

# Awake nasotracheal fiberoptic intubation and self-positioning followed by anesthesia induction in prone patients

## A pilot observational study

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### Abstract

Anesthesia followed by placement in the prone position takes time and may result in complications. This study aimed to evaluate the feasibility of awake nasotracheal fiberoptic intubation and self-positioning followed by anesthesia induction in prone-positioned patients under general anesthesia.

Sixty-two patients (ASA physical status I–II) scheduled for awake nasotracheal fiberoptic intubation and prone self-positioning before surgery under general anesthesia were selected. Patient preparation began with detailed preoperative counseling regarding the procedure. Premedication with sedative and antisialagogue was followed by airway anesthesia with topical lidocaine; then, awake nasotracheal fiberoptic intubation was carried out. The patients then positioned themselves comfortably before induction of general anesthesia. The changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), incidence of coughing or gagging, and rate pressure product (RPP) were assessed. Statistical analysis was performed with repeated-measures one-way analysis of variance.

Fifty-eight of the 62 patients completed prone self-positioning smoothly. Compared with values before intubation, SBP, DBP, HR, and RPP were slightly increased after intubation, although the difference was not statistically significant ( $P > 0.05$ ). One patient had moderate coughing and 1 patient had gagging during prone self-positioning, which were tolerable.

These findings indicated that awake nasotracheal fiberoptic intubation and self-positioning followed by induction of anesthesia is safe and feasible alternative to routine prone positioning after induction of general anesthesia.

**Abbreviations:** ASA = American Society of Anesthesiologists, DBP = diastolic blood pressure, HR = heart rate, RPP = rate pressure product, SBP = systolic blood pressure.

**Keywords:** awake nasotracheal fiberoptic intubation, self-positioning, prone position, general anesthesia

## 1. Introduction

Recent advances have expanded the scope of surgery, which can be carried out on virtually any part of the body; however, many operations need patients to be positioned prone<sup>[1,2]</sup>, for example,

neurosurgery of posterior fossa tumor, posterior spinal surgery, and percutaneous nephrolithotomy surgery.<sup>[3,4]</sup> Awake nasotracheal fiberoptic intubation and self-positioning followed by anesthesia induction in prone positioned patients under general anesthesia may be a safer option in these patients, allowing both the anesthesiologist and patient to optimize the neurological function during positioning. However, studies assessing the feasibility of this technique are scarce.

The aim of the present prospective pilot study was to determine the feasibility of nasotracheal fiberoptic intubation and self-positioning followed by induction of anesthesia in prone-positioned patients under general anesthesia.

## 2. Methods

This feasibility study was carried out in a single center from July 1, 2014 to February 1, 2016. It adhered to the standards of the Declaration of Helsinki, and was approved by the institutional Ethics Committee. Written and oral informed consent was obtained from all patients before enrolment. Sixty-two eligible patients were scheduled for surgery under general anesthesia in the prone position; they belonged to American Society of Anesthesiologists (ASA) classes I to II, and aged between 18 and 70 years. Other inclusion criteria were normal neck, throat, and mouth anatomy, mouth opening at least 4 cm, and Mallampati score I to II. Exclusion criteria comprised BMI  $>35$  kg/m<sup>2</sup>, predicted or known airway problem, known difficult mask

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ventilation, decreased mobility in the neck (unable to rotate the head >45 degree or to extend the neck >80 degree), and the need for rapid sequence induction.

Patients were first psychologically and pharmacologically prepared. An informative and reassuring preoperative visit, preoperative counseling regarding the procedure, and a detailed explanation of the technique were provided, with patient questions answered. Premedication was aimed to complement the psychological preparation, providing sedation with phenobarbitone to minimize discomfort, antisialagogue with atropine to reduce secretions, and topical anesthesia with lidocaine to suppress gag reflex and pain.

Before topical anesthesia, patients were intramuscularly administered 0.5 mg atropine and 0.1 g phenobarbital. After entering the operating room, intravenous access was established, with artery catheterization accomplished under local anesthesia; the patient was connected to multifunction monitor to continuously record systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and electrocardiograph (ECG). Common regimens to achieve topical anesthesia of the oropharynx included 10 % lidocaine spray (into the oropharynx) and 5 % lidocaine ointment (applied to the base of the tongue). Topical anesthesia of the larynx and trachea was performed by the “spray as you go” technique with 4 % lidocaine applied to vocal cords through the suction port of an endoscope under direct visualization. A more effective method was transtracheal injection of 4 % lidocaine via the cricothyroid membrane using a 22-gauge needle.

