

The laryngeal mask airway prevents supraglottic leak during ventilation through an uncuffed cricothyroidotomy

[Le masque laryngé prévient les fuites supraglottiques durant la ventilation via une cricothyrotomie sans ballonnet]

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Purpose: A 'cannot intubate-cannot ventilate' situation requires emergency insertion of an infraglottic surgical airway. We present a case of postoperative macroglossia requiring emergency insertion of an uncuffed percutaneous cricothyroidotomy tube. The supraglottic leak was eliminated by the insertion of a laryngeal mask airway with an occluded 15-mm connector.

Clinical features: A 49-yr-old man underwent clipping of a left posterior inferior cerebellar artery aneurysm and his tracheal tube was removed postoperatively. Two hours later, he became dyspneic and developed significant macroglossia. After application of topical anesthesia, direct laryngoscopy, oral fiberoptic bronchoscopy and laryngeal mask insertion were unsuccessful. The patient became progressively hypoxemic, pulseless electrical activity ensued, and cardiopulmonary resuscitation was initiated. An uncuffed percutaneous cricothyroidotomy tube was inserted. Oxygenation and hemodynamics were restored. As the cricothyroidotomy tube was uncuffed, there was a large supraglottic leak with manual ventilation. A laryngeal mask airway was inserted and the cuff was inflated. The 15-mm connector was occluded by a piece of tape. Subsequently, there was no further supraglottic leak with manual ventilation. He was taken to operating room and a surgical tracheotomy was performed.

Conclusion: In a patient with postoperative macroglossia in a 'cannot intubate-cannot ventilate' situation, effective oxygenation was restored by insertion of an uncuffed cricothyroidotomy, but ventilation was affected by a substantial supraglottic leak. A new strategy using an inflated laryngeal mask airway with an occluded connector was utilized to successfully terminate the supraglottic leak, thereby restoring effective lung ventilation.

Objectif : Dans les cas où l'intubation et la ventilation sont impossibles (« cannot intubate – cannot ventilate »), l'accès urgent aux voies aériennes est pratiqué de façon chirurgicale au niveau infraglottique. Nous présentons un cas de macroglossie postopératoire ayant nécessité l'insertion percutanée et urgente d'un tube de cricothyrotomie sans ballonnet. La fuite supraglottique a été éliminée grâce à l'insertion d'un masque laryngé muni d'un connecteur de 15 mm bouché.

Éléments cliniques : Un homme de 49 ans a subi une ligature d'un anévrisme de l'artère cérébelleuse inféro-postérieure gauche et a été extubé à la fin de l'opération. Deux heures plus tard, il est devenu dyspnéique et a développé une macroglossie importante. Après application d'anesthésie topique, la laryngoscopie directe, la bronchoscopie flexible par voie orale et l'insertion d'un masque laryngé ont échoué. Le patient est progressivement devenu hypoxémique, entraînant dissociation électro-mécanique nécessitant les manœuvres de réanimation cardio-pulmonaire. Un tube de cricothyrotomie percutané sans ballonnet a été inséré. L'oxygénation et l'hémodynamie ont été rétablies. Comme le tube de cricothyrotomie ne comportait pas de ballonnet, il y a eu une fuite supraglottique importante durant la ventilation manuelle. Un masque laryngé a été inséré et son ballonnet gonflé. Le connecteur de 15 mm a été bouché par un morceau de ruban adhésif. Par la suite, il n'y a plus eu de fuite supraglottique lors de la ventilation manuelle. Le patient a été emmené au bloc opératoire où une trachéotomie chirurgicale a été effectuée.

Conclusion : Chez un patient avec une macroglossie postopératoire, dans une situation où l'intubation et la ventilation sont impossibles, l'oxygénation a été rétablie de façon efficace grâce à l'insertion d'une cricothyrotomie sans ballonnet ; toutefois, une fuite supraglottique substantielle a gêné la ventilation. Une nouvelle stratégie comportant un masque laryngé gonflé et un connecteur bouché a permis de colmater la fuite supraglottique avec succès, restaurant ainsi la ventilation pulmonaire adéquate.

