ANESTHETIC CONSIDERATIONS IN A NEONATE UNDERGOING THORACOSCOPIC REMOVAL OF A THORACO-AMNIOTIC SHUNT FOLLOWING PRENATAL MANAGEMENT OF FETAL PLEURAL EFFUSION: A CASE REPORT

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Abstract

Fetal pleural effusion is a condition characterized by the accumulation of fluid in the chest cavity of a developing fetus. It may be primary, often caused by lymphatic leakage such as chylothorax, or secondary to immune causes like Rh or ABO incompatibility, as well as nonimmune factors including chromosomal abnormalities, genetic disorders, infections, and congenital heart defects. These effusions may be associated with hydrops fetalis. The preferred prenatal treatment is thoraco-amniotic shunt (TAS), which drains pleural fluid into the amniotic sac. TAS improves lung development and has a survival rate of up to 85% in nonhydropic fetuses. A 34-week pregnant woman (gravida 2, para 1) was referred with suspected fetal lung fluid and diagnosed with fetal pleural effusion by ultrasound. After multidisciplinary evaluation, an ultrasound-guided thoraco-amniotic shunt (TAS) was performed under maternal spinal anesthesia, with fetal analgesia and paralysis achieved using fentanyl and vecuronium. The procedure was successful without complications. The patient delivered by cesarean section at 38 weeks. Postnatal imaging showed the shunt in place without residual effusion. On day six of life, the neonate underwent successful thoracoscopic shunt removal under general anesthesia, with stable intraoperative and postoperative outcomes. Conclusion, Thoraco-amniotic shunt placement and postnatal thoracoscopic removal require careful anesthetic planning and multidisciplinary coordination. Understanding maternal-fetal physiology and neonatal immaturity is essential. With thorough assessment and precise anesthetic management, both intrauterine and neonatal procedures can be performed safely with favorable outcomes.

Keywords: fetal anesthesia, fetal pleural effusion, intrauterine surgery, maternal, neonatal anesthesia

Introduction

Fetal pleural effusion is a rare prenatal condition characterized by the abnormal accumulation of fluid within the fetal pleural cavity, with an estimated incidence of approximately 1 in 10,000–15,000 pregnancies. This condition may be primary (idiopathic

or chylothorax) or secondary to chromosomal abnormalities, congenital infections, or structural anomalies. Progressive pleural effusion can result in mediastinal shift, pulmonary hypoplasia, impaired venous return, and hydrops fetalis, all of which significantly increase perinatal morbidity and mortality.[1–3]

Thoraco-amniotic shunt (TAS) placement has become an established minimally invasive intrauterine intervention for large or progressive fetal pleural effusions. The shunt allows continuous drainage of pleural fluid into the amniotic cavity, reducing intrathoracic pressure and improving lung development. Although TAS placement improves fetal survival, postnatal complications such as shunt migration, infection, pneumothorax, or persistent pleural effusion may necessitate surgical removal after birth. [4, 5]

Thoracoscopic surgery in neonates presents significant anesthetic challenges due to immature respiratory physiology, limited pulmonary reserve, susceptibility to hypothermia, and the effects of carbon dioxide insufflation on cardiopulmonary function. These challenges are further compounded in neonates with a history of intrauterine pleural disease and fetal intervention. This case report describes the anesthetic management of a neonate undergoing thoracoscopic removal of a thoraco-amniotic shunt on day six of life and highlights key anesthetic considerations relevant to neonatal thoracoscopic procedures.[2, 3]

Case Report

A 29-year-old primigravida was referred to the hospital at 28 weeks of gestation following the detection of progressive unilateral fetal pleural effusion on routine obstetric ultrasonography. Serial fetal ultrasounds demonstrated increasing pleural fluid volume with mediastinal shift and early signs of hydrops fetalis. Comprehensive fetal evaluation, including a detailed anomaly scan and karyotyping, revealed no chromosomal abnormalities or structural anomalies.

