Left Head Rotation as An Alternative to Difficult Tracheal Intubation: A Randomized Open Label Clinical Trial

Danya Chan, MD

George Carlos Rosendo RM. Jularbal III, MD, FPSA

Ismael Julius R. Mapili, MD, FPSA, DPBPM

Department of Anesthesiology, Baguio General Hospital & Medical Center, Philippines

Abstract

Background: Tracheal intubation is a life-saving intervention not only for physicians but also for allied health workers. Optimizing the patient's head and neck position for the best glottic view is a crucial step that accelerates tracheal intubation. The left head rotation maneuver has been recently described as an innovative approach to tracheal intubation with marked improvement in glottic visualization and can be an alternative before proceeding to a surgical airway.

Objective: This study aimed to compare the glottic view and intubating conditions in the sniffing position versus left head rotation during direct laryngoscopy.

Methods: This randomized, open-label clinical trial enrolled fifty-two adult patients admitted to the Baguio General Hospital & Medical Center from September to December 2020 for an elective surgical procedure requiring tracheal intubation under general anesthesia. Intubation was done using a 45-degree left head rotation in the experimental group, while the control group was intubated using the conventional sniffing position. Glottic visualization and intubation difficulty with left head rotation and sniffing position were assessed using Cormack-Lehane Grade and Intubation Difficulty Scale, respectively. Successful intubation is measured by observing a capnographic waveform in the end-tidal CO2 monitor after placement of the endotracheal tube.

Results: There was no significant statistical difference in the clinicodemographic characteristics between the two groups. There was no significant difference in the Cormack-Lehane Grade (p=0.449), with the majority of patients classified under Grade 1 (21% in left head rotation and 28% in sniffing position) and Grade 2 (21% in left head rotation and 13% in sniffing position). Also, there were no statistically significant differences (p=0.847) in the Intubation Difficulty Scale scores of patients intubated with left head rotation or sniffing position; 17.3% and 15.4% of patients were easily intubated with left head rotation and sniffing position, respectively while slight difficulty was noted with most patients with no between-group differences (26.9% in left head rotation and 30.8% in sniffing position). Greater than one attempt at intubation, use of an alternative technique such as a stylet, and the need for more than one operator were commonly used with left head rotation. The intubation success rate was 100% (26/26) in the sniffing position, while the success rate was 92% (24/26) with left head rotation .

Conclusions: Sniffing position provided a higher intubation success rate but with comparable laryngeal exposure and intubation ease to left head rotation. However, since our sample size was small, studies with a larger study population are warranted to establish the generalizability of our findings. In addition, we observed inadequate familiarity among anesthesiologists with the left head rotation technique, and the intubation success rate may improve as practitioners attain greater technical familiarization.

Trial Registration:

Keywords: tracheal; endotracheal; intubation; airway management; sniffing position; LeHeR.

Introduction

Tracheal intubation is an essential life-saving intervention. However, patient intubation in a difficult airway requires specialized technical skills, availability of appropriate equipment, and proper assessment of the clinical situation and priorities [1]. Consequently, difficult intubation situations are routinely encountered in the hospital and prehospital settings by experienced and inexperienced physicians or allied health professionals [2]. Moreover, predicting airway management-related difficulties remains a challenge and cause of frustration among anesthesiologists [3]. Although some studies have attempted to predict difficult intubation using a simple bedside physical examination [4], others have noted the limited and inconsistent capacity of bedside physical examination to identify patients with difficult airways [5]. Furthermore, assessing the risk of difficult airway intubation beforehand may be impossible during emergency situations [6].

A study by Cheong et al. [7] on airway practices suggested that only about half of the difficult intubations could be predicted by standard airway exams. Poor visualization of the larynx often leads to difficult intubation, which may result in complications such as aspiration, esophageal intubation, and prolonged hypoxia. Subsequently, these complications may increase patient morbidity and mortality [8]. Therefore, optimizing the patient's head and neck position for the best glottic view is crucial for successful tracheal intubation [9]. Achieving optimal head and neck position is also included in the Difficult Airway Society guidelines for managing adult patients with unanticipated difficult tracheal intubation [10].

Several head and body positions are employed to facilitate tracheal intubation. The sniffing position, which is achieved by the flexion of the lower cervical spine, the extension of the upper cervical spine, and extension of the atlantooccipital joint [9], is the preferred position among anesthesiologists [11] and is the current gold standard in the intubation process [12]. Several studies have reported attaining an optimal head position for direct laryngoscopy and intubation with the normal airway in the sniffing position [9, 12, 13]. However, in some studies sniffing position did not improve glottic visualization, the success rate on first intubation, or intubation time [14, 15]. Consequently, various maneuvers have emerged as an alternative to the sniffing position, such as cricoid pressure application [16], BURP (backward, upward, and rightward pressure) [17], and head extension [18], and external laryngeal manipulation [19].

