OB GYN SONOGRAPHY REVIEW

Amniotic Fluid & Umbilical Cord

Course Outline

- Amniotic Fluid
  - Production & Purposes
  - Estimating Fluid Volumes
  - Amniotic Fluid Abnormalities
  - Fetal Pulmonic Maturity Studies
- Umbilical Cord
  - Normal Anatomy
  - Cord Abnormalities

Amniotic Fluid

Production and Purposes

- Amniotic fluid is derived from fetal urine and the chorioamnion
- It functions to:
  - Cushion the fetus against injury
  - Allow for free movement of the fetus
  - Promote fetal lung maturity
  - Provide for fetal nutrition
  - Aid in maintaining fetal temperature

Estimating Fluid Volume

- Amount of fluid surrounding fetus gradually increases as gestation progresses
- Reaches maximum volume (≈800 cc) at 33 weeks then slowly decreases
- Methods of estimating fluid volume:
  - Subjective assessment
  - Maximum vertical pocket estimate
  - Four-quadrant amniotic fluid index (AFI)

Subjective Assessment

- Early 2nd trimester, fluid volume ≅ fetal volume
- Fetus does not appear confined with free fetal movement
- Later 2nd – 3rd trimesters, volume of fetus ⇧ relative to fluid volume
- Disadvantage – does not provide metric for follow-up

Maximum Vertical Pocket Estimate (MVP)

- Also called single deepest pocket (SDP)method
- AP measurement (depth) of largest pocket that is devoid of fetal parts or umbilical cord
- 2 – 8 cm considered normal

MAXIMUM VERTICAL POCKET ESTIMATE

4-Quadrant Amniotic Fluid Index

- AP measurement taken in each of 4 uterine quadrants
- Measurements are summed
- A progressive ⇧ noted until ≈28 weeks, then slowly ⇩
- After 30 weeks:

☑ **NORMAL AFI = 10 – 20 CM**

  - AFI ≤ 5 cm: oligohydramnios
  - AFI ≥ 20 cm: polyhydramnios

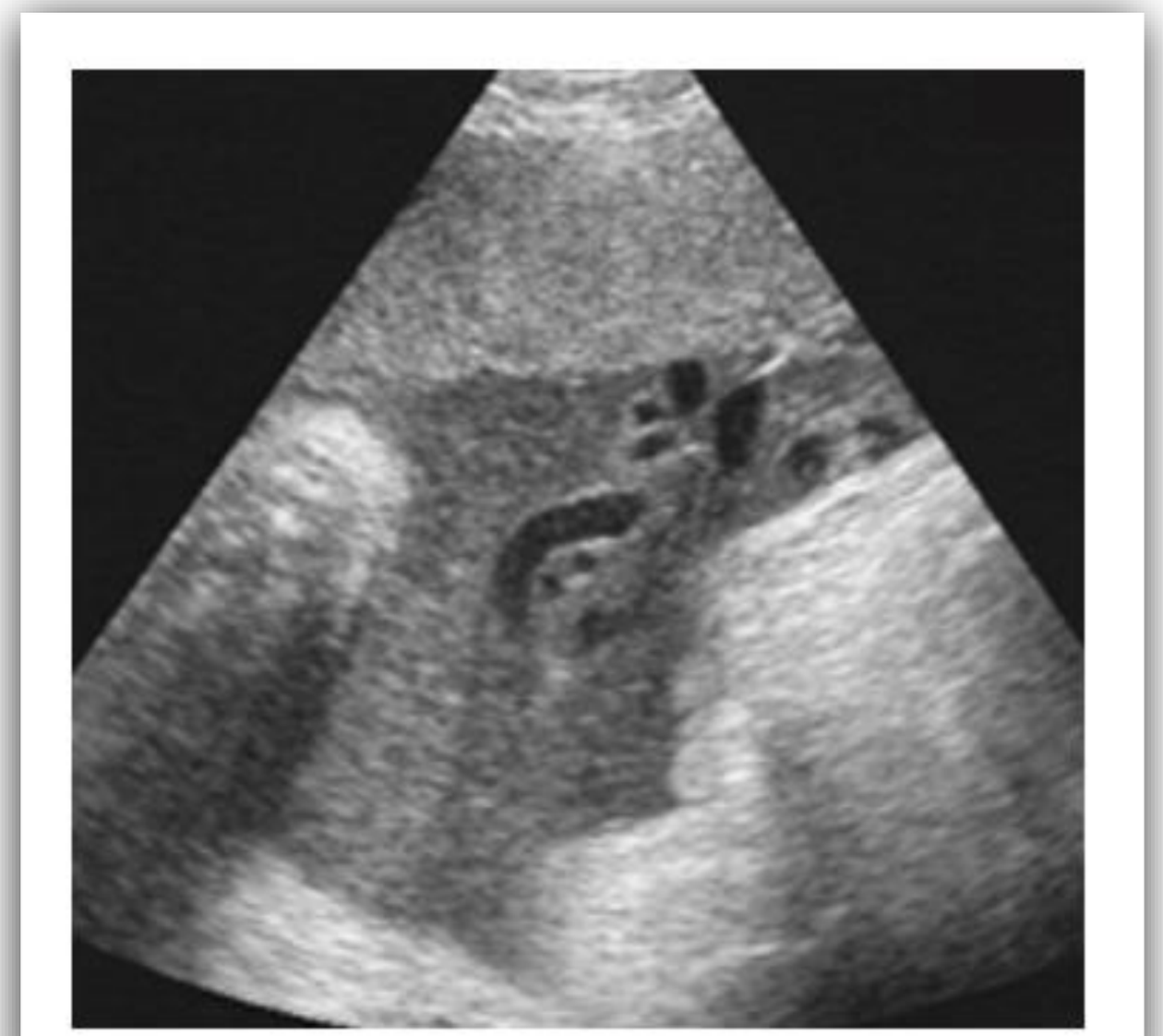
Amniotic Fluid Abnormalities

- *Echogenic amniotic fluid*: usually a normal finding and represents desquamated fetal skin cells (vernix)

- *Oligohydramnios*: abnormally decreased amount of fluid

- *Polyhydramnios*: abnormally increased amount of fluid

ECHOGENIC AMNIOTIC FLUID



Oligohydramnios

- Various quantitative definitions exist
- Multiple maternal and fetal causes. A simple acronym summarizes them. Conditions that leave a **DRIPP** of fluid
  - **D**emise
  - **R**enal abnormalities
  - **I**UGR
  - **P**ROM
  - **P**ost dates

OLIGOHYDRAMNIOS

OLIGOHYDRAMNIOS

Same patient. Demonstrates cause of oligohydramnios

Polyhydramnios

- Commonly defined as AFI > 20 cm
- Multiple maternal and fetal causes
- Frequently a sign of underlying fetal disorder which may include:
  - Fetal neural tube defects
  - Fetal upper GI obstructions
  - Fetal hydrops
  - Trisomy 18
  - Cystic hygroma
  - Twin-twin transfusion syndrome

POLYHYDRAMNIOS

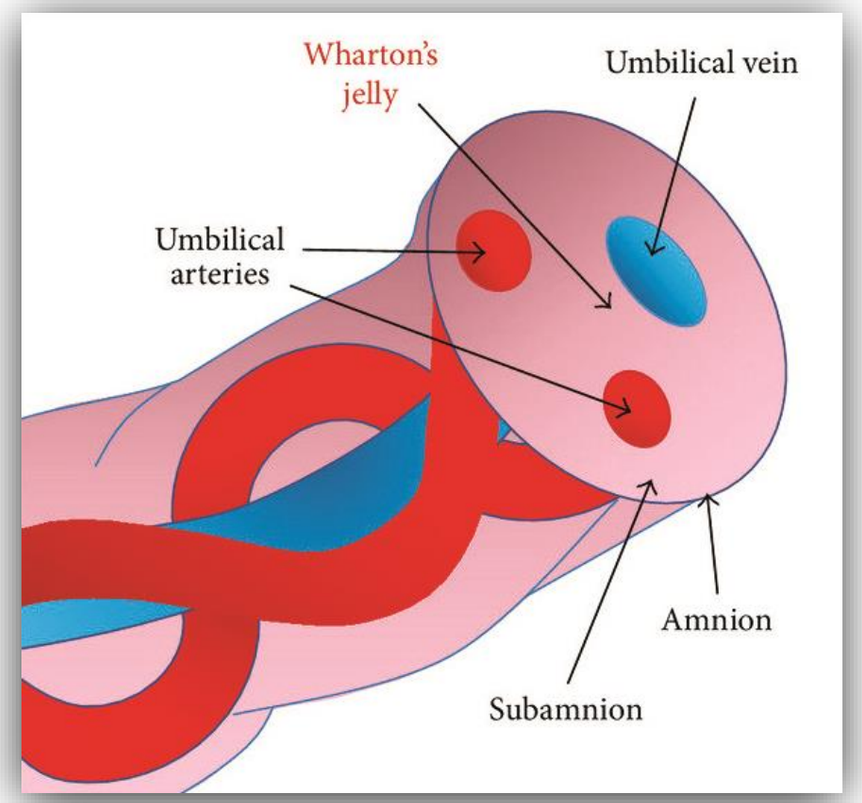
Fetal Pulmonic Maturity Studies

- Biochemical analysis of substances produced by fetal lungs help determine lung maturity, an important consideration in preterm or induction of labor
- Tests include:
  - Lecithin/sphingomyelin ratio (L/S ratio)
  - Phosphatidyl-glycerol (PG)
  - Surfactant-protein (SP-A)

Umbilical Cord

Normal Anatomy

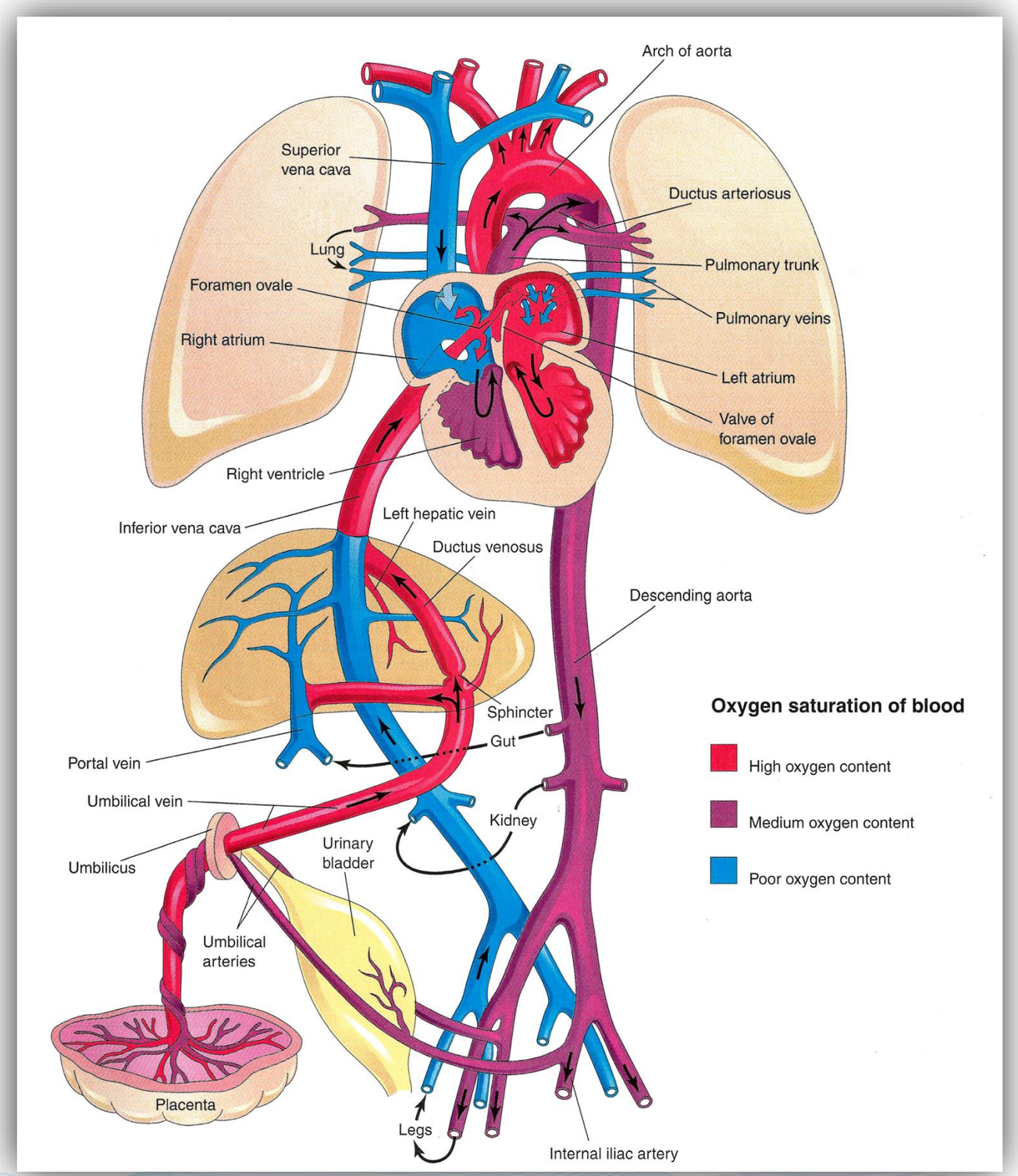
- Normal cord contains 2 arteries; 1 vein
- Average length is 55 cm
- Vessels surrounded by Wharton's jelly and entire cord is covered by amnion



