Abnormally Invasive Placenta

S Robson
Professor of Fetal Medicine
Newcastle University

- Epidemiology
- Pathophysiology
- Screening / diagnosis
- Management
  - Haemorrhage
Abnormally invasive placenta

Histological Classification

- **Accreta**: Direct attachment of EVT to myometrium
- **Increta**: EVT invasion into myometrium
- **Percreta**: EVT invasion to serosa and/or adjacent structures

![Histological images](X40 CK/PAS X40 CK/PAS)
Abnormally invasive placenta

Degree of invasion

- PND (10 series, n=203)
- Pathological (4 series, n=118)

Modified from Jauniaux et al. 2018
Abnormally invasive placenta

Post myomectomy

Post CS
## Abnormally Invasive Placenta
### Incidence & rate of prenatal diagnosis

<table>
<thead>
<tr>
<th>Setting</th>
<th>Diagnosis</th>
<th>Incidence (per 10,000 mat)</th>
<th>Prenatal dx</th>
<th>No risk factors (PP + CS)</th>
<th>Accreta</th>
<th>In/Per-creta</th>
<th>Hysterectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UK (UKOSS)</strong> (Fitzpatrick et al. 2013)</td>
<td>2010-11</td>
<td>221 hospitals n=134</td>
<td>Clinical &amp; Path</td>
<td>1.7</td>
<td>50%</td>
<td>5%</td>
<td>65%</td>
</tr>
<tr>
<td><strong>US (MFMU)</strong> (Bailit et al. 2015)</td>
<td>2008-11</td>
<td>25 hospitals n=158</td>
<td>Clinical &amp; Path</td>
<td>13.7</td>
<td>53%</td>
<td>PP 68%</td>
<td>CS 37%</td>
</tr>
<tr>
<td><strong>Canada</strong> (Mehrabadi et al. 2015)</td>
<td>2009-10</td>
<td>All hospitals n=819</td>
<td>ICD (Canada)</td>
<td>14.4</td>
<td>53%</td>
<td>69%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Nordic (NOSS)</strong> (Thurn et al. 2015)</td>
<td>2009-12</td>
<td>All hospitals n=205</td>
<td>Clinical</td>
<td>3.4</td>
<td>29%</td>
<td>31%</td>
<td>47%</td>
</tr>
</tbody>
</table>
AIP
Risk Factors

- Caesarean section
- Placenta praevia

Uterine curettage (repeated/post delivery)
Uterine surgery
Endometrial ablation

<table>
<thead>
<tr>
<th>Silver et al. 2006 Caesarean Delivery</th>
<th>Placenta praevia*</th>
<th>No placenta praevia</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>3.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Second</td>
<td>11</td>
<td>0.2</td>
</tr>
<tr>
<td>Third</td>
<td>40</td>
<td>0.1</td>
</tr>
<tr>
<td>Fourth</td>
<td>61</td>
<td>0.8</td>
</tr>
<tr>
<td>Fifth</td>
<td>67</td>
<td>0.8</td>
</tr>
<tr>
<td>≥ Sixth</td>
<td>67</td>
<td>4.7</td>
</tr>
</tbody>
</table>
Uterine pathologies associated with AIP

Number of uterine procedures
Adj RR AIP in primiparous women
1  1.5 (1.1-1.9)
2  2.7 (1.7-4.4)
≥3 5.1 (2.7-9.6)

Laparoscopy, hysteroscopy, curettage Incl. TOP), endometrial ablation
Baldwin et al. 2018

Assisted reproductive technology
Nordic OSS aOR 3.1 (1.1-9.0)
UK OSS aOR 32.1 (2.0-509)

but
No increase in RR in meta-analysis cohort studies (Qin et al. 2016)

Jauniaux et al. 2018
Abnormally invasive placenta

Diagnosis

• Screening
  - **History** (e.g. number CS)
  - First trimester US – scar + trophoblast]
  - **Second trimester US**
    (a) Praevia
    (b) Lacunae / Anomalies uterus-bladder interface

• Diagnosis
  - **US** (first, second trimester)
    (a) Individual features (6 gray scale, 4 CD)
    (b) Risk scores (Multiple US features ± history)
      - Accreta Index, Two Criteria System
  - **MRI** (second, third trimester)
    (a) Individual features (5 T2W features)
Abnormally invasive placenta

