

MANAGEMENT OF TRAUMA IN PREGNANCY

ANAESTHESIA TUTORIAL OF THE WEEK 172

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Mario Fernandes
Specialist Registrar in Anaesthesia
Ninewells Hospital, Dundee, United Kingdom.

Correspondence to mfernandes@nhs.net



This tutorial examines the common causes of trauma in pregnancy, the mechanisms of injury and strategies to most effectively manage the mother and unborn child.

QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article, together with a brief explanation.

1. Which of the following statements regarding trauma in pregnancy are correct?
 - a. The highest incidence of trauma in pregnancy occurs in the 1st trimester
 - b. Road traffic accidents account for the majority of cases of trauma
 - c. The Kleihauer-Betke test is not a useful test following trauma
 - d. The onset of uterine contractions following trauma may be the first sign of placental abruption

2. In the management of a term pregnant woman who has sustained serious traumatic injuries:
 - a. Left lateral tilt should be considered after the primary survey is complete
 - b. In the event of cardiac arrest, delivery by peri-mortem caesarean section should be within 5 minutes of commencing CPR
 - c. For cardiac compressions to be effective, left lateral tilt should be reduced to less than 15 degrees
 - d. Placental abruption occurs in up to 50% of major injuries

3. Which of the following statements are correct?
 - a. Fetal mortality approaches 50% when the body surface area burn is >50 %
 - b. Trauma increases the likelihood of pre-term labour
 - c. To reduce the risk of fetal trauma, it is recommended that the lap strap of a 3 point seat belt be placed above the uterus
 - d. Thromboprophylaxis with heparin should be avoided following major trauma in pregnancy

INTRODUCTION

Around 7% of pregnancies are complicated by trauma with most traumatic events occurring during the 3rd trimester. Injuries sustained from road traffic accidents account for 70% of life threatening injuries. Other causes of trauma in pregnancy include accidents and falls at home and work, and injuries sustained as a result of domestic violence.

Emergency teams who provide immediate care to the pregnant trauma patient may be unfamiliar with the physiological changes of pregnancy and strategies to safely manage the fetus. Fetal loss is more common than maternal death and occurs in 40% of major & 2% of minor trauma.

According to the most recent UK Confidential Enquiry into Maternal and Child Health (CEMACH Saving Mothers' Lives 2003-2005), 23 pregnant women or recently delivered mothers died as a result of road traffic accidents, including pedestrian accidents. 12 died undelivered and 8 died despite intense cardio-pulmonary resuscitation and peri-mortem caesarean section. None of the 8 babies delivered survived even though their gestational ages ranged between 24 and 38 weeks.

INITIAL MANAGEMENT

A pregnant trauma victim in the late second or third trimester should be cared for in a centre that has an obstetric team on site for the management of the ongoing pregnancy and/or delivery. A coordinated multi-professional approach is essential to ensure the best outcome for both mother and baby. The team should include a senior obstetrician, anaesthetist, trauma physician/surgeon, midwife and a paediatrician if delivery is anticipated.

Management of the pregnant trauma patient follows the usual ABCDE trauma approach (see below) but also includes some specific strategies:

- **Left lateral tilt at the earliest opportunity**
- The primary survey
- **Assessment of fetal wellbeing & viability**
- Secondary survey
- Definitive management.

Efforts should be made to obtain a history of the incident including mechanism of injury from the patient, bystanders and paramedic staff. A complete past medical and obstetric history should be sought.

Left lateral tilt at the earliest opportunity

From 20 week's gestation, the uterus may compress both the inferior vena cava and the aorta. The degree of compression is influenced by gestation, being greatest at term. It is also increased by multiple pregnancy, polyhydramnios and a large fetus. In the supine position, venous pressure in the lower limbs can be as high as 20-25 mm Hg, and the calibre of the aortic lumen reduced by 40%. The cardiac output of a pregnant woman in the supine position may be reduced by up to 25% compared with in the left lateral position.

A left lateral tilt of 15 degrees or more is essential to reduce aortocaval compression and maximise maternal cardiac output and fetal blood flow. Lateral tilt should be applied to the pregnant woman after 20 weeks gestation and can be achieved in a number of ways; however providing adequate tilt in some trauma situations may be difficult. In cases where there is a possibility of spinal injury, patients should be immobilised on a spinal board and in these situations the whole spinal board can be tilted to the left. At the very least, the uterus should be manually displaced. If the spine has been cleared, a wedge or pillow should be placed under the right hip.

