Original article

J Nepal Health Res Counc 2019 Apr-Jun;17(43): 168-72

DOI https://doi.org/10.33314/jnhrc.v0i0.1721

Effect of Head Elevation to Different Heights in Laryngeal Exposure with Direct Laryngoscopy

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ABSTRACT

Background: The purpose of this study was to determine the optimal pillow height for the best laryngoscopic view in adult patients scheduled for elective surgery under general anaesthesia.

Methods: 150 adult patients undergoing surgery under general anaesthesia with endotracheal intubation with no features suggestive of difficult airway were enrolled for the study. After induction of anaesthesia the assessment of direct laryngoscopic views was done at head positions without a pillow and with non-compressible pillows of heights 5cm and 10cm.

Results: The laryngoscopic view with the 5cm pillow was significantly superior to other head position ($p<0.01$). The incidence of difficult laryngoscopy (Cormack and Lehane grade III) was 32.7% without a pillow which improved to (Cormack and Lehane grade III) 4% with 10cm pillow and there were no cases of difficult laryngoscopy with 5cm pillow.

Conclusions: The use of 5cm pillow in the 'sniffing' position obtains the best laryngoscopic view during direct laryngoscopy.

Keywords: Direct laryngoscopy; head elevation; laryngoscopicview; pillow height.

INTRODUCTION

Endotracheal intubation establishes definitive airway, prevents aspiration of gastric contents, and allows positive pressure ventilation usually facilitated by direct laryngoscopy. Proper positioning of head and neck is important for laryngoscopy to obtain good glottic view and minimize tracheal injury, duration and repeated attempts at laryngoscopy/intubation and reducing complications.[1]

The 'sniff' position is advocated as a standard for direct laryngoscopy where neck is flexed on the chest and the head is extended on the atlanto-occipital joint so that oro-pharyngo-laryngeal axes be in a straight line.[2,3] Head elevation aligns these axes to improve Cormack Lehane grading and ease intubation.

In study by El-Orbany et al.,[4] incidence of difficult laryngoscopy was 8.38% with no head elevation and sniffing position improvedglotticexposure which further improved in elevated position. The objective of this study was to find the optimal height of head elevation.

METHODS

Approval from Department of Anesthesiology, TUTH and IRB, IOM was taken. Consecutive male and female patients, aged >16 years who gave informed consent, scheduled to undergo surgery under general anaesthesia with endotracheal intubation were enrolled. Emergency cases where rapid sequence induction was required, edentulous patients, patients with history of trauma, burn or previous surgery to facial, cervical, or anterior neck region, mass or tumor in neck, facial region, intra-oral or larynx, restricted neck and mandible mobility (Rheumatoid Arthritis, Osteoarthritis), patients with systemic hypertension, obesity and pregnancy were excluded from the study.

Pre-anesthetic evaluation was done a day prior to the surgery. Patient particulars, age, height, Body-mass index (BMI), admitting diagnosis and operative plan were noted. Airway assessment was done in terms of mouth opening, thyromental distance, range of neck movement, modified mallampati classification, neck circumference, neck mobility and upper lip bite test.

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On the day of surgery, after the patient was shifted to the operating room, the patient was placed supine on the OT table (neutral position). Monitors were attached (ECG, NIBP, pulse oximeter).

After induction, adequacy of bag and mask ventilation was checked, if not adequate even with the aid of airway devices, the case was excluded. If adequate, Inj. Vecuronium 0.1mg/kg was administered to achieve adequate muscle relaxation. Laryngoscopy was performed by the investigator who was unaware of the pre-anesthetic airway assessment. All patients were placed on a surgical bed without a pillow first and then with non-compressible pillows of 5cm and 10cm height in random order. Height elevation was done by anaesthesia assistant. Randomization was based on computer-generated codes maintained in serially numbered, sealed, opaque envelopes. Laryngoscopic view as seen by the investigator was recorded in each position by anaesthesia assistant. The view of the larynx was classified using Cormack-Lehane grading[5] without external laryngeal manipulation.

Intubation was done during last laryngoscopy or at the height which had best C-L grade. The preoperative airway assessment and the laryngoscopic findings were collected in a preformed data sheet.

The sample size was calculated as 113 and taken as 150; Confidence level taken 1.96 for 95 percent, percentage incidence of difficult laryngoscopy[1] being 8.1 percent and confidence interval of 5%, expressed as decimal.

As the dependent variable being measured is ordinal, the Friedman test was used as the non-parametric alternative to the one-way ANOVA with repeated measuresand mean ranks between the related groups were compared.

The test statistic (x^2) value (Chi-square), degrees of freedom (df) and the significance level (Asymp. Sig.), as needed to report the result of the Friedman test was derived.

Wilcoxon signed-rank tests was done on the different combinations of related groups to examine where the differences actually occur. To avoid Type I error, Bonferroni adjustment on the results from the Wilcoxon tests was done and was calculated as 0.017, i.e,p value of less than 0.017 is statistically significant. Analysis is done using SPSS statistics for windows, version 21.0.

