COMPARISON OF THE 'SNIFFING THE MORNING AIR' POSITION AND SIMPLE HEAD EXTENSION FOR GLOTTIC VISUALIZATION DURING DIRECT LARYNGOSCOPY

NUR HAFIIZHOH A.H.* AND CHOY YIN CHOY**

Abstract

Background: This was a prospective randomized single-blinded clinical trial comparing the glottic views obtained during direct laryngoscopy between the 'sniffing the morning air' position and simple head extension.

Methods: A sample of 378 patients, aged 18 to 75 years old with ASA physical status I or II, scheduled for elective surgery under general anesthesia with endotracheal intubation, were randomized into 2 groups. Group A used the sniffing position during the first laryngoscopy while Group B was put in simple head extension position. Positions were then interchanged for the second laryngoscopy. Sniffing position was obtained by placing a 7 cm height non-compressible cushion under the patient's head. In simple head extension, patient's head was placed flat. Glottic visualization was assessed based on the Cormack & Lehane scale. Intubation was performed after second laryngoscopy and success rate of first attempt intubation was compared.

Results: The distribution of patients with different Cormack & Lehane scores between the two intubation positions were significantly different ($p < 0.001$). Changing over to the 'Sniffing position' resulted in improvement of the Cormack & Lehane scores in 109 (57.7%) patients, no change in 75 (39.7%) or worsening in 5 (4.8%) patients. Successful intubation at first attempt was better ($p<0.05$) with Group A: 156 (83.5%) while Group B: 121 (64.0%).

Conclusion: sniffing position provided better glottic visualization score and increased the successful rate of intubation as compared to simple head extension.

Key words: sniffing position, simple head extension, intubation, glottis view, Cormack & Lehane score.

* MD.
** MD, FANZCA.
Department of Anaesthesiology and Intensive Care, Universiti Kebangsaan Malaysia Medical Center, Jalan Yaacob Latiff, Bandar Tun Razak, Cheras, 56000, Kuala Lumpur, Malaysia.
Corresponding author: YC Choy, Clinical Associate Professor, Department of Anaesthesiology and Intensive Care, Universiti Kebangsaan Malaysia Medical Center, Jalan Yaacob Latiff, Bandar Tun Razak, Cheras, 56000, Kuala Lumpur, Malaysia. Tel: 006-03-91455783, Fax: 006-03-91456585. E-mail: choy@ppukm.ukm.edu.my; choyyinchoy@ymail.com

Introduction

Tracheal intubation is one of the routine procedures during administration of general anesthesia and usually carried out without difficulties. However, it may occasionally be difficult during elective cases and can be encountered when unexpected. Based on the American Society of Anesthesiologists (ASA) Closed Claims Project database, respiratory complication was a major cause of anesthesia related morbidity and mortality decades ago[1]. Fortunately with advancement in research, improvement in airway management through education and the development of better airway devices, these risks have substantially decreased. Difficult laryngoscopy and intubation, repeated attempts and prolonged instrumentation with increasing forces are associated with dental and oropharyngeal soft tissue injuries, arterial desaturation, hemodynamic instability and unnecessary intensive care unit admissions[2,3]. The incidence of difficult intubation is estimated to be approximately 1-4% and probably 0.05-0.35% of patients with seemingly normal airways would be impossible to be intubated[4,5]. Being uncommon, studies of relevant factors had involved only small number of patients and comparison between such studies is compounded by the absence of an agreed standardized intubation position[6,7,8,9].

A good intubation position is expected to provide a complete glottic view during direct laryngoscopy for easy and smooth tracheal intubation. Sir Ivan Magill in 1936 first described his preferred intubation position as '*the relative position of the airway passages instinctively adopted by a man as he scents the air or drinks a pint.'*[10] In 1944, the 'Three Axes Alignment Theory' was the only valid theory introduced by Bannister and Macbeth who studied various intubation positions and concluded that the main determinant of good glottic visualization is by aligning the line of vision of operator with the mouth, pharynx and laryngeal axes which could be achieved with the head elevated on a pillow, resembling the 'sniffing the morning air' position'[10]. Since then, 'sniffing the morning air' position or sniffing position has long been advocated as the hallmark of recommended airway management for optimization of glottic visualization during direct laryngoscopy[11,12]. In 'sniffing the morning air' position, the neck must be 35° flexed on the chest by elevation of the head with cushion under the occiput and extending the head at the atlanto-occipital joint at 15° as validated by Horton *et al* (1989) using an angle finder[9].

