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Comparison of Laryngoscopic View Obtained by Conventional 10 cm Head Rise to that Obtained by Horizontal Alignment of External Auditory Meatus and Sternal Notch

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Abstract

Objectives: The aim of this study was to determine the effect of position (Sniff / HELP) during laryngoscopy on the extent of change/ improvement in laryngoscopic view of glottis. *Materials and Methods:* This prospective, observational study was conducted on 245 patients who were scheduled to undergo elective surgeries, age 18-60 years, of either sex and ASA physical status I and II. Patients were positioned in HELP at first, following standard anaesthesia induction laryngoscopy was done to evaluate CL grade (HELP score). Patients were then positioned to sniff position and CL grade was reassessed (SNIFF score) and intubated. SNIFF score and HELP score were then compared. Chi-square, Fisher's exact, Student's t-test were used for analysis. *Results:* In 163 cases (66.5%) HELP and Sniff showed equal CL grades. In 67 cases (27.34%) HELP showed improved CL grades in comparison to Sniff. 47 cases (19.2%) of CL grade II by SNIFF position showed grade I view in HELP. Out of total 22 cases (9%) showing C & L grade III in SNIFF position, 15 cases (6.1%) showed grade I and 5 cases (2%) showed grade II in HELP. HELP provided equal/improved view in 230 cases (93.8%) of our study population which was statistically significant. *Conclusion:* HELP provides better glottic visualization and it should be the ideal intubating position for all patients (both obese and non obese) irrespective of age and sex. Neck circumference serves as more accurate predictor of poor glottic visualization during direct laryngoscopy as compared to BMI.

Keywords: HELP; Sniffing position; Laryngoscopic view; Cormack & Lehane grade.

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Introduction

The anticipated difficult intubation led to position the patient in such a way that we get optimal glottic view during laryngoscopy for tracheal intubation. Inadequate positioning may result in protracted or failed tracheal intubation attempts because of the inability to visualize the larynx.

The sniffing position described by Sir Ivan Magill [1] by causing lower cervical flexion and atlanto-occipital extension aligns the oral, pharyngeal and laryngeal axes, thus facilitates laryngoscopic visualization for tracheal intubation. In 1944, Bannister and Macbeth [2] introduced the

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three axis alignment theory (TAAT) to explain the anatomical reasoning behind the superiority of sniffing position.

HELP (Head Elevated Laryngoscopic Position) brings sternal notch and external auditory meatus at one level. Keith Greenland *et al.* [3] by using magnetic resonance imaging (MRI) showed that external auditory meatus reflects the position of clivus (external auditory meatus overlies the clivus) and sternal notch reflects the glottis opening. Clivus lies immediately behind the nasopharynx. So when the patient is placed in HELP, nasopharynx comes to lie above glottic opening (line between glottis and nasopharynx is sloping upwards). This rotates the pharyngeal and laryngeal axes anticlockwise and thereby aligning with oral axis. With head extension, laryngoscopic blade insertion and elevation, glottic opening will come to lie along the line of vision. This is suited in both obese and non-obese.

Cormack RS, Lehane J *et al.* [4] in 1984 scored the laryngoscopic views into four grades for the purpose of making comparisons easier.

We tried to compare Cormack Lehane grade in both Sniff and Head Elevated Laryngoscopy position with respect to parameters like BMI and neck circumference. The aim of this study was to determine the effect of position (Sniff/HELP) during laryngoscopy on the extent of change/ improvement in laryngoscopic view of glottis.

Materials and Methods

Study design: This was a prospective observational study.

Sample size calculation: Sample size was calculated using Right-Size (China-Uganda-Zimbabwe, version 2.0.0.0.2 1/19/2002) statistical software where (N=1700) i.e. total number of patients attending Anaesthesia Department of hospital taking expected frequency of the disease presumed to be at least 20% with 95% confidence level, considering confidence interval of 5%, a total of 245 patients will be required.

