DOI: 10.7860/JCDR/2021/50579.15360

Original Article

Anaesthesia Section

Evaluation of Intubating Conditions during Direct Laryngoscopy using Sniffing Position and Simple Head Extension- A Randomised Clinical Trial

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ABSTRACT

Introduction: Optimal laryngeal visualisation during direct laryngoscopy requires adequate positioning of the head and neck. Traditionally, Sniffing Position (SP) is the recommended position to provide superior glottic visualisation. However various studies in recent past have challenged the superiority of SP.

Aim: To evaluate whether SP provides better glottic visualisation and ease of intubation {as assessed by total Intubation Difficulty Score (IDS) score as well as its individual components} compared to Simple Head Extension (SHE) during direct laryngoscopy and endotracheal intubation.

Materials and Methods: The randomised clinical trial was conducted at GGS Medical College and Hospital, Faridkot, Punjab, India, from May 2019 to October 2020, on 220 patients. Patients undergoing elective surgeries under general anaesthesia were randomly divided into two groups. Laryngoscopy and tracheal intubation in Group I was done in SP, which was obtained by placing a non compressible pillow of height 8 cm under the patient's head. Patients in Group II underwent laryngoscopy and tracheal intubation in SHE position. Glottic visualisation using modified Cormack and Lehane (CL) grades, IDS and sympathetic responses between the two groups were studied. The data was compared using student's t-test and Chi-square test.

Results: Cormack and Lehane Grade I was seen in 69 (62.7%) of patients in Group I as against 51(46.4%) of patients in Group II (p-value=0.015). Easy intubation (total IDS score=0) was seen in a greater number of patients in Group I (60.9%) as compared to Group II (40.95%) (p-value=0.003). Slight difficulty in intubation (total IDS score=1-5) was encountered in 50.0% of patients in group II (n=55) and 35.5% of patients in group I (n=39) (p-value=0.029).

Conclusion: The present study concluded that use of SP resulted in better glottic visualisation and was associated with favourable intubation conditions as compared to SHE position.

Keywords: Glottic visualisation, Head position, Intubation difficulty score

INTRODUCTION

Airway management is the corner stone of anaesthetic practice and failure to maintain a patent airway can be life threatening [1]. The gold standard for airway management is tracheal intubation which is facilitated by direct laryngoscopy. The first and perhaps the most important maneuver before performing the laryngoscopy and tracheal intubation is to place the subject's head and the neck in an optimal position. Optimal positioning of head and neck has been a matter of continuous debate, changing theories and varying explanations over the past few years. Traditionally, recommended and the most commonly used technique is the Sniffing Position (SP) which can be obtained by placing a pillow under the subject's head, thereby raising the head causing neck flexion and the same time causing extension of the head at the atlanto-occipital joint. Further quantitative dimensions to this concept were given by defining the angle for neck flexion to be 35° and the plane of face extension with the horizontal at 15° [2]. Bannister FB and Macbeth RG proposed the Three Axis Alignment Theory (TAAT) advocating that SP causes alignment of laryngeal, pharyngeal, and oral axis causing line of vision to fall on the glottis [3].

However, the superiority of SP has been challenged by Adnet F et al., who could not find any axis alignment in a radiograph obtained during intubation in the SP [4] and it was further supported by an Magnetic Resonance Imaging (MRI) study in 2001, where again they could not find any axis alignment in the various head positions studied [5]. Adnet F et al., in same year found that the IDS was similar between the patients in SP and Simple Head Extension (SHE) position [6]. However, laryngoscopy in these patients was done without muscle relaxant which could have led to suboptimal conditions for laryngoscopy. Furthermore, intubation is sometimes easier with SHE like, by extending the head section of operating table or by removing the cushion from beneath the patient's head and placing it behind the shoulders. The principal difference between SP and SHE resides in inducing neck flexion on the thorax.

In view of recently challenged status, SP considered as the gold standard for direct laryngoscopy and at the same time there were emergence of number of studies supporting its role based on which the present comparative study was carried out. Purpose of the present study was to compare SP with SHE for visualisation of glottis during direct laryngoscopy and ease of tracheal intubation in patients requiring general anaesthesia for elective surgical procedures.

