Disclosures

Nothing to disclose

Placenta Accreta Spectrum

- US findings in First Trimester
- US findings in Second & Third Trimesters
- Recent Literature - controversy
- Optimizing your US Diagnosis
- Management
Why are we Concerned?

- Rising incidence: 1/2500 to 1/533 pregnancies
- 40-60% of cases are diagnosed intrapartum with little preoperative planning
- 71% of placenta accreta cases require a hysterectomy
- 25% of patients with placenta accreta lose >5 liters of blood
- Mortality rate of cesarean hysterectomy 1.6% but as high as 10% with placenta percreta

Terminology

- Placenta accreta: 75%
- Placenta increta: 18%
- Placenta percreta: 7%

Risk Factors

<table>
<thead>
<tr>
<th>TABLE 8.5</th>
<th>Risk Factors for Placenta-Accreta</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Placenta previa and prior cesarean section</td>
<td></td>
</tr>
<tr>
<td>- Advanced maternal age</td>
<td></td>
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<tr>
<td>- Multiparity</td>
<td></td>
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<tr>
<td>- Prior uterine surgery</td>
<td></td>
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<tr>
<td>- Prior uterine irradiation</td>
<td></td>
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<tr>
<td>- Endometrial ablation</td>
<td></td>
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<td>- Asherman’s syndrome</td>
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<td>- Leiomyomas</td>
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<tr>
<td>- Uterine anomalies</td>
<td></td>
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<tr>
<td>- Hypertensive disorders in pregnancy</td>
<td></td>
</tr>
<tr>
<td>- Smoking</td>
<td></td>
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</table>
Risk Factors

Cesarean Section/Placenta Previa

Sonographic Findings

First Trimester
Adapted the European Consensus Group Classification

SMFM Task Force

- SMFM
- ACOG
- AIUM
- ISUOG
- ACR
- SRU
- ARDMS

Boston, December 2018

First Trimester

Location of Gestational Sac

- Low Implantation Pregnancy - a gestational sac located in the lower uterus in proximity to the internal cervical os
- Cesarean Scar Pregnancy - gestational sac implantation in part or totally within the cesarean section scar - Gestational sac may have tear drop or triangular shape

Boston, December 2018
First Trimester Lower Uterine Segment Implantation

- Data base of 90,435 births
- Placenta accreta in 20
- First trimester scan in 7/20
- Sac in lower segment in 6/7

J of Ultrasound in Med 2003;22:19
Cesarean Scar Pregnancy

• 58 cases for histologic review (37 CSP and 21 EAP)
• 2 pathologists reviewed slides
• Looking for myometrial invasion w/o intervening decidua
• Identical histopathological features (kappa = 0.93)


Cesarean Scar Pregnancy
Minimally Invasive Treatment of Cesarean Scar and Cervical Pregnancies Using a Cervical Ripening Double Balloon Catheter

Expanding the Clinical Series

Journal Ultrasound Medicine, August 2018

<table>
<thead>
<tr>
<th>GA (wks)</th>
<th>Patients</th>
<th>Mean ACG (Proportion)</th>
<th>Mean Days Balloon in Place</th>
<th>Mean Days to Negative ACG</th>
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</thead>
<tbody>
<tr>
<td>8-11 wks</td>
<td>7</td>
<td>66.8</td>
<td>11</td>
<td>53</td>
</tr>
<tr>
<td>11-16 wks</td>
<td>8</td>
<td>16.8</td>
<td>11</td>
<td>53</td>
</tr>
<tr>
<td>16-18 weks</td>
<td>2</td>
<td>38.0</td>
<td>1.6</td>
<td>49</td>
</tr>
<tr>
<td>18-20 weks</td>
<td>1</td>
<td>77.0</td>
<td>1.4</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 3. Summary of Outcome.
Multiple vascular lacunae within placenta
Sonographic Findings

Multiple vascular lacunae within placenta (# Lacunae)

Table 2 Distribution of adherent placenta according to lacunar grade

<table>
<thead>
<tr>
<th>Adherent placenta</th>
<th>Grade 0</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>22</td>
<td>6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Lacunae</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Placenta</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>10</td>
<td>11</td>
<td>5</td>
</tr>
</tbody>
</table>

G 0 = 0 lacunae
G 1 = 1-3 lacunae
G 2 = 4-6 lacunae
G 3 = > 6 lacunae


Multiple vascular lacunae within placenta

Personal Observation

Multiple vascular lacunae have very high predictive power in association with a placenta previa
Multiple vascular lacunae within placenta

Pathogenesis of Placental Lacunae
Placental tissue alterations resulting from long-term exposure to pulsatile blood flow

