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SPECIAL ARTICLE

Medical, legal, and ethical challenges associated with pregnancy and catastrophic brain injury

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ABSTRACT

In late 2013, two women from North America gained attention after sustaining catastrophic brain injuries while pregnant. After Marlise Muñoz—who was at 14 weeks of pregnancy when she developed a pulmonary embolism—was pronounced brain dead, hospital officials initially refused to withdraw support, citing a Texas state law requiring them to maintain life-sustaining treatment for a pregnant patient to help to save the fetus. By contrast, when Robyn Benson was pronounced brain dead after a brain hemorrhage at 22 weeks of pregnancy, both her husband and the physicians agreed to continue support until a viable child could be delivered. The Muñoz and Benson cases offer an opportunity to explore the medical, legal, and ethical issues surrounding catastrophic brain injury in pregnant women. It is hoped that the present article will enable clinicians to better appreciate the history and present state of issues involving advance directives for pregnant women, maternal versus fetal interests, and the impact of fetal viability on medical decision making, as well as offer a practical assessment of the various US state laws concerning the rare, yet catastrophic event of brain injury in a pregnant woman.

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1. Introduction

On November 26, 2013, Marlise Muñoz, a 33-year-old woman who had been pregnant for 14 weeks, was found unconscious in her home in Texas, USA, after a pulmonary embolism [1–3]. After being rushed to hospital, she was pronounced brain dead, at which point her family (including her husband and her parents) requested that life support measures be discontinued [1]. Although Muñoz had not left any written directives regarding end-of-life care, her husband stated that she had previously verbalized to him that she did not want to be kept alive by machines [3]. However, officials at the hospital refused to withdraw life support, citing a state law requiring them to maintain life-sustaining treatment for a pregnant patient. Almost 2 months after her fatal event, and following a judge's order, the hospital acknowledged that Muñoz had been brain dead since November 28, 2013, and that her fetus was not viable; life support was then removed [2–4].

While deliberations were continuing in the Muñoz case, a similar tragic fate had occurred to Robyn Benson of Victoria, BC, Canada. On December 28, 2013, Benson was found collapsed on her bathroom floor after having had a cerebral hemorrhage [5]. At 22 weeks of pregnancy, she was declared brain dead, after which both doctors and

her husband agreed to maintain support until the fetus could be delivered by cesarean [6]. According to reports, a healthy child was delivered on February 8, 2014 [6].

Despite differences in the goals and wishes of both the families and hospitals, these two recent cases offer the opportunity to explore the medical, legal, and ethical issues surrounding catastrophic brain injury in pregnant women. It is hoped that a review will provide practicing clinicians with information that will enable them to better understand the history and present state of issues involving advance directives for pregnant women, maternal versus fetal rights, and the impact of fetal viability on medical decision making, as well as offer a practical assessment of where varying US state laws stand on catastrophic brain injury in pregnant women.

2. Incidence and previous reports

Catastrophic neurological injury leads to coma. Patients can progress to brain death or remain in a prolonged coma such as persistent vegetative state (PVS) [7]. The structural abnormalities in PVS fundamentally consist of extensive damage to the subcortical structures of the brain, including the white matter of the cerebral hemispheres and/or the thalamus, irrespective of the cause of injury [7]. The brainstem can also be damaged [7]. By contrast, brain death is caused by a bilateral hemispheric injury that has secondarily resulted in loss of all brainstem function, including breathing [7]. Thus, brain death is defined as loss of

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all brainstem function, resulting in breathing abnormalities and often hypotension requiring vasopressors [7]. Unlike brain death, PVS is not equivalent to death.

The incidence of PVS during pregnancy is unknown but is probably low. Several case reports [8–10] have provided some general insight into PVS and pregnancy relating to the type of insulting injury, gestational age at time of initial insult, gestational age at delivery, and maternal and fetal outcomes. Chiossi et al. [9] reported on two cases of successful delivery of neonates from mothers who were in a PVS after motor vehicle accidents. The initial insults occurred when the fetuses had gestational ages of 80 and 168 days, with successful delivery occurring at 31 and 34 weeks, respectively. Both children were reported to be faring well at age 1 year. One of the earliest gestational period insults was reported by Sim et al. [10]. After a maternal insult after only 4 weeks of pregnancy, a child was delivered at 33 weeks and was reported to be leading a normal life 12 months later. By contrast, Bush et al. [8] reported on a case of a woman who was in a PVS as a result of multiple sclerosis: a neonate was delivered after 24 weeks, but unfortunately did not survive past 24 hours. The mother died 1 year after delivery [8].

Brain death itself is uncommon (<10% of all major acute brain injuries) and therefore is an exceedingly rare event during pregnancy [11–13]. The most common reported causes of brain death in pregnancy include ruptured intracranial aneurysm or ruptured arteriovenous malformation, spontaneous ganglionic hypertensive hemorrhage, or anoxic-ischemic encephalopathy associated with cardiac arrest (including arrest associated with saddle pulmonary emboli) [14]. In most instances, there will be a concomitant fetal demise [13].