Fetoplacental Circulation

- 2 umbilical arteries:
  - Extensions of fetal internal iliac arteries
  - **Arteries** carry deoxygenated blood **AWAY** from fetus (to placenta)
- 1 umbilical vein:
  - **Vein** carries oxygenated blood (from placenta) **TOWARD** fetus
  - Empties into right-sided fetal circulation via portal & hepatic venous shunts

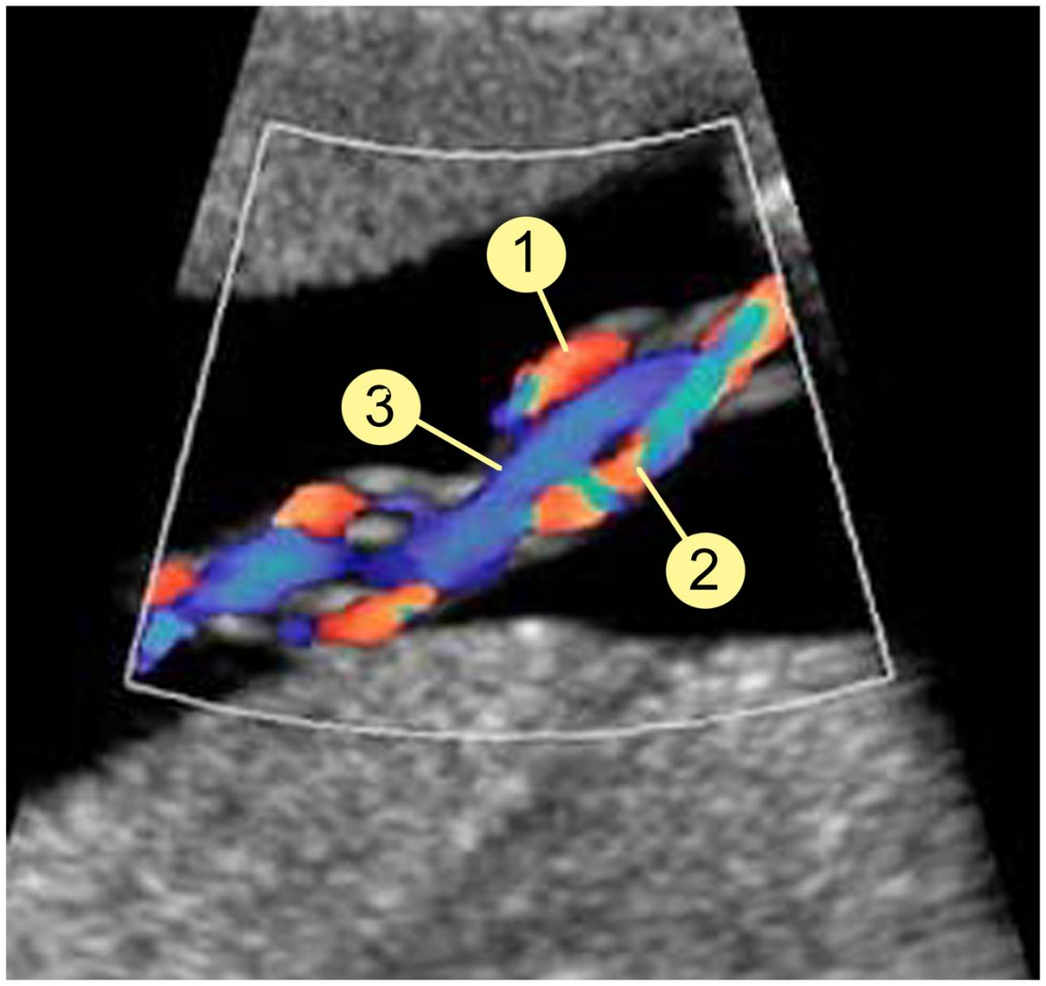
FETOPLACENTAL CIRCULATION

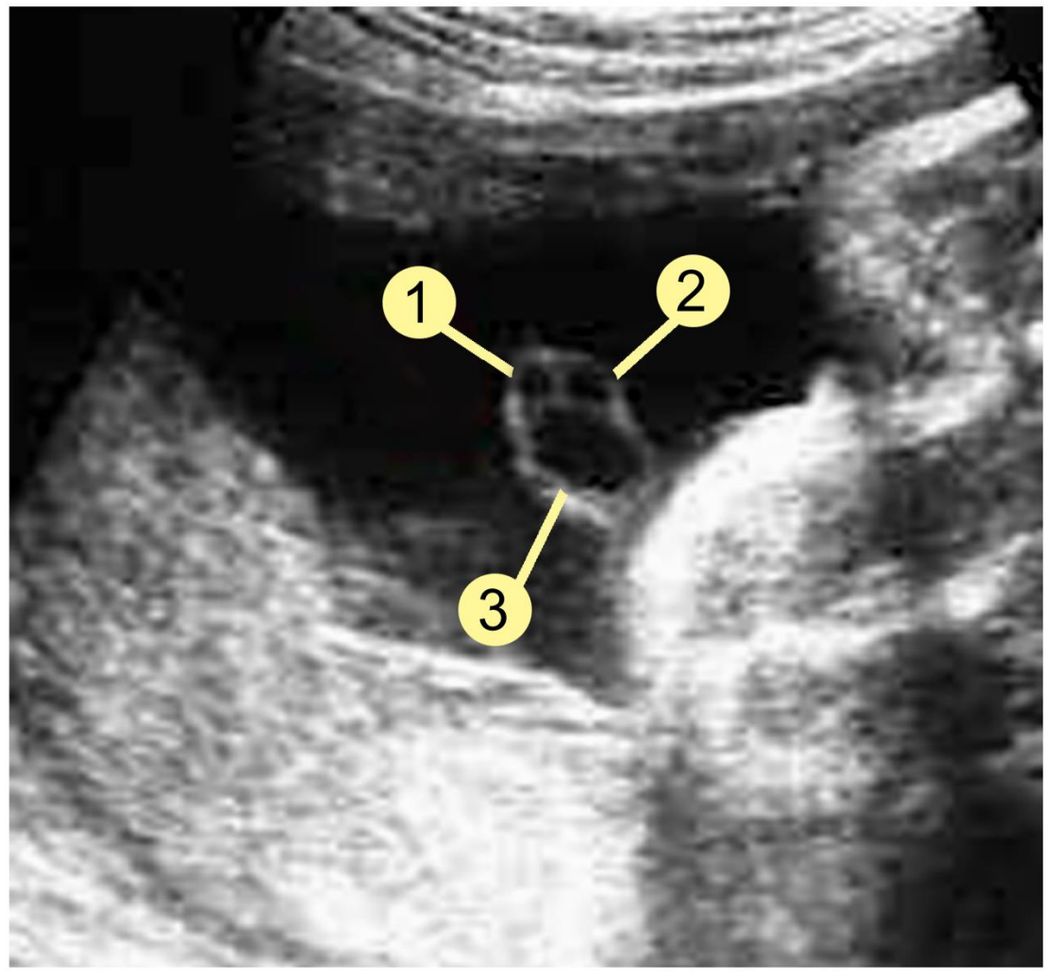


Sonographic Findings

- Imaging protocol to include:
  - 3 vessel cord
  - Cord insertion sites (*fetal* and *placental*)
- Color Doppler useful adjunct
  - Demonstrates flow presence in each vessel
  - Demonstrates normal fetal connections
  - Demonstrates normal placental connections

