Umbilical cord abnormalities in newborns with birth asphyxia

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ABSTRACT

Introduction. Birth asphyxia is a serious condition that causes neurologic sequelae due to decreased blood flow and oxygen to the fetus. We aimed to identify and describe specific macroscopic and microscopic umbilical cord abnormalities in neonates with asphyxia.

Materials and methods. We conducted an observational prospective study over a period of 3 years. 80 patients diagnosed with birth asphyxia which had umbilical cord examination performed were enrolled. The control group consisted in 48 newborns that required neonatal intensive care for at least one week, in the same period of time, for any other reason and that also had available umbilical cord exam.

Results. We analyzed data gathered from both groups by applying specific statistical tests for each type of variable and hypothesis. Thus, umbilical cord abnormalities were associated with the hypoxic-ischemic encephalopathy in a statistically significant manner when comparing the asphyxia group of newborns with the control one (p = .00).

Conclusion. Marginal or velamentous insertion of the umbilical cord was associated with high risk of birth asphyxia.

Keywords: Birth asphyxia, newborns, umbilical cord examination, umbilical cord abnormalities

INTRODUCTION

Perinatal asphyxia is due to an imbalance of gas exchange with decreased oxygen and increased carbon dioxide. Clinically, asphyxia can be classified as acute, moderate or severe. Prolonged asphyxia can determine hypoxic-ischemic lesions. The neuropathology of hypoxic-ischemic neonatal brain lesions is still completely misunderstood [1]. Currently, there is no available explanation for the very different degrees of brain damage in newborns with similar perinatal history.

It is utterly important that the placenta and the umbilical cord have a good function to guarantee a normal pregnancy and delivery. There are a few studies that investigated the role of the placenta and the umbilical cord abnormalities in newborns [2,3] but only one questioned their association with hypoxic-ischemic encephalopathy [4].

Pathological lesions and particular aspects involving the umbilical cord are another important etiological pathway of fetal vascular obstructive lesions, which can lead to hypoxic ischemic lesions [5]. Also, pathological aspects are associated with the presence of umbilical hematomas that cause thrombosis and interrupt the maternal-fetal circulation causing hypoxia.

OBJECTIVES

In this study, our aim was to identify and describe the macroscopic aspect of the umbilical cord abnormalities in neonates with birth asphyxia.

PATIENTS, MATERIAL AND METHOD

We conducted an observational, prospective, non-interventional study, in which we enrolled 128 new-
borns admitted to the neonatal intensive care unit (NICU) of the Filantropia Clinical Hospital, Bucarest, Romania. The enrollment period was between 2016-2019. The main inclusion criteria for the subject group was that the newborn had to be delivered in our hospital in order to make possible immediate umbilical cord examination by our staff. The subject group included only term newborns which needed NICU care after an asphyxia diagnosis. We defined perinatal asphyxia as any sign (clinical, biochemical or imagistic) associated with a perinatal hypoxic-ischemic event: Apgar score less than 6 at 5 and 10 minutes of life, fetal umbilical artery pH less than 7.0 and/or base deficit more than 12 mmol/L, imagistic brain injury on MRI, presence of multisystem organ failure consistent with HIE (hypoxic-ischemic encephalopathy). For the control group, we enrolled 48 term and late preterm newborns (GA > 30 weeks) that were delivered in our hospital and required neonatal intensive care for at least one week, in the same period of time, for any other reason than an hypoxic-ischemic event [6]. Also, parents/legal guardians signed an informed consent agreement before enrollment of the newborn in the study. The study was carried out with the approval of the Ethics Council of Filantropia Clinical Hospital and respected the Declaration of Helsinki on Human Rights and the privacy rules of the patients enrolled.

Immediately after birth, the umbilical cord of each newborn was examined by a neonatologist and a nurse during routine delivery room care. Identified abnormalities of the umbilical cord included were: single umbilical artery, umbilical cord knot, marginal insertion, velamentous insertion and hypercoiled/hypocoiled appearance.

All data were collected from maternal and infant medical records. Statistical analysis was performed with IBM SPSS version 25 (version for Windows) and Microsoft Excel version 16.43. Statistical significance was considered at a p-Value <05.

RESULTS

The study enrolled 128 patients divided into 2 groups according to the presence of birth asphyxia diagnosis. First group (subject group) included 80 patients with birth asphyxia (62.5%). Second group (control group) consisted of 48 newborns without HIE (37.5%). Descriptive data about patients are summarized in table 1.

The umbilical abnormalities were present in 42 (52.5%) patients with birth asphyxia and in 12 (31.2%) patients in the control group and were strongly associated with birth asphyxia (p=.00).

The umbilical cord examination data are summarized in table 2.

