Queensland Clinical Guidelines

Translating evidence into best clinical practice

Maternity and Neonatal **Clinical Guideline**

Trauma in pregnancy

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Information in this guideline is current at time of publication.

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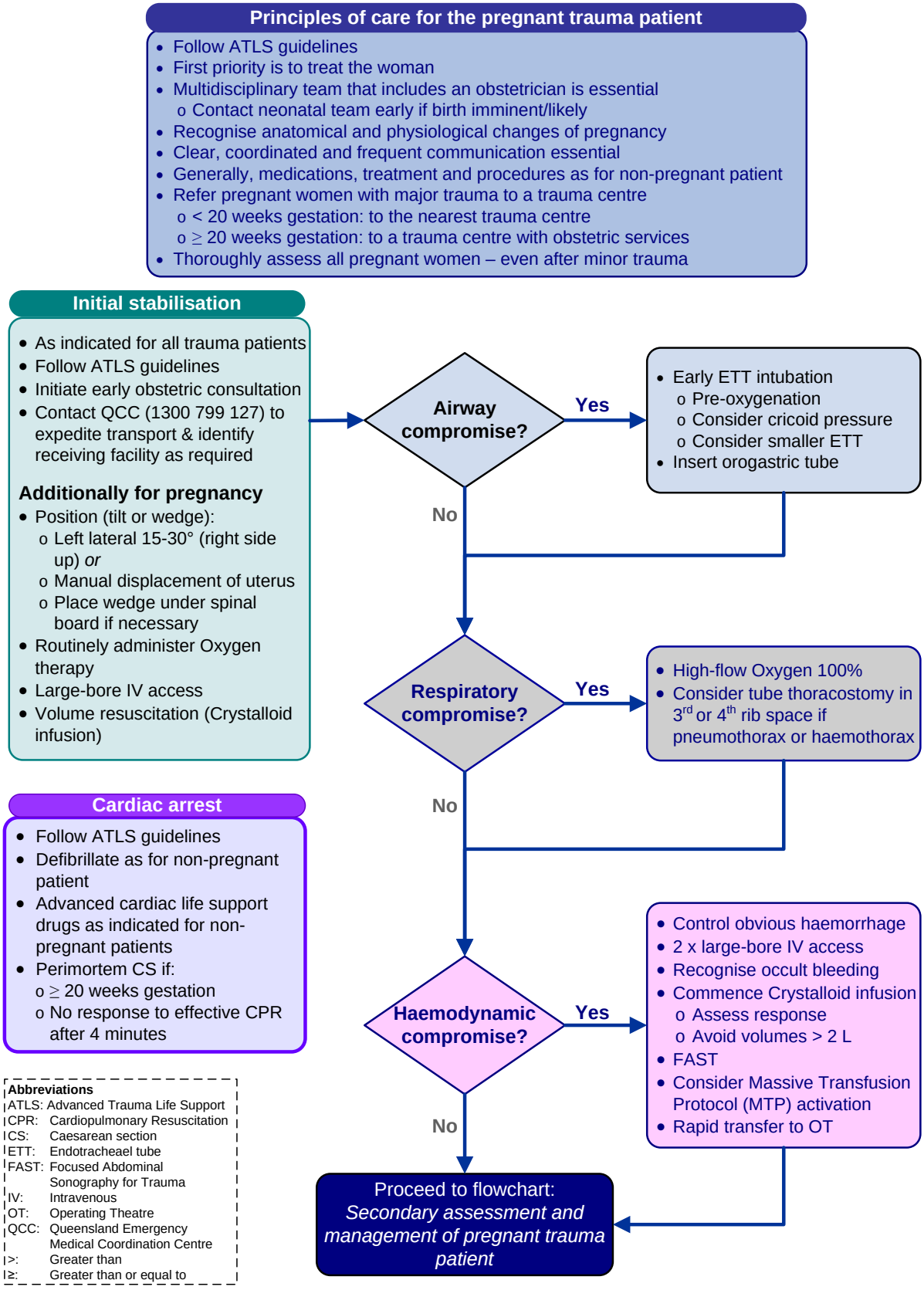
This Guideline does not address all elements of standard practice and assumes that individual clinicians are responsible to:

- Discuss care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes the use of interpreter services where necessary
- Advise consumers of their choice and ensure informed consent is obtained
- Provide care within scope of practice, meet all legislative requirements and maintain standards of professional conduct
- Apply standard precautions and additional precautions as necessary, when delivering care
- Document all care in accordance with mandatory and local requirements

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



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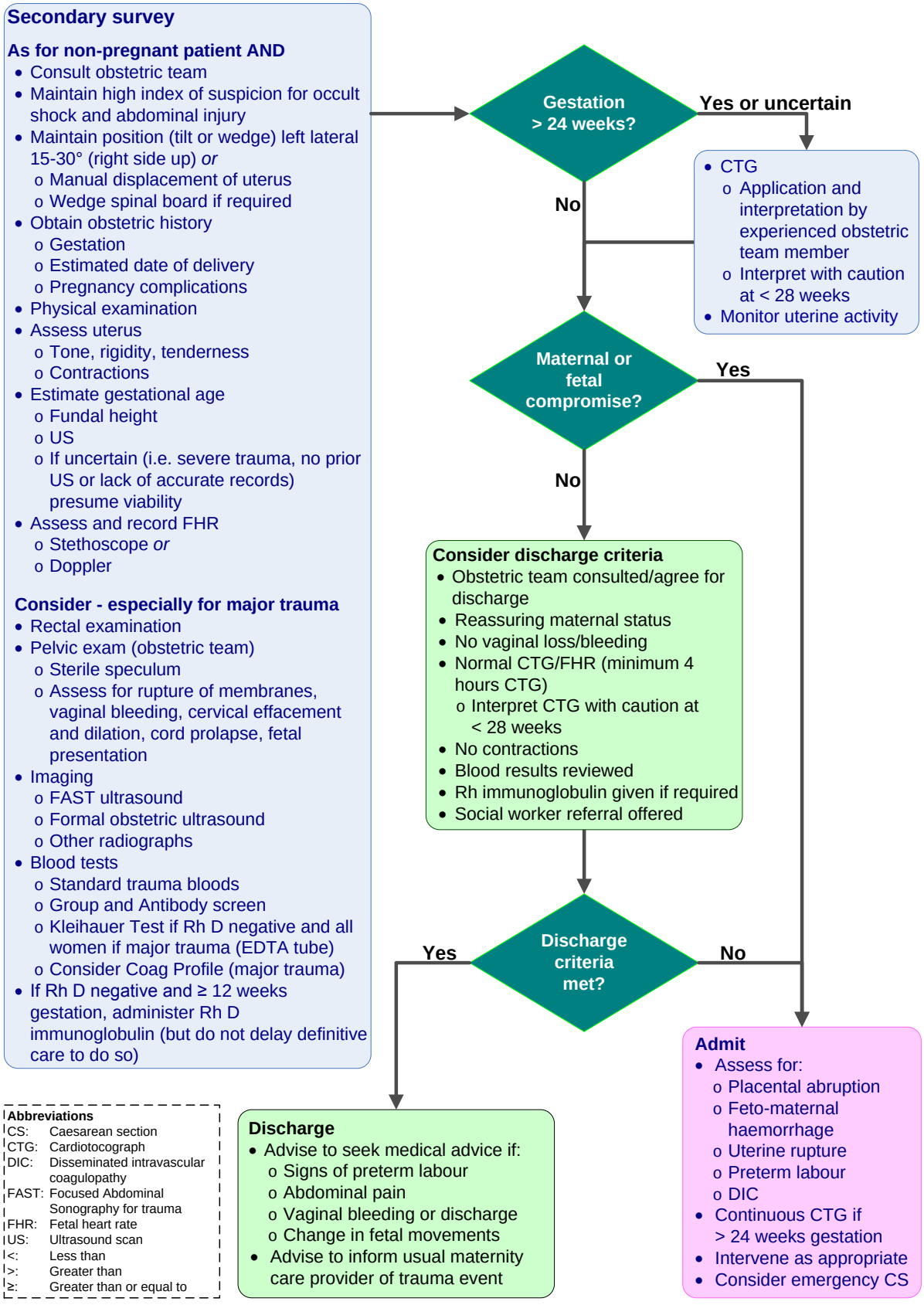
Flow Chart: Secondary assessment and management of the pregnant trauma patient



