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Fetal anesthesia for twin-to-twin transfusion syndrome and fetal hydrothorax drainage: case report

Anestesia fetal para síndrome de transfusión gemelar y drenaje de hidrotórax fetal: reporte de caso

María Belén Chango-Salas^{a,b}, Jenny Mabel Vanegas-Mendieta^{a,b}, Ana Vanessa Mena-López^a

^a Hospital Carlos Andrade Marín, Quito, Ecuador

^b Universidad San Francisco de Quito, Quito, Ecuador.

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Abstract

Fetal surgery in utero is an alternative for treatable congenital malformations. Prognosis will improve with early correction. Once the surgical technique is planned, the anesthetist's knowledge of maternal and fetal physiology is crucial for the selection of the ideal anesthetic technique for each individual case, considering the type of surgical procedure and the expected degree of fetal stimulation. In this way, the optimal surgical field with maternal and fetal safety will be ensured. This article describes 1 case of twin-to-twin transfusion syndrome under spinal anesthesia and sedation, and a second case of hydrothorax drainage under sedation.

Resumen

La cirugía fetal in útero es una alternativa para las malformaciones congénitas tratables, su intervención temprana mejora el pronóstico del feto. Una vez planeada la técnica quirúrgica el conocimiento del anestesiólogo sobre la fisiología materna y fetal es fundamental, puesto que deberá determinar la técnica

anestésica ideal acorde al contexto de cada caso considerando el tipo de procedimiento quirúrgico a realizarse y el grado de estimulación fetal esperado. De esta manera se asegura un campo quirúrgico óptimo ofreciendo seguridad materno fetal.

En este artículo se describen dos casos: el primero síndrome de transfusión gemelar se realizó bajo anestesia raquídea y sedación, en el segundo caso de drenaje de hidrotórax bajo sedación.

Introduction

Congenital malformations are abnormalities of the morphological, structural, and functional development found in 2% to 3% of neonates. They represent a public health problem in developing countries, affecting 2.9% of children and constituting an important cause of child morbidity and mortality.¹

The objective of fetal surgery is to prevent fetal or early postnatal death, or the irreversible damage of organs associated with congenital malformations amenable to surgical correction.^{2,3}

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Correspondence: Alberto Spencer S-26 J, Casa OE3-148, Quito, Ecuador. E-mail: mabe_8717@hotmail.com

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The administration of anesthesia for fetal surgery is a unique challenge requiring the integrated practice of obstetric and pediatric anesthesia.⁴

The current consensus is to provide analgesia and anesthesia for all fetal interventions.⁵ Anesthetic management must focus on maintaining uteroplacental circulation, achieving profound uterine relaxation, optimizing conditions for surgery, maintaining maternal and fetal hemodynamic monitoring, and minimizing the risks for the mother and the fetus.³

The purpose of this report of 2 cases is to recognize the adequate type of anesthesia according to the procedure to be performed, because objectives are different depending on the intervention and the fetal structures involved.

Clinical case 1

A 20-week twin pregnancy in a 31-year-old patient. The ultrasound description was a monochorionic, diamniotic twin pregnancy with twin-to-twin transfusion syndrome and selective restriction, twin 1 weighing 295 g and with a fetal heart rate of 145 bpm, and twin 2 weighing 205 g and with fetal heart rate 135 bpm. Paraclinical tests were normal. Maternal physical examination showed normal cardiopulmonary status, absent uterine activity, and posterior closed cervix. Laser photocoagulation of placental anastomoses was proposed. Under standard monitoring and after asepsis and antisepsis, a single midline subarachnoid puncture was performed at the level of L3 to L4 using a Spinal needle number 27, and 0.75% hyperbaric bupivacaine 8 mg + intrathecal fentanyl 25 µg were administered, achieving adequate sensory and motor levels. The technique was supplemented with sedation, intravenous propofol in Target Controlled Infusion (TCI) mode with bispectral index monitoring (BIS 68–75). Photocoagulation of placental anastomoses was performed under ultrasound guidance with verification of the vital condition of the 2 fetuses using intermittent echocardiography.

Hemodynamic stability of the patient was maintained throughout the surgical procedure which proceeded uneventfully; the patient was then transferred to the recovery room and remained under observation in the hospital for uterine activity as well as fetal vitality with follow-up ultrasound scans.

Clinical case 2

A 41-year-old patient, gravida 2, with no pathological history and a 29-week pregnancy who presented with genital bleeding and ultrasound report of total occlusive placenta previa. Fetal ultrasound showed pericranial edema, cerebellar vermian hypoplasia, hypertelorism, soft-tissue edema of the neck, bilateral hydrothorax, bilateral pulmonary hypoplasia, low-set ears, and moderate polyhydramnios. A thoraco-amniotic shunt was proposed in view of these diagnoses.

The ultrasound-guided procedure was performed under basic non-invasive monitoring using local anesthetic and bispectral index-guided Ramsay IV sedation (BIS 65–70) with intravenous fentanyl 150 µg and TCI propofol infusion 2 to 3 ng/mL. Macrodynamics stability was maintained as well as spontaneous ventilation with O₂ supplementation by nasal cannula in order to ensure pulse oximetry of 97% to 99%. Fetal wellbeing was monitored by means of intermittent echocardiographic assessment.

At the end of the surgical procedure, the patient was transferred to the recovery unit after achieving hemodynamic stability. Uterine activity as well as fetal vitality were monitored using ultrasound during hospital stay.

