

# Queensland Clinical Guidelines

*Translating evidence into best clinical practice*

## Maternity and Neonatal **Clinical Guideline**

### Trauma in pregnancy

|                      |  |
|----------------------|--|
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### Cultural acknowledgement

We acknowledge the Traditional Custodians of the land on which we work and pay our respect to the Aboriginal and Torres Strait Islander elders past, present and emerging.

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**Flow Chart: Initial assessment and management of the pregnant trauma patient**

**Principles of care for the pregnant trauma patient**

- Follow ATLS guidelines
- First priority is to treat the woman
- Multidisciplinary team that includes an obstetrician is essential
  - Contact neonatal team early if viable gestation and birth imminent/likely
- Recognise anatomical and physiological changes of pregnancy
- Clear, coordinated and frequent communication essential
- Generally, medications, treatment and procedures as for non-pregnant patient
- Refer pregnant women with major trauma to a trauma centre
  - < 23 weeks gestation: to the nearest trauma centre
  - ≥ 23 weeks gestation: to a trauma centre with obstetric services
- Thoroughly assess all pregnant women – even after minor trauma

**Initial stabilisation**

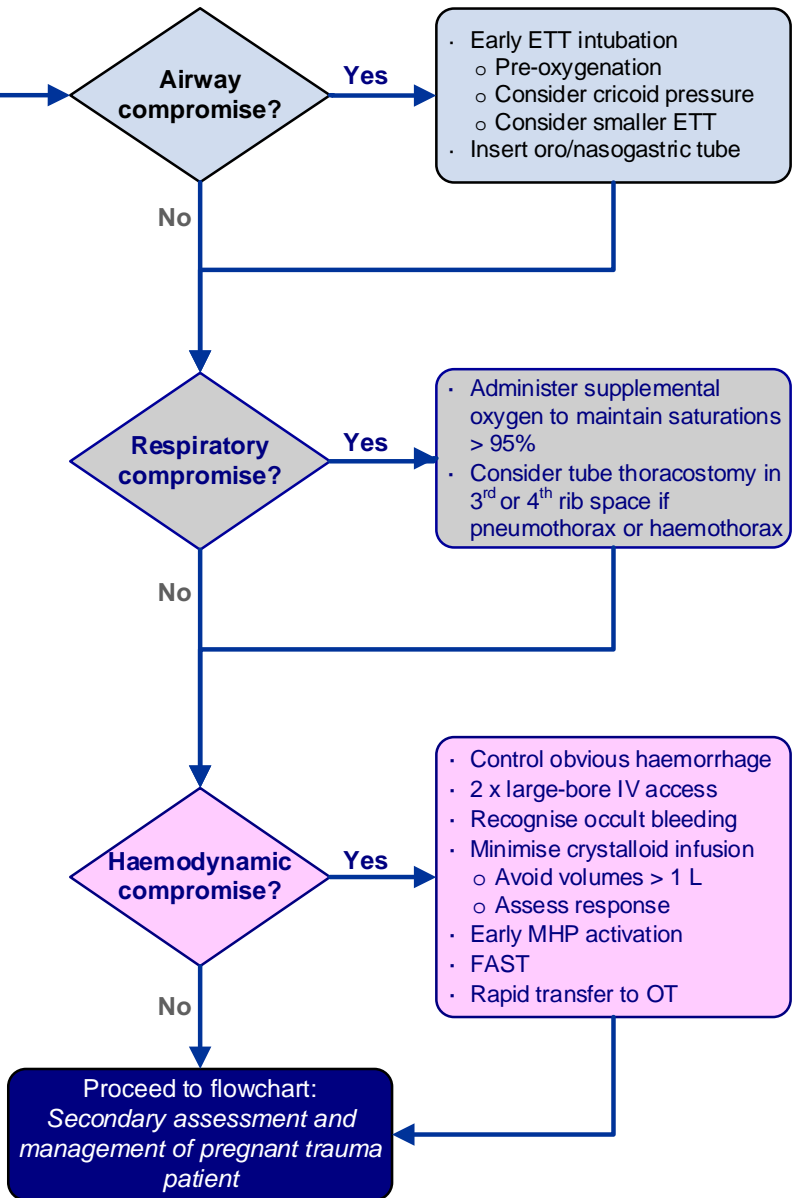
- As indicated for all trauma patients
- Follow ATLS guidelines
- Initiate early obstetric consultation
- Contact RSQ (1300 799 127) to expedite transport & identify receiving facility as required

**Additionally for pregnancy**

- Position (tilt or wedge):
  - Left lateral 15–30° (right side up) or
  - Manual displacement of uterus
  - Place wedge under spinal board if necessary
- Routinely administer oxygen therapy
- Large-bore IV access

**Cardiac arrest**

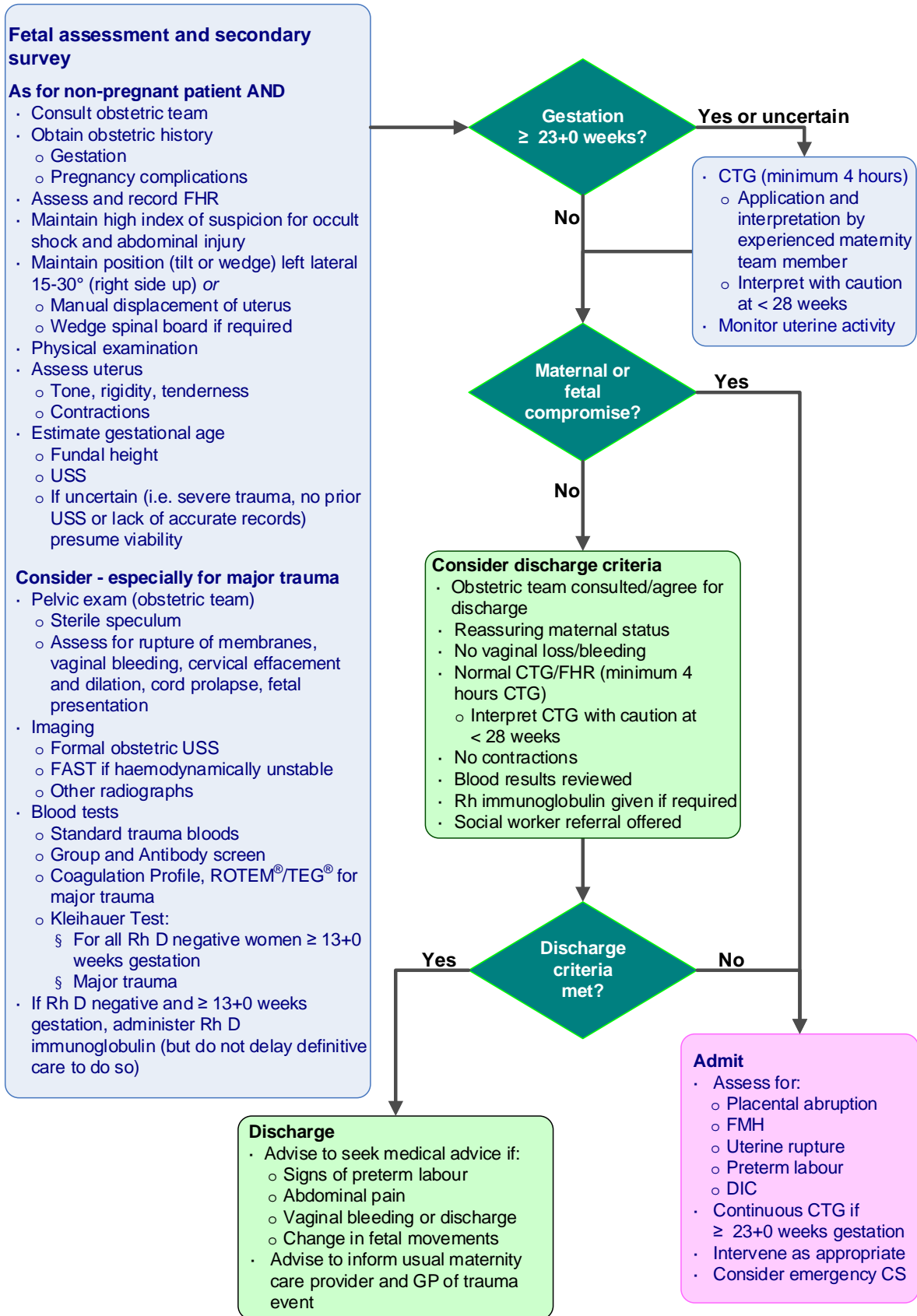
- Manually displace uterus
- If ≥ 20 weeks gestation, commence Resuscitative Hysterotomy (Perimortem CS) as soon as possible
- Follow ATLS guidelines
- Defibrillate as for non-pregnant patient
- Advanced cardiac life support drugs as indicated for non-pregnant patients



**ATLS:** Advanced Trauma Life Support, **CPR:** Cardiopulmonary Resuscitation, **CS:** Caesarean section, **ETT:** Endotracheal tube, **FAST:** Focused Abdominal Sonography for Trauma, **IV:** Intravenous, **MHP:** Massive Haemorrhage Protocol, **OT:** Operating Theatre, **RSQ:** Retrieval Services Queensland, **>:** greater than, **≥:** greater than or equal to

Flow chart: F19.31-1-V2-R24

**Flowchart: Secondary assessment and management of pregnant trauma patient**



**CS:** Caesarean section, **CTG:** Cardiotocograph, **DIC:** Disseminated intravascular coagulation, **FAST:** Focused Abdominal Sonography for Trauma, **FHR:** Fetal heart rate, **FMH:** Feto-maternal haemorrhage, **GP:** General Practitioner, **ROTEM®/TEG®:** Point of care blood clotting analysers, **USS:** Ultrasound scan, **<:** less than, **>:** greater than, **≥:** greater than or equal to

**Abbreviations**

|        |   |
|--------|---|
| ATC    | Acute traumatic coagulopathy                              |
| BP     | Blood pressure  |
| bpm    | Beats per minute  |
| CPR    | Cardiopulmonary resuscitation                             |
| CS     | Caesarean section   |
| CT     | Computerised tomography                                   |
| CTG    | Cardiotocograph   |
| DFV    | Domestic and family violence                              |
| DIC    | Disseminated intravascular coagulation                    |
| FAST   | Focused abdominal sonography for trauma                   |
| FFP    | Fresh frozen plasma                                       |
| FHR    | Fetal heart rate  |
| FMH    | Feto-maternal haemorrhage                                 |
| ISS    | Injury severity score                                     |
| IV     | Intravenous   |
| IVC    | Inferior vena cava  |
| MHP    | Massive Haemorrhage Protocol                              |
| mSv    | millisievert  |
| MVC    | Motor vehicle collision                                   |
| RBWH   | Royal Brisbane and Women's Hospital, Brisbane, Queensland |
| RH     | Resuscitative hysterotomy                                 |
| RSQ    | Retrieval services Queensland                             |
| PHR    | Pregnancy health record                                   |
| PSPABC | Professor Stuart Pegg Adult Burns Centre                  |
| TBSAB  | Total body surface area of burns                          |
| USS    | Ultrasound scan   |
| VE     | Vaginal examination                                       |

**Definition of terms**

|                        |  |
|------------------------|--|
| <b>Cardiotocograph</b> | A recording of the fetal heart beat and uterine activity during pregnancy.   |
| <b>Trauma</b>          | An acute physical harm, injury or hurt inflicted on the body by an external force.   |
| <b>Major trauma</b>    | Classification of trauma depends on the mechanism and severity of injury. Refer to Appendix A: Prehospital criteria for major trauma and Appendix B: Injury Severity Score.  |
| <b>Obstetrician</b>    | Local facilities may, as required, differentiate the roles and responsibilities assigned in this document to an 'Obstetrician' according to their specific practitioner group requirements. For example; Gynaecologists, General Practitioner Obstetricians, Specialist Obstetricians, Consultants, Senior Registrars and Obstetric Fellows. |
| <b>Sievert</b>         | International unit of measurement for the biological effect to human tissue by ionizing radiation.   |

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# 1 Introduction

Physical trauma affects up to 8% of all pregnancies and is the leading cause of non-obstetric death during pregnancy.<sup>1,2</sup> The predominant causes of trauma in pregnancy are motor vehicle collision (MVC) and domestic or family violence (DFV).<sup>3</sup>

Compared with non-pregnant women of reproductive age, pregnant women are nearly twice as likely to die after trauma, and twice as likely to experience DFV.<sup>4</sup> Management of pregnant trauma patients requires consideration of several issues specific to pregnancy. These include alterations to physiology and anatomy during pregnancy, exposure to radiation and possible teratogens, the need to assess fetal well-being, and monitoring for potential obstetric complications that may occur secondary to trauma.<sup>5</sup> Evidence for care provision is limited with the majority of studies being retrospective and reported outcomes varying widely.<sup>3</sup>

