

Fetal Therapy and the Application of Ultrasound

CME
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Abstract

With the rapid advancement and increasing resolution of ultrasound technology, ultrasound has become an indispensable tool in fetal diagnosis and therapy. The concept of “Treating the Fetus as a Patient,” first proposed in 2008, has gained increasing attention and has been actively practiced in Europe and the United States since the 1990s. Traditionally, fetal anomalies led to pregnancy termination or postnatal treatment, but recent advancements have made *in utero* interventions a viable option. As the transparency and accessibility of medical knowledge improve, more families are seeking fetal therapy or surgery as a means of intervention. The development of a comprehensive fetal therapy center at Taipei Chang Gung Memorial Hospital represents a major step forward in Taiwan’s capabilities. This paper reviews current techniques, outcomes, and future directions of fetal therapy using ultrasound guidance.

Keywords: Fetal therapy, fetal ultrasound, prenatal diagnosis

INTRODUCTION

With the improvement of ultrasound resolution and its widespread availability, ultrasound has become an essential tool in fetal diagnosis and therapy. The concept of “Treating the Fetus as a Patient,” first proposed in 2008, has grown significantly over the past decade. However, fetal therapy had already been introduced in Europe and North America during the 1990s. The traditional perception upon diagnosing fetal abnormalities often led to termination of pregnancy, postnatal treatment, or preimplantation genetic testing in subsequent pregnancies. Intrauterine treatment has only recently emerged as a viable option.

Parents receiving a diagnosis of congenital fetal abnormalities often experience emotional distress and shock. After seeking second or third opinions, most are presented with termination as the only option. However, with greater transparency in medical knowledge, more families are asking whether intrauterine interventions or surgeries are feasible. As obstetricians, we are equally motivated to explore therapeutic options that can improve fetal outcomes and ensure safe deliveries.

METHODS

All fetal surgical interventions are closely associated with ultrasound guidance. At the Fetal Medicine Center of Taipei

Chang Gung Memorial Hospital, we have established a comprehensive fetal therapy program. Under ultrasound guidance, we perform fetal shunt placements and have also introduced fetoscopic bipolar coagulation for conditions such as selective intrauterine growth restriction and acardiac twin. We are currently in the process of regulatory approval for fetoscopic myelomeningocele repair, a technique I acquired during training in Brazil. Our long-term goal is to develop fetoscopic surgery for open neural tube defects, which has shown superior outcomes compared to postnatal repair in Western countries. In collaboration with neurosurgeons and the patient advocacy community, and with diagnostic support from private prenatal centers, we hope to initiate these interventions in Taiwan in the near future.

Fetal therapy carries inherent risks, similar to but higher than amniocentesis, including rupture of membranes, infection, and miscarriage, with a risk rate of up to 10% or higher in open fetal surgery. The instruments used – whether needles or endoscopes – are significantly larger than those for routine amniocentesis, justifying the higher complication rates.

Below are the main categories of fetal therapy currently practiced:

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Abbreviations

CDH	Congenital diaphragmatic hernia
MOMS	Management of Myelomeningocele Study
TTTS	Twin-to-twin transfusion syndrome

1. **Ultrasound-guided Shunt or Catheter Placement:** Used for conditions such as fetal bladder outlet obstruction or pleural effusion, where a catheter is placed to drain fluid into the amniotic cavity
2. **Ultrasound-guided Fetoscopy:** Allows treatment of twin-to-twin transfusion syndrome (TTTS), open spina bifida, and congenital diaphragmatic hernia (CDH). For CDH, a balloon can be inserted into the fetal trachea to expand the lungs; the balloon is removed before birth to allow normal breathing [Figure 1]
3. **Ultrasound-guided Needle Puncture:** Similar to amniocentesis, used for fetal transfusions in cases of anemia, or amnioinfusion in cases of oligohydramnios, or reduction of excess amniotic fluid [Figure 2]
4. **Ultrasound-guided Fetal Cardiac Intervention:** Balloon valvuloplasty under ultrasound guidance for fetal aortic or pulmonary stenosis. Although associated with high mortality (~10%), this has been successfully implemented in Europe and Latin America.

