Anesthetic Management of the EXIT (Ex Utero Intrapartum Treatment) Procedure

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The EXIT (ex utero intrapartum treatment) procedure is used to maintain fetal-placental circulation during partial delivery of a fetus with a potentially life-threatening upper airway obstruction. We performed the EXIT procedure on a fetus with a large intra-oral cyst. Sevoflurane was used as the anesthetic because of its rapid titratability. Sevoflurane provided excellent maternal and fetal anesthesia. Modifications to previously described monitoring techniques for the EXIT procedure were also used. © 2001 by Elsevier Science Inc.

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Introduction

The EXIT (ex utero intrapartum treatment) procedure is a method used for treating a fetus with potentially life-threatening upper airway obstruction. The EXIT procedure involves the partial delivery of the fetus during a cesarean delivery using deep inhalation anesthesia, with maximal uterine and fetal relaxation and maintenance of optimal fetal-placental circulation. With the head, neck, and one upper extremity exposed, the airway is secured, which may involve endotracheal intubation, bronchoscopy, or tracheostomy. Fetal-placental circulation remains intact, assuring oxygenation during the establishment of the airway.

We recently performed the EXIT procedure on a fetus with a large intra-oral cyst. We describe our anesthetic management, which differed in some ways from previous reports, as well as our modifications for fetal monitoring.
Case Report

A 28-year-old gravida 2 para 1 woman presented at 38 weeks’ gestation for elective cesarean delivery of a female fetus with a known intra-oral cyst. After a normal screening ultrasound at 16 weeks gestation, a follow-up ultrasound at 32 weeks showed that the fetal mouth was widely open. A level II ultrasound revealed a 5 × 3-cm cystic mass at the base of the tongue causing the mouth to remain open while pushing the tongue up against the hard palate (Figure 1). Because of the risk of fetal airflow compromise at delivery, the decision was made to perform an EXIT procedure.

Senior members from the departments of pediatric surgery, anesthesia, neonatology, obstetrics, and surgical nursing met several weeks before the delivery to plan for the EXIT procedure. The desired sequence of events, the role each member of the team would play, and contingency plans were all discussed. An algorithm was drawn up. The anesthesia team consisted of one anesthesiologist for the mother and one anesthesiologist for the fetus. On the day of the procedure, sterile airway equipment was prepared including endotracheal tubes, laryngoscopes, Laryngeal Mask Airways™ (LMAs; The Laryngeal Mask Airway Co., Inc., Nicosia, Cyprus), masks, a stethoscope, oral airways, and an Ambu bag with oxygen tubing.

The mother’s preoperative hematocrit (Hct) level was 33.9. Following pretreatment with famotidine 20 mg intravenously (IV), metoclopramide 10 mg IV, and sodium bicitrare 30 mL orally, the mother was positioned supine with left uterine displacement. The usual monitors for cesarean delivery, including external fetal heart rate (HR) monitoring, were used. A rapid-sequence induction was performed with thiopental sodium 350 mg and succinylcholine 100 mg. The patient’s trachea was orally intubated with a 7.0 endotracheal tube and a Macintosh 3 laryngoscope. For the maintenance of anesthesia, sevoflurane (3% to 6%) in 50% oxygen nitrous-oxide (O₂/N₂O) was used. Fentanyl 100 μg IV and cis-atracurium 10 mg IV were given shortly after induction. A total of 15 mg of ephedrine was needed to maintain maternal systolic blood pressure (SBP) above 110 mmHg.

Unlike most cesarean deliveries in which a relatively short induction to delivery time is desired, sufficient time for uterine relaxation and preparation is important for the EXIT procedure. The time from induction of anesthesia to uterine incision was 22 minutes. After uterine relaxation and ultrasound placental mapping, a low transverse hysterotomy was performed. A hysterotomy stapling device was used to minimize blood loss. A uterine infusion with normal saline was then begun to preserve uterine volume and prevent placental separation. The fetal head and right upper extremity were delivered. A pulse oximeter probe was placed on the right hand to monitor O₂ saturation (SpO₂), and a fetal scalp electrode (Hewlett Packard 80300A, Hayward, CA) was attached to monitor fetal HR. Atropine 0.1 mg was injected prophylactically into the right deltoid muscle. The lingual cyst was identified and then surgically decompressed with electrocautery, enabling oral intubation using a Miller 0 blade and a 3.5 endotracheal tube (Figures 2 and 3). Fetal HRs of 120 to 130 bpm and SpO₂ of 60% to 75% were noted throughout the procedure. Once the airway was secured, the sevoflur-
Rane was discontinued. The neonate was ventilated with 100% O₂ with an Ambu bag. After delivery, the umbilical cord was clamped and divided. The time from uterine incision to complete fetal delivery was 12 minutes. Apgar scores were 4 at 1, 5, and 10 minutes.

After delivery, the placenta was removed and the uterus externalized. Uterine inversion was noted and was easily reduced. Oxytocin 20 units/1000mL was added to the mother’s IV fluids. The mother received morphine 6 mg IV while she was ventilated with 30% O₂ in N₂O. The

Figure 2. Traction suture in tongue exposing lingual cyst. Right arm (A) has been delivered for monitoring. Arrows indicate intrauterine infusion catheter. (M) denotes maternal abdomen.