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Abbreviations

ATLS	Advanced trauma life support
bpm	Beats per minute
BP	Blood pressure
CPR	Cardiopulmonary resuscitation
CS	Caesarean section
CT	Computerised tomography
CTG	Cardiotocograph
DIC	Disseminated intravascular coagulopathy
ETT	Endotracheal tube
FAST	Focused Abdominal Sonography for Trauma
FHR	Fetal heart rate
FMH	Feto-maternal haemorrhage
FFP	Fresh frozen plasma
INR	International normalised ratio
IV	Intravenous
IVC	Inferior vena cava
mSv	millisievert
MTP	Massive Transfusion Protocol
PPH	Postpartum haemorrhage
QAS	Queensland Ambulance Service
pCO_2	Partial pressure of carbon dioxide
PT	Prothrombin time
QCC	Queensland Emergency Medical System Coordination Centre
RBWH	Royal Brisbane and Women's Hospital, Brisbane, Queensland
US	Ultrasound scan
rad	Radiation-absorbed dose

Definitions

Major trauma	Classification of trauma depends on the mechanism and severity of injury. Refer to Appendix A: Classification of major trauma.
Obstetrician	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 to Gynaecologists, General Practitioner Obstetricians, Specialist Obstetricians, Consultants, Senior Registrars and Obstetric Fellows.
Informed consent	When a woman consents to a recommendation about her care after a process of information exchange that involves providing her with sufficient, evidence-based information about all the options for her care so that she can make a decision, in the absence of coercion by any party, that reflects self-determination, autonomy and control.[1]
Sievert	International unit of measurement for the biological effect to human tissue by ionizing radiation.
Woman centred care	Woman centred care includes the affordance of respect and dignity, by supporting the woman to be central and active in her own care[2] through[3]: • Holistic care taking account of the woman's physical, psychosocial, cultural, emotional and spiritual needs • Focussing on the woman's expectations, aspirations and needs, rather than the institutional or professional needs • Recognising the woman's right to self determination through choice, control and continuity of care from a known or known caregivers • Recognising the needs of the baby, the woman's family and significant others

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1 Introduction

Trauma affects up to 8% of all pregnancies and is a common cause of non-obstetric maternal morbidity and mortality.[4] Both blunt and penetrating (gunshot or knife related) trauma is encountered in Australia but blunt trauma is the most common. Direct fetal injuries occur in less than 1% of cases of severe blunt abdominal trauma.[5] Even minor injuries in the pregnant woman can be associated with placental abruption, preterm labour, massive feto-maternal haemorrhage, uterine rupture and fetal loss.[4,5] The evidence for care provision is limited with the majority of studies being retrospective and reported outcomes varying widely.[6]

1.1 Principles of care

The goal of treatment is maintenance of utero-placental perfusion and fetal oxygenation by avoiding hypoxia and preventing hypotension, acidosis and hypothermia.

- Manage pregnant trauma patients in accordance with the Advanced Trauma Life Support (ATLS) guidelines[6-9]
- The first priority is identification of life threatening injuries to the woman[4,8]
- Thoroughly assess the woman as fetal survival is directly related to maternal wellbeing[4,6]
- A multidisciplinary team approach that includes early involvement of an obstetrician is essential[4,10]
    - Involve neonatal team early if birth imminent/likely
- Recognise maternal anatomical and physiological changes due to pregnancy[4,10]
- Clear, coordinated and frequent communication between care providers is essential[11,12]
- Generally, do not withhold medications, tests, treatments and procedures required for the woman's stabilisation because of pregnancy[6]
- Refer all major trauma cases to a trauma centre [refer to Appendix A: Classification of Major Trauma]
    - If less than 20 weeks gestation, transfer to the nearest trauma centre
    - If greater than or equal to 20 weeks gestation, transfer to a trauma centre with obstetric services[4]
- Provide pregnant women with minor injuries, medical treatment for their injuries and appropriate fetal assessment[13]

1.2 Patient stratification

Table 1. Patient category

Category	Considerations
Potentially pregnant	• History alone is unreliable in excluding pregnancy • Perform a pregnancy test on all women of child bearing age who experience trauma[5,7,8,14] • Where pregnancy is confirmed after a trauma event, provide information and counselling on the implications of the care provided (e.g. diagnostic imaging)
Pre-viable gestation (< 24 weeks)	• Dates and estimations of gestational age may be inaccurate or unreliable • Where there is doubt about the gestation, presume viability • Cardiotocograph (CTG) monitoring not usually indicated • Document presence/absence of fetal heart rate (FHR)
Viable gestation	• Gestations greater than or equal to 24 weeks • Commence CTG monitoring as soon as feasible[15]
Perimortem	• Refer to Section 3.1 Perimortem caesarean section (CS) • Refer to Appendix B: Perimortem caesarean section procedure

1.3 Family support

- Share and discuss information with the woman and/or her family in a manner that enables informed choice and consent[16] [refer to Definition of terms and Disclaimer]
- Support a woman centred approach to care and decision making [refer to Definition of terms]
- Provide frequent information about fetal and maternal status to the woman and/or family[11]
  - Explain rationale and risk/benefit for all procedures to enable informed decision making (as circumstances allow)
- Consider intimate partner violence as a cause of trauma in pregnancy[11]
- 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)
- Offer debriefing to the woman and/or family following pregnant trauma care events[17]

