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Case Report Open Access

Safe Anesthesia Induction in Patients with Anterior Mediastinal Mass Using Muscle Paralysis

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Abstract

Available reports suggest that an anterior mediastinal mass causing more than 50% narrowing of the trachea and compressing the great vessels can cause further narrowing of the airway and cardiovascular collapse after the administration of muscle relaxants. Accordingly, inhalation induction of general anesthesia or awake intubation is used to avoid the use of muscle relaxation.

The following two case reports describe the stepwise safe anesthetic induction of two patients with anterior mediastinal masses using total intravenous anesthesia followed by tailored positive pressure ventilation and administration of muscle relaxant.

Case 1

A 68-year-old female with recurrent large B-cell lymphoma after multiple rounds of chemotherapy and palliative radiation. The patient developed progressive shortness of breath over a 3-month period. The patient also complained of a choking sensation, hoarseness, dysphagia, and orthopnea along with increasing neck size [1-4].

Computed tomography showed a large anterior mediastinal mass measuring 9.3 cm. The mass encased the great vessels and the aortic arch, narrowing the tracheal luminal diameter to 7 mm (Figures 1a and 1b). The patient was scheduled for a rigid bronchoscopy for placement of tracheal stent.

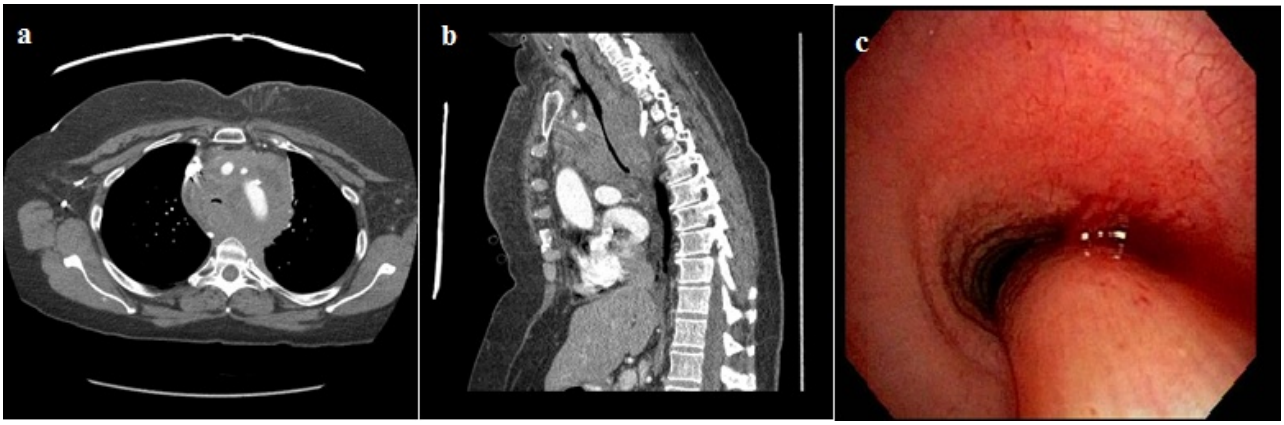

Figure 1: a) Case 1: Axial view, b) Case 1: Sagittal view, c) Case 1: Bronchoscopic view.

Preoperative assessment revealed hoarseness, audible stridor and palpable supraclavicular mass with engorgement of superficial neck veins. Pre-procedure vital signs were heart rate 116, blood pressure 109/59, respiratory rate 16, and saturation 97% on 5 L nasal cannula.

Electrocardiogram showed sinus tachycardia. Pre-procedure echocardiogram showed mild concentric left ventricular hypertrophy, an ejection fraction of 45-50%, and mild global hypokinesis of the left ventricle. Consent for general anesthesia was obtained.

