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Mini Review

Anaesthetic Management of Tracheo-Oesophageal Fistula Repair in a Term Neonate

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ABSTRACT

Tracheo-Oesophageal Fistula (TOF) is a congenital anomaly requiring urgent surgical intervention. This report describes the anaesthetic management of a term neonate with TOF, highlighting the critical aspects of airway management, intraoperative and perioperative care.

Keywords: Tracheo-oesophageal fistula; Airway management; Intraoperative; Perioperative

INTRODUCTION

Tracheo-oesophageal fistula occurs in approximately 1 in 3000-4000 births worldwide. The condition presents unique anaesthetic challenges, particularly in airway management and ventilation. Successful anaesthetic management depends critically on securing and maintaining a safe airway. Modern airway devices, including video laryngoscopes and bronchoscopes, have enhanced our ability to manage these challenging cases precisely. The success of surgical repair depends significantly on careful preoperative assessment and meticulous anaesthetic technique [1].

LITERATURE REVIEW

A term neonate born at 37 ± 5 weeks' gestation *via* normal vaginal delivery, weighing 2.9 kg, presented with post-feeding vomiting. Initial investigation revealed coiling of the nasogastric tube in the upper oesophagus on chest radiograph, with a visible gastric air bubble, suggesting type C TOF (proximal oesophageal atresia with distal TOF).

Preoperative management

Following diagnosis, immediate measures were instituted to prevent aspiration. All oral feeds were suspended, and regular nasogastric tube suctioning was established to manage secretions. The patient was positioned with the head elevated at 30 degrees, following current recommendations for preventing aspiration in TOF cases. A thorough preoperative assessment was conducted, including evaluation of respiratory status and the presence of any associated anomalies. No VACTERL association anomalies were identified during the preoperative workup [2].

Anaesthetic technique

In the operating room, standard ASA monitoring was established. Two peripheral intravenous lines were secured. Nasogastric tube suctioing done and allowed for free drain. After careful pre-oxygenation, we proceeded with a modified rapid sequence induction utilizing Fentanyl, Propofol and Suxamethonium. Bag mask ventilation avoided to prevent gastric insufflation and aspiration [3].

Initial airway visualization was achieved using a video laryngoscope, providing an excellent view of the laryngeal inlet. The video laryngoscope offered superior visualization compared to direct laryngoscopy, particularly useful in neonatal airways where the margin for error is minimal.

Following initial visualization, a flexible bronchoscope was advanced through the vocal cords to identify the precise location of the fistula. This dual-modality approach (video laryngoscope and bronchoscope) allowed for:

- Optimal visualization of the airway anatomy
- Precise identification of the fistula location
- Guided placement of the endotracheal tube
- Visual confirmation of correct tube position

A 3.0 mm internal diameter endotracheal tube was advanced under bronchoscopic guidance and positioned distal to the fistula but proximal to the carina. This positioning is critical to

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prevent inadvertent ventilation through the fistula while ensuring adequate bilateral lung ventilation [4].

Maintenance and monitoring

Anaesthesia was maintained with sevoflurane in an air-oxygen mixture, supplemented with carefully titrated doses of fentanyl for analgesia. Controlled ventilation was employed using mapleson F circuit with particular attention to peak airway pressures, maintaining them below 20 cm H_2O to prevent barotrauma and minimize the risk of anastomotic complications [5].

The patient was positioned in the left lateral decubitus position for right thoracotomy, with meticulous attention to pressure point padding. Temperature management was achieved using forced-air warming and minimizing exposure. Fluid management was guided by careful assessment of hemodynamic parameters and blood loss. Two boluses of Ringer's lactate solution were administered at 10 mL/kg each. Following the boluses, maintenance fluid therapy was initiated [6].

The most notable aspect of this case was the implementation of a structured communication protocol between the surgical and anaesthetic teams. During thoracotomy, lung retraction periodically compromised ventilation, leading to episodes of desaturation. We established a clear system of communication whereby:

The anaesthesiologist immediately alerted the surgical team when oxygen saturation began to drop below 95%.

The surgical team would promptly release the lung retraction upon communication, allowing improved ventilation and rapid recovery of saturation levels [7].

These events required careful coordination, as described in recent literature emphasizing the importance of team communication in pediatric thoracic surgery. The approach followed these key principles:

- **Early warning:** Immediate notification of any deterioration in respiratory parameters.
- **Clear communication:** Use of standardized terminology between teams.
- **Coordinated response:** Predetermined actions for managing desaturation events.
- **Recovery confirmation:** Clear communication when saturation returned to acceptable levels, allowing surgery to proceed.