1.4 Transfer and retrieval

- Manage pregnant women at greater than or equal to 20 weeks gestation (or with fundal height higher than umbilicus) who have major trauma, at a Trauma Centre with obstetric services
- In Queensland, Trauma Centres with obstetric services are located at The Townsville Hospital (TTH) and the Royal Brisbane and Women's Hospital (RBWH)
  - If outside the Brisbane greater metropolitan area, arrange inter-hospital transfer via Queensland Emergency Medical System Coordination Centre (QCC)[18]
    - Telephone QCC: 1300 799 127
  - Within the greater metropolitan area of Brisbane, transfer via Queensland Ambulance Service (QAS) to the Royal Brisbane and Women's Hospital (RBWH)
    - Liaise with the RBWH directly – telephone (07) 3646 5900
- Manage pregnant women at less than 20 weeks gestation at a Trauma Centre
  - Arrange transfer/retrieval as per usual local protocols for major trauma
- Where feasible, major trauma surgery should occur in Level 4 or higher operating suite[19]
- Refer to Appendix A: Classification of major trauma in pregnancy

1.5 Clinical standards

- Accurate documentation is essential in all cases of maternal collapse, whether or not resuscitation is successful[11,17]
- Consider use of *Queensland Maternity Early Warning Tools* to detect deterioration of pregnant patients[11]
- Review all cases of maternal collapse through the clinical governance process[17]
- Report all maternal deaths as per legislated requirements[20]
- Offer debriefing to clinicians involved in pregnant trauma care events[17]
- Educate clinicians about adaptations to cardiopulmonary resuscitation (CPR) for the pregnant woman[17,21]
- Include information about CPR in the pregnant woman in all generic life support training[17,21]
- Ensure equipment to enable a perimortem CS is accessible in all areas where maternal collapse may occur, including in the Emergency Department[17]
- 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]

2 Physiological changes in pregnancy

An understanding of the anatomic and physiologic alterations of pregnancy is essential.[22] Refer to Appendix C for normal pregnancy values.

Table 2. Physiological and physical changes in pregnancy

	Changes in pregnancy	Implication
Cardiovascular system		
Plasma volume	Increased by up to 50%	Dilutional anaemia Reduced oxygen-carrying capacity Signs of shock due to blood loss appear late
Heart rate	Increased 15–20 bpm	Increased CPR demands
Cardiac output	Increased by 40% 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	Sequesters blood during CPR
Arterial blood pressure (BP)	Decreased by 10–15 mmHg	Decreased reserve
Venous return	Decreased by pressure of gravid uterus on inferior vena cava (IVC)	Increased CPR circulation demands Increased reserve
Coagulation	Increased concentrations of most clotting factors	Activated state of coagulation cascade Increased tendency for thrombosis
Respiratory system		
Respiratory rate	Increased	Decreased buffering capacity, acidosis more likely
Oxygen consumption	Increased by 20%	Hypoxia develops more quickly
Residual capacity	Decreased by 25%	Decreased buffering capacity, acidosis more likely
Arterial pCO_2	Decreased	Decreased buffering capacity, acidosis more likely
Laryngeal oedema	Increased	Difficult intubation
Mucosal congestion	Increased	Predisposition to airway bleeding
Other changes		
Gastric motility	Decreased	Increased risk of aspiration
Lower oesophageal sphincter	Relaxed	Increased risk of aspiration
Uterus	Enlarged	Diaphragmatic splinting reduces residual capacity and makes ventilation more difficult Aortal compression causes supine hypotension, reduced venous return and significantly impairs CPR Heart rotation to the left – left axis deviation on ECG can be normal in 3rd trimester
Weight	Increased neck and mammary fat levels	Difficult airway management
Pelvic vasculature	Hypertrophied	Potential for massive retroperitoneal haemorrhage with pelvic fracture, uterine trauma
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 60%. Serum urea, nitrogen, creatinine reduced	'Normal' serum urea nitrogen and creatinine may reflect seriously compromised function

Adapted from Royal College of Obstetricians and Gynaecologists. Maternal collapse in pregnancy and puerperium. Green-top Guideline No. 56. 2011.

2.1 Implications for management

Table 3. Implications for management

Aspect	Clinical care
Positioning	• After 20 weeks gestation, aortocaval compression by the uterus impedes resuscitation by: o Decreasing venous return causing supine hypotension o Reducing stroke volume and cardiac output[17,23] and o Decreasing the effectiveness of thoracic compressions[17,23-25] • Position the woman to minimise inferior vena cava (IVC) compression o Consider gestation and the ability to provide effective care (e.g. intubation) when determining positioning requirements o Left lateral tilt 15–30 degrees[6,8,26,27] (right side up) o Place a firm wedge under the right buttock/hip to achieve tilt o In cases of major trauma, place the wedge under the spinal board[17] • If lateral tilt is not feasible, use manual uterine displacement to minimise IVC compression[5,17,23,26] o Standing on the woman's left, the clinician places two hands around the uterus and gently pulls the uterus towards themself[25] • Refer to Appendix F: Left lateral tilt positioning
Common pitfalls	• Common pitfalls include failure to: o Suspect or recognise shock in the presence of normal vital signs o Suspect or recognise abdominal injury because of a benign examination o Treat shock aggressively with volume replacement (Crystalloids/blood) o Suspect and screen for intimate partner violence o Recognise and treat supine hypotensive syndrome o Conduct necessary radiology studies secondary to fear of injury to the fetus o Observe and cardiotocographically monitor all women with minor trauma and a viable fetus (greater than 24 weeks gestation) o Detect early pregnancy (by not ordering a urine pregnancy test) o Test for Rh D status and administer Rh D immunoglobulin in Rh D negative women o Initiate perimortem CS within 4–6 minutes of no response to effective CPR

3 Cardiac arrest

Table 4. Cardiac arrest

Aspect	Clinical care
Context	• The efficiency of CPR in maintaining organ perfusion is significantly reduced by aortocaval compression[5,28] • There is limited evidence about the degree of tilt required to achieve IVC decompression and the effectiveness of chest compressions performed in the left lateral[29]
Management	• Follow standard guidelines for cardiac arrest[6] • Position the woman to reduce IVC compression[5] o Left lateral tilt 15–30 degrees (right side up) o Manual displacement of the uterus[29] o Place wedge under the spinal board if necessary o Refer to Section 2.1 Implications for management • Defibrillate as for the non-pregnant trauma patient – no significant shock is delivered to the fetus[25,29] o Remove CTG leads prior to defibrillation[25,30] • Administer advanced cardiac life support drugs as would be indicated for the non-pregnant patient[17,29]

3.1 Perimortem caesarean section

Table 5. Perimortem caesarean section

Aspect	Clinical care
Definition	• A CS that is initiated after CPR has commenced[31]
Context	• May improve survival of either or both the woman and fetus[6] but should be considered a resuscitative procedure performed primarily in the interests of maternal survival[17] o Case studies suggest improved maternal condition/survival results from the increase in venous return after removal of the gravid uterus from the IVC[28,29,31] • Survival and neurologic outcome of the viable fetus is related to time between maternal death and birth[14,24,29] o Best fetal survival occurs when birth is within 4 to 6 minutes of the maternal cardiac arrest[4,29,31] o Intact fetal survival has not been demonstrated beyond 30 minutes of cardiac arrest[4] • Delay in initiating a perimortem CS has been linked to adverse outcomes[11]
Management	• Where gestation is greater than 20 weeks, perform perimortem CS after 4 minutes of non-response to effective CPR[28] • Perform CS at the point of resuscitation[17] o Do not delay perimortem CS by moving the woman to an operating environment or by attempting to assess fetal viability[11,17,28] • Continue CPR during and after the procedure[12,28]