RESULTS

The total of 150 patients was included in the study. The baseline characteristics of this study population regarding age-wise distribution, gender wise distribution and distribution according to American Society of Anaesthesiologist's (ASA) Physical Status, weight, height, BMI and airway assessment findings like mouth opening, thyromental distance, range of neck movement, modified mallampati classsification, upper lip bite test and neck circumference are mentioned in the table.

Table 1. Demographic Distribution.

	Minimum	Maximum	Mean
Age	16	70 years	42.35±13.47 years
Height	140cm	177cm.	161±7.0cm
Weight	40kg	85kg	62.83±8.1kg
Neck circumference	26cm	39cm	35.47±2.9cm
Body Mass Index (BMI)	16kg/m^2	30kg/m^2	24.05±2.82 kg/m^2
Gender	Female 87 (58%)	Male 63 (42%)	
ASA PS	ASA PS I 114 (76%)	ASA PS II 36 (24%)	
Modified Mallampati class	Class I105 (70%)	Class II 45 (30%)	
Mouth opening	All more than three finger breadth		
Thyromental distance	All more than 6.5cm		
Range of neck movement	All normal range of neck movement		
Upper lip bite test	All lip bite class 1		

Table 2.Distribution of the tests.

	C-L grade I	C-L grade II	C-L grade III	C-L grade IV
0cm head elevation	57 (38%)	44 (29.3%)	49 (32.7%)	0 (0%)
5cm head elevation	89 (59.3%)	61 (40.7%)	0 (0%)	0 (0%)
10cm head elevation	73 (48.7%)	71 (47.3%)	6 (4%)	0 (0%)

Table 3.Friedman Test and Statistics.

	Mean Rank
C-L GRADE at 0cm	2.41
C-L GRADE at 5cm	1.70
C-L GRADE at 10cm	1.89

The Chi-square test value is 112.178 and the level of significance comes out to be <0.05, hence the null hypothesis is rejected.This proves that head elevation improves C-L grading.

Again, to find out at what height the C-L grading was better, Post hoc analysis was done using Wilcoxon Signed Rank test comparing 0cm with 5cm, 0cm with 10cm and 5cm with 10cm head elevation.

Table 4.Wilcoxon Signed Ranks Test comparing 0cm and 5cm.

		N	Mean Rank	Sum of Ranks
C-L grade at 5cm	Negative Ranks	67	34.00	2278.00
C-L grade at 0cm	Positive Ranks	0	.00	.00
	Ties	8		
	Total	150		

From the above analysis of comparison of 0cm head elevation and 5cm head elevation, it was seen that there are 67 negative ranks and no positive ranks which means C-L grade improved in 67 cases and there was no worsening of C-L grading in any case. However there were 83 ties meaning there was no change in C-L grade in 83 cases. From the data above there were 57 cases with C-L grade I at 0cm where no improvement is expected. The test statistics shows the level of Significance to be <0.01, hence the null hypothesis is rejected. This proves that there is improvement in C-L grade when head is elevated from 0cm to 5cm.

Table 5. Wilcoxon Signed Ranks Test comparing 0cm and 10cm

		N	Mean Rank	Sum of Ranks
C-L grade at 10cm	Negative Ranks	55[a]	28.00	1540.00
C-L grade at 0cm	Positive Ranks	0[b]	.00	.00
	Ties	95[c]		
	Total	150		

From the above analysis of comparison of 0cm head elevation and 10cm head elevation, there are 55 negative ranks and no positive ranks which means C-L grade improved in 55 cases and there was no worsening of C-L grading in any case. However there were 95 ties meaning there was no change in C-L grade in 95 cases. The test statistics shows the level of Significance to be <0.01, hence the null hypothesis is rejected. This proves that there is improvement in CL grade when head is elevated from 0cm to 10cm.

Table 6.Wilcoxon Signed Ranks Test comparing 5cm and 10cm.

		N	Mean Rank	Sum of Ranks
C-L grade at 10cm	Negative Ranks	1[a]	12.50	12.50
C-L grade at 5cm	Positive Ranks	23[b]	12.50	287.50
	Ties	126[c]		
	Total	150		

From the above analysis of comparison of 5cm head elevation and 10cm head elevation, there are one negative rank and 23 positive ranks which means C-L grade improved in only one case when head was further elevated from 5cm to 10cm and there was worsening of C-L grading in 23 case. However there were 126 ties meaning there was no change in C-L grade in 126 cases.The test statistics shows the level of significance was <0.01, hence it can be concluded that the data is statistically significant.

So, this concludes that the C-L grade is optimal at 5cm head elevation.

