



Review Article

Volume 2 Issue 1 – October 2016  
DOI: 10.19080/ARGH.2016.02.555580

Adv Res Gastroentero Hepatol

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## Trauma in Pregnancy - A Review

Vikram Khanna<sup>1\*</sup>, Parul Gupta<sup>2</sup>, Ranjana Khanna<sup>3</sup> and Umamaheshwar Kodide<sup>4</sup>

<sup>1</sup>Consultant, Department of Orthopaedics, Ranjana Hospital, Allahabad, India

<sup>2</sup>Consultant, Department of Obstetrics and Gynaecology, Ranjana Hospital, Allahabad, India

<sup>3</sup>Senior Consultant, Department of Obstetrics and Gynaecology, Ranjana Hospital, Allahabad, India

<sup>4</sup>Resident, Department of Orthopaedics, National Institute of Medical Sciences, Jaipur, India

**Submission:** September 24, 2016; **Published:** October 21, 2016

\***Corresponding author:** Vikram Khanna, Department of Orthopaedics, Ranjana Hospital, Allahabad-211003, India.

### Abstract

**Objective:** 1 in 12 pregnant women are affected by major trauma which has an impact on the maternal mortality and morbidity and finally the pregnancy outcome. This requires a multidisciplinary approach for optimum outcome of both mother and the fetus. The aim of this article was to provide the emergency care providers with an evidence based approach which is systematic towards the management of a pregnant trauma patient.

**Outcomes:** Various parameters involved in the management of pregnant females have been considered in this article in the hope to provide adequate information regarding the management of such patients.

**Evidence:** This literature was retrieved through various searches from the Medline, CINAHL, Cochrane library using the following keywords like (trauma, perimortem Cesarean, Kleihauer-Betke, supine hypotension, electrical shock). The results were restricted to various systematic reviews, RCTs and observational studies.

**Keywords:** Polytrauma; Pregnancy

### Introduction & Background

One of the leading causes of maternal mortality is trauma during the antenatal period [1]. Non-lethal injuries most commonly occur due to domestic violence [1]. Penetrating injuries and falls also constitute a major cause for trauma during pregnancy [2]. Several issues specific to pregnancy have to be kept in mind while deciding the management of such cases like, alterations in the maternal physiology and anatomy, exposure to radiation, assessment of fetal wellbeing and so on. The management warrants multidisciplinary approach including trauma surgeons, emergency medicine physicians, obstetrician and neonatologists. The role of the obstetrician is important as they have to determine the fetal age, optimize uteroplacental circulation, assess fetal wellbeing, evaluating the risks of the radiation and medication and also deciding and performing emergency Caesarean section if required. Through this article we have found answers to some difficult situations while managing a case of trauma in pregnancy.

### Review

#### Primary survey

Assume every young female in the reproductive age group to be pregnant unless proved otherwise: This is because many females are unaware of their pregnancy and may risk the fetus to hazardous radiations. Hence, a detailed obstetrical history should be obtained. In one study it was found that 3% of all young females coming to the trauma center were pregnant out of which 11% didn't know about their pregnancy status [3]. The management protocol in case of a pregnant female is the same as that of a non-pregnant female with the ATLS guidelines to be followed.

**Airway:** In a pregnant female the intubation may prove to be difficult as compared to a non-pregnant female [4] which may be due to the weight gain and edema. Decreased capacity of the lung, increased oxygen demand are some of the causes for the difficulty in maintaining the oxygen concentration [5]. If the

airway is not secured, then a nasogastric tube should be passed to prevent aspiration of gastric substances [6]. This is due to delayed gastric emptying in pregnancy [7].

**Breathing:** The oxygen saturation is to be kept above 95% and if a chest tube is to be inserted then the tube should be inserted 1-2 intercostal spaces higher than normal [8].

**Circulation:** Some precautions are needed while resuscitation of pregnant females. Since, the uterine circulation is very sensitive to the vasopressors causing fetal hypoxia, they are not given till maternal hypotension persists even after replacement of the complete intravascular compartment with adequate amount of fluid [9]. The patient should be kept in the left lateral position as keeping the patient supine causes decrease in blood pressure by 30% [10], which is due to decrease in the venous return by the uterus compressing the inferior vena cava [11]. If anti-shock trousers are to be used then it is advisable not to extend it over the abdomen so as to avoid hypoperfusion of the uterus [12].

