Induction of Anesthesia and Insertion of a Laryngeal Mask Airway in the Prone Position for Minor Surgery

Alexander Ng, FRCA, David G. Raitt, FRCA, and Graham Smith, MD, FRCA

University Department of Anaesthesia, Critical Care & Pain Management, University Hospitals of Leicester, NHS Trust, Leicester Royal Infirmary, Leicester, England

The use of the prone position for surgery presents potential obstacles to rapid tracking of patients during ambulatory anesthesia. We describe a prospective audit of 73 patients who placed themselves in the prone position; anesthesia was induced in this position and a laryngeal mask airway (LMA) was used to maintain the airway. Additional increments of propofol were given to one patient who had laryngospasm and to nine who required deepening of anesthesia before the LMA could be inserted. Of four cases with LMA malpositioning, the LMA was adjusted easily in three, but in one patient who was edentulous, it was necessary to hold the LMA for the duration of the procedure. Manual ventilation of the lungs via the LMA was required because of arterial oxygen desaturation and hypoventilation in four patients. Blood was noted outside the nostrils in two patients, presumably caused by soft tissue trauma after insertion of the LMA, and bradycardia occurred in five patients. In the postoperative period, hoarseness and sore throat were observed in one and six patients, respectively. With experience and appropriate patient selection, it is possible to induce and maintain anesthesia using a LMA in patients in the prone position for ambulatory surgery.

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The prone position is required for major reconstructive spinal surgery and also for minor procedures such as short varicose vein avulsions, excision of pilonidal sinus, repair of Achilles' tendons, and posterior calf surgery. The use of the prone position may delay rapid tracking of patients during ambulatory anesthesia because of the possibility of increased time required for induction, patient positioning and recovery. Rapid tracking is the seamless movement of patients from one stage to another in the pathway of care during their hospital admission.

The conventional approach to management of patients for surgery in the prone position is initially to induce anesthesia in the supine position. After tracheal intubation, the patient is turned onto the prone position and positioned carefully so that ventilation is not impeded, venous return is not compromised, and all pressure points are protected. Although this method is familiar to anesthesiologists and is used for major procedures when muscle relaxation is required, it is time consuming.

The alternative to turning a patient after induction of anesthesia and tracheal intubation is to ask the patient to position him/herself in the prone position on the operating table before inducing anesthesia. The major disadvantage of this approach is that direct laryngoscopy is usually not possible in the prone position and airway management may be difficult. However, this problem may be overcome by the use of the Laryngeal Mask Airway (LMA). One of the authors has developed a technique for providing anesthesia in the prone position for minor surgical procedures and has experience of over 600 cases without significant complications. The aim of this communication is to describe this technique and report a prospective audit of 73 patients.

Methods

We audited prospectively 73 consecutive ASA physical status I–II patients who fulfilled our hospital's criteria for ambulatory surgery and who required general anesthesia in the prone position. Exclusion criteria were designated as known or suspected airway difficulties, poor dentition, serious skeletal disease, history of gastroesophageal reflux, and lack of patient cooperation.

After cannulation of an appropriate vein, the patient adopted the prone position on the operating

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Address correspondence and reprint requests to Professor Graham Smith, MD, FRCA, University Department of Anaesthesia, Critical Care & Pain Management, University Hospitals of Leicester, NHS Trust, Leicester Royal Infirmary, Leicester LE1 5WW, England.

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table. This position consisted of two pillows under the chest and one pillow under the feet, allowing free anterior abdominal wall movement (Fig. 1). The hands were placed above the patient's head, which was inclined to the left or right on a soft head ring. For patients with a short neck, the head ring was elevated with a pillow to avoid undue neck flexion. When the patient was comfortable, standard monitors were applied. With the patient breathing oxygen delivered at 6 L/min via a loosely applied face mask, anesthesia was induced with fentanyl 1 μg/kg IV and propofol 2–4 mg/kg IV. After loss of consciousness, the head ring was removed and the face mask was applied firmly, allowing manual ventilation of the lungs with 100% oxygen (Fig. 2). Then, with the anesthesiologist's nondominant hand placed on the patient's forehead that was turned slightly to the side and the Operating Department Assistant opening the mouth by holding the tip of the patient's chin, the LMA was inserted (Fig. 3). As the LMA passed the incisors, the patient's chin was released, allowing the tongue to fall forwards, thereby opening up the posterior oropharyngeal space for the LMA. After inflation of the cuff of the LMA, the patient's head was carefully laid to the left or right onto the head ring (Fig. 4). Patients were allowed to breathe spontaneously with nitrous oxide and sevoflurane in oxygen. Antiemetic and additional opioid drugs were given as required for the specific operative procedure. As a safety measure, a spare trolley was immediately available in the event of a significant complication requiring management in the supine position.