UMBILICAL CORD

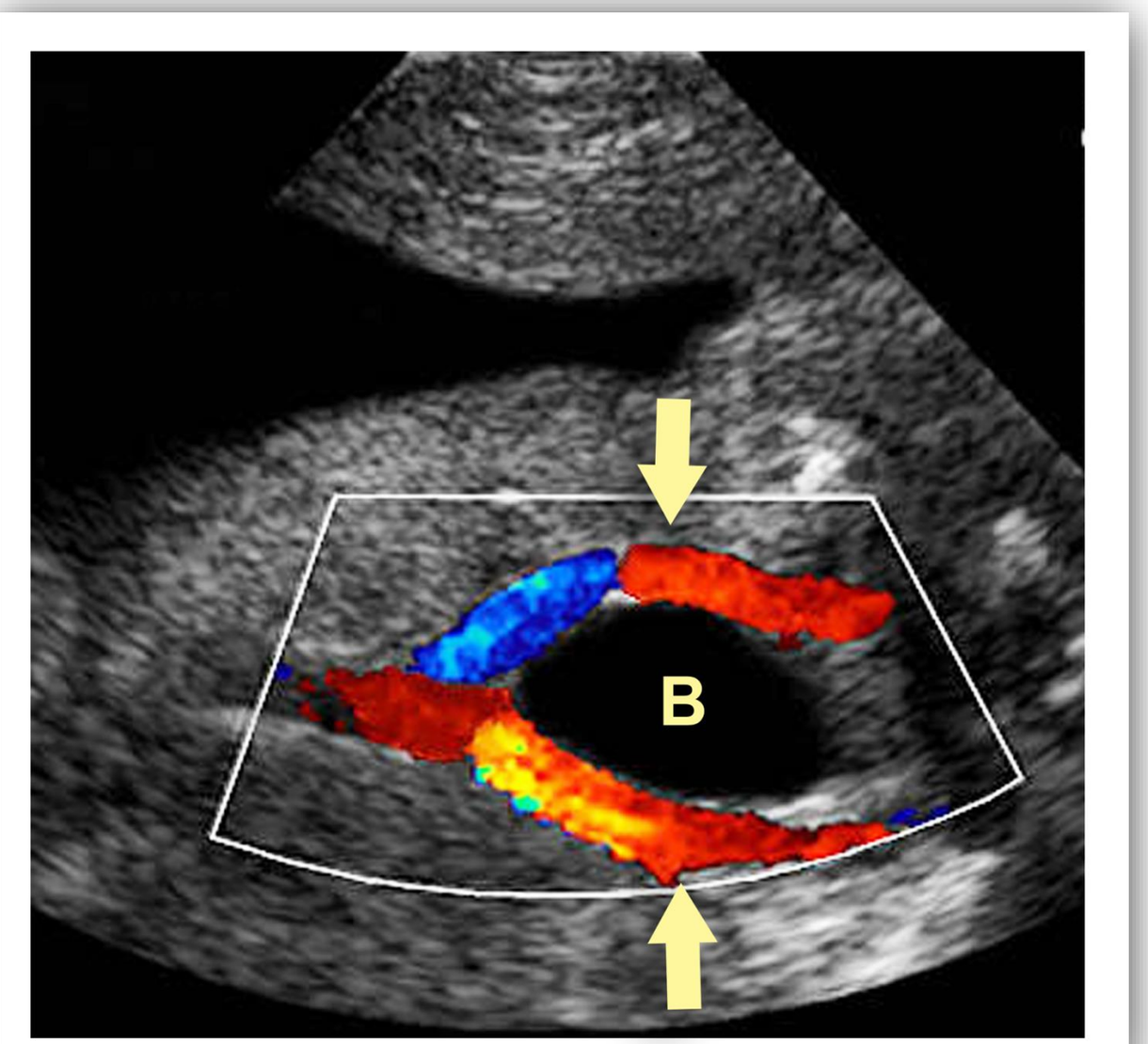




Normal 3 vessel cord

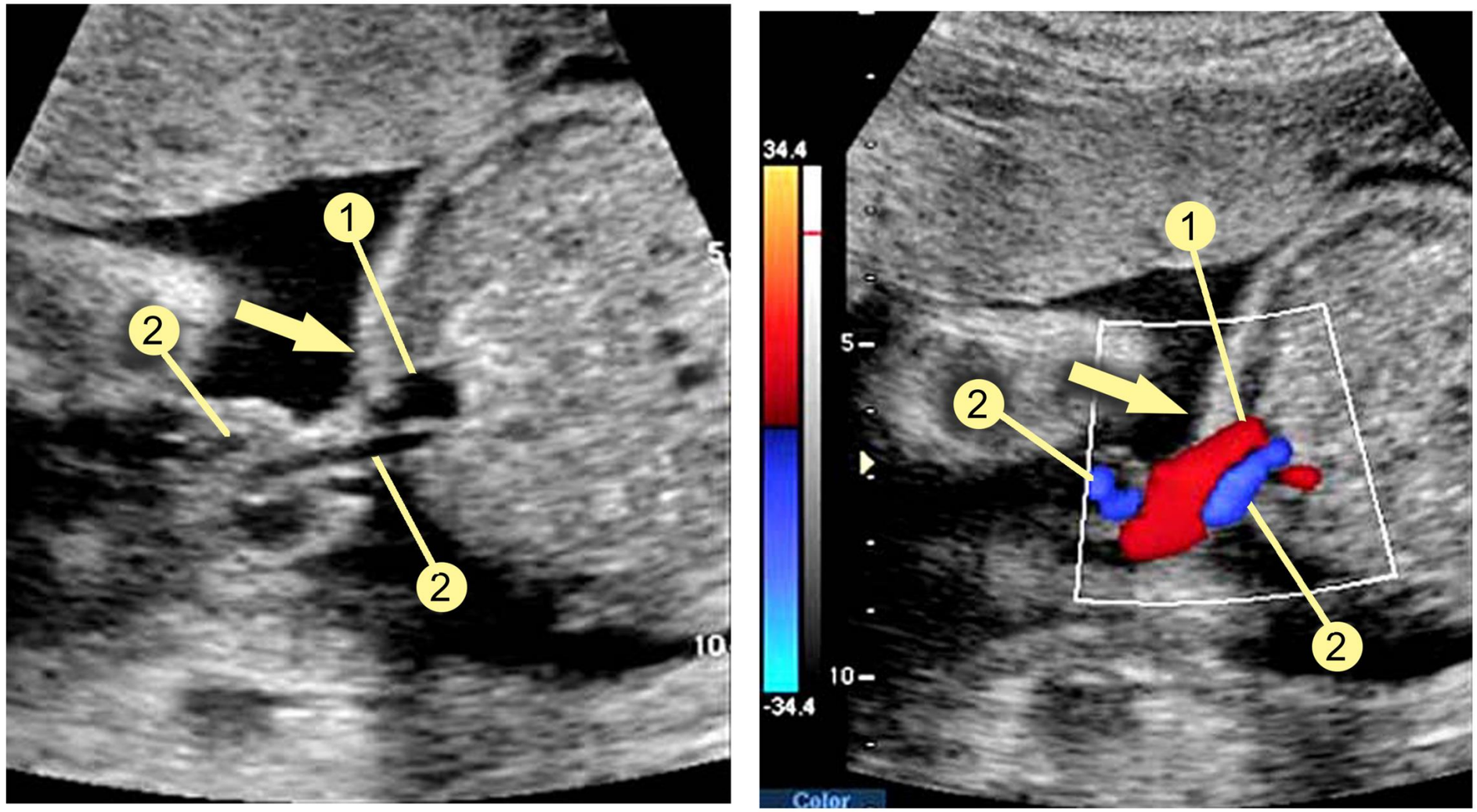
- **1, & 2 = arteries**
- **3 = vein**

UMBILICAL CORD



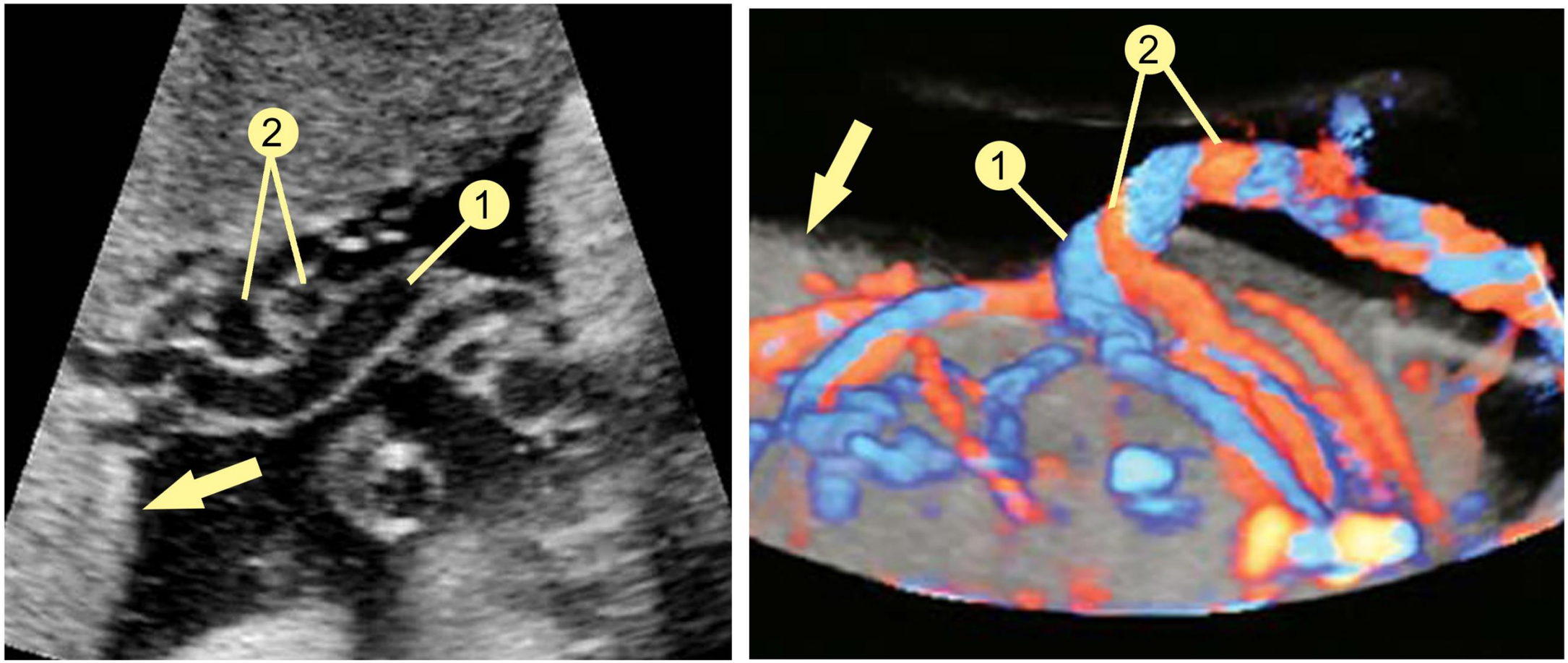
Umbilical/iliac arteries (arrows)
B = urinary bladder

UMBILICAL CORD INSERTION - FETUS



1 = umbilical vein
2 = umbilical artery
arrow = anterior abdominal wall

UMBILICAL CORD INSERTION - PLACENTA



1 = umbilical vein
2 = umbilical artery
arrow = placental surface

Cord Abnormalities

- Vascular abnormalities include:
  - Single umbilical artery (SUA)
  - Cord stricture
  - Umbilical vein thrombosis
- Structural abnormalities include:
  - Short & long cord
  - Nuchal cord
  - Cord knots
  - Cord prolapse
  - Cord entanglement

Cord Abnormalities

- Cord insertion abnormalities include:
  - Battledore placenta
  - Velamentous insertion
- Cord cysts:
  - Omphalomesenteric duct cysts
  - Allantoic cysts
- Cord masses include:
  - Hemangiomas
  - Varices/aneurysms
  - Teratomas
  - Hematomas

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Single Umbilical Artery (SUA)

- Most common cord abnormality
- Most common cause is secondary atrophy of a previously normal vessel
- 20 – 60% incidence of concomitant fetal anomaly
- Increased risk of IUGR
- Also called *two-vessel cord*

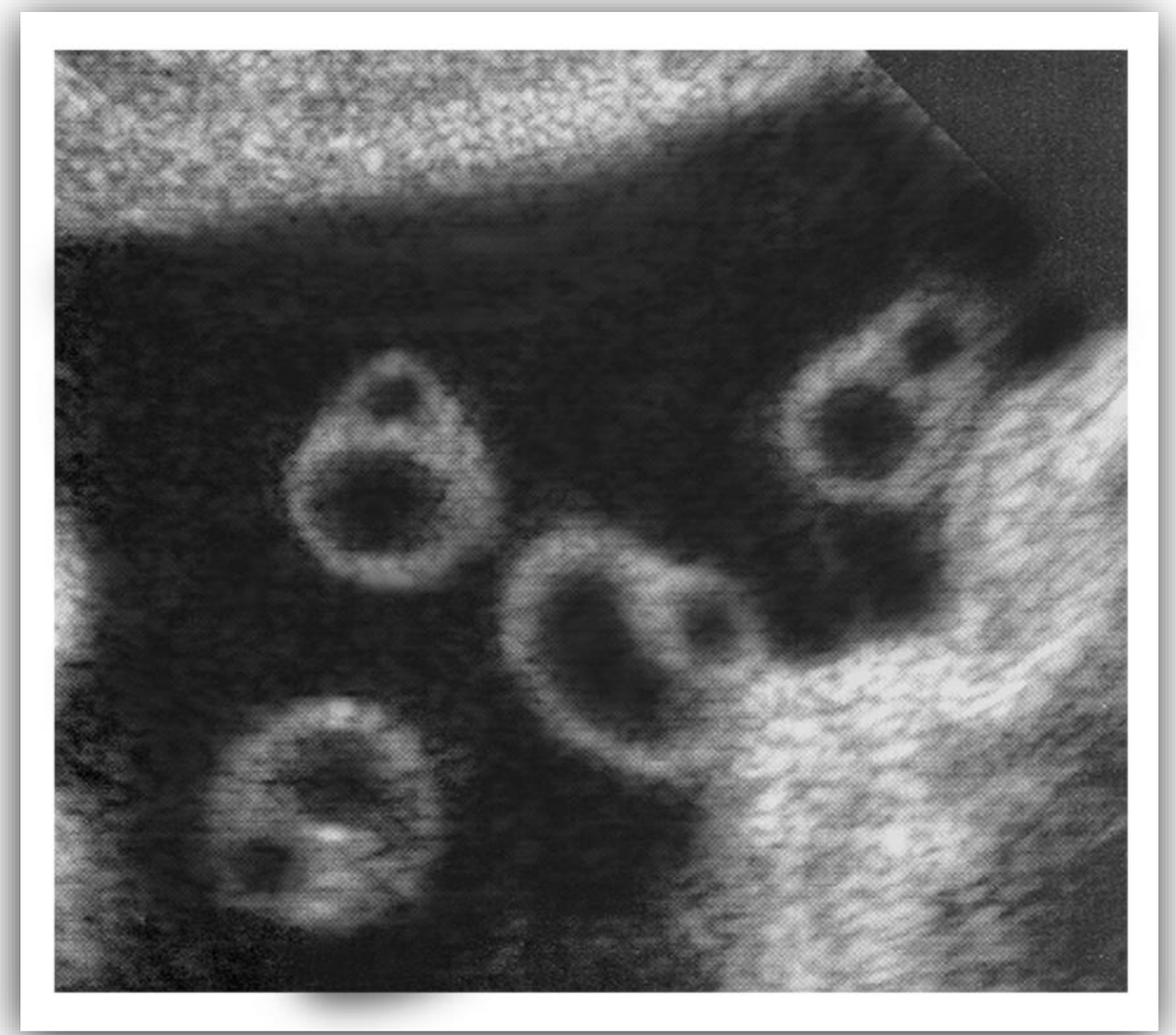
Single Umbilical Artery

- Conditions associated with SUA include:
  - Trisomies 13, 18
  - Multiple gestations
  - Maternal diabetes
  - Congenital renal anomalies
  - Sirenomelia
  - Velamentous insertion of cord (*see below*)

