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Case Report

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Ethical and Clinical Challenges in Managing Brain Death During Pregnancy

Ahmed Adel Yagoub Abdelhafiz[1*], Khaled R Saed[1], Mohamad A Omar[1], Abdallah Hakmi[1], Raghad Aljuboori[2] and Mohamed Nassef[2]

[1]Anesthesia & Intensive Care Unit, Emirates Health Services, Sharjah, UAE

[2]Intensive Care Unit, Al Qasimi Hospital, Sharjah, UAE

ABSTRACT

Introduction: Diagnosis of brain death in a pregnant patient is highly challenging both ethically and clinically when the usual medical criteria for brain death cannot be utilized completely because of pregnancy-related restrictions. The situation is compounded by the requirement to weigh the medical limitations posed by the patient's critical status. Pregnancy itself can interfere with some diagnostic tests, making it difficult to conclude brain death, this case is reported which aims to discuss the ethical challenges and clinical intricacies in diagnosing brain death when critical diagnostic tests are restrained or limited.

Case Report: A 31-year-old pregnant patient at her12 weeks gestation was admitted. We reported her history of headache, vomiting and acute loss of consciousness. Presenting with GCS 3/15 on arrival, unequal, non-reactive pupils on physical examination, she was intubated. Imaging scans revealed a thalamic hematoma on the left side as well as extensive brain edema and signs of herniation of the brain. decompressive craniectomy was carried out to lower intracranial pressure. Due to the patient's pregnancy, an apnea test was not feaasible, The patient also had a craniectomy which made it impossible to use an EEG to determine brain function.

Conclusion: Presented case illustrates ethical and clinical dilemma of establishing a diagnosis of brain death in a pregnant woman when pregnancy-related constraints hamper use of routine tests. Inability to perform critical tests like the apnea test and EEG show complexity of making an irreversibility diagnosis while weighing the risk of harm to both maternal and fetal health.

***Corresponding author**

Ahmed Adel Yagoub Abdelhafiz, Intensive Care Unit, Sharjah Kuwait Hospital, Sharjah, UAE. Tel: +971563535434.

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Case Report

This report is about a 31-year-old pregnant woman who was presented at her 12 weeks gestation and reported a history of anemia. She also reported complaints about headache, vomited once and then became unresponsive shortly after waking up. Upon arrival, her Glasgow Coma Scale (GCS) was 3/15, with unequal, non-reactive pupils (left pupil dilated to 4 mm, right pupil pinpoint). A CT scan revealed a large left thalamic hematoma (5 x 4.3 cm) with surrounding edema, midline shift, and signs of brain herniation. The fetus was viable at the time of presentation, with no immediate signs of distress. Given the patient's critical condition, an urgent surgical decision was made. She underwent a left fronto-temporal decompressive craniectomy, evacuation of the parietal hematoma, excision of the left parietal arteriovenous malformation (AVM), and placement of a left frontal external ventricular drain (EVD) under general anesthesia.

After surgery, the patient was transferred to the ICU and remained intubated on synchronized intermittent mandatory ventilation (SIMV) mode with FiO2 at 35%. She was sedated with midazolam, fentanyl, and Nimbex.

On Day 2, a sedation vacation was performed; however, her GCS remained 3/15. Her pupils were bilaterally dilated and non-reactive, and there was no spontaneous movement. A follow-up CT brain scan revealed evacuation of the left parietal hematoma but also showed infarction of the entire left hemisphere, parts of the right middle cerebral artery territory, midbrain, and pons. The ventricular catheter remained in place, with bulging of the left hemisphere through the craniectomy defect, confirming a poor prognosis.

On Day 3, the patient's GCS remained 3/15. She continued on the ventilator, and her metabolic state worsened with significant lab abnormalities, including hypernatremia (Na+ 155) and thrombocytopenia (platelets 11000), requiring platelet transfusion (12 units). The Obstetrics team was consulted to assess fetal viability, and it was determined that the fetus was viable On Day 4, the patient underwent brain death assessments, including tests

1 and 2. However, an apnea test could not be performed due to the risk posed to the fetus, and EEG was not done due to the craniectomy. ACT angiogram was not performed due to fetal risk. An ethics committee review was scheduled to discuss the decision to withdraw life support or continue until fetal delivery. It was decided to maintain life support, and fetal viability was reassessed.