After multidisciplinary consultation involving obstetrics, anesthesiology, neonatology, and pediatric surgery, an ultrasound-guided thoraco-amniotic shunt was placed in utero. The procedure was performed under maternal sedation and local anesthesia, with direct fetal analgesia and paralysis administered to facilitate safe shunt placement. Post-procedural ultrasound showed a significant reduction in pleural effusion and resolution of hydrops over subsequent weeks. The remainder of the pregnancy progressed uneventfully.

At 37 weeks of gestation, a male neonate was delivered via elective cesarean section with a birth weight of 2,900 g. Initial Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. The neonate required brief supplemental oxygen but did not require mechanical ventilation. Postnatal chest radiography confirmed the presence of the thoraco-amniotic shunt within the pleural cavity, with no evidence of pneumothorax or residual massive effusion.

On day six of life, thoracoscopic removal of the thoraco-amniotic shunt was planned to prevent shunt-related complications. Preoperative evaluation revealed stable vital signs, oxygen saturation of 98% on room air, and no signs of respiratory distress. Laboratory investigations were within normal limits for age. After obtaining informed parental consent, the neonate was scheduled for surgery.

Standard neonatal monitoring was applied in the operating room, and prewarming measures were used to prevent hypothermia. Anesthesia was induced with sevoflurane, followed by intravenous fentanyl and rocuronium, and the airway was secured with a 3.0-mm cuffed endotracheal tube. Mechanical ventilation was managed with low pressures and permissive hypercapnia, while oxygen levels were adjusted to maintain saturation between 94–98%.

During thoracoscopy, carbon dioxide insufflation was kept below 5 mmHg, and hemodynamic parameters remained stable. The 45-minute procedure was completed without complications. After surgery, neuromuscular blockade was reversed, the neonate was extubated once adequate ventilation was restored, and was transferred to the NICU for postoperative observation.

Postoperatively, the neonate remained hemodynamically stable with no signs of respiratory distress. Analgesia was maintained using intravenous paracetamol. Chest radiography performed six hours after surgery showed adequate lung expansion with no evidence of pneumothorax or residual pleural effusion. The patient was discharged from the NICU after 24 hours and later discharged home in good condition on day 10 of life."

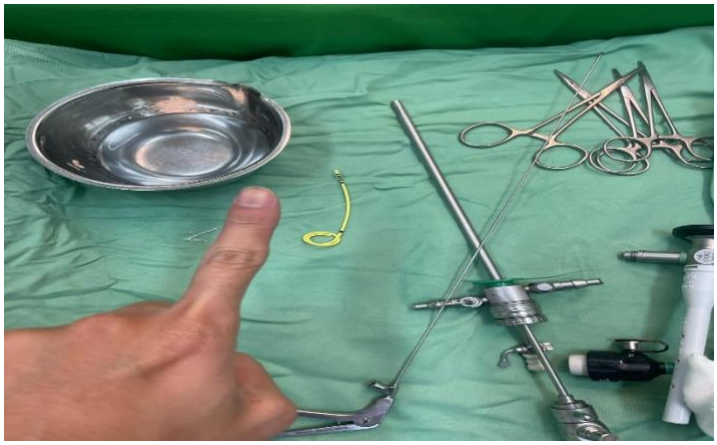

Figure 1. Double-pigtail Catheters Used in TAS (Thoraco-Amniotic Shunt).

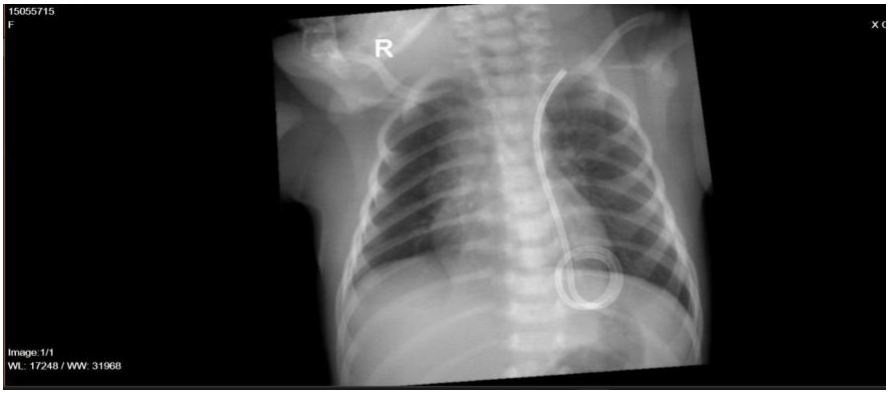

Figure 2. A Female Neonate Born at 38 Weeks of Gestation Following Successful In-utero TAS Placement for Fetal Pleural Effusion.