## 1.1 Clinical standards

Table 1. Clinical standards

| Aspect                            | Consideration  |
|-----------------------------------|--|
| <b>Standard care</b>              | <ul style="list-style-type: none"> <li>Refer to Queensland Clinical Guideline: <i>Standard care</i> for clinical standards such as documentation, communication for safety, consent and woman-centred care<sup>6</sup></li> </ul>  |
| <b>Pregnancy testing</b>          | <ul style="list-style-type: none"> <li>Consider every woman of reproductive age with significant injuries pregnant until proven otherwise<sup>5</sup> <ul style="list-style-type: none"> <li>History alone is unreliable in excluding pregnancy</li> <li>Perform a pregnancy test on all women of child bearing age who experience trauma<sup>7-9</sup></li> </ul> </li> <li>Where pregnancy is confirmed after a trauma event, provide information and counselling on the implications of the care provided (e.g. diagnostic imaging)</li> </ul>  |
| <b>Collaboration</b>              | <ul style="list-style-type: none"> <li>Trauma specialist and team to lead and coordinate clinical assessment and stabilisation</li> <li>A multidisciplinary team approach that includes early involvement of obstetric and midwifery staff is essential<sup>2,10</sup></li> <li>Involve neonatal team early if birth imminent/likely<sup>11</sup> <ul style="list-style-type: none"> <li>Refer to Queensland Clinical Guideline: <i>Neonatal resuscitation</i><sup>12</sup></li> </ul> </li> <li>Clear, timely, coordinated and frequent communication between care providers is essential<sup>11</sup></li> </ul> |
| <b>Transfusion</b>                | <ul style="list-style-type: none"> <li>If transfusion required and birth is not imminent, use cytomegalovirus (CMV) negative products</li> <li>Indicate pregnancy on request forms to blood bank</li> <li>Infuse all women of child bearing age with K negative units where available</li> <li>For women who decline blood products (e.g. Jehovah Witness), manage as per local HHS policy</li> </ul>  |
| <b>Training and staff support</b> | <ul style="list-style-type: none"> <li>Educate clinicians about adaptations to cardiopulmonary resuscitation (CPR) for the pregnant woman<sup>13,14</sup></li> <li>Include information about CPR in the pregnant woman in all generic life support training<sup>13,14</sup></li> <li>Offer debriefing to clinicians involved in pregnant trauma care events<sup>13</sup></li> </ul>  |
| <b>Equipment</b>                  | <ul style="list-style-type: none"> <li>Ensure the following is always available where trauma is managed: <ul style="list-style-type: none"> <li>Equipment to manage a difficult airway</li> <li>Equipment to perform resuscitative hysterotomy (RH)<sup>13,15</sup> <ul style="list-style-type: none"> <li>§ Also known as perimortem caesarean section</li> </ul> </li> <li>Equipment for neonatal resuscitation<sup>11</sup></li> </ul> </li> </ul>  |



## 1.2 General principles

Table 2. General principles

| Aspect                          | Consideration   |
|---------------------------------|---|
| <b>Aim/Goal</b>                 | <ul style="list-style-type: none"> <li>The goal of treatment is maintenance of utero-placental perfusion and fetal oxygenation by avoiding hypoxia and preventing hypotension, acidosis and hypothermia</li> </ul>  |
| <b>General</b>                  | <ul style="list-style-type: none"> <li>Manage pregnant trauma patients in accordance with the Advanced Trauma Life Support (ATLS) guidelines<sup>16</sup></li> <li>The first priority is identification of life threatening injuries to the woman<sup>2,5,8,10</sup></li> <li>Thoroughly assess the woman as fetal survival is directly related to maternal wellbeing<sup>2,3</sup></li> <li>Beyond mid-pregnancy, move the gravid uterus off the inferior vena cava (IVC) to increase venous return and cardiac output in acutely injured woman<sup>5</sup> <ul style="list-style-type: none"> <li>Achieve by positioning woman in left lateral tilt, or by manually displacing the uterus<sup>5</sup></li> </ul> </li> <li>Offer debriefing to the woman and/or family following pregnant trauma care events<sup>13</sup></li> <li>Consider the need for short and long-term psychological support and/or referral following trauma events</li> </ul>   |
| <b>Pregnancy considerations</b> | <ul style="list-style-type: none"> <li>Recognise maternal anatomical and physiological changes due to pregnancy<sup>2,17</sup></li> <li>Generally, do not withhold medications, tests, treatments and procedures required for the woman's stabilisation because of pregnancy<sup>3</sup></li> <li>Provide pregnant women with minor injuries, medical treatment for their injuries and appropriate fetal assessment<sup>18</sup></li> <li>Give tetanus vaccination or immunoglobulin when indicated<sup>5,19</sup> <ul style="list-style-type: none"> <li>Considered safe in pregnancy</li> </ul> </li> </ul>   |
| <b>Positioning</b>              | <ul style="list-style-type: none"> <li>Position the woman to minimise aortocaval compression <ul style="list-style-type: none"> <li>Consider gestation and the ability to provide effective care (e.g. intubation) when determining positioning requirements</li> <li>Left lateral tilt 15–30 degrees<sup>3,8,20</sup> (right side up)</li> <li>Place a firm wedge under the right buttock/hip to achieve tilt</li> <li>In cases of major trauma, place the wedge under the spinal board<sup>13</sup></li> </ul> </li> <li>If lateral tilt is not feasible, use manual uterine displacement to minimise IVC compression<sup>7,13,21,22</sup> <ul style="list-style-type: none"> <li>Can be performed from left or right side of woman: <ul style="list-style-type: none"> <li>Standing on the woman's left, the uterus (abdomen) is cupped with two hands and pulled towards themselves<sup>23</sup></li> <li>Standing on the woman's right, the uterus is pushed towards the woman's left using one hand<sup>23</sup></li> </ul> </li> </ul> </li> <li>Refer to Appendix G: Positioning to relieve aortocaval compression</li> </ul> |
| <b>Common pitfalls</b>          | <ul style="list-style-type: none"> <li>Common pitfalls include failure to: <ul style="list-style-type: none"> <li>Detect early pregnancy</li> <li>Suspect or recognise shock in the presence of normal vital signs</li> <li>Detect abdominal injury because of a benign examination</li> <li>Suspect and screen for DFV</li> <li>Recognise and treat supine hypotensive syndrome</li> <li>Conduct necessary radiology studies due to fear of injury to the fetus</li> <li>Distinguish between eclampsia and head injury<sup>16</sup></li> <li>Observe and monitor with cardiotocograph (CTG) all women with minor trauma and a viable fetus (greater or equal to 23 weeks gestation)</li> <li>Test for Rh D status and administer Rh D immunoglobulin in Rh D negative women</li> </ul> </li> <li>Initiate RH (perimortem caesarean section) as quickly as possible</li> </ul>  |

### 1.3 Transfer, retrieval and place of management

Table 3. Transfer, retrieval and place of management

| Aspect                        | Consideration  |
|-------------------------------|--|
| <b>Place of management</b>    | <ul style="list-style-type: none"> <li>• Refer all major trauma cases to a trauma centre [refer to Appendix A: Prehospital criteria for major trauma]</li> <li>• Generally:               <ul style="list-style-type: none"> <li>○ If less than 23 weeks gestation, transfer to the nearest trauma centre<sup>5</sup></li> <li>○ If greater than or equal to 23 weeks gestation, transfer to a trauma centre with obstetric services<sup>5</sup></li> </ul> </li> <li>• In Queensland, Trauma Centres with obstetric services are located at:               <ul style="list-style-type: none"> <li>○ The Townsville Hospital</li> <li>○ Royal Brisbane and Women's Hospital (RBWH)</li> <li>○ Gold Coast University Hospital</li> </ul> </li> <li>• Where feasible, major trauma surgery should occur in Level 4 or higher operating suite<sup>24</sup></li> </ul> |
| <b>Retrieval and Transfer</b> | <ul style="list-style-type: none"> <li>• Arrange transfer/retrieval as per usual local protocols for major trauma</li> <li>• If outside the Brisbane greater metropolitan area, arrange inter-hospital transfer via Retrieval Services Queensland (RSQ)</li> <li>• Early notification of trauma to RSQ               <ul style="list-style-type: none"> <li>○ Telephone RSQ: 1300 799 127</li> </ul> </li> <li>• Within the greater metropolitan area of Brisbane, transfer via Queensland Ambulance Service (QAS) to the RBWH</li> <li>• Liaise with the RBWH Emergency Consultant – telephone (07) 3646 5900</li> </ul>  |

### 1.4 Gestational considerations

Table 4. Gestational considerations

| Category                                       | Considerations   |
|--|--|
| <b>Estimating gestational age</b>              | <ul style="list-style-type: none"> <li>• Management decisions may require estimation of gestational age<sup>23</sup> <ul style="list-style-type: none"> <li>○ Woman may be unconscious or unaware of pregnancy</li> </ul> </li> <li>• In singleton pregnancies, the symphysis fundal height (measurement from maternal pubic bone to top of uterine fundus) in centimetres approximately corresponds to gestational age in weeks when measured between 16 and 36 weeks gestation<sup>23</sup> <ul style="list-style-type: none"> <li>○ If tape measure is unavailable, finger breadths may be used as a replacement for centimetres</li> </ul> </li> <li>• Rule of thumb landmarks may also be used to estimate gestational age<sup>23</sup>:               <ul style="list-style-type: none"> <li>○ 12 weeks: uterus palpable at above the symphysis pubis</li> <li>○ 20 weeks: uterus palpable at the level of the umbilicus</li> <li>○ 36 weeks: uterus palpable at the level of the xiphisternum</li> </ul> </li> <li>• Estimation may be skewed by other factors including abdominal distention, fetal growth restriction and increased body mass index<sup>23</sup></li> </ul> |
| <b>Pre-viable gestation (&lt; 23 +0 weeks)</b> | <ul style="list-style-type: none"> <li>• Dates and estimations of gestational age may be inaccurate or unreliable</li> <li>• Where there is doubt about the gestation, presume viability</li> <li>• CTG monitoring not indicated</li> <li>• Document presence/absence of fetal heart rate (FHR)</li> </ul>   |
| <b>Viable gestation</b>                        | <ul style="list-style-type: none"> <li>• Gestations greater than or equal to 23+0 weeks are potentially viable<sup>25</sup> <ul style="list-style-type: none"> <li>○ Refer to Queensland Clinical Guideline: <i>Perinatal care at the threshold of viability</i><sup>25</sup></li> <li>○ Seek specialist advice and use clinical judgement, especially in regional and remote locations</li> </ul> </li> <li>• Commence CTG monitoring as soon as feasible<sup>26</sup> <ul style="list-style-type: none"> <li>○ CTG will assess both maternal perfusion and fetal well-being</li> </ul> </li> </ul>   |

## 2 Physiological changes in pregnancy

An understanding of the anatomic and physiologic alterations of pregnancy is essential.<sup>27</sup> Refer to Appendix C for normal pregnancy values.

Table 5. Physiological and physical changes in pregnancy

|                               | Changes in pregnancy  | Implication  |
|-------------------------------|---|--|
| <b>Cardiovascular system</b>  |   |  |
| Plasma volume                 | Increased by up to 50%  | Dilutional anaemia<br>Reduced oxygen-carrying capacity<br>Signs of shock due to blood loss appear late |
| Heart rate                    | Increased 15–20 beats per minute (bpm)  | Increased CPR demands  |
| Cardiac output                | Increased by 30 to 50% <sup>23</sup><br>Significantly reduced by pressure of gravid uterus on IVC | Increased CPR demands  |
| Uterine blood flow            | 10% of cardiac output at term   | Potential for rapid massive haemorrhage  |
| Systemic vascular resistance  | Decreased <sup>23</sup>   | Sequesters blood during CPR  |
| Arterial blood pressure (BP)  | Decreased by 10–15 mmHg   | Decreased reserve  |
| Venous return                 | Decreased by pressure of gravid uterus on IVC <sup>23</sup>                                       | Increased CPR circulation demands<br>Increased reserve   |
| Coagulation                   | Increased concentrations of most clotting factors   | Activated state of coagulation cascade<br>Increased tendency for thrombosis                            |
| <b>Respiratory system</b>     |   |  |
| Respiratory rate              | Increased   | Decreased buffering capacity, acidosis more likely   |
| Oxygen consumption            | Increased by 20 to 33% <sup>23</sup>  | Hypoxia develops more quickly  |
| Functional residual capacity  | Decreased by 25% <sup>23</sup>  | Decreased buffering capacity, acidosis more likely   |
| Arterial pCO <sub>2</sub>     | Decreased   | Decreased buffering capacity, acidosis more likely   |
| Laryngeal oedema              | Increased <sup>11</sup>   | Difficult intubation   |
| Mucosal congestion            | Increased   | Predisposition to airway bleeding  |
| Airway size                   | Decreased <sup>11</sup>   | Difficult intubation   |
| Upper airway blood supply     | Increased <sup>11</sup>   | Friable mucosa of airway may result in impaired airway visualisation and increased bleeding            |
| <b>Other changes</b>          |   |  |
| Gastric motility              | Decreased   | Increased risk of aspiration   |
| Gastro-oesophageal sphincters | Relaxed <sup>23</sup>   | Increased risk of aspiration   |
| Weight                        | Increased neck and mammary fat levels   | Difficult airway management  |
| Pelvic vasculature            | Hypertrophied   | Potential for massive retroperitoneal haemorrhage with pelvic fracture, uterine trauma <sup>2</sup>    |
| Bowel                         | Superior displacement   | Potential for complex and multiple intestinal injuries with penetrating trauma of the upper abdomen    |
| Bladder                       | Anterior and superior displacement by uterus  | Susceptible to injury as effectively an intra-abdominal organ  |
| Renal blood flow              | Increased by 40% <sup>23</sup> . Serum urea, nitrogen, creatinine reduced                         | 'Normal' serum urea nitrogen and creatinine may reflect seriously compromised function                 |

## 2.1 Uterine and placental considerations

Table 6. Implications for uterus and placenta in trauma

| Aspect                                      | Consideration  |
|---|--|
| <b>Uterine changes throughout pregnancy</b> | <ul style="list-style-type: none"> <li>• First trimester (0 to 12+6 weeks)               <ul style="list-style-type: none"> <li>○ Uterus thick walled and small in size</li> <li>○ Uterus confined within and protected by bony pelvis<sup>7</sup></li> </ul> </li> <li>• Second trimester (13+0 to 27+6 weeks)               <ul style="list-style-type: none"> <li>○ Uterus enlarges beyond pelvis</li> <li>○ Fetus is small, mobile and protected by generous amniotic fluid</li> </ul> </li> <li>• Third trimester (28+0 weeks and onwards)               <ul style="list-style-type: none"> <li>○ Uterus thin walled and large in size</li> <li>○ In vertex position, fetal head is usually within pelvis with remainder of fetus exposed above pelvic brim</li> <li>○ Pelvic fracture in third trimester may cause skull fracture or intracranial injury to fetus</li> </ul> </li> </ul>   |
| <b>Implications of enlarged uterus</b>      | <ul style="list-style-type: none"> <li>• Lacks autoregulation and is very sensitive to changes in maternal BP</li> <li>• Maternal hypovolaemia or hypotension cause reduced uterine blood flow and uterine vasoconstriction</li> <li>• Uterine contractions also reduce blood flow, shifting 300 to 500 mL of blood into systemic vessels during contractions<sup>20</sup></li> <li>• Diaphragmatic splinting reduces residual capacity and makes ventilation more difficult</li> <li>• Aortal compression causes supine hypotension, reduced venous return and significantly impairs efficacy of resuscitation</li> <li>• Heart rotation to the left—left axis deviation on electrocardiogram (ECG) can be normal in third trimester</li> <li>• Woman's entire blood volume passes through uterus every 10 minutes<sup>7</sup> <ul style="list-style-type: none"> <li>○ Potential for massive blood loss from traumatised uterus<sup>2,7</sup></li> </ul> </li> </ul> |
| <b>Placenta</b>                             | <ul style="list-style-type: none"> <li>• Little elasticity and is vulnerable to shear force at interface between uterus and placenta which can lead to placental abruption<sup>7</sup> <ul style="list-style-type: none"> <li>○ Refer to 7.2 Placental abruption</li> </ul> </li> <li>• Placenta and fetus extremely sensitive to catecholamine stimulation</li> </ul>   |

### 3 Assessment

Conduct the primary and secondary survey as for non-pregnant patients.<sup>17</sup> Additional considerations for pregnancy are outlined below.