The Primary survey aims to identify and manage life threatening problems. The primary survey includes:

Airway with cervical spine control
Breathing
Circulation
Disability or neurological status
Exposure and environmental control

All pregnant trauma victims should receive high flow oxygen by face mask and early consideration given to securing the airway if there is concern. The potential hazards of a full stomach and difficult intubation in pregnant women should be recognised and appropriate airway equipment made available. In the event of cardiac arrest, cardiopulmonary resuscitation (CPR) should be provided following Adult Life Support guidelines using the same resuscitation drugs and doses as for the non-pregnant patient. During CPR specific strategies to improve the chance of survival of both mother and baby should be employed (see later).

Two large bore intravenous cannulae should be inserted in the upper limbs. Blood samples should be collected for full blood count, coagulation screen, urea & electrolytes and a sample taken for blood cross match. Warm crystalloid infusion should be commenced e.g. Hartmann's solution.

Monitoring of ECG, blood pressure, pulse oximetry, respiratory rate, urine output, end tidal CO₂ (in intubated patients) and fetal heart rate should be carried out during the primary survey.

Fetal assessment

The fetus should be closely monitored since trauma increases the risk of premature labour, placental abruption and fetal loss. Placental abruption occurs in 2-4% of minor traumatic injuries and up to 50% of major injuries.

Auscultation of the fetal heart and assessment of fetal movement should be carried out after the primary survey. Evaluation of fetal heart rate is most simply performed using a hand held Doppler probe but a Pinard stethoscope can also be used if Doppler is not available. The normal fetal heart rate is 120 – 160 beats/minute.

Pelvic ultrasound is very useful in the management of the pregnant trauma patient. Ultrasound may identify a fetal heart beat & heart rate, number of babies, placentation, fetal presentation and any evidence of bleeding or trauma to pelvic structures.

Cardiotocography (CTG) will best identify uterine activity and fetal heart rate changes and should be commenced as soon as possible. Obstetric management decisions based on the CTG findings should be considered in the light of the gestation and viability of the fetus.

The secondary survey identifies problems that are not immediately life threatening and is performed when the patient is stable. This may sometimes take place following emergency surgery and involves a top to toe detailed examination. It should follow the format for any trauma patient but should pay particular attention to signs of injury around the pelvis; including tenderness over the uterus, presence of uterine contractions, and evidence of vaginal bleeding or ruptured membranes.

Peri-mortem Caesarean section

In the event of cardiac arrest, when initial resuscitation attempts fail, delivery of the fetus by emergency caesarean section may improve the chances of successful resuscitation of the mother and fetus. Caesarean section improves the chances of survival by relieving aortocaval compression caused by the gravid uterus. Even with lateral displacement of the uterus, maternal cardiac output is significantly impaired during CPR. The UK Resuscitation Council recommends that caesarean section be performed early, aiming for delivery within 5 minutes of cardiac arrest; however the gestational age of the fetus is important in determining specific management:

Gestational age < 20 weeks. Urgent caesarean need not be considered since aortocaval compression by the uterus is unlikely to compromise maternal cardiac output.

Gestational age 20 – 23 weeks: Caesarean delivery within 5 minutes to maximize chances of maternal survival but at this gestation, neonatal survival is unlikely.

Gestational age > 23 weeks. Caesarean delivery within 5 minutes to help save both mother and baby.

The neonate delivered during a peri-mortem caesarean section is likely to be severely acidotic and hypoxic and a paediatric team should be present to continue neonatal resuscitation and support following delivery.

MATERNAL PHYSIOLOGICAL & ANATOMICAL CHANGES AFFECTING RESUSCITATION IN TRAUMA

An understanding of the physiological changes of pregnancy is essential for effective management of the pregnant trauma patient.

Oxygenation:

Functional residual capacity is reduced by 20% during pregnancy, resulting in airway closure in 50% of supine women at term. Oxygen consumption increases by 20% to about 300ml/min. These changes can result in rapid oxygen desaturation in cases of respiratory arrest or impaired ventilation hence the requirement for oxygen in all pregnant trauma victims and consideration of an early definitive airway if there are signs of airway obstruction or a depressed level of consciousness. Early intubation will also protect from regurgitation and aspiration of stomach contents. There is a greater risk of failed intubation in the pregnant woman and this should be anticipated and appropriate difficult airway equipment should be available. In the case of difficult intubation, the priority should be maintenance of oxygenation by ventilation with either a facemask or by a supraglottic airway e.g. laryngeal mask airway.