**TABLE 1. Patients descriptive statistics (g = grams, NS=non-significant)**

<table>
<thead>
<tr>
<th></th>
<th>Birth asphyxia</th>
<th>Control</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age (weeks)</td>
<td>37.0 +/- 2.4</td>
<td>36.8 +/- 2.5</td>
<td>NS</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>3077.17 +/- 739.83</td>
<td>2796.32 +/- 716.29</td>
<td>.03</td>
</tr>
<tr>
<td>Cesarian section (%)</td>
<td>35.3%</td>
<td>29.4%</td>
<td>NS</td>
</tr>
<tr>
<td>Male gender (%)</td>
<td>32.4%</td>
<td>22.6%</td>
<td>NS</td>
</tr>
<tr>
<td>APGAR 5 min</td>
<td>4.88 +/- 1.4</td>
<td>5.67 +/- 1.50</td>
<td>.00</td>
</tr>
<tr>
<td>Umbilical cord pH</td>
<td>6.98 +/- .05</td>
<td>7.21 +/- .05</td>
<td>.00</td>
</tr>
<tr>
<td>Umbilical cord pCO2 (mmHg)</td>
<td>72.6 +/- .3</td>
<td>46.3 +/- .5</td>
<td>.00</td>
</tr>
<tr>
<td>Umbilical cord base deficit (mmol/L)</td>
<td>-16.2 +/- .02</td>
<td>-4.6 +/- .43</td>
<td>.02</td>
</tr>
</tbody>
</table>

**FIGURE 1. Distribution of umbilical cord abnormalities in both groups**

**TABLE 2. Umbilical cord examination data (NS = non-significant)**

<table>
<thead>
<tr>
<th></th>
<th>Birth asphyxia</th>
<th>Control</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique umbilical artery (%)</td>
<td>15 (40.5%)</td>
<td>8 (31.3%)</td>
<td>NS</td>
</tr>
<tr>
<td>Umbilical cord knot (%)</td>
<td>9</td>
<td>0</td>
<td>.05</td>
</tr>
<tr>
<td>Marginal/Velamentous Insertion of the umbilical cord (%)</td>
<td>14 (27.4%)</td>
<td>1(20.8%)</td>
<td>.04</td>
</tr>
<tr>
<td>Hypercoiled</td>
<td>3 (8.3%)</td>
<td>1 (4.2%)</td>
<td>NS</td>
</tr>
<tr>
<td>Hypocoiled</td>
<td>1 (5.9%)</td>
<td>2 (2.1%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Marginal or velamentous insertion of the umbilical cord was associated with high risk of birth asphyxia (p=04).
FIGURE 2. Marginal insertion of Umbilical Cord (personal collection MD Calomfirescu-Avramescu)

DISCUSSIONS

As Wintermark et al. mentioned, also in our study the following pathological lesions of the umbilical cord were highlighted: destroyed vein vessels, cord hematoma, cord rupture, cord hypercoiled and abnormal insertions [7]. Although rare, these lesions have been associated with fetal death and perinatal death [8,9]. In our study the umbilical cord abnormalities were strongly associated with newborns with birth asphyxia (p = .00).

A populational study on newborns conducted in Norway classified as perinatal risk factors the umbilical cord abnormalities such as velamentous and marginal insertions [10]. In this study, we also identified that abnormal insertions of the umbilical cord were associated with birth asphyxia (p=04).

Nomiyama et al. pointed in their study that Doppler ultrasound during routine sonography in the second trimester is able to accurately identify velamentous cord insertion [11]. Accordingly to their paper, Doppler ultrasound examination performed in that moment of pregnancy has high enough sensitivity and specificity to properly identify risk pregnancies.

In fact, it is not surprising that peripheral cord insertion is frequently associated with fetal distress and hypoxic-ischemic encephalopathy. The umbilical cord, when it has a marginal or velamentous insertion, is more prone to compression that leads to decreased blood flow in the umbilical vessels and subsequent fetal hypoxia or circulatory compromise of the fetus. Twisting of the umbilical vessels at the peripheral insertion site can lead to progressive decelerations and fetal acidosis [12]. This condition can occur acutely or may be present intermittent during pregnancy and thus may be associated with an acute pathology and less serious sequelae [13].

The strength of our study was the accurate diagnosis of birth asphyxia according to current guide recommendations and task forces, using both clinical and biochemical parameters. Yet, as a limitation of our study we should mention the absence of brain MRI in the subject group to further highlight association between extensive brain injury and umbilical cord abnormalities. Nevertheless, in our study we did not performed microscopic examination so, further studies are needed in this direction.

CONCLUSIONS

In conclusion, we can strongly agree that birth asphyxia is associated with the abnormalities of the umbilical cord. In addition, marginal or velamentous insertion of the umbilical cord was associated with high risk of birth asphyxia.

Conflict of interest: none declared

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REFERENCES


7. Wintermark P, Boyd T, Gregas MC, Labrecque M, Hansen A. Placental pathology in asphyxiated newborns meeting the