Intubation in the lateral position has been especially well studied [20-23]. A systematic review of different intubation positions in trauma patients suggests reduced airway patency in the supine position compared to the lateral position [23]. In a supine position, the mechanisms of upper airway obstruction include reduction of pharyngeal dilator muscle activity and gravitational effects on anterior upper airway structures [24]. In contrast, lateral position widens the upper airway [25]; hence, upper airway obstruction can be significantly reduced to improve laryngeal visualization. Although some studies suggest that the lateral position may be more difficult than the supine position [26], a reduction in intubation time was noted after the third attempt in the lateral position [27]. In a more recent study by Goh et al. [28], patients were successfully intubated in the lateral position by anesthesiology trainees on the first attempt, with a mean duration of intubation of 57.3±36.4 seconds. The successful use of a video laryngoscope in the lateral position has also been previously reported [29].

Furthermore, some studies suggest that the head-elevated laryngeal position may be superior to the sniffing position [14, 30], although the degree of head elevation necessary to facilitate the external auditory meatus and sternal notch alignment may vary among patients. Thus, Myatra [31] proposed abandoning the conventional "one size fits all" approach with headrests at a fixed height and considering using an individualized intervention when positioning patients for laryngoscopy.

Adding to the range of available head and body positions to facilitate tracheal intubation, Yezid et al. [8] reported using the left head rotation maneuver to optimize head and neck position during tracheal intubation non-trauma patients in 2019. Like the lateral position, left head rotation increases the upper airway's cross-sectional area due to the lateral displacement of the esophagus to the left of the cricoid cartilage. However, this lateral displacement of the esophagus has only been reported in awake non-trauma patients [32], while studies in sleeping subjects did not observe a decreased pharyngeal pressure with left head rotation [33].

Thus, it remains uncertain whether head rotation improves airway patency and glottic visualization in anesthetized individuals. Therefore, in this randomized open-label clinical trial, we aimed to compare the glottic view and intubating conditions with left head rotation versus the conventional sniffing position during direct laryngoscopy of patients undergoing elective surgery and evaluate if the left head rotation maneuver is a viable alternative for difficult endotracheal intubation.

Method

Study Participants and Research Design

This randomized open-label clinical trial enrolled patients admitted to the Baguio General Hospital & Medical Center from September to January 2021 for an elective surgical procedure requiring tracheal intubation under general anesthesia. The criteria for inclusion in the study were: patients aged 18-65 years old, BMI range of 18.5-35.0 kg/m^2, American Society of Anesthesiology Physical Status (ASA-PS) I to III (see [34] for details of ASA-PS staging), and Mallampati Grade III. Mallampati Grade measures the visibility of pharyngeal structures (tonsillar pillars, soft palate, and base of uvula), which is noted by instructing the patient to open his/her mouth and protrude the tongue maximally in the sitting posture (see [35] for details of Mallampati grade classification).

Patients with Mallampati IV, sternomental distance <12 cm, thyromental distance <6 cm, small mouth opening <3 fingerbreadths, limited head rotation or neck extension, BMI >35 kg/m^2, known gastroesophageal reflux, presence of anterior neck mass, or facial fractures obstructing the airway were excluded from the study.

Enrolled participants who met the inclusion criteria were randomized by draw lots into the experimental (intubated with left head rotation; n=26) and control groups (intubated in the sniffing position; n=26). Group assignments were written on a sheet of paper, which are either 'Group A' (left head rotation) or 'Group B' (sniffing position). The papers were shuffled and numbered and there be an equal number of allocated participants for each group base. The consultant or senior anesthesiology resident opened the papers drawn prior to the induction of anesthesia to determine group assignment. Thus, the consultant or senior anesthesiology resident served as the observer, and the researcher (DC) was blinded during data collection. In addition, senior anesthesiology resident who takes part in the data collection were currently at or beyond their second clinical anesthesia year. The flow of patient selection and randomization is described in Figure 1.

Ethical Considerations

The protocol and informed consent forms were reviewed and approved by the institutional ethics board of Baguio General Hospital & Medical Center (Protocol Number: BGHMC-ERC-2020-27). The researcher obtained written informed consent the day before the scheduled operation. The consent form was available in English, Filipino, and Ilocano with identical content covering the nature of the study; study procedure; risks, benefits, and complications; data security and confidentiality; and voluntary participation and withdrawal. The contents of the consent forms were also verbally explained to the participants, and they were reminded that they were free to withdraw from the study at any point, and if they decided to withdraw prior to the surgical procedure, treatment would not vary, and standard care will be provided. The researcher also provided an audio-visual presentation of the intubation procedures in a manner or language that the patient, senior resident and consultant understands.