### Multidisciplinary approach

The maternal health should be prioritized over the fetal health. Patient should be transferred to the delivery unit when the injuries are not life or limb threatening and the fetus is viable ( $\geq 23$  weeks). If there is a major injury or the fetus is under 23 weeks of gestation, then patient should be managed in the emergency room only. A detailed history of the mechanism of injury should always be taken along with the obstetrical history.

After examination by the ATLS protocol [11] few points should be kept in mind before examining a pregnant patient. The heart rate increases by 15% during pregnancy. The presentation of hypovolemic shock is delayed due to the increase in the blood volume [13]. The first sign of hypovolemic shock in such a patient may be irregular fetal heart rate. This occurs when a significant amount of blood loss has already taken place [14,15]. Hence, it is advisable to start fetal monitoring as soon as possible in a case of trauma during pregnancy. Signs of peritoneal irritation are very rare in pregnant females and so the doctor should rely on investigations as the physical examination doesn't reveal much [16]. Tenderness over the uterus is a red flag sign and generally indicates abruption of the placenta. In such cases urgent evaluation and the decision on an emergency cesarean section should be undertaken [14]. Per vaginal examination should be done to check for the fetal presentation, cervical dilatation, effacement and station. However, if there is vaginal bleeding and the period of gestation is more than 23 weeks then it is advisable to perform an ultrasound before any per vaginal or per speculum examination as vaginal bleeding may denote placenta previa.

### Investigations

**Radiological Studies:** X-rays of the cervical spine, chest and pelvis are generally the first to be ordered in case of trauma [11]. The maximum risk for the development of teratogenicity due to

ionizing radiation is seen during the period of organogenesis (5-10 weeks) with increased risk of miscarriage before that time [17]. After this period radiation is more likely to cause restriction of growth and CNS defects [17]. The radiation level required for the investigation is very low to have any risk on the developing fetus [17].

Radiation exposure of more than 5-10 rads is the cause for fetal malformations or CNS effects and that too is limited to 18 weeks [17,18]. Hence, the mother should not be deprived of any indicated investigation just to avoid radiation. Even a CT scan of the abdomen during the 3rd trimester leads to absorption of 3.5 rads which is still below the threshold causing any fetal malformations or any birth defects [19]. The use of gadolinium based contrast agents are not toxic to the fetus and can be used when indicated [20]. The carcinogenic effects of radiation to the fetus were found to be similar to that of radiation in the childhood [21]. However, limitation on the number of CT scan cuts is advisable.

**Laboratory studies:** In addition to the routine blood investigations, coagulation profile should also be done especially the Serum Fibrinogen levels. In a pregnant female normally the fibrinogen levels are greater than 4 g/L [22]. If the levels fall below 2g/L then it may denote DIC. The PaCO<sub>2</sub> (27-32 mm of Hg), creatinine (50-60 mmol/L) and alkaline phosphatase (140IU/L) values differ in pregnancy as compared to non-pregnant females and should be kept in mind [23].

**Additional Investigations:** FAST USG helps in the diagnosis of intra-abdominal injuries in cases of blunt trauma to the abdomen. In case of free fluid in the peritoneal cavity it is better to get the abdominal CT to evaluate the exact location of the injury.

### Fetal assessment

Assessment of a viable fetus (>23 weeks) should be done as soon as the patient comes to the emergency room. The main objectives are:

- Identification of fetal hypoxia
- Detection of placental complications
- Evaluation of maternal hemorrhage
- Identify fetal injuries
- Identification and management of maternal hypovolemia

Electronic fetal monitoring should be started as soon as possible. In some cases, (40%) [24] uterine contractions maybe seen and these resolve in 90% of cases without any adverse fetal outcomes [25]. The reliability of the electronic fetal monitoring in determining the outcome of pregnancy is not very good (62% sensitivity and 49% specificity) [24]. However, when combined with physical examination it was found to have a negative predictive value of 100% [14,24]. Any abnormal finding in the

fetal monitoring may require further testing and conservative methods like utero resuscitation with supplemental oxygen, IV fluids and left lateral decubitus positioning or delivery, depending on the severity of the abnormal pattern, the presumed cause and gestational age. The requirement of cesarean section following trauma is required in only 2.4% to 7.2% of the patients and they are associated with a high incidence of maternal mortality [15].