Ultrasound features

- **Lacunae** *(Gray scale + CD)*

<table>
<thead>
<tr>
<th>AIP</th>
<th>Grade 0</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yang et al.</td>
<td>None</td>
<td>1-3 small</td>
<td>4-6 larger, more irregular</td>
<td>&gt; 6 large, irregular</td>
</tr>
<tr>
<td>None</td>
<td>22</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accreta</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Increta</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Percreta</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>10</td>
<td>11</td>
<td>5</td>
</tr>
</tbody>
</table>
Abnormally invasive placenta

Ultrasound features

- **Lacunae** *(Gray scale + CD)*
- **Loss of retroplacental hypo-echoic zone** *(Gray scale)*
- **Abnormalities of uterus-bladder interface** *(Gray scale + Colour Doppler)*
- **Abnormal placental vascularization** *(3D Power Doppler)*
Abnormally invasive placenta

Ultrasound features

- Lacunae
- Loss of retroplacental hypo-echoic zone
- Abnormalities of uterus-bladder interface
- Abnormal placental vascularization
Abnormally Invasive Placenta
US diagnosis

- More US features present – greater risk of:
  (a) AIP
  (b) Percreta

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous CS</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>≥2</td>
<td>2</td>
</tr>
<tr>
<td>Lacuna size</td>
<td></td>
</tr>
<tr>
<td>≤ 2 cm</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 2 cm</td>
<td>2</td>
</tr>
<tr>
<td>Obliteration RPCZ</td>
<td>2</td>
</tr>
<tr>
<td>Location placenta</td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>1</td>
</tr>
<tr>
<td>Praevia</td>
<td>2</td>
</tr>
<tr>
<td>Doppler</td>
<td></td>
</tr>
<tr>
<td>Blood flow in lacunae</td>
<td>1</td>
</tr>
<tr>
<td>Hypervascularity P-B and/or U-P interface</td>
<td>2</td>
</tr>
</tbody>
</table>

- Low risk:
  Score ≤5
  99.1% (n=220)

- Moderate risk:
  Score 6-7
  29.4% (n=5)  70.6% (n=12)

- High risk:
  Score 8-12
  84.2% (n=16)  15.8% (n=3)

*Tovbin et al. 2016*
<table>
<thead>
<tr>
<th>Number of features</th>
<th>No AI</th>
<th>Accreta</th>
<th>In/per-creta</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>412</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1 or 2</td>
<td>8</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>&gt;2</td>
<td>0</td>
<td>10</td>
<td>32</td>
</tr>
</tbody>
</table>

Lacunae  
Loss R/P hypo-echoic zone,  
Abn. U-B interface  
Abn. placental vascularization  

SPR = 14%  
FPR 1.7%  
Dehiscence, Vascular malformation (prior surgery)
Abnormally invasive placenta

Placental MRI features

- **Heterogeneous signal intensity**
  - Large, tortuous placental vessels
  - High signal on FISP (=vascular flow)

- **Interruption of myometrium**
  - Thinning & disruption myometrium

- **Dark intraplacental bands** (T2)
  - Low signal on FISP \( \sim 2^\circ \) to fibrin deposition
  - Number /size of bands \( \propto \) degree of AIP

- **Uterine bulging**

- **Extra-uterine invasion**
NE & NC SCN
Referrals to Newcastle for AIP screening/surgery

1 surgery / 16 screened
1 MDT / 10 screened
Abnormally invasive placenta
Purpose of prenatal diagnosis

Avoid False Negative
- Undiagnosed major invasion at CS
  - Risk of major morbidity/mortality from haemorrhage

Avoid False Positive
- Unnecessary caesarean hysterectomy
  - Risk of major surgical morbidity/mortality
NE & NC AIP Service
Screening/diagnosis pathway

