

Trauma during Pregnancy – A Real Challenge

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Abstract

Introduction: Pregnancy increases risk of trauma, due to physiological changes. Major determinant of obstetrical outcome are severity of injury, gestation. Recent systemic review reveals limitation of literature.

Objectives: Present review is to look at whys, what's of trauma, action needed.

Material and Methods: Literature was searched with help of various search engines.

Results: Although precise incidence is not known, trauma complicates 1 of 12 pregnancies, leading non-obstetric cause of maternal deaths, 8 % non-obstetric deaths in pregnant women in some countries. Most common causes include vehicle accidents, domestic/intimate partner violence, burns, homicide, and suicide. Penetrating trauma, toxic exposure account for majority of remainder. Risk increases in women who work outside, especially industries, while walking on slippery floor, hurrying, carrying heavy objects. There is increased risk of motor vehicle crash (MVC) in second trimester. While choosing diagnostic modalities, concern about radiation exposure to fetus is valid, but delayed/missed diagnosis has greater risk than diagnostic hazards. Plain x-ray, digital radiography, fluoroscopy, angiography, Computerized Tomography (CT), do cause ionizing radiation but effects depend on number, location, exposure. Placental abruption, feto-maternal hemorrhage, preterm labor, pre-labour rupture of membrane, cord prolapse, hemorrhage, visible/hidden neurological effects, infection, organ dysfunction, effects of medication, stress, fear are real dangers for mother/baby. Management is unique challenge because two patients mother/fetus are potentially at risk with major anatomic, physiologic differences. Requires multidisciplinary approach, emergency clinician, trauma surgeon, obstetrician, and neonatologist.

Conclusion: Trauma during pregnancy is dangerous. Quick appropriate diagnosis, treatment with multidisciplinary approach is essential.

Keywords: Trauma; Pregnancy

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Received: December 24, 2015; **Accepted:** February 18, 2016; **Published:** February 26, 2016

Introduction

Pregnancy appears to increase the risk of falling, possibly because of increased joint laxity, weight, change in the center of gravity, and other anatomical changes. Alterations in sway responses perturbations have been reported in the third trimester even with uncomplicated pregnancies [1]. The injuries are sometimes intentional. Pregnancy appears to be a risk factor for being assaulted. The major determinant of the obstetrical outcomes after trauma is the severity of injury and gestation. A recent systematic review revealed that the available literature is characterized by severe limitations [2].

Materials and Methods

Literature of the subject was searched with the help of search engines like ObGyn.net, www.update.com./contents/trauma in pregnancy, Queensland clinical guidelines: Trauma in pregnancy, CDC 2011 Guidelines for field triage of injured patients etc.

Results

Reported Incidence with causes

Although precise incidence is not known, trauma is estimated to complicate approximately 1 in 12 pregnancies [3] and is the

leading non-obstetric cause of maternal deaths in some parts of the world [4]. Trauma is responsible for 8 % non-obstetric deaths in pregnant women, 32% due to hit on back, and 20% due of abdomen trauma. Tinker et al. [5] report that 6-7% of all pregnant women experience some sort of trauma, with the greatest frequency in the last trimester. Researchers report that 0.3-0.4% of pregnant women have traumatic injuries that require hospitalization. Kvarnstrand et al. [6] report that, in a study falls presented one half of reported injuries (51.6%) and 9.5% of injuries during pregnancy were intentionally inflicted. The overall rate of Motor Vehicle Crashes (MVC) during pregnancy has been estimated at around 207/100,000 pregnancies. Whitehead et al. [7] report that, of pregnant women involved in a MVC, 87 % receive some sort of medical care. Schiff et al. reported that 0.61/1000 live births can be attributed to MVC [8]. The majority of these admissions occur beyond 20 weeks gestation [9]. Dunnig et al. report that approximately 1 in 4 pregnant women will fall at least once [10]. A population-based study found that 79% of hospitalized women after a fall were in their third trimester, fracture of the lower extremity was the most common injury [11]. The majority of falls occur indoors and 39% involve falling from stairs [10]. In one of the largest studies, Vladutiu et al. evaluated more than 1400 pregnant women using a structured questionnaire administered at 17-22 weeks and at 27-30 weeks, and found an overall injury incidence of 4.1 per 1000 exercise hours [12]. The majority of these injuries were attributed to falls. Dunnig et al. report that 6.3% of employed pregnant workers had fallen at work [13]. In a series of 321 patients, penetrating trauma accounted for 9% of all admissions with trauma during pregnancy and 73% of them were of handgun, 23%, knife and 4% shotgun-related [14]. The prevalence of domestic violence (DV)/intimate partner violence (IPV) across various populations among, more than 60 studies from more than 20 countries have reported a frequency of 1-57% during pregnancy [15-19]. A North Carolina study revealed 55% cases of trauma due to motorcycles, 22% domestic assaults, 22% falls, burns, puncture wounds, animal bites and 5-10% thermal injury [20].

