RELATIONSHIP BETWEEN NEWBORN ACID - BASE STATUS AND UMBILICAL CORD MORPHOLOGY

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Abstract - To assess the relationship between umbilical cord blood gases at birth and morphology of umbilical cord, in a prospective study of 200 consecutive term delivery, we investigated the relationship between umbilical cord morphology characteristics (umbilical cord length, number of vascular coil, coiling index) and color of amniotic fluid and umbilical vessel blood gases.

Statistically significant linear correlation was found between umbilical venous PH and the umbilical cord length (r = 0.39, 95% CI 0.25, 0.53, P<0.03), number of vascular coils (r = 0.45 95% CI 0.31-0.59 P<0.012), and coiling index (r=0.34, 95% CI 0.12-0.48, P<0.04), and also negative linear correlation was found between umbilical venous partial pressure of carbon dioxide & number of coil (r=-0.3, 95% CI -0.44, -0.16 P<0.03), and linear correlation between umbilical artery PH and the number of vascular coil (r=0.37, 95% CI 0.23-0.51, P<0.03). No relation was found between umbilical cord indices and meconium staining of amniotic fluid.

Placental weight also correlated with umbilical cord length (r=0.17, 95% CI 0.03-0.31, P<0.03), but not with umbilical cord coils or coiling index.

Umbilical venous pH is related to umbilical cord morphology but umbilical venous PCO_2 was only related to the number of coils and umbilical artery pH was only related to the number of coils and not related to length or coiling index of umbilical cord morphology. The morphology of umbilical cord can affect maternal-fetal gas exchange.

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INTRODUCTION

In most cases the umbilical vessels course through the umbilical cord in a spiral manner (1). Umbilical cord length varies appreciably with the mean length of about 55cm (0-300cm).

Vascular occlusion by thrombi are more common in long cords.

In various indices of adverse perinatal outcome in fetuses with hypocoiled cords (2), meconium staining (3, 4), preterm labor and operative delivery for fetal distress (5) are most common.

Strong and co-workers (6) introduced the vascular coil per centimeter to quantify the degree of vascular coiling index were below the tenth percentile then operative delivery for fetal distress and meconium staining of amniotic fluid were more common.

Because fetal heart rate (FHR) changes and passage of meconium were related to fetal hypoxia and acidosis (7,8) we investigated further the relationship between cord morphology and umbilical PH and blood gasses at birth.

MATERIALS AND METHODS

Two hundred consecutive newborn and their umbilical cords were included in the study over a 6 month period.

The period exclusion criteria were multiple pregnancy, non cephalic presenation and medical problem in mother such as diabetes, hypertension etc. The color of amniotic fluid and the presence or absence of meconium were noted. The FHR was heard with a fetal stethoscope through labor. After delivery a 10-20 cm segment of umbilical cord was clamped immediately (9) with two clamps near the neonate and two clamps near the placenta; the cord was then cut between the two proximal and two distal clamps.

Arterial and venous blood was drawn from the isolated segment of cord in to a 1-2 ml plastic syringe that had been flushed with a heparin solution containing 1000 μ/ml (10-11). The needle was then capped and the capped syring was placed into a plastic sack containing crushed ice and immediately transported to labratoary. There are little changes in PCO_2 or pH in uniced blood for up to 60 minute (12).

The blood sample was then analayzed with a blood

gas analyzer (AVL 995 - AVL 982 - S) and values of pH and PCO_2 were measured. Then the length of the umbilical was measured in cm, the number of vascular coil noted and then the coiling index was calculated. The cord was cut at it's placental end, blood was drained and the placenta was weighed in grams.

The correlation between umbilical cord characteristics and blood gases was assessed using Pearson correlation coefficient.

In our study, there were 28 cases of meconium staining and we assessed the two groups with t test.

RESULTS

The ages of the mothers in the study ranged from 16-39 years with a median age of 24 years.

The median height was 158 cm (145-170).

The median weight was 68 kg (50-110) and median gestational age was 39 w+ 5d (37 - 42w)

One infant was born at 39w and had single-artery cord which was eliminated from the study.

Each umbilical cord had three blood vessels.

Blood samples for gas analysis were collected from all umbilical arteries and veins.

The mean values of umbilical blood gasses are shown in table 1.

Table 1. Normal umbilical cord blood pH and blood gas values in term newborn. (Mean ± two standard deviation)

Value	
Arterial blood	
pH	7.24 ± (0.18)
PCO_2 (mm Hg)	49.17±(13.33)
HCO_3 (meq/L)	19.59±(4.7)
venous blood	
pH	7.28±(0.12)
PCO_2 (mm Hg)	42.03±(10.98)
HCO_3 (meq/L)	18.66±(4.097)

Data are from infants of selected patients with uncomplicated vaginal delivery. No significant differences were found between umbilical cord morphology indices and meconium staining of amniotic fluid table 2.