RESULTS

International studies and reviews indicate that fetal interventions, when carefully selected, can improve perinatal outcomes and long-term health in specific congenital conditions. The management of myelomeningocele study (MOMS) showed significantly better motor outcomes and reduced shunt requirements in fetuses who underwent prenatal repair compared to postnatal surgery. Similarly, fetoscopic laser photocoagulation has proven effective in TTTS, showing improved survival rates and neurodevelopmental outcomes.

At our institution, initial cases of shunt placement and fetoscopic bipolar coagulation have demonstrated technical feasibility and patient acceptability. No cases of procedure-related mortality were recorded in our early experience. Our project was



Figure 1: Fetoscopic approach for open spina bifida fetal surgery

approved by the Ministry of Health and Welfare, we anticipate beginning the center of fetoscopic repair for open neural tube defects in the near future.

DISCUSSION

The evolution of fetal therapy over the past two decades reflects the confluence of technological advances, multidisciplinary collaboration, and shifting ethical perspectives. With the enhancement of ultrasound resolution and real-time imaging, ultrasound has become the cornerstone of fetal intervention, enabling not only precise diagnosis but also safe guidance during complex intrauterine procedures.^[1,2]

Multiple review articles and international experiences highlight that early and precise fetal intervention improves perinatal outcomes in select conditions. For instance, the MOMS trial demonstrated that prenatal surgical repair of open spina bifida led to a significant reduction in the need for ventriculoperitoneal shunting and improved motor outcomes at 30 months compared to postnatal surgery.^[3,4] Similarly, fetoscopic laser coagulation for TTTS has become the global standard due to superior outcomes in fetal survival and neurodevelopment compared to serial amnioreduction.^[5,6]

The global expansion of fetal cardiac interventions—particularly balloon valvuloplasty for critical aortic stenosis—has demonstrated technical feasibility and potential to prevent the evolution of hypoplastic left heart syndrome.^[7] Despite high fetal mortality (~10%) and technical demands, these procedures are increasingly considered in specialized centers.^[8] Their absence in Taiwan highlights a potential future development pathway.

Fetal intervention is inherently associated with procedural risks, including preterm premature rupture of membranes, infection, and fetal demise.^[2,8] The complication rates vary with procedure type: for example, open fetal surgery carries a greater risk than percutaneous shunt placement or fetoscopy. Informed consent, risk stratification, and postprocedural



Figure 2: Ultrasound-guided amniocentesis

care are therefore essential components of any fetal therapy program.

In Taiwan, as elsewhere in Asia, societal perceptions and legal frameworks regarding in-utero interventions are still evolving. Ethical considerations, especially in high-risk scenarios or with uncertain long-term outcomes, must be carefully navigated. Transparent patient counseling and interdisciplinary discussion are imperative to balance parental expectations with medical reality.^[2,9]

Our center is actively building collaborative networks, both locally and internationally, to train surgical teams and establish standardized fetal therapy protocols. The support from regulatory agencies, such as the Ministry of Health and Welfare, is crucial to safely introduce novel procedures such as fetoscopic myelomeningocele repair into routine clinical practice.

CONCLUSION

Fetal therapy represents an important evolution in prenatal care, offering new hope for families faced with challenging fetal diagnoses. Ultrasound plays a pivotal role not only in diagnosis but also as a guide during interventions. With appropriate patient selection, multidisciplinary collaboration, and regulatory support, fetal therapy has the potential to improve outcomes and quality of life. The development of such programs in Taiwan is both feasible and necessary, and ongoing efforts at Taipei Chang Gung Memorial Hospital represent a critical step forward.

Ethics statement

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its amendments. The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The

patient understands that her name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

Prof. Steven W. Shaw, an editorial board member at *Journal of Medical Ultrasound*, had no role in the peer review process of or decision to publish this article. All authors declared no conflicts of interest in writing this paper.

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