Care was taken to maintain the confidentiality and security of the data. Only DC has access to the password-protected data, and upon completion of the study, all data were archived in the Hospital Information and Management System (HIMS) office for future reference.

Intubation procedure

The anesthesiology resident or consultant in charge performed a physical examination and a thorough airway evaluation during the preoperative evaluation to assess the ease of intubation. Laryngoscopy was done using an EMS Fiber Optic Laryngoscope Stubby Handle (EMS, Germany) throughout the study with Macintosh Mega Mac Blade (EMS, Germany). Laryngoscope blades were disinfected with Caviwipes (Metrex Research LLC, California, USA), washed with soap and water, and sterilized to prevent cross-contamination. Before intubation, the laryngoscope's functionality and the battery status were checked by a senior resident.

Standard ASA monitors (electrocardiogram, noninvasive blood pressure, and pulse oximetry) were applied upon arrival at the operating room. Pre-procedural medication included intravenous (IV) injections of Midazolam (0.1 mg/kg) for anesthesia and Fentanyl (2 mcg/kg) for analgesia. In addition, all patients were pre-oxygenated with 100% oxygen for 3 minutes through a circle system and a standard face mask with a carbon dioxide/flow sensor between the mask and the breathing circuit. Standard induction included injection of Propofol at 2-2.5 mg/kg IV or until the loss of eyelash reflex was achieved and injection of Rocuronium 0.6 mg/kg IV for muscle relaxation to facilitate intubation.

Macintosh number 3 or 4 laryngoscope blade was used depending on the anesthesiologist's decision. Intubation was performed with a tracheal tube size of 7.0 in women and 7.5 in men. Intubation was done using a 45-degree left head rotation (estimated with the aid of a protractor) in the experimental group, while the control group was intubated using a sniffing position by placing a cushion under the head such that the external auditory meatus and sternal notch are on the same horizontal plane. Glottic visualization and intubation difficulty with left head rotation and sniffing position were assessed using Cormack-Lehane Grade [36] and Intubation Difficulty Scale [37], respectively, which were evaluated by the consultant or senior anesthesiology resident in charge (the researcher was not involved in the scoring).

Cormack-Lehane Grade is a conventionally used scale that measures laryngoscopic or glottic view during laryngoscopy [38]. The four Cormack-Lehane Grades are as follows: complete visualization of the vocal cords (Grade 1); visualization of the inferior portion of the glottis (Grade 2); visualization of only the epiglottis (Grade 3); and non-visualized epiglottis (Grade 4). No external laryngeal pressure was applied for grading the laryngoscopic view [36].

The Intubation Difficulty Scale is an objective and comprehensive assessment of the difficulty of intubation based on seven parameters as follows [37]:

N1: number of attempts >1,

N2: number of operators >1,

N3: number of alternative techniques,

N4: Cormack-Lehane Grade,

N5: lifting force required,

N6: external laryngeal manipulation used, and

N7: vocal cord adduction.

A score of 0 on the Intubation Difficulty Scale represents ideal intubation with minimum difficulty, scores between 1 and 5 represent slight difficulty with intubation, and a score greater than 5 represents moderate to major difficulty with intubation.

Alternative techniques were used to facilitate intubation in case intubation was unsuccessful with left head rotation or the sniffing position alone and included a change of blade or tube, the addition of a stylet, change to nasotracheal intubation, applying pressure on the cricoid cartilage, and use of fiberoptic intubation or intubating laryngeal mask airway. In addition, if the intubation was deemed unsuccessful after two attempts, an alternative position was used (change to sniffing position if difficulty intubating with left head rotation, and vice versa). The duration of each intubation attempt was no longer than 10 minutes.

A carbon dioxide/flow sensor measured end-tidal carbon dioxide, the gold standard for confirming successful tracheal intubation. The airway was secured, and breaths were delivered through the endotracheal tube using an anesthesia ventilator by PRVC mode at 12 breaths per minute, inspiratory to expiratory ratio of 1:2, positive inspiratory pressure of 15 cmH_2O, and positive end-expiratory pressure of 0 cmH_2O. The study protocol ended at this point, and the intended surgical procedure proceeded as planned.

