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CLINICAL REPORT

Management of a tumor in the distal trachea while maintaining spontaneous ventilation

Roger Marks · Leigh Tanner · Brett Wenleder

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Abstract A 50-year-old man with carcinoma of the trachea presented for debulking. Due to the distal location of the tumor, a tracheostomy was not feasible. We were asked to provide general anesthesia but to maintain spontaneous ventilation. Sedation was provided with dexmedetomidine 0.7 μg/kg per hour. Following induction with ketamine 2 mg/kg, the trachea was sprayed with 5 ml of 4% lidocaine and, with assistance from the surgeon, a Cook™ Airway Exchange catheter was placed with the distal end just beyond the tumor. We then connected the proximal end to a manual jet ventilator to provide oxygen supplementation and, if necessary, positive-pressure ventilation. Subsequently, the surgeons were able to completely debulk the tumor and examine the airway down to the carina. Spontaneous ventilation was maintained throughout the case, with additional boluses of ketamine as necessary. The patient woke up after the procedure and had no delirium, nightmares, or recall. Dexmedetomidine worked synergistically with ketamine by preventing hypertension, hypersecretion, and postoperative delirium that is often seen when using ketamine alone. The successful use of ketamine and dexmedetomidine in this case demonstrates that this method may be applicable to other clinical situations where deep sedation and maintenance of spontaneous ventilation is required.

Keywords Dexmedetomidine · Ketamine · Delirium · Tracheal tumors · Jet ventilator

R. Marks (✉) · L. Tanner · B. Wenleder
The Department of Anesthesia, Miller School of Medicine, University of Miami, 1611 NW 12 Avenue, Room C301, Miami, FL 33136, USA
e-mail: rmarks@med.miami.edu

Introduction

We present the case of a patient with a tumor in the distal trachea located just 1–2 cm above the carina where tracheostomy was not an option. The patient was not a candidate for a tracheal resection, and therefore the surgical plan was to perform tumor debulking. The surgeons asked us to provide general anesthesia while maintaining spontaneous ventilation. We chose a method combining dexmedetomidine with ketamine that has been used previously to perform awake fiberoptic intubation [1] and report here its use to provide deep general anesthesia for surgery of the lower airway while maintaining spontaneous ventilation.

Case report

A 50-year-old man, American Society of Anesthesiologists (ASA) III, with recurrent carcinoma of the trachea just above the bifurcation at the T2 level presented for debulking. In addition to the tumor, his medical history was positive for hepatitis C, for which he had a liver transplant 9 years earlier, and insulin-dependent diabetes mellitus since transplant. He suffered from congenital deafness but was proficient at reading lips. He had also undergone previous surgery for hip replacement. Two years earlier, he was diagnosed with cancer of the tonsils and underwent a tonsillectomy. Since then, he has had radiation therapy and multiple procedures for evaluation of local recurrence in the trachea. He had no previous anesthesia complications and was living and active lifestyle without limitations and was only complaining of a worsening cough and dysphagia. He was taking regular medications to prevent tumor rejection and osteoporosis, antibiotic/fungal prophylaxis, and insulin. On physical examination, he was 172 cm tall

and weighed 72 kg, awake and oriented, without any respiratory distress, with a heart rate of 58/min and blood pressure of 130/90 mmHg. His oxygen saturation on room air was 98%, and his airway looked normal with a Mallampati of 1. His lungs were clear to auscultation bilaterally, and his heart sounds were normal. His electrocardiogram (ECG) showed normal sinus rhythm. His labs were unremarkable and within normal limits except for a fasting blood glucose of 150 mg/dl. His chest X-ray was unremarkable. Computed tomography showed a lesion in the trachea at the T2 level measuring 1.5 × 1.2 cm in the anteroposterior (AP) and transverse axis positions and extending craniocaudal for 1.6 cm. There was no evidence of tumor infiltration outside the trachea, but a 60% reduction in the diameter of the trachea at this level was noted due to secondary narrowing.

The patient was not considered a candidate for tracheal resection. The purpose of the procedure was to provide palliative tumor debulking. Due to the distal location of the tumor, however, a tracheostomy was not feasible. We were asked by the surgeons to provide general anesthesia but to maintain spontaneous ventilation in order to prevent any further decrease in airway patency. This risk for airway compromise was deemed significant, and therefore, a cardiothoracic surgeon was in the room and a bypass team was on standby. Sedation was provided with midazolam 1 mg, and we then started dexmedetomidine 0.7 μg/kg per hour. Following induction with ketamine 2 mg/kg, direct laryngoscopy was performed and the trachea was sprayed with 5 ml of 4% lidocaine. Under vision, and with assistance from the surgeon, a Cook™ Airway Exchange catheter was placed through the lumen of the trachea, just beyond the tumor. We then connected the proximal end to a manual jet ventilator to provide oxygen supplementation and, if necessary, positive-pressure ventilation. We were also able to connect intermittently to the gas analyzer to monitor end-tidal carbon dioxide (CO_2) (although having an arterial line would have been better). Subsequently, the surgeons placed a rigid bronchoscope and were able to completely debulk the tumor and examine the rest of the airway all the way down below the carina (Figs. 1, 2, 3). Spontaneous ventilation was maintained throughout the surgery, which lasted for over an hour, and additional boluses of ketamine (to a total of 200 mg) were given whenever the patient began to move of started to cough. The patient woke up after the procedure and had no incidence of delirium, nightmares, or recall.