Lacunae – Blood Flow
Lacunae – Blood Flow

Gray Scale & Color

Lacunae – Blood Flow

Gray Scale

Lacunae – Blood Flow

Color Doppler
**Lacunae in Placenta Accreta Spectrum**

<table>
<thead>
<tr>
<th>Study</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cak et al.</td>
<td>78</td>
<td>86</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Connock et al.</td>
<td>93</td>
<td>93</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Wung et al.</td>
<td>100</td>
<td>96</td>
<td>95</td>
<td>75</td>
</tr>
<tr>
<td>Yang et al.</td>
<td>100</td>
<td>96</td>
<td>95</td>
<td>75</td>
</tr>
</tbody>
</table>

Gr 1 = grade 1 (zone to three lacunae), Gr 2 = grade 2 (four to six lacunae)

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**SMFM Task Force**

**Abnormal Uteroplacental Interface**

- Partial or complete loss of the retroplacental hypoechoic zone between the placenta and myometrium*
- This marker is often located along the posterior bladder wall resulting in partial or complete interruption or irregularities of uterovesical interface
- Thinning of the retroplacental myometrium (previously described as the myometrium thickness of <1mm)

*The space represents the uterine decidua and has been described as the "clear zone."

---

**Normal hypoechoic retroplacental zone**
Normal hypoechoic retroplacental zone

Loss of hypoechoic retroplacental zone

Loss of hypoechoic retroplacental zone
Loss of hypoechoic retroplacental zone

Table 1. Utility of the clear space in diagnosis of PTA

<table>
<thead>
<tr>
<th>Author</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crymko et al 24, 25</td>
<td>73</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wong et al 26</td>
<td>100</td>
<td>35</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cali et al 28</td>
<td>90.2</td>
<td>80.8</td>
<td>57</td>
<td>96.7</td>
</tr>
</tbody>
</table>

• False positive rate of 21% or higher
• Should not be used alone
• Angle dependent, can be absent in normal anterior placentas

What defines an accreta

Abnormality of the uterine serosa-bladder interface

- Interruption of line
- Thickening of line
- Irregularity of line
- Increased vascularity on color Doppler
Table 2. Utility of interrupted bladder line in the diagnosis of PAD

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<tr>
<td>Gal et al. 69</td>
<td>70</td>
<td>99</td>
<td>96</td>
<td>92</td>
</tr>
<tr>
<td>Constock et al. 66</td>
<td>20</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>11</td>
<td>70</td>
<td>100</td>
<td>88</td>
</tr>
</tbody>
</table>
New Marker: Placental Thickness

Placental Thickness
How about Color Doppler & PAS?

- Striking color Doppler
- Bridging vessels
- Increased retroplacental flow
How Accurate are PAS Ultrasound Markers when Evaluated in a Blinded Fashion?

- 55 patients with accreta and 56 controls (previa)
- De-identified US studies
- Reviewed by 6 investigators, blinded to Dx

IMAGING
Accuracy of ultrasound for the prediction of placenta accreta

- Placental lacunae (OR 1.4 – 95% CI, 1.3-1.6)
- Loss of retroplacental space (OR 2.2 – 95% CI, 1.6-3.0)
- Irregular bladder wall (OR 1.3 – 95% CI, 1.0-1.6)
- Color Doppler abnormalities (OR 1.3 – 95% CI, 1.1-1.4)
Why Such Disparity?

• Lack of standardization of definitions
• FIGO-SMFM
• Need for optimization of ultrasound examination
• SMFM
• Need for more prospective studies to understand the independent value of each marker

How Common are PAS Ultrasound Markers in Low-Risk Pregnancies?

Prospective, longitudinal cohort study
May 2016 - February 2017

Study Population
- History of prior c-section
- Second trimester scan (18-24 wks)
- Third trimester scan (28-34 wks)

Inclusion criteria:
> 18 years of age, singleton gestation presenting before gestational age of 24w, no known fetal anomalies or genetic conditions

Prevalence of Sonographic Markers of Placenta Accreta Spectrum in Low-Risk Pregnancies

Rochelle Philips, MD1 - Nargel Cangiano, MPH1 - Sarah DeRoche, MPH1 - Tina Cunningham, MPH2 - Lara Melnikova, MD, PhD3 - Caroline Kuzmar, MA1 - Luis Peralta, MD1 - Ahmad Abulafia, MD1

American Journal of Perinatology - Dec 2018
Prevalence of Sonographic Markers of Placenta Accreta Spectrum in Low-Risk Pregnanacies

Jennifer Phillips, MD; Megan Cargan, MPH; Sarah DeShields, MPH; Camille Kanesa, MD; Lee Porcher, MD; Ali Al-Mohammad, MD

Table 3: Retropelvic sonographic findings in the study population and in pregnancies with and without cesarean section.