4 Assessment

Conduct the primary and secondary survey as for non-pregnant patients.[7,10] Additional considerations for pregnancy are outlined in Table 6 and Table 7. Secondary survey

4.1 Primary survey

Table 6. Primary survey additional considerations for pregnancy

Aspect	Clinical care
Airway and C-Spine	• Increased risk of failed intubation – consider: o Earlier intubation than for non-pregnant patients[17,22,27,32] o Use of a short handle laryngoscope o Cricoid pressure o A smaller endotracheal tube (ETT) due to laryngeal oedema[8,25] • Increased risk of aspiration o If intubated consider insertion of an orogastric tube[5] o Consider nasogastric tube if not intubated • Apply cervical spine collar
Breathing and ventilation	• Routinely administer supplemental high flow 100% Oxygen[5,8,10,17,27] • Ventilation volumes may need to be reduced because of elevated diaphragm[25] • If safe to do so, raise the head of the bed to reduce weight of uterus on the diaphragm and facilitate breathing[32] • If a chest tube is indicated, place tube 1–2 intercostal spaces above usual fifth intercostal space landmark due to raised diaphragm[5,6,27]
Circulation and haemorrhage control	• Control obvious external haemorrhage • Position with left lateral tilt 15–30 degrees[26,27] (right side up) [refer to Section 2.1] • Obtain large-bore intravenous (IV) access o Avoid femoral lines due to compression by gravid uterus • Commence Crystalloid IV o Assess response – maintain an awareness of pregnancy related physiological parameters o Aim to avoid large volumes of crystalloids (greater than 2 L) which may lead to pulmonary oedema due to the relatively low oncotic pressure in pregnancy[12] • Avoid vasopressors to restore maternal BP[27] as they may compromise utero-placental flow[33] • Maintain a high index of suspicion for bleeding and an awareness of the limitations of clinical signs[17] • Perform a thorough search for occult bleeding as maternal blood flow is maintained at expense of fetus[5] • Conduct Focused Abdominal Sonography for Trauma (FAST) to assess for intra-abdominal haemorrhage • If hypovolaemia is suspected, initiate fluid resuscitation to ensure adequate maternal and utero-placental perfusion[4,17,26] • Consider Massive Transfusion Protocol (MTP) activation if non-responsive to crystalloids • Rapid transfer to operating theatre as indicated • Refer to the Queensland Clinical Guideline *Postpartum haemorrhage* for blood/product replacement and MTP activation protocols[34] • Evaluate fetal heart rate[26] [refer to Table 7] but do not delay resuscitation for fetal assessments[4]
Disability	• Rapid neurological evaluation[30] utilising the Glasgow Coma Scale

4.2 Secondary survey

Once the woman is stabilised, further assessment can be undertaken.[6]

Table 7. Secondary survey additional considerations for pregnancy

Aspect	Clinical care
Obstetric history	• Gestation in weeks/estimated date of delivery • Previous pregnancy complications • Prenatal care • History of vaginal bleeding
Physical Examination	• Head to toe examination as for non-pregnant trauma patients[26] • Inspect abdomen for ecchymosis or asymmetry • In cases of motor vehicle accident, incorrect positioning of the seat belt across the gravid uterus may [refer to Appendix D: Seat belt positioning in pregnancy]: o Cause marked bruising of the abdomen o Increase the risk of placental abruption o Increase the risk of uterine rupture • Assess uterine tone, contractions, rigidity, tenderness, palpable fetal parts o The gravid abdomen may be relatively insensate to peritoneal irritation
Estimation of gestational age	• Can be estimated by measuring fundal height o 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 o Refer to Appendix E: Estimation of gestational age • Ultrasound scan (US) estimation[31] o Biparietal diameter (BPD) of 60 mm generally corresponds to a gestation age of approximately 24 weeks • Mark the top of the fundus to evaluate the possibility of concealed abruption as noted by increasing fundal height[10]
Fetal heart rate monitoring	• Normal FHR 110–160 bpm[35] • FHR can be assessed using standard stethoscope from about 20 weeks and Doppler from about 12 weeks[5,33] o Differentiate maternal and FHR as maternal tachycardia may cause confusion[26] • For gestations greater than 24 weeks (major trauma), initiate continuous cardiotocography (CTG) as soon as feasible [5,26] o Good sensitivity for immediate adverse outcome o Detects uterine irritability and abnormal fetal heart rate patterns • Abnormalities may be the only indication of injury or compromise to the fetus[27] o Persistent fetal bradycardia more than 5 minutes, loss of baseline variability or recurrent complex variable or late decelerations indicates fetal compromise[35] o Sinusoidal trace indicates fetal anaemia • CTG application and interpretation requires clinicians trained in their use o 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[36] o CTG trace review should be performed by a clinician experienced and confident with CTG interpretation relevant to the gestation[36] o Move staff and equipment to the woman's location rather than transporting a woman to an obstetric unit for monitoring
Pelvic/vaginal examination	• If major trauma, perform a rectal examination to assess for spinal cord damage or local trauma • Perform sterile speculum vaginal examination[8,26] as clinically indicated (preferably by an obstetric/maternity team member[8,26]) o Evaluate for ruptured membranes, vaginal bleeding, cord prolapse, cervical effacement and dilation in labour, fetal presentation[8] o Vaginal bleeding may indicate preterm labour, abruption, pelvic fracture or uterine rupture[10] • Consider urinary catheter insertion[32]

4.3 Diagnostic imaging

Table 8. Diagnostic imaging

Aspect	Clinical care
Context	• The fetus is most vulnerable to radiation during the first 15 weeks of gestation[37] • The risks of radiation to the fetus are small compared with the risk of missed or delayed diagnosis of trauma[38] • 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 mSv[39] • 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[4] • Gadolinium has known teratogenic effects on animals and is not recommended unless benefits clearly outweigh the risks[40]

Management	• X-ray examinations of the extremities, head and skull, mammography and computerised tomography (CT) examinations of the head and neck can be undertaken on pregnant or possibly pregnant women without concern[39,41]
	• Other X-ray examinations may also be undertaken if the radiation dose to the embryo or fetus is likely to be less than 1 mSv[41,42]
	• Where a procedure on a pregnant woman may result in a radiation dose of more than 1 mSv to an embryo or fetus, the following is required[41,42]:
	  o Be justified on an individual basis
	  o Include an assessment of the risks to the:
	  ▪ Embryo or fetus from radiation exposure
	  ▪ Woman if the procedure is not performed
	  o An estimate of the expected radiation dose to the embryo or fetus is made and documented in the health record
	  ▪ If practicable, consult a medical physicist if individual estimation/calculation of embryo or fetal dose is required
	• Optimisation of the examination's exposure parameters has the largest effect on doses
	• 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)[41]
	• It is preferable to perform a single CT scan with iodinated contrast rather than perform multiple suboptimal studies without contrast[4]
	• Refer to Appendix G: Approximate fetal effective doses (mSv) arising from common radiological examination of pregnant women
	• Provide information and counselling to women exposed to radiation during diagnosis and care[43]
	• Refer to local Radiation Safety and Protection Plans