Ventilation is increased by 40% as a result of an increased tidal volume, resulting in a PaCO₂ of 4 kPa with minimal change in respiratory rate. The diaphragm is raised cephalad by about 4cm and this should be considered if a thoracic intervention (e.g. thoracocentesis) is required.

Cardiovascular system:

Plasma volume increases by 50% with an increase in the red cell mass by only 30% resulting in the physiological anaemia of pregnancy. Cardiac output increases by up to 50% at term and remains at this value for 48hrs before returning to non pregnant values 2 weeks post partum. Blood pressure is lower as a result of progesterone mediated vasodilatation and reduction in the systemic vascular resistance.

The fetal blood supply is not autoregulated and is dependant on maternal mean arterial blood pressure.

Estimation of blood loss may be difficult in maternal trauma and loss may sometimes be concealed within the uterus. As a result of these physiological cardiovascular changes, the systolic blood pressure may only fall after about 2000ml (30-40%) blood loss. Hypotension should be aggressively treated taking into account the increase in blood volume when determining resuscitation requirements. Hypotension due to spinal shock following spinal injury may require vasopressors rather than excessive fluids.

BLUNT ABDOMINAL TRAUMA

The bony pelvis protects the uterus up to 12 weeks gestation and fetal loss at this time tends to occur as a result of inadequate oxygenation rather than direct uterine injury. As the uterus enlarges it becomes thinner and rises above the pelvic brim making the fetus and placenta vulnerable to trauma. The bladder is pushed cephalad by the uterus making it also vulnerable to injury and any haematuria should be investigated further. The spleen is engorged due to the increased maternal blood volume and may be a common cause of intraperitoneal haemorrhage as a result of trauma.

Pelvic fractures can be lethal for the fetus resulting in direct injury and a mortality rate of up to 25%. Pelvic fractures may also cause injuries to the bladder, urethra, colon and major vascular structures.

In blunt abdominal trauma the uterus, placenta and amniotic fluid absorb the mechanical forces. The uterus is elastic and may sustain the forces but the placenta can shear leading to a placental abruption. Obstetric complications of blunt abdominal trauma include abruption, preterm labour, premature rupture of membranes, and uterine rupture.

An experienced Obstetrician is vital in assessing patients with abdominal pain or tenderness and differentiating between obstetric and non obstetric causes. A Focused Abdominal Sonography for Trauma (FAST) is a rapid, limited ultrasound scan performed during resuscitation to identify the presence of free fluid in the abdomen. Ultrasound may also identify fluid in the pericardium and pleural cavities as well as identify specific intrauterine abnormalities.

The results of pelvic examinations, fetal monitoring, and ultrasound examinations are important in the diagnosis and management. A CT scan may provide useful information but the risk associated with transfer of a severely injured pregnant patient to the radiology suite must be considered. CT requires the patient to be placed supine and in the case of a pregnant trauma patient, lateral tilt must be applied.

Abdominal pain may be generalized or confined to the upper, middle or lower abdomen. Generalised pain with rebound tenderness and guarding suggests irritation of the peritoneum as a result of ruptured viscus, intra-abdominal haemorrhage, severe infection or pancreatitis. Middle or lower abdominal pain may be more suggestive of a uterine cause.

Bleeding into the uterine muscle or cavity is irritant and onset of contractions may be the first sign of a developing placental abruption. Placental abruption is likely in the presence of direct abdominal trauma with abdominal or uterine tenderness and/or vaginal bleeding. Placental abruption can sometimes lead to disseminated intravascular coagulation (DIC) due to the release of thromboplastin and plasminogen activator.

Uterine rupture is seen in < 1% of blunt abdominal trauma victims and usually occurs in women with a previous uterine scar.

A resuscitative laparotomy may be indicated to identify and stop the source of haemorrhage. There is no place for hypotensive resuscitation in pregnancy and fluid resuscitation should be aggressive.

PENETRATING TRAUMA

Penetrating injuries may be due to knife wounds or gunshot injuries and often require immediate surgical exploration. An exploratory laparotomy is not necessarily an indication for caesarean section; however the gravid uterus may make abdominal surgery difficult because of upward compression of the abdominal contents in which case caesarean delivery may be required. Specific management of penetrating trauma is often individualised and should involve a multidisciplinary team including trauma surgeons and obstetricians.

BURNS

Fetal mortality is approximately 63% when the body surface area burn is 25-50% and approaches 100% when the body surface area burn is >50%. Maternal and fetal deaths are usually a result of inadequate fluid resuscitation, hypoxia or septicaemia.

