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Use of the Laryngeal Mask Airway in Combination with Regional Anesthesia Facilitates Induction and Emergence from General Anesthesia in Patients Undergoing Colorectal Surgery

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ABSTRACT

The laryngeal mask airway (LMA) is selected as an alternative to the endotracheal tube (ETT) when rapid recovery from general anesthesia is considered. However, the clinical significance of this airway for abdominal surgery is unclear. Thus, we evaluated whether the LMA, in combination with regional anesthesia, facilitates the induction of and emergence from general anesthesia in patients undergoing elective colorectal surgery. Anesthesia-controlled time in a ETT/Epidural Anesthesia (EA) group [n = 11; general anesthesia, combined with epidural anesthesia, was maintained by sevoflurane (< 3%) supplemented with a fixed rate of propofol (3 mg/kg/h) under controlled ventilation using the ETT] was compared with that in a LMA/Combined Spinal-Epidural Anesthesia (CSEA) group [n = 10; in combination with spinal-epidural anesthesia, general anesthesia was maintained as the same protocol as the ETT/EA under spontaneous ventilation using the LMA]. Time for airway placement in the LMA/CSEA group was significantly shorter than that in the ETT/EA group. Intervals from the end of surgery until the removal of the airway or the decision to exit the operating room in the LMA/CSEA group were shorter than those in the ETT/EA group. No practical sign of aspiration pneumonia and/or atelectasis was found in patients in either group. Under the circumstance of regional anesthesia being requested for post-surgical pain management, we concluded that the LMA facilitated the emergence from as well as the induction of anesthesia without any practical complication when used for patients in colorectal surgery.

Key words: *Laryngeal mask airway, Colorectal surgery, Anesthesia recovery period*

The development of the mechanical anastomosis technique during the last decade has led to the reduction of operating time for colorectal surgery. The average operating time for this surgical procedure by trained surgeons is around 2-3 hours. A delay in emergence from general anesthesia is thus a considerable problem today when optimized perioperative resource utilization is concerned, i.e., when several patients are sequentially scheduled for a single operating room (or an anesthesiologist) in a working day.

The laryngeal mask airway (LMA) is adequately placed in patients with spontaneous ventilation under light general anesthesia because this airway has an advantage over the endotracheal tube (ETT) in less anesthetic requirement for tolerance during airway management¹. This supports our

hypothesis that the LMA, as an alternative to the ETT, facilitates the emergence from anesthesia in patients for colorectal surgery, although several problems remain to be resolved. The primary concern is that spontaneous ventilation during abdominal surgery is frequently withheld in order to prevent the patient's coughing during surgical manipulation. Most surgeons also request the relaxation of the abdominal cavity when the patient's lung is spontaneously ventilated. However, we suggest that the combination of general anesthesia with regional anesthesia might reduce the problem.

The goal of this study was thus to find a suitable setting for quick anesthesia recovery by using the LMA in combination with regional anesthesia in patients undergoing elective colorectal surgery

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through a prospectively designed and randomized trial.

PATIENTS AND METHODS

After approval by the local Institutional Review Board and informed consent, 24 patients scheduled for resection of rectal cancer by means of mechanical anastomosis using a circular stapler participated in this study. Patients with cardiovascular or respiratory disease and contraindications to spinal-epidural anesthesia were excluded. The patients were randomly allocated into the following two groups.

Anesthetic protocol.

ETT/Epidural Anesthesia (EA) group: patients received 0.5 mg atropine and 2.5 mg midazolam intramuscularly 30 min before arrival at the operating room. Standard monitoring included non-invasive arterial pressure, electrocardiogram, capnogram, and pulse oximetry. After an 18- or 20-gauge plastic cannula was inserted into a forearm vein, epidural catheterization at the Th₁₂-L₁ or L₁-L₂ vertebral interspace was performed. Lidocaine (2%, 3 ml) was injected through the catheter at least 3 min before the induction of general anesthesia. General anesthesia was then induced by intravenous (i.v.) 0.1 mg fentanyl and 20 mg ketamine followed by 1–2 mg/kg propofol. The ETT was intubated after 1 mg/kg vecuronium i.v.. Anesthesia was maintained by propofol and sevoflurane carried by O₂/air (6 liters/min, FiO₂: 0.4–0.5) under controlled ventilation. Anesthetic depth was essentially adjusted by sevoflurane, supplemented by a fixed rate of propofol (3 mg/kg/h). The end-tidal gas concentration of sevoflurane, up to 3%, was considered adequate when changes in the heart rate and arterial pressure were within 20% from baseline and no movement was observed during surgery. Epidural 1.5% lidocaine (4–8 ml) was additionally injected every 45–60 min during operation. Administration of general anesthetics was discontinued when the anesthetists considered that the closure of the peritoneum was not influenced by the management. Extubation was performed according to the following criteria: (1) spontaneous breathing at > 10 breath/min; (2) the patient was able to open eyes and to squeeze the observer's hand in response to verbal commands; and (3) the existence of cough and swallowing reflex. The exit from the operating room was decided when the patient was oriented to his/her name under continuous achievement of the extubation criteria.