There appeared to be widespread acceptance of the 'Three Axes Alignment Theory' and the 'sniffing the morning air' position. However, the reliability of sniffing position as a gold standard intubation position was questioned by Adnet *et al* (2001) when his magnetic resonance imaging study failed to demonstrate that the three axes could be aligned in an awake patient put in the 'sniffing the morning air' position. He was unable to provide evidence to justify any significant advantage of 'sniffing the morning air' position over simple head extension for tracheal intubation[11,13]. This new development triggered controversy and heated debates among anesthetists. Subsequent studies found that the 'sniffing the morning air' position is significantly better than simple head extension for direct laryngoscopy and beneficial in several situations: the setting of known difficult airway, obese patient and patient with obstructive sleep apnoea[14,15,16]. Nevertheless, 'sniffing the morning air' position is still universally accepted despite the lack of any study to date that confirmed or refuted these claims.

The aim of this study was to compare the glottic views based on Cormack & Lehane score with patient placed either in the 'sniffing the morning air' position or simple head extension during direct laryngoscopy and the success of oral tracheal intubation at first attempt.

Methods

This was a prospective randomized single-blinded study conducted in operating theatres of Hospital Kuala Lumpur from December 2011 until April 2012. Prior approval was obtained from the Dissertation Committee of Department of Anaesthesiology and Intensive Care of HKL and UKMMC, Medical Research and Ethics Committee of UKMMC (Project code: FF 400-2011) and National Medical Research.

Three hundred and seventy eight patients, aged 18 to 75 years old with ASA physical status class I or II, scheduled for elective surgical procedures under general anesthesia requiring orotracheal intubation were enrolled. Patients were given a comprehensive explanation regarding the study and written informed consent was obtained prior to the operation day. Patient characteristics and airway assessment such as the Mallampati class, thyromental distance (TMD), range of motion of the head and neck and mouth opening were determined during preoperative assessment. Exclusion criteria included: known difficult airway or anticipated difficult airway (TMD less than 6 cm, limited neck mobility, limited mouth opening, Malampati score III or IV, facial deformity and abnormality of mouth, larynx, pharynx or tongue), patients who required rapid sequence induction because high risk of aspiration, and morbidly obese patient with body mass index (BMI) > 35 kg/m².

Patients were randomized into Group A or B using a computer based randomization software. Group A patients were placed in 'sniffing the morning air' position during initial laryngosopy (L1) followed by simple head extension position for the second laryngoscopy (L2). Group B patients were placed in simple head extension during L1 and then changed to 'sniffing morning air' position during L2. The 'sniffing the morning air' position was obtained by insertion of a standard 7 cm height non-compressible cushion under the patient's head to avoid the variable degree of cervical flexion caused by compressibility of a regular cushion. The cushion was then removed to provide the simple head extension position. Patients were blinded regarding the sequence of the intubation positions.

Patients were fasted for at least 6 hours prior to surgery. Oral midazolam 3.75-7.5 mg, depending on age and weight of the patient, was given as night sedation as well as premedication 1 hour prior to surgery. In the operating theatre, patient was positioned supine with the head placed according to the study protocol. The operating table was set at the same level as the investigator's anterior superior iliac spine. Standard baseline monitoring included: non-invasive blood pressure, electrocardiograph, heart rate and pulse oximetry. For anesthetic induction, intravenous fentanyl 2 mcg/kg, followed by propofol 2 mg/kg was titrated until loss of verbal responses. Intravenous rocuronium 0.6 mg/kg was given for neuromuscular block. Mask ventilation was carried out for 3 minutes with 2-4% sevoflurane in 100% oxygen to achieve adequate anesthetic depth of 1.0-1.2 minimal alveolar concentration.

Laryngoscopies, either L1 or L2 were performed using a size 3 Macintosh laryngoscope blade to obtain the best view of the glottis without external laryngeal manipulation. Before L2 was conducted patient was mask ventilated for another 30 seconds. Grading of glottic visualization during L1 and L2 without external laryngeal manipulation was assessed based on the Cormack & Lehane scale. Direct laryngoscopies were conducted by multiple operators, each having over three years experience in anesthesiology, and competent in airway management. Direct vision endotracheal intubation was done after L2.

An appropriate oral endotracheal tube (ETT) was selected accordingly. Sizes used were 7.0-7.5 mm for female and 7.5-8.0 mm for male patients. A stylet was inserted into each of the ETT to facilitate intubation. When difficulty was encountered, any modified technique necessary to achieve better glottic visualization, successful intubation and securing the airway would be used. The number of intubation attempts and any modified technique to improve glottic view required were recorded. In the event of an unanticipated difficult intubation, the anesthetist in-charge of the operating theatre was informed and airway management was conducted based on Difficult Airway Society guidelines 2004[17].