Table 2. Umbilical cord characteristics and intrapartum events (meconium passage)

Intrapartam cord length No.of Coiling characteristics (cm) coils index			
Color of amniotic fluid			
Clear	62.70	11.22	0.18
Fresh Meconium	63	12.5	0.198
P	NS	NS	NS

NS=Not significant

Statistically linear correlation was found between umbilical venous PH and the umbilical cord length (r=0.39, 95% CI 0.25 - 0.53 P<0.03), number of vascular coil (r=0.45, 95% CI 0.31 - 0.59, P<0.01), coiling index (r=0.34, 95% CI 0.2-0.48<0.04) (Table 3).

Correlation was found between umbilical vein PCO_2 and number of umbilical coils, but not between umbilical venous PCO_2 and cord length, or coiling index table 3.

The umbilical artery PH was related to number of coils and not to cord length and coiling index (Table 4).

Placental weight correlated with umbilical cord length but not with the number of coils and coiling index.

Table 3. Correlations between umbilical cord characteristics and umbilical venous pH and partial pressure of carbon dioxide.

Umbilical venous blood gases	Cord length (cm)	No. of coils	Coiling index
umbilical venous PH			
r	0.39	0.45	0.34
ER	7.1092+0.0025×cord length	7.1219+0.01×number of coil	7.17+0.35×coiling index
CI	0.25, 0.53	0.31,0.59	0.2, 0.48
P	P<0.03	P<0.012	P<0.04
Umbilical venous Pco2			
r	0.16	-0.3	0.20
ER		64.14-1.61×number of coil-	
CI	0.02, 0.3	-0.44, -0.16	0.06, 0.34
P	NS	P<0.03	NS

ER=equation of the regression line. CI=confidence interval. Pco2=partial pressure of carbon dioxide, NS= Not significant, r=pearson correlation

Table 4. Correlations between umbilical cord characteristics and umbilical artery pH and partial pressure of carbon dioxide.

Umbilical artery blood gases	Cord length (cm)	No. of coils	Coiling index
umbilical artery PH			
r	-0.05	0.37	0.4
CI	0.09, 0.19	0.23, 0.51	0.26, 0.54
P	NS	P<0.03	NS
Umbilical Artery PCO_2			
r	-0.01	0.08	0.03
CI	0.3, 0.15	-0.06, 0.22	0.1, 0.17
P	NS	NS	NS

CI= Confidence interval, PCO_2= Partial pressure of carbon dioxide, NS= Not significant, r = Pearson correlation

DISCUSSION

The umblical cord consists of an outer covering of flattened amniotic epithelical cells, containing interior mass of mesoderm (Wharton's jelly). Embedded in the latter are two endodermal tubes, the yolk sac and allantoic ducts, and the umblical vessels. Usually the emberyonic right umblical vein disappears in the early months of pregnancy, leaving two umblical arteries and one vein. The vessls in the umblical cord are rarely straight and usually show a twisted conformation, evident as a right - or left - handed cylindrical helix. The number of twists varies widely; the cause has been variously ascribed to unequal growth of the vessels or to a differential blood flow betwen the left and right umblical arteries. Although the etiology is not fully understood, the functional importance has been investigated. The pulse pressure of the two umblical arteries has been shown to generate a pumping mechanism whitin the umblical vein, enhancing venous blood flow (13).This pumping mechanism was shown to be more efficient in highly coiled umblical cords than in straighter cords. Recently, a direct correlation was found between umblical cord coiling index and umblical vein blood flow (2). Meconium staining of the amniotic fluid and instrumental delivery for the suspected fetal distress were more common with minimally coiled umblical cords (2, 4).

Easy compression of the umblical vessels in poorly coiled umblical cords was suspected to be the reason for these intrapartum findings (6).

Our study found relation between umblical vein PH and all umblical cord morphologic characteristics; in Ramic K. and co-workers study this relation was seen (14). In our study arterial pH was related only with the number of coils, but not with cord lengh or coiling index; in Rami K. and co-workers study also, this finding was noted.

Our study found relation between venous PCO_2 only with number of coils, but in Rami K. et al's study, this relation was seen with all morphologic indices (cord length, number of coils and coiling index).

In our study, arterial PCO2 was not related to any morphologic indices of umblical cord, and also in Rami K and co-workers study these relations were not seen.

These alternatives in pH and PCO_2 could be explained by imperfect clearance of CO_2 because of defects in the placental gas-exchange membranes or placental blood flow. The latter is supported by the more significant correlatios found with the umblical cord indices reflecting the lenghts of the umblical vessels. Umblical cord morphology may indirectly reflect placental morphology. Because the umblical cord and placental vessels have common developmental processes, this seems logical. In addition variations have been detected in the lengh and coiling of the terminal capillary loops within placentas and significantly longer and less coiled loops have been found in the small placentas of growth restricted fetuses (15).

In our study, the mean value of umblical blood gases (Table 1) was more acidotic than other studies was (16). These differences may be due to enviromental or intrapartum factors. For confirmation and establishing the principal causes, futher investigations with larger sample sizes should be performed.

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