Anesthesiology Trainees Performing Flexible Scope Intubation in Patients in the Left Lateral Position and the Supine Position: A Prospective Randomized Trial

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Abstract

Background: Flexible scope intubation is an important airway management skill that requires hands-on training in a real airway. We compared flexible scope intubation by trainees between patients in the left lateral and supine positions.

Methods: Forty patients aged 20 to 80 years with American Society of Anesthesiologists physical status I to III were scheduled for elective surgery under general endotracheal anesthesia in Ramathibodi Hospital from February 2020 to June 2020. Patients were randomly assigned to be intubated in one of two positions: supine (group S) or left lateral (group L). Trainees performed flexible scope intubation in sedated patients under the supervision of an attending anesthesiologist. Intubation success, time to successful intubation, number of attempts, airway adjustment maneuvers, and hemodynamic changes were compared between groups.

Results: Patient characteristics did not differ between groups except for Mallampati airway classification. The rate of successful intubation on the first attempt and intubation time did not significantly differ between groups. The proportion of patients who required a jaw thrust during intubation was significantly lower in group L (10.5% vs. 85%; $P < 0.01$). Blood pressure and oxygen saturation declined in both groups after intubation. Relative risk of desaturation in the left lateral position compared with the supine position was 0.44 (0.1649–1.1978).

Conclusion: The rate of successful flexible scope intubation on the first attempt and intubation time did not differ between both groups. The proportion of patients who required a jaw thrust maneuver was significantly lower in patients in the left lateral position.

Trial registration: <https://www.thaiclinicaltrials.org/> (TCTR20200208001) on 08/02/2020.

Introduction

The flexible bronchoscope has an important role in management of the difficult airway [1]. Newer scopes no longer use fiberoptic technology [2]. Flexible scope intubation (FSI) is a skill that anesthesiologists should have and be able to use when indicated [3]. Practicing this skill improves the likelihood of its successful implementation and reduces the incidence of complications [4]. Although beginners primarily practice FSI with mannequins, the rigid and static nature of the mannequin is a limitation. Trainees need hands-on experience in a real airway [1]. To simulate the difficult airway, the patient should be spontaneously ventilating after sedation is administered. Induction of general endotracheal anesthesia is a good opportunity to practice FSI. The major complications of FSI are hypoxemia from delayed intubation and soft tissue damage [5], which can lead to bleeding and/or airway edema. Unsuccessful FSI can cause complete airway obstruction and life threatening oxygen desaturation, which are potentially catastrophic [6].

During esophagogastroduodenoscopy (EGD), the laryngopharyngeal structure can easily be observed during scope insertion [7]. Although the surgeon and anesthesiologist must share the airway during the procedure, the anesthetized patient can usually maintain a patent airway without the need for a jaw thrust maneuver [8]. Furthermore, the procedure is commonly performed with the patient in the left lateral decubitus position [9]. To resemble this situation, this study compared FSI performed by trainees in the lateral and supine positions.

Material And Methods

Trial design

This prospective randomized study compared trainees performing FSI with patients in the lateral position with trainees performing FSI with the patient in the supine position. It was conducted in a tertiary care hospital (Ramathibodi Hospital, Thailand) from February 2020 to June 2020. Ethics committee approval was obtained. All patients provided written informed consent.

Patients

Patients aged between 20 and 80 years with American Society of Anesthesiologists (ASA) physical status I to III who were scheduled to undergo elective surgery under general endotracheal anesthesia were eligible for study inclusion. Patients with ASA physical status IV and VI, a history of difficult intubation, poor cardiopulmonary reserve, coronary artery disease, cerebrovascular disease, or reactive airway disease were excluded. We also excluded patients who refused participation or were anticipated to have a difficult intubation.

Randomization

The 40 study patients were randomly assigned position of intubation (supine, group S; and left lateral, group L) by data analyst on the day before surgery using a computer-generated random code (L or S) that was sent to the intubating anesthesiologist.

Primary end points

The primary outcome was successful intubation, which was defined as intubation of the airway on the first attempt within 5 minutes. Timing started when the scope entered the Ovarassapian airway and ended when the endotracheal tube was secured in the trachea as confirmed by end-tidal carbon dioxide (ETCO₂) capnography. The timing was reviewed by video recording.

