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Safe and Easy Emergence from Anesthesia in Adults Following Removal of Laryngeal Mask Airway: Utility of Oral Airway and T-connector

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Removal of the laryngeal mask airway (LMA) can be executed while patients are deeply anesthetized or awake. Recent publications have focused on suitable anesthetic concentrations in the brain for removal of LMA in anesthetized patients. Here, we describe an easy and safe method for removal of LMA during deep anesthesia.

The timing of laryngeal mask airway (LMA) removal after surgery is controversial.[1–11] A greater incidence of airway hyperreactivity and complications have been reported by some studies[3,6,7] when the LMA is removed in the awake state as opposed to the anesthetized state. Recent publications[12–15] on LMA removal in a deeply anesthetized state reported the end-tidal concentration of inhalational anesthetics (ETIA) necessary to achieve successful LMA removal in 50% (ED50) and 95% (ED95) of patients. In these studies, which had similar design, after completion of surgery, the oropharynx was gently cleared with suction before the depth of anesthesia was changed, and then the ETIA was adjusted to the predetermined level and maintained for at least 10 minutes to allow the concentration between the alveoli and brain to come to an equilibrium. Their methods, while able to provide an adequate brain concentration for LMA removal during deep anesthesia, might not be practical. Under clinical conditions, it is not usual to intentionally fix the ETIA for "at least" 10 minutes before LMA removal. In addition,

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the suggested ED95 for LMA removal applies to only 95% of patients, and jaw lift as well as mask ventilation for 5–10 minutes were also required.[12,14,15]

With institutional review board approval, upon the completion of minor plastic (debridement, skin graft) or urologic (cystoscopy, ureteroscopy) surgery (<3 hours) under isoflurane anesthesia, we remove the LMA in deeply anesthetized adults following gentle suction of the oropharynx with the depth of anesthesia unchanged. The LMA is removed while still inflated to facilitate a more complete removal of salivary secretions.[16] Following LMA removal, we routinely place an oral airway to keep the airway patent and check if ventilation is adequate according to three principles: observation (synchronized chest wall movement); audition (clear and loud breath sounds); and feel (feeling a hit of warm airflow during expiration). We do not use nasal airways for fear of epistaxis. Although nasal airways are usually better tolerated by patients than are oral airways when in light plane of anesthesia,[17] placement of oral airways would not cause any obvious airway problems during emergence from isoflurane anesthesia if it is placed in deep plane of anesthesia. In addition, capnography and ETIA obtained by gas-sampling via a T-connector provide more information about airway patency and residual inhalational anesthetics. By using our method, jaw lift and assisted mask ventilation are usually not necessary; instead, a mask is placed over the patient's mouth and nose to supply O_2 and we just simply wait for the patient's recovery. Time to obey the order "open your eyes" following LMA removal is 20–30 minutes. As the LMA is removed when the patient is in surgical plane of anesthesia, there should be no coughing, movements or any other airway complications requiring management.

Apnea or airway obstruction as indicated by a decline on pulse oximetry may be detected only belatedly if there is visible chest wall movement. Capnography accurately detects apnea or airway obstruction, which can improve patient safety during light anesthesia.[18] It is better to obtain real-time ETIA data to know the patient's status and how long it will take for the patient to awaken. Therefore, it is also necessary to monitor end-tidal gas concentration during the process of emergence. Modified bite guard has been reported to be helpful for measuring ETIA,[19] but it might not be suitable for LMA removal in deep planes of anesthesia because the air passage is often blocked by the base of the tongue in deeply anesthetized patients.

During operation, a T-connector with tubing (Figure 1A, left white arrow) serves as an extension of the gas-sampling line (Figure 1A, right white arrow), with the Luer Lock connectors being linked

