Original Article

# Comparing the posture and comfort of anaesthesiologists during laryngoscopy and tracheal intubation in the head-elevated laryngoscopy position in supine position and with a 25° backup: A randomised clinical crossover trial

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## ABSTRACT

**Background and Aims:** The head-elevated laryngoscopy position (HELP) and a 25° backup have been proposed to enhance glottic visualisation, yet concerns about ergonomic discomfort hinder their widespread adoption. This study compares the comfort and posture adopted by anaesthesiologists while performing laryngoscopy and tracheal intubation with patients in HELP while in a supine position or with 25° backup. **Methods:** The study included 48 patients aged 18–60 years with normal airways and 12 experienced anaesthesiologists. Patients were randomised into two groups using permuted block randomisation. Anaesthesiologists performed laryngoscopy and intubation in supine HELP and 25° backup HELP positions. Anaesthesiologist's posture was determined by measuring the angles of neck, wrist, elbow, back and knee joints, which were compared using Student's *t*-test, and subjective comfort assessed on a Likert scale was compared using the Chi-square test. As mentioned by the anaesthesiologist, Cormack- Lehane grading was also noted and compared using a Chi-square test between groups, taking a *P* value <0.05 as significant. **Results:** Both positions demonstrated comparable anaesthesiologist posture ($P = 0.919$) and comfort ($P = 0.644$). However, the 25° backup HELP positions significantly improved Cormack–Lehane grades, with 68% achieving grade 1 compared to 31% in the supine HELP group ($P = 0.012$). Haemodynamic stability and tracheal intubation time showed no significant differences between the groups ($P = 0.475$ and 0.117, respectively), and no complications were reported in either group. **Conclusion:** Anaesthesiologists' posture and comfort during laryngoscopy and tracheal intubation are similar between supine and 25° backup in patients with easy airways.

**Keywords:** 25° Backup, ergonomics, head-elevated laryngoscopy position, intratracheal, laryngoscopy, patient positioning, posture, tracheal intubation

## INTRODUCTION

Proper patient positioning is crucial for optimal glottic visualisation and improved tracheal intubation success. Research suggests that the head-elevated laryngoscopy position (HELP) surpasses the sniffing position in facilitating laryngoscopy and tracheal intubation.[1,2] Also, it has been stated that a 25° backup along with HELP has been proven to enhance the anaesthesiologist's glottic visualisation further.



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Despite these proven benefits, these positions were not commonly utilised for laryngoscopy or intubation. When informally enquired, anaesthesiologists stated that they were not comfortable and were afraid of abnormal posturing while intubating in a backup position. One study reported objective measurements of an anaesthesiologist's posture by measuring various angles of the neck, back, arms and leg joints while performing intubation in the sniffing position.[3] However, there is a paucity of objective data available on laryngoscopy and tracheal intubations performed with HELP in supine and a 25° backup.

We hypothesised that implementing the 25° backup with HELP would improve the anaesthesiologist's posture and procedure ergonomics for laryngoscopy and tracheal intubation. The primary objective of this study was to measure and compare the posture adopted by anaesthesiologists by measuring angles of neck flexion, wrist angle deviation, arm angle exertion and lower back flexion while performing tracheal intubation with patients in supine or with 25° backup HELP. The secondary objectives included a comparison of the anaesthesiologist's posture and anaesthesiologist's comfort by a 4-point Likert scale, Cormack–Lehane (CL) grade, time to tracheal intubation, haemodynamics and complications in both positions during laryngoscopy and tracheal intubation.

## METHODS

This randomised crossover clinical trial was conducted at tertiary care teaching hospital between February 2021 and November 2021, following approval by the Institutional Human Ethics Committee (vide approval number MGMCRI/Res/01/2019/05/IHEC/001 dated 28 February 2020) and registration in the Clinical Trials Registry-India (vide registration number CTRI/2020/06/025651, accessible at www.ctri.nic.in). The study was carried out according to the principles of the Declaration of Helsinki, 2013 and good clinical practice.