Secondary end points

Secondary outcomes included (1) time from insertion to vocal cord and total time; (2) number of attempts; (3) and measurements of heart rate, oxygen saturation, and systolic, diastolic, and mean

arterial blood pressure (SBP, DBP and MAP, respectively), which were recorded before and within one minute after induction. Post-intubation complications were examined within 24 hours.

Anesthesia procedures and quality control

On the day before surgery, all patients underwent a preoperative assessment, including airway examination and routine investigations. The consent was obtained. All patients fasted more than eight hours prior to intubation. After standard monitoring was initiated, glycopyrrolate 0.1–0.2 mg was injected intravenously and 10% xylocaine spray was applied to the posterior pharynx. Patients were positioned for intubation in the left lateral or supine position as determined by randomization. The anesthetic trainee performed the intubation under supervision by an attending anesthesiologist. Patients were preoxygenated with 100% oxygen via facemask for at least three minutes prior to induction. Sedation with intravenous propofol 0.5–2 mg/kg and/or fentanyl 0.5–1 mcg/kg and/or midazolam 0.05–1 mg/kg was administered to maintain a Ramsay sedation scale score of 2 to 3.

First, the flexible intubating bronchoscope was introduced through the Ovassapian airway and then through the hypopharynx, vallecula, epiglottis and vocal cords. At the cords, 10 mg of 2% xylocaine was sprayed through the tip of bronchoscope outlet. Then, the scope was advanced into the trachea where another 10 mg of 2% xylocaine was sprayed. After the carina was identified, propofol 1-2 mg/kg was administered intravenously and the endotracheal tube was railroaded during inspiration. The scope was then slowly withdrawn. After confirmation of tube placement in the trachea using ETCO₂ capnography, non-depolarizing muscle relaxant (atracurium 0.5–0.6 mg/kg intravenous or cisatracurium 0.15-0.2 mg/kg intravenous) was administered. Intubation time was obtained from video recordings.

To maximize patient safety, anesthesiology trainees had to have practiced FSI with the mannequin in the supine position at least five times before intubating a patient. Intubation failure was defined as an intubation that required more than 10 minutes or more than two attempts. Rescue maneuvers included jaw thrust by an assistant when airway obstruction was noticed. If oxygen saturation was less than 95% for more than 10 seconds, desaturation was recorded as a complication [10]; when this occurred, the trainee stopped FSI and applied 100% oxygen facemask ventilation. A second attempt could begin after appropriate desaturation treatment. If a second attempt was required or intubation required more than 10 minutes, the patient was immediately placed in the supine position for intubation by an attending anesthesiologist using conventional laryngoscopy.

Sample size

Our sample size calculation was based on a previous FSI study [11]. We estimated that a sample size of at least 14 participants in each group was required to detect group differences with 80% power and 95% confidence intervals. A 20% dropout was estimated. Therefore, 40 participants (20 in each group) were enrolled.

Statistical analysis

Statistical analysis was performed using SPSS software version 18.0 (IBM Corp., Armonk, NY, USA). Patient characteristics are reported as means with standard deviation and range, medians with interquartile range, or frequencies with percentage. Intergroup differences were evaluated using the Student's t-test for normally distributed continuous variables, chi-square test for categorical variables, and Mann–Whitney U test for non-normally distributed continuous variables. $P < 0.05$ was considered significant.

Results

Study population

Fifty-two patients undergoing elective surgery under general endotracheal anesthesia were eligible for study inclusion. Among these, 12 did not meet inclusion criteria. Therefore, 40 patients were enrolled and randomly assigned to intubation in the supine (group S, $n = 20$) or left lateral position (group L, $n = 20$). The study flow diagram is shown in consolidated standards of reporting trial flow diagram (Figure 1).

Overall, patient characteristics were well balanced between the groups. (Table 1) Age, sex, weight, height, and body mass index did not significantly differ. Although group L did not have any patients with a Mallampati class 3 or 4 airway, group S had 9 (45%).

Trainee experience

Level of training was not significantly different between groups ($P = 0.245$). Group L was mostly third-year residents (50%) and Group S was mostly second-year residents (55%). Trainee experience prior to performing FSI was also not significantly different ($P = 0.304$) (Table 2). Some trainees commented that the anatomy was confusing with the patient in the left lateral position.

Primary outcome

Almost all patients (95% in both groups) were successfully intubated by FSI. The rate of successful intubation in groups L and S was 57.9% and 42.1%, respectively; the difference was not significant. The proportion of patients who required jaw thrust during FSI was significantly higher in group S (85% vs. 10.5%; $P < 0.01$) (Table 3).