Single Umbilical Artery

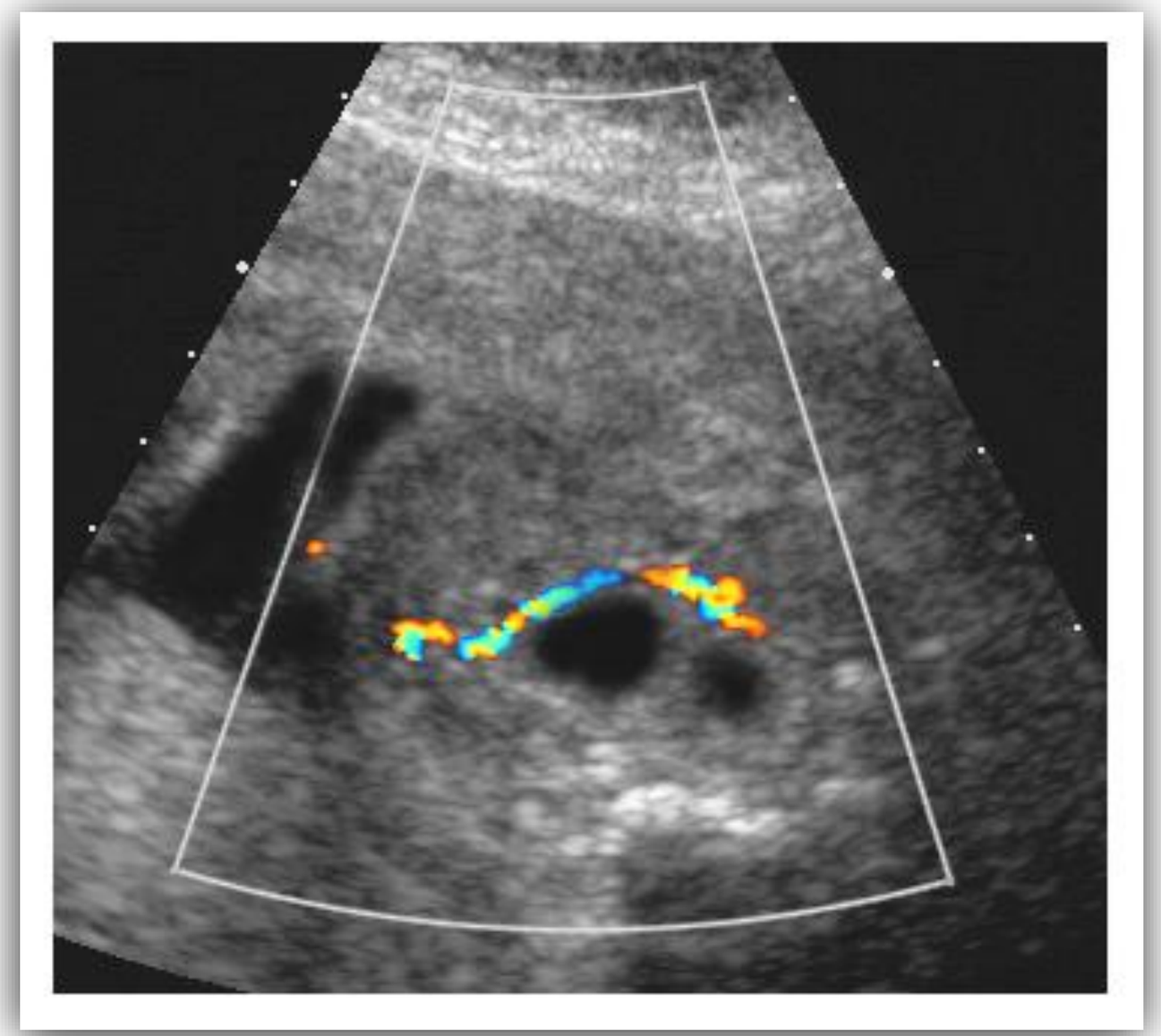
- Sonographic findings include:
  - Only 2 vessels demonstrated in a true cross section through cord
  - Absence of an umbilical artery entering fetal internal iliac artery seen with color Doppler imaging

SINGLE UMBILICAL ARTERY



True cross section through cord

SINGLE UMBILICAL ARTERY



Absent umbilical artery in fetal pelvis

Cord Stricture

- Mechanical constriction of the cord may cause a hemodynamically significant reduction of flow to fetus or placenta
- Etiology is unknown
- Most severe cases result in fetal demise
- Cannot be diagnosed prenatally with US

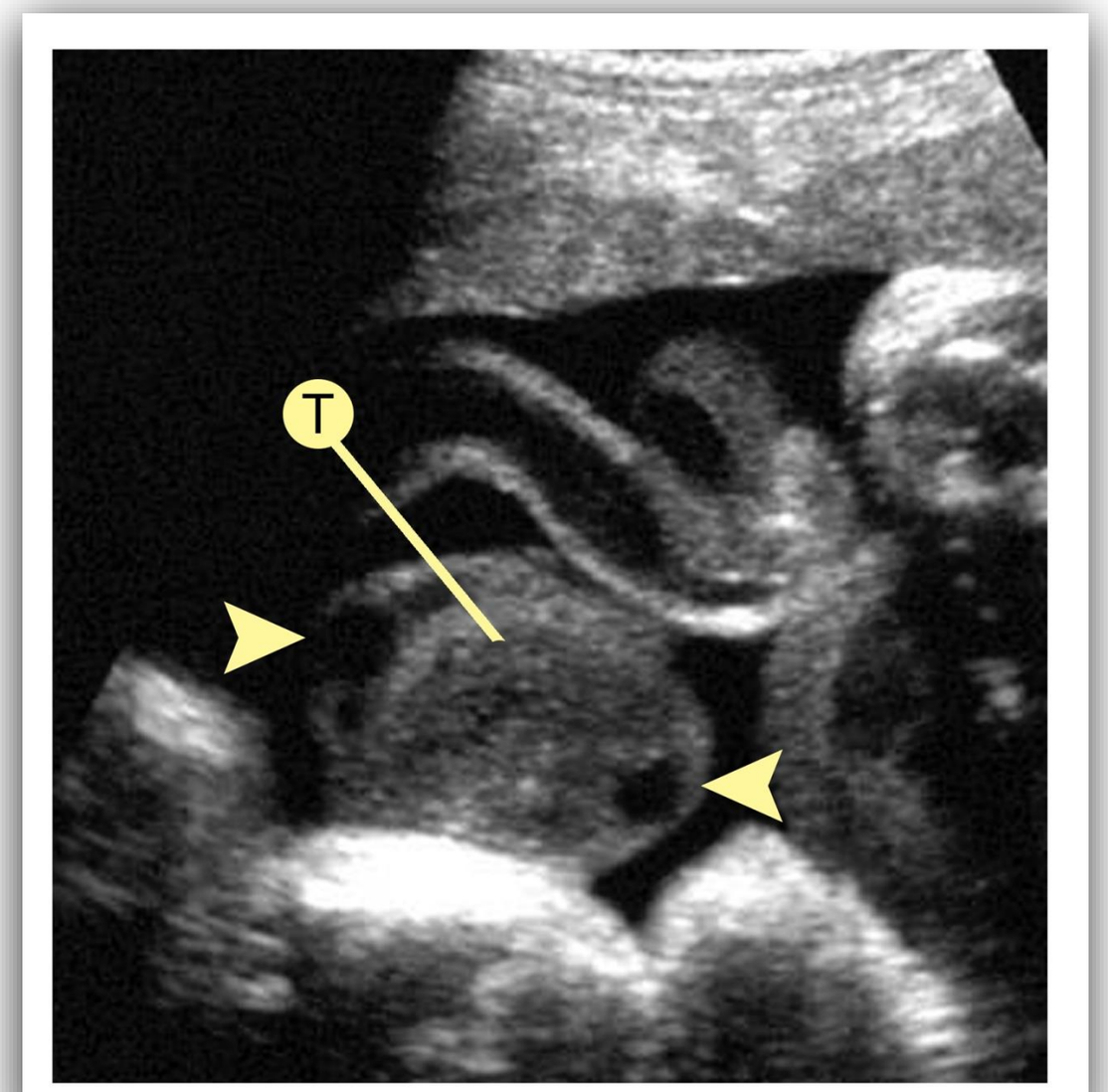
Umbilical Vein Thrombosis

- Occlusive thrombosis of umbilical cord, which is uniformly lethal, may be caused by:
  - Torsion
  - Compression
  - Knotting
- Most common in:
  - Diabetic mothers
  - Fetal nonimmune hydrops

Umbilical Vein Thrombosis

- Sonographic findings include:
  - Increased echogenicity in the lumina of umbilical vessels
  - Absence of spectral Doppler signals within an umbilical vessel
  - Absence of color flow within an umbilical vessel

UMBILICAL VEIN THROMBOSIS



Thrombus in umbilical vein (T)
Arrows = paired umbilical arteries

Cord Abnormalities

- Vascular abnormalities include:
  - Single umbilical artery (SUA)
  - Cord stricture
  - Umbilical vein thrombosis
- Structural abnormalities include:
  - Short & long cord
  - Nuchal cord
  - Cord knots
  - Cord prolapse
  - Cord entanglement

Short Cord

- May cause complications during labor and delivery
  - Inadequate fetal descent
  - Fetal heart-rate abnormalities related to cord compression
  - Placental abruption

Short Cord

- Associated conditions include:
  - Oligohydramnios
  - Multiple gestations
  - Tethering of fetus by amniotic bands
  - Intrinsic fetal anomalies
  - Musculoskeletal abnormalities
  - CNS abnormalities

Long Cord

- May lead to cord compression and subsequent vascular compromise
- Compromise more likely if cord is twisted, kinked, or obstructed
  - Knots
  - Prolapse
  - Entanglement

