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The intersection of fetal palliative care and fetal surgery: Addressing mortality and quality of life

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ABSTRACT

Over the last few decades, the fields of fetal surgery and maternal–fetal medicine have developed interventions aimed at modifying severe diseases in utero. Innovations in fetal approaches to congenital diaphragmatic hernia and myelomeningocele have shown considerable promise in modifying the clinical course with fetal intervention. Patients who present to fetal centers to be evaluated for these interventions face challenging decisions that directly relate to questions of mortality and quality of life. This article explores how clinicians might apply the tools and principles of fetal palliative care to supporting a woman and her family who are considering fetal surgery.

Introduction

Congenital anomalies are diagnosed in 3% of pregnancies and account for a disproportionate amount of infant mortality, as high as 20%. As fetal imaging has improved and become the standard of care, more and more families learn prenatally that their fetus may have a life-limiting condition. For many, the diagnosis occurs too late for termination to be an option and others wish to carry the pregnancy to delivery for philosophical, moral, religious, or emotional reasons. Fetal palliative care programs developed in response to this evolving challenge and there are now more than 75 such programs across the United States; most of these started within the last 10 years.[1]

While palliative care providers have focused their expertise on supporting families in the face of life-threatening diagnoses, pediatric surgeons and perinatologists have tackled the challenges of mortality head on with the development of a variety of fetal interventions. More recently, innovators have devised in utero techniques aimed at improving long-term quality of life.

Many of the characteristics that define excellence in a fetal center overlap considerably with indicators of high-quality perinatal palliative care programs. Further, families wrestling with decisions about fetal intervention face some of the same emotional and existential challenges as families who learn their fetus has a life-limiting diagnosis. In this article, I explore this overlap in some depth, using fetal intervention for congenital diaphragmatic hernia (CDH) as the prime example of efforts to improve mortality and fetal myelomeningocele (MMC) repair as representative of efforts aimed at improving quality of life. I offer some insights derived from the principles of palliative care and from recent research in perinatal palliative care that may have practical value for all clinicians engaged in the care of a woman considering fetal intervention.

Fetal surgery for CDH

The best postnatal care of the 1980s and 1990s for babies with CDH, including the use of extracorporeal membrane

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oxygenation, resulted in a perinatal mortality rate as high as 60% when including fetal demise.[2] Dissatisfied with this outcome, pediatric surgeons developed fetal animal models of congenital diaphragmatic hernia and pursued two fundamental approaches—direct surgical repair of the fetal diaphragmatic hernia or fetal tracheal occlusion to facilitate lung growth.

Michael Harrison, widely regarded as the father of fetal surgery, used a fetal sheep model of CDH to demonstrate proof of principle—if surgeons could provide physical space in the fetal chest (reduced by herniation of fetal abdominal contents) for the lungs to grow, the pulmonary hypoplasia and pulmonary hypertension associated with CDH could be relieved. Harrison and his colleagues developed surgical techniques to repair CDH in fetal lambs, which they further refined in a primate model. Unfortunately, when they applied the approach to human fetuses with moderate-to-severe CDH, it did not improve mortality in a formal randomized, controlled trial. Premature delivery brought on by disturbing the uterus for the fetal surgery proved a significant hurdle, ending attempts to pursue direct fetal repair for CDH.[3]

Simultaneously, pioneering fetal surgeons worked on a potentially less invasive approach to reduce the damage done by CDH. They found that occluding the fetal trachea blocks the efflux of fetal lung fluid, creating back pressure in fetal airways and promoting growth of the lung. Again, they demonstrated efficacy of this technique in animal models. Hypoplastic lungs could be made larger and the herniated abdominal organs successfully pushed out of the thorax. Researchers conducted pilot studies with various occlusion techniques in both the United States and Europe.[4,5] Recent efforts known as Fetal Endoscopic Tracheal Occlusion (FETO) involve endoscopically placing a balloon occluding the trachea for 6–8 weeks to facilitate lung growth. Experimenters learned a critical lesson in early animal and human feasibility studies, namely that the occlusion should be removed around 34 weeks of gestation to allow type 2 pneumocyte development. Studies of this approach have shown considerable promise in improving mortality for fetuses with the most severe forms of CDH—those with a lung (volume)-to-head (circumference) ratio (LHR) of less than one and a portion of liver herniated into the thorax.[6] There are ongoing trials to further evaluate the short- and long-term impact of this approach.[7]

Fetal surgery for myelomeningocele

The driving impetus for the pursuit of a fetal intervention for MMC differed from that for CDH. Patients with spina bifida face considerable morbidity with a high incidence of cognitive deficits as well as physical problems related to their inability to control urination and impaired ambulation. Further, as many as 80% of children with MMC have required ventriculoperitoneal shunts to manage hydrocephalus secondary to Chiari malformation and hindbrain herniation. One persuasive theory holds that exposure of the spinal cord to amniotic fluid causes physical or chemical injury and explains the degree of severity of disability in patients with spina bifida.[8,9] Thus, fetal surgeons undertook to find a way to close the defect in the developing fetal spinal column and thereby decrease the morbidities associated with myelomeningocele.

As with the development of interventions for CDH, creative animal experiments demonstrated proof of principle of fetal repair of MMC and pilot studies started in the 1990s. Considerable enthusiasm arose with early apparent successes and several centers in the United States began pursuing clinical programs. With concerns about insufficient long-term data and potential maternal complications, the proliferation of these clinical programs was interrupted in order to facilitate a multicenter randomized controlled study known as the MOMS trial (Management of Myelomeningocele Study). While it took many years to enroll participants, the trial was stopped early for meeting its primary endpoints. Half as many patients in the fetal surgery arm required VP shunts compared to the control group and the composite measure of mental development and motor function at 30 months of age was significantly improved as well. There was no difference in overall mortality between the fetal surgery and postnatal repair groups.[10] This study demonstrated improved outcomes with fetal repair; however, expectant parents face the very real risk of premature birth and its associated complications as a result of a decision to proceed with fetal surgery.

Risk

Fetal surgery entails some very specific risks that make counseling unique. By its very nature the fetus is accessed through the mother's body, putting her at some degree of medical risk. Further, the manipulation of her uterus increases the risk of premature delivery. For those who go on to deliver prematurely following fetal intervention, the mother may develop a sense of guilt for having made the decision that resulted in this dangerous situation. One cannot accept the promise of potential benefit without also accepting this new risk.

In addition, in the case of fetal interventions for congenital diaphragmatic hernia (and several other as-yet unproven interventions), only fetuses at high risk of death are selected for the fetal procedure. As with any new medical or surgical treatment, there is no certainty that the intervention will actually improve the outcome for particular patients. Consequently, the risk of death will remain for any given fetus.

In addition, clinicians and expectant parents face the problem of appropriate patient selection. Many maternal–fetal pairs may present for evaluation for a fetal intervention, but only some will meet previously agreed-upon inclusion criteria. This is true in both ongoing research protocols and for established clinical interventions. Thus, some women may leave a series of evaluations both having learned that indeed their fetus has a clinically important congenital anomaly, but that fetal intervention is not an option. This possibility creates an obligation for clinicians to develop systems and communication tools to support all expectant parents presenting for care at a fetal center.