Secondary outcomes

The average total intubation time in groups L and S was 209.37 ± 80.05 seconds and 202.47 ± 91.48 seconds, respectively (Table 4). The difference was not significant. Following successful intubation, all hemodynamic parameters (SBP, DBP, MAP, and heart rate) immediately responded in the same way in both groups. However, blood pressure (SBP, DBP and MAP) declined in both groups. Oxygen saturation also declined in both groups after intubation but remained above 95%. Desaturation below 95% occurred during intubation in four group L patients and nine group S patients. The relative risk of desaturation in

the left lateral position compared with the supine position was 0.44 (0.1649–1.1978). No patient experienced harm.

Discussion

This prospective randomized trial compared anesthesiology trainees performing FSI with patients in the supine position with trainees performing FSI with patients in the left lateral position. The rate of successful intubation on the first attempt and time of intubation did not significantly differ between the positions. However, the proportion of patients who required jaw thrust for airway assistance was significantly lower for the left lateral position group.

When practicing difficult airway intubation with a flexible scope, using sleeping patients who are spontaneously breathing provides two advantages. First, the flexible scope can be introduced into the airway without causing discomfort and laryngospasm risk is minimized. Second, if airway obstruction develops or spontaneous ventilation is not maintained, the anesthetic drugs can be stopped immediately [1]. Induction of general endotracheal anesthesia provides a good opportunity for FSI practice.

During EGD, sedated patients can maintain their airway without the need for a jaw thrust maneuver and the vocal cords can usually be visualized [9]. Furthermore, the lateral or semilateral position provides a better glottis view without any assistance or need to displace the tongue [12]. Our study found that FSI in the left lateral position can be archived mostly without performing the jaw thrust maneuver. In the supine position, the tongue or soft tissue of the throat can sag downward, which can obstruct the operator's view [13]. The lateral position structurally improves maintenance of the passive pharyngeal airway and is associated with a lower degree of upper airway obstruction compared with the supine position [14, 15]. The jaw thrust maneuver can produce a significance sympathetic response [16], jaw pain [17], patient discomfort [18], and bruising [19]. It can also narrow the spinal canal [20], which may cause spinal cord injury in patients with a cervical spine injury.

Our study demonstrated similar FSI success rates between patients in the left lateral and supine positions. The results are comparable to success rates after light wand-assisted intubation in the lateral decubitus position [21], video laryngoscope intubation in the left lateral position [22], and laryngeal mask intubation in the supine, right lateral, and left lateral positions [23]. In contrast, Li et al. [11] reported that intubation time was shorter in the lateral position and the first-attempt success rate was higher; however, in their study, all patients were paralyzed and FSI was performed by experienced anesthesiologists. Relaxation of muscle tone due to paralysis may have seriously affected their ability to intubate supine patients. Moreover, some trainees in our study commented that they were unfamiliar with the view of the airway anatomy with the patients in the left lateral position. McCaul et al. reported deterioration of the laryngoscopic view in the left lateral position in 35% of patients [24]. Two trainees in our study were unable to complete FSI with the patient in both the supine and left lateral positions; multiple factors may be involved, including their skill and experience.

Intubation in the left lateral position may have benefits. First, in patients undergoing surgery in the lateral position (e.g., endoscopic retrograde cholangiopancreatography), there is no need to reposition the patient after induction of general anesthesia, which may decrease the incidence of complications such as nerve injury, cervical spine injury, and accidental dislodgement of the endotracheal tube. Moving the patient may also cause loss of airway patency, change in endotracheal cuff pressure, tracheal mucosal damage, and microaspiration [25]. Second, this could be an alternative airway access in unavoidable circumstance such as penetrating wound at the back or cervical which patient couldn't be positioned in supine [26].

Our study groups did not differ in patient characteristics except for Mallampati class. Group S had multiple patients with a class 3 or 4 Mallampati score. The Mallampati score is used to predict the ease of endotracheal intubation [27]. However, previous meta-analyses concluded that this score by itself is inadequate for predicting difficult intubation [28]. Nonetheless, we found no difference in success rate between groups.

Overall, FSI in either position resulted in a transient decline in blood pressure. Because FSI causes less sympathetic stimulation than conventional direct laryngoscopic intubation [29] and propofol was administered to prevent the gag reflex prior to railroading of the endotracheal tube, FSI may require fewer doses of anesthetic drugs to attenuate the sympathetic response. Therefore, the incidence of drug side effects is expected to be lower.