Carboxyhaemoglobin level should be measured in all major burns, especially those around the airway. Carbon monoxide can cross the placenta and produce fetal carboxyhaemoglobin. A carboxyhaemoglobin level >10% indicates significant inhalation of carbon monoxide. Physical symptoms are seen at levels of 20% and levels >60% result in death.

Developing airway oedema, due to an airway burn can make an already challenging maternal airway more difficult to manage. Early intubation is recommended in major burns and in those with evidence of airway injury.

Aggressive fluid resuscitation is essential (especially in the first 12-24 hrs) as fluid volumes required are greater than in the non pregnant woman with burns. Prophylactic systemic antibiotics are recommended.

Obstetric management is individualised but urgent delivery should be carried out in burns >50% for a second or third trimester pregnancy.

OTHER CONSIDERATIONS

For penetrating injuries patients should receive tetanus toxoid 0.5 ml if they have not received a booster in the past 5 years. If they have not been immunized previously and if there is risk of heavy contamination then they should receive 500 units of tetanus immunoglobulin intramuscularly.

Pregnancy is a pro-thrombotic state and trauma victims may be immobilised which further increases the risk of venous thromboembolism. Thromboprophylaxis with heparin, pneumatic compression devices and early ambulation should be provided.

Trauma in pregnancy may result in fetal haemorrhage and mixing of fetal blood with maternal blood (fetomaternal haemorrhage). Fetal haemorrhage may result in fetal anaemia and fetal death in the event of a massive bleed. In Rhesus negative mothers, blood from a Rhesus positive fetus may sensitise the mother and lead to the development of Rhesus antibodies. These women will need Anti-D immunoglobulin immediately or within 72 hours of suspected exposure. A Kleihauer-Betke test measures the amount of fetal haemoglobin transferred from the fetal circulation to the maternal blood stream.

PREVENTION

The majority of pregnant women who die from trauma in the UK do so as a result of injuries sustained in road traffic accidents. Recommendations for the use of seat belts in pregnancy to limit the risk of fetal trauma have been made in the previous two CEMACH reports. Three point seat belts should be worn throughout pregnancy with the lap strap placed as low as possible beneath the uterine "bump" lying across the thighs with the diagonal shoulder strap above the bump lying between the breasts. The seat belt should be adjusted to fit as snugly as is comfortably possible, and if necessary the seat should be adjusted.

The most recent CEMACH report has also revealed that pregnant women in the UK who died as a result of trauma were more likely to lead socially complex lives with a higher prevalence of recreational drug misuse and domestic abuse. In the majority of cases of domestic abuse, clear signs and symptoms of abuse were present but they were not followed up or acted upon.

Women, especially teenage girls, should be educated about the dangerous effects of alcohol and substance misuse and be referred for counselling or provided with support. Routine enquiries should be made about domestic abuse, either when taking a social history when pregnancy first presents, or at another opportune point during the antenatal period.

ANSWERS TO MCQS

1. a)F b)T c)F d)T

The highest incidence of trauma occurs in the third trimester and is most commonly a result of road traffic accidents. The Kleihauer-Betke test measures the amount of fetal haemoglobin transferred from the fetal circulation to the maternal blood stream. It is usually performed on Rhesus-negative mothers to determine the required dose of Rho(D) immunoglobulin to inhibit formation of Rhesus antibodies in the mother and prevent Rhesus disease in future Rh-positive children.

2. a)F b)T c)F d)T

Left lateral tilt should be provided as soon as possible to the pregnant trauma patient who is more than 20 weeks pregnant and should be maintained during CPR.

3. a)F b)T c)F d)F

Fetal mortality approaches 100% when the maternal burn surface area is >50%. The lap strap of the seat belt should be placed *below* the uterine bump to reduce the risk of injury in the event of a road traffic accident. Both pregnancy and trauma increase the risk of venous thromboembolism. Thromboprophylaxis with prophylactic subcutaneous heparin should be provided to all pregnant women who have sustained major trauma unless they have ongoing bleeding or impaired coagulation

FURTHER READING

Managing Obstetric Emergencies and Trauma. Ed: Howell C, Grady K and Cox C. The MOET course manual, (2nd edition 2007). RCOG press, ISBN 978-1-904752-21-9

The Confidential Enquiry into Maternal and Child Health (CEMACH). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer - 2003-2005. Lewis, G (Ed) 2007. www.cemach.org.uk