Novel Approaches to Managing Umbilical Cord and Placental Issues

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Causes of fetal death after 20 weeks’ gestation

God-given safeties in umbilical cord

Amniotic fluid
Wharton’s jelly
Coiling
Two arteries

When these favorable mechanisms are broken down, fetus might take a risk!
Umbilical cord abnormalities

- Abnormal cord insertion
- Hyper- or Hypo-coiled cord
- Cord entanglement
- Single umbilical artery
- Umbilical cord prolapse

Abnormal Cord Insertion

Normal placenta and umbilical cord
Abnormal Cord Insertions

- Marginal: 5%
- Velamentous: 2%
- Vasa previa: 1/2000

Pathophysiology of velamentous insertion

- Lack of Wharton's jelly
- Vessels are easily compressed!

Vasa Previa
FHR at 34 weeks

Emergency CS was determined!

Frequencies of VD • NRFS • eC/S

Ultrasound diagnosis of velamentous insertion

(1) Umbilical vessels enter the placenta margin parallel to the uterine wall and connect to superficial placental vessels.
(2) The umbilical vessels diverge as they traverse the membrane.
(3) The cord insertion is immobile, even when the uterus is shaken.
Cord insertion on the lower uterine segment is strongly associated with vasa previa.

Hasegawa Fetal diagnosis and Ther. 2007

Diagnosis of vasa previa should be made during early second trimester!

Vasa previa is not infrequent

1/500
by ultrasound diagnosis

1/2000 (retrospective estimation)
Vasa previa in the first trimester

Probe beyond the surface

Screening of vasa previa

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adjusted OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberrant vessels on membrane</td>
<td>65.1 (5.8-733)</td>
<td>0.001</td>
</tr>
<tr>
<td>Cord insertion on the lower uterus</td>
<td>344.7 (31-3838)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Hasagawa et al. Prenatal Diagnosis, 2010

Confirmation of normal placental location with normal insertion is recommended for safe delivery!
Summary (abnormal insertion)

- Velamentous vessels on the lower uterus is high risk.
- In vasa previa, fetal death is avoidable only antepartum ultrasound diagnosis and elective CS.
- Case with vasa previa should be performed CS before rupture of membrane until 36 weeks' gestation.

Hyper-coiled Cord

Coiling Index = \[
\frac{1}{\text{one cycle of coil (cm)}}
\]

Degani et al. Obstet Gynecol, 1995
Antenatal and postnatal Coiling Index

<table>
<thead>
<tr>
<th>Measurement at (n)</th>
<th>10% tile</th>
<th>50% tile</th>
<th>90% tile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hypo-</td>
<td>Normo-</td>
<td>Hyper-</td>
</tr>
<tr>
<td>18-22wks (258)</td>
<td>0.23</td>
<td>0.37</td>
<td>0.58</td>
</tr>
<tr>
<td>28-32wks (196)</td>
<td>0.21</td>
<td>0.34</td>
<td>0.49</td>
</tr>
<tr>
<td>At delivery (1969)</td>
<td>0.10</td>
<td>0.17</td>
<td>0.27</td>
</tr>
</tbody>
</table>

*: p<0.05 ANOVA, post-hoc test

Abnormal antenatal Coiling Index > 0.5 (2.0 cm/cycle)

Pathophysiology of hyper-coiled cord

Complicated narrow cord (umbilical ring)

Easy to obstruct

Hyper-coiled cord and fetal death

Pregnant parturient visited to our hospital due to lack of fetal movement at 22 weeks +5. Diagnosis of fetal death caused by umbilical ring constriction was made.
Summary (Hyper-coiled cord)

- Strict FHR monitoring during labor is required in cases with hyper-coiled cord.
- Precise observations are required in FGR or abnormal Doppler findings associated with hyper-coiled cord.
- However, fetal death often occurs during early-mid gestation. It is not avoidable and predictable.