<table>
<thead>
<tr>
<th>Second trimester</th>
<th>Total sample</th>
<th>With prior CD</th>
<th>Without prior CD</th>
<th>P value</th>
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<tbody>
<tr>
<td>Retropelvic myometrial thickness (mm), median (IQR)</td>
<td>5.5 (3.2)</td>
<td>5.0 (3.1)</td>
<td>5.4 (3.2)</td>
<td>0.08*</td>
</tr>
<tr>
<td>Retropelvic myometrial thickness &lt; 4 mm</td>
<td>0.8%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.05</td>
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<tr>
<td>ECL score &lt; 1</td>
<td>14 (8.1)</td>
<td>12 (7.3)</td>
<td>15 (8.0)</td>
<td>0.06</td>
</tr>
<tr>
<td>Presence of subplacental myometrial vessels</td>
<td>62 (37.2)</td>
<td>12 (41.3)</td>
<td>57 (30.8)</td>
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Percent of patients:

- Total number of patients
- Second trimester assessment
- Third trimester assessment

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<td>75.0%</td>
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<td>24.1%</td>
<td>24.1%</td>
</tr>
</tbody>
</table>
Understand Relevance of a-Priori Risk

• Always use the transvaginal approach
• Evaluate placenta in real time & Magnify
• Always add color Doppler in low velocity
• Carefully assess the lower segment /cervical area (look for cervical invasion)
• Develop a protocol
• Stratify risk for bleeding (High-Intermediate-Low)

High Risk for Bleeding
Low Risk for Bleeding

Intermediate Risk for Bleeding

Placenta Accreta Spectrum: Optimizing the Outcome
Complications of PAS

- Damage to local organs
- Postoperative bleeding
- Amniotic fluid embolism
- Consumptive coagulopathy
- Transfusion-related complications
- Acute respiratory distress syndrome
- Postoperative thromboembolism
- Infectious morbidities
- Multi-system organ failure
- Maternal death


Complications of Cesarean Hysterectomy (NICHD 2009)

<table>
<thead>
<tr>
<th>Complication</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRBC</td>
<td>156</td>
<td>83.9</td>
</tr>
<tr>
<td>FFP</td>
<td>59</td>
<td>31.7</td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td>22</td>
<td>11.8</td>
</tr>
<tr>
<td>Platelets</td>
<td>26</td>
<td>15.1</td>
</tr>
<tr>
<td>Post op fever</td>
<td>21</td>
<td>13.3</td>
</tr>
<tr>
<td>Beas</td>
<td>10</td>
<td>5.4</td>
</tr>
<tr>
<td>Exlap</td>
<td>7</td>
<td>3.8</td>
</tr>
<tr>
<td>Maternal death</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>Bowel injury</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>DVT</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Uteral injury</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Cystotomy</td>
<td>18</td>
<td>10</td>
</tr>
</tbody>
</table>

Steps to Optimize Outcome in PAS
1- Improve your Antenatal Diagnosis

- Learn of PAS sonographic markers
- Review European, FIGO & SMFM standardization
- Understand limitations
- Common in low-risk population
- Standardize approach to ultrasound (Protocol)

2- Standardize your Antenatal Preparation

- Create a protocol and a check list
- Provide patient counseling
- Perform follow-up ultrasounds
- Consider a PAS clinic

2- Standardize your Antenatal Preparation

- Assemble skilled multidisciplinary team
- Best pelvic surgeons
- Skilled nursing teams
- Experienced anesthesiology
- Intervention radiology
- Urology
- Blood bank (massive transfusion)
- Skilled OR team
- Critical care
3- Plan Cesarean Delivery at 34-37 Weeks

- Large number of patients with PAS report hemorrhage after 35 weeks

**Planned Delivery**
- Associated with shorter OR times
- Lower frequency of transfusions
- Lower ICU admission

4- Optimize Surgical Approach

- Consider midline skin incision
- Ultrasound mapping of placental implantation site intraoperatively
- Classical uterine incision above placenta
- Cesarean hysterectomy with placenta left in situ
**4- Optimize Surgical Approach**

- Uterine stapler (if decision for hysterectomy)
- Abdominal retractors: Bookwalter retractor
- Appropriate size clamps: Masterson clamps
- Ligasure impact coagulator
- Bipolar cautery forceps
- Appropriate sutures
- Cell saver suction

