Dexmedetomidine, Propofol & HFNO for Spontaneous Ventilation under anaesthesia in upper Airway Procedures

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INTRODUCTION

The combination of dexmedetomidine, propofol and HFNO (high flow nasal oxygen) has been used at Alder Hey Children's Hospital for MLTB surgeries and has shown to provide equivalent conditions when compared to inhalational anaesthetic techniques. The pediatric airway can be extremely challenging for the anaestheist and NAP4 highlighted the importance in proper assessment, planning and execution of airway management in order to prevent catastrophic outcomes. Blind application of adult techniques is not always possible because of differing challenges with pediatric populations. A reduced residual capacity, and increased in O2 utilisation means that desaturation occurs much more rapidly than in adults. Awake techniques are often not an option due to compliance. Therefore a technique that provides an anaesthetised but spontaneously ventilating patient is next best option. Here we describe the use of HFNC and dexmedetomidine in three cases of airway procedures.

	Case 1	Case 2	Case 3
Age/ Weight	7 Weeks. 3.8kg	7 years. 18.6kg	15 months. 10Kg
PHMx	Mediastinal mass compressing left pulmonary artery and left main bronchus. Hyperinflation left lung. Home O2	Tracheoesophageal fistula and laryngeal cleft T3. CLD Home O2. Tracheostomy.	Multiple congenital abnormalities (micrognathia, limited mouth opening, mandibular dysostosis, cleft palate). Prev POGO 0%.
Procedure	Longline line and biopsy	3rd repair laryngeal cleft. Difficult surgical access requiring tubeless surgery.	Mickey button change
Technique	Sevoflurane induction. Dexmedetomidine 1mcg/kg. Propofol 160 to 180 mcg/kg/min. Lignocaine 2% 5mg/kg	Sevoflurane induction. Dexmedetomidine 1mcg/kg; then 0.5mcg/kg/60mins. Propofol 5mg/kg then 140 to 160 ug/kg/min plus 0.5mg/kg boluses PRN. Lidocaine 2% 4mg/kg then 0.5mg/kg every 45 mins	Sevoflurane induction. Dexmedetomidine 1mcg/kg. Propofol 2mg/kg then 200 ug/kg/min. Lignocaine 2% 4mg/kg
Airway	Fiberoptic nasal intubation	Tracheostomy removed for tubeless surgery	Fiberoptic nasal intubation
Time of spontaneous ventilation	5 minutes	7h 15m	10mins
Obs	Sats 95-100%, HR 120–150	Sats 96-100%, HR 75-110	Desaturation HR 99-110
Issues	No issues	No issues. Trache 4.5 re-sited.	Laryngospasm post lidocaine to cords; desaturation to 28% recovered rapidly to 85% with PEEP but took 5 mins to return to 95%.

DISCUSSION

Retrospective data was collected on three cases where the use of HFNC and dexmedetomidine was applied to facilitate an airway procedure. The indications were:

1. **mediastinal mass with bronchial compression**
2. **tubeless surgery**
3. **anticipated difficult airway.**

In all cases anaesthesia was induced with sevoflurane and then converted to total intravenous anaesthesia (TIVA) with a propofol infusion, aiming for spontaneous ventilation followed by a dexmedetomidine bolus of 1 microg/kg. High flow nasal cannula were applied with an FiO2 of 1.0 and flow rates of 2mls.kg. The airway was topicalized with 2% lidocaine.

For **Case 1** the intention was to maintain airway tone to prevent airway obstruction from the compression effect of the mediastinal mass. Maintaining spontaneous ventilation throughout the procedure and avoiding any positive pressure ventilation that may worsen the hyperinflation of the left lung. A fiberoptic scope was used to site the ETT with the tip 1cm above carina.

Case 2 was a prolonged surgery taking over 7hours. In this instance there had previously been significant issues with surgical access to the airway and this technique allowed for a tubeless surgery for completion of repair to a laryngeal cleft. Dexmedetomidine boluses of 0.5microg/kg were repeated every 60min and spontaneous respiration was maintained throughout with no issues reported.

In **Case 3**, there was a significant desaturation secondary to laryngospasm. This resolved with PEEP and on reflection the anaesthetist felt this was likely due to inadequate depth of anaesthesia at the time of airway manipulation.

Dexmedetomidine is an α_2-adrenergic agonist that provides sedation whilst maintaining spontaneous ventilation and airway tone. It reduces airway sensitivity and cough and has provided good surgical conditions for MLTB at Alder Hey. Bradycardia can occur but is self limiting and very rarely problematic.

HFNC provides continuous positive airway pressure and gaseous exchange through flow-dependent dead space flushing and is used in spontaneously ventilating patients in this setting to provide oxygenation and increase safe apnoea time.

Alternative Techniques

Inhalation technique with sevoflurane maintenance via a nasally placed tube with the tip in the pharynx is one technique. Benefits include familiarity with use of sevoflurane, reliable maintenance of spontaneous ventilation and the ability of the ENT surgeons to pass the tube if required. drawbacks may include reliable sevoflurane delivery in an unsecured airway, lack of reliable end tidal monitoring, inability to provide PEEP, drying of the mucosa and epistaxis with the nasal ETT, environmental issues and theatre staff exposure.

TIVA with remifentanil with propofol may also be used. Again there is greater familiarity with remifentanil which also reduces airway sensitivity. Dosing may be challenging when attempting to achieve adequate sedation whilst maintaining spontaneous ventilation.

LIMITATIONS

The use of dexmedetomidine is a relatively new technique to Alder Hey. There is a small number assessed in this case series and data collection was retrospective. The use of HFNC requires at least a partially open airway and tongue fall or laryngospasm can cause severe desaturations. There is a risk of CO2 retention and a cost implication. We also noted that patients receiving dexmedetomidine remain drowsy in recovery for a longer period.

CONCLUSION

The combination of HHFO and dexmedetomidine can provide good conditions for airway procedures. This may have a number of applications including the management of the anticipated difficult airway, however, further experience is required with the technique and larger numbers to draw solid conclusions.

REFRENCES

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