Ultrasound	• US can assess solid organ injury, intra-peritoneal fluid, gestational age, FHR, fetal activity, fetal presentation, placental location, amniotic fluid volume[4,38] • US is not a reliable indicator of recent placental abruption[4,38,44] • FAST scan is as accurate as in non-pregnant patients[8] for intra-abdominal free fluid • Consider formal obstetric US following FAST as clinically indicated

5 Obstetric complications

5.1 Feto-maternal haemorrhage

Table 9. Feto-maternal haemorrhage

Aspect	Clinical care
Context	• Feto-maternal haemorrhage (FMH) occurs in approximately 10–30% of pregnant trauma patients[5,30] • 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 • Clinical presentation of FMH is variable and can be non-specific[45,46] o Decreased or absent fetal movements have been reported[45,46] o Fetal distress – especially if the fetal heart tracing is sinusoidal (indicating fetal anaemia) o Massive FMH is a rare but severe complication which can result in fetal anaemia, fetal hypoxia, intrauterine death or neonatal neurologic damage[46] o Women may experience a transfusion reaction (nausea, oedema, fever, and chills)[45] o May occur more commonly with anteriorly located placentae and in women who experience uterine tenderness after trauma[47]
Assessment of feto-maternal haemorrhage	• The Kleihauer test is used to detect and quantify FMH[48] o Commonly to determine dose of Rh D immunoglobulin for Rh D negative women[49] o Results are reported quantitatively in mL of fetal blood within maternal circulation o A 'negative' result is commonly understood to be less than 1 mL of fetal blood o The Kleihauer test is not a test for placental abruption[44,50] o The evidence is limited about the usefulness of a positive Kleihauer test for predicting outcomes and guiding clinical management [49,51-53] (beyond determining the dose of Rh D immunoglobulin for Rh D negative women) • Flow cytometry is the most accurate quantitative test for FMH[48] and will be initiated by Pathology Queensland as a standard procedure when the quantitative result of the Kleihauer test is greater than 4 mL
Management	• Continuous electronic fetal monitoring of the viable fetus • Abdominal US to detect fetal heart activity, placental location, amniotic fluid index, suspected intraperitoneal bleeding, gestational age, fetal weight • Elevated peak systolic velocity of the fetal middle cerebral artery correlates with fetal anaemia[54,55] • Emergency CS may be indicated
Recommendation	• Following a trauma event: o Kleihauer test is recommended for all Rh D negative women greater than 12 weeks gestation[48,56,57] to determine the dose of Rh D immunoglobulin required [refer to Table 10] o Consider a Kleihauer test for all women with major or abdominal trauma to aid identification of FMH and inform immediate and longer term pregnancy management and outcomes o Maintain a high index of suspicion and clinical surveillance for the possibility of significant FMH

5.1.1 Prevention of Rhesus immunisation

Table 10. Rh D immunoglobulin

Aspect	Clinical care
Assessment	• For the Rh D negative woman greater than 12 weeks gestation, collect maternal blood (blood group, antibody screen and Kleihauer test) prior to administration of Rh D immunoglobulin[56] • Do not delay or withhold administration of Rh D immunoglobulin based on or pending the results of quantitative testing
Rh D immunoglobulin	• Indicated for the non-sensitised Rh D negative woman within 72 hours of the sensitising event where: o Gestation is greater than 12 weeks o Gestation is unknown/possibly greater than 12 weeks • Not indicated when gestation is less than 12 weeks • If not offered within 72 hours, a dose offered within 9–10 days may provide protection[56] • 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[48]
Dose	• Rh D immunoglobulin 625 IU via intramuscular injection [48,56] • If FMH is quantified at greater than 6 mL, give additional doses of Rh D immunoglobulin sufficient to provide immunoprophylaxis within 72 hours[56] (625 IU for each additional 6 mL (or part thereof) of fetal red cells detected)
Contraindications	• Rh D positive woman • Rh D negative woman with preformed Anti-D antibodies[56] • Previous sensitivity or allergy to Rh D immunoglobulin

5.2 Preterm labour

Table 11. Preterm labour

Aspect	Clinical care
Context	• Onset of labour before 37 completed weeks gestation[50]
Clinical presentation	• Uterine contractions of more than 4 per hour accompanied by cervical change[8] • Cramping abdominal/back pain[50] • Pelvic pressure[50] • An increase or change in vaginal discharge[50] • Vaginal bleeding[50]
Management	• Consult with an obstetrician regarding management appropriate for the circumstances • Refer to the Queensland Clinical Guideline *Preterm Labour*[58]: o Consider tocolytic therapy o Consider corticosteroids aimed at promoting fetal lung maturity

5.3 Placental abruption

Table 12. Placental abruption

Aspect	Clinical care
Context	• Common complication of trauma especially following motor vehicle accidents[15] (rate in general obstetrical population of 0.4 to 1.3%)[59] o One study reported frequency after motor vehicle accident with severe, non-severe or no injury of 13%, 7.4% and 8.5% respectively[59] • Leading cause of fetal death following trauma[4,15] accounting for 50–70% of all trauma-related fetal losses[4] • Can occur with rapid deceleration without direct trauma[7] • Can occur following relatively minor trauma[7,47] • Has not been reported when less than 1 contraction is present in any 10 minute interval over a 4 hour period[6]
Clinical presentation	• Abdominal pain[44,60] • Vaginal bleeding[60] – 80% of cases[50] o Amount does not necessarily correlate with severity[50] • Uterine contractions[4] • Uterine tenderness[60]/tense or 'woody' feel[44] • Expanding fundal height[10] • Evidence of fetal compromise[44] • Maternal haemodynamic instability[50] • Can also present asymptomatically[50]

Investigations	• Although US may detect abruption, it is not sensitive enough to exclude abruption[44,60]
	  o False negative reported 50–80%[38]
	• CTG is better than US in risk stratifying for suspected placental abruption[4,5]
	  o Uterine contractions have high-frequency, low-amplitude pattern with an elevated baseline tone[50]
	  o Fetal heart rates can show recurrent late or variable decelerations, bradycardia, or sinusoidal patterns[50]
	• Consider feto-maternal haemorrhage[17] [refer to Table 10]
	• Request full blood count, coagulation studies, blood group and antibody[50]

