

The ex utero intrapartum treatment procedure: anesthetic considerations

Leon C. Chang · Krzysztof M. Kuczkowski

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Abstract The ex-utero intrapartum treatment (EXIT) procedure is an uncommon operation indicated for fetal lesions with the potential to cause life-threatening airway obstruction immediately after delivery. By maintaining utero-placental circulation, the fetal airway can be evaluated and secured prior to delivery. The anesthetic goals for the EXIT procedure differ significantly from a cesarean delivery and include profound uterine relaxation, fetal anesthesia and maintenance of the maternal-fetal circulation. We present a case of an uneventful EXIT procedure and include a discussion of the anesthetic goals for this operation.

Keywords Ex utero intrapartum treatment (EXIT) procedure · Fetal malformation · Cesarean delivery · Obstetric anesthesia · General anesthesia · Pregnancy · Fetal perinatal surgery

Introduction

The ex-utero intrapartum treatment (EXIT) procedure is an uncommon operation indicated for fetal lesions with the potential to cause life-threatening airway obstruction immediately after delivery such as cystic hygroma, neuroblastoma, hemangioma or congenital goiter [1–9]. Maintenance of the maternal–fetal circulation under general

anesthesia can allow time for the fetal airway to be secured before delivery. The anesthetic goals for the EXIT procedure differ significantly from a cesarean delivery and include profound uterine relaxation, fetal anesthesia and maintenance of the maternal–fetal circulation (Table 1) [1–9]. Care must be taken to avoid maternal or fetal morbidity and a multidisciplinary approach to management is optimal. We present the case of a parturient who underwent uneventful general anesthesia for the EXIT procedure.

Case report

The patient was an otherwise healthy 28-year-old gravida 1, para 0 female at 39 weeks gestation. Prenatal surveillance (fetal ultrasound) revealed a fetus with severe micrognathia and polyhydramnios. Due to concern of life-threatening airway obstruction upon delivery, an EXIT procedure was planned jointly by a multidisciplinary team of experts including obstetric anesthesia. Two 18-gauge peripheral intravenous access lines were placed, and the patient was placed supine with left uterine displacement. Endotracheal intubation followed a routine rapid sequence induction of general anesthesia (with cricoid pressure) using propofol, 150 mg and succinylcholine, 100 mg. A radial arterial line was placed. General anesthesia was maintained with 5% sevoflurane, 50% nitrous oxide and oxygen, vecuronium, 5 mg and fentanyl, 300 mcg. A nitroglycerin infusion at 30 mcg/min was initiated to ensure uterine relaxation and maternal blood pressure (BP) was maintained with 5 mcg kg⁻¹ min⁻¹ of dopamine along with 1 l albumin 5% and 2.5 l Lactated Ringer's solution. Systolic BPs were maintained at 120–140 mmHg, with mean arterial BPs ranging from 75 to 100 mmHg. The fetus was partially delivered

L. C. Chang · K. M. Kuczkowski
Departments of Anesthesiology and Reproductive Medicine,
University of California San Diego, San Diego, CA, USA

K. M. Kuczkowski (✉)
Department of Anesthesiology, UCSD Medical Center,
200 W. Arbor Drive, San Diego, CA 92103-8770, USA
e-mail: kkuczkowski@ucsd.edu

Table 1 EXIT procedure versus standard Cesarean section: major differences

1.	Deep volatile anesthesia (e.g., above 2 MAC) is often employed
2.	There is no need to limit induction of anesthesia, skin incision to delivery time
3.	Maintenance of maternal hemodynamics might necessitate infusions of dopamine
4.	Continuous infusion of nitroglycerine may be required to maintain uterine relaxation
5.	The fetus is only partially delivered with maintenance of placental support
6.	Direct fetal anesthesia for airway management might be necessary

from the head to the thorax 5 min after skin incision, the airway was evaluated by the pediatric anesthesiologist; the neonate was intubated after one attempt (Fig. 1), and then delivered 18 min into the procedure. Fetal heart rate and saturation were directly monitored during this time. After delivery, the nitroglycerin and dopamine infusions were discontinued, and sevoflurane was reduced to 1.5%. Intravenous oxytocin infusion, 20 units/l and carboprost tromethamine, 250 mcg intramuscularly were given to enhance uterine contraction. Total operative time was 42 min, with 1,000 cc of estimated blood loss. Both mother and neonate tolerated the procedure well.