To improve patient comfort and acceptance of FSI, sedation should be administered appropriately [30]. In moderate to deep sedation, respiratory depression and/or upper airway obstruction usually occurs, which leads to hypoxemia. The reported incidence rates of hypoxemia during moderate to deep sedation range between 12% and 33% [31–34]. The incidence of oxygen desaturation in our study was 36.84%. To avoid any participant harm, we defined desaturation as oxygen saturation <95% for >10 seconds [10]. In other studies, it was defined as saturation lower than 95% [31–34]. The incidence of desaturation in our study was lower in patients in the left lateral position; however, the difference was not significant. Future studies should include a greater number of participants to enhance statistical power and further examine the incidence of desaturation in sedated patients undergoing FSI in the left lateral position.

Some trainees in our study reported difficulty with FSI in the left lateral position. The main reason for this appears to be unfamiliarity and confusion with the view, which can cause esophageal intubation. Practice is required to become proficient. All levels of trainees should occasionally practice FSI with patients in positions other than the traditional supine position.

Conclusion

When performed by anesthesiology trainees in spontaneously breathing patients, the rate of successful FSI on the first attempt and intubation time did not differ between patients in the left lateral position and those in the supine position. Incidence of desaturation was lower in patients in the left lateral position. Furthermore, the proportion of patients who required a jaw thrust maneuver was significantly lower in

patients in the left lateral position. However, trainees were more confused with the view and esophageal intubation was more frequent in patients in the left lateral position. Anesthetic drugs should be carefully titrated during FSI induction to reduce hemodynamic fluctuations and drug side effects.

Limitations

This study has several limitations. First, the examiners could not be blinded as the intubation position was clearly visible. Second, our sample size was small and limited to trainees. A larger and more comprehensive sample of practitioners may give a more reliable estimate of the success rate of lateral intubation.

Abbreviations

flexible scope intubation (FSI), end-tidal carbon dioxide (ETCO₂), oxygen saturation (SpO₂)

Declarations

Ethics approval and consent to participate

Ethics committee approval was obtained by Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (COA. MURA2020/418). All experiments and methods were performed in accordance with relevant guidelines and regulations. Informed consent was obtained from all subjects and/or their legal guardian(s).

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that there is no competing of interest.

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Authors' contributions

PC and NS contributed to the design and implementation of the research. PC and TP collected data and the analysis of the results. PC, PL and TP worked on the manuscript. All authors discussed and approved the final manuscript.

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Declaration of interest statement

The authors declare that there is no conflict of interest.

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Tables

Table 1
Patient characteristics according to group

	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Sex, n (%)	14 (70.0%)	13 (65.0%)	0.114 ‡	0.736
Female	6 (30.0%)	7 (35.0%)		
Male				
Age (years), mean ± SD	54.30 ± 10.20	57.10 ± 8.53	-0.942 †	0.352
ASA physical status, n (%)	4 (20.0%)	2 (10.0%)	5.131 ‡	0.081
Stage I	12 (60.0%)	7 (35.0%)		
Stage II	4 (20.0%)	11 (55.0%)		
Stage III				
Physical examination				
Height (cm.), mean ± SD	159.36 ± 9.91	158.88 ± 8.78	0.160 †	0.873
Weight (kg.), mean ± SD	62.24 ± 12.06	63.22 ± 11.67	-0.261 †	0.795
BMI (kg/m), mean ± SD	24.49 ± 4.23	25.59 ± 4.34	-0.779 †	0.441
Mallampati class, n (%)	0	1 (5.0%)	12.120 ‡	0.003*
Class 4	0	8 (40.0%)		
Class 3	12 (60.0%)	6 (30.0%)		
Class 2	8 (40.0%)	5 (25.0%)		
Class 1				

*P <0.05, □ Z value, †t value, ‡χ² value

SD, standard deviation; ASA, American Society of Anesthesiologists; BMI, body mass index

	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Others, n (%)	0	3 (15.0%)	6.754 ‡	0.123
Neck precaution	1 (5.0%)	1 (5.0%)		
Thyromental distance 6 cm	0	1 (5.0%)		
Mouth opening 3 cm	0	1 (5.0%)		
Mouth opening <3 cm	0	1 (5.0%)		
Partial dentition	19 (95.0%)	13 (65.0%)		
None				
*P <0.05, º Z value, †t value, ‡χ² value				
SD, standard deviation; ASA, American Society of Anesthesiologists; BMI, body mass index				

