

## Anaesthesia and subglottic airway obstruction

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**Keywords:** shared airway; jet ventilation; TIVA/TCI; laser excision; monitoring

### Abstract

In this article, we describe the anaesthetic management and laser excision of a subglottic tumour that caused upper airway obstruction. Stridor was the presenting feature. A good history and careful assessment will reduce the likelihood of erroneous or delayed diagnosis and will improve patient outcome. This case report highlights the use of target-controlled infusions and jet ventilation (high-pressure source ventilation) in the surgical excision of a subglottic tumour.

© Peer reviewed. (Submitted: 2009-07-14, Accepted: 2010-10-04)

S Afr J Anaesth Analg 2011;17(2):182-184

### Introduction

Surgery on the upper airway remains challenging for both surgeon and anaesthesiologist. A shared airway requires careful preoperative assessment, constant intraoperative awareness of oxygenation and precise and clear communication during surgery. Postoperative monitoring in a high care unit for early detection of complications is recommended.

### Case report

A 13-year-old girl weighing 61 kg with a height of 1.6 m was referred to a specialist centre for upper airway obstruction. A history of stridor for three years was noted and she was initially diagnosed and treated for asthma. Following direct laryngoscopy in Botswana three weeks earlier, a tumour and narrowing below the vocal cords were noted. She was referred for laser excision of the subglottic tumour. On presentation, we saw a distressed teenager holding an oxygen mask to her face. She was being given four-hourly nebulisation with ipratropium bromide and salbutamol. On examination, there was mild expiratory stridor and on auscultation, good breath sounds were heard bilaterally. We felt that her problems emanated from her upper airway obstruction rather than asthma.<sup>1</sup> She had made a long overnight journey by road and the new unfamiliar hospital environment added to her anxiety. Laboratory values were normal and her HIV status was negative.

### Anaesthetic management

Midazolam 7.5 mg was given orally for anxiolysis. Inhalational induction with 100% oxygen and sevoflurane 3% was commenced. Following induction, gentle manual assistance by face mask was given and chest movements were observed. As ventilation could be assisted and the airway was not compromised, mivacron 0.07 mg/kg was given as a muscle relaxant. When adequate anaesthetic depth was achieved, direct laryngoscopy with a rigid laryngoscope was performed. During the procedure, which involved sharing the airway with the surgeon, jet ventilation at 250 kPa was done intermittently. We ensured that the patient was well oxygenated with oxygen saturation above 95%. Jet ventilation was intermittently halted when the laser was in use. When oxygen saturation began to drop, jet ventilation was resumed and the resumption was clearly communicated to the surgeon. Close co-operation between team members was vital and at no time was oxygen saturation allowed to drop below 90%. The hazards of an airway fire or a precipitous drop in oxygen saturation were thus minimised. A target-controlled infusion (TCI), propofol at 2.8 µg/ml (Schneider model) and remifentanyl at 5 ng/ml (Minto model), was used to maintain anaesthesia during the procedure. For infusions of 60-minute durations, propofol/opioid combinations estimated by Absalom et al (2.5 µg/ml; 4.78 ng/ml) are associated with the fastest recovery from anaesthesia.<sup>2</sup>

Standard monitoring included non-invasive blood pressure, ECG and pulse oximetry. End-tidal CO<sub>2</sub> monitoring was not possible in the open system that was used.

In the absence of capnography, the adequacy of jet ventilation was determined by clinical observation of chest wall movements during periods of oxygenation. No stress response was observed during the panendoscopy procedure.

We observed a fleshy tumour below the vocal cords covering almost the entire rim of the tracheal lumen (Figure 1). Laser excision was done and a mass lesion was removed (Figure 2). Bleeding was minimal and adrenaline swabs were used for haemostasis at the surgical site. The procedure lasted less than an hour. Dexamethasone 0.1 mg/kg was given intraoperatively to reduce swelling of the surgical site.