MATERIALS AND METHODS

The randomised clinical trial was conducted at GGS Medical College and Hospital, Faridkot, Punjab, India, on 220 patients, as per the Indian Council of Medical Research (ICMR) guidelines for biomedical research in human subjects and in accordance with the principles of Declaration of Helsinki 2013. Ethical approval was obtained from Institutional Ethical Committee on 02/2019 and the trial was registered with the Clinical Trial Registry of India (CTRI/2019/05/019065).

Inclusion criteria: This study was conducted on 220 adult male and female patients of American Society of Anaesthesiologists (ASA) grade I or II, aged 21-50 years, scheduled for elective surgeries under general anaesthesia with their written informed consent.

Exclusion criteria: Patients with anticipated difficult airway {restricted neck movements, bucked teeth, Thyromental Distance (TMD) less than 65 mm, limitation of Temporomandibular Joint (TMJ)}, Body Mass Index (BMI) >30 kg/m^2, cervical spine fracture or instability, undergoing head and neck surgery and ASA III or IV were excluded from study.

All patients were randomly divided into following two groups of 110 each, using a computer generated randomisation programme.

- Group I (SP)- patients were placed supine and a cushioned wooden block of 8 cm height was placed under the head. At the time of laryngoscopy, the head was extended on the atlanto-occipital joint maximally.
- Group II (SHE)- patients were placed supine, without wooden block. The head was extended maximally on the atlanto-occipital joint at the time of laryngoscopy.

Preanaesthetic check-up including a detailed history, general and systemic examination was done a day before surgery to rule out any major medical illness. Detailed airway assessment including Modified Mallampati Grading (MMPG) (class III and IV) [7], Inter- Incisor Distance (IID) (<3.5 cm), TMD (<6.5 cm), sternomental distance (<12 cm), TMJ movement, amplitudes of neck extension (<35) and neck circumference (>40 cm) were noted by an independent anaesthesiologist. Values mentioned in the brackets represents cut-off for predicting difficult airway. The patients were kept fasting overnight and given tab. ranitidine 150 mg and tab. alprazolam 0.25 mg on the night before surgery and next morning. On arrival in the operating room, monitoring of heart rate, Non Invasive Blood Pressure (NIBP), Electrocardiography (ECG) and oxygen saturation (SpO_2) were instituted and intravenous (i.v.) access secured. All the patients were premedicated prior to surgery with i.v. glycopyrrolate 0.2 mg and i.v. morphine 0.1 mg/kg.

Following pre-oxygenation with 100% oxygen for three minutes, the standard induction technique including i.v. propofol 1.5-2.5 mg/kg followed by i.v. vecuronium 0.1 mg/kg to facilitate tracheal intubation was used in each patient. After four minutes of administration of muscle relaxant, direct laryngoscopy was performed using Macintosh laryngoscope blade (size 3) by one of three senior authors, each having over eight year experience in anesthesiology and competent with respect to airway management, to ensure consistency of the technique. Glottic visualisation during laryngoscopy was assessed using Modified Cormack and Lehane (CL) Grading system [8]:

- Grade 1- complete view of glottis seen,
- Grade 2a- partial view of glottis seen,
- Grade 2b- only the posterior extremity of the glottis seen,
- Grade 3- only epiglottis seen and
- Grade 4- neither glottis nor epiglottis seen.

After noting the grade of laryngoscopy, tracheal intubation was performed and Intubation Difficulty Score (IDS) was recorded [Table/Fig-1] [9].

Sympathetic stimulation in terms of haemodynamic changes were noted on induction, at the time of laryngoscopy, then five minutes and 10 minutes after intubation. Anaesthesia was maintained by Nitrous oxide: Oxygen (2:1) and isoflurane. At the end of surgical procedures, the neuromuscular block was reversed with i.v. neostigmine 0.05 mg/kg with glycopyrrolate 0.01 mg/kg and all the patients shifted to post anaesthesia care unit.

