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# Nitroglycerin for Relaxation to Establish a Fetal Airway (EXIT Procedure)

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**BACKGROUND:** The ex utero intrapartum treatment (EXIT) procedure is a technique designed to establish an airway at the time of delivery in fetuses at risk of airway obstruction and requires maintenance of uterine relaxation to continue placental perfusion and prevent placental separation. We describe the use of intravenous nitroglycerin to maintain uterine relaxation during the EXIT procedure.

CASE: A 17-year-old primigravida with a fetus known to have an anterior neck mass was admitted for a scheduled operative delivery at 38 weeks of gestation using a modified EXIT procedure. Anesthesia was administered with a combined spinal-epidural technique. Intravenous nitroglycerin was administered as a bolus and then as a continuous infusion to maintain uterine relaxation until evaluation of the neonatal airway was completed.

**CONCLUSION:** Intravenous nitroglycerin is an effective agent for maintenance of uterine relaxation and placental perfusion during the EXIT procedure. (Obstet Gynecol 2004; 103:1113-5. © 2004 by The American College of Obstetricians and Gynecologists.)

The use of inhaled volatile anesthetics, such as isoflurane or enflurane, has been recommended to maintain uterine relaxation during the ex utero intrapartum treatment (EXIT) procedure.<sup>1</sup> Nitroglycerin has been shown to be effective in inducing uterine relaxation to assist in obstetric complications such as correcting uterine inversion, manual extraction of the placenta, and external cephalic version.<sup>2–4</sup> Nitroglycerin has been shown to be equally 8. Becker RM. Intracardiac surgery in pregnant woman. Ann Thorac Surg 1983;36:453–8.

Received August 14, 2003. Received in revised form October 2, 2003. Accepted October 9, 2003.

effective in inhibiting uterine contractions as compared with magnesium sulfate and ritodrine.<sup>5</sup> We describe the use of nitroglycerin to maintain uterine relaxation during the EXIT procedure in a fetus with an anterior nuchal lymphangioma. Thus, this article documents another option for maintaining uterine relaxation to allow time for securing the airway in the presence of a large fetal neck mass.

### CASE

A 17-year-old primigravida was referred for routine ultrasound examination at 19 weeks of gestation. During the examination an isolated anomaly was noted, consisting of a large multicystic anterior neck mass. The mass extended from the mandible to the upper thorax. The fetal mandible seemed to be intact, without evidence of destruction. Color Doppler imaging demonstrated no apparent flow within the cystic areas, suggesting the lesion to be a lymphangioma. An amniocentesis was performed for karyotype analysis, in which a normal female chromosome complement was reported. Follow-up examinations demonstrated no significant changes of the lesion, which had a maximal diameter of 10 cm and caused extension of the fetal head.

The fetus was noted to be in a breech presentation at 36 weeks of gestation. Pediatric surgery, anesthesia, and neonatology consultations were obtained to discuss options in management of a potential obstructed airway at the time of delivery. It was decided that an EXIT-type procedure would be warranted for evaluation of the neonatal airway while maintaining uteroplacental perfusion and neonatal oxygenation. The patient was counseled and agreed to undergo a modified EXIT procedure at 38 weeks of gestation.

On the day of the procedure the patient was crossmatched for 2 units of packed red blood cells. She was then brought to the operating room, and maternal monitors including electrocardiograph leads, pulse oximeter, and blood pressure cuff were placed. Oxygen was administered by nasal cannula at 3 L/min.

While in a sitting position, a combination spinal-epidural anesthetic was administered using 10 mg of 0.5% bupivacaine and 25  $\mu$ g of fentanyl in the subarachnoid space. The Whitaker needle was removed and the epi-

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dural catheter was inserted without complications. After placement, the patient received  $275 \cdot \mu g$  doses of phenylephrine and 10 mg of ephedrine to maintain a systolic blood pressure of 110 mm Hg or more.

The patient was then placed in a supine position with left uterine displacement by using a right hip roll. Initial blood pressure was noted to be 120/70 mm Hg, with a pulse of 80 beats per minute (bpm). A slight decline in systolic blood pressure to 110 mm Hg was noted at 10 minutes and was treated with 10 mg of ephedrine, which returned the blood pressure to 120/70 mm Hg and increased the pulse by 5–10 bpm. A T-3 dermatomal anesthetic level was obtained.

A Pfannenstiel incision was made on the maternal abdomen and carried down to the peritoneal cavity. The peritoneum was opened sharply, followed by dissection of the bladder flap inferiorly to expose the lower uterine segment. After exposure of the lower uterine segment and before uterine incision, a 100-µg dose of nitroglycerin was administered intravenously, followed by a continuous infusion at 40  $\mu$ g/min. The uterine tone was assessed after administration and found to be adequately relaxed at approximately 60 seconds. The blood pressure remained stable at 110/60 mm Hg, with a pulse of 80-90 bpm. A low transverse uterine incision was made and extended bluntly without difficulty. The complete breech fetus was delivered through the incision, with a fetal cry noted with delivery of the fetal head. The pediatric surgeon and neonatologist examined the infant with direct visualization of the vocal cords by laryngoscopy. No evidence of upper airway obstruction was noted. The uterus remained relaxed during the initial evaluation and only a small amount of bleeding was noted from the uterine incision.

Approximately 4 minutes after delivery, the umbilical cord was clamped and divided after an adequate airway was ascertained. The female infant weighed 3,830 g, with 1-minute and 5-minute Apgar scores of 8 and 9, respectively.