Table 2
Trainee experience in flexible scope intubation according to group

	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Level of training, n (%)	0	1 (5.0%)	3.996 ‡	0.245
Fellow	4 (20.0%)	2 (10.0%)		
Resident, first year	6 (30.0%)	11 (55.0%)		
Resident, second year	10 (50.0%)	6 (30.0%)		
Resident, third year				
Median numbers of experience (range)	4 (0–9)	3 (0–6)	-1.028 º	0.304
* P <0.05, º Z value, † t value, ‡ χ² value				

Table 3

Intubation times, success rates, and proportions of patients who required jaw thrust during flexible scope intubation according to group

	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Intubation time				
Identify vocal cord (seconds)	70.0 (35.0, 95.0)	60.0 (23.0, 65.0)	-0.760 [□]	0.447
Pass vocal cord (seconds)	130.0 (90.0, 194.0)	122.0 (75.0, 184.0)	-0.482 [□]	0.630
Pass ETT, identify ETCO ₂ (seconds) or total time (seconds)	209.37 ± 80.05	202.47 ± 91.48	0.247 [†]	0.806
Success rate, % (n/N)	95 (19/20)	95 (19/20)	-	-
All attempts	57.9 (11/19)	42.1(8/19)	0.947 [‡]	0.330
The first attempt	42.1 (8/19)	57.9 (11/19)		
The second attempt				
Jaw thrust, n (%)	2 (10.5%)	17 (85.0%)	21.631 [‡]	<0.001*
Yes	17 (89.5%)	3 (15.0%)		
No				
* P <0.05, [□] Z value, [†] t value, [‡] χ^2 value				
ETT, endotracheal tube; ETCO ₂ , end-tidal carbon dioxide				

Table 4
Vital sign measurements during flexible scope intubation according to group

Item	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Intubation data (vital signs)				
SBP (mm Hg), mean ± SD				
Baseline	136.40 ± 25.26	148.35 ± 22.27	-1.587 [†]	0.121
After intubation within 1 minute	104.20 ± 25.51	120.60 ± 28.25	-1.927 [†]	0.062
Difference in SBP	-32.20 ± 23.92	-27.75 ± 20.20	-0.636 [†]	0.529
DBP (mm Hg), mean ± SD				
Baseline	80.80 ± 12.37	89.10 ± 15.51	-1.871 [†]	0.069
After intubation within 1 minute	66.05 ± 15.93	76.50 ± 18.67	-1.904 [†]	0.064
Difference in DBP	-14.75 ± 12.23	-12.60 ± 19.36	-0.420 [†]	0.677
MAP (mm Hg), mean ± SD				
Baseline	94.85 ± 15.04	107.60 ± 15.96	-2.600 [†]	0.013 [*]
After intubation within 1 minute	76.75 ± 16.49	90.35 ± 21.44	-2.249 [†]	0.030 [*]
Difference in MAP	-18.10 ± 15.65	-17.25 ± 21.19	-0.144 [†]	0.886
HR (beats/min), mean ± SD				
Baseline	82.65 ± 11.93	89.05 ± 18.50	-1.300 [†]	0.203
After intubation within 1 minute	83.80 ± 14.49	89.20 ± 14.94	-1.160 [†]	0.253
Difference in HR	1.15 ± 8.87	0.15 ± 12.57	0.291 [†]	0.773
SpO₂ (%), mean ± SD				
Baseline	99.60 ± 1.10	100.0 ± 2.22	-0.721 [†]	0.475
After intubation within 1 minute	97.80 ± 3.47	98.95 ± 1.88	-1.303 [†]	0.203

* P < 0.05, [‡] Z value, [†] t value, [‡] χ^2 value

SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure, MAP, mean arterial pressure, HR, heart rate; SpO₂, oxygen saturation

Item	Group L (n = 20)	Group S (n = 20)	Statistic	P-value
Difference in SpO ₂	-1.80 ± 3.49	-1.05 ± 2.74	-0.756 [†]	0.454
* P < 0.05, [‡] Z value, [†] t value, [‡] χ ² value				
SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure, MAP, mean arterial pressure, HR, heart rate; SpO ₂ , oxygen saturation				

Figures

ASA, American Society of Anesthesiologists

Figure 1

Consolidated standards of reporting trial flow diagram