Blunt Abdominal Trauma in a Pregnant Patient: Evaluation with Computed Tomography

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ABSTRACT

Trauma is the leading cause of nonobstetric maternal mortality, affecting up to 8% of pregnancies and representing a significant cause of fetal death. A 34-year-old patient with a 17-week pregnancy was a restrained front seat passenger in a head-on motor vehicle crash. Emergency computed tomography (CT) of the abdomen and pelvis with intravenous contrast administration revealed a hyperdense nodule in the right adrenal gland, a lack of contrast enhancement in a significant area of the placenta, retroplacental hyperdensity, hyperdense amniotic fluid, and a displaced parietal skull fracture of the fetus. A right adrenal hemorrhage, placental abruption, and an intrauterine fetal skull fracture were diagnosed by CT; the latter two CT findings were confirmed in the emergency cesarean section. This case emphasizes that CT is the proven modality of choice for the evaluation of injured pregnant patients and the gravid uterus. Following the CT evaluation, immediate action should be taken to reduce the morbidity and mortality of the patient and the fetus.

CASE REPORT

A 34-year-old woman with a 17-week pregnancy was a restrained front seat passenger in a head-on motor vehicle crash. At the emergency department, ecchymosis was noted on the left facial region, lower anterior abdominal wall (with the transverse band of ecchymosis corresponding to the seat belt lap strap), and bilateral lower legs. Lower abdominal pain and massive vaginal bleeding were also present. Blood analysis revealed leukocytosis (white blood cell count, 34,790/µL) and a hemoglobin level of 11.7 g/dL. The blood pressure was 141/105 mmHg. Ultrasonography (US) of the fetus performed by an obstetrician showed no fetal heartbeat.

Emergency non-enhanced CT of the brain showed no identifiable intracranial hemorrhage in the patient; the effective CT dose was 2.32 mSv. CT of the abdomen and pelvis with intravenous contrast administration (total of three phases: precontrast-enhanced, postcontrast-enhanced arterial, and delayed venous phases) revealed the following: a transverse band of subcutaneous infiltration in the lower anterior abdominal wall corresponding to the skin ecchymosis; a 3.2 cm, oval, hyperdense lesion (attenuation value of 43 HU) in the right adrenal gland (Fig. 1); a lack of contrast enhancement in a significant area of the placenta (i.e., less than 25% contrast enhancement of the placenta); retroplacental hyperdensity; hyperdense amniotic fluid; and a displaced parietal skull fracture...
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fraction of the fetus (Fig. 2). The effective dose was 44.7855 mSv. Therefore, the total effective dose administered to the patient during cranial, abdominal, and pelvic CT was 47.1055 mSv. A right adrenal hemorrhage, placental abruption and hematoma, and an intrauterine fetal skull fracture were diagnosed by CT; the latter two CT findings were confirmed in the emergency cesarean section. The operation revealed fetal death. The patient’s blood hemoglobin level dropped to 6.8 g/dL and packed red blood cells were administered. Her white blood cell count returned to the normal range on the 3rd postoperative day. The patient had an uneventful course and was discharged on the 6th day of hospitalization.

DISCUSSION

Trauma is the leading cause of nonobstetric maternal mortality, affecting up to 8% of pregnancies [1-5] and representing a significant cause of fetal loss (1–50%) [2-3]. Motor vehicle accidents account for over half of trauma cases in pregnant patients [1-2, 6]. While most such trauma is minor, it contributes to the majority of fetal mortality [1-2]. Pregnant trauma patients are more likely to sustain severe abdominal injury than non-pregnant trauma patients, with most obstetric complications of trauma occurring in the third trimester [3]. This is due to decreased fetal protection provided by a uterine wall thinned by fetal growth as well as the relative reduction of amniotic fluid in the third trimester, rendering the fetus more susceptible to injury [2]. The physiological changes of pregnancy (splenomegaly, hydronephrosis, engorged ovarian and pelvic veins, upward displaced bowel, and downward displaced and compressed urinary bladder) may explain the increased incidence of abdominal injuries in pregnant patients [1]. Retroperitoneal hemorrhage is also more common in pregnant trauma patients due to increased pelvic blood flow [3]. The adrenal gland is the most common retroperitoneal organ susceptible to injury [7]. The right side is more frequently injured than the left counterpart due to the shorter right adrenal vein, which renders the right adrenal gland more vulnerable to venous congestion injury [8]. Acute adrenal hemorrhage is typically hyperdense (40–60 HU) on CT, does not enhance, decreases in size and density over time, and may finally calcify.

Maternal death almost always leads to fetal death [1-3]. Therefore, all efforts are made to stabilize the mother. An evaluation of the fetal condition should begin only after maternal stabilization. After maternal mortality, the most common cause of fetal loss is placental abruption. A fetus can survive delivery after 24–26 weeks of gestation or at 500 g [3]. Continuous external fetal monitoring is the most sensitive method for diagnosing placental abruption, preterm labor, and fetal distress. Signs of placental abruption such as increased uterine contractility, fetal bradycardia, and late deceleration after 24 weeks of gestational age should prompt emergency cesarean delivery. Traumatic placental abruption results from the shearing force between the rigid placenta and the relatively elastic uterus [2-3]. Two types of abruptions are possible according to the location of the separation: marginal placental abruption at the placental margin and retroplacental abruption involving the central placenta, with the latter having a worse prognosis.