#### 3.1 Primary survey

As for non-pregnant patients, the priority for pregnant women following trauma remains airway, breathing and circulation.<sup>28</sup>

Table 7. Primary survey considerations for pregnancy

| Aspect                                     | Consideration  |
|--|--|
| <b>Airway and C-Spine</b>                  | <ul style="list-style-type: none"> <li>• Increased risk of airway management difficulties due to<sup>5</sup>:               <ul style="list-style-type: none"> <li>○ Weight gain</li> <li>○ Respiratory tract mucosal oedema<sup>11</sup></li> <li>○ Hyperaemia and hypersecretion of upper airway<sup>11</sup></li> <li>○ Decreased functional residual capacity</li> <li>○ Reduced respiratory system compliance</li> <li>○ Increased airway resistance</li> <li>○ Increased oxygen requirements</li> </ul> </li> <li>• Consider airway to be difficult and have most experienced provider secure and maintain airway<sup>11</sup></li> <li>• Increased risk of failed or difficult intubation<sup>5</sup>—consider:               <ul style="list-style-type: none"> <li>○ Early intubation<sup>5,13,20,27,28</sup></li> <li>○ Use of a short handle laryngoscope</li> <li>○ Smaller endotracheal tube (ETT)<sup>5,8,29</sup></li> <li>○ Use of laryngeal mask airway if unable to intubate</li> </ul> </li> <li>• Increased risk of aspiration due to delayed gastric emptying in pregnancy<sup>5</sup> <ul style="list-style-type: none"> <li>○ Ensure early gastric decompression with nasogastric or orogastric tube<sup>16</sup></li> </ul> </li> <li>• Apply cervical spine collar</li> </ul> |
| <b>Breathing and ventilation</b>           | <ul style="list-style-type: none"> <li>• Increased risk of rapid desaturation<sup>11</sup> <ul style="list-style-type: none"> <li>○ Provide oxygen supplementation to maintain maternal oxygen saturation greater than 95% to ensure adequate fetal oxygenation<sup>8</sup></li> </ul> </li> <li>• If safe to do so, raise the head of the bed to reduce weight of uterus on the diaphragm and facilitate breathing<sup>28</sup></li> <li>• If a chest tube is indicated, insert 1–2 intercostal spaces higher than usual to avoid potential abdominal injury due to raised diaphragm<sup>3,7,8,20,28</sup></li> <li>• Increased risk of aspiration<sup>11</sup></li> </ul>  |
| <b>Circulation and haemorrhage control</b> | <ul style="list-style-type: none"> <li>• Control obvious external haemorrhage</li> <li>• Position with left lateral tilt 15–30 degrees<sup>20</sup> (right side up) or perform manual left uterine (abdominal) displacement [refer to Appendix G: Positioning to relieve aortocaval compression]</li> <li>• If seriously injured, insert two large bore intravenous (IV) lines<sup>5</sup></li> <li>• Avoid femoral lines due to compression by gravid uterus</li> <li>• If unable to achieve IV access, consider intraosseous lines</li> <li>• Assess response—maintain an awareness of pregnancy related physiological parameters</li> <li>• Aim to avoid large volumes of crystalloids (greater than 1 L) which may lead to pulmonary oedema due to the relatively low oncotic pressure in pregnancy<sup>30</sup></li> <li>• Perform a thorough search for occult bleeding as maternal blood flow is maintained at expense of fetus<sup>7</sup></li> <li>• If haemodynamically unstable, Focused Abdominal Sonography for Trauma (FAST) is useful to identify presence of free fluid in intra-abdominal and intrathoracic cavities</li> <li>• Refer to Section 4 Haemorrhage</li> </ul>   |
| <b>Disability</b>                          | <ul style="list-style-type: none"> <li>• Rapid neurological evaluation<sup>31</sup> utilising the Glasgow Coma Scale and assess for neurological deficits distally</li> </ul>  |
| <b>Exposure</b>                            | <ul style="list-style-type: none"> <li>• Head to toe examination as for non-pregnant trauma patients<sup>5</sup> <ul style="list-style-type: none"> <li>○ Expose and thoroughly examine all body parts<sup>5,16</sup></li> <li>○ Prevent hypothermia</li> </ul> </li> </ul>  |

### 3.2 Fetal assessment

Following primary survey assessment and resuscitation of the woman, assess the fetus before conducting secondary survey.<sup>16</sup>

Table 8. Fetal assessment

| Aspect                               | Consideration  |
|--------------------------------------|--|
| <b>Obstetric history</b>             | <ul style="list-style-type: none"> <li>• If available, consult Pregnancy Health Record (PHR)</li> <li>• Gestation in weeks and current pregnancy complications</li> <li>• Singleton or multiple pregnancy</li> <li>• Current fetal lie, presentation and placental location</li> <li>• Antenatal care and rhesus status</li> <li>• Previous pregnancy and birth complications</li> </ul>   |
| <b>Estimation of gestational age</b> | <ul style="list-style-type: none"> <li>• Ideally obtained from woman or PHR</li> <li>• Can be estimated by measuring fundal height               <ul style="list-style-type: none"> <li>◦ Refer to Appendix F: Estimating gestational age by fundal height</li> </ul> </li> <li>• Ultrasound scan (USS) estimation<sup>32</sup></li> <li>• Biparietal diameter (BPD) of 60 mm corresponds to around 24 weeks</li> </ul>  |
| <b>Fetal response to trauma</b>      | <ul style="list-style-type: none"> <li>• Fetal wellbeing is dependent on adequate uterine blood flow<sup>20</sup></li> <li>• Fetus may become hypoxic and respond by centralising blood flow to fetal brain<sup>20</sup></li> </ul>  |
| <b>FHR monitoring</b>                | <ul style="list-style-type: none"> <li>• Normal baseline FHR for a term fetus is 110–160 bpm<sup>33</sup></li> <li>• FHR is sensitive indicator of maternal blood volume and fetal well-being<sup>16</sup></li> <li>• Differentiate maternal and FHR<sup>22</sup></li> <li>• If greater than 23 weeks, initiate continuous CTG as soon as feasible<sup>7,22,26</sup> <ul style="list-style-type: none"> <li>◦ Monitor FHR via CTG for minimum of 4 hours<sup>5,22,34</sup></li> <li>◦ Good sensitivity for immediate adverse outcome</li> <li>◦ Highly sensitive in detecting fetal distress and maternal perfusion<sup>26</sup></li> </ul> </li> <li>• Abnormalities may be only indication of injury or compromise to the fetus<sup>20</sup></li> <li>• CTG application and interpretation requires clinicians trained in their use               <ul style="list-style-type: none"> <li>◦ Physiological control of FHR and resultant CTG trace interpretation differs in the preterm fetus compared to the term fetus, especially at gestations less than 28 weeks<sup>35</sup></li> <li>◦ CTG trace review should be performed by a clinician experienced and confident with CTG interpretation relevant to the gestation<sup>35</sup></li> </ul> </li> <li>• Move staff and equipment to the woman's location rather than transporting a woman to an obstetric unit for monitoring</li> </ul> |

### 3.3 Secondary survey

Once primary life threats are excluded or managed, further assessment can be undertaken.<sup>3</sup>

Table 9. Secondary survey additional considerations for pregnancy

| Aspect                                 | Consideration   |
|--|---|
| <b>Physical examination</b>            | <ul style="list-style-type: none"> <li>• Inspect abdomen for ecchymosis or asymmetry</li> <li>• In cases of MVC, incorrect positioning of the seat belt across the gravid uterus may:               <ul style="list-style-type: none"> <li>◦ Cause marked bruising of the abdomen</li> <li>◦ Increase the risk of placental abruption and uterine rupture</li> <li>◦ Refer to Appendix E: Seat belt positioning in pregnancy</li> </ul> </li> <li>• Assess uterine tone, contractions, rigidity, tenderness, palpable fetal parts               <ul style="list-style-type: none"> <li>◦ The gravid abdomen may be relatively insensate to peritoneal irritation</li> </ul> </li> </ul>   |
| <b>Pelvic/vaginal examination (VE)</b> | <ul style="list-style-type: none"> <li>• If indicated, perform sterile speculum VE<sup>8,22</sup> <ul style="list-style-type: none"> <li>◦ Evaluate for ruptured membranes, vaginal bleeding, cord prolapse, cervical effacement and dilation in labour, fetal presentation<sup>8</sup></li> <li>◦ Vaginal bleeding may indicate preterm labour, abruption, pelvic fracture or uterine rupture<sup>17</sup></li> </ul> </li> <li>• Do not perform digital VE until placenta praevia is excluded<sup>5</sup> <ul style="list-style-type: none"> <li>◦ Experienced practitioner to perform VE when indicated</li> </ul> </li> <li>• Consider urinary catheter insertion<sup>28</sup></li> <li>• If suspected spinal cord injury, perform rectal examination for anal tone and perineal sensation</li> </ul> |

### 3.4 Diagnostic imaging

Table 10. Diagnostic imaging in trauma in pregnancy

| Aspect                 | Clinical care   |
|------------------------|---|
| <b>Context</b>         | <ul style="list-style-type: none"> <li>• The risks of radiation to the fetus are small compared with the risk of missed or delayed diagnosis of trauma<sup>34</sup></li> <li>• Risk to fetus is dependent on gestational age and radiation dose<sup>36</sup> <ul style="list-style-type: none"> <li>◦ The fetus is most vulnerable to radiation during the first 15 weeks of gestation<sup>37,38</sup></li> </ul> </li> <li>• Confusion about safety of diagnostic imaging for pregnant women can result in unnecessary avoidance<sup>36</sup></li> <li>• Magnetic resonance imaging does not have radiation and is appropriate for assessment of spinal cord injury as per non-pregnant patient</li> </ul>   |
| <b>Radiation dose</b>  | <ul style="list-style-type: none"> <li>• Increased risks to the embryo or fetus have not been observed for intellectual disability, birth defects, growth restriction, neurobehavioural effects, impaired school performance, convulsive disorders, or embryonic or fetal death below an effective dose of 100 millisieverts (mSv)<sup>39</sup></li> <li>• Optimisation of the examination's exposure parameters has the largest effect on doses</li> <li>• It is preferable to perform a single computerised tomography (CT) scan with iodinated contrast rather than perform multiple suboptimal studies without contrast<sup>2</sup></li> <li>• Personal protective equipment, (e.g. lead gown) is advised for pregnant women only when the position of the uterus is in the direct X-ray beam (and not if it interferes with imaging)<sup>40</sup></li> <li>• Refer to Appendix H: Approximate fetal effective doses (mSv) from common radiological examinations</li> </ul> |
| <b>Contrast</b>        | <ul style="list-style-type: none"> <li>• Although iodinated contrast agents cross the placenta and may be taken up by the fetal thyroid, no cases of fetal goitre or abnormal neonatal thyroid function have been reported in connection with in-utero contrast exposure<sup>2</sup></li> <li>• Gadolinium has known teratogenic effects on animals and is not recommended unless benefits clearly outweigh the risks<sup>41</sup></li> </ul>   |
| <b>Ultrasound scan</b> | <ul style="list-style-type: none"> <li>• USS can assess gestational age, solid organ injury, intraperitoneal fluid, pericardial fluid, FHR, fetal activity, fetal presentation, placental location, amniotic fluid volume<sup>2,34,38</sup></li> <li>• USS is not a reliable indicator of recent placental abruption<sup>2,13,34</sup></li> <li>• FAST scan is as accurate as in non-pregnant patients,<sup>8</sup> for detecting presence of intra-abdominal or intrathoracic free fluid</li> </ul>  |
| <b>Recommendation</b>  | <ul style="list-style-type: none"> <li>• Do not defer radiographic studies indicated for maternal evaluation including abdominal CT due to concerns regarding fetal exposure to radiation<sup>5</sup></li> <li>• If risk of non-diagnosis outweighs risk of exposure, perform examination<sup>36</sup></li> <li>• X-ray examinations of the extremities, and CT examinations of the head and neck can be undertaken on pregnant or possibly pregnant women without concern<sup>39,40</sup></li> <li>• Provide information and counselling to women exposed to radiation during diagnosis and care</li> </ul>  |

