

**Trauma Service Guidelines**

**Title:** Pregnancy and Trauma

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## Background

The Royal Melbourne Hospital (RMH) is one of Australia's busiest major trauma services, and has been designated to care for Victorian obstetric trauma patients due to its co-location with the Royal Women's hospital. In 2014, RMH admitted and cared for over 4000 trauma patients; of these, only 1.8% were pregnant, and 0.43% were classified as having severe injuries. However, this is a unique group that requires specific expertise to ensure good outcomes for the pregnant women and their babies.

Trauma occurs in 8% of all pregnancies. It is the most common cause of non-obstetric fetal and maternal mortality, and is associated with significant complications. Mortality following trauma increases with gestational age, with just over half of all reported incidences occurring in the third trimester of pregnancy. Perinatal mortality relates to the severity of the trauma and the mechanism of injury.<sup>1-17</sup>

A pregnant woman represents two patients. The key management principle is to optimally resuscitate the mother, as doing so will maximise fetal survival. However, where possible, all management decisions should be made in the best interests of the fetus (such as the choice between two equally effective drugs with differing fetal toxicity risks).<sup>1, 3, 17</sup>

Specific anatomical and physiological changes occur during pregnancy that alter the body's response to injury, and thus the pregnant patient requires a modified approach to resuscitation.<sup>3, 11, 14, 17-19</sup> The underlying principles guiding the management of the multitrauma pregnant patient are that the initial reception and resuscitation will be conducted at RMH, providing a multidisciplinary approach including emergency physicians, anaesthetists, trauma surgeons, obstetricians, nursing and radiology input.

If the injury to the pregnant woman is assessed as being minor and does not require admission to a general hospital for trauma care, she may require transfer (following appropriate guidelines) to an obstetric hospital such as The Royal Women's. This is a joint decision between the woman, the admitting Consultant Surgeon at The Royal Melbourne Hospital and the Duty Obstetrician from The Royal Women's Hospital.

## Mechanisms of Injury

The risk of perinatal mortality depends on the severity and mechanism of the injury. The main causes are motor vehicle accidents (79% of all pregnant trauma patients present to RMH as a result of a MVA. All fetal deaths at RMH 2005-2013 were a direct result of an MVA, falls, assaults or penetrating injuries<sup>20</sup>). Pregnant women compared with non-pregnant women have a higher incidence of serious abdominal injury and a lower incidence of chest and head injury. Even relatively minor falls from standing height are associated with significant shearing forces and potential injury to the uterus, placenta and/or fetus, and falls are more common in pregnancy due to an altered centre of gravity and other factors.<sup>1-3, 7-9, 11, 17, 21</sup>

In the 1<sup>st</sup> trimester (1-13 weeks) the bony pelvis, fluid filled amniotic sac and soft tissues protect the fetus.

In the 2<sup>nd</sup> (14-26 weeks) and 3<sup>rd</sup> (27-40 weeks) trimesters, injuries to the fetus tend to be more severe. There is a physiologic decrease in the amniotic fluid and the majority of the fetus lies above the protective confines of the bony pelvis. Once the head has entered the inlet of the pelvic ring, the fetus is more vulnerable to accelerative and decelerative forces.<sup>1, 3, 8-12</sup>

Direct fetal trauma can cause organ ruptures, cervical and skull fractures, intracranial haemorrhage and cord rupture. Indirect trauma such as rapid compressive forces, decelerative, contra-coup and shearing forces can cause uterine rupture, placental abruption, fetomaternal haemorrhage and preterm labour.<sup>1, 3, 8-12</sup>

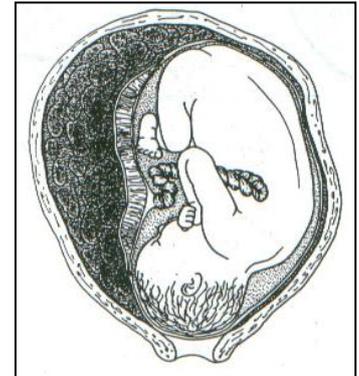
Entrapment is more common in pregnancy due to the size and immobility of the mother. The increased vascularity of the pelvis can lead to massive haemorrhage in a pelvic fracture which is associated with bladder and urethral injury, retroperitoneal bleeding and fetal skull fracture.<sup>3, 9-11, 22</sup>

### Fetal Outcome Determinants

The most common cause of fetal death is placental abruption which occurs in 2-4% of patients with minor trauma and up to 50% in those with major trauma (RMH 32% fetal loss in major pregnant trauma patients<sup>20</sup>), occurring most commonly in gestations > 16 weeks (RMH average of 27 weeks, range 8-37 weeks).<sup>5, 7, 12, 17</sup> Proper seatbelt use in Australia is one of the predictors of fetal outcome in road accidents. Unrestrained pregnant patients are two times more likely to have maternal haemorrhage and 2.8 times more likely to have fetal death.<sup>3, 5, 7, 16</sup>

Factors associated with abruption include maternal hypotension and hypoxia, high injury severity score, maternal pelvic fracture, young maternal age, acidosis, shock and uteroplacental/fetal injury. The best predictor of fetal outcome is the injury severity of the mother. It is important to remember that fetal loss can occur in minor trauma when there are no abdominal injuries.<sup>1, 3-5, 7-9, 11, 14-16</sup>

Placental Abruption



### Trauma Care

As in all trauma management identification and treatment of life-threatening injuries is the first priority.<sup>1, 3, 11, 16</sup>

The primary goal of treatment is the maintenance of uteroplacental perfusion of the mother, and fetal oxygenation by avoiding hypoxia, preventing hypotension, acidosis and hypothermia. Only when stabilised or if the mother has minor injuries should the secondary survey be performed, including assessment of fetal well-being utilising CTG monitoring and ultrasound.