On Day 5, a bedside ultrasound [finger 3] performed by the obstetrics team confirmed a live fetus with a detectable heartbeat, though bradycardic. The placenta was located in the upper segment, and the amniotic fluid was adequate. However, on Day 7, the patient developed vaginal bleeding and underwent a miscarriage. The fetus, a male, was expelled. A total of 100 cc of clots were removed, but no active bleeding or placental separation was noted. Oxytocin was administered to assist with uterine contractions.

On Day 8, the patient's hemodynamic status continued to deteriorate, necessitating escalating doses of vasopressors. She became unresponsive to resuscitative efforts, prompting a code blue. CPR was initiated, and medications including adrenaline, calcium gluconate, and sodium bicarbonate were administered. Despite 30 minutes of continuous resuscitation, the patient did not achieve return of spontaneous circulation (ROSC) and was ultimately declared deceased.

Discussion

Managing brain-dead pregnant women is a rare and complex challenge that requires a coordinated effort from neurologists, obstetricians, intensivists, and ethicists. Between 1982 and 2010, only 30 cases have been documented where maternal somatic functions were successfully maintained to support fetal development [1]. This method is centered on maintaining maternal physiological stability even without brain function, to establish a viable intrauterine environment for the fetus [2]. But major ethical and medical challenges are posed on maternal autonomy, fetal viability or possibility to maintain pregnancy without brain function [3]. Brain death is legally defined as irreversible loss of all brain and brainstem function in most jurisdictions [4]. This patient developed an acute left thalamic hematoma which resulted in extreme brain swelling and herniation eventually leading to irreversible neurological deterioration. Despite receiving decompressive craniectomy and evacuation of the hematoma she had a GCS of 3/15 and fixed pupils and missing brainstem reflexes which fulfilled the clinical criteria for brain death [4].

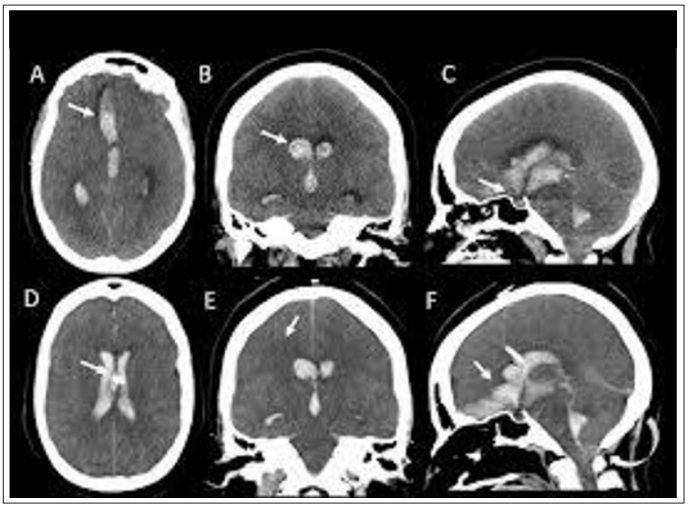

Figure 1: Non-Enhanced Ct Brain on Admission Time

Diagnosis of brain death during pregnancy is also challenging. Usual investigations like apnea test, EEG, and CT angiography are risky or inconvenient because of fetal safety or previous neurosurgery. For example, in this case the apnea test was omitted to prevent maternal-fetal hypoxia and EEG results were inconclusive as a result of the craniectomy. Clinical brainstem examinations and imaging confirmatory procedures were employed instead as Hamade et al., 2024 has also reported. Current studies emphasize the need for incorporating clinical assessment, Doppler ultrasound of cerebral blood flow and fetal monitoring to provide a precise diagnosis with minimal injury to the fetus [3]. Fetal viability is the main issue among brain-dead pregnant women. Even with maternal brain death, placenta can continue to function and provide oxygen and nutrients for the fetus to survive under stable maternal status [4]. Here, fetal cardiac activity was identified at 12 weeks which means continuous placental function but maternal hemodynamic instability and vaginal bleeding during progression of the pregnancy resulted in miscarriage. This is consistent with current research revealing that fetal survival is enhanced in cases where maternal brain death takes place after 20 weeks allowing for improved chances of cesarean delivery [1].