LMA/Combined Spinal-Epidural Anesthesia (CSEA) group: these patients were managed by the same protocol as the ETT/EA group with the exceptions described as follows. (1) Spinal anesthesia was combined with epidural anesthesia.

After epidural catheterization, isobaric 0.5% bupivacaine (3 ml) was administered intrathecally at the L₃-L₄ vertebral interspace using a 25-gauge spinal needle. (2) After the induction of general anesthesia, the LMA (classic type; #3 or #4 for female or male, respectively) was placed without using a laryngoscope instead of the ETT intubation. No neuromuscular blocker was used during the anesthesia. (3) Anesthesia was maintained using the same anesthetic agents as for the ETT/EA group under spontaneous ventilation. (4) The LMA was removed after the swallowing reflex was confirmed. Recovery of consciousness was not necessary for the removal. The exiting criteria were the same as for the ETT/EA group.

Measurement of event-to-event intervals.

Event-to-event intervals were measured as follows: (1) The interval from the arrival at the operating room until the induction of general anesthesia. This was taken to prepare for the epidural/spinal anesthesia and defined as the regional part of anesthesia-controlled time. (2) The interval from the induction of general anesthesia until the placement of the airway; (3) The operating time; (4) The interval from the end of surgery until the removal of the airway; and (5) until the decision for exiting the operating room. Duration of anesthesia was defined as the interval from induction until the decision to exit the operating room. General part of anesthesia-controlled time was defined as the subtraction of operating time from "duration of anesthesia".

Evaluation of respiratory complications.

Evaluation of aspiration pneumonia and/or atelectasis was practically evaluated by: (1) an anteroposterior chest roentgenograph taken on the day following the operation; (2) the decrease in SpO₂ by pulse oximetry; (3) and/or the patient's dyspnea.

Statistical analysis.

Data were expressed as mean \pm SD. The comparison of age and times between groups was performed using an unpaired t-test. The gender ratio was tested by a chi-square test. A value of *P* less than 0.05 was considered as significant.

RESULTS

Three patients were excluded from this study because their surgical procedure was changed after intraoperative exploration. As a result, eleven cases in the ETT/EA group and ten cases in the LMA/CSEA group were evaluated. There was no significant difference in age and gender ratio between the groups. No significant difference in the regional part of anesthesia-controlled time was observed between the groups. In contrast, the general part of anesthesia-controlled time in the

Table 1. Patient Demographics

	ETT/EA	LMA/CSEA
Number of patients	11	10
Age (yr)	67.9 ± 10.7	69.8 ± 12.0
Gender (Male/Female)	8/3	6/4
Operating time (min)	141 ± 57	123 ± 43
Duration of anesthesia (min)	180 ± 57	146 ± 41
Anesthesia-controlled time (min)		
General part*	38 ± 6	23 ± 5
Regional part	17 ± 6	17 ± 3
Total*	56 ± 8	40 ± 5

*Significant difference between groups ($p < 0.05$).

Table 2. Detailed event-to-event interval during induction and emergence from general anesthesia

	ETT/EA (min)	LMA/CSEA (min)
Induction time		
#1*	6 ± 2	3 ± 1
Emergence time		
#2*	4 ± 4	-5 ± 4
#3*	16 ± 3	9 ± 3

#1, Interval from the induction until the placement of airway; #2, from the end of surgery until the removal of airway; and #3, until the decision for exiting the operating room. *Significant difference between groups ($p < 0.05$).

LMA/CSEA group was significantly shorter than that in the ETT/EA group. Total anesthesia-controlled time in the LMA/CSEA group was also significantly shorter, although the duration of anesthesia was not influenced by the use of the LMA, possibly due to the wide variation of operating time (Table 1). Event-to-event intervals during induction and emergence were summarized in detail (Table 2). The time for airway placement (i.e., induction time) in the LMA/CSEA group was shorter than in the ETT/EA group. Intervals from the end of surgery until the removal of the airway or the decision for exiting the operating room were significantly reduced by use of the LMA, contributing to an accelerated emergence from general anesthesia. No practical sign of aspiration pneumonia was found in patients in either group.

DISCUSSION

Several advantages of the LMA over the ETT have been reported in a number of previous studies. A meta-analysis of these reports conducted by Brimacombe¹ revealed that the stress response at induction is reduced by use of the LMA when compared with the ETT, and that placement of the LMA is faster than that of the ETT. The lower stress response at placement of the LMA leads in turn to a commonly adopted anesthetic protocol, where no muscle relaxant is used for the placement. In the present study, we confirmed that

induction time in the LMA/CSEA group was significantly shorter than in the ETT/EA group. Because there was no patient with airway problems in this study, and anesthetic management was conducted by skilled practitioners, trained for at least three years, the difference in the induction time appeared to have been caused by the waiting time for the onset of muscle relaxants in the ETT/EA group.