Safety Considerations

The anesthesiologist in charge prioritized the patient's comfort and safety, and any changes in vital signs such as hypotension and bradycardia were actively looked out for . Adequate hydration, oxygenation, and pain control were maintained throughout the procedure, and the risk of desaturation was minimized with 100% oxygen insufflation during laryngoscopy. Patient safety during apnea was ensured by continued physiological monitoring, including pulse oximetry in all cases. Although routine suction of secretions from the upper airways is not explicitly recommended, it was performed if symptoms suggestive of secretion accumulation were observed. The induction of the anesthetic, as well as the use of neuromuscular blocking agents, followed the latest anesthetic guidelines.

If injuries occurred because of difficult intubation, it was addressed as follows: if a tooth was chipped or extracted, the patient's watchers were informed, and strict aspiration precautions were applied. Minor lacerations on the lips were allowed to heal via secondary intention, while large lacerations with continuously bleeding were sutured. Patients who failed to be intubated using left head rotation or standard sniffing position received an appropriate standard point of care based on Difficult Airway Society guidelines. An otolaryngologist or general surgeon was available if the procedure required invasive airway access, such as tracheostomy or cricothyrotomy. Untoward reactions were included in the report, and a close follow-up was advised.

Sample Size Calculation

The sample size was computed using 95% confidence interval, 80% power, 68% exposed with the outcome, and 100% unexposed with outcome using OPEN-EPI version 3.1. Due to limited studies with intubation using left head rotation, the sample size computation was based on the study by Khan et al. [26], where the exposure outcome was based on a 68% success rate in intubation with direct laryngoscopy using the left lateral position while the unexposed outcome was based on success rate in intubation with direct laryngoscopy using the sniffing position. The total sample size was computed at fifty-two, with twenty-six participants in each group.

Statistical Analysis

Statistical analysis was conducted using Statistical Package for Social Sciences (SPSS) Software (Version 17.0, SPSS, Inc, Chicago, IL, USA). The conceptual framework for the analysis is described in Figure 2. Descriptive statistics, which include patient age, sex, and BMI, as well as differences in Cormack-Lehane Grades (Grade 1-4) and intubation difficulty (minimum, slight, moderate to major), were presented as frequency and percentage, and the differences between experimental and control groups were compared using the Chi-square test. In addition, independent-sample t-tests were used to compare the mean Intubation Difficulty Scale scores of the two groups, and Z-test was used to compare the proportions of patients staged under six out of seven component variables of the Intubation Difficulty Scale (N1, N2, N3, N5, N6, and N7), while an independent t-test was used for N4. Finally, the intubation success rate was presented as frequency and percentage. All tests were two-sided, and p-values of <0.05 were considered statistically significant.

Results

Descriptive Data

A total of fifty-two adult patients were enrolled in this study; 57.7% were males, and 55.8% were 45 years or older (Table 1). The BMI of 50% of the patients in both groups was in the normal range, while the rest were overweight or obese. No between-group differences were noted in the clinicodemographic characteristics of patients intubated with left head rotation or sniffing position.

Glottic Visualization and Intubation Difficulty

The majority of patients were classified under Grade 1 and Grade 2 on the Cormack-Lehane Grade scale. There was no significant association between Cormack-Lehane Grade and the two intubation positions ($p=0.449$, Table 1). Further, 17.3% of patients were easily intubated with no difficulty in the left head rotation position, while 15.4% were easily intubated in the sniffing position. However, slight difficulty was noted with most patients with no between-group differences (26.9% in left head rotation and 30.8% in sniffing position). Moderate to major difficulty with intubation was noted in only a small number of patients in the two groups (5.8% in left head rotation and 3.58% in sniffing position). The mean Intubation Difficulty Scale score was similar between patients intubated with left head rotation and sniffing position.

We also did not observe between-group differences in any of the seven variables of the Intubation Difficulty Scale. Overall, eleven patients required more than one intubation attempt (11% in left head rotation and 9% in sniffing position), four needed more than one operator (5.8% in left head rotation and 1.9% in sniffing position), thirteen required the use of alternate techniques (13.5% in left head rotation and 11.5% in sniffing position) for the successful passage of the endotracheal tube through the glottis, eighteen required lifting force (13.5% in left head rotation and 21.5% in sniffing position), ten required application of laryngeal pressure (5.8% in left head rotation and 13.5% in sniffing position), and five had vocal cord mobility (5.8% in left head rotation and 3.85% in sniffing position) (Table 1). The average number of glottic exposure was 1.36 in both groups.

Intubation Success Rate

The intubation success rate was 100% in the sniffing position (Table 1). In addition, two patients in the sniffing position who were classified under moderate to major difficulty on the Intubation Difficulty Scale were intubated successfully after the second attempt; hence shifting position was deemed unnecessary.