## 4 Haemorrhage

Table 11. Management of haemorrhage

| Aspect  | Consideration   |
|---|---|
| <b>General principles</b>                           | <ul style="list-style-type: none"> <li>Obstetric haemorrhage is often underestimated and may be concealed<sup>42</sup></li> <li>Clinical signs may not be apparent until blood loss is severe               <ul style="list-style-type: none"> <li>1200–1500 mL of blood loss before signs of hypovolaemia apparent<sup>30</sup></li> <li>Danger of failing to identify blood loss and/or underestimating severity<sup>30</sup></li> </ul> </li> <li>Maintain a high index of suspicion for bleeding and an awareness of the limitations of clinical signs<sup>13</sup></li> <li>Be attentive to possibility of acute traumatic coagulopathy (ATC):               <ul style="list-style-type: none"> <li>Unique pathophysiology present in up to a quarter of trauma patients<sup>43</sup></li> <li>Characterised by failure of coagulation system to maintain haemostasis following major injury<sup>43</sup></li> </ul> </li> </ul>   |
| <b>Clinical signs</b>                               | <ul style="list-style-type: none"> <li>Most common signs of hypovolaemia are<sup>30</sup>:               <ul style="list-style-type: none"> <li>Increase in heart rate (greater than 100 bpm)</li> <li>Tachypnoea and pallor</li> <li>Cold, pale, sweaty, cyanosed skin with delayed capillary refill</li> <li>Alteration of mental state</li> <li>Fall in urine output</li> <li>Narrowed pulse pressure and hypotension (late sign)</li> </ul> </li> </ul>   |
| <b>Fibrinogen</b>                                   | <ul style="list-style-type: none"> <li>In pregnant women, fibrinogen levels increase to an average of 5–6 g/L compared to non-pregnant levels of 2.0–4.5 g/L<sup>42</sup></li> <li>Use fibrinogen concentrate or cryoprecipitate early and aim to maintain fibrinogen levels above 2.5g/L<sup>44</sup></li> </ul>   |
| <b>Point of care (POC) blood clotting analysers</b> | <ul style="list-style-type: none"> <li>Both thromboelastography® (TEG®) and thromboelastometry (ROTEM®) point of care blood clotting analysers are in use in Queensland</li> <li>If available, follow a locally agreed algorithm relevant to device used and facilitate education and training on use</li> <li>Ensure algorithm has appropriate parameters and targets for pregnancy</li> </ul>   |
| <b>Massive Haemorrhage Protocol (MHP)</b>           | <ul style="list-style-type: none"> <li>Activate MHP early in pregnant patients<sup>42</sup></li> <li>Establish and follow a locally agreed MHP for pregnant women               <ul style="list-style-type: none"> <li>If no local MHP refer to Queensland Clinical Guideline <i>Primary postpartum haemorrhage</i><sup>45</sup> or the National Blood Authority MHP<sup>42,46</sup></li> </ul> </li> <li>There is no evidence that the dose and timing of fresh frozen plasma (FFP) should differ from standard MHPs in pregnant women, except when disseminated intravascular coagulation (DIC) is present               <ul style="list-style-type: none"> <li>Refer to Table 24 Disseminated intravascular coagulation</li> </ul> </li> <li>In the setting of trauma with significant bleeding, tranexamic acid is considered safe for the fetus<sup>1</sup> <ul style="list-style-type: none"> <li>Unknown if use in pregnancy trauma reduces mortality<sup>1</sup></li> </ul> </li> </ul>   |
| <b>Management</b>                                   | <ul style="list-style-type: none"> <li>Principles of treatment are same as for non-pregnant patients</li> <li>Identify source of bleeding as external or internal</li> <li>Control external bleeding with direct manual pressure on wound, limb elevation, packing, or by reduction and immobilisation of fractures</li> <li>Management of internal bleeding may be aided by use of binders or splint application</li> <li>Rapid transfer to operating theatre or interventional radiology as indicated</li> <li>If hypovolaemia suspected, initiate volume limited fluid resuscitation to restore circulating volume and ensure adequate maternal and utero-placental perfusion<sup>2,13</sup></li> <li>If required, transfuse O-negative blood until cross-matched available<sup>5</sup></li> <li>If ongoing volume resuscitation required, consider activating MHP or ROTEM®/TEG® algorithm</li> <li>Treat ATC as per principles of non-pregnant patient               <ul style="list-style-type: none"> <li>Control bleeding through rapid surgical or radiological intervention, and with balanced resuscitation of blood and blood components</li> <li>Early use of Tranexamic Acid (TXA)</li> <li>Utilise MHP and coagulation testing with ROTEM®/TEG®</li> </ul> </li> <li>Avoid vasopressors<sup>20</sup> as they may compromise uteroplacental perfusion<sup>5</sup> <ul style="list-style-type: none"> <li>Use only for intractable hypotension that is unresponsive to fluid resuscitation, or to manage neurogenic shock<sup>5</sup></li> </ul> </li> </ul> |



## 5 Cardiac arrest

Preparedness for pregnant patients in cardiac arrest is essential for all emergency departments.<sup>11</sup> Ensure that team members with responsibility for pregnant women are familiar with physiological changes of pregnancy which can affect resuscitation techniques and potential complications.<sup>23</sup> Ideally, a maternal cardiac arrest team is comprised of an adult resuscitation team, as well as obstetric, anaesthetic, midwifery and neonatal teams.<sup>11</sup>

Table 12. Implications for CPR

| Aspect                    | Consideration  |
|---------------------------|--|
| <b>General principles</b> | <ul style="list-style-type: none"> <li>• Follow standard guidelines for cardiac arrest<sup>3,47</sup></li> <li>• If primary cause is trauma, focus efforts on reversible causes:               <ul style="list-style-type: none"> <li>○ Prevention of hypoxia by securing patent airway</li> <li>○ Restoration of circulating blood volume</li> <li>○ Chest decompression</li> <li>○ Early consideration of resuscitative thoracotomy</li> </ul> </li> <li>• First priority for medical cardiac arrest is to commence compressions<sup>30</sup> <ul style="list-style-type: none"> <li>○ Hand placement for compressions is the same as for non-pregnant patients<sup>23</sup></li> </ul> </li> <li>• Do not monitor fetus<sup>47</sup></li> <li>• Remove internal and external fetal monitors if present<sup>23,47</sup></li> <li>• Commence RH as soon as possible               <ul style="list-style-type: none"> <li>○ Refer to 5.1 Resuscitative hysterotomy (perimortem caesarean section)</li> </ul> </li> <li>• Defibrillate as for the non-pregnant trauma patient<sup>11</sup>—no significant shock is delivered to the fetus<sup>23,29,48</sup> <ul style="list-style-type: none"> <li>○ When indicated, perform without hesitation or delay<sup>23</sup></li> <li>○ Ensure CTG leads are removed prior to defibrillation<sup>29</sup></li> </ul> </li> <li>• Administer advanced cardiac life support drugs as would be indicated for the non-pregnant patient<sup>13,48</sup></li> <li>• Deflate air-filled mattresses if in use<sup>23</sup></li> </ul> |
| <b>Positioning</b>        | <ul style="list-style-type: none"> <li>• After 20 weeks gestation, the uterus impedes resuscitation by:               <ul style="list-style-type: none"> <li>○ Decreasing venous return causing supine hypotension</li> <li>○ Reducing stroke volume and cardiac output<sup>13,21,30</sup></li> <li>○ Decreasing the effectiveness of thoracic compressions<sup>13,21,29,49</sup></li> </ul> </li> <li>• If uterus is palpated at or above the umbilicus, perform manual left uterine (abdominal) displacement to minimise aortocaval compression<sup>11,23,30</sup> <ul style="list-style-type: none"> <li>○ Simultaneously allows for aortocaval decompression and high-quality chest compressions<sup>11,23</sup></li> <li>○ Allows woman to remain supine which improves airway access, ease of defibrillation and IV access<sup>11</sup></li> <li>○ Refer to Appendix G: Positioning to relieve aortocaval compression</li> </ul> </li> <li>• Tilting women in cardiac arrest can:               <ul style="list-style-type: none"> <li>○ Delay starting compressions</li> <li>○ Reduce quality and efficacy of compressions<sup>11,30,47</sup></li> </ul> </li> </ul>  |
| <b>ABC considerations</b> | <ul style="list-style-type: none"> <li>• Refer to Table 7. Primary survey considerations for pregnancy</li> <li>• Hypoxaemia develops more rapidly in pregnant patients, therefore, rapid and high-quality airway and breathing interventions are essential<sup>23</sup></li> <li>• Insert advanced airway early in resuscitation<sup>47</sup></li> <li>• Initially ventilate with 100% oxygen<sup>47</sup></li> <li>• Tidal volumes may need to be reduced because of elevated diaphragm<sup>11,29</sup></li> <li>• There is no significant vertical displacement of the heart during pregnancy<sup>50</sup> <ul style="list-style-type: none"> <li>○ No need to alter hand placement for chest compressions</li> </ul> </li> </ul>   |

## 5.1 Resuscitative hysterotomy (perimortem caesarean section)

Table 13. Resuscitative hysterotomy

| Aspect            | Consideration  |
|-------------------|--|
| <b>Definition</b> | <ul style="list-style-type: none"> <li>• A CS that is initiated after CPR has commenced<sup>32</sup></li> <li>• Also known as Perimortem caesarean section</li> </ul>  |
| <b>Benefits</b>   | <ul style="list-style-type: none"> <li>• Primarily performed as a resuscitative procedure in the interests of maternal survival<sup>13</sup></li> <li>• RH within 4—5 minutes of cardiac arrest is widely supported for potential survival of both the woman and the fetus<sup>3,51</sup></li> <li>• Emptying the uterus through RH provides several important benefits for the woman: <ul style="list-style-type: none"> <li>○ Allows for complete aortocaval decompression once uterus evacuated<sup>11</sup></li> <li>○ Alleviates compression of IVC, improving venous return<sup>32,47,48,51,52</sup></li> <li>○ Allows for redistribution of uterine blood to other organs<sup>51</sup></li> <li>○ Increases functional residual capacity of woman, allowing for better oxygenation<sup>51</sup></li> <li>○ Overall increased effectiveness of CPR<sup>51</sup></li> <li>○ Delay in initiating RH has been linked to adverse outcomes<sup>15</sup></li> </ul> </li> </ul>  |
| <b>Timing</b>     | <ul style="list-style-type: none"> <li>• If CPR has commenced and woman is more than 20 weeks gestation, perform a RH as quickly as possible<sup>53</sup></li> <li>• For both women and the fetus, there is roughly linear decrease in injury free survival rates as the time interval from maternal arrest to birth increases<sup>53</sup></li> <li>• Survival and neurologic outcome of the viable fetus is related to time between maternal death and birth<sup>9,48,49</sup></li> <li>• Reversible causes for maternal cardiac arrest are absolute indications for prompt delivery<sup>23,53</sup></li> </ul>  |
| <b>Management</b> | <ul style="list-style-type: none"> <li>• Perform RH at the point of resuscitation<sup>13,23,47</sup> as quickly as possible<sup>53</sup>, no later than 4—5 minutes following maternal cardiac arrest when possible<sup>5</sup> <ul style="list-style-type: none"> <li>○ Do not wait until four minutes post cardiac arrest to commence RH<sup>53</sup></li> <li>○ Do not delay RH by moving the woman to an operating environment or by attempting to assess fetal viability<sup>13,23,30,52</sup></li> </ul> </li> <li>• Ideally, make a vertical midline incision to skin <ul style="list-style-type: none"> <li>○ This incision is extensible if further surgical interventions are required</li> <li>○ Incision to uterus may be horizontal or vertical depending on clinical circumstances and skill/experience of surgeon</li> <li>○ Priority is to do procedure as quickly as possible</li> <li>○ Refer to Appendix C: Resuscitative hysterotomy procedure</li> </ul> </li> <li>• Continue CPR during and after the procedure<sup>30,52</sup></li> <li>• Ensure neonatal team and neonatal resuscitation equipment are ready to receive infant once born<sup>11</sup></li> </ul> |

## 6 Mechanisms and causes of trauma in pregnancy

Compared to non-pregnant women of childbearing age, there is a higher incidence of MVCs and penetrating trauma in pregnant trauma patients.<sup>54</sup>

### 6.1 Blunt trauma

Table 14. Blunt trauma in pregnancy

| Aspect                               | Consideration   |
|--------------------------------------|---|
| <b>Context</b>                       | <ul style="list-style-type: none"> <li>• Most common type of trauma presentation in pregnancy (82%)<sup>10</sup></li> <li>• MVC is most common cause of blunt trauma<sup>16</sup> and the most common mechanism of trauma for pregnant patients<sup>54</sup> <ul style="list-style-type: none"> <li>○ Other causes include falls and direct assault<sup>16</sup></li> </ul> </li> <li>• Direct fetal injuries occur in less than 1% of cases of severe blunt abdominal trauma<sup>7</sup> <ul style="list-style-type: none"> <li>○ Abdominal wall, uterine myometrium and amniotic fluid act as buffers protecting fetus from direct injury<sup>16</sup></li> </ul> </li> </ul>   |
| <b>Motor Vehicle Collision (MVC)</b> | <ul style="list-style-type: none"> <li>• Leading cause of maternal death in pregnant population<sup>5</sup> <ul style="list-style-type: none"> <li>○ Mechanism of injury often involves uterus<sup>5</sup></li> </ul> </li> <li>• Outcome is related to<sup>5</sup>: <ul style="list-style-type: none"> <li>○ Mechanism of collision and acceleration-deceleration velocities</li> <li>○ Use of protective devices such as seat belts and air bags</li> </ul> </li> <li>• Wearing a seat belt in a motor vehicle during pregnancy is effective in reducing risk of adverse outcomes in a MVC<sup>5,16</sup></li> <li>• Provide information to pregnant women about the importance of correct positioning of motor vehicle seat belts while pregnant [refer to Appendix D: Seat belt positioning in pregnancy]</li> <li>• Potential injuries and consequences include<sup>18</sup>: <ul style="list-style-type: none"> <li>○ Placental abruption as a result of shearing forces and abrupt changes in amniotic fluid pressure</li> <li>○ Uterine contractions leading to preterm labour</li> <li>○ Feto-maternal haemorrhage</li> <li>○ Direct fetal intracranial injury (uncommon)</li> </ul> </li> </ul> |