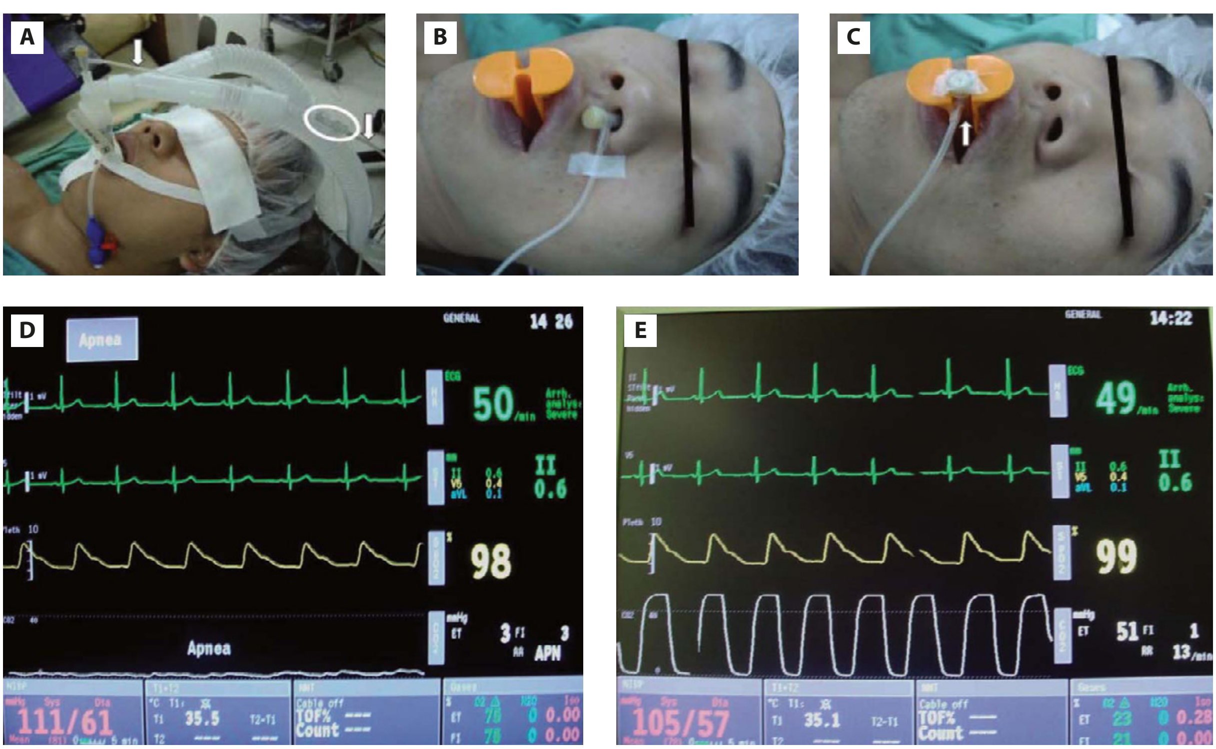

Figure 1 (A) The T-connector as an extension of the gas-sampling line during surgery. (B) Gas sampling through nasal route with an adequate Berman airway placed following removal of laryngeal mask airway. (C) Gas sampling through oral route with an adequate Berman airway placed following removal of laryngeal mask airway. (D) Capnography obtained by gas sampling through nasal route. (E) Capnography obtained by gas sampling through oral route.

well together (Figure 1A, white oval). After LMA removal, the rectangular end of the T-connector can be used to facilitate gas sampling and monitor the recovery state of patients during emergence. At first, we tried to link a T-connector to the end-tidal gas sampling line and put the rectangular end of the T-connector near the nostrils to obtain the gas data (Figure 1B). However, this method failed in almost every case (Figure 1D) with an oral airway placed in the oropharynx. The reason for failure could be related to the natural rules of fluid dynamics, which states that a fluid (can be liquid or gas) tends to flow through the route of least resistant to avoid external tension. In anesthetized patients with spontaneous breathing, loss of upper airway muscle tone allows the tongue base (sometimes even epiglottis) to fall back against the posterior pharyngeal wall. If we introduce an oral airway to solve the problem, the major gas outlet will become the mouth instead of the nostrils owing to the smaller and more resistive nasal passage. Thus, we then placed the rectangular end of the T-connector in the lateral channel of the oral airway (Figure 1C) and temporarily fixed the end to the lateral channel with tape. The waveform obtained with this method (Figure 1E) was almost identical to that obtained during LMA anesthesia. As we just put the rectangular end of the T-connector into the lateral channel (Figure 1C, white arrow) and not into the mouth, there is low possibility of occlusion of the sample line by secretions.

A point that needs to be stressed is that this method should only be performed in anesthetized adults with spontaneous ventilation. It is not suitable for patients with impaired ventilatory drive (e.g. curarization) because an oral airway can only provide upper airway patency.

This method was employed in over 300 ASA class I–II adults, and all recovered from anesthesia smoothly without any obvious complication. Most could obey the instruction to open their mouth for removal of the oral airway. If time permits, this safe and easy method of early LMA removal can be applied selectively in deeply anesthetized adult patients.

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