On the other hand, only 92% of the patients were successfully intubated using left head rotation. Three patients in the left head rotation were staged under moderate to major difficulty on the Intubation Difficulty Scale. Patient 1 had an Intubation Difficulty Scale score of 6 and had successful intubation after changing the operator on the second attempt. Patient 2 had a Grade 3 glottic visualization and an Intubation Difficulty Scale score of 7 in the left head rotation position. Despite using a stylet, cricoid pressure, and additional lifting force, intubation was unsuccessful in this patient after two attempts. However, Cormack Lehane Grade improved to Grade 2 and the Intubation Difficulty Scale score to 3 upon changing to the sniffing position. Patient 3 had Grade 4 glottic visualization with an Intubation Difficulty Scale score of 8. The patient's airway could not be secured using left head rotation despite two intubation attempts, the use of a stylet, application of cricoid pressure and additional lifting force, or the change of operator. After changing to the sniffing position, Cormack Lehane Grade improved from Grade 4 to Grade 1, the Intubation Difficulty Scale score improved from 8 to 2, and intubation was successful on the first attempt.

Discussion

Principal Results

Considering Mallampati III as a sensitive criterion to difficult intubation, the findings of this study suggest that glottic visualization and intubation difficulty with left head rotation may be an alternative to the conventional sniffing position for endotracheal intubation in anesthetized patients undergoing elective surgery. We used the Intubation Difficulty Scale scores to define difficult intubation that reflects all intubation courses [39]. Earlier studies have shown that patients with Mallampati class III or IV, decreased thyromental distance, reduced mouth opening, and other anatomical abnormalities are more likely to have higher Intubation Difficulty Scale scores than patients without any predictive factors of intubation difficulty [39]. This is comparable to the recent studies of Oria et. al. citing higher risks of difficult intubation among patients with Mallampati III and IV, decreased mouth opening and reduced neck mobility [40, 41]. Even though the presence of moderate to major difficulty is infrequent in earlier reports and observed in only about 8% of the patients, the rate of intubation with any problem is surprisingly low [39]. We defined easy intubation (zero value of Intubation Difficulty Scale) as one performed without additional effort, comprising one attempt, practiced by one operator, using a single technique, with complete visualization of the laryngeal aperture (vocal cords abducted). Even though the differences in the seven constituent parameters of the Intubation Difficulty Scale were statistically non-significant between patients intubated with left head rotation and sniffing position, it is worth noting that numerically fewer patients required the use of increased lifting force (13.5% vs. 21.5%) and laryngeal pressure (5.8% vs. 13.5%) when patients were intubated with left head rotation.

Nevertheless, the intubation success rate with left head rotation was not statistically significant to intubation in the sniffing position, with only 92% of patients being successfully intubated with left head rotation compared to 100% of the patients in the sniffing position. All three patients in the left head rotation group with unsuccessful intubation had moderate to major difficulty on the Intubation Difficulty Scale; one patient was successfully intubated after a change in operator, and the other two required changing to sniffing position for successful intubation. Greater than one attempt at intubation, use of an alternative technique such as a stylet, and the need for more than one operator were commonly used when the patient was in the left head rotation position. These results indicate that the sniffing position provides a higher intubation success rate since there is better laryngeal exposure and intubation ease than left head rotation.

Although alternate intubation techniques and devices such as video laryngoscopes and flexible bronchoscopes may make the left head rotation maneuver seem less effective, the use of advanced techniques may not be readily available in all hospitals, especially in low- and middle-income settings, as is the case in this study. Therefore, anesthesiologists should continue to explore other modalities to optimize the glottic view during direct laryngoscopy [31]. Adding left head rotation may provide better visualization of the glottis in hospitals where advanced techniques are unavailable. The clinical experience of anesthesiologists performing endotracheal intubations may also have played a significant role in our assessments of the difficulty of endotracheal intubation. Senior residents and consultants who participated in the study were oriented with the research process but had limited experience with left head rotation. Some awkwardness was noted during the first intubation attempt as residents performed intubation in the left head rotation position. The senior residents also noticed the need for greater familiarization with the left head rotation technique. Since the sniffing position is almost always the default approach, simulation training of left head rotation for practitioners is warranted to provide greater familiarization. Furthermore, regular use of the left head rotation technique in the future and documentation of challenges may help improve the intubation conditions with left head rotation. In this study, most residents noted some difficulty intubating with left head rotation during the first attempt, but intubation became easier during subsequent attempts with left head rotation.