With the patient's head in a neutral position, a fiberoptic bronchoscope (FOB) was inserted via the nasal airway toward the oropharynx. As the FOB was advanced, the uvula and soft palate were visualized. Further advancement of the tip deflected anteriorly allowed visualization of the epiglottis and glottic opening. Keeping the FOB midline was essential in avoiding inadvertent tip positioning in the piriform sinus. The FOB was then advanced through the vocal cords into the trachea until visualization of the carina. The leading edge of the endotracheal tube was kept anteriorly and advanced over the FOB into the trachea. Once the endotracheal tube positioned in the trachea with the carina visualized, the FOB was removed and the cuff inflated to minimize leak. Once tracheal intubation was completed, a small tube was placed inside the endotracheal tube to provide supplemental oxygen.

The patient was allowed to place himself/herself in the prone position on the operating table while awake, which helped patients achieve a comfortable prone position, and was least likely to cause nerve injury. Rolls were placed to support shoulders/upper chest and pelvis while allowing the abdomen to hang free, thus preventing abdominal compression. All pressure points (e.g., knees, elbows, anterior superior iliac spine, and shoulder peak) were well padded, asking the patient whether additional padding was needed or any discomfort noted. External genitalia in men and breasts in women were checked to ensure proper positioning and avoid injury from compression.

Spontaneous and comfortable breathing to maintain adequate ventilation was confirmed before general anesthesia induction. Anesthetic breathing circuit was connected, reconfirming tracheal tube's position, both visually and using capnography. After fixed position, patients were administered midazolam (0.1–0.15 mg/kg), sufentanil (0.1–5.0 µg/kg), etomidate (0.15–0.3 mg/kg), and atracurium (0.3–0.6 mg/kg) for general anesthesia induction. During this process, patients with severe cough, dramatic hemodynamic fluctuation, painful

**Table 1****Demographics of patients.**

Demographic data	Mean ± SD
Age, y	65.3 ± 5.1
Weight, kg	69 ± 8
Height, cm	168 ± 9
BMI kg/m <sup>2</sup>	25.4 ± 1.9
Male/female	37/25

BMI = body mass index, SD = Standard deviation.

expression, or intolerance after successful intubation gestured as agreed preoperatively; in this case, the experiment was discontinued. Anesthesia was maintained with sevoflurane 2 % to 3 % in oxygen remifentanyl, infused at 0.1 to 0.15 µg/kg/min, and atracurium 5–10 µg/kg/min.

SBP, DBP, and HR were recorded in patients at baseline (T0), immediately after endotracheal intubation (T1), 3 minutes after intubation (T2), immediately after turn over (T3), and 3 minutes after turn over (T4), respectively; then, RPP (heart rate-blood pressure product) was calculated. Incidence and duration of cough or gagging in the prone position during the process were recorded (mild cough, 1–2 times; moderate, 3–5 times; severe, >5 times) to evaluate the tolerance to endotracheal tube. In postoperative follow-up, complications related to endotracheal intubation were assessed.

Data analyses first entailed the characterization of participants using descriptive and summary statistics (mean ± SD for continuous variables; percentages for categorical variables). Means of independent samples were compared using repeated-measures 2-way analysis of variance. Statistical analyses were performed with SPSS version 16.0 (IBM, NY, USA). Two-tailed  $P < 0.05$  was considered statistically significant.

**3. Results**

A total of 62 patients were enrolled in this study; 8 individuals were excluded, and data from 58 patients were analyzed. Patient demographic characteristics are presented in Table 1.

Of the 62 cases, 58 successfully underwent awake nasotracheal fiberoptic intubation and prone self-positioning, well tolerating the endotracheal tube; no incidence of severe cough or gagging was observed during the whole process. After intubation, 4 cases developed violent cough, dramatic hemodynamic fluctuation, and painful expression in the prone position after anesthesia induction. Compared with data obtained at T0, SBP, DBP, HR, and RPP at T1, T2, T3, and T4, respectively, were slightly increased in all 58 patients, although the differences were not statistically significant ( $P > 0.05$ ) (Table 2).

**Table 2****Hemodynamic changes in patients at various time points.**

Time	SBP, mmHg	DBP, mmHg	HR, bpm	RPP
T0	126 ± 23	78 ± 13	71 ± 11	8946 ± 1457
T1	124 ± 18	83 ± 10	78 ± 10	9672 ± 1621
T2	138 ± 25	90 ± 8	86 ± 9	11868 ± 3725
T3	130 ± 21	85 ± 11	82 ± 8	10660 ± 2821
T4	128 ± 26	82 ± 9	79 ± 13	10112 ± 2672

Values are mean ± SD. There were no significant differences between time points for each Parameter. DBP = diastolic blood pressure, HR = heart rate, RPP = rate pressure product, SBP = systolic blood pressure, SD = Standard deviation.