Discussion

The EXIT procedure can be a life-saving maneuver, allowing time to obtain a fetal airway while maintaining uteroplacental circulation. [1–9] The anesthetic goals and principles

**Fig. 1** Neonatal airway management (intubation) on placental support during the EXIT procedure

for an EXIT procedure differ markedly from a routine Cesarean section (Tables 1, 2) [1–9]. General anesthesia is preferred over a regional technique. Prevention of uterine contractions, placental separation and preservation of the uterine and placental blood flow following hysterotomy and partial delivery of the fetus are the hallmarks of the EXIT procedure. This is accomplished through the maintenance of a profound uterine relaxation achieved with deep levels of general anesthesia with potent inhalational agents. Prior case reports of EXIT procedures using regional anesthesia noted fetal movement following partial delivery [4], and the fetus must be anesthetized directly. The EXIT procedure can take longer than the effect of a single dose spinal anesthesia. Furthermore, tocolytics must be administered, and hemodynamic control may be more difficult if serious bleeding should occur.

Profound uterine relaxation is mandatory to prevent uterine contractions and placental separation. Several authors have recommended inhalation anesthetic at concentrations of at least 2MAC [1, 6–8], which in addition to causing uterine relaxation also provides deep anesthesia for both the mother and fetus. Prior case reports describe intramuscular paralysis of the fetus [6], but we did not find this necessary. Uterine relaxation can be enhanced with tocolytics such as terbutaline and magnesium sulfate. Nitroglycerin is especially potent and has the added benefit of being easily titratable and short acting [2].

Many of the maneuvers to enhance uterine relaxation potentially decrease maternal BP and uteroplacental perfusion. We employed aggressive volume expansion as well as a dopamine infusion to maintain maternal arterial BPs, which were directly monitored (arterial catheter). Dopamine is easily titratable and improves blood flow to the

Table 2 Anesthetic principles for the EXIT procedure

1.	Understanding the anatomical and physiological changes of pregnancy
2.	Avoiding and treating hypotension
3.	Maintaining an adequate uteroplacental blood flow
4.	Avoiding aorto-caval compression
5.	Selecting anesthetic drugs and techniques with good record for safety
6.	Selecting anesthetic drugs and agents with rapid titratability
7.	Providing adequate fetal surveillance until delivery
8.	Making appropriate perioperative adjustments as guided by the results
9.	Preventing placental separation following partial delivery of the fetus
10.	Maintaining fetoplacental circulation following partial delivery of the fetus
11.	Providing fetal anesthesia for fetal airway manipulations (if needed)

kidneys and viscera, presumably also increasing uterine blood flow [10].

The potential length of the EXIT procedure coupled with uterine relaxation can result in significant bleeding. Furthermore, the high concentration inhalation anesthetic combined with tocolytics can lead to uterine atony and continued hemorrhage post delivery [7, 8]. It is imperative that the anesthetic team be prepared for large amounts of blood loss and to replace blood products if necessary [1–9]. Our case had an estimated blood loss of 1,000 ml, slightly higher than normal for our institution; significantly larger losses have been reported [6]. Post-delivery oxytocin and carboprost in conjunction with uterine massage were needed to facilitate uterine contraction.

The EXIT procedures are well tolerated by the mothers and their fetuses, and the reported perioperative morbidity rates remain low.

In summary this case illustrates the specific anesthetic goals demanded by the EXIT procedure. When performed properly, it can allow life-saving fetal airway interventions to be performed prior to delivery. A multidisciplinary approach and communication are crucial to the outcome and success of the procedure.

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