The duration of monitoring is under debate and it was concluded by many studies [24,26] that the patient had to be monitored for 24 hours if any of the following risk factors were seen:

- uterine tenderness,
- significant abdominal pain,
- vaginal bleeding,
- a contraction frequency of more than one per 10 minutes,
- rupture of the membranes,
- atypical or abnormal fetal heart rate pattern,
- high risk mechanism of trauma, or
- serum fibrinogen < 200 mg/dL

If no such risk factors were present, then the patient could be discharged after 4 hours of monitoring as it was seen that the uterine contractions following trauma generally subsided within the first 4 hours of the injury.

### Fetomaternal Hemorrhage (FMH) and alloimmunization

FMH is seen in 10-30% of all pregnant patients with trauma [27]. The amount of FMH gives an idea as to how much is the transplacental hemorrhage and also the status of the alloimmunization of the mother. Even as little as 0.001ml of fetal blood may cause alloimmunisation in a Rh negative mother. Therefore, anti-D IgG should be given to all Rh negative pregnant trauma patients [28]. The anti D injection should be given within 72 hours of the trauma and should be given as a single dose of 300mgs. This provides sensitization against 30 ml of fetal blood [28]. Since, generally the estimated amount of fetal blood in the maternal circulation is less than 15ml (90%) [25,29] hence, a single ampoule is enough to provide adequate protection against the alloimmunisation in a Rh negative mother following trauma. To determine if any additional dose of anti D injection is required Kleihauer-Betke test for the quantification of the FMH can be performed.

### Role of ultrasound

Ultrasound may be useful in:

- determination of gestational age
- demonstration of fetal cardiac rate and rhythm

- placental localization and exclusion of placenta Previa
- assessment of amniotic fluid volume
- cervical length assessment
- fetal well-being (biophysical profile)
- detection of fetal anemia by peak systolic flow velocity in the middle cerebral artery
- delineation of possible fetal injury, and
- confirmation of fetal demise.

However, it is not useful in assessing placental abruption [25] nor the biophysical profile [30] following trauma. The electronic fetal monitoring is useful in this context as it gives a good idea about the placental abruption and the fetal well-being [25,29].

### Obstetric complications of trauma

**Placental abruption:** Is seen in 5-50% of all cases of maternal trauma [25,29]. It is the most common cause of fetal death following blunt trauma. Results from a difference of elasticity between the placenta and the uterine wall. All abruptions take place within 2-6 hours with a maximum of 24 hours [14,31]. Clinical findings include abdominal pain, uterine tenderness, uterine contractions or hypertonicity, vaginal bleeding, preterm labour, or an atypical or abnormal EFM tracing. Severe abruption maybe lethal to the fetus but with quick action and cesarean section the survival rates may be as high as 75% [15,32]. Placental abruption is also associated with premature labour and a trial for normal delivery may be done if the baby is near term and the mother is hemodynamically stable. However, if the fetal or maternal deterioration is seen then it is better to go for a cesarean section even if the child is premature [31].

**Uterine rupture:** It is a very rare complication seen generally in a scarred uterus in the second half of pregnancy. Clinical feature suggestive of uterine rupture include: maternal shock, abdominal distension, irregular uterine contour, palpable fetal parts, sudden abnormal fetal heart rate pattern, recession of fetal presenting part and peritoneal irritation (abdominal rigidity, guarding and tenderness). There is a 100% fetal mortality seen, whereas the maternal mortality is also high. Management is done via emergency laparotomy to control bleeding and assist in resuscitation.

**Preterm labour:** This may occur due to various reasons. Abruption: leading to decidual necrosis, leading to prostaglandin secretion leading to labour [33]. Direct trauma: to the uterus may lead to prostaglandin secretion, leading to labour [34]. Preterm premature rupture of membranes. If such a situation occurs, then the neonatologist should be consulted and further management should be decided according to the period of gestation of the child.

### Penetrating injury

Incidence of maternal visceral injury is 15-40% in a pregnant female as compared to 80-90% in a non-pregnant female [35]. The visceral organs are spared as they are generally displaced upwards but an upper abdominal stab wound may produce a complex bowel injury. Thoracoabdominal injuries (anteriorly 4th intercostal space and posteriorly scapula) may produce visceral injuries which may be missed. The gravid uterus while preventing the visceral organs is itself susceptible to injuries. The extent of fetal injury depends on the gestational age and fetal death can occur in a case of a penetrating injury to the uterus.