### 6.2 Penetrating trauma

Table 15. Penetrating trauma in pregnancy

| Aspect                           | Consideration   |
|----------------------------------|---|
| <b>Context</b>                   | <ul style="list-style-type: none"> <li>• Less common trauma presentation type (18%)<sup>10</sup></li> <li>• Gunshot and stab wounds are primary causes<sup>5</sup> <ul style="list-style-type: none"> <li>○ Stab wounds tend to have better prognosis than gunshot wounds</li> </ul> </li> <li>• Fetal loss is frequent following penetrating trauma to uterus (71% in gunshot wounds and 42% in stabbings)<sup>2</sup></li> </ul>  |
| <b>Anatomical considerations</b> | <ul style="list-style-type: none"> <li>• Beyond second trimester, maternal bowel less likely to be involved due to protection by uterus</li> <li>• Visceral organs displaced upward <ul style="list-style-type: none"> <li>○ Less likely to be injured overall</li> <li>○ Upper abdominal stab wounds can result in more complex bowel injury</li> <li>○ Penetrating injuries below fourth intercostal space anteriorly or below tip of scapula posteriorly may cause visceral injuries</li> </ul> </li> <li>• Uterus and fetus are susceptible to significant injury after penetrating abdominal trauma <ul style="list-style-type: none"> <li>○ Fetus more likely to sustain significant injury than mother <ul style="list-style-type: none"> <li>§ Fetus sustains injury in 60–70% of cases, while visceral maternal injuries are only seen in 20% of penetrating abdominal trauma</li> </ul> </li> </ul> </li> </ul> |
| <b>Gunshot wounds</b>            | <ul style="list-style-type: none"> <li>• More damaging and higher mortality for both mother and fetus than low velocity injuries</li> <li>• Fetal injury is generally a result of prematurity, maternal shock, uteroplacental injury or direct fetal injury<sup>5</sup></li> </ul>  |
| <b>Recommendation</b>            | <ul style="list-style-type: none"> <li>• Management does not differ in pregnant patient<sup>1</sup></li> <li>• Low threshold for exploratory laparotomy<sup>17</sup> <ul style="list-style-type: none"> <li>○ Exploratory laparotomy does not necessitate a CS<sup>1</sup></li> </ul> </li> </ul>   |

### 6.3 Burns

Table 16. Burn trauma in pregnancy

| Aspect                       | Consideration   |
|------------------------------|---|
| <b>General context</b>       | <ul style="list-style-type: none"> <li>• Paucity of evidence on major burns during pregnancy<sup>55</sup> <ul style="list-style-type: none"> <li>○ Most from developing countries where incidence of burns is higher<sup>56,57</sup></li> </ul> </li> <li>• Total body surface area of burns (TBSAB) positively associated with maternal death<sup>55</sup> <ul style="list-style-type: none"> <li>○ Maternal survival declines incrementally when TBSAB exceeds 55%</li> <li>○ Inhalation injury exacerbates maternal-perinatal risk</li> </ul> </li> <li>• Maternal endocrine system changes alter water distribution in pregnancy<sup>58</sup> <ul style="list-style-type: none"> <li>○ Fluid shift towards interstitial space can lead to difficult fluid resuscitation in pregnant burn victims<sup>58</sup></li> </ul> </li> <li>• Fetal outcome highly dependent on gestation and extent of maternal injury<sup>57</sup> <ul style="list-style-type: none"> <li>○ Fetal injuries are not typically direct injuries, but rather secondary to maternal state<sup>1</sup></li> <li>○ If TBSAB is less than 10%, risk to mother and fetus is minimal, but is significant when TBSAB exceeds 50%</li> </ul> </li> </ul> |
| <b>Queensland context</b>    | <ul style="list-style-type: none"> <li>• The Professor Stuart Pegg Adult Burns Centre (PSPABC) situated at the RBWH is the only tertiary referral centre for burns in Queensland</li> <li>• Pregnant women with burns are a rare presentation</li> <li>• Between 1997 and 2017, 13 pregnant women were admitted to PSPABC<sup>59</sup> <ul style="list-style-type: none"> <li>○ Represents 0.01% of all women admitted to unit</li> <li>○ 100% maternal and fetal survival</li> <li>○ Nine patients received operative management</li> <li>○ Three women required CS</li> <li>○ TBSAB ranged from 0.5–30% (average 8.5%)</li> <li>○ Predominant mechanism of injury was scalding of hot liquid (50%)</li> </ul> </li> <li>• Time from point of injury to admission to RBWH varies widely <ul style="list-style-type: none"> <li>○ If emergent birth is indicated, consider all circumstances and if CS prior to transfer is warranted</li> </ul> </li> </ul>  |
| <b>Management principles</b> | <ul style="list-style-type: none"> <li>• Basic principles of treatment unchanged by pregnancy<sup>60</sup>, aside from considerations about teratogenic drugs<sup>56</sup></li> <li>• Emergent assessment including <ul style="list-style-type: none"> <li>○ Extent of TBSAB</li> <li>○ Presence of inhalation injury</li> <li>○ Gestational age and electronic fetal monitoring for viable pregnancies</li> </ul> </li> <li>• Early supplemental oxygen if inhalation injury suspected</li> <li>• Consider risk of thrombosis as per pregnancy state</li> <li>• Burns do not increase risk of venous thromboembolism: <ul style="list-style-type: none"> <li>○ Use standard thromboprophylaxis<sup>61</sup></li> </ul> </li> <li>• High suspicion for sepsis with early and aggressive treatment</li> <li>• Low threshold mechanical ventilatory support</li> <li>• If circumferential burns to trunk (abdomen or thorax) and respiratory compromise, escharotomy is indicated</li> </ul>  |
| <b>Fluid Resuscitation</b>   | <ul style="list-style-type: none"> <li>• Fluid resuscitation according to Parkland's formula (TBSAB and urine output)<sup>57</sup></li> <li>• Limited evidence to guide rate and volume for pregnant women with burns</li> </ul>  |
| <b>Birth</b>                 | <ul style="list-style-type: none"> <li>• If burns are extensive and woman is in third trimester, recommend early birth<sup>57</sup></li> <li>• If TBSAB 55% or more for viable fetus, recommend urgent CS without delaying for corticosteroids<sup>1,55</sup></li> <li>• If TBSAB less than 55%, administer corticosteroids with expectant management<sup>1,55</sup></li> </ul>   |

## 6.4 Domestic and family violence

Table 17. Domestic and family violence in pregnancy

| Cause                 | Consideration  |
|-----------------------|--|
| <b>Context</b>        | <ul style="list-style-type: none"> <li>Incidence increases during pregnancy<sup>54</sup>, especially in third trimester<sup>5</sup></li> <li>Most commonly struck body area is abdomen<sup>5</sup></li> <li>Mechanism may be blunt or penetrating</li> </ul>   |
| <b>Reporting</b>      | <ul style="list-style-type: none"> <li>It is not mandatory to report child protection concerns relating to an unborn child. This does not constrain staff from reporting their concerns about the potential risk of harm to a child following their birth to Child Safety Services<sup>62</sup></li> <li>If aware of other children in the family where violence has occurred, consider mandatory reporting<sup>62</sup></li> <li>Undertake a search of systems where Unborn Child High Risk Alert may be recorded and respond appropriately where applicable<sup>63</sup></li> </ul>                              |
| <b>Recommendation</b> | <ul style="list-style-type: none"> <li>Consider DFV as a cause of trauma in pregnancy               <ul style="list-style-type: none"> <li>Be vigilant and question every woman who sustains trauma about DFV without partner present<sup>5</sup></li> </ul> </li> <li>Offer referral to social workers as appropriate to the circumstances (e.g. intimate partner violence, following fetal demise, if transfer required, for counselling and support)</li> <li>Consider psychosocial assessment prior to discharge where DFV is a consideration and ensure discharge summary is sent to primary carer</li> </ul> |

## 7 Potential obstetric complications

### 7.1 Uterine rupture

Table 18. Uterine rupture

| Aspect                       | Clinical care  |
|------------------------------|--|
| <b>Context</b>               | <ul style="list-style-type: none"> <li>Uterine rupture is more likely with advanced gestational age and severe direct abdominal trauma<sup>7,30</sup></li> <li>Diagnosis usually made on USS<sup>64</sup> (extrusion of uterine contents, free fluid in pelvis)</li> </ul>   |
| <b>Clinical presentation</b> | <ul style="list-style-type: none"> <li>CTG abnormalities<sup>64</sup> (most common feature)</li> <li>Severe pain</li> <li>Fetal demise<sup>64</sup></li> <li>Positive FAST</li> <li>Uterine tenderness with guarding and rigidity<sup>30,64</sup></li> <li>Vaginal bleeding<sup>64</sup></li> <li>Palpable fetal parts abdominally<sup>30,64</sup></li> <li>Maternal shock including hypotension and tachycardia<sup>64</sup></li> </ul> |
| <b>Management</b>            | <ul style="list-style-type: none"> <li>CS with midline laparotomy</li> <li>Urgent delivery of fetus</li> <li>Repair of uterus (simple repair, subtotal hysterectomy or total hysterectomy) as indicated by individual circumstances<sup>30</sup></li> <li>Prompt haemodynamic resuscitation with blood products decreases risk of DIC<sup>65</sup></li> <li>Hysterectomy if uncontrolled haemorrhage<sup>65</sup></li> </ul>             |

## 7.2 Placental abruption

Table 19. Placental abruption

| Aspect                       | Consideration  |
|------------------------------|--|
| <b>Context</b>               | <ul style="list-style-type: none"> <li>Common complication of trauma especially following MVC<sup>3,26</sup></li> <li>Separation of implanted placenta before birth<sup>64</sup> <ul style="list-style-type: none"> <li>Separation can be complete or partial<sup>64</sup></li> </ul> </li> <li>Leading cause of fetal death following trauma<sup>2,5,26</sup> accounting for 50–70% of all trauma-related fetal losses<sup>2</sup></li> <li>Can occur with rapid deceleration without direct trauma<sup>66</sup></li> <li>Can occur following relatively minor trauma<sup>30</sup></li> <li>Most occur within 2–6 hours of injury, and almost all within 24 hours<sup>5</sup></li> </ul>  |
| <b>Clinical presentation</b> | <ul style="list-style-type: none"> <li>Presentation can vary widely and include a lack of symptoms<sup>64,67</sup></li> <li>Abdominal pain<sup>5,68,69</sup></li> <li>Vaginal bleeding 60–80% of cases<sup>5,64</sup> <ul style="list-style-type: none"> <li>Amount does not necessarily correlate with severity<sup>64</sup></li> </ul> </li> <li>Uterine contractions<sup>2,5</sup></li> <li>Uterine tenderness<sup>69</sup>/tense or ‘woody’ feel<sup>68</sup> <ul style="list-style-type: none"> <li>If placenta is posterior, abdomen may be soft<sup>30</sup></li> </ul> </li> <li>Evidence of fetal compromise<sup>5,68</sup></li> <li>Maternal haemodynamic instability<sup>64</sup></li> </ul>  |
| <b>Investigations</b>        | <ul style="list-style-type: none"> <li>Although USS may detect abruption, it is not sensitive enough to exclude abruption<sup>68,69</sup> <ul style="list-style-type: none"> <li>False negative reported 50–80%<sup>34</sup></li> <li>Do not delay treatment for USS<sup>34</sup> confirmation</li> </ul> </li> <li>CTG better than USS in risk stratifying for suspected placental abruption<sup>2,7</sup> <ul style="list-style-type: none"> <li>Uterine contractions have high-frequency, low-amplitude pattern with an elevated baseline tone<sup>64</sup></li> <li>FHR can show recurrent late or variable decelerations, bradycardia, or sinusoidal patterns<sup>64</sup></li> </ul> </li> <li>Consider feto-maternal haemorrhage (FMH)<sup>13</sup> [Refer to Section 7.4 Feto-maternal haemorrhage]</li> </ul>   |
| <b>Management</b>            | <ul style="list-style-type: none"> <li>Significant placental abruption requires urgent delivery by CS<sup>45,68</sup> <ul style="list-style-type: none"> <li>Midline incision preferable if other abdominal injuries suspected</li> </ul> </li> <li>Consider hospital admission for surveillance as clinically indicated</li> <li>Give Rh D immunoglobulin to all non-sensitised Rh D negative women independent of whether routine antenatal prophylactic Rh D immunoglobulin has been administered [refer to Table 22. Rh D immunoglobulin in trauma]</li> <li>Consider antenatal corticosteroids between 23+0 and 34 +6 weeks gestation<sup>13</sup></li> <li>Monitor for DIC and request urgent clotting studies as indicated<sup>68</sup> <ul style="list-style-type: none"> <li>Do not delay treatment by waiting for coagulation results if massive blood loss occurs<sup>68</sup></li> </ul> </li> </ul> |