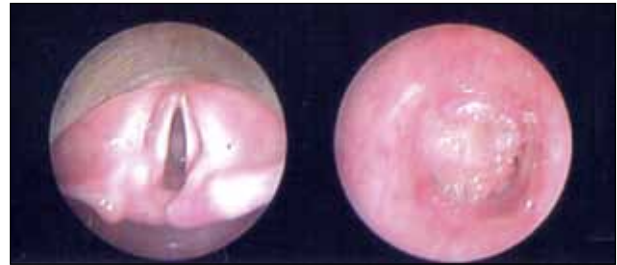
Ketorolac (0.5 mg/kg), intravenous paracetamol (15 mg/kg) and tramadol (1 mg/kg) were given intraoperatively for pain relief. Post-surgery, the patient was transferred to a high care unit for overnight monitoring. Supplemental oxygen was given and four-hourly nebulisation with adrenaline was prescribed.

The patient was stable overnight and no respiratory distress occurred. A repeat procedure done a week later showed excellent healing (Figure 3). A biopsy revealed an inflammatory myofibroblastic tumour measuring 15 x 15 mm. These are borderline malignant tumours with a 25% recurrence rate.

## Discussion

Jet ventilation and TCI/TIVA (total intravenous anaesthesia) are our techniques of choice for procedures that involve a shared airway. Using a TCI system, a desired concentration (target concentration) of an anaesthetic agent is delivered, based on the pharmacokinetics of the agent used. This can be set and changed based on its clinical effects on the patient. The target concentration may be blood (C<sub>p</sub>) or effector (C<sub>e</sub>) site concentration. The Asena Mark III (TCA/TIVA) infusion system programmed for propofol and remifentanyl was used targeting effector (C<sub>e</sub>) site concentrations. The optimal propofol/remifentanyl combination estimated by Vykh et al with a 95% probability of no response to surgical stimuli is (2.8 µg; 7.61 ng/ml).<sup>3</sup> Combinations of agents that result in supra-additive clinical effects offer significant benefits. In general, the hypnotic agent (intravenous) tends to have more profound cardiovascular effects than opioids. The dose of the hypnotic can be titrated to improve cardiovascular stability.<sup>2</sup>

During laser surgery, the surgeon requires unimpeded access and a still, quiet patient. The anaesthetised patient has to be well oxygenated and at an adequate depth of anaesthesia. Jet ventilation may be supraglottic (via the surgeon's laryngoscope), subglottic (via a small catheter placed through the vocal cords) or transtracheal (via a cannula placed percutaneously into the trachea). In high-pressure source ventilation (HPSV), gas enters at high pressures. The initial driving pressure may vary from 50 kPa to 400 kPa. The Manujet 3 used has a connecting tube that is attached to a side-arm of the surgeon's laryngoscope. This allows for supraglottic jet ventilation through a small metal tube. Lung volumes are triggered manually. Difficulties relate to tidal volume measurement, CO<sub>2</sub> detection and the



Figures 1: Panendoscopy of the larynx before excision



Figure 2: View of the larynx immediately post-surgery



Figures 3: Panendoscopy of the larynx one week post-surgery

monitoring of airway pressures. Fire risk is lower, bleeding is minimal and the surgical field is unobstructed. pH and  $\text{PCO}_2$  measured by arterial blood gas will show hypercapnia.<sup>4</sup> In procedures of long duration, we have observed  $\text{PCO}_2$  greater than 6 kPa and a pH of less than 7.2.

Complications may occur with all modes of ventilation. Serious morbidity and death have been reported. Hypoxia, laryngospasm and other minor complications related to barotrauma occur. These include pneumothorax, pneumomediastinum and surgical emphysema, all of which impact on hospital stay, costs and outcome.

Progress in transcutaneous  $\text{CO}_2$  monitoring may improve outcome, but the clinical monitoring of patients still remains crucial. This involves ensuring an adequate level of anaesthesia, analgesia and muscle relaxation.<sup>5</sup>

HPSV involves wide variations in clinical practice. Expert opinion is often the only source of reference. Best practice guidelines have been proposed by Cook and Alexander<sup>4</sup> for transtracheal ventilation that applies to other modes of HPSV.

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