Study population: Total 245 patients, of age group 18–60 years, with American Society of Anaesthesiologists (ASA) physical status I and II, who were scheduled to undergo elective surgical procedures under general anaesthesia with endotracheal intubation were enrolled in this study. Exclusion criteria were patients with connective tissue disorders, diseases in which bones are prone to fracture example renal osteodystrophy in chronic kidney disease, metabolic disorders like diabetes mellitus with possibility of cervical spine involvement and decreased atlanto-occipital movement, acromegaly, tonsillar hypertrophy, pregnancy, epiglottitis, craniofacial abnormality, burn patients with neck contracture, buck teeth, thyromental distance <6.5 cm, hyomental distance <6 cm, sternomental distance <12.5 cm, interincisor distance <5 cm, receeding mandible, micrognathia, loose teeth, head extension <70 degrees, Samsoon & Young scores III & IV.

Study protocol: The study was started following Institutional Ethics Committee approval. Written informed consent was taken from the patients. Preoperative assessment was done and BMI, neck circumference at the level of thyroid cartilage, Samsoon and Young scores, thyromental distance, hyomental distance, sternomental distance, interincisor distance, head extension and mobilility of atlanto-occipital joint were noted.

After all standard preparations, routine monitors such as ECG, non invasive blood pressure cuff, pulse oximeter were connected to the patient. An intravenous access was secured.

Patients were kept in HELP at first. HELP was achieved by placing a firm pillow of 10 cm size underneath the head and then making necessary arrangements with the help of multiple drapes and table tilt to align external auditory meatus and sternal notch. Idea behind this approach was, when we try to shift the patient to sniff position, we needed only drapes to be removed from underneath of the patient.

Patients were preoxygenated with 100% O_2 for 3 minutes with a close fitting mask in HELP at first. After administration of fentanyl (2 mcg/kg i.v), intravenous induction was done with propofol (2-3 mg/kg body weight) and muscle relaxation with vecuronium (0.1 mg/kg body weight). Patients were ventilated for 3 minutes. The anaesthesiologist then did laryngoscopy with Macintosh 3 or 4 size blade and assessed the Cormack Lehane grade. For the purpose of comparison we called it as "HELP SCORE".

After that anaesthesiologist sprayed 10% lignocaine between vocal cords into trachea. The patients were then placed in sniff position following which the anaesthesiologist with the same laryngoscope blade reassesssd the Cormack Lehane grade (it was called as SNIFF SCORE) and the trachea was intubated.

In this way both the anaesthesiologist and the patient served themselves as his/her own control.

Anaesthesia was maintained with isoflurane 1–2% with O_2-air mixture on controlled ventilation. HELP SCORE and SNIFF SCORE were then compared.

For ease of comparison and to standardize a common reference point for all laryngoscopists, the pictures of Cormack Lehane grades (Figure 1) were shown to them during laryngoscopy. The laryngoscopist ticked on the appropriate picture of Cormack Lehane grade based on glottic visualization during HELP positioning (HELP score) and sniff positioning (SNIFF score).

The laryngoscopy view was graded according to the CL grade as follows:

Grade I - Visualization of entire laryngeal aperture.

Grade II - Visualization of just the posterior portion of laryngeal aperture

Grade III - Visualization of only the epiglottis

Grade IV - Visualization of just the soft palate

Statistical analysis: The data of the present study was recorded and fed into the computer and after its proper validation, checked for error; coding & decoding was compiled and analyzed with the help of SPSS 20 software for windows. Appropriate univariate and bivariate analysis and the descriptive statistics carried out. Other statistical tests such as Student's t-test for continuous data and Fishers Exact Test or χ^2 test for categorical data were applied to support the hypothesis. All means are expressed as mean ± standard deviation and the proportion as in percentage (%). The p value of less than 0.05 is considered as significant for the results.

Results

There was no statistically significant difference between mean age of male and female group (p value > 0.05, t = 0.237). (Table 1)

From table 2 it was found that in sniffing position 56.7% cases had grade 1, 34.3% cases grade 2 and 9% cases grade 3 CL score. While in HELP 75.9% cases had CL grade 1, 23.3% cases grade 2 and only. 8% cases had grade 3 CL scores. By applying McNemar Chi-square test, we got t value of 36.51 and p value of less than 0.0001 which was highly significant.