Most common causes of trauma include three categories, first fall from hills, huts, high buildings, on road and others, second vehicles related bicycle, scooter, car, airplane and third violence. MVC and DV/IPV and burns, homicide, suicide, penetrating trauma and toxic exposure account for the majority of the remainder [2,21,22]. Studies from developed countries reveal trauma most commonly due to motor accidents (66% cases) and 33% due to other risk factors. Another study revealed 48% trauma during pregnancy due to hit or slapping or kicking. Unintentional trauma accounts for a large portion of major trauma during pregnancy [8].

Reported risk factors

An epidemiologic study reported an increased risk of MVC in the second trimester compared with pre-pregnancy (6.5 versus 4.6 events per 1000 annually), but a causal relationship is unproven [23]. These mothers were more likely to use alcohol, smoke during pregnancy, employed, having epilepsy than mothers who did not report an injury. Mothers who reported an injury during pregnancy were more likely to be older than 18 years and

less likely to be age 30 years or older. At a major trauma center, Patterson et al. [24] reported 43.5% of MVC cases positive for some intoxicant and Schiff et al., report alcohol implicated in 45% [25]. The major risk factor for MVC is improper seatbelt use in both front and rear collisions. The impact with the steering wheel can be avoided with proper belt use [26], however counseling regarding seatbelt is missed during prenatal care. In one study only half of patients reported having received the advocacy [27]. Risk increases in women who work. It is known that increased joint laxity and weight gain can affect gait and predispose pregnant women to slips and falls. Major risk factors include walking on slippery floors, hurrying, or carrying heavy objects, women who work in industries. Dynamic postural stability decreases with pregnancy, especially during the third trimester. In developing countries women work in fields, walk long distance to get water, firewood from far off places, with all the risk of falling with water pot/firewood on head.

Diagnosis

While choosing diagnostic modality, concern about radiation exposure of the fetus is valid, but delayed or missed diagnosis has greater risk than diagnostic hazards. Plain x-ray, digital radiography, fluoroscopy, angiography, Computerized Tomography (CT) and nuclear medicine do cause ionizing radiation but effect depends on number, location, type of exposure. The three modalities most studied in pregnancy include ultrasound, CT, and magnetic resonance imaging (MRI). The exposure of radiation to embryo is minimized by wearing lead apron. Gadolinium used in MRI crosses placenta, and goes into amniotic fluid, so should not be used. There is no effect of non-ionizing imaging modalities like ultrasound, MRI which involve magnetic field at 1.5 Tesla or lower. Most common nuclear medicine perfusion with Tc 99m causes pulmonary embolus, so the helical CT is commonly used during pregnancy. The radiation exposure upto 50-100 mGy is safe. Diagnostic imaging procedures typically emit <0.05 Gy (5 Rads) radiations. One x-ray chest or limb emits 1mGy (0.1 rad). US Nuclear Regulatory Commission advocates that the occupational radiation exposure of pregnant women not exceeding 5mGy (500mrad) to the embryo/foetus during entire pregnancy is quite safe. However there are reports which reveal that in utero-radiation exposure of even low levels (eg 0.01 to 0.02 Gy/1 to 2 rad) may increase risk of childhood cancers particularly Leukemia, by a factor 1.5 to 2 over the baseline incidence.