Inclusion criteria encompassed individuals aged 18–60 years, classified as American Society of Anesthesiologists physical status I and II, scheduled for elective surgeries under general anaesthesia requiring endotracheal intubation. In addition, participants needed to exhibit a mouth opening exceeding 3 cm, possess Mallampati grades I and II, demonstrate a complete range of neck movements and yield a positive upper lip bite test. Exclusion criteria comprised patients with anticipated difficult airway (including challenges in mask ventilation or intubation), those undergoing emergency surgery, and individuals with haemodynamic instability or a risk of aspiration or a body mass index (BMI) exceeding 35 kg/m$^2$. The study also recruited anaesthesiologists with experience in at least five laryngoscopies and tracheal intubations in the 25° backup HELP positions for the performance of laryngoscopy and intubation, and their permission was taken to photograph them while performing laryngoscopy and intubation, so that angles of neck, arms, knees and back flexion could be measured. Informed consent was obtained from patients and anaesthesiologists to participate in the study and use the data for research and educational purposes.

Using convenience sampling, grouping was allocated by permuted block randomisation with a block size of four and ratio of 1:1, prepared using 'Statistics and Sample Size Pro App' (version 4.0 developed by Thai Thanh Inc) by a resident who did not participate further. Allocation concealment was done using the sealed envelope technique (four envelopes of each block were again placed inside a bigger envelope). Twelve anaesthesiologists took part in this study, and each anaesthesiologist performed the study on four patients as per permuted block randomisation.

Patients were allocated to either Group B or Group S after obtaining informed consent from them, and all underwent laryngoscopy sequentially in both positions, followed by intubation in any one position. Patients were preoxygenated with 100% oxygen. Patients received intravenous (IV) 1–2 mg midazolam and 2 μg/kg fentanyl as premedication, followed by general anaesthesia, which was induced with 2 mg/kg IV propofol and 0.1 mg/kg vecuronium to facilitate neuromuscular blockade. Based on their group allocation, patients were placed in either a supine position with HELP or a 25° backup position with HELP before induction of anaesthesia. To achieve a 25° backup position, the operating table was flexed gradually to 25° using a remote, with the aid of the 'ANGLE identifier' app on the mobile phone to align the patient's tragus to the sternal notch; in case they were not aligned, then cushions were placed beneath the patient's head to facilitate the alignment. In both positions, it was ensured that the patient's head was at the level of the anaesthesiologist's xiphisternum [Figures 1 and 2].

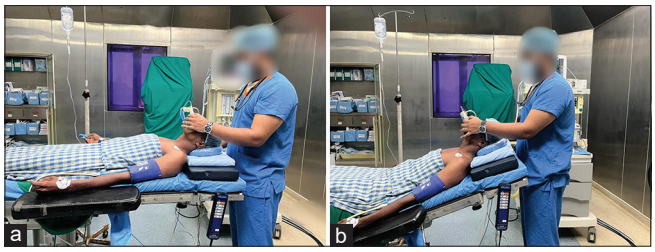


**Figure 1:** Patient's positioning: (a) patient in supine with head-elevated laryngoscopy position, (b) patient positioned at 25° backup with head-elevated laryngoscopy position

All patients underwent direct laryngoscopy in the first position, followed by a change in patient position, a second laryngoscopy and intubation. The glottic view was assessed using CL grading. In Group B, patients were initially placed in supine HELP, then switched to 25° backup HELP, followed by tracheal intubation. Group S patients started in 25° backup HELP, transitioned to supine HELP and the trachea was intubated in supine HELP. Joint flexion was measured using the 'Angles in photo' app, and anaesthesiologist postures during intubation were documented from the obtained photographs [Figure 2]. Haemodynamic changes and saturation (heart rate and noninvasive blood pressure) were monitored and recorded throughout the procedures. The anaesthesiologists' comfort level in each position during laryngoscopy and oxygen intubation was rated on a 4-point Likert scale. If tracheal intubation failed in the first attempt, the patient was repositioned and a second attempt was made. If the second attempt also failed, unanticipated difficult airway protocol was followed, and the methods used for successful intubation were noted.