### Primary Survey

The primary survey is conducted in the same manner as for a non-pregnant patient.

**AIRWAY:** A patent airway remains the first priority. Administration of oxygen is appropriate for all patients since maternal hypoxia is associated with poor fetal outcome.<sup>1, 3, 4, 7-9, 11, 14-16</sup>

Standard cervical spine assessment, immobilisation and management are required.

Obstetric patients have been shown to have an eight-fold increase in the rate of failed intubation.<sup>16</sup> If the patient requires intubation, difficult airway equipment must be immediately available. A fibre optic or video linked (C- MED) intubation should be anticipated in patients with a known difficult airway, those with facial or cervical fractures and the morbidly obese. Confirmation of tube placement should be with auscultation & capnography.<sup>9, 16</sup>

**BREATHING:** If intubated, a nasogastric or orogastric tube should be placed due to the increased risk of aspiration. Nasogastric tube placement in pregnancy is associated with an increased risk of epistaxis due to mucosal hyperaemia. Patients in late pregnancy should have intercostal catheters placed one or two rib spaces higher due to the patient's elevated diaphragm. Ventilation should aim to achieve a normal PaO<sub>2</sub> and a CO<sub>2</sub> 27-32mmHg.<sup>1-3, 7-9, 11, 16, 22</sup>

**CIRCULATION:** Left lateral tilt (30-45 degree tilt) using a wedge can significantly improve the systolic blood pressure and must be utilised in the care of the pregnant woman. Maintenance of circulating blood volume is critical and aggressive fluid resuscitation should be initiated if hypovolemia is suspected, to optimise the maternal cardiac output and maintain uteroplacental perfusion.<sup>11</sup>

Intravenous access should be secured and routine trauma bloods ordered including Kleihauer if Rh (D) negative.

Initial resuscitation should be based on ATLS/EMST principles, which include early and empirical administration of RBC's in patients with severe shock, not corrected by 1 to 2 litres of crystalloid solution.<sup>23, 24</sup>

Haemorrhage control may be impossible without surgical intervention; maternal shock is associated with high fetal mortality rates. Caution must be taken in penetrating trauma not to 'over-resuscitate' and thereby risk interference with clot formation (which may contribute to increased blood loss, hypothermia, acidosis and coagulopathy). Fluid resuscitation should aim to normalise vital signs and urine output for the pregnant state.<sup>1-3, 7-9, 11, 16, 22</sup>

### Pregnant Trauma Patient Guideline > 20 weeks

A **Trauma Call** should be initiated for all pregnant patients  $\geq 20$  weeks sustaining trauma with ruptured membranes, PV bleeding and/ or fetal heart rate  $< 100$  bpm.

If the prehospital information does not meet a **Trauma Call** and it is a known pregnant patient who is  $> 24$  weeks gestation, a **Trauma Alert** should be sent (ED consultant should contact the obstetrician if required)

ED senior medical staff to contact the Obstetrician of the day. This contact should occur on notification of an ETA for the arrival of the trauma call or alert for a pregnant patient at RMH.

**RWH TELEPHONE: 8345 2000 or in an emergency 8345 2222**  
(request to speak to the Obstetrician of the day)

If the patient **requires immediate** laparotomy/ caesarean or other urgent trauma surgery, this should always be conducted at The Royal Melbourne Hospital, with an obstetrician in attendance, and the availability of a neonatologist to care for the infant.

**If immediate caesarean section is required THE NEONATAL RESPONSE TEAM should be contacted.**  
**Team includes:** Neonatal Consultant/ Fellow/ resident and NISC admission nurse)  
Call RWH switch **8345 2222**; Neonatal fellow (24/7) page 53313

If delivery is NOT urgent the obstetrician already involved in the case will inform all the RWH team of the necessary details.

### Secondary Survey

The secondary survey is commenced once the life threatening injuries are identified and treated. The process is the same as for the non-pregnant patient and includes a head to toe assessment, a complete history, and an obstetric and fetal assessment. Complications of pregnancy can occur with little or no signs of injury.<sup>1, 4, 8, 9, 16, 18</sup>

### FAST

Ultrasound is safe in the pregnant patient without adverse effects on the fetus. The diagnostic yield of FAST becomes increasingly limited with advancing gestational age. Evaluations in the first trimester are associated with high sensitivity (90%) and specificity (89%). However sensitivity drops ( $< 50\%$ ) in the second and third trimesters, whilst retaining specificity.<sup>25</sup>

### Investigation and Intervention Decisions

Patients fall into four groups

1. Those with a **Negative FAST, minor injuries**, with **no fetal distress** patients require 4 hours of CTG monitoring before being discharged. Those discharged home will be given specific instructions re: preterm labour, bleeding and abdominal pain. Patients may be transferred to the Royal Women's Hospital for ongoing care after consultation.
- 2 Those with a **negative FAST** and complex **injuries** require hospital admission, CTG monitoring for at least 4 hours and obstetrician review before ceasing monitoring.
3. Those with a **positive FAST** and **no peritoneal signs** and who are **haemodynamically stable** can go on to have abdominal CT scan to assist in determining the need for laparotomy (unless a laparotomy is indicated for caesarean section on fetal grounds)
- 4 Those with a **positive FAST** and who are **haemodynamically unstable or have peritoneal signs** require urgent theatre for laparotomy.