Anesthesia

The patient was taken to the bronchoscopy suite and was placed in a sitting position. Preoxygenation with non-rebreather facemask was started under standard American Society of Anesthesiologists monitoring. Additionally, a Bispectral index (BIS) and non-invasive arterial blood pressure monitoring were utilized. Propofol infusion at 250 μg/kg/min, and 50 μg of fentanyl were given. As the BIS reading dropped to the 60s positive pressure ventilation was initiated with tidal volume in the range of 500s ml with a peak airway pressure of 20 cm

H_2O and I:E ratio of 1:4 in order to avoid air trapping. As the vital signs and saturation remained stable, the patient was gradually lowered to a supine position and the stability of the vital signs and ventilation were reassessed and deemed stable before 120 mg of succinylcholine was given intravenously. Ventilation and hemodynamics were unchanged after muscle paralysis, an 11.2 mm rigid bronchoscope was inserted without difficulty and jet ventilation commenced. Airway examination showed that the positive pressure generated by jet ventilation was associated with increase in the diameter of the airway and adequate chest rise. However, during the expiratory phase the airway diameter decreased to the narrowed baseline. As a result, we elected to increase the expiratory time relatively to allow for adequate exhalation. Neuromuscular relaxation was maintained during the procedure using 5 mg of Cisatracurium. Bronchoscopic airway inspection revealed 70 to 80% obstruction of the trachea and main carina, 10% obstruction of the proximal right mainstem bronchus while the left mainstem was 60% obstructed (Figure 1c). Balloon dilatation was carried out in the trachea using the Boston Scientific CRE balloon dilator. The patient was then extubated and re-intubated using a 13.2 mm rigid bronchoscope through which a silicone Y Stent was deployed (Figures 2a-2c). The rigid bronchoscope was then removed and a laryngeal mask airway (LMA) was placed. The muscle relaxation was reversed and the patient was extubated. The patient's dyspnea and stridor resolved immediately after the procedure.

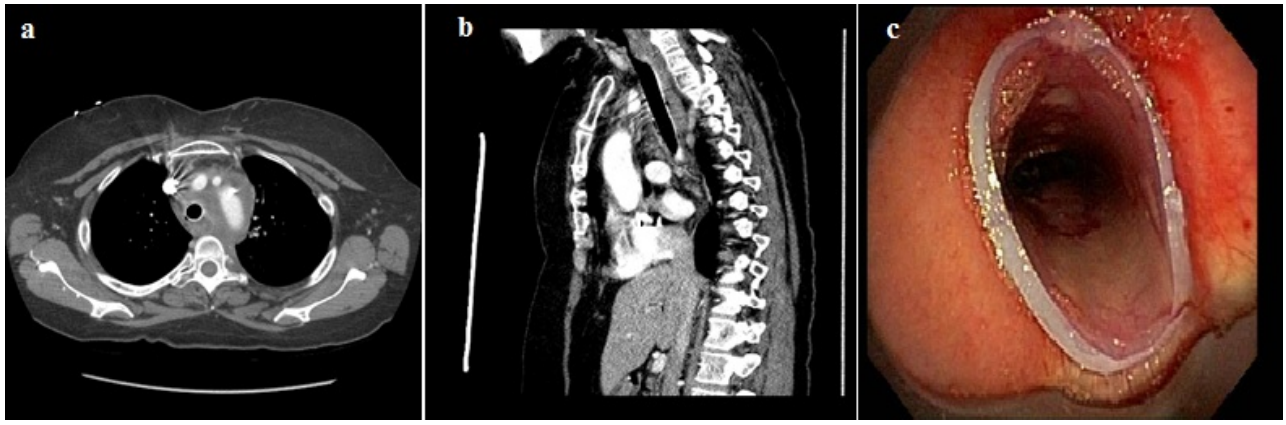

Figure 2: a) Case 1: Post stenting Axial View Post stenting, b) Case 1: Post stenting Saggital view, c) Case 1: Post stenting Bronchoscopic view

Case 2

A 74-year-old male with advanced poorly differentiated squamous cell carcinoma of the esophagus presented for acute worsening of shortness of breath shortly after an upper endoscopy. The patient complained of retrosternal chest discomfort and was noted to have wheezing and stridor. CT scan of the chest revealed a large mediastinal mass, suggestive of a mediastinal abscess. The tracheal lumen was narrowed by approximately 80%. There were bilateral pleural effusions as well as a mild to moderate pericardial effusion (Figures 3a and 3b).

