Fetal Anesthesia and Pain Management for Intrauterine Therapy

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KEYWORDS

• Fetal anesthesia • Fetal access • Fetal drug delivery • Fetal monitoring
• Fetal resuscitation

KEY POINTS

- There is a range of fetal interventions that are undertaken; the nature of procedure, as well as its ramifications for maternal and fetal nociception, will dictate the nature of the fetal anesthetic.
- Fetal access may be limited, often requiring combined modalities of drug delivery (eg, transplacental and intramuscular).
- Fetal monitoring is often limited to fetal heart rate monitoring, requiring an understanding of fetal cardiovascular physiology and how medications and interventions may affect fetal well-being and how these are revealed by the fetal heart rate.
- Fetal cardiovascular collapse can be sudden, requiring that there be a fetal resuscitation plan in place before beginning an intervention.

A RANGE OF POSSIBLE FETAL INTERVENTIONS

As experience with fetal intervention has grown,[1] so too has the knowledge about fetal anesthesia and analgesia. With some endoscopic procedures, the site of surgical intervention is not innervated; thus, the fetus may not sense a noxious stimulus, and its anesthetic requirements may be minimal. Nevertheless, fetal immobility remains essential to procedural safety and success. Other interventions may require that a needle be inserted into the fetus, which may elicit a noxious stimulus and possibly even cause pain. Open procedures can produce significant noxious stimuli.

In addition to surgical demands, each mother and fetus exhibits a unique physiologic, pharmacologic, and pathophysiologic profile. Both fetal and maternal hemodynamic stability, as well as uteroplacental integrity, must be assured; given that fetal

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hemodynamic collapse can be sudden and dramatic, a plan to resuscitate the fetus must be developed.

Fetal interventions may be roughly divided into 3 categories (**Table 1**). Open midgestational (or hysterotomy-based) procedures are generally performed between 18 and 26 weeks and typically involve exteriorization of the fetus (or affected fetal body part) with subsequent replacement in the uterus, allowing further maturation. Such procedures are generally performed on fetuses with well-defined lesions and for whom there is the expectation of preterm demise or significant postpartum morbidity or mortality without intervention.

Ex utero intrapartum therapy (EXIT) procedures, also known as operations on placental support, are generally performed on term or near-term fetuses with significant airway obstruction or pulmonary insufficiency. In such cases, surgical intervention is performed with intact uteroplacental function before cord clamping. EXIT-to-extracorporeal membrane oxygenation (ECMO) cases similarly depend on intact placental function before ECMO cannulation and initiation.

Finally, there are an ever-increasing variety of techniques for minimally invasive fetal procedures. Fetoscopic, ultrasound-guided, and fetal transesophageal echocardiographically assisted procedures may be undertaken at nearly any gestational age for the ligation or ablation of aberrant fetoplacental vessels, the placement of shunts

Table 1
Diseases eligible for fetal intervention

Disease	Intervention Types
CCAM	EXIT, EXIT-to-ECMO (if significant airway obstruction)
CDH	EXIT, EXIT-to-ECMO, or minimally invasive (ultrasound- or fetoscopically guided tracheal plug placement and removal)
Cervical teratoma	EXIT, EXIT-to-ECMO (if significant airway obstruction)
CHAOS	EXIT, EXIT-to-ECMO (if significant airway obstruction)
Congenital goiter	EXIT, EXIT-to-ECMO (if significant airway obstruction)
Cystic hygroma	EXIT, EXIT-to-ECMO (if significant airway obstruction or high-output cardiac failure)
HLHS	Minimally invasive (ultrasound-guided percutaneous aortic valve dilation)
Hydronephrosis and bladder outlet obstruction	Minimally invasive (ultrasound- or fetoscopically guided shunt placement)
MMC	EXIT, minimally invasive (fetoscopic patch application)
Pulmonary sequestration, bronchogenic cysts, and mixed or hybrid pulmonary lesions	EXIT
SCT	EXIT, EXIT-to-ECMO (for high-output cardiac failure)
TRAP	Minimally invasive (fetoscopic laser/photoablation of aberrant vasculature)
TTTS	Minimally invasive (fetoscopic laser/photoablation of aberrant vasculature)

Abbreviations: CCAM, cystic adenomatoid malformation; CDH, congenital diaphragmatic hernia; CHAOS, congenital high airway obstruction syndrome; ECMO, extracorporeal membrane oxygenation; EXIT, ex utero intrapartum therapy; HLHS, hypoplastic left heart syndrome; MMC, myelomeningocele; SCT, sacrococcygeal teratoma; TRAP, twin reversed arterial perfusion sequence; TTTS, twin-twin transfusion syndrome.