STATISTICAL ANALYSIS

The sample size was calculated based on pervious literature using the proportion of IDS Score 0 in simple extension group as 0.40 under the null hypothesis and 0.588 under the alternative hypothesis and the proportion in Group I as 0.40. In order to achieve 80% power to detect a difference of 0.188 between the group proportions at a significance level of 0.05, using a two sided Z-test with pooled variance, the study required a minimum sample of 110 subjects in each group. Statistical analysis was done using IBM Statistical Package for the Social Sciences (SPSS) statistics version 22.0 and MedCalc Statistical software version 19 (MedCalc Software bvba, Ostend, Belgium). Comparison of two groups was done by Student's t-test and Chi-square test was used to compare proportions. The p-value <0.05 was taken as significant and <0.001 was taken as highly significant.

Intubation difficulty score	Parameter
N1	0-no supplementary attempt required
	1-any supplementary attempt required
N2	0-no supplementary operator required
	1-supplementary operator required
N3	0-no alternative intubation technique used
	1-any alternative intubation technique used
N4	0-Cormack and Lehane Grade I
	1-Cormack and Lehane Grade II
	2-Cormack and Lehane Grade III
	3-Cormack and Lehane Grade IV
N5	0-no subjectively increased lifting force required during laryngoscopy
	1-subjectively increased lifting force required during laryngoscopy
N6	0-no optimal external laryngeal manipulation required
	1-optimal external laryngeal manipulation required
N7	0-vocal cords are abducted
	1-vocal cords are adducted blocking the tube passage
	2-vocal cords not visualised

[Table/Fig-1]: Intubation difficulty score (IDS)*.
*IDS is the sum of N1 to N7; Score 0=no difficulty at all; Score1-5=mild difficulty; Score >5=moderate to severe difficulty

RESULTS

Both the groups were comparable with respect to demographic data including age, sex, weight, BMI and ASA grades [Table/Fig-2]. Regarding airway assessment parameters like Modified Mallampati grades, inter-incisor distances and TMD, there was no significant difference between two groups [Table/Fig-3]. Present study showed that placing the head in SP improved glottic visualisation. Cormack and Lehane Grade I i.e., complete glottic visualisation was seen in 62.7% of patients in Group I as against 46.4% of patients in Group II (p-value=0.015) [Table/Fig-4]. More number of patients with modified Cormack and Lehane grade 2b were seen in Group II (21.8%) as against 10% of patients in Group I (p-value=0.017).

Parameters (mean±SD)	Group I (n=110)	Group II (n=110)	p-value
Age (years)	35.78±8.49	37.64±9.49	0.128
Sex (M/F)	32/78	28/82	0.545
Weight (kg)	69.98±7.472	68.76±8.728	0.267
BMI (kg/m^2)	24.24±3.61	24.62±3.11	0.584
ASA I/II	51/59	47/63	0.587

[Table/Fig-2]: Demographic data and details of surgery.
Unpaired t-test; Sex and American Society of Anaesthesiologists (ASA) grade (Chi-square test); *p-value <0.05 significant

Parameters (mean±SD)	Group I (n=40)	Group II (n=40)	p-value
MMP grades (I/II/III/IV)	48/64/0/0	56/54/0/0	0.289
Thyromental distance (mm)	6.982±0.24	7.018±0.30	0.327
Interincisor gap (mm)	60.88±6.55	60.32±6.03	0.425
Neck circumference (cm)	33.4±1.5	32.9±1.1	0.387
Sternomental distance (cm)	16.8±1.2	17.2±1.4	0.566
TMJ movement (Abnormal)	0	0	-
Neck extension (<35)	0	0	-

[Table/Fig-3]: Airway assessment parameters of two groups.
Unpaired t-test; Modified Mallampati (MMP) grades (Fischer's test); p-value <0.05 significant

Favourable intubation conditions as assessed by total IDS score as well as its individual components were seen in Group I [Table/Fig-5,6]. Easy intubation and slight difficulty in intubation were seen in a greater number of patients in SP as compared to Group II, again showing advantage of SP over SHE. No statistically significant difference was seen in sympathetic response in two groups of patients in terms of change in heart rate [Table/Fig-7] and the Mean Arterial Pressure (MAP) at different time intervals [Table/Fig-8].