Close fetal monitoring was important in this situation. Real-time ultrasound evaluations enabled observation of fetal viability and identification of the progression of bradycardia. Evidence favors preserving maternal life support until fetal distress or maternal metabolic failure, resulting in the best fetal outcome without allowing prolonged non-viable pregnancy [2]. This case highlights the fine balance between fetal maintenance and maternal physiological deterioration, which calls for specific ethical and clinical guidelines in the management of brain-dead pregnant women. In order to advance diagnosis and management, non-invasive diagnostic technologies should be prioritized to promote both maternal and fetal safety. Transcranial Doppler ultrasonography (TCD) is also proving to be a useful method for evaluating cerebral blood flow in brain-dead patients without exposure to radiation [5]. Magnetic resonance angiography (MRA) is also safe with low fetal risk and high-resolution cerebral circulation imaging [6]. Contrast-enhanced ultrasound (CEUS) has also been shown to be highly sensitive in diagnosing brain death [7].

Routine fetal assessment needs to be part of standardized protocols for pregnant patients alongside maternal neurological assessment. Ethical issues necessitate multidisciplinary consultation by neurologists, obstetricians, and ethicists to guide maternal life support and fetal viability decisions [8]. Existing frameworks such as World Brain Death Project guidelines, need to be adapted to accommodate pregnancy-specific brain death challenges [9]. By embracing advanced imaging technologies and optimizing standardized protocols, the medical community can enhance diagnostic precision, surmount ethical challenges and improve mother and fetal outcomes.

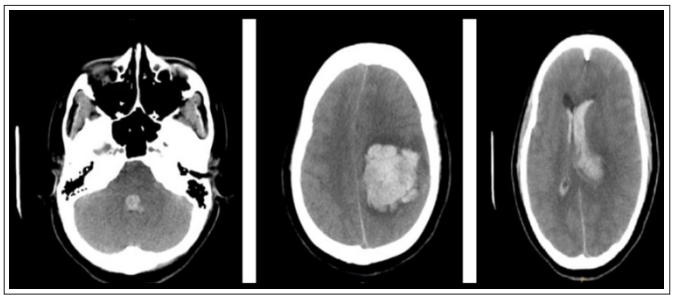

Figure 2: CT Imaging Revealed a Large Left Thalamic Hematoma

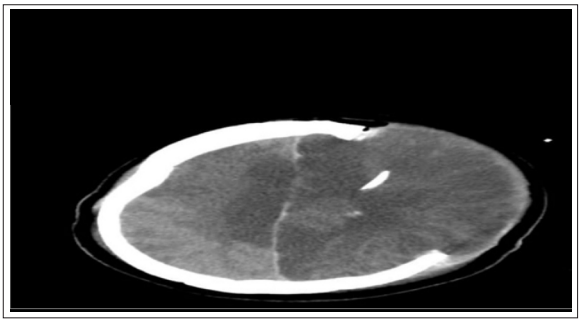

Figure 3: Follow up Imaging with CT Brain Was Done

Figure 4: A Bedside Ultrasound Revealed a Single, Live Fetus with a Bradycardic Heartbeat, an Upper Segment Placenta, and Adequate Amniotic Fluid

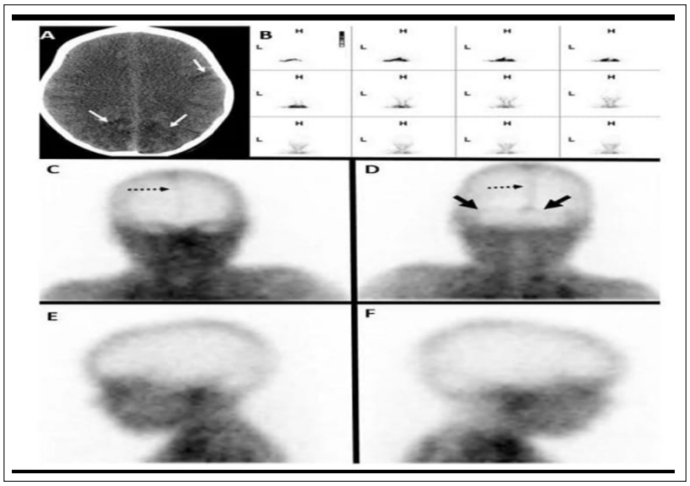

Figure 5: Death Imaging Criteria by Hypoxia

The figure illustrates factors contributing to **preterm brain injury**, categorized into **antenatal, perinatal, and postnatal** influences. **Antenatal factors** include infection and chronic hypoxia, while **preterm birth** leads to oxidative stress and vascular immaturity. **Postnatal factors** such as mechanical ventilation and infection further impair brain development, increasing inflammation, cell death, and myelination failure, resulting in brain injury.