Discussion

Thoracoscopic surgery in neonates requires careful anesthetic planning due to the unique physiological characteristics of this population. Neonates have a highly compliant chest wall, reduced functional residual capacity, and increased oxygen consumption, making them particularly vulnerable to hypoxemia during thoracic procedures. These challenges are magnified in patients with a history of fetal pleural effusion, as residual pulmonary hypoplasia or compromised lung mechanics may persist even after successful prenatal intervention.[3, 4]

Carbon dioxide insufflation during thoracoscopy can further exacerbate respiratory and cardiovascular instability by increasing intrathoracic pressure, reducing venous return, and causing hypercapnia. Therefore, maintaining low insufflation pressures and employing lung-protective ventilation strategies are essential. Pressure-controlled ventilation with permissive hypercapnia has been shown to reduce barotrauma while maintaining adequate gas exchange in neonatal thoracoscopic procedures.[6]

Thermoregulation is another critical aspect of neonatal anesthesia. Neonates have a high surface area-to-body weight ratio and limited thermoregulatory capacity, predisposing them to rapid heat loss. Hypothermia can lead to metabolic acidosis, coagulopathy, and delayed recovery from anesthesia. In this case, proactive warming measures were effective in maintaining normothermia.[1, 4]

Close communication between the anesthesiology and surgical teams is essential, particularly during CO_2 insufflation and lung manipulation. Anesthesiologists must be prepared to manage sudden changes in ventilation or hemodynamics and be ready for rapid conversion to open thoracotomy if required.[5, 7]

Neonatal thoracoscopic surgery demands careful anesthetic management due to their unique physiology, including a compliant chest wall, reduced functional residual capacity,

and high oxygen consumption, which increase the risk of hypoxemia. Special attention is required in patients with a history of fetal pleural effusion due to potential residual lung compromise. Maintaining low carbon dioxide insufflation pressures, using lung-protective ventilation strategies such as pressure-controlled ventilation with permissive hypercapnia, and ensuring effective thermoregulation are essential to minimize respiratory, cardiovascular, and metabolic complications. Close collaboration between anesthesiology and surgical teams is critical to promptly manage any intraoperative instability and ensure patient safety.

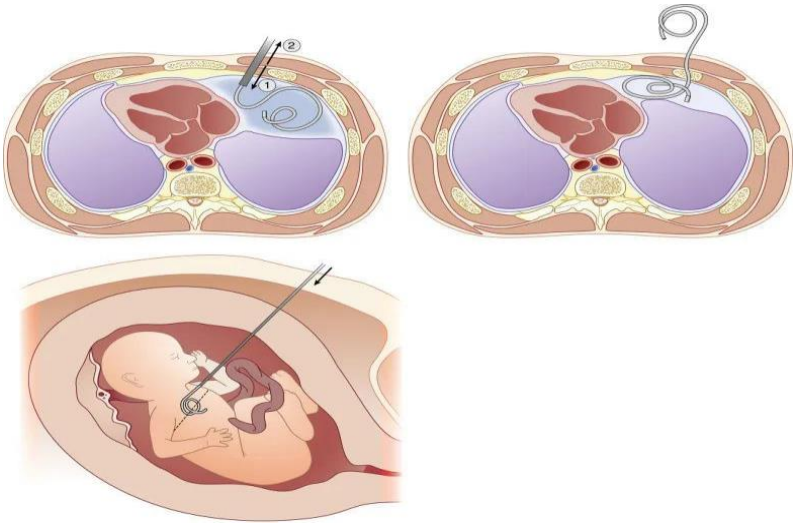

Figure 3. Schematic Diagram of Thoraco-amniotic Shunt.

Competing Interests

Authors declare no conflicts of interest

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