Left head rotation maneuver is also compliant with the Difficult Airway Algorithm recommended by the Difficult Airway Society and, with more technical familiarity, may be a practical noninvasive alternative approach to improve the glottic view among anesthetized patients requiring tracheal intubation. In addition, the potential outcome of this study can benefit patients by providing quicker airway access during intubations and fewer intubation attempts, thereby improving patient safety.

It is worth noting that while the study included patients who had Mallampati III Classification during preoperative evaluations, only eight out of the fifty-two patients enrolled in this study had a Cormack-Lehane Grade of ≥ 3. Modified Mallampati classification is a widely used tool for predicting difficult airways, and a Mallampati score of III or IV is considered a good predictor of difficult intubation [42, 43]. However, even though the Mallampati classification has exceedingly high specificity when used alone, the sensitivity is typically low, with an increased number of false-positive results [43, 44]. While multiple indicators have been identified for predicting difficult airway [4, 44] and a single specific technique would be ideal for a quick and easy assessment, the observation in this study support the findings of previous studies that Mallampati classification, when used solely, may not have adequate sensitivity in predicting difficult laryngoscopy, intubation, or bag-valve-mask ventilation [43, 45].

Limitations

There are several limitations of this study. First, the present study was conducted for a brief period and lacked adequate population representation. Second, the sample size was small, and more extensive trials with a larger study population, in diverse settings, and over an extended period are needed to establish the effectiveness of left head rotation or lack thereof. Third, given the scarcity of evidence to support the use of left head rotation as a maneuver to optimize tracheal intubation, this study was limited to a patient population where a minimal delay to the intubation period would not present a significant risk to the subject, further limiting the generalizability of our findings. Fourth, the study was conducted during the COVID-19 pandemic, and the use of level 4 personal protective equipment may have influenced the intubation techniques. Studies even before the pandemic have identified the practical problems of excessive heating and fogging while wearing a transparent face shield device during tracheal intubation of patients, although personal protective equipment had no significant effect on the intubation times [46]. Fifth, since the study is a randomized, open-label clinical trial, the observer could not be blinded due to apparent differences in head positions. Lastly, proper airway evaluation and visualization can be affected by the skill of the anesthesiologist, which was not factored in our analysis.

Comparison with Prior Work

Except for the case study by Yezid et al., which described the intubation of four patients using left head rotation [8], the effect of axial head rotation on airway patency has not been evaluated systematically. However, from our correspondence with the author (Dr. Nur Hafiza Yezid, Emergency and Trauma department, Hospital Jitra, Kedah, Malaysia; December 2019), we are aware of two ongoing studies using left head rotation: one being conducted at the Department of Anesthesiology, Ampang Hospital, Malaysia and the other at the Department of Emergency Medicine, University of Malaya, Malaysia. Unfortunately, the results of these investigations are yet to be published.

However, prior studies have used variations of left head rotation in specific circumstances. For instance, Le Bervet et al. [47] showed improved Cormack-Lehane Grade score and intubation efficiency with a left-handed Macintosh blade when combined with a rotation of the cervical spine to the left in about 10% of patients under general endotracheal anesthesia. Similarly, Ueda et al. showed that adding left head rotation to the "ramped position" improved laryngeal view compared to ramped position alone [48]. Head rotation is also recommended when performing cardiopulmonary resuscitation [49] and during drug-induced sleep endoscopy in patients with obstructive sleep apnea in the supine position [50].

Furthermore, difficult mask ventilation often coexists with difficult tracheal intubation. Two crossover clinical trials [24, 51] have compared the efficiency of head rotation on face mask ventilation in patients requiring general anesthesia. Head rotation of 45 degrees in anesthetized apneic adults significantly increased the efficiency of mask ventilation compared with the neutral head position [24]. On the other hand, a 30-degree clockwise lateral head rotation did not significantly affect mask ventilation volume, resulting in an increase in some patients and a decrease in others [51]. It is noteworthy that these crossover clinical trials used right head rotation, but because airway obstruction for most individuals is symmetric, rotation in the opposite direction is unlikely to alter the findings. In all these cases, intubation with head rotation was successful after more than one intubation attempt and in conjunction with other maneuvers (ramped position, sniffing position, supine position, hyperextension, and aid of a bougie). To our knowledge, the current study is the first to comprehensively compare the effectiveness of left head rotation with the sniffing position as the primary technique used to facilitate tracheal intubation of anesthetized non-trauma patients undergoing elective surgery.

Conclusion

This study showed that the sniffing position provided a higher intubation success rate but with comparable laryngeal exposure and intubation ease than left head rotation. In addition, since the sniffing position is used as the default, the intubation success rate with left head rotation may improve as practitioners attain greater technical familiarization. However, since our sample size was small, studies with a larger study population are warranted to establish the generalizability of our findings.