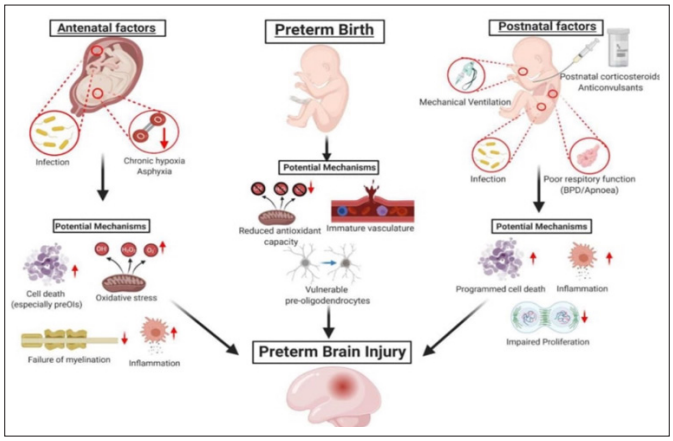

Figure 6: Pathophysiology of Brain Injury in the Preterm Infant

Figure 6: Above figure illustrates factors contributing to **preterm brain injury**, categorized into **antenatal, perinatal, and postnatal** influences. **Antenatal factors** include infection and chronic hypoxia, while **preterm birth** leads to oxidative stress and vascular immaturity. **Postnatal factors** such as mechanical ventilation and infection further impair brain development, increasing inflammation, cell death, and myelination failure, resulting in brain injury.

Diagnosing brain death in a pregnant patient presents unique medical and ethical challenges due to physiological changes in pregnancy and limitations in confirmatory tests. Standard diagnostic procedures such as the apnea test, electroencephalogram (EEG), and CT angiography (CTA) are often impractical or pose risks to the fetus, necessitating alternative diagnostic and management approaches. The apnea test is crucial component of confirming brain death and it is difficult in pregnant patients to perform the test because it comes with complications like maternal hypoxia leading to fetal distress or death [10]. We also avoided this apnea test was avoided due to these risks. Other non-invasive modalities such as transcranial Doppler ultrasound (TCD) and near-infrared spectroscopy were proposed to quantify cerebral blood flow without compromising fetal health [11]. EEG was another routine confirmatory test, but it is crucial to know its sensitivity during pregnancy is debatable. Hemodynamic alterations in pregnancy can alter cerebral perfusion can lead false-negative EEG [12]. among patients in whom a craniectomy has been performed the EEG electrodes may not provide reliable results our patient presented [13]. CT angiography is used to confirm absence of cerebral blood flow is challenging with risks of radiation exposure. Some authors suggest MRI-based approaches or CEUS as safer alternatives [14]. Fetal irradiation by strong magnetic fields in MRI remains an area of investigation [15]. Medical management concentrates on maintaining maternal physiological stability to improve fetal viability because of diagnostic limitations. This covers respiratory management, metabolic regulation, infection prevention and hemodynamic support as [16]. Standard neurosurgical techniques for treating cerebral hemorrhage and brain edema were used in this patient including decompressive craniectomy, hematoma evacuation and external ventricular drain placement [17]. Maternal metabolic disturbances such as hypernatremia and thrombocytopenic need to be monitored with caution as they have a profound effect on placental function and fetal oxygenation [18]. show severe management of electrolyte disturbances and coagulopathy is vital to avoid multi-organ dysfunction in brain-dead pregnant women.

In this patient, platelet transfusions and vasopressor therapy were needed which are the best practices suggested.

Psychosocial and Psychological Considerations

Emotional toll on families of brain-dead pregnant patients is profound as they struggle with grief or ethical dilemmas and uncertainty [19]. Paradox of somatic survival complicates acceptance has been associated with distress and PTSD [20]. Cultural beliefs may further influence decisions on life support continuation [21]. Ethical conflicts among family members often arise so grief counseling and clear communication may be needed to resolve conflicts [22]. Healthcare teams must provide psychosocial support and ethical consultations and bereavement counseling to assist families in navigating these emotionally complex cases [23].