The LMA has been chosen as an airway management device in recent studies concerning rapid discharge from the operating room in day-case surgery^{3,6,7}. Another retrospective study also indicated that use of the LMA significantly shortened discharge time although the type of surgery and anesthesia were not controlled⁵. These reports, however, did not indicate the significance of the LMA for lower abdominal surgery. In the present study where the type of surgical procedure was limited to a resection of rectal cancer by using a circular stapler, a significant shortening in the emergence from general anesthesia in the LMA/CSEA group, in comparison with the ETT/EA group, was demonstrated.

Several points in the anesthetic protocol emerged as important for this fast recovery from general anesthesia in the LMA/CSEA group. Of these, it is essential that the LMA was removed in the period between the closure of the peritoneum and the skin suture (Table 2, #2). Although there was no significant difference between groups in the total consumption of general anesthetic agents, which was retrospectively calculated from anesthesia records (data not shown), early removal of the LMA was linked *in turn* to an earlier discontinuation of general anesthetics in the LMA/CSEA group in comparison with the ETT/EA. We suggest that these results were achieved due to the advantages of the LMA over the ETT in the stress response for airway tolerance and in the frequency of coughing during emergence, as demonstrated by a number of previously published randomized trials¹. Indeed, the removal of the LMA did not provoke the cough reflex, nor did it influence the above specified surgical process in the present study. On the other hand, the ETT was extubated after the skin suture because this manipulation is commonly accompanied by coughing that disturbs the surgical process.

We suggest that the safe and early removal was achieved because the patient's spontaneous tidal volume as well as respiration rate was observed by anesthetists throughout surgery in the LMA/CSEA group. We also suggest that the reduced general anesthetic requirement by regional anesthesia to prevent surgical stress was important for spontaneous ventilation during abdominal major surgery, although we could not clearly detect the impact of combined regional anesthesia

in the present study. On the other hand, one may speculate that the advantage of the LMA in reducing anaesthesia-controlled time (i.e., induction and emergence time) may be limited by the combination with CSEA since roughly 20 min was taken to prepare for the regional anaesthesia. The primary reason for selecting this combination was that regional anaesthesia is required for spontaneous ventilation under light general anaesthesia. Another important reason for the combination was that a continuous epidural morphine/bupivacaine is our routine procedure for post-surgical analgesia after colorectal surgery. Epidural analgesia was selected because of the clinical arrangements in our hospital, where patients are returned directly to the surgical ward from the operating room without passing through a post-anaesthesia care unit. If regional anaesthesia is not combined, the initial management for post-surgical pain using intravenous opioids would have to be done in the operating room after recovery. The latter would possibly cause a delay in the decision to exit the operating room, followed in turn by a delay in the setup of next operation. On the other hand, post-surgical pain after lower abdominal surgery is commonly less than moderate when regional anaesthesia is combined with general anaesthesia. Indeed, no additional management for pain relief was requested up to exiting the operating room in this study. A recent report from Junger et al⁵⁾ partly supports the pivotal role of regional anaesthesia in the rapid discharge from the operating room.

In addition to epidural anaesthesia, spinal anaesthesia was also combined in the LMA/CSEA group. This was designed after a preliminary trial for this study using the LMA, where most of the spontaneously ventilated patients moved and/or coughed during the insertion of a circular stapler from their anus. The movement of patients occurred even though an epidural was combined with the general anaesthesia. This is likely to have been caused by the lack of low sacral sensory blockade by epidural anaesthesia at the thoracolumbar level. From these findings, we decided to combine spinal anaesthesia using isobaric bupivacaine with epidural anaesthesia. No harmful reflex during the mechanical anastomosis was observed in the LMA/CSEA group. The upper area for spinal anaesthesia was not examined before the induction of general anaesthesia, but no practical complications of this block (e.g. difficulty in spontaneous breathing, severe hypotension, etc.) was observed. Our results also showed that the addition of spinal anaesthesia to the epidural did not significantly extend the time for management.

A possible risk of gastric regurgitation is frequently cited as a limiting feature of the LMA⁸⁾. In our study, which focused on colorectal surgery, it

was notable that no clinical sign of aspiration was observed. We suggest that our regimen, where the LMA was removed as soon as the swallowing reflex was confirmed, contributed to the prevention of regurgitation. Recent reports also support the advantage of early removal of the LMA^{2,4)}.

We demonstrated through the present study that spontaneous ventilation by using the LMA is a beneficial alternative to the ETT for patients undergoing colorectal surgery when rapid recovery from general anaesthesia is considered, while the combination of regional anaesthesia was suggested as essential for anaesthetic management. Where an epidural block is requested and/or required for post-surgical pain management, we concluded that the LMA facilitated emergence from as well as induction of anaesthesia without any practical complication when used for patients in colorectal surgery.

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