Manual In-Line Stabilization of the Cervical Spine Increases the Rate of Difficult Oro-Tracheal Intubation in Adults - A Randomized Controlled Trial

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Abstract

Background: Patients with traumatic brain injury present with loss of consciousness and suspected cervical fracture. The aim of this study was to determine the rate of difficult orotracheal intubation in surgical patients undergoing various procedures when manual in-line neck immobilization technique was applied. **Methods**: This was a randomized prospective study at the Lagos University Teaching Hospital. A total of 100 patients were enrolled into the study and were allocated into 2 groups of either Manual In-Line Stabilization (MILS) or Early Morning Sniffing position (EMSP) techniques during intubation. Successful or unsuccessful intubations within 30secs, as well as time to successful intubation were the outcome measures. **Results**: The mean ± SD intubation time for successful intubation was similar in both groups (MILS=17.9±7.7seconds, EMSP=14.6±6.6 seconds (p=0.359)).There were more failed intubations in the MILS group (27%) and (2%) in the EMSP group (p=0.001). **Conclusion**: The study showed that patients who had MILS had more failed intubations than those that were intubated with the EMSP technique. With this level of failed intubations there is need for provision of difficult airway laryngoscopic adjuncts for patients with diagnosed cervical fracture and uncleared cervical injury who require orotracheal intubation.

Key Words: Manual inline stabilization, Cervical spine injury, Orotracheal intubation, Difficult intubation

Introduction

Manual in-line stabilization (MILS) of the cervical spine is an integral part of airway management when dealing with trauma patients(1). Accentuation of existing neurologic abnormalities has been documented after intubation of patients with unsuspected cervical spine injury(2). Immobilization of the neck is indicated before airway management in all acute trauma patients with depressed consciousness, cervical pain, posterior midline cervical tenderness, extremity paraesthesia, or focal neurological deficit or when pain from other injuries is likely to mask the neck pains (3). Suspicion of cervical spine injury (CSI) is increased by the following risk factors, a high risk mechanism of injury such as falls, diving, high speed motor vehicle accidents and restriction of active neck movements especially rotation (4).

Normal intubation in an adult involves the placement of the head in the early morning sniffing position (EMSP) which anatomically flexes the neck on an extended atlanto-occipital joint of the cervical vertebrae. MILS is a manoeuvre that is performed by grasping the mastoid process of the patient, thus preventing movement of the cervical spine during tracheal intubation (5). Though it prevents further damage to the spinal cord, MILS limits movement of the head during tracheal intubation and impairs visualization of the larynx, as consistently shown by a reduction in Cormack and Lehane's grade visualization and an increased incidence of grades 2, 3 and 4 (1,6). This theoretically may result in a higher incidence of difficult intubation. MILS is frequently used while securing the airway of patients with a known or potentially unstable cervical spine but its effect and other immobilization techniques on the success of endotracheal intubation is still a subject of major debate (6,7). The effect of MILS on the incidence of difficult intubation has not been investigated among the black Africans.

This study sought to evaluate the rate of difficult orotracheal intubation during laryngoscopy in surgical patients undergoing MILS and to compare it with those who had laryngoscopy in the standard EMSP.

Methods

This was a randomized controlled study conducted at the Lagos University Teaching Hospital (LUTH) and approved by the hospital's research and ethics committee. The study population were a convenient sample of 100 adult patients (>18 years of age) based on previous similar study, screened from a population of patients undergoing elective surgery under general anaesthesia with planned orotracheal intubation who had given informed consent (8). LUTH is a 700 bed tertiary hospital in an urban centre with an average population of 18 Million people. It provides anaesthetic services for all surgical specialties with an average of 5000 operations performed yearly. Patients were excluded for the following reasons; Inappropriate surgical table precluding the application of MILS, any contraindication to medications used to induce anaesthesia, patients who were impossible to ventilate by facemask, or history of difficult tracheal intubation requiring alternatives to direct laryngoscopy. Also excluded were the morbidly obese (BMI 35 and above), those with anatomical anomalies of the upper airway, symptomatic gastro eosophageal reflux or patients requiring insertion of a double lumen orotracheal tube.