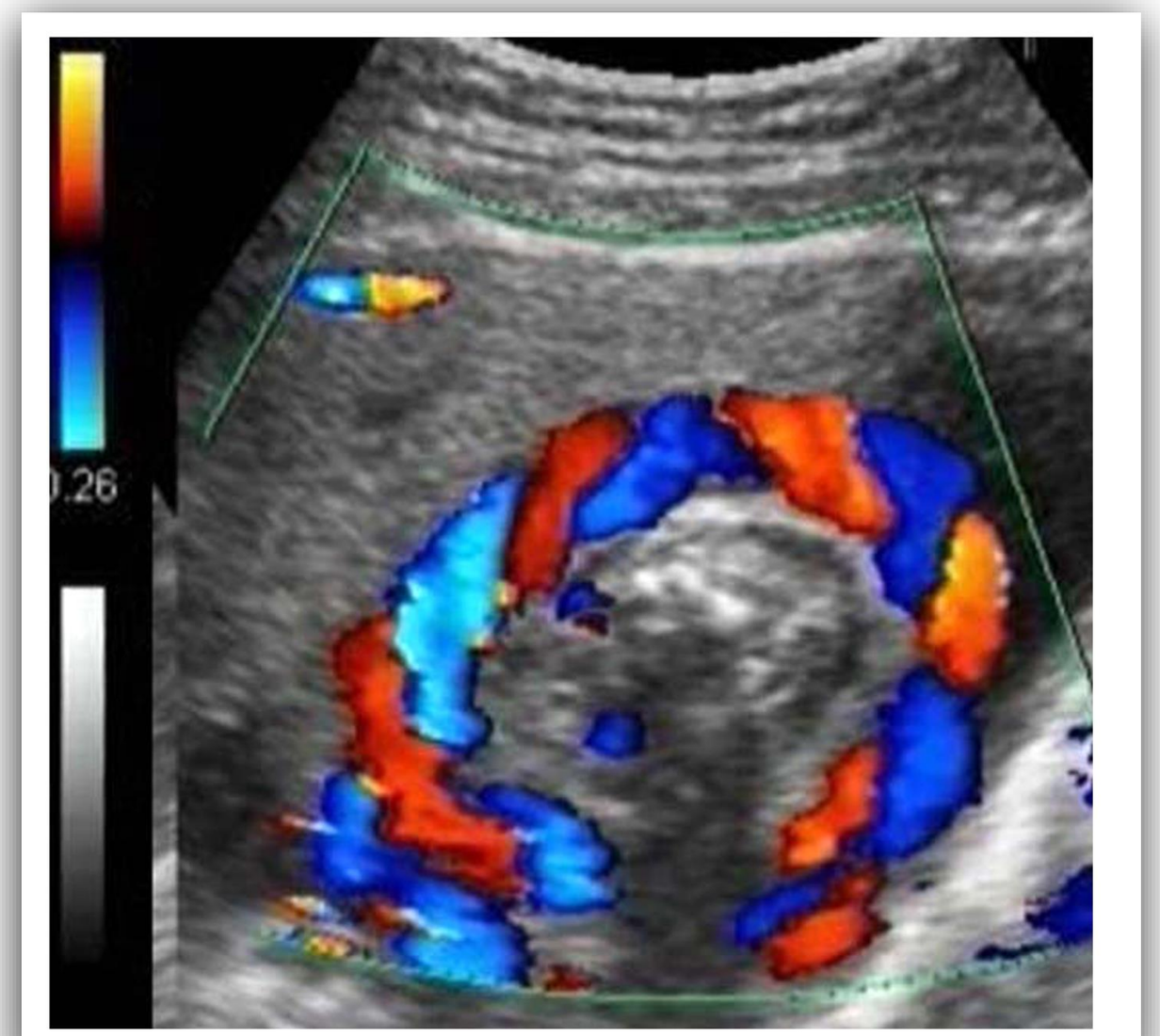
Nuchal Cord

- Present in 25% of pregnancies at term
- Single or double loop not of clinical significance
- Multiple loops associated with:
  - Meconium in amniotic fluid
  - Abnormal fetal heart rate patterns
  - Operative vaginal delivery
  - Mild postnatal acidosis

Nuchal Cord

- Associated conditions include:
  - Long cord
  - Fetal heart rate abnormalities
- Sonographic findings:
  - Two adjacent loops of cord in cross section posterior to fetal neck in sagittal section
  - Loops of cord circumferentially around the neck in transverse section

NUCHAL CORD



Loops of cord circumferentially around neck - transverse

Cord Knots

- Two classifications:
  - *True knots*: occur in 1% of singleton pregnancies. Torsion of cord which forms a loop through which fetus cam slip[to forma a knot
  - *False knots*: a simple redundancy of vessels which appear as vascular protrusions
- Neither can be visualized sonographically

Cord Prolapse

- Umbilical cord protruding into a dilated cervical canal
- Cord preceding presenting part and rupture of membranes can result in prolapse
- Creates a potential obstetric emergency
- Necessitates an expeditious delivery

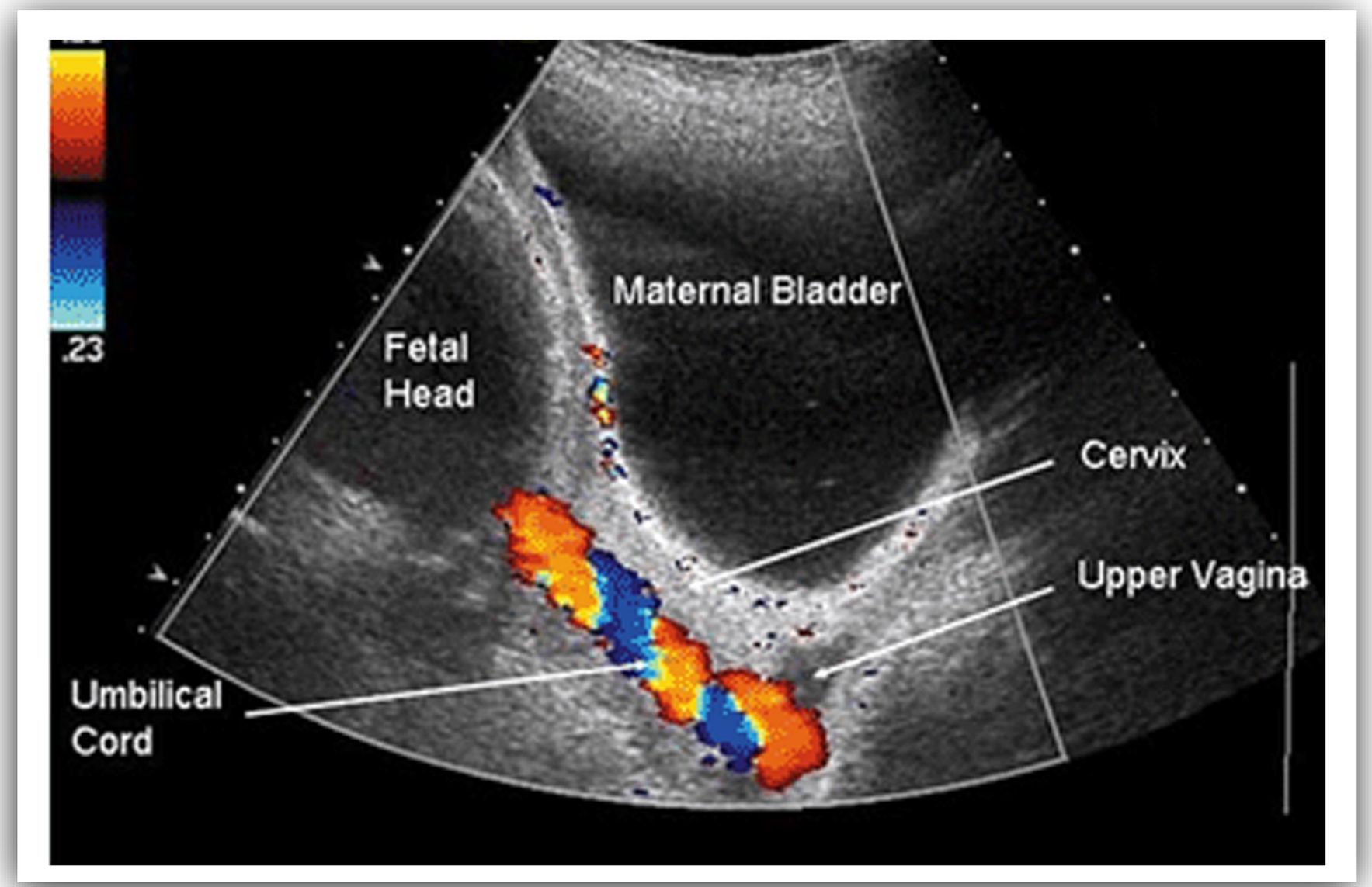
Cord Prolapse

- Associated conditions include:
  - Multiple gestation
  - Breech or transverse presentation
  - Low birth weight (<2500 grams at birth)
  - Polyhydramnios
  - Premature rupture of membranes (PROM)
  - Long cord

Cord Prolapse

- Sonographic findings include:
  - Presence of cord in dilated cervical canal
  - Hemodynamic activity in cord with color Doppler imaging

CORD PROLAPSE



Presence of cord in dilated cervical canal

Cord Entanglement

- Long cord loops encircles fetal body parts or become intertwined
- Classic feature of mono/mono/mono twin pregnancies
- Normal finding in 1st trimester
- Only problematic if hemodynamic compromise occurs in later gestation

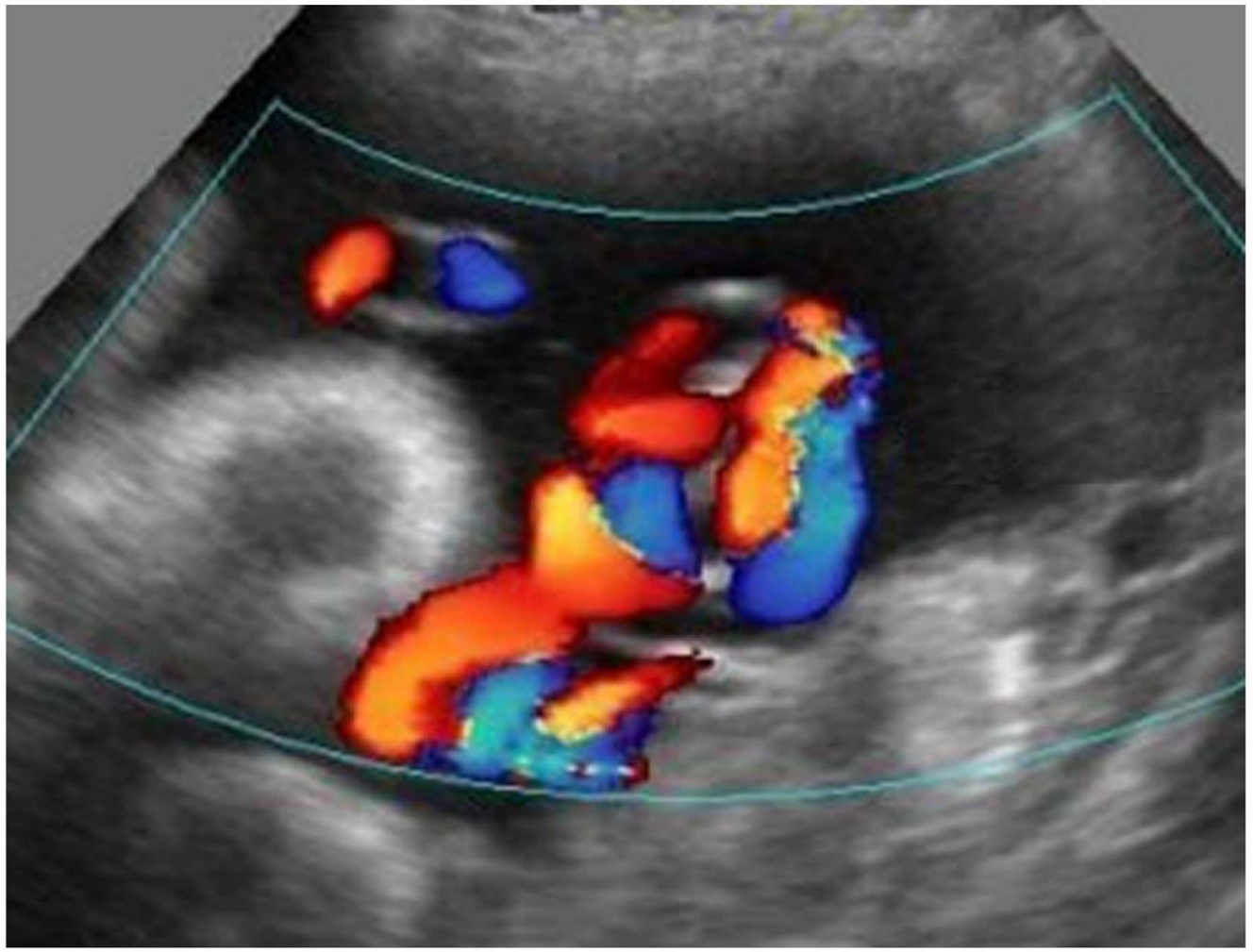
Cord Entanglement

- Associated conditions include:
  - Long cord
  - Monochorionic/monoamniotic twin pregnancy
- Sonographic findings:
  - Abnormal resistivity indices (RIs) and S/D ratios
  - Presence of diastolic notching
  - Reduction in end-diastolic flow in UAs
  - Pulsatile waveform in umbilical vein