The sample size was calculated based on the study by Lee *et al*.,[4] which stated that in the supine position, the anaesthesiologist's neck flexion was 54° (13°). We hypothesised that 25 backups would be associated with less neck flexion. To find a 25% (14°) reduction in neck flexion with 25° backup positions with a beta of 95% and an alpha of 0.05, we calculated that 22 patients would be needed for each group, taking a 10% dropout into account. We recruited 24 patients per group. Statistical analysis was done using Jeffrey's Amazing Statistics Program (JASP team 2019, version 0.11.1; Eric-Jan Wagenmakers, Amsterdam, The Netherlands). Parametric data, such as age, BMI, angles of neck, arms, knees and back flexion, laryngoscopy time, intubation time and haemodynamics, were expressed as mean (standard deviation). Nonparametric data, such as gender, anaesthesiologist comfort and CL grades, were

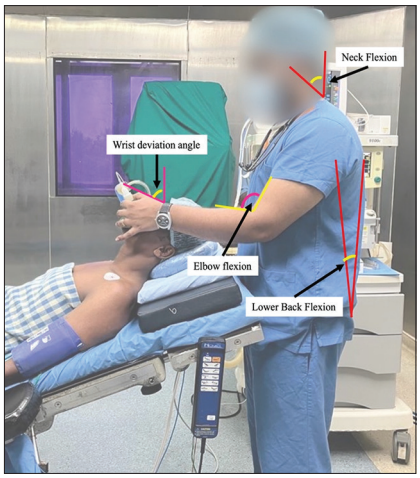


**Figure 2:** Measurements of various angles were taken for comparison in this study

expressed as numbers and percentages. Student's *t*-test was used to compare angles of neck, arms, knees and back flexion, laryngoscopy time, intubation time and haemodynamics. The Chi-square or Fisher's exact test was used for anaesthesiologist comfort and CL grades. $P < 0.05$ was considered significant.

## RESULTS

Forty-eight patients and 12 anaesthesiologists participated in this randomised crossover trial [Figure 3]. The study included 33 female and 15 male patients; the median (25–75 percentile) age was 31.5 (26–44) years, with a median BMI of 25.85 (23.01–28.45) kg/m$^2$. Tracheal intubation was successful in a single attempt in all patients. Anaesthesiologist's joint angles and comfort during laryngoscopy and intubation were comparable between the two groups [Table 1]. The CL grade was significantly better in Group B compared to Group S [Table 1]. None of the individuals had a CL 3 in Group B, whereas 4% had a CL grade of 3 in Group S ($P = 0.012$). There was no significant difference between the groups with regard to haemodynamic variations, and there was no incidence of bradycardia or severe hypotension (>20% fall in MAP) in either group [Table 2]. There was no difference in the time taken for intubation, and none of the patients in either group experienced any airway-related complications such as trauma, desaturation or failure to intubate.

## DISCUSSION

Our results showed no significant difference in the posture adopted by the anaesthesiologist in either position during laryngoscopy and tracheal

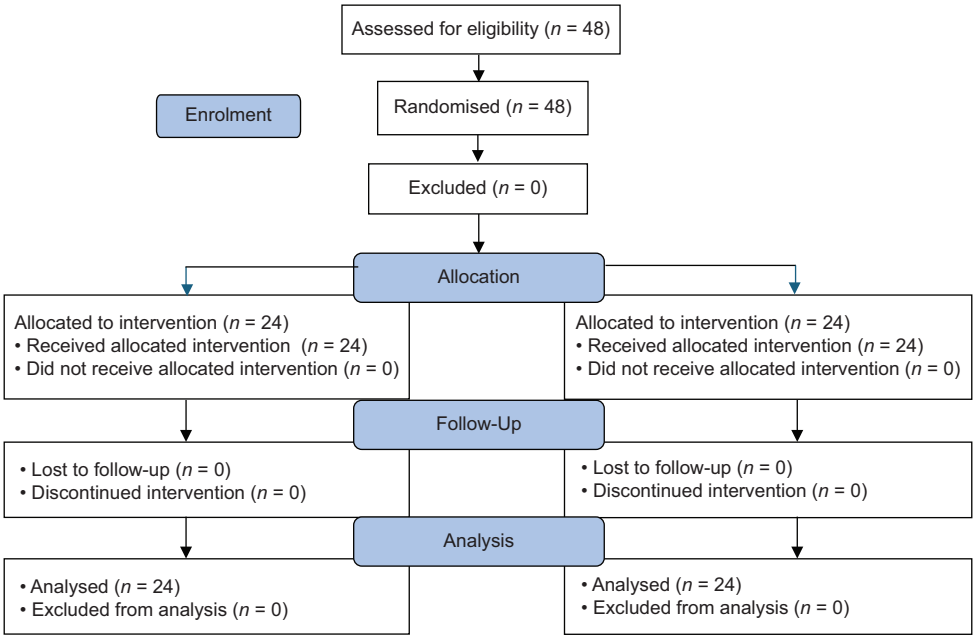


**Figure 3:** Consolidated Standards of Reporting Trials (CONSORT) flow diagram

**Table 1: Joint angles and comfort of the anaesthesiologist between the groups during laryngoscopy and intubation and the Cormack–Lehane grading between the groups**