Management	• Difficult to diagnose in mild forms[12,15]
	• Consider admission for surveillance as clinically indicated
	• Give Rh D immunoglobulin to all non-sensitised Rh D negative women independent of whether routine antenatal prophylactic Rh D immunoglobulin has been administered[17] [refer to Table 9]
	• Consider antenatal corticosteroids between 24 and 34 weeks + 6 days gestation[17]
	• Monitor for disseminated intravascular coagulopathy (DIC) and request urgent clotting studies, platelet count as indicated[44]
	  o Do not delay treatment by waiting for coagulation results if massive blood loss occurs[44]
	• Significant placental abruption requires urgent delivery by CS[44]
	  o Incision – mid line preferable if other abdominal injuries suspected
	  o Refer to Queensland Clinical Guideline *Postpartum haemorrhage* for management of PPH, blood/product replacement and MTP activation protocols[34]

5.4 Uterine rupture

Table 13. Uterine rupture

Aspect	Clinical care
Context	• Uterine rupture is more likely with advanced gestational age and severe direct abdominal trauma[5] • Diagnosis usually made on US[50] (extrusion of uterine contents, free fluid in pelvis)
Clinical presentation	• CTG abnormalities[12,50] (most common feature) • Fetal demise[50] • Positive FAST • Uterine tenderness/pain[50] • Vaginal bleeding[50] • Palpable fetal parts[50] • Maternal shock including hypotension and tachycardia[50]
Management	• CS with midline laparotomy • Urgent delivery of fetus • Repair of uterus (simple repair, subtotal hysterectomy or total hysterectomy) as indicated by individual circumstances[12] • Prompt haemodynamic resuscitation with blood products decreases risk of DIC[61] • Hysterectomy if uncontrolled haemorrhage[61]

5.5 Amniotic fluid embolism

Table 14. Amniotic fluid embolism

Aspect	Clinical care
Context	• Exposure of the amniotic fluid to the maternal circulation may cause amniotic fluid embolism and DIC[5] although the exact mechanism is unknown[50]
Clinical presentation	• Maternal hypotension[17,50] (100% of women[12,25]) • Respiratory distress • Seizure[17] • Cardiac arrest[17,50] (87% of women[25]) • Fetal distress develops acutely[17,50] • Massive haemorrhage[17] • Coagulopathy/DIC[17,50]
Management	• Supportive care – there is no proven effective treatment[12,17,25] • Resuscitation and airway management[50] • Multidisciplinary care • Blood product replacement including Fresh Frozen Plasma (FFP), Platelets and Cryoprecipitate[50]

5.6 Disseminated intravascular coagulopathy

Table 15. Disseminated intravascular coagulopathy

Aspect	Clinical care
Context	• May arise following placental abruption, fetal demise and amniotic fluid embolism[12] • Early delivery protects against severe DIC – which is partly due to the massive release of thromboplastins from the damaged uterus[12]
Clinical presentation	• May result in clinically detectable microvascular bleeding as well as abnormal blood coagulation tests[34,62] including: o Platelet count less than 50 x 10^9/L o Prothrombin time (PT) greater than 1.5 x normal o International normalised ration (INR) greater than 1.5 o Activated partial thromboplastin time (aPTT) greater than 1.5 x normal o Fibrinogen level less than 2.5 g/L[34]
Management	• Refer to Queensland Clinical Guideline *Primary postpartum haemorrhage* for management, blood/product replacement and MTP activation protocols[34] • Treat underlying cause • Requires early aggressive management[17] • Collect baseline bloods early and frequently • If clinical signs present do not delay treatment by waiting for coagulation results[44] • Avoid hypothermia and acidosis • If undelivered, deliver fetus and placenta[17] • Advise Platelet transfusion if marked or moderate thrombocytopenia • Advise early use of Cryoprecipitate to maintain fibrinogen levels above 2.5 g/L • Give FFP if actively bleeding or significantly elevated INR • Consult with a Haematologist[44], especially if considering: o Recombinant Activated Factor VII (rFVIIa) – has been used off licence in some obstetric patients with DIC o Tranexamic Acid

5.7 Musculoskeletal injury

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

Table 16. Musculoskeletal injury

Type	Clinical care
Penetrating trauma	• Low threshold for exploratory laparotomy[10]
Spine and spinal cord injuries	• Adequate immobilisation of neck and spine[10] • Position left lateral tilt 15–30^o(right side up) – if possible • Early multidisciplinary approach to care • Consider delivery at advanced gestations
Major pelvic fracture	• Immobilise pelvis • Vaginal birth is not absolutely contraindicated[10] o Birth by CS if unstable fracture or pelvic architecture disrupted[10] • Consider fetal injury/skull fracture – may be more common with fetal head engagement[10] o Consult with neonatologist
Limb fracture and longer term immobility	• Assess for venous thromboembolism (VTE) risk and consider prophylaxis[37] o Refer to the Queensland Clinical Guideline *Venous thromboembolism (VTE) prophylaxis in pregnancy and the puerperium*[63]

5.8 Minor trauma

Table 17. Minor trauma

Aspect	Clinical care
Definition	• Any trauma injury that does not meet the criteria for defining major trauma • Refer Appendix A Classification of major trauma in pregnancy
Context	• Severity of injury may not be predictive of fetal outcome[4,13] • Adverse fetal outcomes are increased after minor trauma not requiring hospitalisation[4,7,13] • Placental abruption has not been reported when less than one contraction is present in any 10 minute interval over a 4 hour period[6]
FHR monitoring	• CTG provides good screening/high sensitivity for *immediate* adverse outcome • Monitor FHR via CTG for 4 hours[26,38,61] at a minimum
Discharge following minor trauma	• Consult with the obstetric team prior to discharge • Criteria: o Normal CTG[26] ▪ Interpret with caution at 24–28 weeks gestation ▪ Refer to Table 7 for Fetal heart rate monitoring considerations o No contractions o No vaginal bleeding/loss[26] o Reassuring maternal status o Laboratory evaluation within normal limits o Kleihauer test reviewed and sufficient Rh D immunoglobulin administered (if required) • Offer social work referral before discharge • Advise the woman to inform her usual obstetric care provider of the trauma event • 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[13] and placental abruption[4] • Advise the woman to inform her usual obstetric care provider of the trauma event • Advise the woman to seek medical advice if experiencing: o Signs of preterm labour o Abdominal pain o Vaginal bleeding o Change in fetal movements

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Appendix A: Classification of major trauma in pregnancy

If any ONE criterion (except systolic BP*) is present from any category (vital signs, injury pattern or mechanism of injury), consider the trauma 'Major' and respond accordingly.