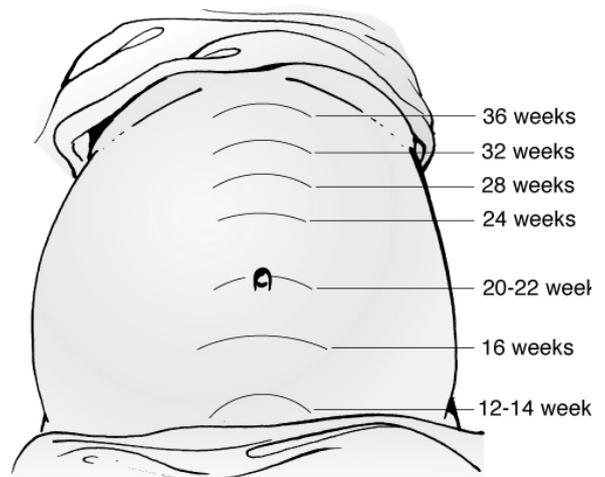
### Obstetric Examination

Obtaining an early history is important in identifying any comorbidity that may alter patient management and includes:

- ◆ Estimated delivery date (EDD) based on early pregnancy ultrasound
- ◆ Date of last menstrual period if ultrasound EDD not known or not performed
- ◆ Pregnancy related or other problems and/or complications (including any fetal movements or contractions).

Gestational age can be immediately estimated by measuring the fundus. Measure the vertical distance in the midline from the symphysis pubis to the top of the fundus (in cm). This measurement should correlate roughly with gestational age. <sup>15</sup> A viable fetus is 24-26 weeks' gestation or 500 grams. Only a viable fetus will require monitoring. <sup>8</sup>

Gestation age in weeks	Location of the uterus
12-14	Just above the pubis
16	Halfway between pubis & umbilicus
20-22	At umbilicus
28	Halfway between umbilicus & xyphoid
32	3/4 of the way between umbilicus & xyphoid
36-40	Near xyphoid



### Abdominal Assessment looking specifically for:

- ◆ Abdominal tenderness and pain
- ◆ Uterine tone - a firm hard uterus is indicative of placental abruption
- ◆ Uterine contractions
- ◆ Uterine tenderness
- ◆ Fetal presentation/orientation/lie

If a pelvic exam is required this should be conducted by an experienced doctor/obstetrician looking for:

- ◆ Vaginal bleeding- in 2<sup>nd</sup> and 3<sup>rd</sup> trimester is associated with placental abruption, preterm labour, placenta previa
- ◆ Cervical effacement & dilation in labour
- ◆ Amniotic fluid-Indicates ruptured membranes
  - vaginal secretions pH 5.0 & amniotic fluid pH: 7.0-7.5

Repeated examinations should be avoided. <sup>1, 2, 4, 5, 7-9, 15, 16</sup>

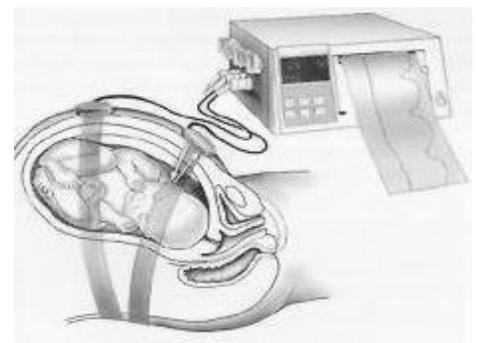
NOTE: Placental abruption can occur without vaginal bleeding

### Fetal Assessment and Cardiotocography (CTG) Monitoring

Fetal assessment is performed for viable pregnancies >24 weeks' gestation. Fetal assessment by Cardiotocography (CTG) may not be appropriate even at 24-26 weeks as interpretation is difficult. Ultrasound assessment may be a better determinant of fetal wellbeing at these gestations.

Normal fetal heart rate ranges from 110 to 160 bpm with the average being 140 bpm and varies according to gestation. Fetal heart rates generally decrease towards the lower ranges of normal closer to term. The CTG monitors fetal heart rate and uterine activity. Appropriate CTG monitoring should be implemented as part of the secondary survey. <sup>16</sup> Monitoring can detect signs of fetal compromise. It also detects uterine activity which may indicate a risk of premature labour or abruption. <sup>8</sup>

CTG variability is a normal sign of fetal wellbeing as it is an indirect measure of fetal oxygenation. Absence of variability may be an indication of fetal compromise as is the presence of a decelerating fetal heart rate.



