The Umbilical Cord

- Two umbilical arteries + one umbilical vein
- Surrounded by Wharton's jelly
  gelatinous mucopolysaccharides
  protect umbilical vessels
- Outer amniotic layer
- Inner sub-amniotic layer
  rich source of mesenchymal stem cells

Ultrasound of normal umbilical cord
- 3 vessels — 2 arteries & 1 vein
- Surrounded by small amount of
  Wharton’s jelly
- Coiled/helical configuration
- Inserts into central part of placenta

Abnormalities of Umbilical Cord
- 2 vessels, 1 artery & 1 vein
- Anomalous venous return
- Masses or cysts
- Nuchal cord
- Abnormal placental cord insertion
  velamentous
  marginal
- Cord presenting/prolapse

Are there really 3 vessels?
Single umbilical artery
0.2 – 1% of pregnancies
Whites > Blacks, Asians
Multiple > Singleton gestations
Incidence in monozygotic twins often discordant
Incidence of fetal anomalies

Ultrasound findings
2-vessel cord
Color Doppler
2-vessel cord
Single vessel by bladder

Outcome at birth
31% congenital anomalies*
(4% aneuploidy)
69% normal

Associated anomalies
Cardiovascular (51%)
Gastrointestinal (38%)
Central nervous system (24%)
Genitourinary (16%)
Pulmonary (11%)
Musculoskeletal (8%)

*Most identified by prenatal ultrasound
Isolated 2-Vessel Cord on Prenatal Ultrasound

Outcome at birth
- 7% Congenital anomalies
- 93% Normal

Structural anomalies at birth not diagnosed at prenatal ultrasound
- Ventricular septal defect
- Tracheoesophageal fistula
- Ambiguous genitalia
- Clubfoot

Misdiagnosis of 3-vessel cord
- 17 weeks
- 30 weeks
Anomalous Umbilical Venous Return

- Drainage of umbilical vein through channels other than ductus venosus in liver
- Alters flow to and through heart
- May lead to hydrops
- Associated with anomalies & aneuploidy

Persistent right umbilical vein
- Absent ductus venosus
- Direct into systemic circulation
- Ductus venosus to systemic circulation
- Intrahepatic porto-systemic shunt
- Extrahepatic porto-systemic shunt

Right umbilical vein

Absence of ductus venosus, Polyhydramnios
- Umbilical vein drains into left hepatic vein

Umbilical vein drains into infrahepatic inferior vena cava

Absent ductus venosus

Normal hepatic vein waveform
Normal portal vein waveform
Abnormal hepatic vein waveform
Lesions of Umbilical Cord

- Cyst - allantoic duct
- Focal thickening of Wharton’s jelly
- Venous varix
- Mass — teratoma, hemangioma

Associated with adverse outcome: fetal distress, intrauterine growth restriction, demise, anomalies

Umbilical Cord Cysts

1st Trimester
- Prevalence ~ 0.4 – 3.4%
- Usually detected at 8 – 9 weeks
- Typically resolve before 2nd trimester & normal outcome
- If persist into 2nd trimester ↑ anomalies & aneuploidy

2nd Trimester
- Cysts associated with omphalocele
- Patent urachus
- Urinary anomalies
- Pseudocyst associated with aneuploidy anomalies
Boothroyd UC cyst

Cyst of the umbilical cord – 9 weeks

Cyst of the umbilical cord – 17 weeks

Lymon UC cyst

Cyst of the umbilical cord – 17 weeks

Vazquez UC cyst & omphalocele

Umbilical cord cyst

Omphalocele

Vazquez UC cyst & omphalocele

13 weeks

Umbilical cord cyst

13 weeks

Omphalocele

20 weeks

Garney UC cyst

patent urachus

19 weeks

Umbilical cord cyst

13 weeks

26 weeks

Umbilical cord cysts

30 weeks

34 weeks

Umbilical cord thickening
Garney UC cyst
patent urachus

Delivery:
Umbilical
cord
thickening

Neonate: Patent urachus
Opening from bladder to umbilical cord

Placental Cord Insertion
- Required element of 2nd & 3rd trimester scan
- Assess for abnormal insertion
  Velamentous
  Marginal
- Locate for percutaneous umbilical blood sampling (PUBS)
- Color Doppler
  follow umbilical vessels to placenta

Marginal and Velamentous
Umbilical Cord Insertions
- Abnormal insertion of cord into placenta
  Marginal: < 1cm from placental edge
  Velamentous: vessels travel unprotected beneath membranes before insertion
  At risk for rupture, thrombosis
  Risk higher for velamentous

Marginal and Velamentous
Umbilical Cord Insertions
- Predisposing factors
  Multiple gestation
  Low-lying placenta or previa
  Uterine scarring
  Uterine anomalies

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<tr>
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<th>Singletons</th>
<th>Twins</th>
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<tbody>
<tr>
<td>Marginal</td>
<td>7%</td>
<td>20%</td>
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<tr>
<td>Velamentous</td>
<td>1%</td>
<td>12%</td>
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Marginal cord insertion

Velamentous cord insertion

Velamentous cord insertion

Velamentous cord insertion between succenturiate lobes

Velamentous cord insertion

On intertwin membrane

Vasa Previa

- Velamentous cord insertion in lower uterine segment with fetal vessels crossing cervix
- Associated with high perinatal mortality
- May develop from prior low-lying placenta

23 weeks

31 weeks
**Vasa Previa**

Ultrasound and Color Doppler findings
- Vessels lying across the cervix

Spectral Doppler findings
- Umbilical arterial & venous waveforms

**Cord (Funic) Presentation**

- Associated with abnormal fetal heart rate patterns
- Obstetrical emergency
- Risk of cord prolapse

- Color Doppler umbilical vessels between fetus and cervix
Umbilical Vein Varix

Focal dilatation of umbilical vein
Associated with
- Fetal anomalies & normal karyotype (12%)
- Aneuploidy (10%)
- Fetal demise (10%)
- Anemia (6%)
Umbilical Artery Doppler

Assess fetal well-being

Absent or reversed end diastolic flow

Associated with

↑ morbidity

↑ mortality

Concerning findings:

- Diminished end diastolic flow
- Elevated systolic/diastolic (S/D)

Absent or reversed end diastolic flow

Associated with

↑ morbidity

↑ mortality

Normal

Diminished End Diastolic Flow

Reversed End Diastolic Flow

Umbilical Cord Vessels

Unusual cases
3 - vessel cord?

Or 2 - vessel cord?

22 weeks

32 weeks

Hypoplastic Umbilical Artery

Tetralogy of Fallot

Thrombosed umbilical artery

How many vessels?

6 - Vessel Cord