US determines the gestational age of the fetus and whether a fetal heart rate is present. FAST (focused abdominal sonography for trauma) assesses 4 regions of pericardial and peritoneal fluid: subxiphoid, bilateral upper quadrants, and suprapubic areas. Acute placental abruption is a hyperechoic or isoechoic retroplacental hemorrhage relative to the overlying placenta, and becomes hypoechoic or eventually anechoic within 2 weeks after trauma [1, 4]. However, US is not sensitive for detecting placental abruption (with false negative findings of 50–80%) and maternal injury, including active arterial bleeding [1, 3-4].

CT with intravenous contrast administration is the modality of choice for evaluating both the pregnant trauma patient and the fetus, with sensitivities of 86–100% and specificities of 80–98% for the detection of placental abruption [1, 3]. The intravenous non-ionic iodine-based contrast medium is safe and rated as FDA (Food and Drug Administration) category B [1, 3, 5]. CT appearances of placental abruption are as follows: mildly hyperdense retroplacental hematoma, hyperdense blood clots in the amniotic fluid (especially in the dependent site), a retroplacental or full-thickness region of decreased placental enhancement forming an acute angle with the myometrium, and areas of
**Figure 2.** The precontrast-enhanced CT **a.** and the corresponding postcontrast-enhanced delayed venous phase **b.** of the gravid uterus demonstrate a hyperdense blood clot level of amniotic fluid (angular arrow in a), retroplacental hyperdensity (open arrow in a), and only a portion of the placenta shows contrast enhancement (curved arrow in b). The thin arrow indicates the relatively hypodense and non-enhanced placenta. Contrast-enhanced CT 4 cm above c. and the reformatted coronal image d. reveal the displaced parietal skull fracture of the fetus (open arrow in c) and a transverse band of mildly hyperdense infiltration in the subcutaneous region of the anterior abdominal wall corresponding to the skin ecchymosis caused by the seat belt lap strap (arrowhead). Less than 25% contrast enhancement of the placenta is seen (curved arrow). The thin arrow in d indicates the relatively hypodense and non-enhanced placenta.
contrast medium extravasation in the infarcted placenta [1, 3]. Decreased placental enhancement to less than 25% on one slice of a CT image is the marker of a placental abruption very likely to require cesarean delivery [5, 9]. A CT false negative diagnosis of placental abruption may occur when the retroplacental hematoma is isodense to the still normally enhanced placenta [10]. CT false positives for placental abruption may occur due to hypodense myometrial contractions (which form obtuse angles with the adjacent myometrium, in contrast to the acute angles formed during placental abruption), prominent chorionic plate indentations on the fetal side of the placenta (resembling ischemic changes), venous lakes on the maternal side (mimicking active bleeding into the placenta), placental cotyledons (as round hypodensities among the normally enhancing placenta), clinically insignificant small wedge-shaped placental infarcts, small subchorionic hemorrhages, and preplacental hemorrhages [1, 3-4]. To achieve high sensitivity, a low threshold of suspicion is recommended for placental abruption on CT, as the cost of a missed diagnosis is high [1, 4]. The specificity may be improved by training for familiarization with the normal placental appearance on CT [4, 9].

During diagnostic imaging of a pregnant trauma patient, the unshielded fetus receives approximately 30% of the radiation to which the mother is exposed [2]. According to the 2008 American College of Radiology practice guidelines for imaging pregnant or potentially pregnant patients and the American College of Obstetricians and Gynecologists, fetal radiation doses of less than 50 mGy are not associated with increased fetal anomalies or fetal loss throughout pregnancy [11-12]. Thus, all diagnostic imaging examinations that utilize ionizing radiation (except fluoroscopy) for a trauma study fall well below this threshold [1, 3]. The absolute risks of fetal effects are small at the fetal dose of 100 mGy and negligible at doses of less than 50 mGy [11, 13]. Nonetheless, the dose used to examine a pregnant patient should be kept as low as reasonably possible.

The use of seatbelts prevents ejection-associated mortality and is associated with a lower injury severity and therefore lower fetal demise [2]. The lap belt portion should be placed as low as possible on the hips and across the upper thighs and never above or over the abdomen, which may injure the gravid uterus (as in our case) [2, 3, 10]. The shoulder strap should be positioned to the side of the uterus between the breasts and over the midpoint of the clavicle. To decrease fetal injury resulting from airbag deployment during a motor vehicle accident, women should position themselves at least 10 inches (25 cm) from the steering wheel or dashboard.

In conclusion, a pregnant patient can sustain intraabdominal and intrauterine injuries in a blunt traumatic event. The risk of radiation posed by CT performed during pregnancy is small as compared with the risk of a missed or delayed diagnosis of maternal injury. CT is the proven modality of choice for the evaluation of the injured pregnant patient and the placenta. Following a CT evaluation, appropriate management should be administered to reduce the morbidity and mortality of the patient and fetus.

REFERENCES