The most common problem caused by trauma is uterine contractions due to a release of prostaglandins secondary to placental trauma.<sup>14</sup> Occasional contractions are normal and not associated with adverse outcomes in 90% of cases. Eight contractions or more an hour over more than four hours is associated with placental abruption and carries a fetal mortality rate of 67-75%.<sup>7</sup>

CTG monitoring initiated in the secondary survey should continue throughout the acute period including ICU and the wards as prescribed by the obstetrician. Dependent on these orders monitoring may be continuous for the first four hours and then intermittent or as defined in the obstetric management plan.

RMH does not have the appropriate staff to manage ongoing continuous CTG monitoring. Appropriate midwifery care may need to be arranged for the patient at RMH if the patient is not suitable for transfer. Appropriate CTG monitoring can be useful in reassuring parents and staff about fetal status and it informs discharge planning.

A CTG monitor is located in the Emergency Department; interpretation will be via the obstetrician.

Either by:

1. By the attending Obstetrician / registrar
2. If in ED trauma 1 or 2 by (i) plugging the CTG into the port on the bollard, (ii) entering the information on the computer outside T1, and (iii) informing RWH labour ward and obstetric registrar of the clinical scenario.
3. By faxing a 30 minute CTG trace to the RWH obstetric registrar, after discussion of the clinical scenario with them.

Ultrasound has poor sensitivity for placental abruption and more than half of cases will be missed. It can be used to measure fetal heart rate in M-mode. It can also be used to assess fetal activity. Trained operators can estimate the gestational age in the second and third trimesters using head circumference or femur length. Placental location and amniotic fluid volume can also be assessed by trained operators.<sup>9, 12, 26</sup>

### General Care of the Pregnant Trauma Patient

Active patient warming is to be conducted in the following situations:

- ◆ If a major trauma patient's core temperature drops below 36.5 degrees centigrade
- ◆ In any major trauma patient with signs suggesting the possibility of significant blood loss. This includes the normotensive patient with significant tachycardia (pulse rate = 110 per minute) or who is cold and shut down peripherally.
- ◆ Active warming includes all fluids being infused through warming devices (core warmers or the Level I rapid infuser system), and external warming devices (including the Thermamed or Bair-Hugger). Other more invasive forms of active warming can be employed if necessary, including the infusion of warm fluids into peritoneal or thoracic cavities.

### Radiology

***Treat the mother first: initial treatment and imaging priorities in the pregnant trauma***

***patient are the same as for the non-pregnant patient.***

### Please notify radiology of the presence of a pregnant patient requiring imaging

- ◆ Most diagnostic radiology procedures pose no substantial risk to the mother or fetus, including plain x-ray imaging of the head, neck, chest, pelvis and extremities and CT imaging of the head, neck and chest.
- ◆ Radiation risk is related to the fetal effective dose and to the stage of pregnancy. This is most significant during organogenesis, with very few abnormalities demonstrated after 7 weeks in a fetus who received >500 millisieverts of radiation. see Einsiedel, Gumm, Judson, Trauma<sup>27</sup>

- ◆ Interventional radiology procedures involving extended fluoroscopy and CT scan of the abdomen and pelvis may result in a significant fetal dose and consequently an increased risk. Nevertheless, it is highly unlikely that the fetal effective dose from diagnostic or most interventional procedures will exceed 100 millisieverts, when nervous system abnormalities, malformations, growth retardation and fetal death are possible.
- ◆ Remember that in the emergency situation the optimal resuscitation, imaging and treatment of the mother will ensure the optimal chance of fetal survival.

Please see the complete guideline on [X-Ray Imaging During Pregnancy](#)

### Transfusion

Both fetal susceptibility to CMV (due to an immature immune system) and the risk of Rh (D) isoimmunisation must be considered when transfusion is required for resuscitation of the mother.

#### Recommendations

- ◆ Irrespective of the CMV status of the mother (i.e. irrespective of whether the status is known or unknown, or whether it is negative or positive), for red cell and platelet transfusions the units should be CMV antibody negative.
- ◆ Bedside leukodepletion filter is not required, as the current platelet inventory is already pre-leukodepleted if CMV negative platelet concentrates are not available
- ◆ Only Rh(D) negative red cells and platelets should be used for pregnant women and women of child-bearing potential (e.g. <50 years of age) who are Rh(D) negative, or whose Rh(D) status is unknown.
- ◆ A prophylactic dose of anti-D is required if a Rh (D) negative female who is pregnant or of child-bearing potential receives Rh (D) positive platelets.
- ◆ Pregnant women and females of child-bearing potential who are Kell blood group negative should receive Kell negative red cells where possible.
- ◆ Transfusion support haematological consultation is required for newborns or infants (e.g. following an emergency Caesarean Section) to ensure special transfusion requirements are met.