The uterine cavity was explored, and the placenta was still attached. The nitroglycerin infusion was discontinued after umbilical cord clamping, and an oxytocin infusion was begun. Approximately 90 seconds after discontinuation of the nitroglycerin, increased uterine tone was noted, with spontaneous separation of the placenta. The uterus was closed with adequate hemostasis and uterine tone noted. The blood loss was estimated at 800 mL. The postoperative hematocrit level was 34%, which was decreased from preoperative level of 37%.

The neonate required no respiratory support and underwent initial resection of the mass on the fourth day after birth. Pathologic examination of the surgical specimen confirmed the mass to be a cystic lymphangioma.

#### COMMENT

Prenatal diagnosis of a potential airway obstruction allows time for a planned and controlled delivery. In the past, disastrous results were encountered with the unexpected discovery of a large neck mass and the inability to establish an airway for the newborn in a timely fashion.

The EXIT procedure was initially designed to allow for reversal of tracheal occlusion in fetuses that underwent fetal tracheal clip application for severe congenital diaphragmatic hernias. Over time its use has expanded to include a variety of situations, including care of the neonate with a large neck mass at delivery.<sup>3</sup>

The EXIT procedure as previously described uses deep inhalational anesthesia with desflurane, isoflurane, or other inhaled anesthetic to maintain uterine relaxation and allow continued uteroplacental gas exchange. In addition, anesthesia is potentiated with the administration of muscle relaxants and narcotics.<sup>2</sup> One of the potential significant complications is the risk of post-EXIT uterine atony.

To establish the airway, only the fetal head and shoulders are delivered through the hysterotomy incision. The remainder of the fetus is delivered after the airway is secured so that uterine volume can be maintained, thus decreasing the likelihood of uterine contraction and placental separation. Depending on fetal position, this often requires a classic uterine incision, which has a higher risk for increased blood loss as well as implications for future pregnancies.

Organic nitrates and nitrites have been used successfully for uterine relaxation as early as the 1880s.<sup>6</sup> Relaxation of the uterus is mediated by nitric oxide, which leads to an increase in intracellular guanosine monophosphate.<sup>7</sup>

Although not widely used, nitroglycerin has proven effective in many cases requiring rapid uterine relaxation.<sup>4,5,7,8</sup> Advantages of its use include rapid onset of action, effective uterine relaxation, short half-life, intravenous administration, and possible avoidance of general anesthesia. In addition, nitroglycerin is a widely used medication and most anesthesiologists would be comfortable administering it. The potential disadvantages include the risk of profound hypotension and protracted uterine atony.

Studies and reports have proposed a wide range of dosing of nitroglycerin for uterine relaxation. Most recommend a loading bolus of 100  $\mu$ g, with continued dosing as needed to maintain effective relaxation.<sup>7,8</sup> It seems that bolus dosing greater than 500  $\mu$ g is associated with an increased risk of significant hypotension.<sup>8</sup> Uterine relaxation is generally obtained in 30–60 seconds,

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and because of the short half-life, duration of action is only 60–120 seconds.<sup>8</sup>

Another advantage is that nitroglycerin can be given intravenously, thus avoiding the use of more volatile inhalational agents and the need for deep general anesthesia. Because the majority of anesthesia-related maternal morbidity and mortality occurs during general anesthesia administration from either failed intubation or aspiration, the use of regional anesthesia avoids these related complications.

Although pharmacokinetic studies have demonstrated placental transfer of nitroglycerin, no significant fetal hemodynamic effects were detected. This is most likely related to the rapid placental metabolism, short half-life, and high maternal-fetal gradient.<sup>4</sup>

In this case, after administration of nitroglycerin, a hysterotomy incision was made in the lower uterine segment, and the fetus was delivered from a breech presentation. Although uterine volume was not maintained with partial delivery of the fetus, uterine relaxation was maintained during the initial neonatal evaluation, with no evidence of placental separation. This mode of delivery allowed the avoidance of a classic incision of the uterus in the setting of a fetal malpresentation.

The EXIT procedure has proven to be an effective method to establish an airway in the newborn in a variety of situations. Because of its rapid onset of action, short half-life, and effective uterine relaxation, nitroglycerin provides another option for maintaining uteroplacental perfusion until an airway can be established.

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Received September 9, 2003. Received in revised form October 22, 2003. Accepted November 6, 2003.

were found during gestation. Birth weight discordance in the

twins was 49.5%. Histologic examination revealed immature

villi, with a shortage of terminal villi and an abundance of intermediate mature villi, as well as hypoxic areas with al-

tered villi in the part of the placenta supplying the smaller

CONCLUSION: The causes underlying discordant growth in karyotypically normal twin pregnancies without evidence of

twin-twin transfusion syndrome are not entirely clear. There

# Very-Early-Onset Discordant Growth in Monochorionic Twin Pregnancy

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BACKGROUND: The significance of growth restriction in the first trimester in karyotypically normal fetuses is uncertain.

CASE: We report a case of diamniotic monochorionic twin pregnancy with marked growth discordance noted in the first trimester. No major congenital or karyotype abnormalities or ongoing evidence of twin-twin transfusion syndrome

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may be other conditions responsible for discordant growth that occur in the first or early second trimester of pregnancy. (Obstet Gynecol 2004;103:1115-7. © 2004 by The American College of Obstetricians and Gynecologists.)

# CASE

twin.

A 22-year-old primigravida with a spontaneous twin pregnancy was noted at 10 weeks of gestation to have a discrepancy in crown-rump length between the 2 fetuses. Ultrasonography revealed a single placenta, a membrane

VOL. 103, NO. 5, PART 2, MAY 2004 © 2004 by The American College of Obstetricians and Gynecologists. Published by Lippincott Williams & Wilkins.

0029-7844/04/\$30.00 1115 doi:10.1097/01.A0G.0000125872.96052.9f

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