

## CASE REPORT

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### Fetal Death Following Maternal Trauma: Two Case Reports and a Survey of the Literature

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**ABSTRACT:** When a fetus dies after its mother has suffered trauma, questions often arise about whether the fetal death was linked to the maternal injury. Many state statutes make it a criminal act to cause the death of a fetus by injuring the mother. The authors present two cases in which fetal death resulted from maternal trauma. In addition, we review the pertinent literature on this subject and offer guidelines that may help forensic pathologists evaluate these difficult and often emotionally charged cases.

**KEYWORDS:** pathology and biology, fetal death, pregnancy, injuries, trauma in pregnancy

Fetal death following maternal physical or psychological trauma may raise questions about the relationship between the traumatic incident and the termination of the pregnancy. Such cases may involve important legal issues for doctors who become involved. The authors present two cases in which fetal death could be clearly related to an incident of maternal trauma. In addition, we discuss various mechanisms by which injury to the mother may cause the death of the fetus.

#### Case 1

A 25-year-old female, in the ninth month of an uncomplicated pregnancy, was struck in the abdomen with a milk crate during an assault by a male acquaintance. After being struck she developed cramping abdominal and back pain but did not immediately seek medical attention. The next morning, she went to the emergency room because she felt no fetal movements. Traumatic placental abruption was diagnosed, and a stillborn, full-term male fetus without injury or abnormality was delivered. At the autopsy of the fetus, there were no injuries or abnormalities that would explain the death. When the placenta

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was examined, dark clotted blood remained adherent to the maternal surface, which was consistent with traumatic abruption. The cause of fetal death was determined to be placental abruption due to maternal blunt trauma.

### Case Two

A 21-year-old female, in her eighth month of an uncomplicated pregnancy, was a passenger in an automobile that collided head-on at highway speeds with another automobile. There was no information concerning the use of restraints. She suffered multiple injuries, including blunt abdominal trauma, and was in critical condition following the accident. Two hours after the collision she delivered a near full-term, stillborn male fetus with no external injuries. At the autopsy of the fetus, there was a very small subdural hematoma of less than 2 cc of clotted blood overlying the left parietal lobe of the brain. No evidence of additional injury or abnormality was found. On examination of the placenta, there was laceration through its full thickness, immediately adjacent to the attachment of the cord. The laceration had caused massive fetal bleeding into the amniotic space. The fetal death was determined to be due to laceration of the placenta due to maternal blunt trauma from an automobile collision. Though the subdural hematoma was probably due to the incident of maternal trauma, it was considered too small to have significantly contributed to the fetal death.

### Discussion

From ancient times, there has been an assumption that stress to the mother often causes spontaneous abortion or induced labor [1]. However, in the last century, this relationship between maternal injuries and fetal death has been challenged [1-4]. One study reviewed 1000 cases of failed pregnancy, 9 of which had a strong history of antecedent trauma. All 9 of these cases were found to have had natural abnormalities that would have made continued normal development nearly impossible, even in the absence of trauma. The statement was made that "all too often, justice is not served and that the plaintiff is awarded damages for an abortion or miscarriage in which trauma was at most, only coincidentally concerned" [5]. Though that study obviously referred to civil litigation, a recent Illinois statute indicates that such cases may be tried in criminal courts. The statute makes it a homicide to kill an unborn child other than by legal abortion [6]. The number of states with similar statutes is growing. Clearly, the relationship between fetal death and maternal injury is a medical and legal issue of increasing importance. Because of possible civil litigation and recent criminal statutes, fetal deaths following maternal trauma may increasingly be brought to the attention of forensic pathologists. While studies have questioned the relationship between maternal trauma and fetal death, it has been shown that trauma can result in termination of pregnancy and death of the fetus [1-4]. To assist pathologists with these often difficult cases, we will review the ways in which trauma to the mother has been shown to cause fetal demise and will discuss the handling of these deaths.

The most common cause of traumatic fetal death is the death of the mother. Maternal death or serious injury can result in fetal death even if the fetus is not directly injured. Accidents due to motor vehicle collisions are by far the most common cause of severe injuries and traumatic death in pregnant women [4]. Violent assaults, usually with firearms, are the second most common cause and are increasing [7]. In order to survive, the fetus needs perfusion of its mother's uterus with blood and delivery of oxygen through the placenta to its own circulation. Therefore, if the mother suffers cardiac arrest or hemorrhagic shock, the uterus is not perfused and the fetus quickly asphyxiates [8]. Asphyxia may also be due to carbon monoxide, which interferes with the oxygen-carrying

capacity of the blood. Fetal deaths may be caused by carbon monoxide intoxication even when exposure is not fatal to the mother [9].