DISCUSSION

According to our study, out of 150 study population, C-L grade at 0cm was found to be grade III in 49 (32.7%) patients. Head elevation has improved C-L grading which was statistically significant ($p<0.05$). There was no incidence of difficult airway at 5cm head elevation. However, when head was further elevated to 10cm, the incidence of CL grade III was observed in 6 (4%) cases. There was improvement in C-L grade from 5cm to 10cm in only one case. So, of the three positions compared, best laryngoscopic view was attained at 5cm head elevation ($p<0.01$).

Our findings were consistent with the study conducted by Sinha et al[1] where the assessment of direct laryngoscopic views was done at 4 head positions and the laryngoscopic view with the 4.5cm pillow was significantly superior to that with other pillows and without a pillow ($p<0.01$).

In another study, Schmitt et al.,[6] performed head elevation when a grade 3 view was encountered in the first laryngoscopy and laryngeal visualization improved when head was elevated with 6cm cushion in 19 of 21 patients.This finding is comparable to our study finding of best laryngeal exposure with 5cm head elevation.

In the study by El-Orbany et al.,[4] head elevation was associated with improved laryngeal exposure and it did not worsen laryngeal exposure in any single subject in their study. This finding was similar to the finding of our study where head elevation improved C-L grading.

Our study finding remains in contradiction with the findings of Adnet et al[7] who conducted study in 456 patients and recommended that the routine use of the sniffing position appears to provide no significant advantage over simple head extension for tracheal intubation because while assessing the glottis exposure by C-L grading, in comparison to simple head extension, sniffing position, they have found out that glottic exposure improved in 18% of patients and worsened in 11% of patients. However, they have adviced that the sniffing position be used in obese and head extension-limited patients where it appears to be advantageous.

In another study, Levitan et al[8] used a video camera to continuously record the change in the laryngeal view while changing the head position from flat to maximum elevation in 7 fresh human cadavers which improved laryngeal exposure in all 7 cadavers.

Chris Johnson and Neville W Goodman[9] published a study "Time to stop sniffing the air: snapshot survey" where they asked anaesthesiologists to take the position of "sniffing the morning air" and photographed them. The results showed wide variation in the angulations and postures attained. So they concluded that this classical "sniffing" position is not consistent even among the anaesthesiologists.In another study, P. G. Brindley et al.[10] have described 'win with the chin' analogy to be better over the classical "Sniffing the morning air" analogy where participants independently positioned a simulator manikin head and neck based upon their understanding. The results of 81 readings showed that the 'win with the chin' and anatomic instructions were significantly better (P = 0.002). Therefore they concluded that the 'win with the chin' analogy resulted in adequate airway positioning significantly more often than the 'sniffing position' or control.

However, as these studies by Chris Johnson and Neville W Goodman[9] is done in awake individuals and by Brindley et al.[10] was done in manikin, its direct correlation with anaesthetized patients is questionable. Further, as laryngoscopy aids in alignment of the oro-pharyngo-laryngeal axes, evaluation without laryngoscopy is also questionable.

Benumof et al.[11] have given stress on the importance of the head position, and in particular of the sniffing position, as the single most important factor in cases of difficult laryngoscopy. This can be directly correlated to our study as the cases of difficult laryngoscopy at simple extension and head flat position, have improved in laryngoscopic view when head is elevated to sniffing position both at 5cm and 10cm. This strengthens the findings of our study.

Michael F. Murphy[12] in his article "Bringing the Larynx Into View: A Piece of the Puzzle" states that: This is one small piece of a large clinical puzzle, but it is an important piece in answering the question: "How much is enough?" ".Do head elevation and an enhanced POGO score lead to improved intubation rates in real patients?"

In a review article "Head and Neck Position for Direct Laryngoscopy" by El-Orbany et al[13], they have stated that direct laryngoscopy is a dynamic process that should start with properly positioning the patient in the sniffing position, but may require further position adjustment in search for the best exposure.

The baseline characteristics of the patients included in our study differed from those in other study population. All patients had a BMI less than $30 kg/m.^2$ Perhaps, the optimal head elevation in other patient population may differ from our studied population (mean BMI, $24.05 \pm 2.821 kg/m^2$). As the study by Adnet et al[7] showed that head elevation beyond sniffing position was helpful in obese patients, correlating the optimal height (resulting in the best view) to obesity, length of the neck or neck circumference was not investigated and may need further studies. Hence, using a pillow to elevate head provides better laryngoscopic view compared to laryngoscopy at neutral position. Further, the 'sniffing' position using a 5cm pillow provides the best laryngoscopic views when compared with laryngoscopy with 10cm pillow. So, it can be concluded that use of 5cm pillow during direct laryngoscopy in the 'sniffing' position obtains the best laryngoscopic view.

CONCLUSIONS

This study demonstrates that using a pillow to elevate head provides better laryngoscopic view compared to laryngoscopy at neutral position. Further, the 'sniffing' position using a 5 cm pillow provides the best laryngoscopic views when compared with laryngoscopy with 10 cm pillow. So, it can be concluded that use of 5 cm pillow during direct laryngoscopy in the 'sniffing' position obtains the best laryngoscopic view.

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