### Perimortem Caesarean Section

Peri mortem caesarean should be contemplated in patients with a viable fetus (> 24 weeks or 2 finger breaths above umbilicus) with cardiac arrest not responding to CPR. This procedure can be lifesaving for mother and her fetus if performed within 5 mins, although the primary aim of the procedure is to optimise maternal resuscitation. Consideration must also be given to the aetiology of the cardiac arrest considering both obstetric and traumatic complications.<sup>3, 14, 28, 29</sup> In maternal hypovolaemic arrest, the fetus may have already suffered a prolonged period of hypoxia.<sup>1</sup>

Cardio pulmonary resuscitation (CPR) may be very difficult and, when combined with aortocaval compression, may be inefficient in providing enough cardiac output for organ perfusion in the pregnant patient with a viable fetus (> 24 weeks or 2 finger breaths above umbilicus).<sup>1, 3, 7, 8, 11, 12, 28-31</sup>

The tolerable duration of apnoea and pulselessness for a pregnant woman is only 5 minutes, with the chances of successful resuscitation of woman or fetus decreasing after this time. Therefore perimortem caesarean section should be performed within 4 minutes to optimise fetal outcome.<sup>8, 9, 11, 15, 16, 28, 30, 31</sup> This timeframe precludes transfer to the operating theatre, and as the fetal condition has no bearing on the decision to perform a perimortem caesarean, time should not be wasted attempting to confirm the presence of a fetal heartbeat.

Perinatal outcomes are optimized when delivery is performed within 5 minutes of cessation of maternal circulation; beyond 30 minutes no benefit has been demonstrated.<sup>3, 11, 12</sup>

Maternal CPR should be continued throughout the delivery of the fetus which may improve venous return and increase the success of CPR, thus increasing the chance of maternal survival. This should be conducted in the supine position.<sup>31</sup>

**If immediate caesarean section is required the Neonatal Response Team (Neonatal Consultant/ Fellow/ resident and NISC admission nurse) should be alerted via RWH switch Ph: 8345 2222**

### Fetomaternal Haemorrhage Assessment

Trauma in pregnancy is unique: even a trivial injury may provoke abruption, preterm labour and its cascade of serious complications. It may also cause fetomaternal haemorrhage (FMH), which itself is associated with an increased incidence of abruptio placentae<sup>32</sup> and is a predictor of preterm labour.<sup>33</sup> Fetomaternal haemorrhage occurs in 8 to 30% of pregnant women suffering abdominal trauma. The role of detectable FMH in the absence of obstetric findings on presentation is questionable and not well reported. Unfortunately, a lack of symptoms does not preclude the possibility of abruption. With the advent of better monitoring equipment and practices, the role of FMH in asymptomatic pregnant trauma patients (other than the need to calculate the additional anti D immunoglobulin) is doubtful.

### Anti-D Administration

Haemolytic disease of the newborn may arise if the mother develops anti-red cell antibodies against fetal red cell antigens. For this reason mothers who are Rh(D) negative usually require prophylactic Rh(D) immunoglobulin therapy at various times in pregnancy. Anti-D administration and Kleihauer testing is also required for Rh (D) negative women following delivery.

All Rh (D) negative pregnant women should be offered anti-Rh (D) immunoglobulin prophylaxis, in this setting.

Dosage for pregnancy regardless of gestation is 625 iu IM

**N.B.** For women in the Second and Third trimesters a Kleihauer test should be performed on the mother. This test quantitates the volume of the fetomaternal haemorrhage. The doses of anti-Rh (D) listed above are given initially, without waiting for the result of the Kleihauer test. Once the Kleihauer test result is available then an additional dose may be required, depending on the result.

In this setting the Kleihauer test does not need to be done urgently, as there is a 72 hour window to administer any additional dose of anti-D, depending on the Kleihauer test finding. Kleihauer blood sample should be taken with the other trauma bloods, but will only be processed during working hours, hence the result in most cases may not be available until the next day.

Anti-D dosing is best done in consultation with a haematologist +/- or obstetrician

### Hospital Admission and Obstetric Review

Hospital admission & obstetric review is mandatory in patients with vaginal bleeding, uterine irritability, abdominal tenderness, pain, cramping, in the absence of fetal heart sounds, and in women with leaking amniotic fluid

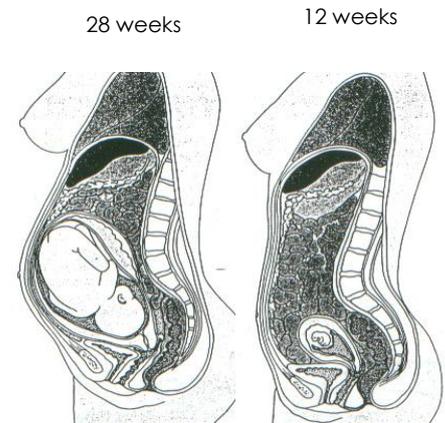
After immediate clinical priorities are managed, the patient's usual obstetrician and GP should be notified as soon as possible.

## Appendix 1 Physiological Changes in Pregnancy

Pregnancy alters the physiology in most systems, adding to the complexity of caring for a pregnant trauma patient.<sup>14,22</sup>

### Uterus

Until the 12<sup>th</sup> week of gestation, the uterus is a thick walled structure of limited size that sits within the pelvis, relatively resistant to injury. At 20 weeks, the uterus has reached the level of the umbilicus and the fetus is small and mobile, cushioned by generous amounts of amniotic fluid. By 36 weeks the uterus reaches maximal height at the costal margins and it is now a large thin walled organ with a volume of approximately 5L. During pregnancy there is a progressive increase in the uteropelvic blood flow from 60 to 600ml/min, increasing the potential for massive blood loss from the traumatised uterus or pelvis.<sup>1,3,9,11,16,34</sup>