In some patients, however, a living fetus remains after maternal resuscitative efforts. Cases of prolonged support of a mother deemed brain dead with the goal of sustaining the fetus are reported in the literature and, since 1982, there have been over 25 reported cases of successful deliveries after prolonged support. A 2010 review of 30 pregnant women who were declared brain dead [15] found that the mean maternal age at the time of brain death was 26.5 years, the mean gestational age at the time of brain death was 22 weeks, and the mean gestational age at time of delivery was 29.5 weeks. Twelve viable neonates were born and survived the neonatal period [15]. However, none of these reported cases were within the last 15 years in the USA.

It is possible that many of the reported cases of brain death during pregnancy could have been misdiagnosed and therefore misclassified. Pregnant women are not candidates for organ donation, and organ procurement agencies will not proceed with any pregnant woman with a live fetus. This issue is important because full brain death determination is generally performed in anticipation of organ donation. When donation is out of the question, the incentive to perform a full examination—including the critical apnea test that documents loss of respiratory drive and so is definitive evidence of loss of brainstem function—is reduced. In several case reports [15,16], apnea testing was not performed, perhaps because of an unsubstantiated fear of causing hypoxemic injury to the fetus during the procedure. Furthermore, many of the case reports [16,17] failed to document neurology or neurosurgery physician involvement, or provide full descriptions of brain death testing. It is therefore possible that some of these patients might still have retained function of the medulla oblongata, making long-term hemodynamic support more feasible and affecting neonatal outcomes.

3. Fetal viability and gestational age

A consensus statement from the National Institute of Child Health and Development, the National Institutes of Health, the Society for Maternal Fetal Medicine, the American Academy of Pediatrics, and the American College of Obstetricians and Gynecologists (ACOG) [18] defines periviability broadly as a gestational age of 20 weeks exactly to

25 weeks and 6 days, but acknowledges that neonates born after 20 and 21 weeks of pregnancy do not survive irrespective of resuscitative efforts and that at 22 and 23 weeks survival is uncommon [18]. Although the consensus guidelines recommend aggressive newborn resuscitative efforts begin at a gestational age of 23 weeks exactly, decisions about neonatal resuscitative efforts at birth and ongoing interventions for perivable newborns are complex and personal, and involve many parties, including parents, obstetricians, neonatologists, and individuals who support parents (e.g. family members and religious leaders). Given these challenges, any decision to proceed with prolonged medical support of a mother with the intention to deliver a viable neonate should (at a minimum) consider the gestational age of the fetus.

4. Fetal and maternal legal interests

One area that inevitably arises when confronted with clinical situations that could mean that a woman is denied healthcare decision-making rights in exchange for benefits to her fetus is the legal balance between these potential opposing interests. Legal controversies involving the fetus date as far back as the mid-1880s [19]. In *Dietrich v Inhabitants of Northampton*, a woman brought a claim after slipping on a bridge and a subsequent spontaneous abortion, but the court ruled that the construction company was not liable for the death of the fetus because the woman herself had no injuries [19–21]. This case developed what was ultimately termed the “single entity rule”: a pregnant woman and her fetus were legally considered to be one being [19,21]. However, in 1949, the case of *Verkennes v Corniea* was the first to separate care of the fetus from care of the pregnant woman with the ruling that a hospital and physician could be held liable for the negligent medical care of the viable fetus irrespective of maternal outcomes [19,21,22].

The *Dietrich* and *Verkennes* cases involved third-party injuries to a fetus and not those caused by a mother's decision or action. Courts have since struggled to strike a balance between the potential interests of the fetus and the mother when they oppose one another [19,21,22]. Specific state legislation in the USA has been enacted to protect the interests of pregnant women even when such actions could result in the harm or death of her fetus [23,24]. Additionally, ACOG and the ACOG Ethics Committee support the right of a woman to decide her care irrespective of the consequences to the fetus [21,25]: “In the absence of extraordinary circumstances, circumstances that, in fact, the Committee on Ethics cannot currently imagine, judicial authority should not be used to implement treatment regimens aimed at protecting the fetus, for such actions violate the pregnant woman's autonomy.” However, despite court precedent, legislative measures, and input from professional medical societies, the legal interests of pregnant women and the fetus remain unsettled to date [26,27].

5. The right to terminate support of medical treatment measures

Several landmark legal battles have been fought over the right of a patient to refuse medical treatment [28,29]. The case of *In re AC* [29] provided criteria to be used when the patient is unable to provide clear and convincing guidance at the time [29]. The case itself surrounded a lower court's decision requiring an unconscious woman with cancer to undergo a cesarean delivery in an attempt to save the life of her fetus. It was determined that the patient's written or oral directions concerning treatment should be followed first. When no such directions exist, the person's past decisions concerning medical treatment should be sought. If unknown, her values should be respected. When uncertainty still remains, a process of substituted judgment should follow. This process considers how most people would proceed when confronted with a similar medical situation [29,30].

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