Most sensitive period for ionizing radiation exposure is 14 days after conception which might cause lethal effect. There are threshold values for possible radiation effect, <16 weeks gestation 0.10-0.20 Gy (10-20 rads), for greater than 16weeks 0.50 to 0.70 Gy (50-70 rads), after 20 to 26 weeks of gestation fetus is relatively resistant to teratogenic effect of ionizing radiation. There is no evidence of pregnancy loss, abortion, intrauterine death, still birth, fatal anomalies, growth restriction, childhood cancer – leukemia, microcephaly, intellectual disability (when ionizing radiation dose <0.05 Gy), mental retardation at 8-15 weeks (IQ loss 25 to 31 points per Gy ie. per 100 rads), genetic effects due to ionizing radiation exposure. There is no adverse effect of ventilation perversion (V/Q) scanning, PET scan be

used. Diagnostic radiologic imaging in pregnant trauma patients should be undertaken if clinically indicated and not be withheld or delayed because of fears of fatal effects. Puri et al., report that because of the long acquisition time and difficulty in monitoring a critically ill patient, MRI is utilized substantially less in acute trauma management [28]. Ultrasound is easily accessible in an emergency and can provide crucial information about pregnancy gestational age, viability, and placental location, amniotic fluid and fetal presentation. It is a method of diagnosing placental abruption also, however this may be unreliable in the diagnosis as in one study sensitivity was only 24% [29]. Richards et al. report that focused assessment with sonography for trauma is a safe and efficient method for detecting intraperitoneal free fluid and intra-abdominal injury [30]. The ideal imaging modality during pregnancy for this evaluation has not been determined, but CT appears to have higher sensitivity than plain x-ray film [31]. Abdominal helical CT allows evaluation of multiple organ systems in a stable patient. A known drawback of CT scan is fatal radiation exposure of upto 3.5 rads (0.035 Gy) per study and this risk must be weighed against the potential for identifying life threatening injuries. Importantly, radiation doses <5 rads (0.05 Gy) are not associated with an increased risk of anomalies, pregnancy loss, or growth restriction [32]. CT in first trimester should only be used when benefits exceeds theoretical risk.

In case of major trauma, a complete blood cell count, coagulation profile, should be obtained. In Rh-negative mothers Kleihauer-Betke (KB) test allows for calculation of the dose of RH immune globulin.

Effects Reported

Trauma in pregnancy is a major contributor for maternal mortality in developed countries. Kvarnstrand et al. estimated mortality rate of 1.4 per 1,00,000 and 3.7 per 1,00,000 pregnancies respectively [6]. In United States, it is one of the major causes of pregnancy associated maternal deaths. Fetal mortality is high ranging between 40-70%. Immediate effects on mother due to trauma in pregnancy are blunt abdominal trauma, uterine rupture, penetrating abdominal trauma, placental abruption, fetomaternal hemorrhage (FMH), preterm labour (PL), pre-labour rupture of membranes (PLROM), cord prolapse, hemorrhage, visible or hidden neurological effects, infection, organ dysfunction, effects of medication to decrease preterm birth (PTB), risk of anesthetics, antibiotics and other factors like stress fear etc.

Trauma has been reported to increase the incidence of spontaneous abortions, PPLROM, PTB, stillbirth [33-36]. In a 16-state fetal deaths certificate study conducted over 3 years the rate of fetal deaths from maternal trauma was calculated to be 2.3 per 100,000 live births [21] with placental abruption as a major contributing factor [37]. The reported fetal deaths in women with >12 week gestations are 8% due to trauma, 40 of 176 due to MVC and 20% due to IPV. Reported fetal mortality is 3-38% due to blunt trauma. Pregnancy becomes very complicated when there is spinal cord injury, with many challenges, especially with limited human and other resources.

Trauma in pregnancy causes 30-80% fetal mortality. Maternal

mortality from abruption is less than 1%, but fetal death ranges from 20 to 35%. Penetrating trauma accounts for as many as 36 % of maternal deaths. In the case of gunshot wounds to pregnant abdomen, overall maternal mortality reported was 3.9%. Placental abruption after trauma occurs in 2 to 5% of minor accidents and upto 50% in case of major injuries. Pregnant women involved in MVC appear to be at increased risk for caesarean birth (CB) [36], however Vivian-Taylor et al. reported that, the risk of PTB and perinatal deaths increase only if delivery occurs immediately after MVC [9]. The estimated rate of 0.4% < 20 weeks and 3.5% thereafter [38]. The most common obstetric problem due to trauma is uterine contraction, however some researchers question the routine use of tocolytics for premature labour after trauma because in the majority (90%) of contractions stop spontaneously and those contractions which are not self-limited are often pathological in origin, thus, contraindications to tocolytic therapy. Increased risk of perinatal death associated with immediate delivery reflects the severity of trauma; delivery should never be delayed if clinically warranted in the hope of improved outcomes. Schiff (2008), reported a 4.4-fold increase in preterm labour, an 8-fold increase in fetal hypoxia compared to a randomly selected control [11]. In a prospective study of 31 pregnant women with minor electrical shocks, from home appliances, no differences were noted in mode of delivery, birth weight, or gestational age at delivery compared to controls [39]. Intentional trauma during pregnancy increases the risk of PTB by 2.7-fold and of low birth weight (LBW) by 5.3-fold [40].