## 7.3 Preterm labour

Table 20. Preterm labour

| Aspect                       | Clinical care   |
|------------------------------|---|
| <b>Context</b>               | <ul style="list-style-type: none"> <li>Onset of labour before 37+0 weeks gestation<sup>64</sup></li> </ul>  |
| <b>Clinical presentation</b> | <ul style="list-style-type: none"> <li>Uterine contractions of more than four per hour accompanied by cervical change<sup>8</sup></li> <li>Cramping abdominal/back pain<sup>64</sup></li> <li>Pelvic pressure<sup>64</sup></li> <li>An increase or change in vaginal discharge<sup>64</sup></li> <li>Vaginal bleeding<sup>64</sup></li> </ul>   |
| <b>Management</b>            | <ul style="list-style-type: none"> <li>Consult with an obstetrician regarding management appropriate for the circumstances</li> <li>Refer to the Queensland Clinical Guideline: <i>Preterm Labour</i><sup>70</sup>: <ul style="list-style-type: none"> <li>Consider tocolytic therapy</li> <li>Consider corticosteroids aimed at promoting fetal lung maturity</li> </ul> </li> </ul> |

## 7.4 Feto-maternal haemorrhage

Table 21. Feto-maternal haemorrhage

| Aspect                                 | Clinical care   |
|--|---|
| <b>Context</b>                         | <ul style="list-style-type: none"> <li>• FMH occurs in approximately 10–30% of pregnant trauma patients<sup>7,31</sup></li> <li>• The severity of the FMH is related to the size of the bleed in relation to the overall fetal blood volume, the rate at which this blood is lost and whether the event is acute or chronic</li> <li>• Clinical presentation of FMH is variable and can be non-specific<sup>71,72</sup> <ul style="list-style-type: none"> <li>○ Decreased or absent fetal movements have been reported<sup>71,72</sup></li> <li>○ Fetal distress, especially if the fetal heart tracing is sinusoidal (indicating fetal anaemia)</li> <li>○ Massive FMH is a rare but severe complication which can result in fetal anaemia, fetal hypoxia, intrauterine death or neonatal neurologic damage<sup>72</sup></li> <li>○ Women may experience a transfusion reaction (nausea, oedema, fever, and chills)<sup>71</sup></li> <li>○ May occur more commonly with anteriorly located placentae and in women who experience uterine tenderness after trauma<sup>73</sup></li> </ul> </li> </ul> |
| <b>Assessment of FMH</b>               | <ul style="list-style-type: none"> <li>• The Kleihauer test is used to detect and quantify FMH<sup>74</sup> <ul style="list-style-type: none"> <li>○ Commonly to determine dose of Rh D immunoglobulin (Rh D-Ig) for Rh D negative women<sup>17</sup></li> <li>○ Results are reported quantitatively in mL of fetal blood within maternal circulation</li> <li>○ A 'negative' result is commonly understood to be less than 1 mL of fetal blood</li> <li>○ The Kleihauer test is not a test for placental abruption<sup>64,68</sup></li> <li>○ The evidence is limited about the usefulness of a positive Kleihauer test for predicting outcomes and guiding clinical management<sup>17,75</sup> (beyond determining the dose of RhD-Ig for Rh D negative women)</li> </ul> </li> <li>• Flow cytometry is the most accurate quantitative test for FMH<sup>74</sup> and will be initiated by Pathology Queensland as a standard procedure when the quantitative result of the Kleihauer test is greater than 4 mL</li> </ul>   |
| <b>Management</b>                      | <ul style="list-style-type: none"> <li>• Continuous electronic fetal monitoring of the viable fetus</li> <li>• Abdominal USS to detect fetal heart activity, placental location, amniotic fluid index, suspected intraperitoneal bleeding, gestational age, fetal weight <ul style="list-style-type: none"> <li>○ Elevated peak systolic velocity of the fetal middle cerebral artery correlates with fetal anaemia<sup>76,77</sup></li> </ul> </li> <li>• Emergency CS may be indicated</li> </ul>   |
| <b>Recommendation following trauma</b> | <ul style="list-style-type: none"> <li>• Recommend Kleihauer test for Rh D negative women 13+0 weeks gestation or greater<sup>74,78,79</sup> <ul style="list-style-type: none"> <li>○ Aids determination of RhD-Immunoglobulin dose</li> </ul> </li> <li>• Consider a Kleihauer test for women with major or abdominal trauma <ul style="list-style-type: none"> <li>○ Aids identification of FMH</li> <li>○ May inform immediate and longer term pregnancy management and outcomes</li> </ul> </li> <li>• Maintain a high index of suspicion and clinical surveillance for the possibility of significant FMH</li> </ul>   |

## 7.4.1 Prevention of Rhesus alloimmunisation

Table 22. Rh D immunoglobulin in trauma

| Aspect                   | Clinical care  |
|--------------------------|--|
| <b>Context</b>           | <ul style="list-style-type: none"> <li>• Approximately 21% of women in Queensland are Rh D negative<sup>80</sup></li> <li>• FMH occurs in 10–30% of pregnant trauma patients</li> <li>• Majority of post-traumatic FMH small and subclinical</li> <li>• Massive FMH is rare and generally clinically evident with fetal distress or demise</li> </ul>  |
| <b>Assessment</b>        | <ul style="list-style-type: none"> <li>• If woman is Rh D negative and 12+6 weeks or less, quantification of FMH is not required               <ul style="list-style-type: none"> <li>○ Individualise RhD-Immunoglobulin administration according to clinical circumstances</li> <li>○ Refer to Queensland Clinical Guideline: <i>Early pregnancy loss</i><sup>81</sup></li> </ul> </li> <li>• If woman is Rh D negative and 13+0 weeks or more, collect maternal blood (blood group, antibody screen and Kleihauer test) prior to administration of Rh D immunoglobulin<sup>78</sup></li> <li>• Do not delay or withhold administration of Rh D immunoglobulin based on or pending the results of quantitative testing</li> </ul>   |
| <b>RhD-Ig</b>            | <ul style="list-style-type: none"> <li>• If gestation is less than or equal to 12+6 days and no contraindications:               <ul style="list-style-type: none"> <li>○ Indicated for miscarriage                   <ul style="list-style-type: none"> <li>§ 250 IU for singleton pregnancy</li> <li>§ 625 IU for multiple pregnancy</li> </ul> </li> <li>○ Insufficient evidence to support routine use for bleeding in an ongoing pregnancy<sup>78</sup> <ul style="list-style-type: none"> <li>§ If significant abdominal trauma, individualise RhD-Ig administration according to clinical circumstances<sup>82,83</sup></li> </ul> </li> </ul> </li> <li>• If gestation is 13+0 weeks or more and no contraindications:               <ul style="list-style-type: none"> <li>○ Indicated for obstetric haemorrhage, abdominal trauma, or any other suspected intrauterine bleeding or sensitising event in the non-sensitised woman</li> <li>○ Standard dose 625 IU</li> </ul> </li> <li>• If not offered within 72 hours, a dose offered within 9–10 days may provide protection<sup>78</sup></li> <li>• 625 IU of Rh D immunoglobulin protects against 6 mL fetal red cells (12 mL whole blood), which is equivalent to 0.25% fetal cells in the maternal circulation<sup>74</sup></li> <li>• If FMH is quantified at greater than 6 mL, give additional doses of RhD-Immunoglobulin sufficient to provide immunoprophylaxis within 72 hours<sup>78</sup> <ul style="list-style-type: none"> <li>○ 625 IU for each additional 6 mL (or part thereof) of fetal red cells detected</li> </ul> </li> <li>• Refer to Queensland Clinical Guideline: <i>Early Pregnancy Loss</i><sup>81</sup></li> </ul> |
| <b>Contraindications</b> | <ul style="list-style-type: none"> <li>• Rh D positive woman</li> <li>• Rh D negative woman with preformed Anti-D antibodies<sup>78</sup></li> <li>• Previous sensitivity or allergy to Rh D immunoglobulin</li> </ul>   |



## 7.5 Amniotic fluid embolism

Table 23. Amniotic fluid embolism

| Aspect                       | Clinical care  |
|------------------------------|--|
| <b>Context</b>               | <ul style="list-style-type: none"> <li>• Unpredictable, rare and often fatal<sup>29,64</sup></li> <li>• Acute collapse typically occurring during labour, birth or within 30 minutes of birth<sup>13,30,84</sup> <ul style="list-style-type: none"> <li>○ May also occur in the context of abdominal trauma<sup>85,86</sup></li> </ul> </li> <li>• Also known as anaphylactoid syndrome of pregnancy<sup>29,87</sup></li> <li>• Exact pathophysiological mechanism is poorly understood<sup>64</sup> <ul style="list-style-type: none"> <li>○ Appears to involve abnormal inflammatory maternal response to fetal tissue exposure<sup>87</sup></li> <li>○ Pathophysiological process comparable to anaphylaxis or severe sepsis<sup>13</sup></li> </ul> </li> <li>• Clinical diagnosis is one of exclusion<sup>30,88</sup> <ul style="list-style-type: none"> <li>○ Lack of universally recognised diagnostic criteria<sup>87</sup></li> </ul> </li> <li>• Estimated incidence 1.7–2.5 per 100 000 births<sup>87,88</sup></li> <li>• Mortality rate estimates range from 20–60%<sup>87,88</sup></li> </ul> |
| <b>Clinical presentation</b> | <ul style="list-style-type: none"> <li>• Classic symptoms include respiratory distress, hypoxia, hypotension and coagulopathy<sup>13,88</sup></li> <li>• Other symptoms include <ul style="list-style-type: none"> <li>○ Maternal hypotension<sup>13,29,30,64,87</sup> (100% of women<sup>29</sup>)</li> <li>○ Acute hypoxia (dyspnoea, cyanosis or respiratory arrest)<sup>30,87,88</sup></li> <li>○ Seizures<sup>13,87,88</sup></li> <li>○ Cardiac arrest<sup>13,29,30,64,87</sup> (87% of women<sup>29</sup>)</li> <li>○ Haemorrhage<sup>13,88</sup></li> <li>○ Coagulopathy/DIC<sup>13,30,64,88</sup> <ul style="list-style-type: none"> <li>§ Bleeding from uterus, incisions or IV sites<sup>87</sup></li> </ul> </li> <li>○ If AFE occurs before birth, profound fetal distress<sup>13,87</sup></li> </ul> </li> </ul>  |
| <b>Management</b>            | <ul style="list-style-type: none"> <li>• Management is primarily supportive<sup>13,29,87</sup></li> <li>• Major goals of management<sup>29</sup>: <ul style="list-style-type: none"> <li>○ Adequate oxygenation</li> <li>○ Aggressive restoration of cardiac output</li> <li>○ Reversal of coagulopathy</li> </ul> </li> <li>• Key factors for successful management<sup>89</sup>: <ul style="list-style-type: none"> <li>○ Sharp vigilance</li> <li>○ High level of clinical suspicion</li> <li>○ Rapid, all-out resuscitative efforts</li> </ul> </li> <li>• Involve obstetrician, neonatologist, anaesthetist, haematologist and intensivist as early as possible<sup>13</sup></li> <li>• Prompt delivery if cardiopulmonary arrest<sup>87</sup></li> <li>• Resuscitation and airway management<sup>64</sup></li> <li>• Blood product replacement including FFP, platelets and cryoprecipitate<sup>64</sup></li> </ul>  |

## 7.6 Disseminated intravascular coagulation

Table 24. Disseminated intravascular coagulation

| Aspect            | Clinical care   |
|-------------------|---|
| <b>Context</b>    | <ul style="list-style-type: none"> <li>Life threatening condition<sup>90</sup></li> <li>Always occurs secondary to another occurrence such as:               <ul style="list-style-type: none"> <li>Placental abruption, obstetric haemorrhage, fetal demise or AFE<sup>30,90</sup></li> </ul> </li> <li>Placental abruption and AFE are associated with severe early onset DIC<sup>90</sup></li> <li>Rate in pregnancy ranges from 0.03–0.35%<sup>90</sup></li> <li>May result in clinically detectable microvascular bleeding as well as abnormal blood coagulation tests<sup>45,78</sup></li> </ul>  |
| <b>Diagnosis</b>  | <ul style="list-style-type: none"> <li>Diagnosis is challenging in setting of pregnancy:               <ul style="list-style-type: none"> <li>Increased D-Dimers and fibrinogen levels in pregnancy</li> <li>Activated partial thromboplastin time (APTT) shortened in pregnancy</li> </ul> </li> <li>Key trends indicative of DIC<sup>90</sup>:               <ul style="list-style-type: none"> <li>Decreasing platelet count and fibrinogen</li> <li>Prolongation of prothrombin time</li> <li>Increasing fibrin-related marker</li> </ul> </li> </ul>   |
| <b>Management</b> | <ul style="list-style-type: none"> <li>Overriding management is to treat underlying cause</li> <li>Early and accurate recognition is vital<sup>90</sup></li> <li>Tests need to be repeated to reflect dynamic changes<sup>90</sup></li> <li>Requires early aggressive management<sup>13</sup></li> <li>If undelivered, deliver fetus and placenta<sup>13</sup></li> <li>Collect baseline bloods early and frequently</li> <li>If clinical signs present do not delay treatment by waiting for coagulation results<sup>68</sup></li> <li>If there is bleeding, consider early use of tranexamic acid</li> <li>Replace missing haemostatic components with blood products<sup>91</sup> <ul style="list-style-type: none"> <li>Where available utilise POC blood clotting analysers (ROTEM®/TEG®)</li> </ul> </li> <li>Avoid hypothermia and acidosis</li> <li>Refer to Queensland Clinical Guideline <i>Primary postpartum haemorrhage</i> for management, blood/product replacement and MHP activation protocols<sup>45</sup></li> <li>Consult with a haematologist<sup>68</sup></li> <li>If there is active bleeding, consider early use of cryoprecipitate or fibrinogen concentrate to maintain fibrinogen levels above 2.5 g/L<sup>44</sup></li> <li>Advise platelet transfusion if marked or moderate thrombocytopenia</li> <li>Give FFP if actively bleeding or significantly elevated International normalised ratio (INR)</li> </ul> |

## 8 Musculoskeletal injury

Management principles are generally the same as for the non-pregnant patient.

