J Anesth (2000) 14:221–223

Journal of
Anesthesia

Short communications

Gastric tube guide-equipped laryngeal mask airway

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Key words Laryngeal mask · Gastric tube · Intermittent positive-pressure ventilation

The laryngeal mask airway (LMA) has become a popular device because of its usefulness [1]. However, application of the LMA has remained limited because of one fundamental weak point, incomplete airway protection [2,3]. Intermittent positive-pressure ventilation should be avoided [4], especially during prolonged anesthesia [5], since it can provoke gastric distension, which is considered to induce a high risk of aspiration [3].

To overcome these limitations, some new types of LMA have been proposed [2,6]. However, these improvements often compromise the simplicity and efficacy of the original LMA [2,6]. Currently, some anesthesiologists use a gastric tube (G-tube) with LMA for gastric deflation. The intraoperative insertion of a G-tube is a complicated task for anesthesiologists, and the insertion of a G-tube preoperatively is uncomfortable for patients. We therefore designed and evaluated a new type of LMA, which allows easy G-tube insertion at any time.

Design of G-tube guide-equipped LMA (G-LMA)

Our trial product, G-LMA, was manufactured by modifying the basic structure of an original LMA by attaching a newly created G-tube guide (Fig. 1). This G-tube guide is made of two parts, consisting of a silicone tube (soft portion) and a small endotracheal tube (hard portion). The soft portion is attached to the dorsal surface of the mask portion of the LMA with a mild curved line, and the hard portion is attached to the side surface of the tube portion of the LMA. This attachment design assures the least contact resistance to the patient's oral surface and the least disturbance when the G-LMA is handled.

Case study

A total of 30 patients (9 males and 21 females) were studied after obtaining their informed consent (or that of their parents). All had an ASA physical status of I, II, or III. Their average age was 45 ± 23 (mean ± SD), with a range of 1 to 81 years. The size of the G-LMA was selected according to the LMA instruction manual [7]. Usually, a no. 4 mask was used for adult males and a no. 3 mask for adult females. For children, either no. 2 or no. 2.5 was selected, according to their body weight. The design of the G-LMA allowed for the original insertion technique of the LMA. As a result, all patients underwent the same manipulation as that shown in the LMA instruction manual [7].

After insertion of the G-LMA, artificial respiration through the G-LMA was confirmed. The G-LMA was first fixed to the patient, and then the G-tube (14 Fr double-lumen hard type G-tube made by Terumo (Tokyo, Japan), or a 12 Fr G-tube in the case of G-LMA size no. 2) was inserted. Eight percent lidocaine was previously loaded into the inner lumen of the G-tube guide as a lubricant. First, the cuff of the G-LMA was deflated, then the G-tube was inserted into the guide until it reached an adequate length. Adult males usually needed 55 cm and females 50 cm. In children the length was decided by estimating the length from the nasion to the upper abdomen. The cuff was then reinflated, and the presence of the G-tube in the stomach was con-

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Received: July 19, 1999 / Accepted: June 21, 2000

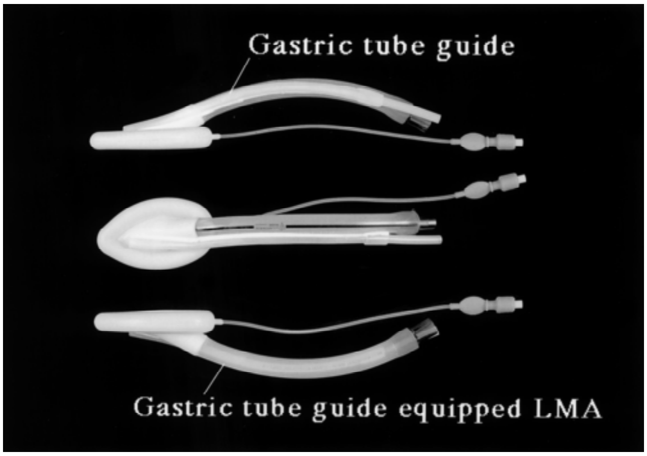

Fig. 1. Structure of the gastric tube guide-equipped laryngeal mask airway (G-LMA). The photographs of the G-LMA show that the G-tube guide is attached to the LMA so that there is the least projection

firmed based on the suction of the gastric contents or any auscultation of sounds during injection of air into the G-tube. The G-tube was used to remove the gastric contents by suction during surgery, and the G-tube was removed just before the extubation of the G-LMA at the end of anesthesia.