---

**4- Optimize Surgical Approach**

- Massive blood loss and Hypovolemic shock:
  - Start transfusion early and stay ahead of bleeding
  - Rapid restoration of effective intravascular volume
  - Cell saver
  - Avoid state of DIC
  - Avoid acidosis
  - Factor VII & Tranexamic acid
  - Recommend a 1:1 ratio of RBC to FFP

---

**4- Optimize Surgical Approach**

- Hypothermia
  - Provide warm covering for patient (bear Hug)
  - Warm irrigation saline
Electrolyte abnormalities
- Major risk for arrhythmias
- Check regularly and correct intraoperatively (K)

4- Optimize Surgical Approach

- Staged surgical approach (intervention radiology)
- Consider conservative management for massive percreta – could be life saving if unprepared
Staged Surgical Approach

<table>
<thead>
<tr>
<th>Table</th>
<th>Staged Approach</th>
<th>Expectant Treatment</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>38.5 ± 4.01</td>
<td>36.0 ± 4.01</td>
<td>.35</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>25.1 ± 4.0</td>
<td>16.1 ± 4.0</td>
<td>.00</td>
</tr>
<tr>
<td>Mode of delivery, %</td>
<td>35.8 ± 4.0 (36-40)</td>
<td>38.5 ± 4.0 (36-40)</td>
<td>.94</td>
</tr>
<tr>
<td>Blood loss, ml</td>
<td>511 ± 437 (295-939)</td>
<td>4517 ± 711 (2500-11,100)</td>
<td>.0001</td>
</tr>
<tr>
<td>Maternal blood loss, %</td>
<td>71.1 ± 30.0 (55-95)</td>
<td>7.2 ± 1.4 (5-85)</td>
<td>.003</td>
</tr>
</tbody>
</table>

- Successful conservative management: 131 (78%)
- Spontaneous placental resorption: 87 (75%)
- Severe maternal morbidity: 10 (6%)

5- Optimize Postoperative Care

- ICU admissions with critical care
- Monitor bleeding in first 24 hours
- Monitor electrolytes and lung function
- Role for intervention radiology if stable
Placenta Accreta Spectrum
Case Presentation:
How Complicated Can It Gets!

Patient History

• 31 year old
• G2 P1001
• One prior CS for failure to progress
• Prenatal care with Maternal-Fetal Medicine
• History of kidney stones
• Prenatal care started in first trimester

12 Weeks
Patient referred to our PAS Clinic

- Counseling
- Anesthesia consult
- Intervention radiology consult
- Coordination for cesarean hysterectomy
Patient History

• Presented to Labor & Delivery unit with abdominal pain & early labor at 33 weeks of gestation
• Decision to proceed with cesarean delivery
• Discussed conservative management
• Preparation for possible hysterectomy
Intraop Findings
• Following delivery of baby, heavy bleeding was noted from the cervix
• Conservative management was not an option
• Plan to proceed with hysterectomy
• Activated massive transfusion protocol

Intraop Findings
• Following delivery of baby –
  • Drop in BP
  • Maternal tachycardia

Attributed to bleeding
Intraoperative Findings

• Intraop, patient noted to go into massive pulmonary edema and right heart failure
• Massive amount of pleural fluid pouring from ET Tube

Intraoperative Findings

• Transesophageal echo notes right heart failure
• Normal electrolytes
• Patient goes into DIC with significant pelvic oozing
Intraoperative Findings

- Suspected Diagnosis:
  - TRALI (Transfusion related acute lung injury) or
  - Amniotic Fluid Embolism (BP drop immediately after delivery of baby)

Intraoperative Management

- Blue towel closure
- Pack abdomen
- Keep fascia open
- Place drains (vacuum)
- Cover with plastic adhesive
Given Severity of Lund Disease and Right Heart Failure
Only Option to Consider is ECMO

Intraoperative Management
• ECMO (extra-corporeal membrane oxygenation)
Postoperative care

• Cardiac ICU admission
• ECMO for 48 hours
• Back to OR for abdomen closure in 48 hours
• Nephrostomy for left renal drainage
• Lithotripsy day 4 for ureteral stone
• Hospital discharge day 7 postop
• Nephrostomy tube removed 2 weeks later

Patient’s consent obtained

4 weeks postoperative

Take Home Message

• Know the maternal risk factors for PAS
• Know the significance and limitations of Ultrasound markers in PAS
• Be conservative, when in doubt—call accreta
• Consider delivery at 34-37 weeks for accreta
• Multidisciplinary approach to care
• Aggressive transfusion & resuscitation
• Plan – Plan – Plan