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Authors Contributions

DC participated in study conception and design, in acquisition of data, in analysis and interpretation of data, and in manuscript draft. GJ and JM were involved in the study conception and design, in interpretation of data, and in manuscript revision. All authors read and approved the final manuscript. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Conflicts of Interest

None declared.

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Tables and Figures

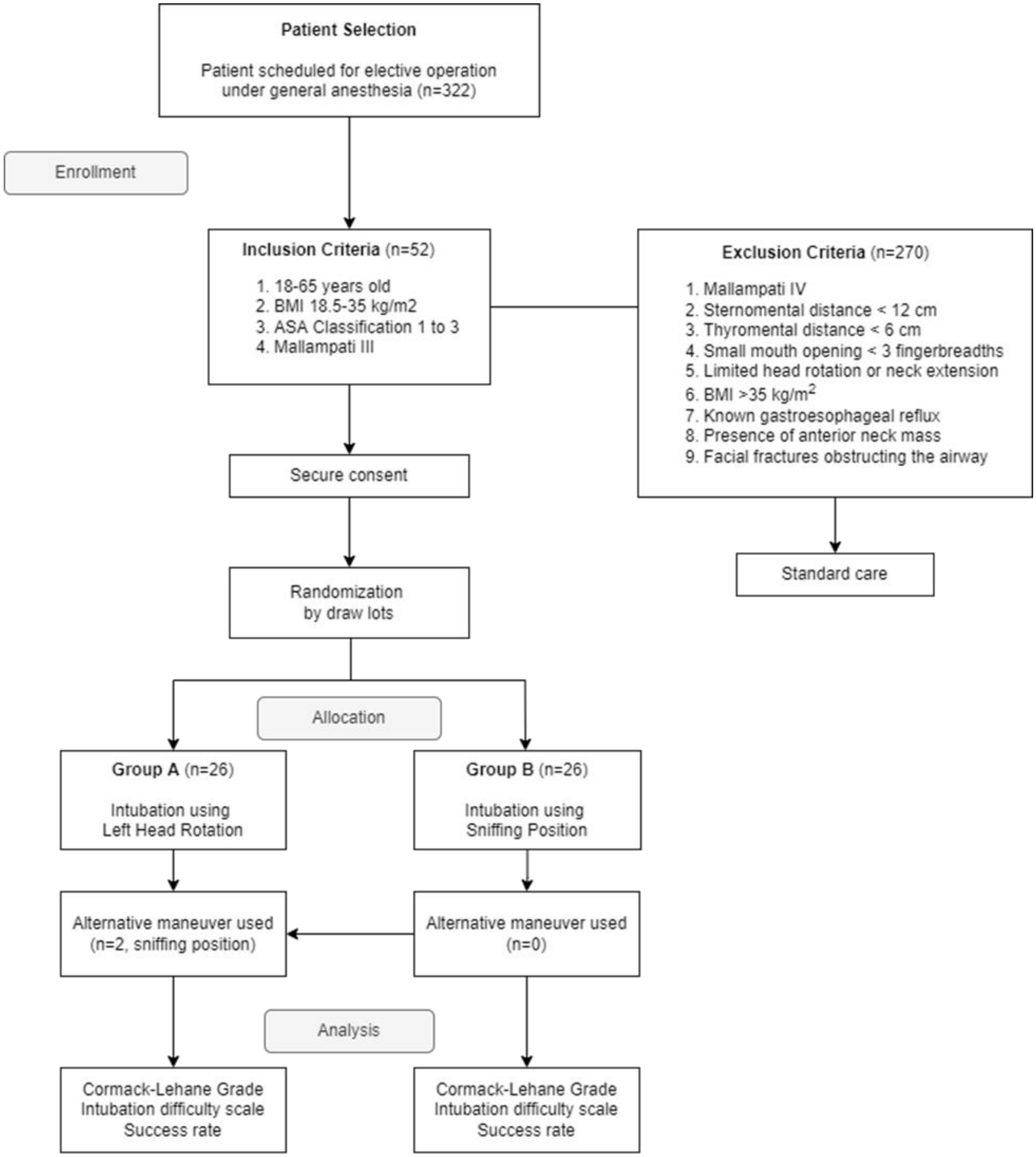

Figure 1. The flow of patient selection and randomization procedure.