The sample size was calculated based on 'Power and Sample Size Calculations' by Casagrande and Pike formula inclusive of 10% dropout and was 378. The alpha error value was set at 0.05, power of study at 90%; and beta value was 0.1[13]. Data were analysed by using parametric and Chi-square test of SPSS version 20.0 software as appropriate. A p-value of <0.05 was considered to be statistically significant.

Results

A total number of 378 patients were included in the study, 189 patients were assigned to each group. Patient demographic parameters were statistically comparable in both groups (Table I) with regards to age, gender, race, ASA physical status classification, BMI and Malampati scores.

Table I
Demographic characteristics of studied patients, values expressed as mean ± SD and numbers (percentage) where appropriate.

Characteristic	Group A (n = 189)	Group B (n = 189)
Age	44.6 ± 14.7	44.0 ± 16.0
Gender		
Male n (%)	70 (37%)	84 (44.4%)
Female n (%)	119 (63%)	105 (55.6%)
Race		
Malay n (%)	111 (58.7%)	106 (56.1%)
Chinese n (%)	30 (15.9%)	33 (17.5%)
Indian n (%)	40 (21.2%)	41 (21.7%)
Others n (%)	8 (4.2%)	9 (4.8%)
ASA		
Class 1 n (%)	99 (52.4%)	95 (50.3%)
Class 2 n (%)	90 (47.6%)	94 (49.7%)
BMI (Kg/m^2)	25.0 ± 4.0	25.3 ± 4.3
Malampati score n (%)		
Class I n (%)	97 (51.3%)	96 (50.8%)
Class II n (%)	92 (48.7%)	93 (49.2%)

Laryngoscopies were successful for all patients. The distribution of Cormack & Lehane scores for the initial and subsequent changed over assessment in the 'sniffing the morning air' position and simple head extensions are listed in Table II and III respectively. There was a statistically significant difference of Cormack & Lehane score I-III between sniffing position and simple head extension.

Table II
Distribution of glottic visualization based on Cormack & Lehane score during first laryngoscopy (L1) (values expressed as number, percentage).

Cormack & Lehane Score n (%)	Group A n = 189	Group B n = 189	P
I	142 (75.1)	51 (26.9)	< 0.001
II	41 (21.7)	122 (64.6)	< 0.001
III	6 (3.2)	16 (8.5)	< 0.001
IV	0 (0)	0 (0)	

Table III
Distribution of glottic visualization based on Cormack & Lehane score during second laryngoscopy (L2), (values expressed as number, percentage).

Cormack & Lehane Score n (%)	Group A n = 189	Group B n = 189	P
I	56 (29.6)	141 (74.6)	<0.001
II	114 (60.3)	46 (24.3)	<0.001
III	18 (9.5)	2 (1.1)	<0.001
IV	1 (0.5)	0 (0)	

Changing over to the 'sniffing the morning air' position from simple head extension and in the reverse resulted in improvement of Cormack & Lehane scores in 109 (57.7%) patients, no change in 75 (39.7%) or worsening in 5 (4.8%) patients as shown in table IV and V.

Table IV
Outcome of Cormack & Lehane Score before and after change of position at L1 and L2 for Group A. Values expressed as number (percentage).

Cormack & Lehane's Score changes	Group A n = 189
I to I	46 (24.3)
I to II	96 (50.8)
II to I	10 (5.2)
II to II	15 (7.9)
II to III	16 (8.5)
III to II	3 (1.6)
III to III	2 (1.1)
III to IV	1 (0.6)

All patients were successfully intubated after L2, with 277 (73.3%) patients being intubated at first attempt regardless of the intubation position. Successful intubation at first attempt was greater with Group A: (156; 83.5%) versus Group B (121, 64.0%); $p<0.05$. Tracheal intubation was successful at second attempt for the rest of the 101 (26.7%) patients as shown in Table VI.

Table V
Outcome of Cormack & Lehane Score before and after change of position
at L1 and L2 for Group B. Values expressed as number (percentage).

Cormack & Lehane's Score changes	Group B N=189
I to I	47 (24.9)
I to II	4 (2.1)
II to I	94 (49.7)
II to II	27 (14.2)
II to III	1 (0.6)
III to II	15 (7.9)
III to III	1 (0.6)
III to IV	0 (0.0)

Table VI
Number of intubation attempt in 'sniffing the morning air' position and simple
head extension, values expressed as number (percentage).