Fanslow et al. [41] report, adverse pregnancy outcomes associated with DV/IPV as increased rate of spontaneous abortion. Jagoe et al. report [42], increased neonatal intensive care unit admissions, increased PTB (Rodrigues et al.) [43], and LBW [42-45]. Penetrating trauma in pregnancy is associated with as high as 73% fetal mortality, increased hospital stay, and complications such as ileus compared to blunt trauma [14]. Awwad et al. report that in their experience of selective laparotomy in 14 penetrating trauma cases in pregnancy over a 16-year period during the civil war in Lebanon, fetal mortality occurred in 50% [46]. In a prospective study of 317 patients with minor trauma, placental abruption occurred in one case and was not predicted by conventional testing including tocodynamometry, ultrasound [47]. Blunt trauma to the abdomen can cause broad ligament hematoma. Patron et al. reported that, the incidence of cardiopulmonary arrest is 1:20000 [48]. Fetal mortality and overall maternal morbidity remain exceedingly high (73% and 66%, respectively) following penetrating abdominal injury, homicides (36%) and MVC (32%) are the most common injuries that result in death. With penetrating wounds injury to the fetus is in as many as 70% of third trimester cases and cause maternal visceral injuries in 19% cases. By one estimate, as many as 1 in 3 pregnant women admitted to the hospital for trauma deliver during hospitalization [22].

Suggested Management Strategies

Management of pregnant woman with trauma presents a unique challenge requires critical evaluation, since the presence of the fetus means that there are two patients with major anatomic and physiologic differences potentially at risk. Management

should be directed by the status of the mother. Pregnancy should not lead to under diagnosis or under treatment of trauma due to the fear of adverse fetal effects. The primary initial goal is to stabilize the mother's condition. Fetal outcome is directly related to early and aggressive maternal resuscitation [49]. The priority for treatment of injured pregnant patient remains the same as those for the non-pregnant patient. It is essential to address the airway/cervical spine control, breathing and circulation (ABC; volume replacement/hemorrhage control), with the mother receiving treatment priority. Direct cervical spine trauma makes securing an airway more difficult and may necessitate fiber optic bronchoscopy [50]. Supplemental oxygen is essential to prevent maternal and fetal hypoxia. Prevention of aorto-caval compression is also essential to optimize maternal and fetal hemodynamics. Pregnant patient beyond 20 weeks gestation should not be left supine during the initial assessment. Left uterine displacement should be used by tilting the backboard to the left or as a final measure; the uterus can be manually displaced. The pneumatic anti-shock garment (PASG) may be used to stabilize lower extremity fractures and perhaps control hemorrhage. However inflation of the abdominal compartment of the PASG should be avoided because it compromises utero-placental blood flow.

To improve the effectiveness of cardiopulmonary resuscitation, clinicians should perform left lateral uterine displacement by tilting the whole maternal body 25 to 30 degree. Unique aspects of the advanced cardiac life support include early intubation, removal of all uterine and fetal monitors, and performance of perimortem caesarean delivery. Proper seatbelt use reduces the risk of maternal and fetal injuries in MVC.

If trauma occurs to spinal cord during 20th-24th weeks of gestation, 15 degree tilt to left, by rolled towels beneath spinal cord is advised to prevent supine hypotension syndrome because of aortocaval compression. If there is no response to advanced cardiac life support within 2 to 3 minutes, maternal cardiopulmonary resuscitation must be continued, anterior thoracotomy with open-chest cardiac massage (OCM) should be considered with emergency CB for a viable fetus. Studies have shown that conventional external cardiac massage (ECM) becomes less effective as the patient approaches term because of mechanical factors. Simultaneous (not sequential) evaluation by trauma and obstetric team is essential. Personnel trained in difficult intubation should be readily available. Penetrating injuries are more likely to affect the fetus, especially those anterior and below uterine fundus. If a thoracotomy tube is indicated, it should be placed 1-2 intercostal spaces above usual fifth intercostal space landmark to avoid abdominal placement. Pelvic fractures do not necessarily preclude vaginal delivery.