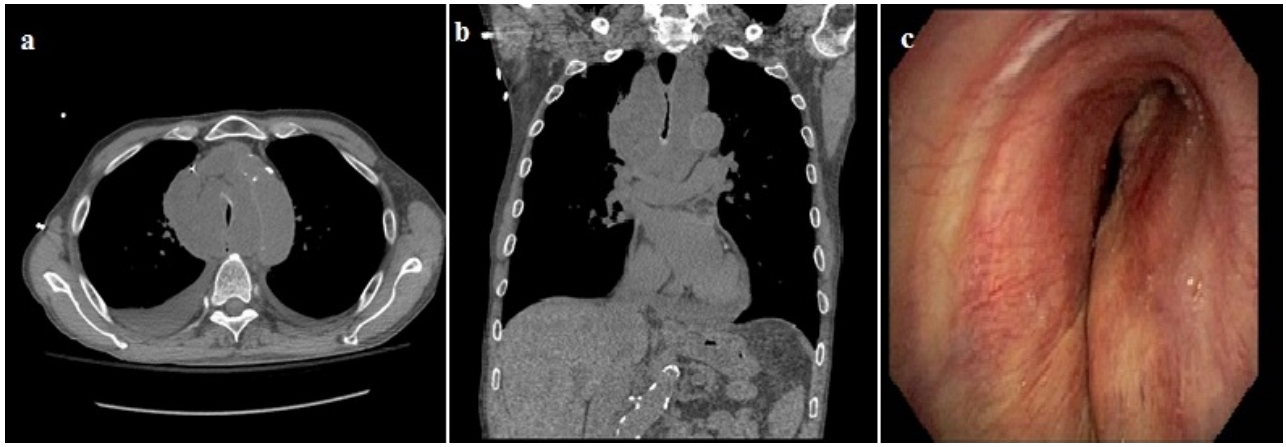

Figure 3: a) Case 2: Axial view, b) Case 2: Coronal view, c) Case 2: Bronchoscopic view.

Preoperative assessment showed stridor, audible wheezing and engorged neck veins. Pre-procedure vital signs were heart rate 150, respiratory rate 30, blood pressure 108/68, and saturation 94% on non-rebreather facemask. Electrocardiogram showed atrial fibrillation with rate of 149. Pre-procedure echocardiography was normal with ejection fraction of 55-60% and a small pericardial effusion. Consent for general anesthesia was obtained.

Anesthesia

The patient was positioned, monitored and pre-oxygenated in a similar manner to case 1. Anesthesia was induced with a propofol infusion at the rate of 200 µg/kg/minute. Bag-mask ventilation was difficult due to the inability to create an adequate mask seal. As a result, a LMA was inserted. Positive pressure ventilation through the LMA was adequate with tidal volumes of 500-800 cc at a peak airway pressure of 18 cm H_2O and I:E ratio of 1:4. The patient was gradually lowered to a recumbent position and adequate ventilation and hemodynamics were confirmed. Airway examination showed 80% obstruction of the trachea (Figure 3c) with increase in the diameter of the airway with positive pressure ventilation and subsequent return of the airway diameter to the narrowed baseline during the expiratory phase. The patient hemodynamics and ventilation remained stable before 6 mg of cisatracurium was administered. The LMA was removed and the patient was intubated without difficulty using a 12 mm diameter rigid bronchoscope and Jet ventilation was initiated. The trachea was dilated using the barrel of the rigid bronchoscope and a self-expandable hybrid metal stent was deployed into the lower trachea (AeroTM airway stent system 18 × 60 mm) (Figures 4a-4c). The rigid bronchoscope was then removed and a LMA was placed. The muscle relaxation was subsequently reversed and the patient was extubated. Post procedure the patient reported marked improvement in his dyspnea.