SUCCESSFUL INTUBATION	Sniffing position n = 189	Simple head extension n = 189	p
1st attempt	156 (83.5)	121 (64.0)	<0.05
2nd attempt	33 (16.5)	68 (36.0)	<0.05

Discussion

Current teaching for tracheal intubation stresses the importance of the head position, and in particular of the 'sniffing the morning air' position, as the single most important factor in cases of difficult laryngoscopy[2]. Common intubation positions used during direct laryngoscopy include: 'sniffing the morning air' position, simple head extension, combined head and neck extension, as well as the head elevated laryngoscopy position or ramped position. In contrary to studies done by Adnet *et al* (2001) and Prakash *et al* (2011), which failed to demonstrate the superiority of 'sniffing the morning air' position over simple head extension in anaesthetized patients[13,18], our study showed that 'sniffing the morning air' position has significantly improved Cormack & Lehane scores as compared to simple head extension. This is consistent with many other previously published studies and strongly supports the 'sniffing the morning air' position as the ideal intubation position for direct laryngoscopy[14-16].

Adnet *et al* (2001), using magnetic resonance imaging, found that it was not possible to achieve the required anatomic alignment of the laryngeal, pharyngeal, and the mouth axes based on the three axes alignment theory neither in the neutral, simple head extension, nor the 'sniffing the morning air' position[11]. Takenaka *et al* (2007) in his radiological study showed that the 'sniffing the morning air' position provided greater occipito-alanto-axial extension angle, increased the submandibular space and facilitated vertical alignment of the mandible, tongue base, and larynx[19]. However, these two studies involved non-anesthetized volunteers, and laryngoscopy was not performed. Placing the patient in the 'sniffing the morning air' position does not align the anatomic airway axes, and application of a force via the laryngoscope blade is required to achieve alignment of the oral, pharyngeal and laryngeal axes to facilitate direction vision for the laryngoscopist[19]. The anterior and caudad force exerted by a laryngoscope blade on the oropharyngeal structures with the head in the 'sniffing the morning air' position required the least forces to displace the soft tissues of the oropharyngeal cavity and to align the laryngoscopic axes resulting in good visualization of the vocal cords[5,18,20]. Therefore it was not a surprise that in our study, 83.5% successful first intubation were achieved with the 'sniffing the morning air' position compared to only 64.0% in simple head extension position. These effects would be further improved if the pillow height was elevated especially in cases of difficult direct laryngoscopy[21,22]. Park *et al* demonstrated that laryngoscopic view obtained with the 'sniffing the morning air' position using a 9 cm pillow was significantly superior to that of the 6 cm pillow[21]. However, use of single standard pillow size did not always provide optimal cervical flexion for all patients because of modest variation in weight, head circumference and length of the neck[19].

In non-obese patients, the optimal ‘sniffing the morning air’ position is achieved by raising the occiput 7 cm from the bed. This produces approximately 35˚ of flexion of the lower cervical spine on the chest. However, this degree of neck flexion cannot be achieved by a 7 cm pillow maneuver in morbidly obese patients. Their anatomy requires stacking to achieve not only 35˚ of neck flexion on the chest, but also 90˚ of extension of the head on the neck at the atlanto-occipital joint so that a parallel imaginary line can be drawn from the external auditory meatus to the sternal notch[23,24]. It is possible that stacking an obese patient produces the same alignment of the axes of intubation that the ‘sniffing the morning air’ position produces in normal weight patients[24].

There were several limitations noted in this study. Firstly, despite standard anesthetic induction and use of muscle relaxant before direct laryngoscopy, there was no neuromuscular monitoring device used to monitor the depth of neuromuscular blockade to confirm that the pharyngeal and laryngeal muscles were adequately relaxed and optimal intubation condition had been achieved. Secondly, it was impossible to blind the laryngoscopist to the intubation position or the sequence of which laryngoscopy was to be conducted. This could have introduced bias in the amount of extension performed by the laryngoscopist. Preferably, the glottic view had been photographed and the picture analyzed by an independent assessor to grade the Cormack & Lehane score. Thirdly, the laryngoscopies were conducted by several laryngoscopists. This would contribute to an observational bias and inconsistency of the Cormack & Lehane scored. In relation to intra-rater and inter-rater reliability of Cormack & Lehane score, Levitan *et al* and Jeremiah *et al* conducted a clinical trial involving an airway assessment by using percentage of glottic opening (POGO) score instead of Cormack & Lehane score. POGO score has significantly better inter and intra-rater reliability compared to Cormack & Lehane score[26,27]. However those studies were conducted among the emergency medicine personals. Ochroch *et al* compared reliability of both scoring systems amongst the anesthetists and came to similar conclusions[28]. However, in this study Cormack & Lehane scoring system was still used to score the glottis visualization because of its familiarity amongst the laryngoscopists. To reduce any observational mistake, the Cormack & Lehane score figures were attached in the data collection form for a quick reference and the laryngoscopists were limited to those who had 3 years experience in anesthetic practice. In conclusion this study showed the sniffing position when compared to simple head extension had provided a better glottic visualization score and increased the success rate of tracheal intubation.

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