Managing brain death in pregnancy presents unique medical and ethical or legal challenges which require structured approach to be carefully managed. Multidisciplinary collaboration involve neurology, obstetrics and ethical or legal teams to navigate complexities of diagnosis, maternal-fetal viability and decision-making [10]. Risks which are associated with standard brain death diagnostic tests include apnea test, EEG and CT angiography so healthcare providers can prioritize non-invasive alternatives like transcranial Doppler ultrasound (TCD) contrast-enhanced ultrasound (CEUS) and MRI-based cerebral perfusion studies to confirm brain death while minimizing fetal harm [12]. development of ethical frameworks can balance maternal autonomy and fetal rights and ensure institutional policies align with legal and ethical standards [13]. Many hospitals lack clear guidelines for managing such cases can cause inconsistencies in care and legal uncertainties [17]. Advocating for standardized institutional protocols can provide legal clarity and uniformity in decision-making [16]. Psychosocial support for the family are needed as they often face emotional and ethical dilemmas regarding continued maternal somatic support for fetal viability [18].

Ethical values in the management of brain death during pregnancy require balancing autonomy, beneficence, non-maleficence and justice. The mother's autonomy becomes critical when there were previously documented wishes regarding life support and fetal management [21]. In the absence of previously documented preferences, ethical dilemmas arise in determining whether to continue somatic support for fetal viability. Beneficence principle emphasize duty to act in maximally favorable interests of the fetus and mother while non-maleficence emphasizes to minimize harm. Extended maternal support would mean physiological burdens such as metabolic instability and multi-organ failure which could add complexity to fetal viability [13]. Justice demands fair medical choices ensuring that resources are distributed ethically and the mother's dignity is preserved. Multidisciplinary consultation, such as with bioethics specialists, obstetricians, and neurologists, aids in the facilitation of such challenges [24]. Cultural and religious beliefs also shape decision-making, as there are some who believe in sustained fetal support even when maternal brain death occurs. Setting precedent ethical guidelines can help resolve disagreements while providing respectful patient-centered care.

Healthcare systems should create detailed policies on the handling of brain death among pregnant women with ethical, legal, and medical clarity. These policies should delineate universal criteria for brain death diagnosis using supplementary confirmatory tests such as transcranial Doppler ultrasound to prevent injury to the fetus [25]. The policies should require multidisciplinary decision-making from neurologists, obstetricians, ethicists, and legal experts to ensure maternal autonomy versus fetal rights [26]. In light of global differences, some nations mandate continuation of life support to fetal viability, whereas others emphasize maternal preference [13]. Unambiguous legal guidelines need to direct family and physician decision-making to avoid conflicts and facilitate jurisdictional compliance [24]. Global legal contrasts demonstrate the necessity of harmonizing policy, applying best practices aligned with local legal and cultural environments, and regulating ethical review procedures [27].

Subsequent studies on brain-dead pregnant patients should be aimed at improving diagnostic methods that reduce risks to both the mother and fetus and enhance fetal survival. [10]. Noted the importance of having standardized protocols and multidisciplinary management to increase fetal viability [28]. Recommended hormonal supplementation, such as corticosteroids and thyroid hormones, to facilitate fetal growth [29]. Pointed out ethical questions, such as whether maternal somatic support should never be extended [30]. indicated legal discrepancies between fetal and maternal rights [31]. Reviewed metabolic complications, stressing the danger of hypoxia and hemodynamic instability [32]. Reported a case in which a brain-dead woman carried pregnancy for 117 days, showing the possibility of prolonged fetal survival [18]. has recommended extracorporeal life support (ECLS) to enhance placental oxygenation, and [13]. Advocated international ethical guidelines [33]. Ultimately proposed AI-based predictive models for evaluating fetal viability. All these findings imply hormonal therapy, machine learning algorithms, and novel life-support technologies can enhance fetal outcomes in such scenarios and long-term neonatal health, fetal neurodevelopment and ethical frameworks must be the areas of research in the future to make maternal-fetal care sustainable and evidence-based.

Conclusion

Care of brain-dead pregnant women is a difficult task that takes into account medical, ethical, legal and psychosocial aspects. In this case, as observed, although maintaining somatic maternal function can be an aid to fetal viability but maternal and fetal outcomes are still indeterminate. Although progress in medical management has occurred, limitations of available diagnostic facilities and dangers to the maternal and fetal condition presents the need for an interdisciplinary policy with participation by obstetricians, intensivists, neurologists, ethicists and legal counselors. Value of simple explanation to the family and of consultation on ethics and the law regarding life-support decision making and organ donation is best demonstrated in this case. Extended survival of the fetus, albeit unsuccessfully, points towards function of placenta during early pregnancy and its ability to maintain fetal life without maternal neurological capacity. While there exists limited literature on brain-dead pregnant women, it remains influential in guiding clinical practice as well as ethical discourse which suggests that individualized care and careful consideration of all relevant factors is critical.

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