Distribution of modified CL grades			Group I	Group II	Total	p-value
Modified Cormack and Lehane grading	1	Count	69	51	120	0.015
		% within modified CL grading	57.5%	42.5%	100%	
		% within group	62.7%	46.4%	54.5%	
	2a	Count	27	25	52	0.751
		% within modified CL grading	51.9%	48.1%	100%	
		% within group	24.5%	22.7%	23.6%	
	2b	Count	11	24	35	0.017
		% within modified CL grading	31.4%	68.6%	100%	
		% within group	10.0%	21.8%	15.9%	
	3	Count	3	10	13	0.045
		% within modified CL grading	23.1%	76.9%	100%	
		% within group	2.7%	9.1%	5.9%	
Total		Count	110	110	220	
		% within modified CL grading	50%	50.0%	100%	
		% within group	100%	100%	100%	

[Table/Fig-4]: Distribution of modified Cormack and Lehane grades in Group I and Group II.
Unpaired t-test; p-value <0.05 significant; CL: Cormack and Lehane

Ease of intubation	Group I (N=110)	Group II (N=110)	Total	p-value
Easy Intubation (total IDS score=0)	67 (60.9%)	45 (40.9%)	112 (50.9%)	0.003
Slight difficulty in intubation (total IDS score=1-5)	39 (35.5%)	55 (50.0%)	94 (42.7%)	0.029
Moderate to major difficulty in intubation (total IDS score >5)	4 (3.6%)	10 (9.1%)	14 (6.4%)	0.097

[Table/Fig-5]: Distribution of total IDS scores in Group I and II.
Unpaired t-test, p-value <0.05 significant

	N1			N2		N3			N4			N5		N6		N7	
Group	0	1	2	0	1	0	1	2	0	1	2	0	1	0	1	0	1
Group I (N=110)	103	3	4	110	0	104	5	1	69	38	3	83	27	95	15	109	1
Group II (N=110)	96	12	2	110	0	94	16	0	51	49	10	60	50	80	30	109	1
p-value	0.043			-------		0.026			0.010			0.001		0.012		1.000	

[Table/Fig-6]: Comparison of IDS variables in Group I and Group II.
Unpaired t-test, p-value <0.05 significant

Heart rate	Group	Mean	Std. deviation	p-value
5 min before	Group I	80.35	6.122	0.715
	Group II	80.64	5.690	
At induction	Group I	82.82	6.090	0.121
	Group II	84.18	6.863	
After 5 min	Group I	82.27	5.542	0.131
	Group II	83.50	6.429	
After 10 min	Group I	79.53	4.885	0.094
	Group II	80.63	4.806	

[Table/Fig-7]: Comparison of mean Heart Rate (HR) at four different time intervals.
Unpaired t-test; p-value <0.05 significant

Mean arterial pressure	Group	Mean	Std. deviation	p-value
5 min before	Group I	93.939	6.0763	0.865
	Group II	93.791	6.8603	
At induction	Group I	96.152	5.8515	0.485
	Group II	96.758	6.9655	
After 5 min	Group I	95.636	5.7225	0.302
	Group II	96.509	6.7493	
After 10 min	Group I	93.752	4.7604	0.367
	Group II	94.394	5.7330	

[Table/Fig-8]: Comparison of Mean Arterial Pressure (MAP) at different time intervals.
Unpaired t-test; p-value <0.05 significant

DISCUSSION

Laryngoscopy and tracheal intubation are key events for general anaesthesia. Any difficulty encountered during laryngoscopy and endotracheal intubation can result in adverse outcomes. In most instances, poor visualisation of the glottis correlates with difficult intubation. Traditionally, SP has been recommended as the standard position of head and neck during laryngoscopy. However, the superiority of SP over the SHE position has recently been questioned. The present study had evaluated that SP provides better glottic visualisation and ease of intubation (as assessed by total IDS score as well as its individual components) compared to SHE during direct laryngoscopy and endotracheal intubation.