Hypo-coiled cord

Cord entanglement
Cord entanglement

- 30% of all deliveries
- Nuchal cord is most frequently observed

Incidence of acute delivery stratified by number of nuchal cord

<table>
<thead>
<tr>
<th>Number of Times</th>
<th>Nulliparous n=2382</th>
<th>Multiparous n=1770</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>13.3%</td>
<td>20.9%</td>
</tr>
<tr>
<td>1</td>
<td>13.3%</td>
<td>25.0%</td>
</tr>
<tr>
<td>2</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6.6%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7.0%</td>
<td></td>
</tr>
</tbody>
</table>

*: p<0.05

Summary (nuchal cord)

- Although there appears to increase over gestation in the presence of cord entanglement, nuchal cord keeps appearing and disappearing over time.
- Thus, number of the nuchal cord is determined near the term.
Fore-lying cord and Umbilical cord prolapse

Transvaginal ultrasound picture of fore-lying cord

Fetal head

Uterine Os

Umbilical cord
Clinical risk factors for poor neonatal outcomes in umbilical cord prolapse from nation wide survey in Japan

Purpose: To clarify the clinical risk factors associated with poor neonatal outcomes due to umbilical cord prolapse.

Methods: A postal questionnaire survey was attempted in Japan. The clinical risk factors and managements associated with poor neonatal outcomes were analyzed in cases of umbilical cord prolapse treated in Japan.

2007-2011
- Delivery institution: 942
- Deliveries: 2,037,460
- Umbilical cord prolapse: 369 (174 institutions)
- Incidence: 0.018%, 1:5521
### Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Fore-lying (85)</th>
<th>Prolapse (284)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact survival</td>
<td>88.2 % (75)</td>
<td>78.9 % (224)</td>
</tr>
<tr>
<td>Survival with disability</td>
<td>7.6 % (6)</td>
<td>6.7 % (19)</td>
</tr>
<tr>
<td>Neonatal death</td>
<td>1.2 % (1)</td>
<td>5.3 % (15)</td>
</tr>
<tr>
<td>Fetal death</td>
<td>0 % (0)</td>
<td>3.2 % (9)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3.5 % (3)</td>
<td>6.0 % (17)</td>
</tr>
</tbody>
</table>

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### Occurrence of cord prolapse

Hasegawa, Arch Gynecol Obstet 2015
St. Marianna University School of Medicine Dept. of Obstetrics and Gynecology Hasejun

### Outcomes (after 36 weeks)

<table>
<thead>
<tr>
<th></th>
<th>Fore-lying (40)</th>
<th>Prolapse (168)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact survival</td>
<td>97.5 % (39)</td>
<td>87.5 % (147)</td>
</tr>
<tr>
<td>Survival with disability</td>
<td>2.5 % (1)</td>
<td>7.1 % (12)</td>
</tr>
<tr>
<td>Neonatal death</td>
<td>0 % (0)</td>
<td>1.8 % (3)</td>
</tr>
<tr>
<td>Fetal death</td>
<td>0 % (0)</td>
<td>2.4 % (4)</td>
</tr>
<tr>
<td>Unknown</td>
<td>0 % (0)</td>
<td>0.6 % (1)</td>
</tr>
</tbody>
</table>

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The results of the multivariate regression analysis for poor outcomes

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Adjusted odds ratio (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolapsed amniotic sac</td>
<td>4.49 (1.31, 15.42)</td>
</tr>
<tr>
<td>Preterm labor</td>
<td>2.99 (1.25, 7.17)</td>
</tr>
<tr>
<td>Replacement of cord into the uterus</td>
<td>2.87 (1.03, 7.95)</td>
</tr>
<tr>
<td>Intrapartum diagnosis</td>
<td>0.28 (0.11, 0.75)</td>
</tr>
<tr>
<td>Emergency cesarean section</td>
<td>0.11 (0.04, 0.28)</td>
</tr>
</tbody>
</table>


The cumulative survival curves regarding the interval between the diagnosis and the delivery for the intact survival and poor outcome infants