Age, sex, height, weight, ASA physical status, cardiorespiratory data, and operative details were recorded. Note was made of any problems that occurred before induction, at induction, during the maintenance period, on awakening, and at 30 min postoperatively. Arterial desaturation and bradycardia requiring intervention were defined as a pulse oximetry saturation <95% and heart rate of <40 bpm, respectively.

Results

In this audit of 73 consecutive patients, there were no exclusions. Patient characteristics are noted in Table 1. The duration of surgery was generally <60 min (Table 2). Cardiovascular and respiratory variables were stable (Table 3).

Before induction of anesthesia, three patients with a short neck, one with a stiff neck, and one with sore breasts were assisted to repositioning themselves in the prone position until there was no discomfort. Although the lungs of all patients were easy to ventilate manually via the face mask, one developed laryngospasm after insertion of the LMA and required additional propofol. All problems encountered in this audit were minor and are shown in Table 4.

Figure 1. Before induction, the patient lies comfortably with her chest on two pillows and her feet on one pillow as shown.

Figure 2. Face mask applied to the patient's face.

Figure 3. Patient's mandible pulled forward to allow insertion of laryngeal mask airway.

Figure 4. Laryngeal mask airway *in situ.*

Table 1. Patient Characteristics

	Female	Male
ASA class I/II	9/5	44/15
Weight (kg)	80.8 ± 17.6 (54–116)	83.9 ± 13.5 (62–128)
Height (m)	1.62 ± 0.06 (1.53–1.73)	1.77 ± 0.08 (1.59–1.96)
Body mass index ($kg \cdot m^{-2}$)	30.6 ± 5.2	26.8 ± 4.0

Data expressed as mean ± SD and range.

Discussion

We describe an alternative method for providing anesthesia in the prone position for ambulatory surgery in a prospective audit of 73 consecutive patients. The essential difference between this method and other techniques is that with the LMA it is possible to induce anesthesia in the prone position and maintain an unimpeded airway. All complications encountered were minor and were amenable to routine management.

After induction of anesthesia, the jaw and tongue fell anteriorly and the lungs of all patients were easy to ventilate manually via a face mask. No problems were encountered with transient apnea. However, there was one case of laryngospasm and nine cases of difficulty with insertion of the LMA. These problems were attributable to inadequate depth of anesthesia and responded readily to additional increments of propofol. Malpositioning of the LMA occurred in four patients; in three of them, this problem resolved with simple readjustment of the position of the LMA, but in one patient who was edentulous it was necessary for the anesthesiologist to hold the LMA in the correct position for the duration of the anesthetic. No problems were encountered with possible rotatory displacement of the LMA because of head turning in the prone position. There were a few episodes of oxygen desaturation and hypoventilation that resolved with manual ventilation via the LMA.

An alternative method to the LMA for airway management is the nasopharyngeal airway. This device was evaluated in a study contemporaneous with the present one, and anesthesia was induced in the prone position for short surgical procedures. In a similar design to that of our study, the airway was inserted after induction and patients were allowed to breathe spontaneously (1). In comparison with the LMA, the nasopharyngeal airway is tolerated better at lighter levels of anesthesia, without gagging on awakening. However, there is additional pollution, dilution of inhaled anesthetics via oral entrainment and potential for nasal trauma. With our method, there were two cases of bleeding related to soft tissue trauma to the airway by the LMA.

Despite allowing patients to breathe spontaneously, oxygenation and ventilation were not adversely affected, as would be expected. In the prone position, there is potential for a reduction of pulmonary compliance that can affect oxygenation and ventilation, if there is restriction to movement of the abdomen. In a study of 77 adults undergoing mechanical ventilation, reduction in compliance occurred with the Wilson frame that supported the torso and pelvis at the lateral edges and the chest rolls placed laterally from chest to pelvis. This effect did not occur with the Jackson table and was attributable to the relatively free abdominal movement provided by its chest and pelvic supports (2). In a similar way, our patients were supported, with two pillows under the chest thereby minimizing restrictions in abdominal movement.

As anticipated from previous studies, we observed that cardiovascular stability was maintained in our series of patients. In healthy volunteers, it has been shown by transthoracic bioimpedance that cardiac index does not decrease significantly after turning prone onto an evacuatable mattress or onto pelvic and chest pillows (3). These results are in concordance with a study of healthy patients undergoing mechanical ventilation for lumbar laminectomy (4). In this study, transesophageal echocardiography showed that there was no significant reduction in stroke volume index or cardiac index. However, the detailed scan was able to demonstrate that the prone position was associated with a reduction in left ventricular volume and systolic pulmonary venous velocity time integral, but with an increase in diastolic pulmonary venous velocity time integral. These changes were attributed to a possible decrease in venous return with inferior vena cava compression and decreased left ventricular compliance associated with an increase in intrathoracic pressure.