The table 3 compares HELP and SNIFF scores according to neck circumference. For the purpose of comparison we took the median value of neck circumference (which came out to be 35 cm) and then divided total cases into two groups (<35 cm group and >35 cm group).

In <35 cm group, by applying Mantel Haenszel Chi-square test for linear trend we got a p value of 0.06251 which indicated that there was a positive and significant linear trend of improvement of laryngoscopic view in HELP as compared to sniff position. In >35 cm group, by applying Mantel Haenszel Chi-square test for linear trend we found a very highly significant linear trend of improvement of CL grade (p value of 0.0000001) in HELP.

Though HELP caused statistically significant improvement of glottic view in both these groups, the linear trend of improvement of glottic visualization became more statistically significant in higher neck circumference patients as compared to patients with lower neck circumference.

The table 4 compares HELP and SNIFF scores according to BMI. For the purpose of comparison, we formed two groups (<25 BMI group, >25 BMI group).

In <25 BMI group, Chi-square test for linear trend showed a p value of 0.002972 which indicated a significant linear trend of improvement of glottic view in HELP as compared to Sniff position. In >25 BMI group, Chi-square test for linear trend

Table 1: Age and sex distribution

Age (in years)	M (n=162)	F (n=83)	Total (n=245)
<20	8 4.9%	1 1.2%	9 3.7%
20-29	35 21.6%	19 22.9%	54 22.0%
30-39	44 27.2%	23 27.7%	67 27.3%
40-49	34 21.0%	25 30.1%	59 24.1%
50-59	41 17.3%	15 12.0%	56 15.5%
Mean ± SD	38.48 ± 12.855	38.08 ± 11.420	38.35 ± 12.365

showed a p value of 0.000000729 which indicated a significant linear trend of improvement of glottic view in HELP as compared to sniff position.

Though HELP caused statistically significant improvement of view in both these groups, the linear trend of improvement of glottic visualization became more statistically significant in higher BMI patients as compared to patients with lower BMI.

The regression model using logistic regression analysis (Table 5, Figure 2), taking SNIFF Score as dependent variable and neck circumference (in cm), BMI as predictors showed a significant F ratio ($F=13.092$; $p<0.0001$, $R^2=0.098$) and it was observed that neck circumference compared to BMI was significantly correlated with increased CL Grade ($t=3.875$; $p<0.05$ for neck circumference and $t=0.720$; $p>0.05$ for BMI). The results of regression analysis strongly recommend that the neck circumference is statistically more accurate in predicting poor glottic visualization as compared to BMI.