All women with Uterine scar
Placenta implanted over scar

Newcastle Fetal Medicine Centre
by 28 w

Introduced in 2015
NE & NC AIP Service
Referrals to Newcastle for AIP diagnosis

Newcastle Fetal Medicine Centre

US Features

- None
- One / two
- ≥ Three

<table>
<thead>
<tr>
<th></th>
<th>Se (%)</th>
<th>Sp (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accreta</td>
<td>25</td>
<td>86.3</td>
<td>12.5</td>
<td>93.6</td>
<td>0.56</td>
</tr>
<tr>
<td>Increta</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>1.0</td>
</tr>
<tr>
<td>Percreta</td>
<td>100</td>
<td>96</td>
<td>71</td>
<td>100</td>
<td>1.0</td>
</tr>
</tbody>
</table>

n=57 (11 AIP) *Whitby (p.c.)*

1.5 T (T1 W (sagittal), T2 W (axial, coronal, sagittal) Balanced GE (axial, sagittal)
NE & NC AIP Service
Referrals to Newcastle for AIP diagnosis

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Degree (in/percreta vs accreta)
GA at delivery
Anaesthetic: regional/general
IR: IIA/CIA/ Aortic
Ureteric stenting
Incision (skin/uterus)
Placental removal
Hysterectomy
Myometrial resection
Cell salvage / blood products

Surgical plan / Consent (by 30 wk)

MDT
FM specialist (2)
(Uro)gynaecologist (3)
Radiologist (IR) (3)
Obstetric Anaesthetist (2)
Midwife (1)

75%
Abnormally Invasive Placenta
Surgical Management – Options

• Resective primary surgery
  - Hysterectomy (total vs subtotal)
  - Uterine conservation (complete vs. partial [3P])
  ? Iliac vs aortic endovascular occlusion
  ? Ureteric stenting

• Placental conservation
  - Await spontaneous expulsion / resorption
  - Secondary hysterectomy
AIP – Surgical Management
‘Conservative’ surgery

One-stop (complete) resection
Palacios Jaraquemada 2004, 2012

1. Disconnection of vesico- & colpo-uterine anastomotic systems
2. T/V hysterotomy
3. Ligation of uterine arteries
4. Resection of invaded tissue and entire placenta in one piece

1º Failure (PPH) → CH
- S1 (n=46) 4%
- S2 (n=22) 72%
UT damage 5%
2º PPH (CH) – 0%
Infection/Sepsis – 3%
DIC/VTE – 3%
Recurrent AIP – 2%
Case series of ‘Conserving’ CS in AIP

<table>
<thead>
<tr>
<th>Author</th>
<th>Design</th>
<th>Comparison with CH</th>
<th>N</th>
<th>Uterine preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courbiere et al. 2003</td>
<td>R</td>
<td></td>
<td>84%</td>
<td>13</td>
</tr>
<tr>
<td>Kayem et al. 2004</td>
<td>R</td>
<td></td>
<td>85%</td>
<td>20</td>
</tr>
<tr>
<td>Timmermans et al. 2007</td>
<td>R</td>
<td></td>
<td>60%</td>
<td>60</td>
</tr>
<tr>
<td>Sentilhes et al. 2010</td>
<td>R</td>
<td></td>
<td>78%</td>
<td>167</td>
</tr>
<tr>
<td>Amsalem et al. 2011</td>
<td>R</td>
<td></td>
<td>60%</td>
<td>10</td>
</tr>
</tbody>
</table>

Difficulties in interpretation
- Prenatal diagnosis (planned vs. emergency)
- Conservation (complete vs. partial)
- Selection

1 Review of 48 (case) reports
2 Review of experience from 25 French centres

1º PPH → CH (15-20%)  
2º PPH → CH (10-20%)  
Infection / sepsis – 30% / 10%  
DIC/VTE – 10%  
Recurrent AIP 30%
**Accreta**
n= 27

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In/per creta at laparotomy</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Placenta removed</td>
<td>25/25 (100%)</td>
</tr>
<tr>
<td>BL &gt; 1.5L</td>
<td>10/25 (40%)</td>
</tr>
<tr>
<td>CCS</td>
<td>8/25 (32%)</td>
</tr>
<tr>
<td>Hysterectomy*</td>
<td>4/24 (16%)</td>
</tr>
</tbody>
</table>