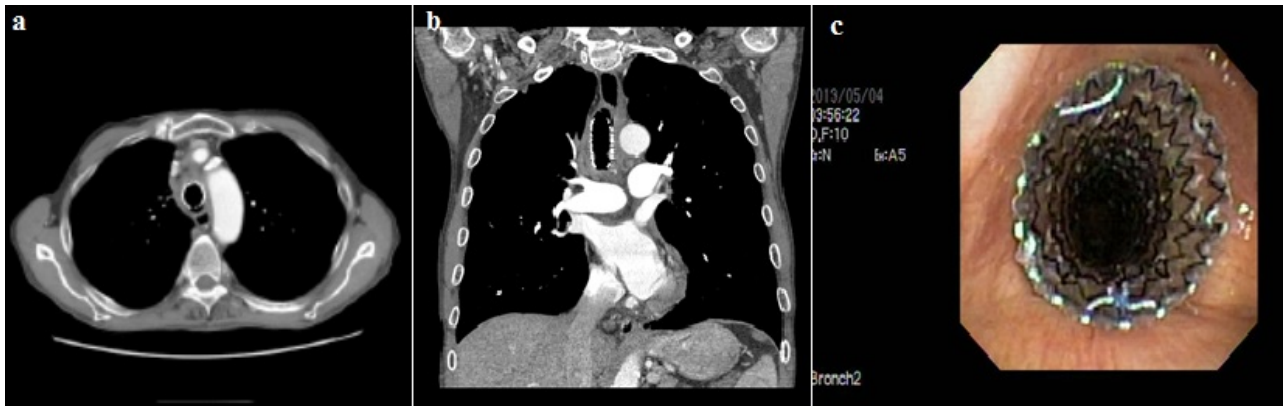

Figure 4: a) Case 2: Post stenting Axial view, b) Case 2: Post stenting Coronal view stent, c) Post stenting Bronchoscopic view.

Discussion

These two cases illustrate that safe use of total intravenous anesthesia, including the judicious use of muscle relaxants, in patients with mediastinal masses compressing the tracheobronchial tree is possible. Key elements are, adequate preoperative understanding of the obstructive physiology in question. Careful planning and appropriate safety precautions including the availability of rigid bronchoscopy and advanced airway management if needed is mandatory. Ensuring the patient is in the sitting position and adequately pre-oxygenated prior to anesthesia induction adds a margin of safety. As the patient is gradually sedated, stepwise reduction in the angle of inclination while reassessing the adequacy of positive pressure ventilation permits better control of a fluid clinical situation. If bag mask ventilation proves to be difficult at any point, insertion of an LMA should be attempted and the adequacy of positive pressure ventilation should be assessed. Increasing the expiratory time to avoid air trapping distal to the obstruction should be considered. Unrecognized air trapping with consequent hyperinflation and increase in intrathoracic pressure could lead to cardiovascular collapse secondary to impaired venous return. Once ventilation adequacy and stable vital signs are established with tailored positive pressure ventilation parameters, a muscle relaxant can be administered safely and positive pressure ventilation can be maintained at the same ventilator settings. With adequate neuromuscular blockade in place, the insertion of a rigid bronchoscope becomes easier and provides an added safety measure, as it is able to stent the airway open beyond the obstruction eliminating any air trapping.

Difficulty with bag mask ventilation in patients with anterior mediastinal mass is generally attributed to the narrowing of the airway, however in our experience particularly with patients with extrinsic airway compression, this is not the case. Under direct bronchoscopic vision, the airway diameter is noted to enlarge when positive pressure ventilation is administered. The airway diameter is even larger when positive pressure is given in a paralyzed patient as muscle relaxation enhances airway and lung expansion. This suggests that at least some of the difficulties reported in bag mask ventilation of these patients may be due to air trapping and consequent hyperinflation. It is also important to note that our back up plan in both cases was to insert the rigid bronchoscope under local anesthesia if difficulty in ventilation or hemodynamic instability were encountered during induction [5,6]. Additionally, pediatric patients are known to have more collapsible airway than adults and the aforementioned technique was not examined in the pediatric population [7,8]. The anesthesia technique described in this case report was utilized in cases where airway stenting was planned and should not be inferred to other procedures such as mass biopsy or central line placements where a rigid bronchoscope and airway stent are not available [9,10].

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