁾. Excessively long cords are associated with thrombus or true knots⁽⁴⁾. These abnormalities may reflect maternal systemic diseases, delivery complications, respiratory distress of the fetus, vertex presentation, cord entanglement, fetal anomalies, increased birth weight and true knots in cords⁽⁴⁾.

2. Abnormalities of the umbilical cord diameter. Enlargement of the proximal umbilical cord is due to abnormalities related to vitelline duct and/or allantoic duct development, localized enlargement of the umbilical cord diameter are also related to edema (10%), neoplasm, vascular aberration⁽⁵⁾.

3. The flaccid umbilical cord aspect, given by some studies by flow through the umbilical vessels was associated with⁽⁶⁾: oligohydramnios, small for gestational age, amniotic fluid meconium, and perinatal asphyxia.

Microscopic computerized morphometry prove that in fetuses with intrauterine growth restriction the Wharton jelly quantities at birth is lower⁽⁷⁾ and some authors showed that in pregnant women with gestational diabetes is in higher quantity. Other authors showed that in postmature births, in fetuses with a smaller diameter of umbilical cord, antepartum deceleration are more common and a flaccid umbilical cord was commonly associated with fetal distress and a severe reduction in amniotic fluid volume^(8,9).

1. Abnormalities of the umbilical vessel:

a) Abnormal number of vessels (e.g. single umbilical artery, 2 veins-2 arteries, 1 vein-1 artery duct)⁽⁵⁾. Accompanying systemic abnormalities can affect all body systems as follows: musculoskeletal (polydactyly, cerebral anomalies, cleft lip and palate etc.), urogenital (renal agenesis, hydronephrosis and hydronephrosis, malformed external genitalia), cardiovascular (patent ductus arteriosus, truncus anomalies, valvular anomalies), gastrointestinal (esophageal atresia or stenosis, tracheo-esophageal fistula,

imperforate anus), nervous system (neural tube defects, anencephaly, meningomyelocele), others (eye abnormalities⁽⁸⁾, pulmonary hypoplasia or aplasia, laryngeal atresia⁽⁹⁾, diaphragmatic hernia)⁽⁵⁾;

b) Track and abnormal connections between vessels (eg. the umbilical cord venous duct agenesis, arteriovenous fistula)⁽⁵⁾. They may associate: esophageal atresia, congenital hip dislocation, spina bifida, ventricular septal defect, trisomy 21⁽⁵⁾;

c) Abnormal structure or configuration of vessels (eg. hypoplastic umbilical artery, arteries or umbilical vein thrombosis, varicose veins, abnormal umbilical cord coiling)⁽⁵⁾ may associate: polyhydramnios, congenital heart malformations, intrauterine growth restriction⁽¹⁰⁾.

2. Cord cysts and tumors in approx. 3% of pregnancies, both associated with fetal abnormalities (20% chromosomal disorders e.g. Trisomy 18)⁽⁵⁾.

3. Nuchal cord is present in 20-33% of pregnancies, more commonly in males, in few cases they were related with amniotic fluid emboli or spasm of axillary artery with limb ischemia followed⁽⁵⁾. True umbilical cord knot and nuchal cord may be associated with fetal distress⁽⁵⁾.

4. Disruption in linear cord⁽⁴⁾ is extremely rare, followed by direct exposure to the entire or focal length of the umbilical vessels. All cases were associated with acute fetal distress, meconium amniotic fluid and perinatal death⁽⁴⁾.

5. Umbilical cord hematoma is associated with a short umbilical cord^(11,12).

6. Umbilical cord aneurysm is associated with trisomy, fetal death⁽¹³⁾.

7. Umbilical cord hemangioma is associated with polyhydramnios, omphalocele^(14,15).

8. Umbilical cord teratoma very rarely (conjoined twins)⁽⁵⁾.

9. Umbilical cord angiomyxoma is associated with fetal death⁽¹⁶⁾.

Conclusions

Features of the umbilical cord can reflect fetal distress degree even if it was not antenatally diagnosed. Umbilical cord features analysis is one easy and certainly method for fetal distress diagnosis. ■

References

- Di Naro E, Raio L, Cromi A, Giocolano A. Sonographic Assessment of the umbilical cord donald school. *Ultrasound Obstet Gynecol*, 2012, 6(1), 66-75.
- Hill LM. Sonographic assessment of the umbilical cord, online courses, available from <https://iame.com/online/umbilical/content.php>, accessed 2015-02-20.
- NSebire NJ. Copyright 2007 ISUOG. Published by John Wiley & Sons, Ltd., *Ultrasound Obstet Gynecol* 2007, 30, 804-6.
- Beall MH, Ross MG, Talavera F, Gaupp FB, Chelmos D. Umbilical Cord Complications, available from <http://emedicine.medscape.com/article/262470-overview#aw2aab6b3>, accessed 2015-02-20.
- Will Blackburn. Umbilical cord. In: Human Malformation and related anomalies, Roger E. Stevenson, Judith G. Hall, New York: Oxford University Press, 2006, 1413-57.
- Fernando Heredia, Umbilical cord anomalies, available from <http://sonoworld.com/fetus/page.aspx?id=1149>, accessed 2015-02-20
- Raio L, Ghezzi F, Di Naro E, Franchi M, Maymaon E, Mueller MD, Bruhwiler H. Prenatal diagnosis of a lean umbilical cord a simple marker for the fetus at risk of being small for gestational age at birth, *Ultrasound Obstet Gynecol* 1999, 13, 176-80.
- Scalerio F, Ferraro M, Mastrantonio P, Scalerio A. Single umbilical artery (SUA) and congenital eye abnormalities. 2 case reports. *Minerva Pediatr* 1998, 50(4), 141-4.
- Meizner I, Sherizly I, Mashiach R, Shalev J, Kedron D, Ben-Rafael Z. Prenatal sonographic diagnosis of laryngeal atresia in association with single umbilical artery. *J Clin Ultrasound* 2000, 28(8), 435-8.
- Petrikovsky B, Schneider E. Prenatal diagnosis and clinical significance of hypoplastic umbilical artery. *Prenat Diagn* 1996, 16(10), 938-40.
- Seoud M, Aboul-Hosn L, Nassar A, Khalil A, Usta I. Spontaneous umbilical cord hematoma: a rare cause of acute fetal distress. *Am J Perinatol* 2001, 18(2), 99-10.
- Csacsei K, Kovacs T. Spontaneous haematoma of the umbilical cord with a single umbilical artery. *Eur J Obstet Gynecol Reprod Biol* 1996, 64(2), 231-3.
- Berg C, Geipel A, Germer U, Gloeckner-Hofmann K, Gembruch U. Prenatal diagnosis of umbilical cord aneurysm in a fetus with trisomy 18. *Ultrasound Obstet Gynecol* 2001, 17(1), 79-81.
- Armes JE, Billson VR. Umbilical cord hemangioma associated with polyhydramnios, congenital abnormalities and perinatal death in a twin pregnancy. *Pathology* 1994, 26(2), 218-20.
- Miller KA, Gauderer MW. Hemangioma of the umbilical cord mimicking an omphalocele. *J Pediatr Surg* 1997, 32(6), 810-2
- Fortune DW, Ostor AG. Angiomyxomas of the umbilical cord. *Obstet Gynecol* 1980, 55(3), 375-8.