Figure 3. Trachea of the fetus being intubated on placental bypass.
hysterotomy and abdominal incision were closed, and the neuromuscular blockade was reversed with neostigmine 3 mg IV and glycopyrrolate 0.6 mg IV. Following the return of spontaneous ventilation and awakening, the mother’s trachea was extubated. The estimated blood loss was 500 mL. The time from delivery to arrival at the Postanesthesia Care Unit (PACU) was 44 minutes. The total operating room (OR) time was one hour and 36 minutes.

The mother’s recovery was uneventful. The postoperative Hct was 31.6. She was discharged on postop day #4. The neonate was taken to the Neonatal Intensive Care Unit where she was extubated at 24 hours. The fluid in the cyst reaccumulated, and on day #7 the cyst was reexcised in the OR with general anesthesia. The neonate’s trachea was intubated easily for this procedure, and she was discharged home on day #11, successfully breastfeeding. The infant has normal tongue mobility and continues to feed well at 8 months follow-up. The infant also displays normal neurologic development. The histopathology of the cyst was consistent with a lingual foregut duplication.

Discussion
Since 1990, several single case reports of airway management during placental support have been reported. More recently, three groups described their systematic approach in neonates with upper airway obstruction, which they termed the EXIT procedure, or ex utero intra-partum treatment. The physiologic goals during the EXIT procedure are to provide 1) adequate general anesthesia for the mother without recall, 2) maximal uterine relaxation to facilitate delivery of the fetal head while minimizing the chance of placental separation, 3) maintaining uteroplacental blood flow to ensure fetal oxygenation, and 4) adequate fetal anesthesia, especially during the fetal surgery, so that movement is kept to a minimum. These goals have been met with high concentrations [1.5–2 minimum alveolar concentration (MAC)] of isoflurane in 100% oxygen. We used the newer volatile anesthetic, sevoflurane, in 50% O2 and N2O for the EXIT procedure described above.

Sevoflurane has a blood-gas partition coefficient of 0.69, compared with 1.4 for isoflurane, making it more insoluble and therefore more rapidly titrated. Gambling et al. evaluated sevoflurane during elective cesarean births and found no differences between sevoflurane 1% and isoflurane 0.5% for maintenance of general anesthesia. Maternal HR and blood pressure (BP), blood loss, uterine tone, perioperative complications, Apgar scores, recovery times, and postoperative comfort were similar with both drugs. Thus, sevoflurane offers no particular advantage for elective cesarean delivery. During an EXIT procedure, however, maximal uterine relaxation is required before hysterotomy, followed closely by return of uterine tone immediately after delivery so as to reduce the potential for hemorrhage. Given the lower solubility of sevoflurane, we chose to use this drug rather than isoflurane for this case. Additionally, rapid fetal relaxation is necessary to provide a quiet surgical field that will help to secure the fetal airway. Sevoflurane in doses of 2 to 3 MAC provided excellent fetal anesthesia such that opioids and muscle relaxants were not needed for the fetus. The low fetal Apgar scores resulted from residual inhalation anesthesia, which was expected. These scores improved rapidly as the sevoflurane was eliminated. Maternal BP was easily maintained with fluids and small doses of ephedrine. Uterine inversion, which can occur with any inhalation drug, happened in this case, with no clinical significance. The rapid reversibility of sevoflurane as it applies to uterine tone is another potential advantage of its use in the EXIT procedure. Sevoflurane thus appears to be a good inhalation drug for the EXIT procedure, offering potential advantages over isoflurane in its more rapid titratability.

Previous reports on the EXIT procedure advocate 100% oxygen either during the entire procedure or during hysterotomy. Because it is our usual practice to provide a 50% O2-N2O mixture during cesarean births, and because we were monitoring fetal SpO2 with a pulse oximeter during the fetal surgery, we felt that fetal O2 delivery would be adequate with a maternal inspired O2 concentration (FIO2) of 50%. Fetal SpO2 remained in the 60% to 75% range, which correlates with fetal partial pressures of O2 (pO2) of 30 to 40 mmHg. Although we used 50% N2O in this case, and there were no demonstrable problems with this technique, it might be prudent in future cases to use 100% O2. One study investigating women undergoing elective cesarean deliveries with general anesthesia found a statistically higher (although clinically irrelevant) fetal pO2 in those neonates who were exposed to 100% O2 compared with those whose mothers received 50%O2. Previous EXIT case reports all used a maternal FIO2 of 100%.

In addition to fetal pulse oximetry and intermittent ultrasound, a fetal scalp electrode was used to provide continuous fetal HR monitoring during the procedure. This electrode was easy to apply directly to the fetal scalp once the head was delivered. Both oximetry and scalp monitoring provided data only intermittently because of less than ideal skin conditions, but one of the two monitors was always functional. This situation underscores the importance of having a backup system for fetal monitoring during the EXIT procedure.

The importance of intense preparation for the EXIT procedure has been emphasized in previous reports. The EXIT procedure is multidisciplinary, requiring extensive planning to provide for all contingencies. For this case, at least two attending physicians from pediatric surgery, obstetrics, anesthesia, and neonatology were present in the OR. An adjoining OR was prepped and ready for use in the event that the neonate required an emergent tracheostomy.

In summary, we describe a case of the EXIT procedure in a neonate with an intralingual foregut duplication cyst. Sevoflurane with 50% O2 and N2O provided suitable maternal and fetal anesthesia, while scalp electrode and pulse oximetry supplied the necessary fetal monitoring.
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References