☑	Vital signs criteria	
	Conscious state	Altered level of consciousness
	Respiratory rate	< 10 or > 30 breaths/minute
	SpO_2 (room air)	< 95%
	Heart rate	> 120 bpm
	*Systolic BP	< 90 mmHg

**Interpret BP in conjunction with gestation, other vital signs, injury pattern and mechanism of injury*

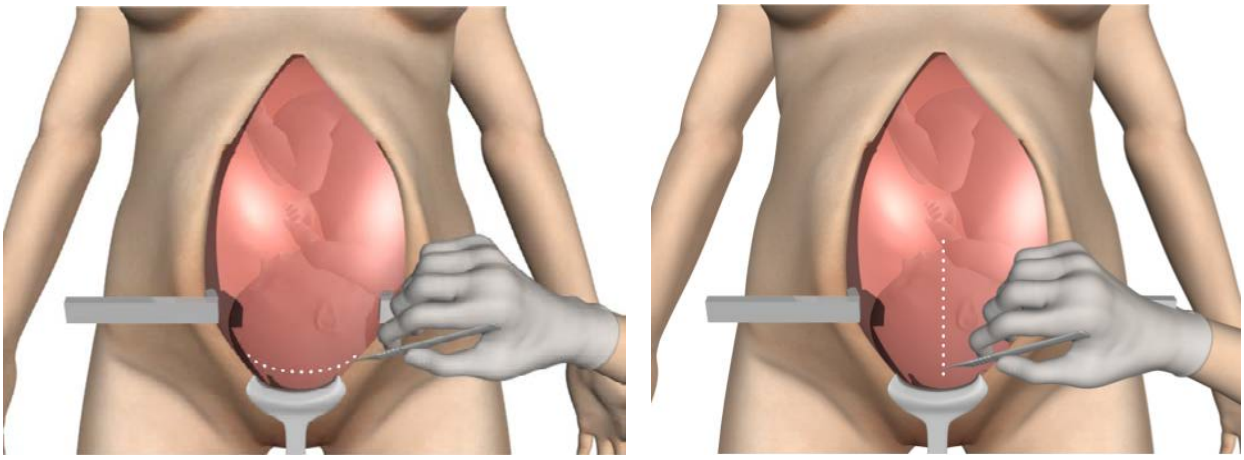
☑	Injury pattern criteria
	Penetrating or blast injury to the head, neck, chest, abdomen, pelvis, axilla or groin
	Significant blunt injury to a single region of head, neck, chest, abdomen, pelvis or axilla
	Injury to any two or more body regions of head, neck, chest, abdomen, pelvis or axilla
	Limb 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 and respiratory tract
	Serious crush injury
	Major compound fracture or open dislocation with vascular compromise
	Fractured pelvis
	Fractures involving two or more of the following: femur, tibia, humerus

☑	Mechanism of injury criteria
	Ejected from vehicle
	Fall from height > 3 metres
	Involved in an explosion
	Involved in a high impact motor vehicle crash with incursion into the occupants compartment
	Involved in a vehicle rollover
	Involved in a road traffic collision in which there was a fatality in the same vehicle
	Entrapped for > 30 minutes
	Pedestrian impact
	Motorcyclist impact > 30 kph

Adapted from: Queensland Government. Queensland Ambulance Service (QAS) Field Reference Guide. 2011 and Queensland Government, Statewide Clinical Coordination and Retrieval Services. SOP No.3.7 Criteria for early notification of trauma for interfaculty transfers

Appendix B: Perimortem caesarean section procedure

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



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Appendix C: Haemodynamic and laboratory values in pregnancy

Mean values for haemodynamic changes throughout pregnancy

	Pre-pregnancy	1st Trimester	2nd Trimester	3rd Trimester
Heart rate (beats/min)	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/min)	4.5	4.5	6.0	6.0
Uterine blood flow (mL/min)	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 10^9/L
	13–24	6.2–14.8	x 10^9/L
	25–42	5.9–16.9	x 10^9/L
	>42	5.7–16.9	x 10^9/L
Neutrophils	1–12	3.6–10.1	x 10^9/L
	13–24	3.8–12.3	x 10^9/L
	25–42	3.9–13.1	x 10^9/L
	>42	3.6–13.1	x 10^9/L
Eosinophils	1–>42	<0.6	x 10^9/L
Lymphocytes	1–12	1.1–3.5	x 10^9/L
	13–24	0.9–3.9	x 10^9/L
	25–42	1.0–3.6	x 10^9/L
	>42	0.9–3.9	x 10^9/L
Platelets	1–12	170–390	x 10^9/L
	13–24	170–410	x 10^9/L
	25–42	150–430	x 10^9/L
	>42	150–430	x 10^9/L
Red Blood Cells (RBC)	1–12	3.52–4.52	x 10^{12}/L
	13–24	3.20–4.41	x 10^{12}/L
	25–42	3.10–4.44	x 10^{12}/L
	>42	3.10–4.52	x 10^{12}/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/hr
	13–24	<64	mm/hr
	>24	<72	mm/hr
Bicarbonate (Total CO_2)	All	18–26	mmol/L
Creatinine	All	40–80	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 D: Seat belt positioning in pregnancy

Correct positioning of the seat belt includes:

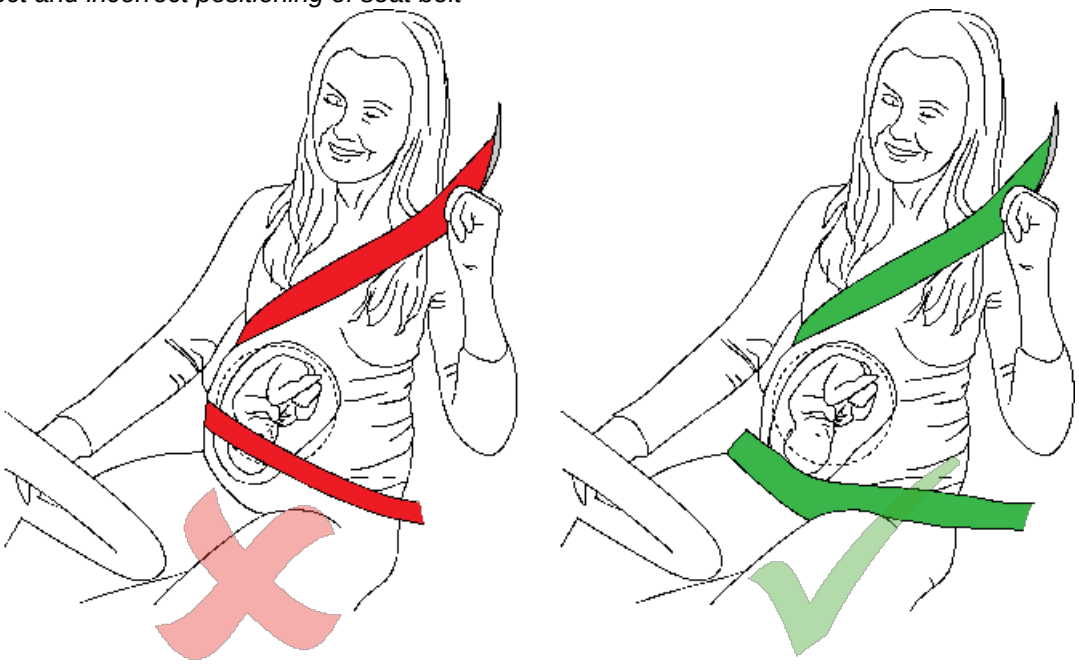
- Lap belt over hips below uterus
- Sash between breasts above uterus