In the present study, glottic visualisation as assessed by Modified Cormack and Lehane grades was compared between the two groups of patients and found visualisation of entire glottic aperture was possible in higher number of patients when laryngoscopy was performed in SP. These results are in accordance with the study done by Singhal SR et al., where Cormack and Lehane grade I was seen in 58% of patients in group A (SP) and 51% of patients in group B (SHE) [10]. Grade II was seen in 35% and 42% of patients in group A and group B, respectively. Grade III was seen in 6% and 7% of patients in group A and B, respectively. In the study done by Bhattarai B et al., CL grade was I in 66.5% of patients, II in 31%, III in 2% and IV in 0.5% patients during SP while in Group II CL grade was in 59.5%, 32%, 8.5% and 0 patients, respectively [11]. Prakash S et al., also concluded that SP was superior to SHE for optimal head positioning during laryngoscopy [12].

This study also found that intubation was easier when patients were placed in SP and these results are in agreement with studies done by Hochman II et al., Levitan RM et al., Takenaka I et al., and Lee BJ et al., who, concluded that intubation becomes easier when patient is placed in SP as compared to SHE [13-16]. The results of present study are not in accordance with study done by Adnet F et al., in 2001 [6]. In their study, easy intubation (Total IDS=0) was seen in 56% of patients in SP and 48% of patients in Group II. Slight difficulty in intubation (total IDS=1-5) was seen in 41% patients in SP and 48% patients in SHE. Moderate to major difficulty in intubation was seen in 2.6% of patients in both groups. This difference in the result could be due to avoidance of neuromuscular blockers in their study and failure to place head in proper SP. In their study, the authors did not clearly state that the head was actually extended on the neck at the atlanto-occipital joint, as failure to do so would constitute failure to achieve the SP.

Similar results were also seen in study done by Singhal SR et al., in which easy intubation (IDS=0) was seen in 58% of patients in SP as against 41% of patients in Group II (p-value <0.05) [10]. Slight difficulty in intubation was seen in 41% patients in SP and 57% patients in SHE. As with the present study, higher number of patients in Group II (22%) required alternative techniques (N3>0) as compared to Group I (10%). Similarly in study done by Bhattarai B et al., easy intubation (IDS=0) was seen in 58% of patients in SP and 41% of patients in Group II [11]. Slight difficulty in intubation was seen in 41% patients in SP and 57% patients in SHE.

The present study also found that no alternative techniques were required (i.e., N3=0) for intubation in more number of patients in group I (n=104) as compared to group II (n=94) showing advantage of the group I over group II. This difference between two groups

was statistically significant with p=0.025. Alternative techniques including the use of stylet or different size of tubes or blades were required in more number of patients in group II (n=16) as compared to group I (n=6). These results are also in agreement with study done by Prakash S et al., with respect to total IDS scores [12]. Easy intubations were seen in 60.4% of patients in SP as against 47.6% patients in SHE. Slight difficulty in intubation was seen in 38.2% in SP and 52.4% in SHE. Alternative techniques (N3>0) were required in 4.4% patients in SP and 8.9% patients in SHE. Increased lifting force (N5=1) was required in only 5.8% patients in SP as compared to 12.9% in SHE. External laryngeal manipulation was required in 43% of patients in Group II and 32.7% patients in SP.

Limitation(s)

Major limitation was the unblinded nature of the study as it was impossible to blind the operators to the intubating positions. Also being a unicentric study, the study population was limited (n=220). Also, the depth of neuromuscular blockade was not monitored which could have affected the intubating conditions.

CONCLUSION(S)

Placing the head in SP resulted in better glottic visualisation and associated with favorable intubation conditions as compared to SHE position. Hence, this study supported the practice of using SP as the standard position of head and neck for direct laryngoscopy and endotracheal intubation.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 29, 2021
- Manual Googling: Jul 14, 2021
- iThenticate Software: Jul 30, 2021 (22%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **May 28, 2021**
Date of Peer Review: **Jul 08, 2021**
Date of Acceptance: **Jul 20, 2021**
Date of Publishing: **Sep 01, 2021**