### Cardiovascular

By the end of the 1<sup>st</sup> trimester (week 12), there is an increase in cardiac output (CO) of 1.0-1.5L/ min due to an increase in plasma volume (40 to 50%). There is also a decrease in pulmonary and peripheral resistance due to increasing progesterone levels. Systolic blood pressure will decrease by 15 to 20% with its lowest point at 28 weeks, rising again at the end of pregnancy. Blood volume will increase by 20% during pregnancy resulting in a dilutional anaemia. The increase in cardiac output and heart rate (10-15 bpm) and decrease in resting blood pressure can mask signs of hypovolaemia. A pregnant woman may lose up to 2 litres of blood before it becomes clinically apparent in some cases. Some pregnant women in the absence of bleeding may exhibit hypotension in the supine position due to aortocaval compression (decreased venous return and CO up to 25%).

All pregnant women >20 weeks should be managed in the left lateral tilt position using a wedge under right hip (please see diagram) and manual displacement of the uterus to reduce the effects of caval compression.<sup>1,3,9,11,14,16</sup>

### Haematological

White blood cell count, levels of most clotting factors including fibrinogen, and plasma proteins increase in pregnancy, causing a relatively hypercoagulable state, increasing the risk of venous thromboembolism. The reference range of the APTT and INR are unaltered in pregnancy.

Placental abruption and other obstetric complications may precipitate DIC (disseminated intravascular coagulation).

Haemolytic disease of the newborn may arise if the mother develops antibodies against fetal red cell antigens. For this reason mothers who are Rh (D) negative require prophylactic Rh (D) immunoglobulin therapy at various times in pregnancy and following delivery.

Given the immaturity of the immune system of the fetus when pregnant women require blood transfusion, specialised red cell products are usually indicated (e.g. CMV negative products).<sup>1,3,9,11,16,34</sup>

### Respiratory

Many changes occur in the respiratory system of the pregnant woman with important implications. There is a 20% increase in oxygen consumption in the 3<sup>rd</sup> trimester. A 20% reduction in functional residual capacity can lead to a VQ mismatch and decrease oxygen reserves in the compromised patient. These changes predispose the pregnant patient to rapid oxygen desaturation.

An increased tidal volume and respiratory rate lead to an increased minute volume and thus a decreased PaCO<sub>2</sub> (27 to 32mmhg), therefore a pregnant patient with respiratory failure may have a normal PaCO<sub>2</sub>.<sup>3,11</sup>

### Gastrointestinal

Gastric emptying is slowed in pregnancy, increasing the risk of aspiration. A full stomach should be assumed in all pregnant patients, and a naso/orogastric tube inserted in those with an altered conscious state or intubated.

Stretching of the peritoneum decreases its sensitivity and may mask signs of peritonitis. The intestines are higher in the abdomen and shielded by the uterus, with liver and spleen position remaining unchanged.<sup>3,11</sup>

**Renal**

Glomerular filtration rate and renal plasma blood flow increases during pregnancy, with a slight decrease in serum urea and creatinine. Glycosuria is common in pregnancy.

Mild hydronephrosis occurs in late pregnancy. The urinary bladder is pulled out of the pelvis by the enlarging uterus, increasing the risk of damage in major trauma. <sup>3, 4, 10, 11, 14, 16, 34, 35</sup>

**Pregnancy Changes Summary**

References: <sup>2, 3, 7-9, 11, 16</sup>

<b>Cardiovascular</b>	
Blood pressure	Minimal change Slight ↓ in 1 <sup>st</sup> & 2 <sup>nd</sup> trimester, normal in 3 <sup>rd</sup>
Heart rate	↑ 15-20% ↑
Cardiac output	↑ 30-40% 6-7 L/min during pregnancy
ECG	Non-specific ST changes, Q waves in leads III & AVF, atrial and ventricular ectopic
Systemic Vascular resistance	↓ to 1000-14000 Due to progesterone and blood volume

<b>Haematological</b>	
Blood Volume (ml)	↑ 30-50% Volume ↑ with multiple gestations
WCC (mm <sup>3</sup> )	↑ to 5,000-14,000
Haemoglobin (g/dL)	↓ to 100-140
Haemocrit (%)	32-42
Plasma volume (ml)	↑ 30-50%
RBC volume (ml)	↑ to 1900
Coagulation Factors	↑ factors VII, VIII, IX, XII
Platelet (mm <sup>3</sup> )	200,00-350,000
Fibrinogen, plasma (mg/dL)	264-615

<b>Respiratory</b>	
RR	No change
Oxygen demand	↑ 15%
FRC	↓ 25%
Minute Ventilation	↑ 25-50% or 7-15 ml/min
Tidal Volume	↑ 25-40% or 8-10mls/kg
PaO <sub>2</sub>	↑ 10 mmHg or 104-108mmHg
PaCO <sub>2</sub>	↓ 27-32 mmHg
Arterial pH	↑ 7.40-7.45
Bicarbonate	↓ 19-25mmmol/l

<b>Renal</b>	
Urea (mg/dL)	4-12
Sodium (mEq/L)	132-140
Potassium (mEq/L)	3.5-4.5
Chloride (mEq/L)	90-105
Calcium ionized (mEq/L)	4-5

**Appendix 2 Pregnancy Complications**

**Placental Abruption** <sup>1, 7-9, 16</sup>

Signs:

- ◆ Uterine tenderness
- ◆ Bleeding, haemorrhagic shock
- ◆ Uterine tetany
- ◆ Expanding fundal height
- ◆ Evidence of fetal compromise (60% of cases)

Symptoms

- ◆ Vaginal bleeding
- ◆ Uterine irritability

**Premature Membrane Rupture** <sup>7-9, 16</sup>

- ◆ Ruptured membranes < 37 weeks in absence of contractions
- ◆ If the mother is stable and the pregnancy is viable and vaginal birth is possible, labour may be induced (not necessarily immediately). If there is evidence of fetal compromise, birth will be expedited by the most appropriate method including caesarean section.