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



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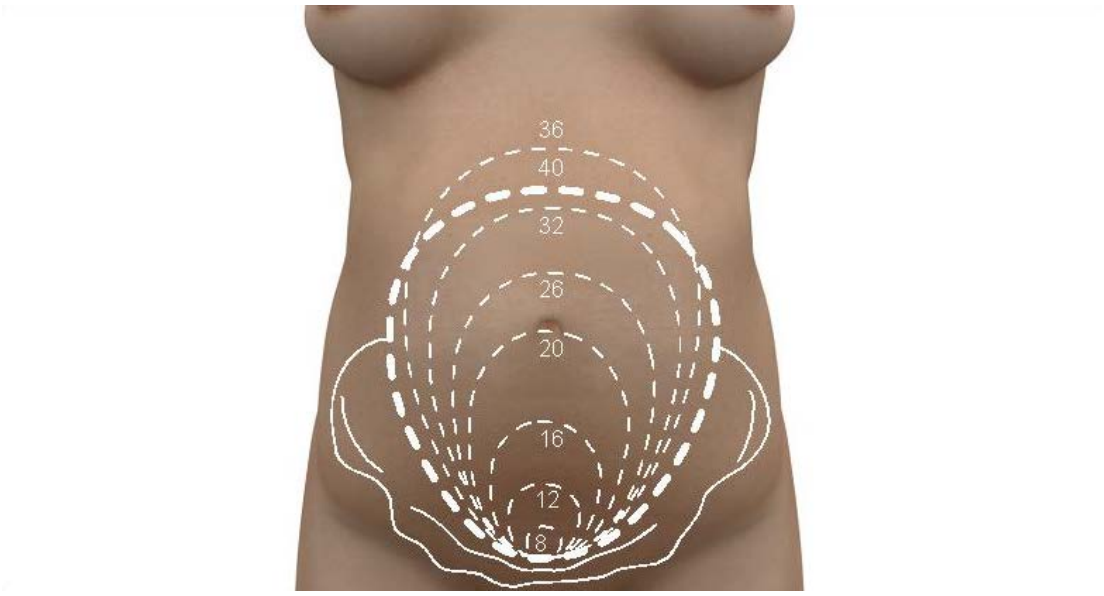
Appendix E: Estimation of gestation

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

Estimating gestational age by fundal height



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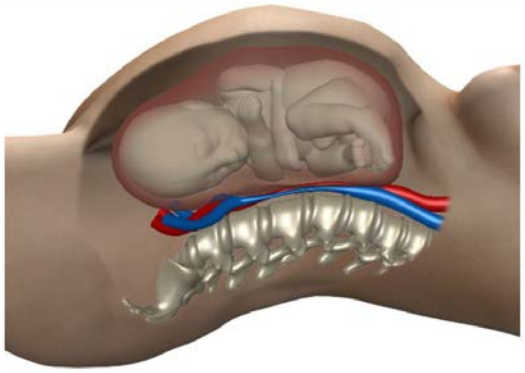
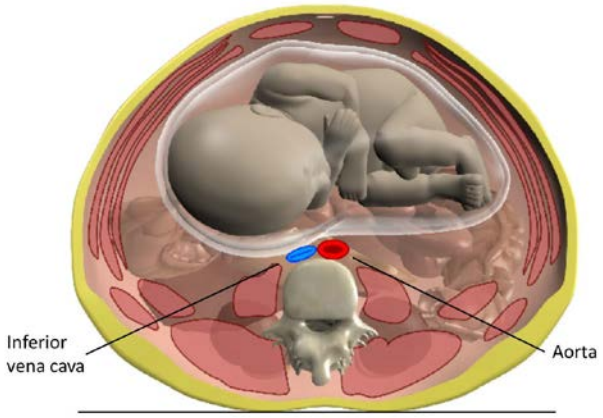
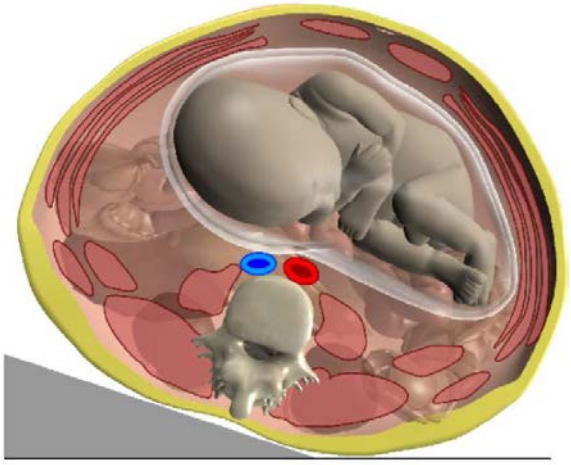
Appendix F: Left lateral tilt positioning

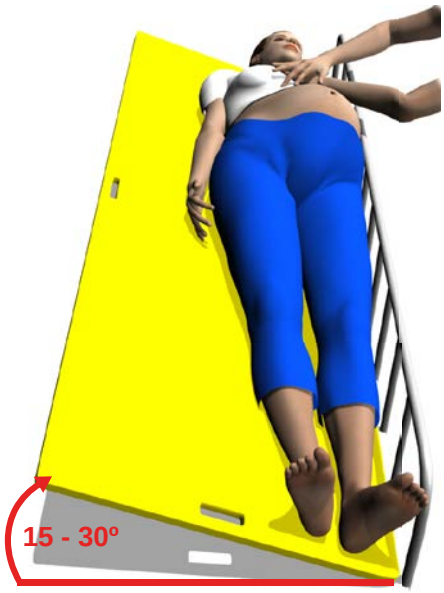
Inferior vena cava compression when positioned supine



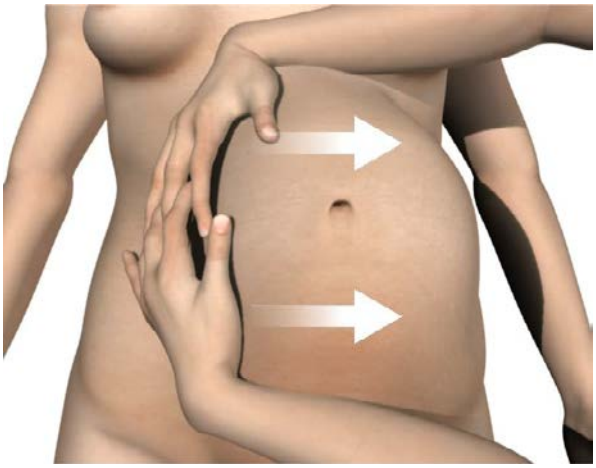


Left lateral tilt (right side up) 15-30 degrees to relieve compression





Manual displacement of the uterus to relieve compression



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

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

Examination	1st Trimester	3rd Trimester
Conventional radiography		
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 pyleogram (IVP)	2	10
Extremities	<0.01	<0.01
Mammography	<0.01	<0.01
Barium meal	1	6
Barium enema	7	25
Computerised Tomography (CT)		
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

Note: All doses should be treated as indicative only as individual doses can differ from the tabulated values by as much as a factor of 10, except for those examinations remote from the lower abdomen

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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