Tocolytics play an important role in management. Beta adrenergic drugs like terbutaline, ritodrine etc. exacerbate sepsis which leads to shock, also affects cardiovascular system. Calcium ions lead to cardiovascular effects when there is sepsis. Prostaglandins synthesis inhibitors like indomethacin cause platelet dysfunction. Because of pregnancy related critical changes, there is need of medications like halogenated anesthetics, epidural anesthetics. In this condition CB is life saving for both mother and fetus. It helps to increase 60 to 80% cardiac output in 4 minutes. There

is irreversible brain damage in non-pregnant individuals after 4-6 minutes of anoxia. In pregnancy anoxia occurs sooner, than non-pregnant condition which decreases functional residual capacity (FRC).

There are ethical issues during management for considering future and laws for termination of the pregnancy as per gestational age. Post traumatic disorder can also cause loss of baby. Future fertility needs to be considered. CDC reported that transport feasibility depends on the individual circumstances of a given case [51]. Cardiac arrest, loss of an airway, blood pressure <80/40 mm Hg, pulse <50 or >140 bpm, respiratory rate <10 or >24 breaths per minute, or a fetal rate <110 or >160 bpm should immediately alert the physician of probable catastrophic trauma requiring immediate stabilization and initiation of advanced cardiac life support [52] as well as advanced trauma life support [53]. Intravenous access should be secured and targeted laboratory tests to be ordered. In case of severe hemorrhage, transfusion of fresh frozen plasma, platelets and packed red blood cells at 1:1:1 ratio lowers the rate of coagulopathy and may improve survival (Pacheco et al.) Medical anti-shock trousers have been used for the pre-hospital management of trauma patients but they in fact may delay transportation to hospital and worsen outcome of penetrating trauma to the thorax and abdomen [54]. Management of penetrating injuries will depend largely on the entrance location of the wound and the gestational age. Visceral injuries are less likely when the entry site is anterior and below the uterine fundus. If a thoracotomy tube is required in a pregnancy, some have recommended that it be placed at least 1 or 2 intercostal space above the usual landmark of the 5th intercostal to avoid inadvertent abdominal insertion [49].

Trauma can cause paraplegia. In this situation, the mode of delivery also becomes a problem. Most women can safely attempt vaginal birth following a pelvic fracture, even those that occur during the third trimester [55]. Peritoneal lavage can be performed during pregnancy. An open technique is recommended after placement of nasogastric tube and a Foley's catheter [56]. Since pregnancy-specific criteria have not been reported, non-pregnant parameters for a positive peritoneal lavage should be used [57].

Perimortem caesarean section, performed in the face of maternal cardiac arrest, can be lifesaving for both mother and fetus. In a multicenter retrospective cohort study of 114,952 trauma admissions including 441 pregnant women, 32 emergency CS had a reported 45% fetal and 75% maternal survival [58]. Survival of both is dependent on multiple factors including the interval between maternal cardiac arrest and delivery, the underlying etiology of the arrest, where the arrest takes place, and the expertise of the team attending to the mother [59]. Perimortem CB may be appropriate in the setting of imminent maternal death or after 4 minutes of properly performed cardiopulmonary resuscitation has failed to revive the mother, as both infant and maternal survival are increased [58,60]. Although delivery should ideally occur within 4 minutes of failed maternal revival. Notably, resuscitation efforts may improve following delivery as a result of diminished aortocaval compression and improved volume return to the heart [60]. Anecdotally, reports of the women

undergoing cardiopulmonary resuscitation suggest the possibility of improvement in maternal condition following CB. However, no evidence exists that CB actually improves rates of maternal survival for any specific condition. More prospective studies are needed to define the optimal approach to the evaluation and treatment of pregnant women who suffer trauma.

Conclusion

Care of pregnant trauma patient with severe injuries is not

uncommon, requires a multidisciplinary approach, involving an emergency clinician, trauma surgeon, obstetrician and neonatologist. Direct fetal injury is relatively uncommon because the maternal soft tissues, uterus, placenta and amniotic fluid all tend to absorb and distribute the energy of the blow. The most common cause of fetal death is maternal shock, which is associated with a fetal mortality rate of 80%. This explains why efforts to assess fetal well-being are secondary to resuscitation of the mother.

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