Table 25. Musculoskeletal injury

| Aspect  | Clinical care   |
|---|---|
| <b>Spine and spinal cord injuries</b>           | <ul style="list-style-type: none"> <li>Adequate immobilisation of neck and spine<sup>17</sup></li> <li>If possible, position left lateral tilt 15–30 degrees (right side up)</li> <li>Early multidisciplinary approach to care</li> <li>Consider birth at advanced gestations</li> </ul>  |
| <b>Major pelvic fracture</b>                    | <ul style="list-style-type: none"> <li>Immobilise pelvis</li> <li>Vaginal birth is not absolutely contraindicated<sup>1</sup> <ul style="list-style-type: none"> <li>Birth by CS if unstable fracture or pelvic architecture disrupted<sup>17</sup></li> </ul> </li> <li>Consider fetal injury/skull fracture—may be more common with fetal head engagement<sup>17</sup> <ul style="list-style-type: none"> <li>Consult with neonatologist</li> </ul> </li> </ul> |
| <b>Limb fracture and longer-term immobility</b> | <ul style="list-style-type: none"> <li>Assess for venous thromboembolism (VTE) risk and consider prophylaxis<sup>37</sup> <ul style="list-style-type: none"> <li>Refer to the Queensland Clinical Guideline: <i>Venous thromboembolism (VTE) prophylaxis in pregnancy and the puerperium</i><sup>92</sup></li> </ul> </li> </ul>  |

## 9 Minor trauma

Table 26. Minor trauma

| Aspect                                  | Clinical care  |
|---|--|
| <b>Definition</b>                       | <ul style="list-style-type: none"> <li>• Pre-hospital transfer, any trauma injury that does not meet the criteria for defining major trauma               <ul style="list-style-type: none"> <li>◦ Refer to Appendix A: Prehospital criteria for major trauma</li> </ul> </li> <li>• An Injury Severity Score (ISS) of less than 12               <ul style="list-style-type: none"> <li>◦ Refer to Appendix B: Injury Severity Score</li> </ul> </li> </ul>   |
| <b>Context</b>                          | <ul style="list-style-type: none"> <li>• Even minor injuries in the pregnant woman can be associated with placental abruption, preterm labour, massive FMH, uterine rupture and fetal loss<sup>2,7</sup></li> <li>• Severity of injury may not be predictive of fetal outcome<sup>2,18</sup> <ul style="list-style-type: none"> <li>◦ Around 50% of fetal losses occur following minor trauma<sup>93</sup></li> </ul> </li> <li>• Adverse fetal outcomes are increased after minor trauma not requiring hospitalisation<sup>2,18,66</sup></li> </ul>   |
| <b>FHR monitoring</b>                   | <ul style="list-style-type: none"> <li>• CTG provides good screening/high sensitivity for immediate adverse outcome</li> <li>• Monitor FHR via CTG for 4 hours<sup>22,34</sup> at a minimum<sup>5</sup></li> </ul>   |
| <b>Discharge following minor trauma</b> | <ul style="list-style-type: none"> <li>• Criteria:           <ul style="list-style-type: none"> <li>◦ Normal CTG<sup>22</sup> <ul style="list-style-type: none"> <li>§ Interpret with caution at 23–28 weeks gestation</li> <li>§ Refer to Table 8. Fetal assessment for FHR monitoring considerations</li> </ul> </li> <li>◦ No contractions</li> <li>◦ No vaginal bleeding/loss<sup>22</sup></li> <li>◦ Reassuring maternal status</li> <li>◦ Laboratory evaluation within normal limits</li> <li>◦ Kleihauer test reviewed and sufficient Rh D immunoglobulin administered (if required)</li> </ul> </li> <li>• Consult with the obstetric team prior to discharge</li> <li>• Consider review by physiotherapy team prior to discharge to assess and treat musculoskeletal injuries and conditions such as whiplash</li> <li>• Offer social work referral before discharge</li> <li>• Advise the woman to seek medical advice if experiencing:           <ul style="list-style-type: none"> <li>◦ Signs of preterm labour</li> <li>◦ Abdominal pain</li> <li>◦ Vaginal bleeding</li> <li>◦ Change in fetal movements</li> </ul> </li> </ul> |
| <b>Follow up</b>                        | <ul style="list-style-type: none"> <li>• Establish local policies and procedures to ensure adequate follow up of all investigations</li> <li>• Increased antenatal surveillance is required even after minor trauma as the risk of adverse obstetric outcomes is increased including premature labour, low birth weight, fetal demise<sup>18</sup> and placental abruption<sup>2</sup></li> <li>• Advise the woman to inform her usual maternity care provider of the trauma event</li> <li>• Ensure that discharge summary is provided to both the woman and her primary care provider</li> </ul>   |

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## Appendix A: Prehospital criteria for major trauma

If any of the following criteria (except systolic BP\*) present, consider the trauma 'Major' and respond accordingly.

| R Vital signs criteria   |  |
|--|--|
| Conscious state  | Altered level of consciousness                 |
| Respiratory rate   | Less than 10 or greater than 30 breaths/minute |
| SpO <sub>2</sub> (room air)  | Less than 95%                                  |
| Heart rate   | Greater than 120 bpm                           |
| *Systolic BP   | Less than 90 mmHg                              |
| <i>*Interpret BP in conjunction with gestation, other vital signs, injury pattern and mechanism of injury</i>  |  |
| R Injury pattern criteria  |  |
| Injuries to the head, neck, chest, abdomen, pelvis, axilla, or groin that:   |  |
| <ul style="list-style-type: none"> <li>· Are penetrating</li> <li>· Are Significant blunt injuries</li> <li>· Are Sustained from blasts</li> <li>· Involve two or more of those regions</li> </ul> |  |
| Limb amputation above the wrist or ankle   |  |
| Suspected spinal cord injuries   |  |
| Burns > 20% or other complicated burn injury including burn injury to the hand, face, genitals, airway, or respiratory tract   |  |
| Serious crush injury   |  |
| Major open fracture, or open dislocation with vascular compromise  |  |
| Fractured pelvis   |  |
| Fractures involving two or more of the following: femur, tibia, or humerus   |  |
| R Mechanism of injury criteria   |  |
| Ejection from vehicle  |  |
| Fall from height ≥ 3 metres  |  |
| Explosion  |  |
| High impact motor vehicle crash with incursion into the occupant's compartment   |  |
| Motorcyclist impact >30km/hour   |  |
| Motor vehicle crash >60km/hour   |  |
| Vehicle rollover   |  |
| Road traffic crash in which there was a fatality in the same vehicle   |  |
| Entrapped for > 30 minutes   |  |
| Pedestrian impact  |  |
| Struck on head by falling object >3m   |  |

Adapted from: Queensland Government. Queensland Ambulance Service (QAS) Clinical Practice Manual (CPM) Clinical Practice Guideline: Trauma/Pre-hospital trauma by-pass. 2017 and Queensland Government, Retrieval Services Queensland. RG1001 Early notification of trauma guidelines 2017

## Appendix B: Injury Severity Score

The Injury Severity Score (ISS) assesses the collective effect of multiple injuries. It is based on an anatomical injury severity classification known as the Abbreviated Injury Scale (AIS). Each individual injury is assigned an Abbreviated Injury Scale (AIS) score. The AIS classifies each injury as follows:

- 1: Minor
- 2: Moderate
- 3: Serious
- 4: Severe
- 5: Critical
- 6: Maximal (unsurvivable)

Each of the AIS injury scores are then assigned to one of six body regions:

- Head or neck
- Face
- Chest
- Abdominal or pelvic contents
- Extremities or pelvic girdle
- External

The three most severely injured body regions have their score squared and added together to produce the ISS. Scores range from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable), the ISS is automatically assigned to 75. An ISS greater than 12 constitutes major trauma.

## Appendix C: Resuscitative hysterotomy procedure

Large vertical abdominal incision required. Uterine incision may be either vertical or horizontal

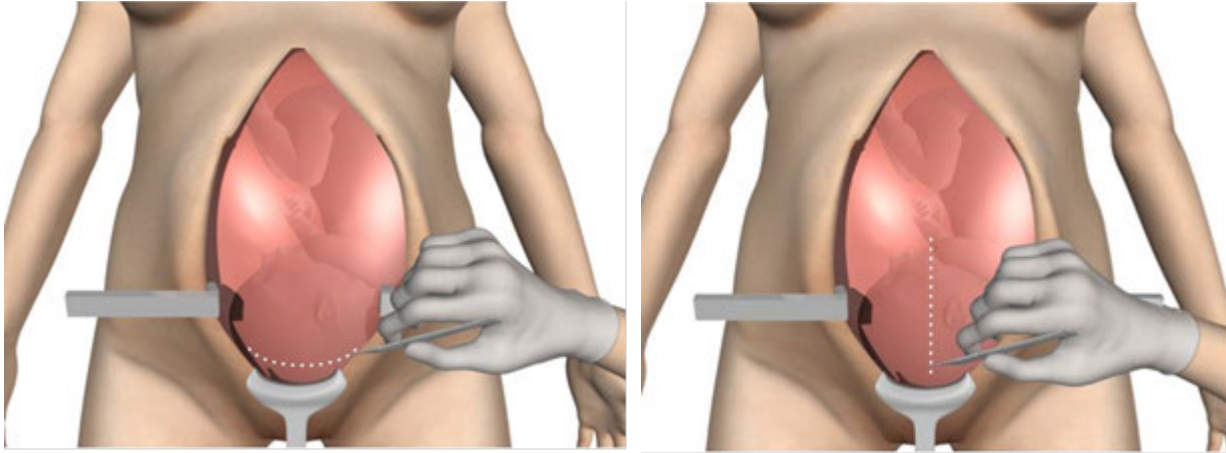


Image produced by: Clinical Multimedia Unit, Metro North Hospital and Health Service, Queensland.



## Appendix D: Average haemodynamic and laboratory values in pregnancy

Mean values for haemodynamic changes throughout pregnancy

|                                | Pre-pregnancy | 1 <sup>st</sup> Trimester | 2 <sup>nd</sup> Trimester | 3 <sup>rd</sup> Trimester |
|--------------------------------|---------------|---------------------------|---------------------------|---------------------------|
| Heart rate (beats/minute)      | 70            | 78                        | 82                        | 85                        |
| Systolic BP (mmHg)             | 125           | 112                       | 122                       | 115                       |
| Diastolic BP (mmHg)            | 70            | 60                        | 63                        | 70                        |
| Central venous pressure (mmHg) | 9.0           | 7.5                       | 4.0                       | 3.8                       |
| Femoral venous pressure (mmHg) | 6             | 6                         | 18                        | 18                        |
| Cardiac output (L/minute)      | 4.5           | 4.5                       | 6.0                       | 6.0                       |
| Uterine blood flow (mL/minute) | 4000          | 4200                      | 5000                      | 5600                      |

Source: Suresh MS, Latoya Mason C, Munnur U. Cardiopulmonary resuscitation and the parturient. Best Practice and Research: Clinical Obstetrics and Gynaecology. 2010; 24(3):383-400.

Pathology Queensland reference intervals

|  | Gestation (weeks) | Reference range | Units                 |
|--|-------------------|-----------------|-----------------------|
| White Blood Cells (WBC)                    | 1–12              | 5.7–13.6        | x 10 <sup>9</sup> /L  |
|  | 13–24             | 6.2–14.8        | x 10 <sup>9</sup> /L  |
|  | 25–42             | 5.9–16.9        | x 10 <sup>9</sup> /L  |
|  | >42               | 5.7–16.9        | x 10 <sup>9</sup> /L  |
| Neutrophils                                | 1–12              | 3.6–10.1        | x 10 <sup>9</sup> /L  |
|  | 13–24             | 3.8–12.3        | x 10 <sup>9</sup> /L  |
|  | 25–42             | 3.9–13.1        | x 10 <sup>9</sup> /L  |
|  | >42               | 3.6–13.1        | x 10 <sup>9</sup> /L  |
| Eosinophils                                | 1–>42             | <0.6            | x 10 <sup>9</sup> /L  |
| Lymphocytes                                | 1–12              | 1.1–3.5         | x 10 <sup>9</sup> /L  |
|  | 13–24             | 0.9–3.9         | x 10 <sup>9</sup> /L  |
|  | 25–42             | 1.0–3.6         | x 10 <sup>9</sup> /L  |
|  | >42               | 0.9–3.9         | x 10 <sup>9</sup> /L  |
| Platelets                                  | 1–12              | 170–390         | x 10 <sup>9</sup> /L  |
|  | 13–24             | 170–410         | x 10 <sup>9</sup> /L  |
|  | 25–42             | 150–430         | x 10 <sup>9</sup> /L  |
|  | >42               | 150–430         | x 10 <sup>9</sup> /L  |
| Red Blood Cells (RBC)                      | 1–12              | 3.52–4.52       | x 10 <sup>12</sup> /L |
|  | 13–24             | 3.20–4.41       | x 10 <sup>12</sup> /L |
|  | 25–42             | 3.10–4.44       | x 10 <sup>12</sup> /L |
|  | >42               | 3.10–4.52       | x 10 <sup>12</sup> /L |
| Haemoglobin                                | 1–12              | 110–143         | g/L                   |
|  | 13–24             | 100–137         | g/L                   |
|  | 24–42             | 98–137          | g/L                   |
|  | >42               | 98–143          | g/L                   |
| Haematocrit                                | 1–12              | 0.31–0.41       |                       |
|  | 13–24             | 0.30–0.38       |                       |
|  | 25–42             | 0.28–0.39       |                       |
|  | >42               | 0.28–0.41       |                       |
| Mean Cell Haemoglobin (MCH)                | 1–>42             | 27.5–33.0       | pg                    |
| Mean Cell Haemoglobin Concentration (MCHC) | 1–>42             | 320–360         | g/L                   |
| Erythrocyte Sedimentation Rate (ESR)       | 1–12              | <30             | mm/hour               |
|  | 13–24             | <64             | mm/hour               |
|  | >24               | <72             | mm/hour               |
| Bicarbonate (Total CO <sub>2</sub> )       | All               | 18–26           | mmol/L                |
| Creatinine                                 | All               | 32–73           | mmol/L                |
| Protein (Total)                            | 14–40             | 61–75           | g/L                   |
| Albumin                                    | 27–40             | 33–40           | g/L                   |
| Urate                                      | 1–14              | 0.10–0.25       | mmol/L                |
|  | 15–27             | 0.10–0.30       | mmol/L                |
|  | >27               | 0.10–0.35       | mmol/L                |

## Appendix E: Seat belt positioning in pregnancy

Improper seat belt use is a major risk factor for adverse outcomes during motor vehicle collisions.<sup>3</sup>

Correct positioning of the seat belt includes:

- Lap belt over hips below uterus
- Sash between breasts above uterus

Correct application of the seat belt

- Reduces maternal/fetal injuries
- Reduces ejection mortalities
- Improves fetal survival

Use of a lap belt only is not recommended. It increases uterine flexion and may increase placental abruption.