CORD ENTANGLEMENT

Entangled mass of cord vessels

CORD ENTANGLEMENT



Entangled mass of cord vessels with CDI

Cord Abnormalities

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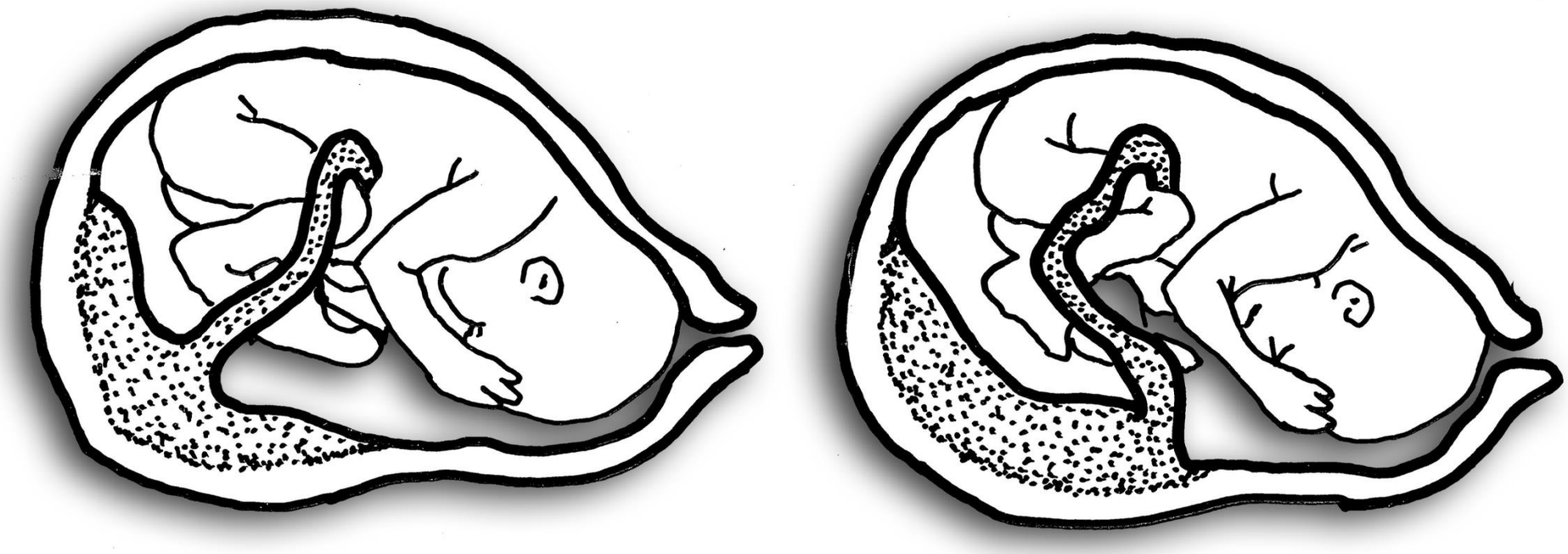
  - Battledore placenta
  - Velamentous insertion
- Cord cysts:
  - Omphalomesenteric duct cysts
  - Allantoic cysts
- Cord masses include:
  - Hemangiomas
  - Varices/aneurysms
  - Teratomas
  - Hematomas

Battledore Placenta

- Cord inserts along margin of placenta
- Also called *marginal insertion*
- Usually of no clinical significance

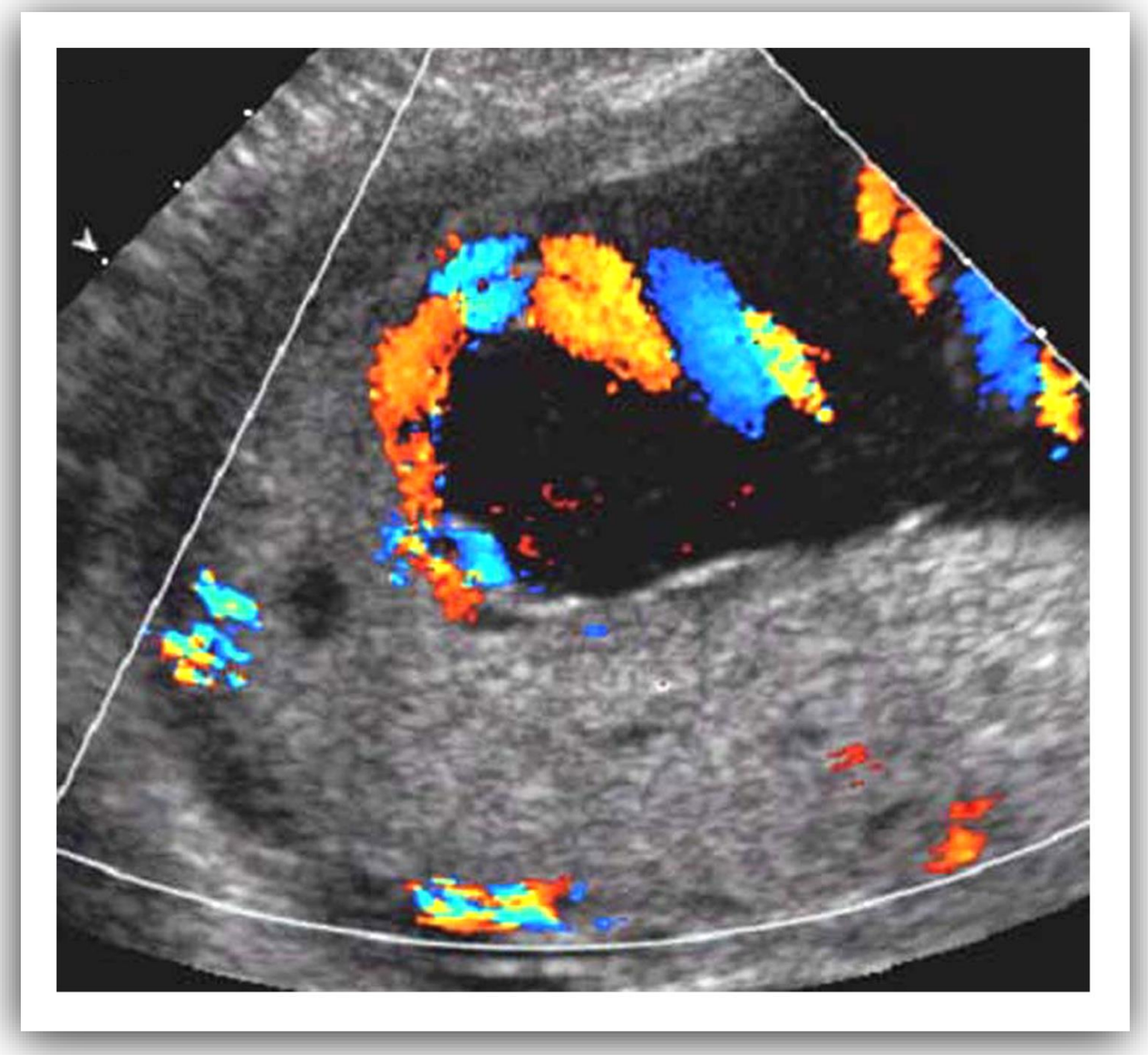
Battledore rackets

UMBILICAL CORD – INSERTION ABNORMALITIES



Battledore placenta

UMBILICAL CORD – INSERTION ABNORMALITIES

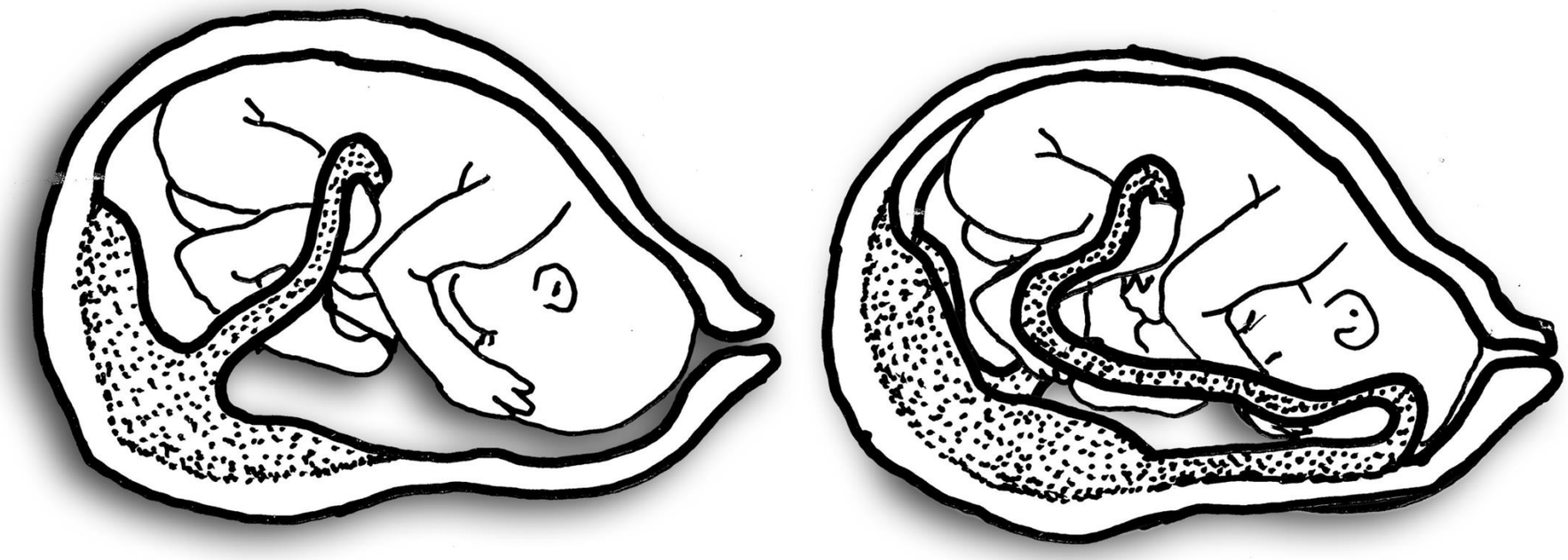


Marginal insertion (battledore placenta)