In the case of gunshot wounds, shockwaves and cavitations cause more fetal and maternal damage as compared to other penetrating wounds. 70% of abdominal gunshot wounds cause fetal injuries out of which 40-65% die [36]. The maternal mortality is not increased but the fetal mortality is significantly higher than a penetrating or blunt trauma. The management of a penetrating wound is the same as that of a non-pregnant patient. The only difference being the decision of cesarean during exploration. Factors influencing this decision include gestational age, extent and severity of fetal injury, degree of uteroplacental compromise, parameters of fetal well-being, and the need for hysterectomy with extensive uterine injury. A dead fetus is not an indication for cesarean section as it is generally aborted vaginally. Tetanus vaccine is safe and can be given whenever required as it is safe during pregnancy [37].

### Common modes of injury

**Domestic violence:** Abdomen is generally the most commonly struck organ. Every woman who sustains trauma, particularly penetrating abdominal trauma, should be questioned specifically about domestic violence. Such inquiry should occur in absence of the partner.

**Road traffic accident:** The outcome is related to various factors including collision itself, acceleration-deceleration velocities, and the use of protective mechanisms, like seat belts and air bags. Wearing a seat belt in a motor vehicle accident during pregnancy is effective in reducing the risk of adverse pregnancy outcomes including maternal death [38,39]. However, the lap belt should be below the abdomen, not over the uterus, and the shoulder belt should be between the breasts. The belt should not be too tight but comfortable. Airbags may be beneficial in a severe RTA [40] but may also prove disastrous causing complications like uterine rupture, placental abruption and fetal death during deployment of the airbag [41]. Not enough data is present to comment on the use or disuse of the airbags. RTA mainly causes blunt injuries with gross hemorrhage leading to adverse fetal outcome.

**Falls:** Occurs in 3-31% of maternal trauma [24,42]. Increase in the lumbar lordosis causes the center of gravity to shift anteriorly causing the fall [42]. Falls are very common in the third trimester of pregnancy especially after the 32nd week [24,30].

Falls are associated with preterm labour, placental abruption, uterine rupture, fetal growth restriction, and fetal death [42].

**Electrical trauma:** There is very little literature regarding this and all the case reports mention an adverse fetal outcome [43-45]. The possible cause being the current passing through the myometrium and causing contractions like labour or current passing through the amniotic fluid causing spontaneous abortion. Management is done for maternal and fetal well-being [46]. ECG, urine analysis to look for muscle damage and X-ray imaging may be done to assess the mother, and electronic fetal monitoring for the fetus. If loss of consciousness is there along with a viable fetus, then it is better to do fetal monitoring for 24 hours. However, injuries of a low voltage current do not show any adverse fetal effects until later.

### Perimortem cesarean section

It is the concept of doing a cesarean section parallel to the maternal resuscitation. It was introduced in 1986 and it was recommended that the cesarean should be done within 4 minutes of the maternal cardiac arrest [47,48]. The principle behind this was that with the removal of the baby, the venous return via the inferior vena cava increases and aortocaval compression by the gravid uterus gets removed. Since, the maternal neurological injury starts after 6 minutes, and for resumption of the cardiac flow by 5 minutes it is necessary for the cesarean section to start no later than 4 minutes [49,50]. This is generally recommended for fetus with 23 weeks of gestation or fundal height 2 or more fingerbreadths above the umbilicus [50]. Since, at this time not only the gravid uterus is big enough to compress the vessels but also the fetus has a chance to survive in case the mother does not. The maternal resuscitation is generally successful in case of cardiac failure due to heart disease during the course of pregnancy but is generally unsuccessful in the event of cardiac failure following trauma, here the main use of perimortem cesarean section is to salvage the fetus. A word of caution that if there is no maternal cardiac activity for 15-20 mins then chances of getting a viable fetus are very less [48,50]. Whereas, if there is no fetal cardiac activity at the time of presentation then doing the cesarean section is futile [15].

### Conclusion

Pregnant females coming with trauma is a complex condition requiring multidisciplinary approach. With appropriate management protocols it may be possible to save the lives of both the mother and fetus. This article may prove to be helpful in providing better care and avoiding mistakes during the management of such cases as we know that instead of 1, 2 lives are at stake and we must do whatever necessary to save both the lives.

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