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CANNOT intubate-cannot ventilate (CICV) situations are life threatening.^{1,2} Hypoxic brain damage and death can ensue unless successful corrective measures are undertaken rapidly. The incidence of CICV requiring emergency invasive infraglottic airway insertion is approximately 0.01 to 2 in 10,000 patients.^{2,3} Anesthesiologists need to be fully prepared to insert an invasive infraglottic airway in this rare but emergent situation. After obtaining informed consent, we report a patient who developed a CICV situation postoperatively where his airway was secured with simultaneous intervention with percutaneous dilatational cricothyroidotomy and a laryngeal mask airway.

Case report

A 49-yr-old, 93-kg, 183-cm male, presented with a history of headache for two days. His level of consciousness deteriorated and his Glasgow coma scale was 8 on arrival to the emergency room. A brain computed tomography scan showed a subarachnoid hemorrhage and cerebral angiography revealed a left posterior inferior cerebellar artery aneurysm.

The next day, the patient underwent clipping of the aneurysm under general anesthesia in the prone position. Tracheal tube insertion was uneventful. The head was positioned in a Sugita frame and a bite block was placed between his teeth. The surgery lasted 11 hr. The estimated blood loss was 200 mL. The endotracheal tube was removed in the operating room, and he was transferred to the neurosurgical intensive care unit (ICU) with a Glasgow coma scale of 15.

Two hours postoperatively, the patient became dyspneic. His SpO₂ decreased to 94% and respiratory rate was 30 min⁻¹. Anesthesiology was urgently consulted. At this time, macroglossia with tongue protrusion beyond the lips was observed with no associated lip or facial swelling. The oral-pharyngeal mucosa was topicalized by blindly inserting a 1% lidocaine spray nozzle into the oral cavity. Direct laryngoscopy with a #3 MacIntosh blade was unsuccessful. Oral fiberoptic bronchoscopy was attempted with no visualization of the epiglottis or larynx, and insertion of a size 4 laryngeal mask airway was unsuccessful. While attempting nasal fiberoptic bronchoscopy, the patient's SpO₂ decreased to 50%, pulseless electrical activity ensued and cardiopulmonary resuscitation was initiated. As there were no experienced surgeons in the ICU, the anesthesiologist proceeded to insert a percutaneous dilatational cricothyroidotomy (C-TCCS-600; Cook Inc., Bloomington, IN, USA) with a 6-mm internal diameter uncuffed tube. One minute following cricothyroidotomy insertion and manual ventilation, SpO₂

increased to 92% and the patient regained a systolic blood pressure of 120. Cardiopulmonary resuscitation was terminated and the total duration of cardiopulmonary resuscitation was five minutes. Arterial blood gas showed pH 7.38, PCO₂ 51 mmHg, PO₂ 108 mmHg.

As the cricothyroidotomy tube was uncuffed, there was a large supraglottic leak with manual ventilation. In an attempt to eliminate the supraglottic leak, a size 4 laryngeal mask airway was inserted into the oral pharynx and the cuff was inflated with 20 mL of air. The 15-mm connector of the laryngeal mask airway was occluded by a piece of tape. Subsequently, there was no further supraglottic leak with manual ventilation. He was taken to the operating room and a surgical tracheotomy was performed.

The patient's neurologic status improved. The tracheostomy was subsequently downsized and was removed 35 days postoperatively. While in hospital, he was assessed by an allergist. A diagnosis of postoperative tongue angiodema was made. However, latex and penicillin skin testing, and the workup for CI esterase inhibitor, were negative.