Velamentous Insertion

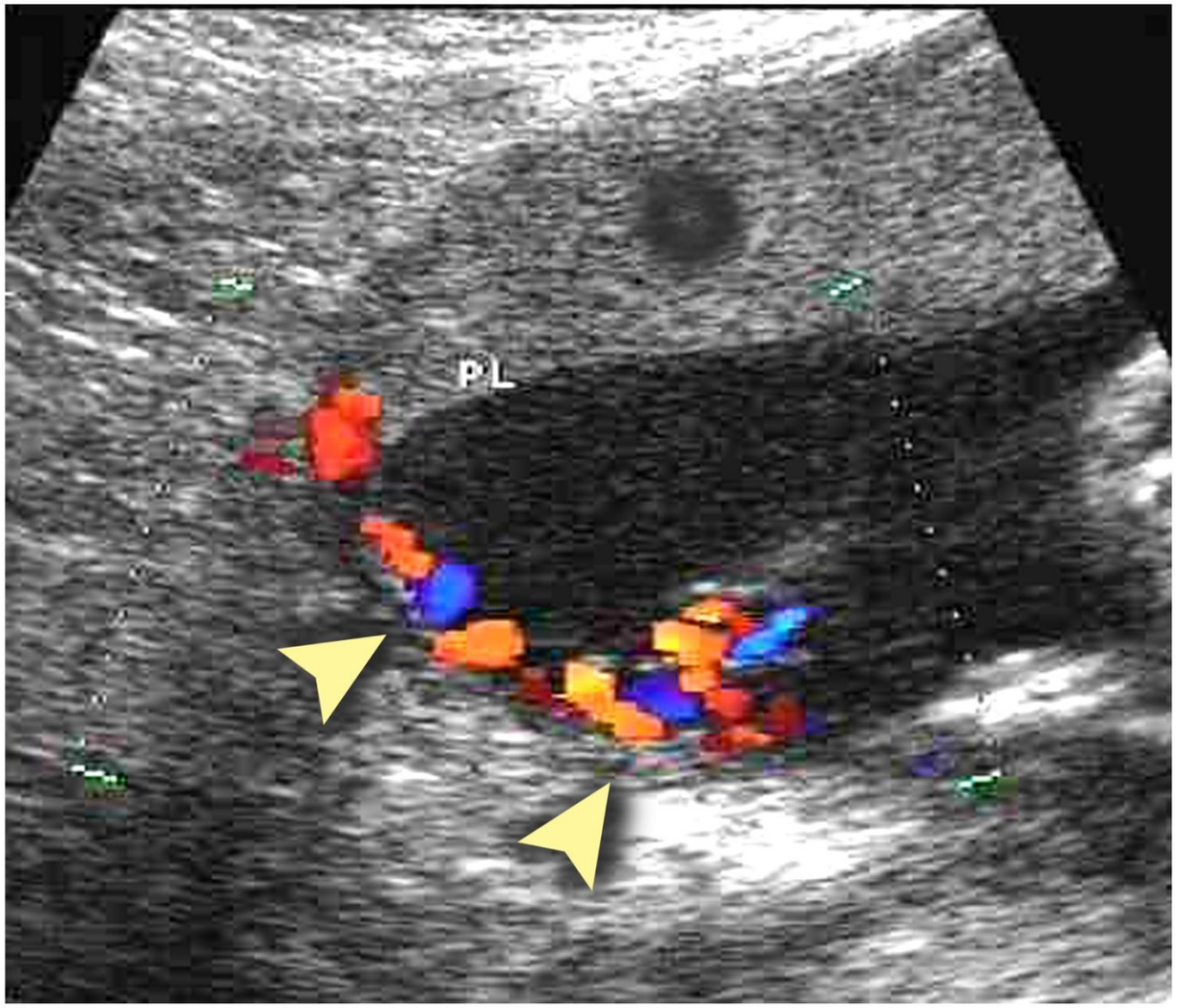
- Cord attaches beyond the placental edge and into the free membranes
- Clinical complications include:
  - Rupture or thrombosis of umbilical vessels
  - IUGR resulting from diminished cord flow
  - Twin-to-twin transfusion syndrome in multiple gestations
  - Vasa previa

UMBILICAL CORD – INSERTION ABNORMALITIES



Velamentous insertion

UMBILICAL CORD – INSERTION ABNORMALITIES



Velamentous insertion

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- Cord masses include:
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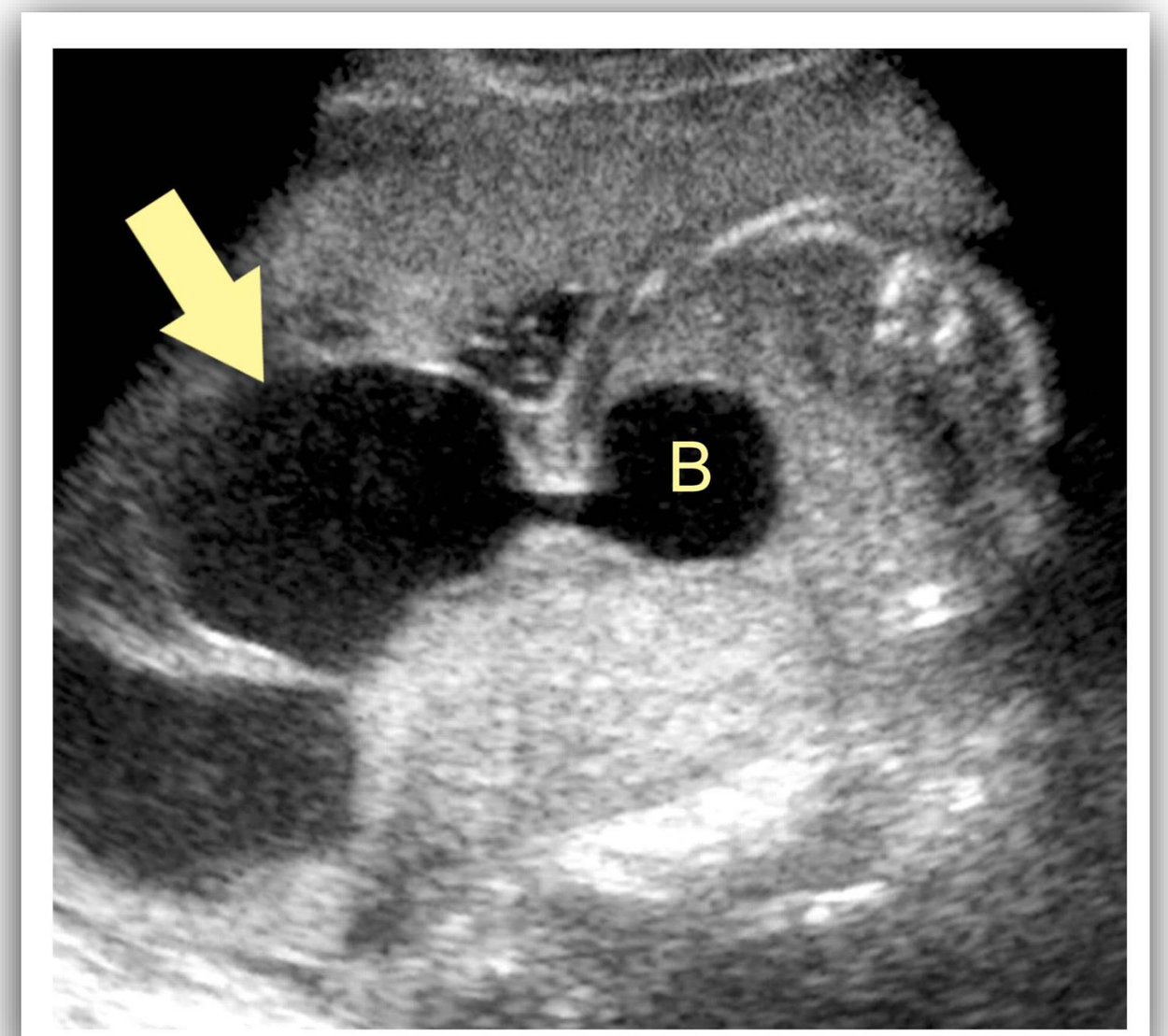
  - Teratomas
  - Hematomas

Cord Cysts

- May arise from the omphalomesenteric duct or allantois
- Distinguishable only by histological examination
- Omphalomesenteric duct cysts
  - Close to fetus
- Allantoic cyst
  - Away from fetus

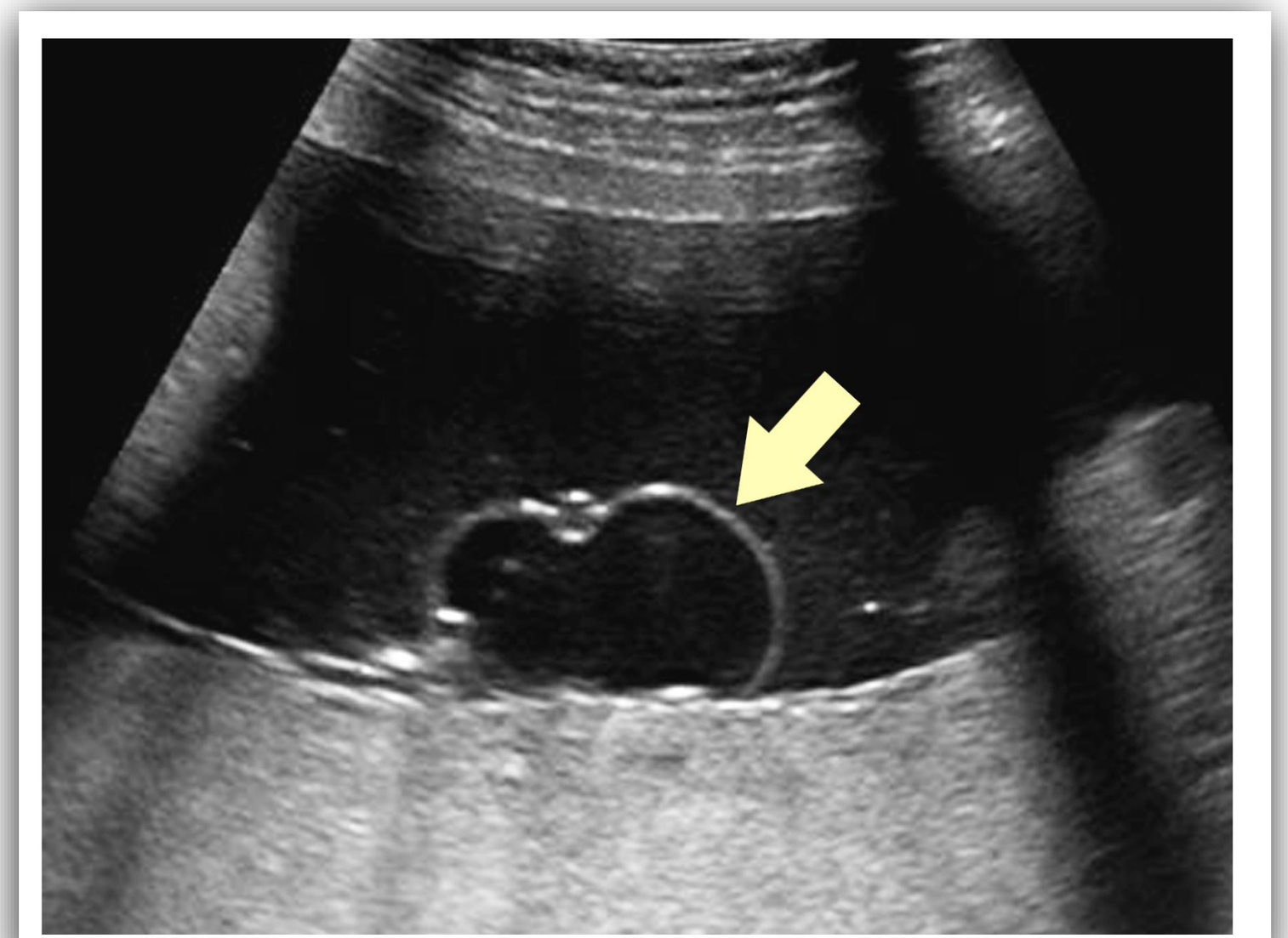
UMBILICAL CORD – INSERTION ABNORMALITIES

B = urinary bladder



Omphalomesenteric duct cyst

UMBILICAL CORD – INSERTION ABNORMALITIES



Allantoic cyst

Cord Abnormalities

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- Cord masses include:
  - Hemangiomas
  - Varices/aneurysms
  - Teratomas
  - Hematomas

Hemangiomas

- All cord masses are rare but hemangiomata are most common type of cord mass
- Benign vascular tumor
- Associated conditions include:
  - Polyhydramnios
  - Fetal hydrops
  - Elevated AFP levels