* All 4 emergency procedures, no CCS
**NE & NC AIP Service**

**Referrals to Newcastle for AIP diagnosis**

**Newcastle Fetal Medicine Centre**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In/percreta at laparotomy</td>
<td>37</td>
<td>97%</td>
</tr>
<tr>
<td>Placenta removed*</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Attempted resection (none S2)</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>Hysterectomy*</td>
<td>36</td>
<td>95%</td>
</tr>
<tr>
<td>BL &gt; 1.5L</td>
<td>25</td>
<td>66%</td>
</tr>
</tbody>
</table>

1. Urgent delivery by ‘on-call’ team
2. Uterine conservation in 2, failure → Hyst in 2
Management of AIP
Strategies to minimise the risk of major haemorrhage

- Accurate prenatal diagnosis & surgical planning (MDT)
- Optimisation pre-delivery Hb (aim > 110 g/L) - parenteral Fe
- Elective delivery by experienced surgical team
- Availability blood and blood products on site (MOH protocol)
- 24 h Haematology advice (protocols for rapid access to platelets and clotting factors)
- Interventional radiology (iliac / aortic occlusion)
- Intraoperative cell salvage
- Tranexamic acid
- Haemostatic agents & sealants
- ‘Advanced’ compression or respective surgery
Placenta percreta / accreta

Haematological support

90% women with in-/per-creta will need transfusion
Average blood loss is 3-5 L

- Inform consultant haematologist in advance
  Massive Obstetric Haemorrhage protocol
- IV access - Large bore peripheral lines
  - Arterial line
- Intraoperative cell salvage (leucodepletion filter)
  - Two suction probes
- Monitor loss and haemostatic competence
  POC - HemoCue
  - Thromboelastography (TEG) / Thromboelastometry (ROTEM)
  Lab - Fibrinogen (aim > 1 g/L)
  - PT (aim < 1.5 x normal)
  - Platelets (aim > 50 x 10⁹/L)
  - Lactate
Management of AIP
Intraoperative cell salvage

Advantages

- No risk allogenic transfusion reactions or blood borne infections
- Avoid immune-modulating effects allogenic transfusion (nocosomial infection)
- Immediate availability blood
- Accepted by some Jehovah’s Witnesses
- More physiological than stored blood

<table>
<thead>
<tr>
<th>ICS Collected Blood</th>
<th>Packed Red Blood Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Room temperature</td>
</tr>
<tr>
<td></td>
<td>1-10°C</td>
</tr>
<tr>
<td>Levels of 2,3-DPG</td>
<td>Physiological</td>
</tr>
<tr>
<td></td>
<td>Decreased by up to 90%</td>
</tr>
<tr>
<td>Potassium</td>
<td>Physiological or slightly decreased</td>
</tr>
<tr>
<td></td>
<td>Increased</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>50-80%</td>
</tr>
<tr>
<td>Removed Components</td>
<td>Plasma, platelets, activated clotting factors</td>
</tr>
<tr>
<td>Additive</td>
<td>None*</td>
</tr>
<tr>
<td></td>
<td>Citrate</td>
</tr>
</tbody>
</table>

Disadvantages

- Capital costs
- Set-up time
- Insufficient volume salvaged blood
- FMH (with alloimmunisation)
- Hypotension
- Bacterial contamination

Key challenge in AIP:
Rate of haemorrhage vs Rate salvage/allogenic transfusion

Close liaison with the hospital transfusion laboratory is essential for women presenting with placenta praevia or a low-lying placenta. [New 2018]

Rapid infusion and fluid warming devices should be immediately available. [New 2018]

Cell salvage is recommended for women where the anticipated blood loss is great enough to induce anaemia, in particular, in women who would decline blood products.
Management of AIP
Cell salvage during CS where ‘at risk’ of PPH (SALVO trial)