**Table 3****Incidence and duration of coughing or gagging in patients during prone self-positioning.**

Classification of cough	Incidence (%)	Duration (s)
Mild	21.4	2.2±1.4
Moderate	7.1	4.8±1.7
Severe	0	0

Values are mean ± standard deviation or percentages.

Fifty-eight cases successfully underwent awake nasotracheal fiberoptic intubation and prone self-positioning, with 21.4% and 7.1% having mild and moderate coughing or gagging, respectively, lasting only a few seconds; severe coughing or gagging was absent (Table 3). No postoperative complications such as hoarseness, subcutaneous or mediastinal emphysema, esophageal injury, pneumothorax, and special discomfort were found during the 3 following-up days.

#### 4. Discussion

Surgery is an important treatment option in several diseases; with advances in medical science, more and more surgeries have been successfully performed. However, some operations must be performed in the prone position. The traditional positioning requires patients in the operating room to be placed in the ideal position according to the principles of human body mechanics by surgeons, anesthetists, and nurses, based on their experience and knowledge of anesthesia induction. After general anesthesia, patients show complete muscle relaxation; spine and body joints are in the state of no support and protection. Therefore, in converse position, medical staffs must move patients, and provide enough support for each body part; head and neck, chest, waist, legs, and other body parts are assigned to designated health care specialists, keeping head, neck, and spine synchronous rotation, and maintaining the functional position.<sup>[5]</sup> Slight carelessness may cause spinal cord injury; meanwhile, it may result in limb injury, nerve damage, and other related complications, or even the patient dropping off the bed, which can lead to disability or even death. Under anesthesia, the physiological function alterations caused by posture changes are amplified, causing damage to patients. General or local anesthesia can inhibit the cardiovascular system reaction to position change, and reduce patient's ability of protective reflex and adaptation to damage, causing postural hypotension and even cardiac arrest.

Therefore, medical staff have developed active measures such as design and application of new prone position frames, use of more reasonable posture gaskets, regular assessment of pressure parameters, and appropriate changes in posture; however, complications associated with general anesthesia in prone position surgery often occur.<sup>[6,7]</sup> Therefore, we hypothesized that using awake nasotracheal fiberoptic intubation and self-positioning for patients is appropriate in selecting a comfortable position after anesthesia induction, with staff's guidance. This study demonstrated that SBP, DBP, HR, and RPP in patients were higher than baseline values, but ART and HR were no >30%. RPP can indirectly reflect the balance between myocardial oxygen supply and demand, and is useful in estimating the degree of imbalance in myocardial oxygen supply.<sup>[8]</sup> RPP >120,00 indicates possible myocardial ischemia and angina pectoris.<sup>[9]</sup> It is worth noting that RPP in patients assessed here

did not exceed 12,000. These findings suggest that stress level was limited in the patients evaluated, and subjective expression of patients is acceptable in using anesthesia.

In the present study, four points should be paid special attention to. First, before operation, full communication with patients should be made to reduce the anxiety so that they can fully understand the upcoming process and what to do in the operating room; after tracheal intubation, placing the patient in a comfortable position with the cooperation of medical staff is critical, and specific discomfort may occur during this period. It is best to deepen the intuitive understanding of video data. During the process, patients unable to tolerate and talk can use their hands to pat the forehead. Second, Transtracheal injection of 4% lidocaine via the cricothyroid membrane is a key technique because endotracheal intubation is an operation with intensive stimulus, and the relatively strong discomfort causes pronounced stress response, results in severe hemodynamic fluctuations, and negatively impacts the patients. Only giving full intratracheal surface anesthesia can reduce stimulation of tracheal intubation in patients, which can facilitate proper positioning. In this study, 8 patients withdrew from the study because of violent cough, dramatic fluctuations of heart rate and blood pressure. When necessary, topical anesthesia of the larynx and trachea was performed by the "spray as you go" technique with 4% lidocaine applied to vocal cords through the endoscope's suction port under direct visualization. Third, Some patients may have nasal mucosa injury or bleeding; so patients must undergo routine examination of platelets and blood coagulation, and only gentle alteration should be obtained. Fourth, preoperatively, oxygen should be provided, as well as a full conversation with patients to ease tension, to prevent laryngeal or bronchial spasm. Operation should be gentle and carried out as quickly as possible to avoid stimulation of the laryngeal part of the pharynx and airway's mucous membrane. In case of airway spasms, supplying patients with oxygen, spasmolysis, and sedation, and intubation under general anesthesia should be immediately performed if they persist.

Our findings indicated that awake intubation, guided by fiberoptic bronchoscopy, can allow patients to select comfortable body positions after anesthesia induction under medical staff's guidance. When mastered, endotracheal intubation-guided fiberoptic bronchoscopy can reduce workload, decrease postoperative complications, and provide good clinical effects as well as high medical staff satisfaction. Therefore, this is a simple and reliable method, with improved clinical value.

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