The operated areas consisted of the head and neck in 8 cases, the extremities in 16 cases, the lower abdomen in 5 cases, and the chest in 2 cases (1 case also included the lower abdomen). The operation time averaged 187 ± 98 (mean ± SD) min and ranged from 60 to 430 min. The average anesthesia time was 255 ± 115 (100–570) min. The type of anesthesia and ventilation was selected by the anesthesiologist in charge. Ten patients received inhalational anesthesia, including 4 patients who also had epidural anesthesia. Twenty patients received total intravenous anesthesia, including 8 patients who also received epidural anesthesia. Controlled ventilation was performed in 29 patients, and 1 patient had assisted ventilation because of spontaneous respiration. The inspiratory pressure averaged 16 ± 2 (mean ± SD) and ranged from 12 to 21 cmH_2O.

In all cases, G-LMA was easily inserted in the same manner as the original LMA. The success rate on the first try was 97% (29 patients); a second try to complete the insertion was needed in only 1 patient. Similarly, the G-tube was easily inserted except for 1 patient in whom a second try was also needed. Thus, the success rate of the first try was 97%.

The total volume of suctioned gastric contents was 31 ± 40 ml (mean ± SD; range, 0–181 ml). No patients had any upper abdominal expansion or vomiting. Three patients (10%) had transient sore throat pain just after anesthesia.

Discussion

Brain et al. [2] proposed a new prototype laryngeal mask (pLMA), which isolated the airway from the digestive route. The pLMA is composed of double masks and double dorsal cuffs, in which the second mask isolates the upper esophagus from the airway, and the second dorsal cuff increases the seal pressure. Akhtar [6] proposed another prototype of the laryngeal mask, which was equipped with an esophageal vent (esophageal vent-LMA). The esophageal vent is made with a 10-mm (inside diameter) tracheal tube. The vent is fixed to the dorsal surface of the mask portion of the LMA and projects from the distal tip of the LMA.

Both prototypes of LMA were thought to prevent regurgitation of the gastric contents. However, these improvements may also result in a decreased ability to manipulate the LMA. The success rates for a single attempt to insert the pLMA, the esophageal vent-LMA, and the G-LMA were 90% [2], 76% [6], and 97%, respectively. In 10% of the attempts, the pLMA could not be inserted by any techniques, including rotation and using a laryngoscope. However, we achieved a 100% success rate with our G-LMA for insertion by the second attempt using the standard insertion technique. The esophageal vent-LMA may need a laryngoscope, because of the structure of the esophageal vent. Using a laryngoscope, however, defeats the main advantage of the LMA, its easy manipulation. These findings show that the manipulation of the G-LMA is superior to that of other prototypes.

Why can the G-tube be inserted so easily through the G-LMA? Easy insertion depends on maintaining a good relationship between the anatomy of the pharynx and the G-LMA. If the G-LMA can be inserted in the correct position into the pharynx, then the distal tip of the cuff can be placed in the entrance of the esophagus. The distal tip of the G-tube guide is then directed into the distal tip of the cuff.

Previously reported incidences of sore throat after use of the LMA range from 0% to 30% [3]. The G-LMA is also less invasive to the oropharyngeal mucous membrane.

Because is difficult for some anesthesiologists to make the G-LMA, we plan to commercially produce a disposable G-tube guide, which can be instantly attached before use.

Clinically unrecognized LMA malpositions have been observed by fiberoptic findings [8]. Such malpositioning is a significant risk factor for gastric air insufflation [9]. The incidence of regurgitation is likely to increase with the duration of anesthesia [10]. As a result, anesthesiologists avoid using LMA during prolonged, controlled ventilation [11]. Eighty percent of our patients underwent a prolonged operation of over

2 h, and such operations have been reported to have a higher incidence of regurgitation [5]. Furthermore, 29 patients had intermittent positive-pressure ventilation. However, no cases of vomiting or respiratory complications were seen, and intermittent positive-pressure ventilation was also smoothly performed by the G-LMA in this study.

Nevertheless, use of the G-tube has some risks: there is a possibility of decreasing the esophageal opening pressure, and a dysfunction of the flap valve may occur in the lower esophageal sphincter. The former leads to gastric insufflation, and the latter leads to the aspiration of gastric contents. To overcome this risk, the G-tube must completely remove the gastric contents.

We believe the G-LMA should be used for anesthesia under intermittent positive-pressure ventilation, especially for prolonged anesthesia. However, more research is needed to elucidate its advantages.

Acknowledgments. The authors wish to thank Takayuki Itadani and Isao Noguchi (Japan Medico) for their advice in preparing the medical materials. We also wish to thank M. Ragin, M. Sci. (Department of Anesthesiology, University of California, San Diego), who corrected our manuscript.

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