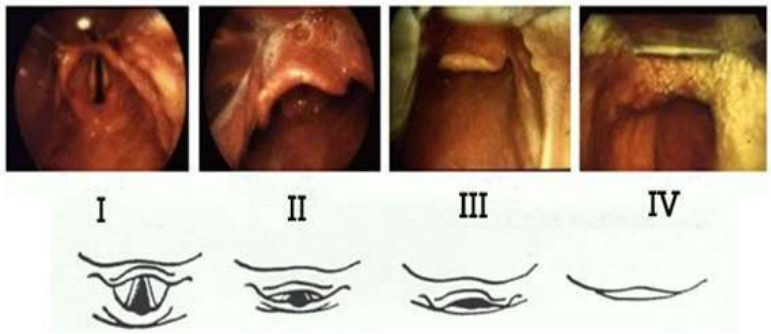

Fig. 1: Cormack Lehane Grades

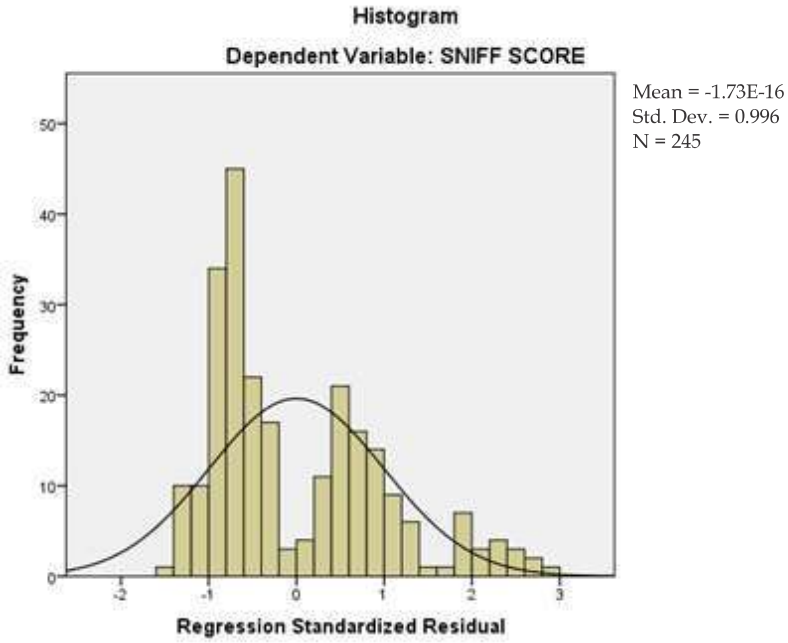

Fig. 2: Histogram- SNIFF score dependent variable

Table 2: Comparison of HELP score and SNIFF score

1		Help Score 2	3		Total
Sniff Score	1	124 50.6%	15 6.1 %	0 0.0%	139 56.7%
	2	47 19.2%	37 15.1%	0 0.0%	84 34.3%
	3	15 6.1%	5 2%	2 0.8%	22 9.0%
Total		186 75.9%	57 23.3%	2 0.8%	245

McNemar Chi-square t value = 36.516; p<0.0001

Table 3: HELP and SNIFF score comparison according to neck circumference

Cormack Lehane Grade	<35 CM		>35 CM	
	HELP	Sniff Position	HELP	Sniff Position
1	93 76.9%	84 69.4%	93 75.0%	55 44.4%
2	27 22.3%	31 25.6%	30 24.2%	53 42.7%
3	1 0.8%	6 5.0%	1 0.8%	16 12.9%
Total	121	121	124	124
	t value=3.47; p=0.06251		t value=31.31; p=0.0000001	

Table 4: HELP and SNIFF score comparison according to BMI

Cormack Lehane Grade	BMI <25kg/m²		BMI >25kg/m²	
	HELP	Sniff Position	HELP	Sniff Position
1	125 74.0%	104 61.5%	61 80.3%	35 46.1%
2	42 24.9%	55 32.5%	15 19.7%	29 38.2%
3	2 1.2%	10 5.9%	0 0.0%	12 15.8%
Total	169	169	76	76
	T value =8.82; p=0.002972		T value =24.54; p=0.000000729	

Table 5: Comparison between neck circumference and BMI for predicting poor glottic visualisation

Variables	t value	p value
BMI	0.720	0.472
Neck Circumference	3.875	0.0001

Dependent Variable: SNIFF SCORE

Discussion

In our study we compared the laryngoscopic view of glottis between two positions Sniff and HELP. Results showed that HELP was better in laryngoscopic view for both obese and non obese patients.

Positioning the patient to HELP improves jaw mechanics during laryngoscopy by achieving greater mouth opening and the more thyromental space. So the increased thyromental space means more place for tongue to get displaced making better glottic visualisation.

The tension in anterior cervical muscles created by extending head provides a counterforce on laryngoscope blade during lifting. As face plane remains parallel to ceiling in HELP position, there is less tension on anterior cervical muscles. By de-tensing anterior cervical muscles, HELP facilitates laryngoscopy.

HELP by elevating head and shoulder decreases pressure exerted on thorax by abdominal contents.

It simplifies ventilation leading to increased functional residual capacity and tidal volume. Thus extends the duration of safe apnea period.