Discussion

In 1991, the incidence of CICV was estimated to be 0.01 to 2 per 10,000 patient cases.²⁻⁴ The laryngeal mask airway has since been shown to be mostly effective in providing rescue ventilation in the majority of CICV situations.^{4,5} Currently, the incidence of CICV requiring emergency invasive infraglottic airway insertion may be lower than 2 in 10,000 patients.²⁻⁴ According to the latest ASA practice guidelines for management of the difficult airway⁶ and the Difficult Airway Society guidelines⁷ for management of the unanticipated difficult intubation, in a cannot intubate, face mask ventilation-inadequate situation, insertion of laryngeal mask airway is the recommended step.⁵ If a laryngeal mask airway does not restore ventilation/oxygenation, a CICV pathway is considered.^{3,6-8} The next step should be the utilization of a *non-invasive* airway including a rigid bronchoscope or Combitube®. If non-invasive airway ventilation is unsuccessful, the recommended step is the insertion of an *invasive* airway device including percutaneous or surgical cricothyroidotomy or tracheostomy.⁶⁻⁹ In our patient, after unsuccessful attempts to insert a fiberoptic bronchoscopy and a laryngeal mask airway, he developed progressive hypoxemia and was in a CICV situation. A rigid bronchoscope was not available and the managing physicians had no experience with the Combitube®. We followed the ASA difficult airway algorithm and proceeded to insert a percutaneous

cricothyroidotomy.⁶ Once the infraglottic airway was established, ventilation, oxygenation and circulation were restored.

The patient developed significant macroglossia two hours postoperatively resulting in acute upper airway obstruction. The differential diagnosis of acute macroglossia includes trauma, infection, superior vena cava syndrome, venous obstruction, lymphatic obstruction, circulatory overload, anaphylaxis, CI esterase inhibitor deficiency, and post-ischemic hyperemia.¹⁰⁻¹⁴ There was no obvious trauma with tracheal tube insertion, and no infection was identified locally or in blood cultures. Lack of head, lip and generalized edema made superior vena cava syndrome, venous obstruction, and circulatory overload unlikely. Skin testing and immunoassay did not reveal any offending agents or evidence of CI esterase inhibitor deficiency.

We believe the most likely explanation was the occurrence of tongue ischemia during prolonged surgery in the presence of a combination of factors, including the bite block pushing the tongue posteriorly, the presence of the endotracheal tube in a fixed limited oral cavity, and the head fixated in a flexed position with the patient in a prone position.¹⁴ Postoperatively, tongue ischemia was relieved, resulting in post-ischemic reperfusion hyperemia and capillary leak leading to acute tongue edema, macroglossia and upper airway obstruction.¹⁰⁻¹²

Once the percutaneous cricothyroidotomy was successfully inserted, effective ventilation was limited by the presence of a large supraglottic leak with manual ventilation. The management options at that time included accepting the leak, transtracheal jet ventilation via the cricothyroidotomy¹⁵ and use of saline soaked oral-pharyngeal gauze packing to minimize supraglottic leak. A new strategy using an inflated laryngeal mask airway with an occluded connector was utilized to successfully terminate the supraglottic leak, thereby enabling the restoration of effective lung ventilation. The combined use of cricothyroidotomy and a laryngeal mask airway in a CICV situation has not been reported elsewhere. There exist a number of newer supraglottic airway devices such as the Laryngeal Tube®, CobraPLA®, Intubating Laryngeal Airway™, and SLIPA™ which may be utilized to achieve the same goal as the laryngeal mask airway to prevent a supraglottic leak. However, the laryngeal mask airway is currently the most ubiquitous and readily available supraglottic airway, key factors for its utilization in this case. Several of the newer cricothyroidotomy sets also have cuffed cricothyroidotomy tubes, which would most likely have eliminated the supraglottic leak encountered in our patient. However, the con-

ventional uncuffed cricothyroidotomy sets are still utilized by many health care institutions.

In summary, a patient developed acute postoperative macroglossia, upper airway obstruction and an emergent life threatening CICV situation following prolonged surgery in the prone position. Effective oxygenation was restored by insertion of an uncuffed cricothyroidotomy, but ventilation was impaired by a substantial supraglottic leak. A new strategy using an inflated laryngeal mask airway with an occluded connector was utilized to successfully terminate the supraglottic leak, thereby enabling the restoration of effective lung ventilation.

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