**Uterine Rupture** <sup>7-9, 16</sup>

Signs

- ◆ Smaller than expected symphysis-fundal height measurement for the gestation
- ◆ Oblique /transverse lie
- ◆ Hypovolaemic shock
- ◆ Fetal bradycardia or absence of fetal heart tones
- ◆ Rebound guarding

Symptoms

- ◆ Referred shoulder tip pain
- ◆ Severe pain
- ◆ Abdominal pain

Diagnosis :

- ◆ Ultrasound can show evidence of extrusion of the uterine contents, free fluid in pelvis and paracolic region. Confirmation is by laparotomy.
- ◆ Occurs in 1% of pregnancies with blunt trauma and is associated with a pelvic fracture

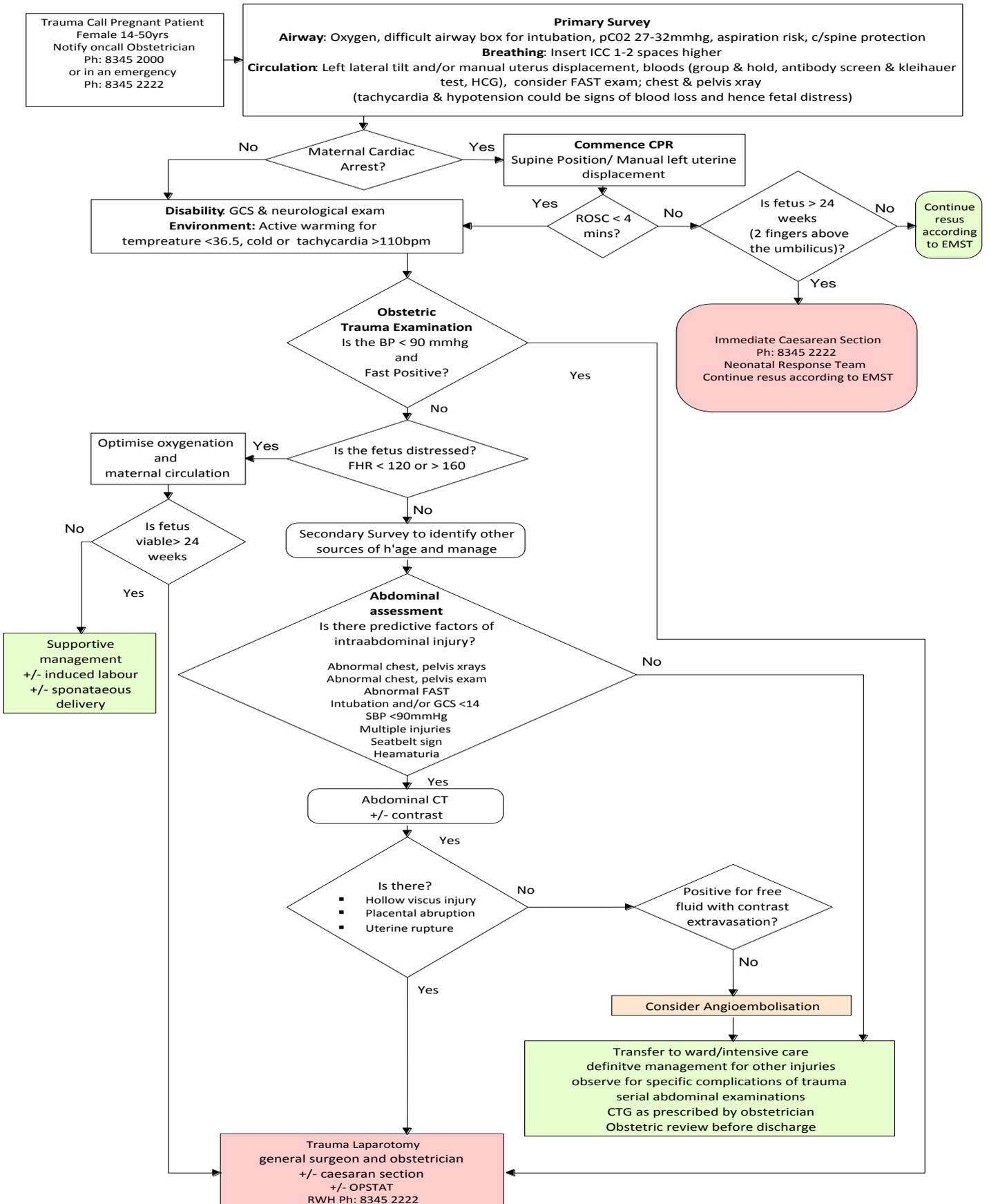
**Uterine contractions**<sup>7-9, 16</sup>