Discussion

Maintaining spontaneous ventilation during anesthesia is difficult because most pharmacologic agents cause reduced

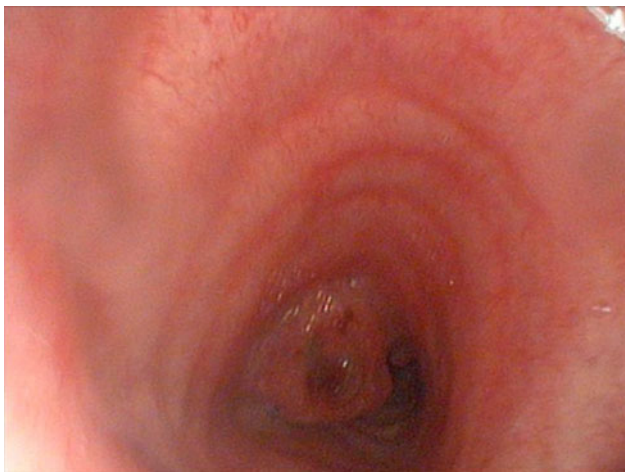

Fig. 1 Endoscopic view of tumor

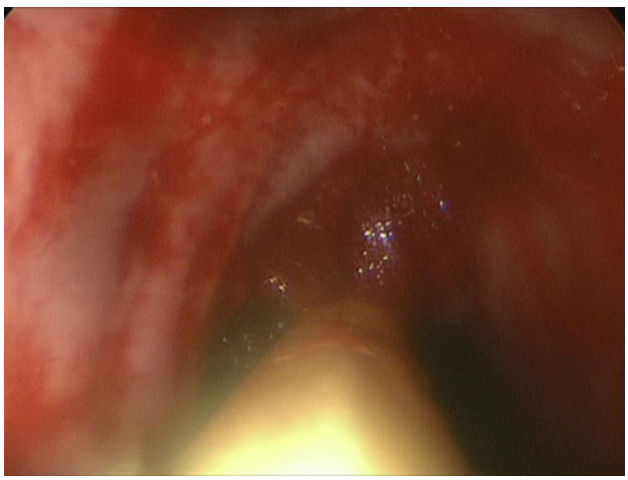

Fig. 2 Exchange catheter placed beyond tumor

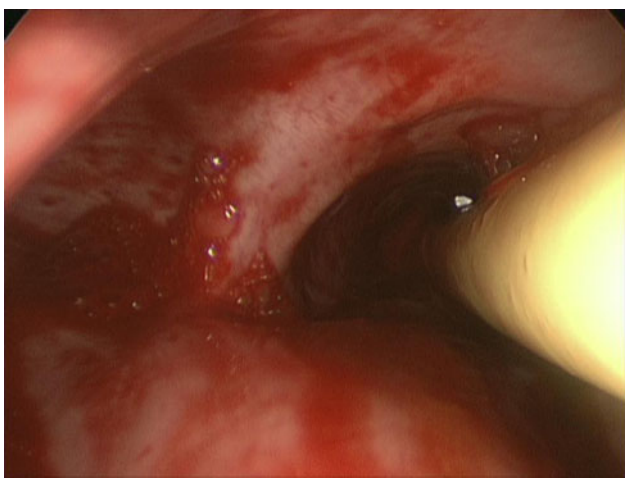

Fig. 3 Tracheal bifurcation with exchange catheter just entering right mainstem bronchus

ventilation in a dose-dependent manner. Whereas volatile anesthetics can be used to maintain spontaneous ventilation, their use is problematic during open procedures of the airway in which the providers, both anesthetist and surgeon, get exposed to the gas. Other methods of total intravenous anesthesia (TIVA) with propofol or propofol with remifentanil would most probably have caused significant hypoventilation at the levels necessary for prolonged instrumentation of the airway. We therefore chose a method of TIVA that would permit "anesthetic" levels of sedation without compromising spontaneous ventilation or airway reflexes. The combination of dexmedetomidine and low-dose ketamine has been used to provide conscious sedation for awake fiberoptic intubation [1]. Dexmedetomidine and high-dose ketamine together with muscle relaxants has also been used for general anesthesia [2]. However, we believe this is the first report of its use to provide deep general anesthesia for surgery of the lower airway while maintaining spontaneous ventilation. Ketamine, developed in the early 1960s, is classified as an *N*-methyl-D-aspartic acid (NMDA) receptor antagonist that at high doses induces a state referred to as dissociative anesthesia [3]. Ketamine is unique because it is the only agent that produces anesthesia without causing a dose-dependent decrease in ventilation. It has been used extensively for emergency surgery in field conditions as early as the Vietnam War and as recently as the Haiti earthquake [4]. Nevertheless, its routine use is limited due to a number of significant side effects, mainly psychological, including hallucinations and postoperative delirium [5]. It usually stimulates the circulatory system, causing an increase in heart rate and blood pressure, and for this reason, it is sometimes used in anesthesia for emergency surgery when the patient's fluid volume status is unknown (e.g., from traffic accidents). Ketamine also increases salivary secretions, which can produce potential problems, especially in children, by causing upper airway obstruction [6]. The use of benzodiazepines has been widely shown to attenuate the psychological effects of ketamine [7–9]. Interestingly, the lesser-known alpha-2 receptor agonist, dexmedetomidine, has also been shown to be equal or even superior to midazolam in preventing the psychotropic effects of ketamine [2, 10]. Dexmedetomidine has two other very important advantages for its concomitant use with ketamine: it usually reduces the heart rate and blood pressure and is also an antisialogogue. These effects are particularly relevant to the case we present here: any increase in tracheal secretions would have made the surgery much more difficult, and by preventing the increase in blood pressure, we were able to avoid increasing the risk for intraoperative bleeding. Dexmedetomidine and ketamine both have unique attributes that supplement and complement each other, and their successful use in this case demonstrates that this method may be applicable to a much larger patient population in whom deep sedation and maintenance of spontaneous ventilation is required.

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