Various types of injury to the abdomen may cause fetal loss even when the mother survives an incident of trauma. Blunt abdominal trauma during pregnancy most commonly results from motor vehicle accidents, as it did in Case 2, followed in frequency by falls, and then assaults, such as that in Case 1 [8]. The fetus may even die from blunt force injury which does not significantly harm the mother [8]. Seat belt use has been shown to protect occupants in automobile accidents, including pregnant women, by preventing ejection from the vehicle. However, fetal death, without severe injury to the mother, may be caused by the lap belt in a collision. The fetus or placenta may be damaged when the mother's upper body jackknives over the lap restraint. For this reason three-point restraint systems have been recommended, and they reportedly reduce fetal loss [4,10-12].

When blunt trauma to the abdomen causes loss of the pregnancy, the most common mechanism of fetal death is placental abruption, illustrated in Case 1. Pressure on the abdomen may deform the uterus around the inelastic placenta. The placenta, which, unlike the uterus, contains no elastic tissue, may then separate from the uterine lining. Placental abruption may cause fetal death by means of asphyxia because separation of the placenta and uterus interferes with respiratory exchange between the fetus and mother [8]. Abruption due to trauma typically develops within 48 h, but may occur as late as 5 days after the traumatic incident. Common clinical findings include abdominal pain, amniotic fluid leakage, and possibly vaginal bleeding [4]. As we found in Case 1, there may be an attached clot on the maternal surface of the placenta. Microscopic examination of such a clot may help determine the time of the traumatic event. After 18 to 36 h, fibrin appears, but until then, primarily red blood cells are present. Between 24 and 48 h, neutrophilic white cells infiltrate the edge of the clot. After 5 to 7 days, pigment-laden macrophages may be present [13].

Though uncommon, another mechanism of fetal death due to maternal trauma is uterine rupture. It usually is caused by very forceful direct abdominal trauma to the mother, such as occurs in high-speed automobile collisions. Abdominal blunt trauma may also occasionally cause laceration of the placenta or cord, as occurred in our second case. Laceration of the placenta or cord may result in fetal death due to exsanguination into the amniotic space or even into the mother's circulation. Blunt force injury to the fetus itself is uncommon because of the combined cushioning effect of the muscular uterus and the amniotic fluid. However, severe fetal injuries, especially to the head, have been reported to be due to both direct impact injury and deceleration injury. Head trauma to the fetus is most likely to occur in the later part of the pregnancy when the engaged head can be damaged by fracture of the mother's pelvis [8]. On rare occasions, the fetus may sustain nonfatal injury and go on to be delivered later with healing wounds or fractures [4]. Studies using radiological or microscopic examination may help determine the age of such trauma.

In addition to blunt force injuries, sharp force injuries to the pregnant uterus by such diverse objects as pitchforks, scythes, animals' horns, and sickles, as well as knives, have been described [14]. Penetrating injuries to the abdomen of a pregnant woman can seriously injure the fetus or placenta and commonly cause fetal death. However, especially in the general urban population, gunshot wounds are by far the most common cause of penetrating abdominal injury to the pregnant women [4,14,15]. Because of its size and dense consistency, the uterus acts as a shield for the mother's abdominal organs. Low-velocity handgun bullets penetrating the abdomen in later pregnancy generally transfer most of their energy to the uterus and its contents. Therefore, ironically, though fetal death is a common result of abdominal gunshot wounds of the mother, maternal death is extremely rare [4,14,15]. This protection may not be as effective, however, with other

types of firearm injuries. We have seen a case in which serious injury to both mother and fetus resulted from a shotgun blast to the mother's abdomen.

The role of psychological trauma in the interruption of pregnancy is both poorly understood and highly controversial. Various mechanisms have been suggested, including stimulation of the uterus directly by the autonomic nervous system or through the effects of epinephrine. However, at this time, no explanation of how psychological trauma might lead to termination of pregnancy has been generally accepted [1,2].

When one event happens after another it is almost always possible that the second event has occurred because of the first. But caution should be exercised when linking a fetal death to maternal trauma. Careful examination of the placenta, the fetus, and the maternal clinical history must show, as in the two cases we report, that the fetal death resulted from the incident of trauma and that there was no other equally plausible explanation [1,4]. The literature on this issue clearly shows both that pregnant women may suffer severe injuries without interruption of pregnancy and that loss of the fetus very often results from preexisting fetal or placental abnormalities [1,4,5]. In our jurisdiction, when examination of the fetus and the placenta does not show a definite natural or traumatic cause of fetal death, we list the cause of death as "etiology undetermined." Forensic pathologists should require more than a temporal relationship to link an incident of maternal trauma to fetal death; they must be able to demonstrate clearly how a mechanism, such as one of those we have discussed, resulted in the death of the fetus.

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