- ◆ Most common side effect of trauma, due to release of prostaglandins. Whilst 70% will settle, some women may progress to labour.
- ◆ Labour can occur at any gestation

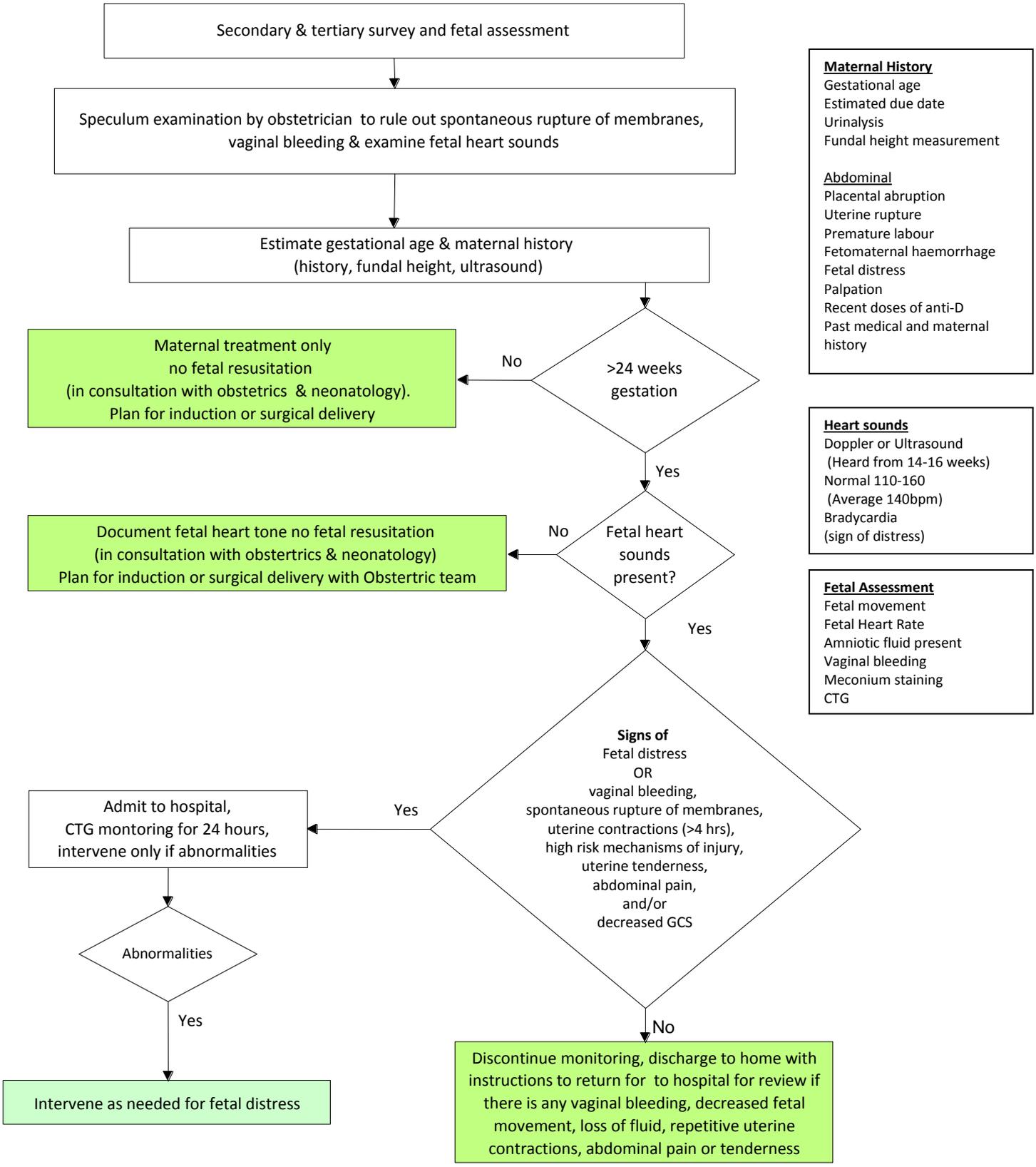
Diagnosis:

- ◆ Regular Uterine contractions
- ◆ Effacement and dilation of the cervix

*Labour must NOT be suppressed when there is any placental abruption, maternal complications such as pre-eclampsia or hemodynamic instability.*



**Pregnant Trauma Patient Secondary and Tertiary Survey**



**Maternal History**  
 Gestational age  
 Estimated due date  
 Urinalysis  
 Fundal height measurement

**Abdominal**  
 Placental abruption  
 Uterine rupture  
 Premature labour  
 Fetomaternal haemorrhage  
 Fetal distress  
 Palpation  
 Recent doses of anti-D  
 Past medical and maternal history

**Heart sounds**  
 Doppler or Ultrasound (Heard from 14-16 weeks)  
 Normal 110-160 (Average 140bpm)  
 Bradycardia (sign of distress)

**Fetal Assessment**  
 Fetal movement  
 Fetal Heart Rate  
 Amniotic fluid present  
 Vaginal bleeding  
 Meconium staining  
 CTG

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