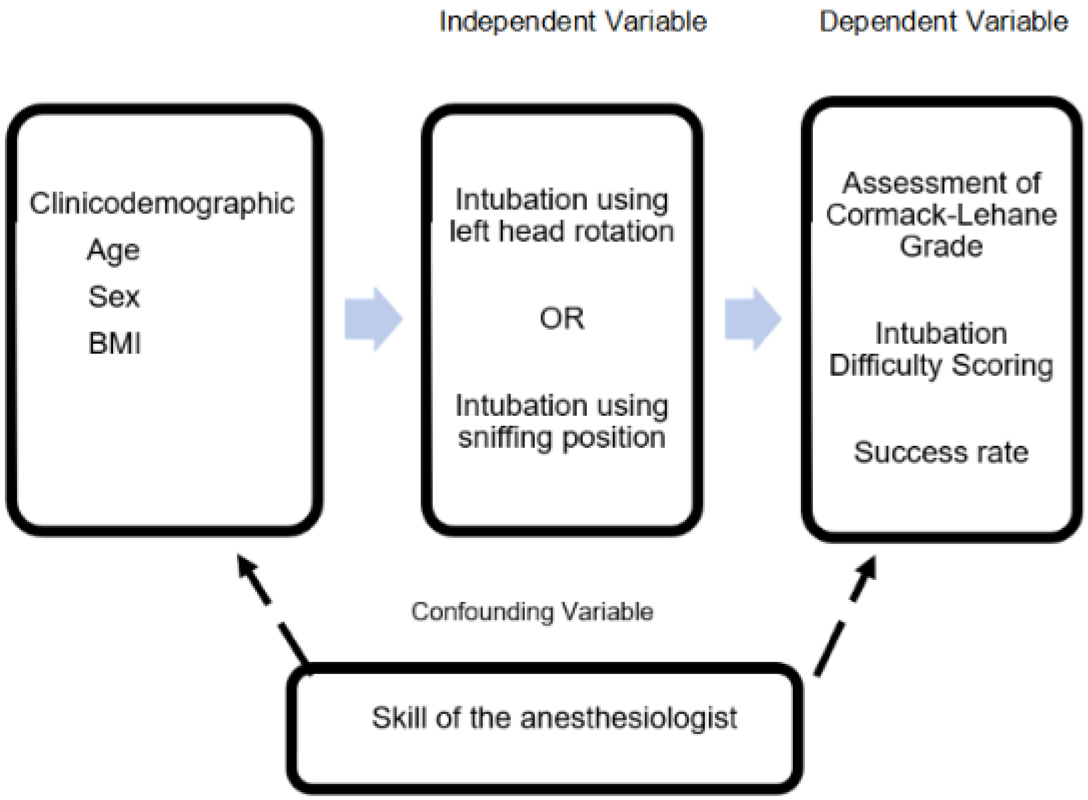

Figure 2. Conceptual framework: the relationship of variables in left head rotation.

Figure 3. Left head rotation.

Table 1. Characteristics of patients undergoing tracheal intubation with left head rotation or sniffing position.

Variables	Left Head Rotation		Sniffing Position		p-value
	f	%	*f*	%	
Age, *years*					
18-26	5	9.62	2	3.85	
27-35	4	7.69	4	7.69	
36-44	3	5.77	5	9.62	0.710
45-53	6	11.54	8	15.38	
54-65	8	15.38	7	13.46	
Sex					
Male	18	34.62	12	23.08	0.160
Female	8	15.38	14	26.92	
BMI					
Normal	13	25.00	13	25.00	0.924
Overweight	8	15.38	7	13.46	
Obese I	5	9.62	6	11.54	
Cormack-Lehane Grade					
Grade 1	11	21.15	15	28.85	0.449
Grade 2	11	21.15	7	13.46	
Grade 3	3	5.77	4	7.69	
Grade 4	1	1.92	0	0.00	
Intubation Difficulty					
Minimum difficulty	9	17.31	8	15.38	0.822
Slight difficulty	14	26.92	16	30.77	
Moderate to major difficulty	3	5.77	2	3.85	
Mean IDS score*	1.77		1.88		0.847
Intubation Difficulty Scale Variables					
N1: Number of attempts >1	6	11.54	5	9.62	0.8219
N2: Number of operators >1	3	5.77	1	1.92	0.4703
N3: Number of alternative techniques	7	13.46	6	11.54	0.8342
N4: Cormack-Lehane Grade	Mean=1.36		Mean=1.36		0.978
N5: Lifting force required	7	13.46	11	21.15	0.4636
N6: External laryngeal manipulation used	3	5.77	7	13.46	0.3469
N7: Vocal cord adduction	3	5.77	2	3.85	0.7463
Comparison of intubation Success Rate					
No. of Successful Intubation	24	92	26	100	
Alternative Techniques used					
Sniffing Position	2	100		0	
Left head rotation		0		0	
Head elevation		0		0	