
Biting the laryngeal mask : an unusual cause of negative pressure pulmonary edema

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Purpose: To describe negative pressure pulmonary edema due to biting of the laryngeal mask tube at emergence from general anesthesia.

Clinical features: A healthy patient underwent general anesthesia using a laryngeal mask airway and mechanical ventilation. During recovery, the patient strongly bit the laryngeal mask and made very forceful inspiratory efforts until the mask was removed. Five minutes later, the patient developed dyspnea and had an hemoptysis of 50 ml fresh blood. Chest radiograph showed bilateral alveolar infiltrates. Pharyngo-laryngeal examination was normal. Bronchoscopy revealed no injury but diffuse pink frothy edema fluid. Clinical examination and chest radiograph became normal after 12 hr of nasal oxygen therapy confirming airway obstruction as the most available cause of this pulmonary edema.

Conclusion: Airway obstruction due to biting of a laryngeal mask tube may result in negative pressure pulmonary edema.

Objectif : Décrire un œdème pulmonaire à pression négative causé par la morsure du tube du masque laryngé (ML) au réveil de l'anesthésie générale.

Éléments cliniques : Un patient en santé a subi une anesthésie générale avec ML et ventilation artificielle. Pendant la récupération, il a fortement mordu le ML et a énergiquement tenté d'inspirer jusqu'au retrait du masque. Cinq minutes plus tard, il a développé une dyspnée et a présenté une hémoptysie de 50 ml de sang frais. La radiographie pulmonaire a montré des infiltrats alvéolaires bilatéraux. L'examen pharyngo-laryngé était normal. La bronchoscopie n'a révélé aucune lésion, mais des sérosités diffuses, rosées et spumeuses. L'examen clinique et la radiographie pulmonaire étaient normaux après 12 h d'oxygénothérapie nasale, confirmant ainsi l'obstruction des voies aériennes comme cause la plus probable de cet œdème pulmonaire.

Conclusion : L'obstruction des voies aériennes causée par une morsure du tube du masque laryngé peut causer un œdème pulmonaire à pression négative.

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BITING a laryngeal mask airway is a common and usually uncomplicated event at emergence from general anesthesia.¹ We report the case of a healthy adult patient who developed pulmonary edema following upper airway obstruction related to the biting of a laryngeal mask tube. We discuss the importance of placing a bite block when a laryngeal mask is used during general anesthesia and the benefit of measuring the concentration of protein in edema fluid to identify the mechanism of negative pressure pulmonary edema.

Case report

A 19-yr-old male patient, physical status ASA 1 (weight 66 kg, height 1.76 m), scheduled for surgery to a cutaneous nevus was deeply anesthetized with 2 $\mu\text{g}\cdot\text{kg}^{-1}$ fentanyl and 3 $\text{mg}\cdot\text{kg}^{-1}$ propofol to allow insertion of a size-4 laryngeal mask. No bite block was used. General anesthesia was maintained with isoflurane and a $\text{N}_2\text{O}/\text{O}_2$ mixture with mechanical ventilation. The duration of surgery was 45 min and 500 ml Ringer's Lactate were infused. The patient was transferred to the recovery room at the conclusion of surgery breathing spontaneously with supplemental oxygen (6 $\text{l}\cdot\text{min}^{-1}$) via a T-piece connected to the laryngeal mask. In the recovery room, the patient began to swallow, cough, and vigorously bite the laryngeal mask tube. He then started to make very forceful inspiratory efforts. The arterial haemoglobin oxygen saturation (SpO_2) decreased to 50% before successful removal of the laryngeal mask. Thereafter, the patient breathed normally and the SpO_2 recovered to 98% with 10 $\text{l}\cdot\text{min}^{-1}$ of oxygen via a face mask. Cardiac and pulmonary auscultation were normal. Five minutes after removal of the mask, the patient developed moderate dyspnea and had an hemoptysis of 50 ml fresh blood. Upon auscultation of the chest, crackles were heard in both lung fields. Chest radiograph (Figure) showed diffuse bilateral pulmonary edema. The arterial blood sample showed: pH 7.36, PaO_2 59 mmHg, PaCO_2 46 mmHg, SaO_2 89% with FiO_2 0.21. The oropharyngolaryngeal examination revealed no oropharyngolaryngeal injury, but the presence of blood beyond the vocal cords. Fiberoptic bronchoscopy performed under local anesthesia showed no tracheo-bronchial injury but diffuse bilateral pink frothy edema fluid. Also, bronchoscopy showed no evidence of gastric contents in the airways. Cardiac auscultation, electrocardiogram and cardiac enzymes were normal. The patient was transferred to the intensive care unit with nasal oxygen. Neither diuretics neither non-invasive mechanical ventilation were used. After 24 hr, he was discharged from ICU