*Correct and incorrect positioning of seat belt*

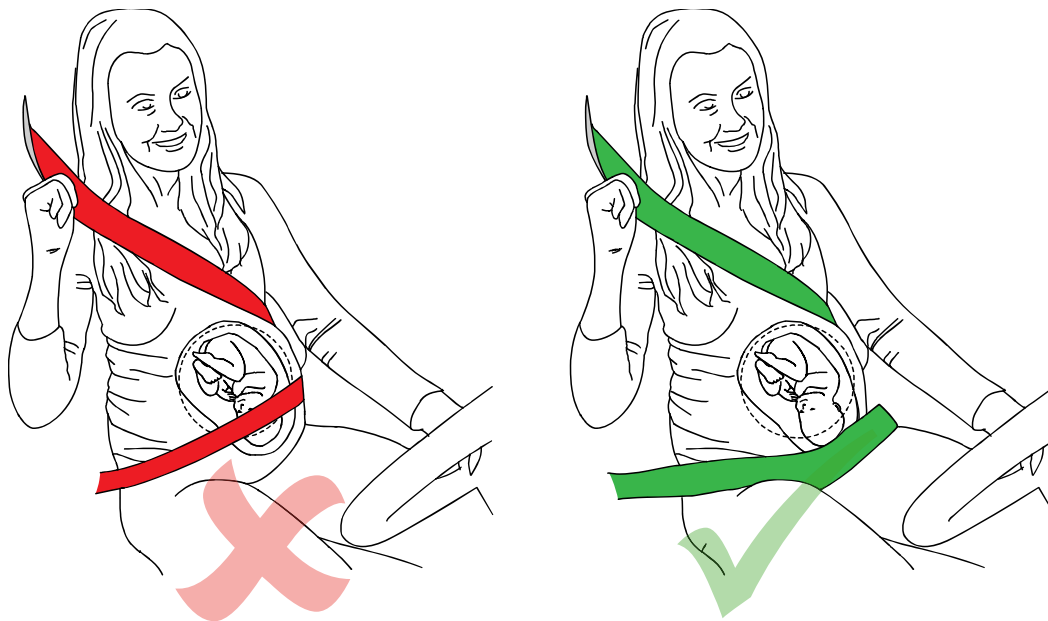


Image produced by: Clinical Multimedia Unit, Metro North Hospital and Health Service, Queensland.

## Appendix F: Estimating gestational age by fundal height

Measure the vertical distance in the midline from the symphysis pubis to the top of the fundus in centimetres. This measurement correlates approximately with the gestational age.

Considerations that may impact on accuracy include:

- Multiple pregnancy
- Growth restriction
- Poly/oligohydramnios
- Breech or abnormal lie

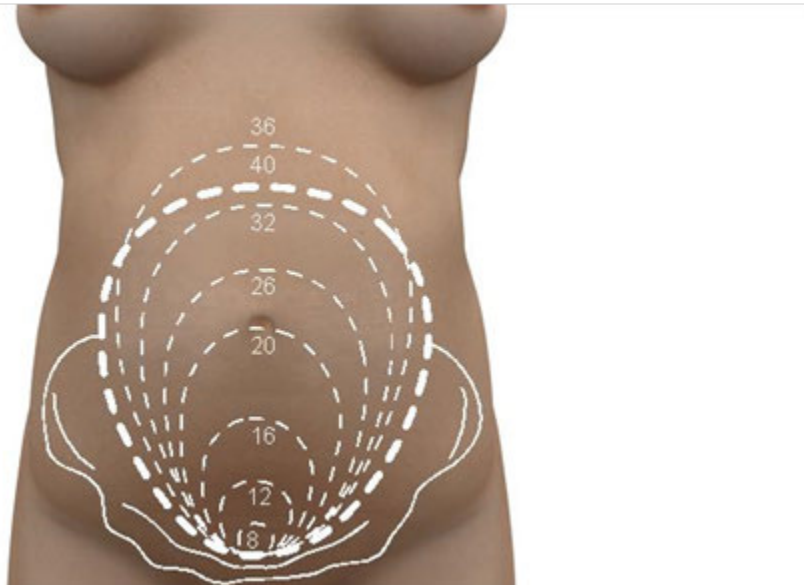
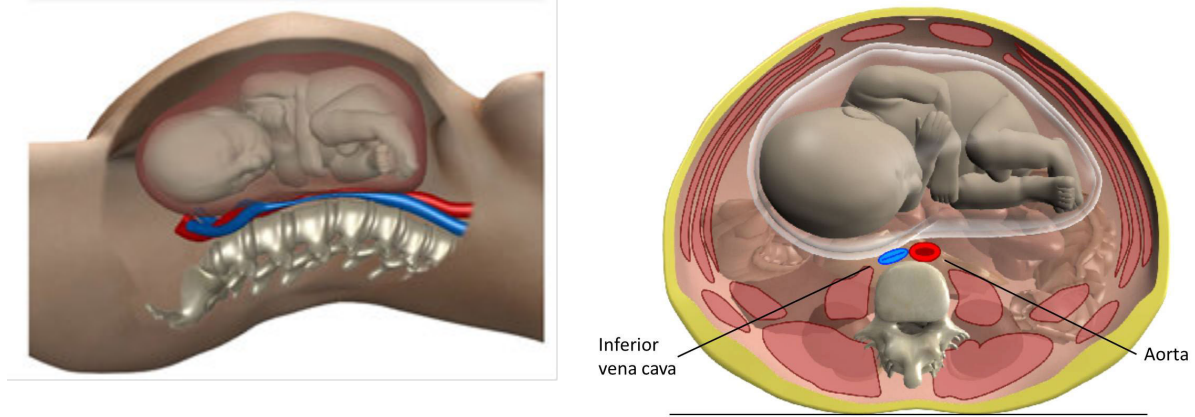


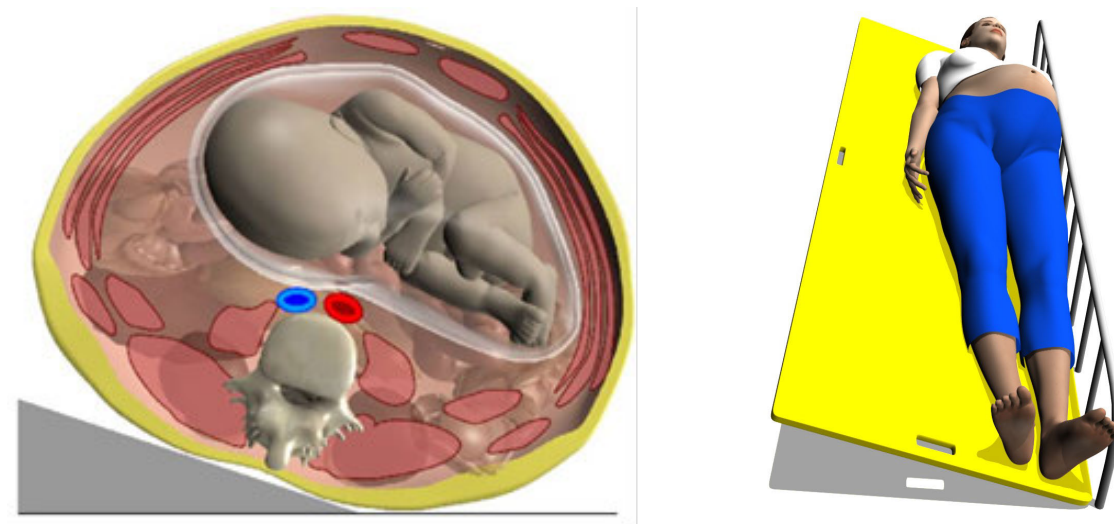
Image produced by: Clinical Multimedia Unit, Metro North Hospital and Health Service, Queensland

## Appendix G: Positioning to relieve aortocaval compression

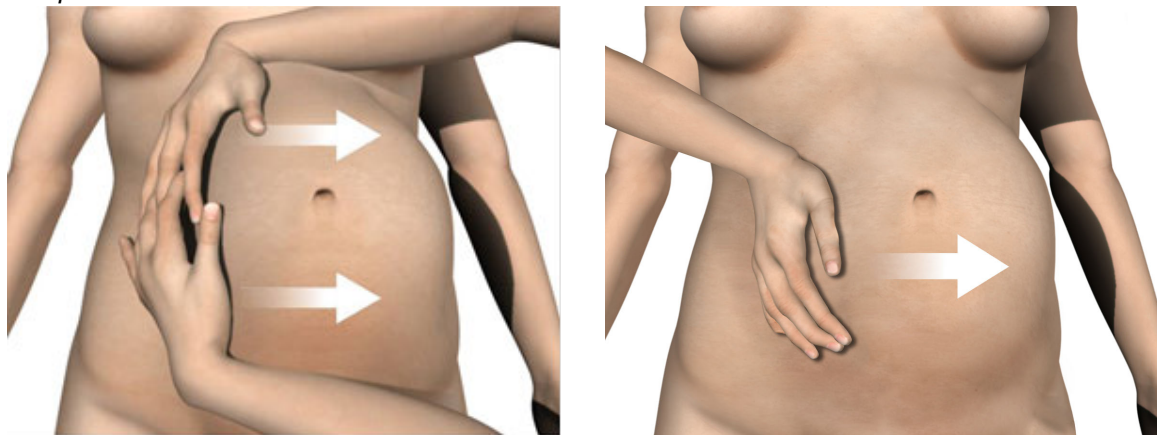
*Inferior vena cava compression when positioned supine*



*Left lateral tilt (right side up) 15-30 degrees to relieve compression*



*Manual displacement of the uterus to relieve compression—preferred position for cardiac compressions*



Images produced by: Clinical Multimedia Unit, Metro North Hospital and Health Service, Queensland

## Appendix H: Approximate fetal effective doses (mSv) from common radiological examinations

Note: Treat all doses as indicative only. Individual doses can differ from tabulated values by as much as a factor of 10, except for those examinations remote from the lower abdomen.

| Examination                         | 1 <sup>st</sup> Trimester | 3 <sup>rd</sup> Trimester |
|-------------------------------------|---------------------------|---------------------------|
| <b>Conventional radiography</b>     |                           |                           |
| Skull                               | <0.01                     | <0.01                     |
| Chest                               | <0.01                     | <0.01                     |
| Cervical spine                      | <0.01                     | <0.01                     |
| Thoracic spine                      | <0.01                     | <0.01                     |
| Lumbar spine                        | 2                         | 6                         |
| Abdomen                             | 1.5                       | 2.5                       |
| Pelvis                              | 1                         | 2                         |
| Intravenous pyelogram (IVP)         | 2                         | 10                        |
| Extremities                         | <0.01                     | <0.01                     |
| Mammography                         | <0.01                     | <0.01                     |
| Barium meal                         | 1                         | 6                         |
| Barium enema                        | 7                         | 25                        |
| <b>Computerised Tomography (CT)</b> |                           |                           |
| Head                                | <0.005                    | <0.005                    |
| Neck                                | <0.005                    | <0.01                     |
| Chest without portal phase          | 0.1                       | 0.6                       |
| Chest with portal phase             | 1                         | 7                         |
| Chest (pulmonary embolism)          | 0.1                       | 0.4                       |
| Chest/abdomen/pelvis                | 12                        | 13                        |
| Abdomen/pelvis – single phase       | 12                        | 12                        |
| Abdomen/pelvis – multiple phase     | 15                        | 30                        |
| Thoracic spine                      | 0.2                       | 1.0                       |
| Lumbar spine                        | 10                        | 25                        |
| Pelvimetry                          | –                         | 0.2                       |

NB: < = less than

Source: Australian Radiation Protection and Nuclear Safety Agency. Radiation protection in diagnostic and interventional radiology; Radiation protection series RPS 14.1. 2008.

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