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Number (%)</th>
<th>Crude analysis</th>
<th>Intervention odds ratio (95% CI)</th>
<th>p-Value</th>
<th>Adjusted analysis¹</th>
<th>Intervention odds ratio (95% CI)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n = 1,492)</td>
<td>Cell salvage (n = 1,498)</td>
<td>Risk difference percent (95% CI)</td>
<td>p-Value</td>
<td>Risk difference percent (95% CI)</td>
<td>Intervention odds ratio (95% CI)</td>
<td>p-Value</td>
</tr>
<tr>
<td>Primary analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received donor blood transfusion</td>
<td>52 (3.5%)</td>
<td>37 (2.5%)</td>
<td>-1.02 (-2.23, 0.20)</td>
<td>0.10</td>
<td>-1.03 (-2.13, 0.06)</td>
<td>0.65 (0.42, 1.01)</td>
<td>0.056</td>
</tr>
<tr>
<td>Sub-group analysis by indication for cesarean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency cesarean (n = 1,641)</td>
<td>37 (4.6%)</td>
<td>25 (3.0%)</td>
<td></td>
<td>0.58</td>
<td>(0.34, 0.99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective cesarean (n = 1,349)</td>
<td>15 (2.2%)</td>
<td>12 (1.8%)</td>
<td></td>
<td>0.83</td>
<td>(0.38, 1.83)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-group analysis by placenta®</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal placenta (n = 2,720)</td>
<td>40 (2.9%)</td>
<td>24 (1.8%)</td>
<td></td>
<td>0.56</td>
<td>(0.34, 0.94)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal placenta (n = 270)</td>
<td>12 (8.9%)</td>
<td>13 (9.6%)</td>
<td></td>
<td>0.98</td>
<td>(0.42, 2.32)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sensitivity analysis: assuming return salvaged blood in control group in emergency situation avoided transfusions – aOR 0.56 (0.36, 0.86)
Secondary outcomes: No differences in maternal outcomes (e.g. stay, Hb, fatigue)
FMH increased in salvage group: 10.5% vs 25.6% (aOR 5.53 [1.43, 22.1])

*Khan et al. BMJ 2018*
# Management of AIP

## Intraoperative cell salvage

**Retrospective analysis pre & post routine IOCS in AIP**

<table>
<thead>
<tr>
<th></th>
<th>Controls (n=115)</th>
<th>IOCS (n=108)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EBL (ml)</strong></td>
<td>1600 (200, 6500)</td>
<td>1575 (300, 5500)</td>
<td></td>
</tr>
<tr>
<td><strong>Allogenic RBC Tx (ABT)</strong></td>
<td>66 (57%)</td>
<td>21 (19%)</td>
<td>0.17 (0.10-0.33)</td>
</tr>
<tr>
<td><strong>FFP</strong></td>
<td>33 (29%)</td>
<td>8 (7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Volume colloids</strong></td>
<td>500 (0,1500)</td>
<td>9 (0, 1500)</td>
<td></td>
</tr>
</tbody>
</table>

**Relationship between EBL and blood volume recovered**

Zeng et al. 2018

**Control**: BL >2L nearly all required ABT

**IOCS**: ABT avoided in 80% (BL 2.1-3L)

29% (BL 3.1-4L & > 4L)
Placenta percreta / accreta

Haematological support

90% women with in-/per-creta will need transfusion
Average blood loss is 3-5 L

• Blood products
  - Packed RBC (4u available)
  - Fresh frozen plasma
  - Platelets
  - Cryoprecipitate

Move to military trauma transfusion protocols
5:2:2:1 / 4.5:2:1:1 / 4.5:1:1

• Tranexamic Acid (1g IV) - 2nd dose after 30 min if haemorrhage continues or recurs within 24h

• [rFVIIa - risk of arterial thrombosis]

Fibrinogen content

<table>
<thead>
<tr>
<th></th>
<th>Fibrinogen content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 u FFP</td>
<td>400 mg/250 mL</td>
</tr>
<tr>
<td>1 10 u cryoppt</td>
<td>2500 mg/150 mL</td>
</tr>
<tr>
<td>1 PRBC</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>1 6 pack platelets</td>
<td>480 mg</td>
</tr>
</tbody>
</table>
Endovascular occlusion in AIP
Internal iliac arteries