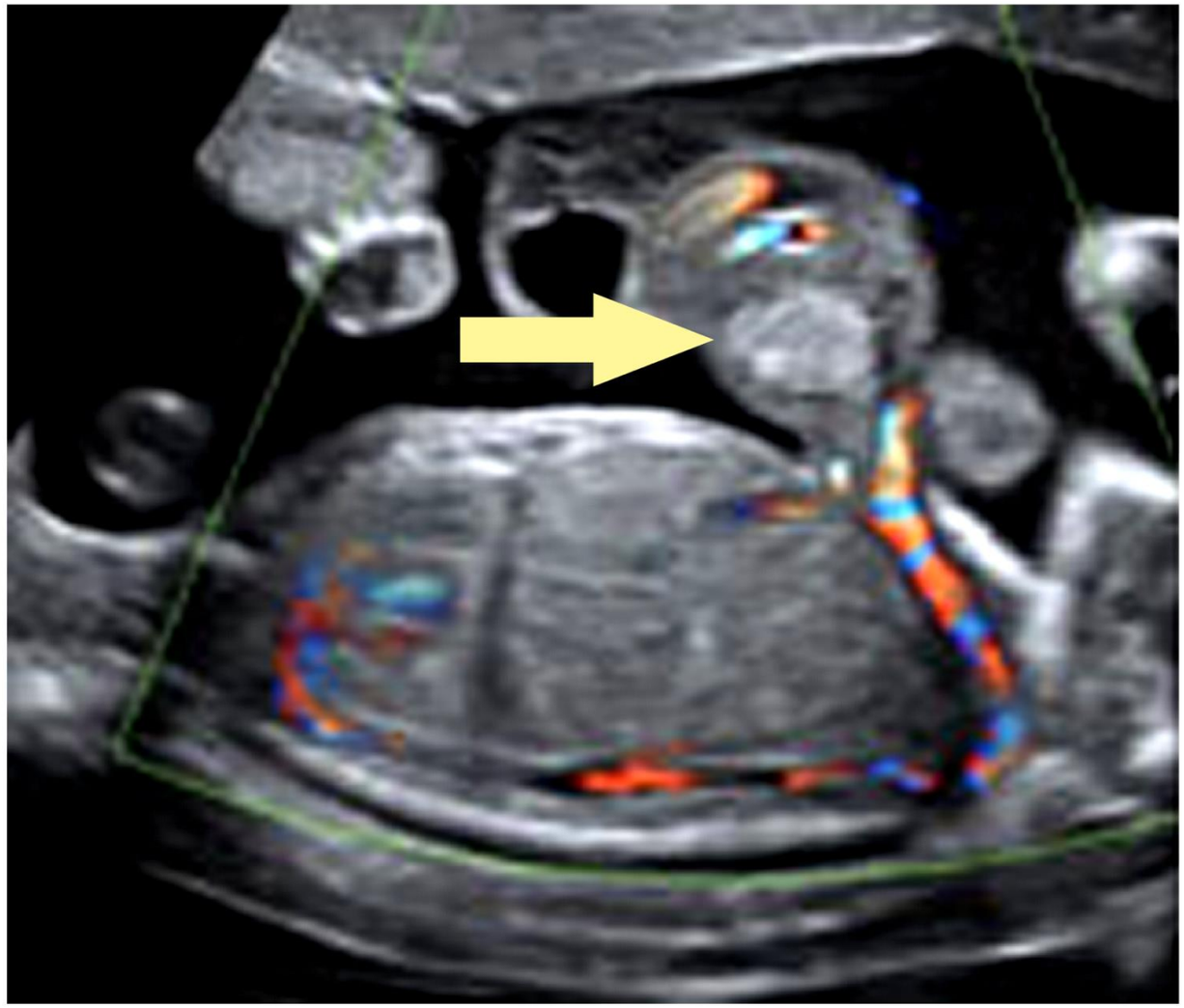
Terminology FAQ

Plural of …oma

Add …ata

Myoma = myomata
Hemangioma = hemangiomata
Atheroma = atheromata

UMBILICAL CORD – INSERTION ABNORMALITIES



Cord hemangioma

Varices/Aneurysms

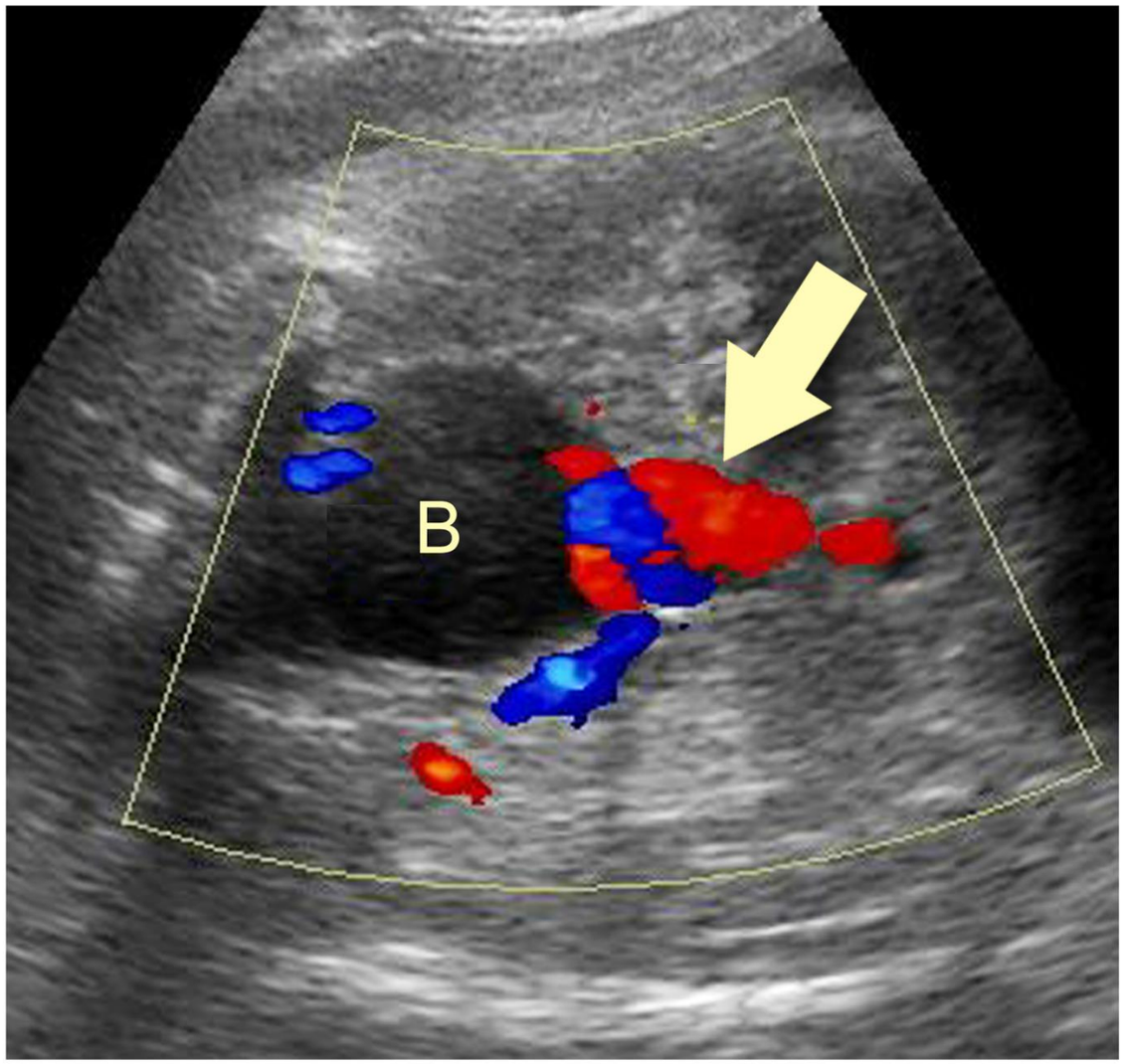
- Focal dilatation of and umbilical artery or vein
- Rare occurrence
- Dilated artery: *aneurysm*
- Dilated vein: *varix (varicosity)*
- Associated conditions include:
  - Poor fetal outcomes
  - Other fetal anatomic abnormalities

Varices/Aneurysms

- Sonographic clinical pearl
- Color Doppler useful in differentiating arterial from venous pathology

UMBILICAL CORD – CORD MASSES

B = urinary bladder

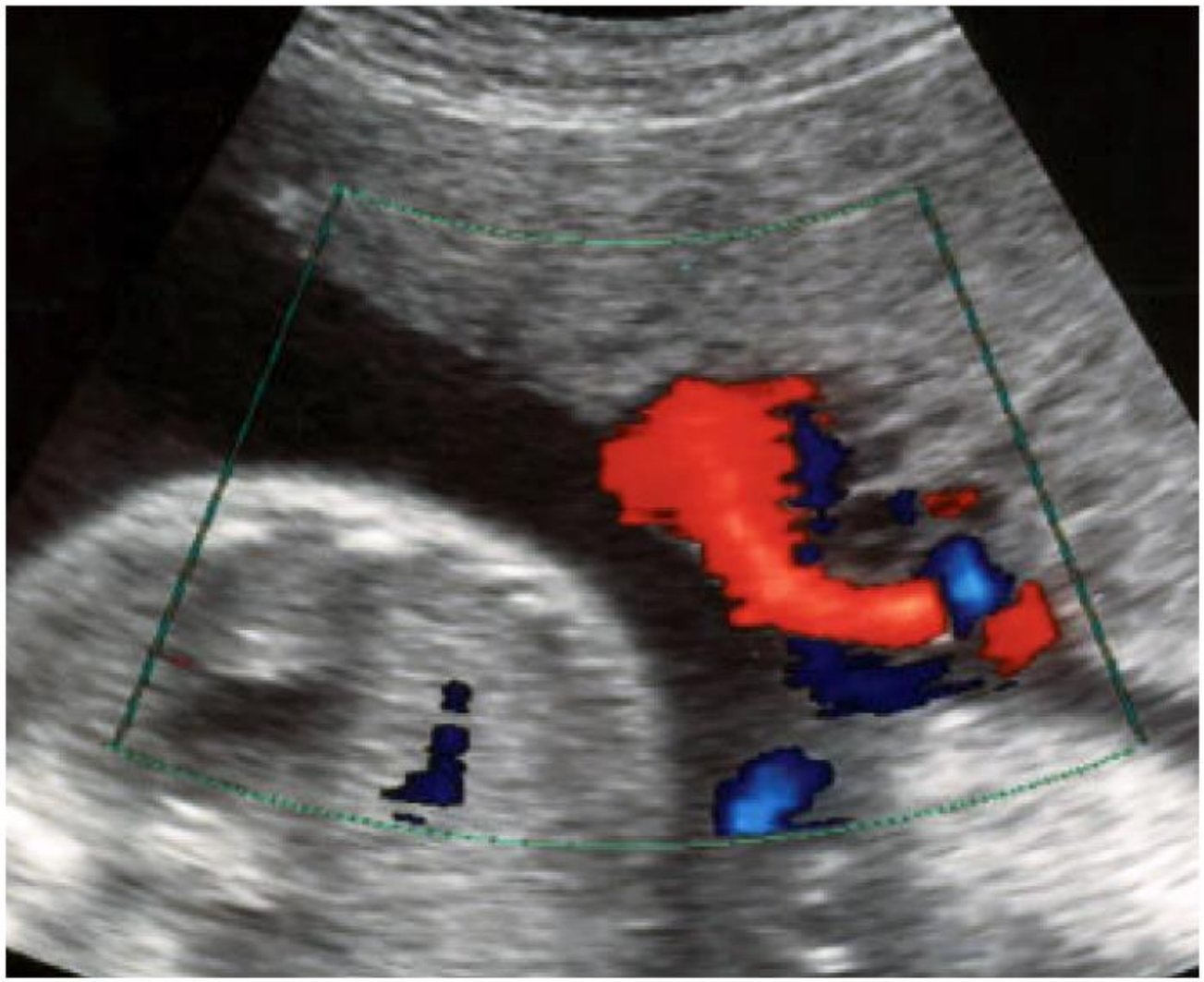


Umbilical venous varix

UMBILICAL CORD – CORD MASSES

Umbilical artery aneurysm – Gray scale image

UMBILICAL CORD – CORD MASSES



Umbilical artery aneurysm – Color Doppler image

OB GYN SONOGRAPHY REVIEW

Amniotic Fluid & Umbilical Cord