to the surgical ward. Vital signs, temperature, clinical examination, chest radiograph and arterial blood gases were normal.

Discussion

With the use of a laryngeal mask airway, emergence from general anesthesia can be associated with complications.¹ Airway obstruction is common whatever the time of removal of the laryngeal mask, whether the patient be awake or still anesthetised.¹ Airway obstruction may be due to laryngospasm, poor positioning of the device, or biting the tube of the laryngeal mask. In this report, laryngospasm may have been the cause of airway obstruction, but the complete resolution of inspiratory effort after mask removal argues against this explanation. Moreover, physical examination did not show any residual stridor. These findings suggest that biting down on the tube of laryngeal mask was the most likely cause of airway obstruction. Biting down on the tube of laryngeal mask is common and is not usually a serious adverse event.¹ However, Brain² has recommended the use of a bite block whenever a laryngeal mask airway is used. This report shows the importance of placing a bite block during general anesthesia using a laryngeal mask and of leaving it in place until removal of the laryngeal mask to prevent obstruction of the tube.

This is the first case report of negative pressure pulmonary edema associated with biting of a laryngeal mask tube. Some cases of pulmonary edema associated with the laryngeal mask have been reported, but were related to insertion difficulties³ or to laryngospasm during anesthesia.⁴ Pulmonary edema related to upper airway obstruction is well described in children and



FIGURE Chest radiograph obtained immediately following development of hypoxemia and bilateral rales. The radiograph shows diffuse bilateral alveolar infiltrates.

adults⁵ and is related to the large transpulmonary pressure gradients generated when trying to breathe against an obstructed airway. The very high negative intrapleural pressure provides high negative hydrostatic pressure in the pulmonary interstitium and increases venous return to the right heart and hydrostatic pressure in the pulmonary microvasculature favouring formation of pulmonary edema. In this case, pulmonary edema was clearly related to airway obstruction. Moreover, in this young healthy patient, cardiac function was normal and there was no sign of oropharyngo-laryngo-bronchial injury or of aspiration of gastric contents. A recent publication indicates that this type of pulmonary edema has a hydrostatic etiology without increased alveolo-capillary membrane permeability.⁶ The authors measured the ratio of total protein concentration between pulmonary edema fluid and plasma which is an established, accurate method for distinguishing hydrostatic from increased permeability pulmonary edema.⁶ A ratio of less than 0.65 is characteristic of hydrostatic pulmonary edema, whereas patients with increased-permeability pulmonary edema, as seen in acute lung injury, have a ratio between 0.75 and 1.0.⁶ In this case, the mechanism of negative pressure pulmonary edema remains uncertain: the appearance of fresh blood suggests local disruption of alveolo-capillary membrane but the blood became ultimately frothy, possibly indicating another cause of the pulmonary edema as secondary hydrostatic or increased permeability. Unfortunately, the protein concentration of the edema fluid was not measured in this patient. Appearance of fresh blood may also be due to tracheo-bronchial vessels injury as described by Bhavani-Shankar *et al.*⁴ but such lesions were not found during bronchoscopy.

Conclusion

Partial or complete airway obstruction due to biting of laryngeal mask is a common and usually uncomplicated event. However, airway obstruction due to biting of a laryngeal mask tube may result in negative pressure pulmonary edema.

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