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Elective Use of the Ventrain for Upper Airway Obstruction during High Frequency Jet Ventilation

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Abstract

The success of high pressure source ventilation is entirely dependent upon upper airway patency to facilitate passive expiration and prevent increasing intrathoracic pressure and its associated deleterious sequelae. Distortions in airway anatomy may make passive expiration inadequate or impossible in some patients.

Keywords: Intrathoracic pressure; Passive expiration; Ventilation; Squamous cell carcinoma

Introduction

The success of high pressure source ventilation is entirely dependent upon upper airway patency to facilitate passive expiration and prevent increasing intrathoracic pressure and its associated deleterious sequelae. Distortions in airway anatomy may make passive expiration inadequate or impossible in some patients. We would like to report the elective use of the Ventrain device to provide ventilation in a clinical setting of upper airway obstruction in a patient with post radiation fibrosis that had previously prevented passive expiration during attempted high pressure source ventilation.

Case Report

A 58 year old man, weight 56 kg, height 172 cm, American society of Anaesthesiologists' (ASA) status 2 (arterial hypertension) with a previous history of squamous cell carcinoma of the right vocal cord and anterior commissure presented for a second attempt at laser excision of symptomatic post radiotherapy supraglottic stenosis. Surgery had been abandoned some 4 weeks previously due to inadequate expiration during high frequency jet ventilation with a Monsoon® high frequency jet ventilator (Accutronic medical systems, Hirzel, Switzerland). Ventilation on this occasion had been attempted via both a subglotically placed catheter and the suspension laryngoscope. The patient was known to be a difficult intubation with grade IV Cormack Lehane laryngoscopic views obtained during previous anaesthetic episodes. On returning to theatre, nasal awake fibre optic intubation was again performed. Topical anaesthesia of the nasal mucosa was achieved using Moffatt's solution (2 mls 10% cocaine, 1 mL 1:1000 adrenaline, 2 mls 8.4% sodium bicarbonate and 5 mls 0.9% sodium chloride) delivered via a mucosal atomising device (MAD nasal, Teleflex medical, North Carolina, USA). The oropharynx was topicalised with 4 mls of 4% Lidocaine. Sedation was provided by remifentanil and propofol target controlled infusions of 3 ng/mL and 1 mcg/mL respectively. Nasal endoscopy was performed with a 3.7 mm, 65 cm Storz fiberscope (Karl Storz GmbH & Co. KG, Tuttlingen, Germany), the airway was secured with a size 5.0 microlaryngeal endotracheal tube (Portex® Blue line®, Smiths Medical International Limited, Kent, UK) and the patient was fully anaesthetised. Remifentanil and propfol target controlled infusions were titrated toa BIS of 40-60 (BIS VISTA™, Aspect Medical Systems, Inc, Massachusetts, USA). Skin overlying the cricothyroid membrane was infiltrated with lidocaine with adrenaline 1:200,000 and a 2.0 mm internal diameter 75 mm long Cricath® cannula (Dolphys Medical BV, Eindhoven, The Netherlands) was inserted through the cricothyroid membrane after withdrawal of the nasal endotracheal tube under fibreoptic guidance. Ventilation was then commenced using the Ventrain® using an I:E ratio of 1:1 at a rate of 10-12 breaths per minute with approximately 15 L/min oxygen driving gas supplied from our Drager Primus anaesthetic machine (Drägerwerk AG & Co, Lübeck, Germany). Laser release of laryngeal fibrosis was performed for a period of over 60 minutes thereafter with saturations maintained at 100% and capnography indicating an $ETCO_2$ of 5.4-6.0 kPa. Visible chest wall movement was observed throughout the case. At the conclusion of surgery target controlled infusions of propfol and remifentanil were switched off and the patient woke up smoothly and was transferred to our post-surgical recovery area. His stay there was uneventful though a small amount of surgical emphysema was noted bilaterally at the base of the neck. He was discharged to the surgical ward some two hours later (Figures 1-3).