| Joint angles measured at laryngoscopy and intubation | Group B (*n*=24) | Group S (*n*=24) | *P* | df |
|---|---|---|---|---|
| Neck flexion (degrees) | | | | |
| Laryngoscopy | 50.1 (8.3) [46.78, 53.42] | 50.7 (6.3) [48.18, 53.22] | 0.919 | 46 |
| Intubation | 42.0 (8.2) [38.72, 45.28] | 54.3 (1.3) [53.78, 54.82] | 0.184 | 46 |
| Wrist deviation (degrees) | | | | |
| Laryngoscopy | 42.7 (3.1) [41.42, 43.98] | 42.0 (2.5) [41, 43] | 0.974 | 46 |
| Intubation | 39.2 (2.5) [38.2, 40.2] | 42.3 (3.3) [40.98, 43.62] | 0.245 | 46 |
| Elbow flexion (degrees) | | | | |
| Laryngoscopy | 81.7 (8.1) [78.46, 84.94] | 82.0 (8.9) [78.44, 85.56] | 0.960 | 46 |
| Intubation | 75.8 (10.4) [71.64, 79.96] | 75.7 (2.1) [74.86, 76.54] | 0.347 | 46 |
| Lower back flexion (degrees) | | | | |
| Laryngoscopy | 17.5 (4.4) [15.74, 19.26] | 17.4 (4.1) [15.76, 19.04] | 0.919 | 46 |
| Intubation | 18.3 (3.7) [16.82, 19.78] | 15.7 (2.1) [14.86, 16.54] | 0.216 | 46 |
| Anaesthesiologist comfort 1/2/3/4 (*n*) | | | | |
| Laryngoscopy | 17/7/0/0 | 17/7/0/0 | 0.644 | 2 |
| Intubation | 17/7/0/0 | 19/5/0/0 | 0.505 | 2 |
| Cormack–Lehane grading (*n*) 1/2/3/4 | 16/8/0/0 | 8/15/1/0 | 0.012 | 2 |

Data expressed as mean (SD) [95% confidence interval] or numbers. df=Degrees of freedom, SD=Standard deviation, *n*=Number of patients

intubation. The anaesthesiologists reported no significant difference in comfort perceived during laryngoscopy or tracheal intubation in either position. However, they reported significantly better glottic views in 25° backup HELP. In addition, the time to complete intubation was comparable between the groups, with all intubations performed in a single attempt.

An optimal glottic view during laryngoscopy and seamless intubation requires proper patient positioning.[4] To facilitate glottic visualisation,

**Table 2: Heart rate and mean arterial pressure between two groups at different time intervals**

| Time interval | Group B (*n*=24) | Group S (*n*=24) | *P* | df |
|---|---|---|---|---|
| Heart rate (beats per minute) | | | | |
| Baseline | 77 (11) [72.6, 81.4] | 78 (14) [72.4, 83.6] | 0.587 | 46 |
| First laryngoscopy | 77 (10) [73, 81] | 78 (13) [72.8, 83.2] | 0.786 | 46 |
| Second laryngoscopy | 79 (10) [75, 83] | 80 (12) [75.2, 84.8] | 0.752 | 46 |
| Intubation | 79 (10) [75, 83] | 81 (11) [76.6, 85.4] | 0.475 | 46 |
| Mean arterial pressure (mmHg) | | | | |
| Baseline | 68 (4) [66.4, 69.6] | 68 (3) [66.8, 69.2] | 0.965 | 46 |
| First laryngoscopy | 69 (4) [67.4, 70.6] | 68 (3) [66.8, 69.2] | 0.445 | 46 |
| Second laryngoscopy | 69 (3) [67.8, 70.2] | 68 (3) [66.8, 69.2] | 0.144 | 46 |
| Intubation | 69 (3) [67.8, 70.2] | 68 (3) [66.8, 69.2] | 0.248 | 46 |