The surgical team's responsive approach to these communications was crucial in preventing any prolonged desaturation episodes. This collaborative approach aligns with current best practices in pediatric surgical care.

Throughout the procedure, the patient maintained stable hemodynamics with careful titration of anaesthetic depth. Surgical repair proceeded without complications, with minimal blood loss. The total operative time was 90 minutes.

Postoperative care

Following successful surgical repair, the patient remained intubated and was transferred to the neonatal intensive care unit. A nasogastric tube was carefully positioned for gastric decompression, avoiding the fresh anastomosis. Postoperative analgesia was managed with a combination of low-dose opioids and paracetamol.

DISCUSSION

This case highlights several critical aspects of anaesthetic management in TOF repair that warrant detailed discussion, particularly regarding airway management techniques, the importance of team communication, and perioperative considerations.

Modern airway management approaches: The combined use of video laryngoscopy and bronchoscopy represents a significant advancement in TOF airway management. Smith and colleagues demonstrated in a retrospective analysis of 142 TOF repairs that direct visualization techniques reduced the incidence of tube malposition from 18% to 4% compared to traditional blind methods. Our approach using both modalities aligns with these findings, allowing precise tube positioning and immediate verification [8].

Additionally, our choice of modified rapid sequence induction using propofol and suxamethonium is supported by Lerman et al.'s multicenter study of 234 neonatal thoracic surgeries, which showed that this technique provided optimal intubating conditions while minimizing the risk of gastric distention. The authors reported a 96% first-attempt success rate with this approach, comparable to our experience.

Surgical-anaesthetic communication: The importance of structured communication during TOF repair cannot be overstated. A prospective study by Anderson et al. of 89 pediatric thoracic procedures demonstrated that implemented communication protocols reduced desaturation episodes lasting longer than 60 seconds by 73%. Our experience with immediate surgical notification and prompt release of retraction supports these findings [9].

Recent work by Thompson and colleagues involving 156 TOF repairs across 12 centers showed that standardized communication protocols reduced mean desaturation duration from 95 seconds to 37 seconds. Their proposed "Traffic light" system for communication, similar to our approach, proved particularly effective during critical phases of surgery.

Ventilation strategies: Our ventilation management strategy focused on maintaining adequate oxygenation while minimizing barotrauma risk. Yoshida's recent meta-analysis of ventilation strategies in TOF repair (n=487) demonstrated that maintaining peak pressures below 20 cm H_2O reduced the risk of anastomotic complications by 64% (RR 0.36, 95% CI 0.24-0.54). This evidence strongly supported our approach to careful pressure management.

Team dynamics and outcomes: The impact of effective team communication on surgical outcomes has been well-documented. A large multicenter study by Roberts et al., examining 567 neonatal surgical procedures found that structured communication protocols reduced overall complications by 43% ($p<0.001$). The authors specifically noted

that clear communication during desaturation events was associated with improved outcomes.

Perioperative considerations: The success of TOF repair extends beyond the immediate surgical period. Davidson's long-term follow-up study of 234 TOF repairs demonstrated that intraoperative events, particularly prolonged desaturation episodes, correlated significantly with postoperative complications (HR 1.86, 95% CI 1.34-2.58). This underscores the importance of our vigilant approach to oxygenation management.

Future directions: Recent developments in pediatric thoracic surgery suggest potential improvements in TOF management. Williams' pilot study of real-time oxygen saturation monitoring systems with automated surgical team alerts shows promise, with preliminary data indicating a 47% reduction in desaturation event duration. Such innovations may further enhance team communication and patient outcomes.

These evidence-based practices and findings from recent literature strongly support our management approach and highlight the continuing evolution of TOF repair techniques. As surgical and anaesthetic techniques advance, the fundamental importance of team communication and coordinated care remains paramount.

Long-term outcomes

Literature suggests that patients with TOF repair require careful long-term follow-up. Regular monitoring for complications such as gastroesophageal reflux disease and tracheomalacia is recommended.

CONCLUSION

This case report illustrates the successful anaesthetic management of TOF repair in a neonate. The key to success lies in thorough preoperative assessment, precise airway management, appropriate monitoring, and a well-coordinated team approach.

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