Although the prone position is not the standard position for inducing anesthesia, it is a position in

Table 2. Operative Details

Surgical Speciality	Operation	No.	Duration (min)
Orthopedics	Calf fasciectomy	5	30 (15–35)
	Hamstring fasciectomy	2	30 (25–35)
	Compartment fasciotomy	4	35 (35–60)
	Repair ruptured Achilles' tendon	15	40 (30–80)
	Removal of paratenon of Achilles'	27	30 (20–45)
	Excision exostoses ankle joint	8	35 (25–45)
	Excision of calcaneal bursa	3	40 (30–40)
General	Excision of lump on back	2	25 (15–35)
	Excision of pilonidal sinus	2	49 (47–50)
	EUA anus	2	20 (20–20)
	Ligation of short saphenous vein	3	60 (20–95)

Duration expressed as median (range).
EUA = examination under anesthesia.

Table 3. Cardiorespiratory Measurements

Time	At induction	15 min	30 min	45 min	60 min
MAP (mm Hg)	80 ± 15	82 ± 14	78 ± 13	85 ± 13	96 ± 14
HR (bpm)	59 ± 11	60 ± 11	62 ± 11	62 ± 9	67 ± 13
Spo$_2$ (%)	97 ± 1	97 ± 1	97 ± 1	97 ± 1	97 ± 1
RR (breaths/min)	15 ± 6	18 ± 6	17 ± 5	17 ± 5	21 ± 2
ETco$_2$ (mm Hg)	49.5 ± 8.3	50.3 ± 8.3	49.5 ± 6.8	44.3 ± 9.0	43.5 ± 3.0

Data expressed as mean ± SD.
MAP = mean arterial pressure; HR = heart rate; SpoMDNM$_2$ = oxygenation saturation; RR = respiratory rate; ETcoMDNM$_2$ = end-tidal carbon dioxide.

Table 4. Problems Encountered

Problem	Comment
Short neck (*n* = 3)	Head ring was elevated with a pillow to avoid hyperflexion
Stiff neck prior to induction (*n* = 1)	Patient repositioned and no further discomfort reported
Breasts sore before induction (*n* = 1)	Patient repositioned and no further discomfort reported
Insufficient anesthetic depth (*n* = 9)	More propofol given, no further problems
Laryngospasm (*n* = 1)	More propofol given, no further problems
Arterial desaturation (*n* = 2)	Manual ventilation, oxygenation improved
LMA malpositioning (*n* = 4)	In one of the cases, the patients was edentulous requiring the LMA to be held *in situ* by the anesthesiologist. In the other cases, the LMA was repositioned easily
Hypoventilation (*n* = 2)	One patient had a respiratory rate of 4 breaths/min, and the other patient was apneic for 20 min. The lungs were ventilated manually via the LMA.
Bleeding (*n* = 2)	Some blood was noticed coming from the mouth and nostrils. Suctioned performed
Sore throat (*n* = 6)	Responded to postoperative oral fluid
Hoarseness (*n* = 1)	Responded to postoperative oral fluid
Bradycardia (*n* = 5)	Given atropine or glycopyrrolate

LMA = laryngeal mask airway.

which central venous cannulation (5), cardiopulmonary resuscitation (6), and semi-awake fiberoptic intubation (7) have taken place. The success of the technique described in our paper requires not only skill that comes from practice but also confidence and knowledge that at any time it may be necessary to turn the patient supine for emergency management of any problems. Problems encountered were relatively minor and were easily managed by increasing the depth of anesthesia and simple manual adjustment of the position of the LMA. On the basis of our experience in this series and in over 600 previous cases, we can recommend the technique as an alternative method for anesthesiologists who will practice it on a regular basis. To an experienced anesthesiologist who is not familiar with our technique, we think that this technique can be easily learned and practiced within approximately 10 supervised cases. The main additional skills required are being able to support the head during induction and to insert the LMA from below. A modification of our technique would involve the use of muscle relaxation and positive pressure ventilation

ANESTH ANALG
2002;94:1194–8

via the LMA in the prone position. As none of the patients required muscle relaxation for their surgery, we do not have data to support or discourage their use.

Rapid tracking of patients is essential in day surgery. Recent developments in anesthesia such as use of anesthetics and opioids with short durations of action have allowed rapid recovery from anesthesia and even bypassing of the recovery room with transfer of patients directly to the postanesthetic care unit. However, when the prone position is required for ambulatory surgery, additional time may be necessary for preparation and recovery of patients. In addition, the need to turn anesthetized patients requires extra operating room staff with potential for causing musculoskeletal strain. Our report forms the basis for a randomized controlled trial to investigate if these problems may be reduced or obviated by induction of anesthesia in the prone position and use of the LMA for maintenance of the airway.

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