In 2004, Collins *et al.* [5] showed that arranging blankets underneath a morbidly obese (BMI>40 kg/m^2) patient's upper body and head until horizontal alignment was achieved between the external auditory meatus and sternal notch, significantly improved laryngoscopic view in comparison to a separate similar group of morbidly obese patients whose head was supported only by a 7 cm cushion. Working from the findings of Collins *et al.*, P.W. Lebowitz *et al.* tried to evaluate direct laryngeal visualization in anaesthetized adult patients in the HELP position and using each patient as his/her own control, compare it with laryngeal visualization in sniff position.

We did our study based on the protocols followed by P.W. Lebowitz *et al.* [6] Main difficulty associated with this study was to create a protocol that did not give an advantage to either of the two positions. The ideal study design would have had patients selected at random to receive either the "HELP" or the "sniff" position first and the other second. The logic behind this approach is that an anaesthesiologist who performs laryngoscopy on a given patient get to know the landmarks and feel for that patients' airway and will have an easier time attempting a second laryngoscopy on that patient. This logic then would seem to favor the sniff position in our study since it was always performed after HELP. We accepted this limitation because moving an anaesthetized patient, particularly an obese one into HELP would have required several assistants and increased injury chances to the patient which was not encountered simply by removing the HELP.

Different patients have different airway anatomy. By studying the effect of two positions on laryngeal view in same patient, we had eliminated the bias that might have occurred in the study because of different airway anatomies in different patients.

Since the senior anaesthesia residents served as laryngoscopists, the variability in laryngoscopic skills and interpretation of resultant laryngoscopic views among the participants provided another limiting variable in assessing our results. To standardize a common reference point for all the anaesthesiologists participating in the study, each anaesthesiologist was shown pictures of different grades of Cormack Lehane scale before laryngoscopy. Furthermore, the study required the anaesthesiologist to perform both laryngoscopies in each study patient so as to standardize the grading. Hence, while there was variability among the laryngoscopists, each anaesthesiologist served as his/her own control.

Collins *et al.* enrolled 60 morbidly obese patients undergoing elective bariatric surgery and randomly assigned them into two groups. First group patients were intubated in HELP and second group of patients in SNIFF position. They found improved laryngeal view in HELP when compared to sniff (p value of 0.037). Our study was in agreement with the study of Collins et al. with respect to the superiority of HELP. The two studies had difference with respect to sample size (60 cases in Collins et al. study versus 245 cases in our study) and also we included both non obese and obese patients while Collins et al. included only morbidly obese patients.

Levitan *et al.* [7] did laryngoscopy in 7 fresh human cadavers at first in head lying flat on the table and then in HELP. They found that HELP provided better view than head flat. Our study also found that HELP provided superior view but on contrary to 7 cases studied in Levitan *et al.* study we included 245 live anaesthetized patients (not human cadavers) in our study.

We did our study based on the protocol followed by P.W. Lebowitz *et al.* Our study was in unison with the study of P.W. Lebowitz *et al.* and showed that HELP was superior in improving laryngoscopic view than sniff position in both obese and non obese patients. The difference in two studies was sample size (189 cases in P.W. Lebowitz *et al.* study versus 245 patients in our study). They had taken into account only BMI for comparing CL grades in different patients but we compared CL grades in different patients with respect to both BMI and neck circumference.

The studies [8,9,10] supported the sniffing position as optimal laryngoscopic position. Sahay N *et al.* [11] in their meta-analysis showed that sniffing position provides better glottis exposure, therefore should be used as initial position when attempting intubation. But these studies did not made any comparison of sniff position to HELP.

Our secondary objective was to compare between neck circumference and BMI in accuracy of predicting poor glottic visualization. Our study showed that neck circumference was statistically more accurate in predicting poor glottic visualization as compared to BMI. The study results were congruent with the results of Brodosky *et al.* [12], Ezri T, G. Gewurtz *et al.* [13] and Gonzalez *et al.* [14] and showed that neck circumference is a better predictor of poor glottic visualization as

compared to BMI.

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Conflicts of interest: There are no conflicts of interest.

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