- Widely practiced
- Complications 6-16% (Dilauro et al. 2012)
  Haematoma, aneurysms, dissection, TE (2-3%)
- One RCT (n=27) - no effect on blood loss or RBC transfusion (Salim et al. 2015)
- Meta-analysis of effect ‘IR’ (D’Ontonio et al 2018)
  - Heterogeneity of technique (embolization) & effect
  - Reduced blood loss but no effect on transfusion & major morbidity
- ‘Failure’ rates’ high (35-58%)
  - (Clark 1985, Chattopahyay et al. 1990)
- Limited haemodynamic effects
  - Pulse pressure ↓ 85% (Burchall 1964)
  - Uterine artery Doppler PI - no change (Chitrit et al. 2000)
## Management of AIP

**Role of interventional radiology: SR and meta-analysis**

D’Antonio et al. 2018

<table>
<thead>
<tr>
<th>15 studies (995 women)</th>
<th>N. Studies (sample)</th>
<th>Mean difference (95% CI) or Rates (Pooled OR [95% CI])</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only 1 study at low risk of bias</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### All women

- **Blood loss (L)**
  - N. Studies: 13 (821)
  - Mean difference: -1.01 (-1.59, -0.43)
  - p <0.001

- **PRBC transfused (u)**
  - N. Studies: 9 (254)
  - Mean difference: -2.20 (-5.52, 1.13)
  - p 0.2

- **FFP transfused (u)**
  - N. Studies: 3 (106)
  - Mean difference: -2.59 (-7.09, 1.92)
  - p 0.3

<table>
<thead>
<tr>
<th>BL ≥ 2.5L</th>
<th>N. Studies (sample)</th>
<th>Rates (Pooled OR [95% CI])</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (126)</td>
<td>29% vs 65% (OR 0.18 (0.04-0.78))</td>
<td></td>
</tr>
<tr>
<td>PRBC transfused ≥ 5u</td>
<td>5 (112)</td>
<td>33% vs 52% (OR 0.45 (0.17-1.24))</td>
</tr>
</tbody>
</table>

### PND AIP undergoing hysterectomy

- **Blood loss (L)**
  - N. Studies: 6 (258)
  - Mean difference: -0.68 (-1.24, -0.12)
  - p 0.02

- **PRBC transfused (u)**
  - N. Studies: 5 (160)
  - Mean difference: -2.92 (-9.34, 3.50)
  - p 0.4

- **FFP transfused (u)**
  - N. Studies: 3 (205)
  - Mean difference: -1.66 (-2.71, -0.61)
  - p 0.02

<table>
<thead>
<tr>
<th>BL ≥ 2.5L</th>
<th>N. Studies (sample)</th>
<th>Rates (Pooled OR [95% CI])</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (155)</td>
<td>23% vs 63% (OR 0.10 (0.02-0.47))</td>
<td></td>
</tr>
<tr>
<td>PRBC transfused ≥ 5u</td>
<td>4 (150)</td>
<td>32% vs 54% (OR 0.57 (0.07-4.67))</td>
</tr>
</tbody>
</table>

No differences in: PLT or Cryoppt transfused, operative time, length of stay
Surgical complications, bladder-ureteral injuries, re-laparotomy, infection, DIC

D’Antonio et al. 2018
Management of AIP
Multidisciplinary specialised team (MST)

- Retrospective series suggest MST approach reduces maternal morbidity *(Walker et al. 2012, Shamshirsaz et al. 2014)*
- ‘Benefits’ mainly related to:
  - blood loss (BL), transfusion vs. organ damage/uterine conservation
  - prenatally diagnosed cases with major invasion
  - Management of placenta at laparotomy
- Morbidity higher in planned vs. urgent deliveries *(Shamshirsaz et al. 2018)*
- BL /transfusion requirements improve with experience *(Shamshirsaz et al. 2017)*

In UK care for women with AIP (diagnosis & management) to be a specialised (nationally) commissioned service in small number of regional centres *(NHSE 2018)*
Abnormally invasive placenta

Conclusions

- Care pathways need to focus on minimising morbidity by (a) accurate prenatal diagnosis and (b) appropriately conducted surgical delivery by an experienced (multidisciplinary) team. *All obstetricians need to know how to manage unexpected AIP*

- Conservative (resective) surgery feasible in a minority of carefully selected cases but with definitive diagnosis of in/percreta primary CH remains current treatment of choice

- Strong case for all suspected cases to be managed by a *regional specialised team*