Discussion

There is a strong debate regarding the gestational age at which the fetus feels pain. According to Hoagland and Chatterjee,³ thalamo-cortical connections required for pain perception develop only at around 23 to 30 weeks. In contrast, Vasco Ramírez claims that peripheral pain receptors start to develop by 7 weeks of gestation and they are fully developed at 26 to 30 weeks.⁴ Noxious stimuli may elicit neuroendocrine and hemodynamic responses as early as 18 to 20 weeks of gestation.³

The serotonin-mediated inhibitory system develops after birth and that is why fetuses experience more pain than neonates.⁴

Pain-related hemodynamic responses result in the elevation of catecholamines and cortisol, leading to increased vascular resistance and reduced fetal blood flow, which in turn result in bradycardia and compensatory flow redistribution from the peripheral tissues to the brain, heart, and placenta.^{3,4}

Fetal anesthesia and analgesia are required for fetal surgical procedures because they prevent hemodynamic and neuroendocrine alterations that may result in catastrophic consequences for the fetus. Moreover, they inhibit fetal movements and provide adequate uterine relaxation thus optimizing the surgical field.^{6–8}

The anesthetic technique depends on the planned fetal surgery, the degree of fetal stimulation, and the maternal medical history.³

Procedures in non-innervated fetal tissues such as placenta and umbilical vessels do not require fetal analgesia.³

Anesthetic considerations

Minimally invasive procedure

It is performed under local or neuroaxial anesthesia with or without sedation, and does not provide uterine relaxation or fetal anesthesia or analgesia.^{3,6}

The neuroaxial technique is preferred over local anesthesia based on surgeon position, duration and

complexity of the procedure, and postoperative analgesia.⁶

Supplemental sedation and analgesia with intravenous opioids, benzodiazepines or propofol may provide varying degrees of fetal immobility and anesthesia through placental transfer.⁶

Remifentanyl has been shown to provide adequate maternal sedation and fetal immobilization.⁹

Mid-gestational open procedures

These procedures require hysterotomy and need to be performed under general anesthesia using inhalation agents to allow dose-dependent uterine relaxation.^{3,6} Early administration of high concentrations of these agents during prolonged periods before hysterotomy may cause hypotension and could lead to intraoperative bradycardia, in particular with desflurane.⁶

It may be advisable to use total intravenous anesthesia initially and supplemental anesthesia with a halogenated agent, increasing the concentrations of volatile anesthetics from minimum alveolar concentration (MAC) 2 to 3 in order to achieve the desired uterine tone before hysterotomy, thus maintaining hemodynamic stability, optimizing placental blood flow, and improving fetal acid-base balance.³

Procedures outside the uterine cavity

Technique designed to allow partial delivery while continuous oxygenation is maintained by means of placental support.^{3,7} Most of the procedures are performed under general anesthesia with oral intubation of the patient, using halogenated agents before hysterotomy.^{6,7}

Twin-to-twin transfusion syndrome

Monochorionic twin pregnancies may be associated with arteriovenous anastomoses of the placental vessels where maternal blood supply is not equally shared between twins.^{9,10} Without treatment, mortality is higher than 80%, and approximately 30% of the survivors have neurodevelopmental abnormalities. Fetoscopic laser ablation is the treatment of choice and it may be performed under general or local anesthesia, sedation, neuroaxial anesthesia or a combination of general, and neuroaxial anesthesia.^{10,11} A bilateral transverse abdominis plane block may be used, with sedation.¹⁰

General anesthesia may be required in technically challenging cases such as anterior placenta, in which extreme positions are needed for inserting the trocar.¹⁰

Neuroaxial anesthesia was used in the case presented here, creating optimal conditions for uterine manipulation without causing pain to the mother. The parenteral administration of a hypnotic sedative that crosses the uteroplacental barrier immobilized the fetus, lowering the probability of injuring the fetus with the laser. Because of

the type of procedure which does not require fetal manipulation, fetal analgesia was not needed.

Fetal hydrothorax

It is a rare condition with a reported incidence of 1 in 10,000 to 15,000 pregnancies. It consists of a severe fluid buildup in the pleural space which may result in hypoplasia, cardiac compression and obstruction of the venous return system, leading to fetal hydrops.^{12,13} If left untreated, perinatal mortality is 22% to 55%.^{12,13} A potential alternative is thoracoamniotic shunt which is performed by placing a trocar perpendicular to the fetal chest wall to reach the pleural effusion and insert a catheter until 1/2 of it plus the distal loop are inserted in the fetal chest and the rest of the proximal loop is placed in the amniotic cavity, creating a permanent communication between the pleural space and the amniotic cavity.¹³

No literature exclusively describing the anesthetic technique for these procedures was found. However, Yinon et al¹⁴ assessed thoracoamniotic drainage in a retrospective study of 88 fetuses and reported that local anesthesia was used in 4%, sedation plus local anesthesia in 21%, and general anesthesia in 2%.

Sedation with local anesthesia was used in the case presented here, achieving fetal analgesia and immobilization. Monitoring of maternal sedation level using the bispectral index offers good guidance to maintain optimal sedation without compromising ventilation. However, there is no permanent fetal monitoring method.

Conclusion

Based on a thorough analysis of the maternal clinical history and the knowledge of the procedure, the anesthesiologist is responsible for determining the optimal anesthetic technique for maintaining maternal and fetal hemodynamic stability, ensuring the performance of safe and effective fetal surgical procedures.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document work in the power of the correspondence author.

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Conflict of interest

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