Data expressed as mean (SD) [95% confidence interval]. df=Degrees of freedom, SD=Standard deviation, *n*=Number of patients

anaesthesiologists often adopt various postures such as flexing the neck, bending forward, stooping, bending their knees, standing on their toes or exerting their arms.[5] Although these positions are held for short periods during laryngoscopy and intubation, repeated performance in these stressful positions may have long-term impacts on joint performance.[6] Therefore, it is crucial to consider ergonomics and adopt proper techniques to minimise the risk of long-term injury from the performer's standpoint and ensure optimal patient care.[7] The results of our study indicated no significant difference in the posture adopted by anaesthesiologists while performing laryngoscopy or intubation in either the supine or backup HELP, which we infer from the lack of notable variation in the degree of neck flexion, wrist deviation, elbow flexion and lower back flexion. Hence, anaesthesiologists should not be apprehensive of discomfort while performing laryngoscopy and intubations with patients in 25° backup HELP, especially since sufficient evidence shows that this positioning provides better glottic visualisation.[8,9]

Our study found a significant difference in the CL grade visualisation between groups, with 25° backup HELP providing a better glottic visualisation. The results were consistent with the study findings of other authors.[10] It was found that the HELP position was superior when compared to supine in improving the CL grade. This can be explained by the HELP position aligning the sternal notch and external auditory meatus in a horizontal line, which in turn aligns the three axes of the airway, namely, the pharyngeal, laryngeal and oral axes.[9] A 25° backup further improves the line of sight to visualise the glottic opening for the anaesthesiologist behind the patient. It may require less force to elevate and displace the tongue. The height of the operating theatre (OT) table in our study was set at the xiphisternum of the performer, which could have also contributed to the lower CL grade as described in a study by Lee *et al*.[11] This study reported how table height influenced laryngeal views and anaesthesiologist comfort. The authors found that the operating table level at the xiphisternum provided better laryngeal views and anaesthesiologist comfort; hence, we decided to adopt this height in our study.

In our study, the time taken for intubation was comparable between the groups. The lack of variations in our study could be explained by the fact that we recruited anaesthesiologists with a minimum experience of five intubations in 25° backup positions, and since the patients recruited had a mouth opening exceeding 3 cm, with Mallampati grades I and II, normal neck movements and a positive upper lip bite test, all considered easy intubations, these could have contributed to the lower CL grades and a high success rate.

There were some noteworthy strengths in our investigation. Firstly, we used a crossover design, which allowed us to compare both positions with the same patient and with the same anaesthesiologist. Secondly, we recruited anaesthesiologists with experience in more than five intubations in the 25°

backup positions to minimise the difficulties that novices may encounter. Thirdly, we standardised the adjustment of the height of the operating table to the individual's xiphisternum to minimise bias that could arise from varying performer heights. Finally, we employed subjective and objective assessments of the anaesthesiologist's comfort and posture, providing a more comprehensive evaluation of the two positions.

Limitations of our study include the single-centre study with a small sample size of patients and anaesthesiologists. This may have limited our ability to detect significant differences between the positions, and recruitment of a larger sample could provide more robust results. The measurement of joint angles was performed over the scrubs of the anaesthesiologist, which could have resulted in variations in the angles. Since our study recruited only patients with easy airways, that is, those with a normal BMI, mouth opening of more than 3 cm, Mallampati grades 1 and 2, normal neck movements and positive upper lip bite test, it is uncertain whether the findings can be applied to laryngoscopy and intubation in difficult airways. Even though research suggests that even in simulated difficult airways, the percentage of glottic opening and the CL grade are improved with backup HELP,[11] future prospective research can be designed to evaluate the posture and effectiveness between the two positions in anticipated difficult airways, like obese or restricted neck movements.

## CONCLUSION

Our study concludes that the posture and comfort of anaesthesiologists during laryngoscopy and tracheal intubation are similar between supine and 25° backup HELP in patients with a mouth opening of more than 3 cm, Mallampati grades 1 and 2, normal neck movements and positive upper lip bite test.

### Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval as per the authors' institution policy.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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