Discussion

High pressure source ventilation (jet ventilation) may be delivered to a patient using a number of different techniques ranging from suspension laryngoscopes to trans-tracheal catheters. In some individuals, distortion of the upper airway by disease processes prevents passive expiration [1]. Traditionally, such cases have necessitated abandonment of surgery or insertion of large bore transcricoid or transtracheal cannulas to allow adequate ventilation. The Ventrain®

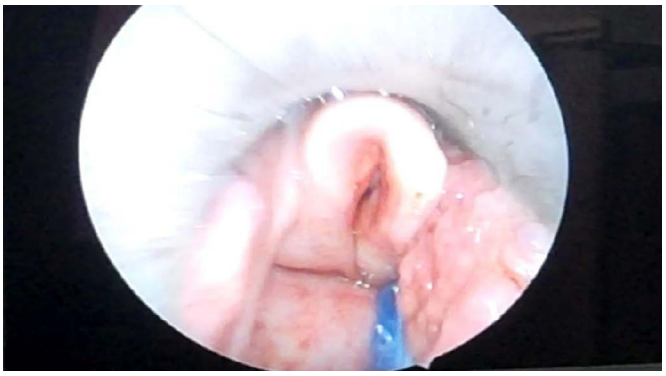

Figure 1: Subglottic views achieved with the suspension laryngoscope.

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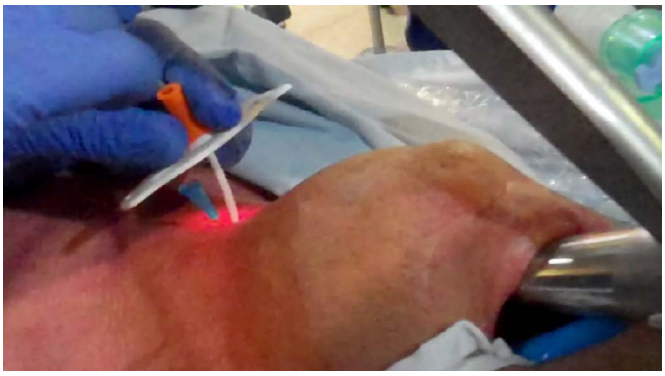

Figure 2: Insertion of the *Cricath*® cannula through the cricothyroid membrane.

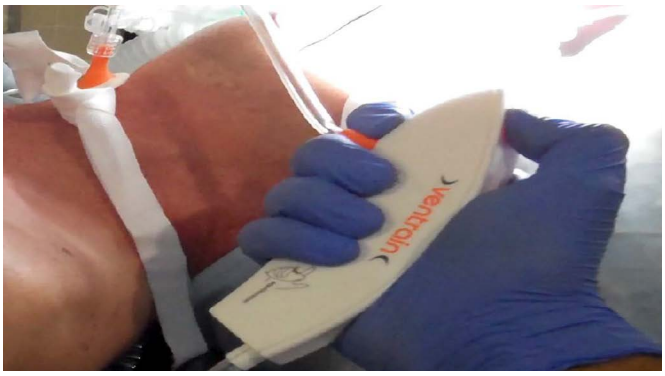

Figure 3: Ventilation using the Ventrain® device.

is a single use ventilation device capable of delivering low airway pressure ventilation via a 2 mm internal diameter catheter in patients with upper airway obstruction [2]. Expiratory Ventilation Assistance (EVA) actively removes gas from the lungs during the expiratory phase by utilising the sub atmospheric pressure created within the device. Minute ventilation is dependent upon the flow rate of the driving gas used and intrinsic properties of the lung and airways being ventilated but minute ventilations in excess of 7.01 /min are achievable in healthy lungs with a driving gas flow rate of 15 L/min. Entrainment of gas in this way also facilitates measurement of capnometry [3]. Manikin studies comparing this device with other available transcricoid devices have shown favourable results in terms of time taken to achieve oxygenation [4]. In a clinical setting we have found this device simple and easy to use and it provided perfectly adequate ventilation in this 56 kg gentleman for over one hour. In our experience in other patient's we have found the Cricath® cannula to be kink resistant.

The Ventrain® device now forms part of our difficult airway trolley and it is our go to device when traditional jet ventilation proves impossible due to upper airway obstruction. It is also our first choice device when emergency needle cricothyroidotomy is performed for a can't intubate, can't ventilate scenarios.

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