After prolapse before CS

Relieve pressure on the cord or Knee-chest position

Umbilical cord prolapse after onset of labor

Station at prolapse

Dilatation of os at prolapse
Timing of prolapse

Singleton, head presentation
n=181

- Unruptured (fore-laying) 13%
- Spontaneous ruptured 5%
- Independent of rupture 35%
- During amniotomy 24%
- Independent of rupture 28%

Hasegawa, Arch Gynecol Obstet 2015

Summary (umbilical cord prolapse)
- Cord prolapse is associated with:
  - abnormal fetal position
  - polyhydramnios
  - use of dilatation balloon
  - prolapsed amniotic bag in the early gestation
  - placental cord insertion on the lower uterus
- Do not touch the umbilical cord, even when prolapse occur.
- Emergency CS is required. Fetal presenting part should be pushed back into the uterus until delivery.

Managements of delivery in cases with umbilical cord abnormalities
Aspects of FHR in abnormal umbilical cord

Ultrasound diagnosis is not GOAL!

Purpose of screening is to obtain healthy babies!

Method of continuous investigation inside of the uterus is only FHR tracing!!

Continuous FHR monitoring!

Frequency of decelerations in cord abnormalities

1st stage of labor

2nd stage of labor

Aspects of FHR in abnormal umbilical cord

- Variable decelerations even without or weak uterine contraction.
- FHR monitoring is most important before onset and during first stage of labor.
- Atypical variable decelerations might be showing compression of weak point of the umbilical cord.

Hasegawa J Perinatal Medicine 2009
Hasegawa J Obstetrics and Gynaecology Res. 2009

Atypical Variable Decelerations

Krebs AJOG 1983
Screening (first trimester)

- Location of cord insertion
  Cases whose umbilical cord insertion located into lower uterine segment have frequently cord and placental abnormalities later in pregnancy.

- Two umbilical arteries
  Agenesis type of single umbilical artery is associated with fetal congenital anomalies.


Screening (second trimester)

- Placenta previa
- Velamentous insertion or vasa previa
- Umbilical cord coiling

Screening (third trimester)

- Fore-lying cord
- Nuchal cord
- Obstructive type of single umbilical artery
- Re-confirm of umbilical cord abnormalities, risk assessment, and determination of management at delivery.
**Risk classifications**

<table>
<thead>
<tr>
<th>Risks</th>
<th>Ultrasound findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk</td>
<td>Velamentous cord insertion, Marginal insertion on the low uterus, Hyper-coiled cord, Three or more nuchal cords, Obstructed single umbilical artery, Low-lying placenta, FGR (≤-2.0SD)</td>
</tr>
<tr>
<td>Middle risk</td>
<td>Twice nuchal cords, Aganiss type of single umbilical artery, FGR (≤-2.0 &lt; FW ≤-1.5SD)</td>
</tr>
<tr>
<td>Low risk</td>
<td>Without any abnormalities</td>
</tr>
</tbody>
</table>

**Management of delivery**

- **Extreme high risk**
  - Intensive FHR monitoring during pregnancy
  - Elective CS
- **High risk**
  - Induction of labor
- **Middle risk**
  - Continuous FHR monitoring during labor
- **Low risk**

**Frequencies of NRFS and emergency CS stratified by risk classifications**

<table>
<thead>
<tr>
<th>Risk</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>6.2%</td>
</tr>
<tr>
<td>Middle risk</td>
<td>11.1%</td>
</tr>
<tr>
<td>High risk</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

* p<0.05 compared with Low risk
Detection of placenta and umbilical cord abnormalities are also required in antenatal ultrasound screening.

According to ultrasound diagnosis, risk classification before onset of labor is strongly recommended for safe deliveries.

Continuous FHR tracing shows fetal condition, but only during tracing!

The use of FHR monitoring under familiarization of the umbilical cord abnormalities is the best way to avoid fetal complications.

Conclusions

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Thank you for your attention!