During preoperative review risk factors for difficult intubation such as Mallampati score, interincisor distance, thyromental and sternomental distances as well as dental status, presence of retrognathism (side view of the patient revealed chin as being posterior to the plane of the face), inability to prognate, height and weight of the patients were recorded. All the patients had standard monitoring which included electrocardiography (ECG), automated oscillometry, precordial stethoscope and pulse oximeter. End-tidal carbon dioxide was sampled at the L-shape connector between the breathing circuit and the endotracheal tube (ETT).

Patients were allocated to one of two groups by a randomizer. Group EMSP had their head positioned on a pillow in the sniffing position before induction of anaesthesia. Group MILS technique patients had their head and neck immobilized by an assistant who was crouched at the left side of the attending anaesthetist holding down the mastoid process, while applying sufficient force to limit as much movement of the head and the cervical spine during laryngoscopy and intubation. All laryngoscopies were performed by the authors who were anaesthetists. Following pre-oxygenation for 3 minutes, anaesthesia was induced with fentanyl (1-3 mcg/kg), Propofol (1-2.5mg/kg) or STP (3-5mg/kg), and Suxamethonium (1.5mg/kg). Only the Mackintosh laryngoscope blade size 3 was used and no external manipulation of the larynx was permitted nor the use of any instrument to facilitate tracheal intubation. Tracheal intubation time was measured with a stop watch from insertion of the laryngoscope into the mouth to inflation of the oro-tracheal tube cuff. Correct tube placement was confirmed by capnography.

Thirty seconds was allowed for an intubation attempt in either group. If intubation was not successful within 30 seconds, this was recorded as a failed intubation in the EMSP group and the airway managed according to the difficult tracheal intubation algorithm of the ASA. All failed intubations in the MILS group were aborted and the patient ventilated for 30 seconds. Another intubation attempt was then made in the EMSP position while recording the laryngoscopic view at both times. When this failed the protocol was discontinued and the airway managed according to the difficult tracheal intubation algorithm of the ASA. When arterial oxygen saturation fell below 90% at any time during the study, the protocol was terminated and recorded as a failure. Cormack and Lehane's (C&L) grading was used to assess the laryngoscopic view (9).

Grade 1-complete visualization of the vocal cords;
Grade 2-visualization of the posterior portions of the cords;
Grade 3-visualization of the epiglottis only;
Grade 4-inability to visualize the epiglottis

Specific numbers were randomly generated by the randomizer application. These numbers were allocated randomly to either MILS or EMSP groups. The envelope bearing the next consecutive number was then opened to reveal the technique to be used by the laryngoscopist.

Statistical analysis was performed using SPSS version 11 (SPSS Inc. Chicago,Illinois) and EPI-INFO 6.04 where appropriate. Probability value less than 0.05 was considered significant and analysed data were presented as Mean±SD or percentages as well as tables and graphical representation where appropriate were used. Patient's demographic data was analysed by 2x2 test of significance, student's t test, and Pearson's Chi square tests with Yates correction for test of significance where appropriate. Fisher's exact test was used where the expected frequency was less than 5.

Results

A total of 57 subjects had MILS while 43 subjects were randomized to the EMSP. (Figure1). Thirty-five (36%) male and sixty three (64%) female patients participated in the study. The mean age, weight, height and BMI of patients in the two groups did not differ significantly. Intubation time was similar in both groups with the mean intubation time for MILS patients being17.9±7.7seconds compared to 14.6±6.6 seconds in the EMSP (P= 0.359) group. (Table 1)

Table1: Patients Demographics

	Male	Female	Mean Age of all patients(years)	Mean weight(kg)	Mean height(m)	Mean intubation time (seconds)
Manual inline stabilization technique (n = 57)	21%(21)	36%(36)	39.4±13.9	70.3±13.8	1.58±0.06	17.9±7.7
Early morning sniffing position (n = 43)	15%(15)	28%(28)	36.9±15.7 p=0.212	70.9±14.5 p=0.32	1.64±0.07 p=0.90	14.6±6. p=0.35
Total	36	64				

Figure. 1: Distribution of failed and successful intubation between MILS 1st attempt and EMSP techniques

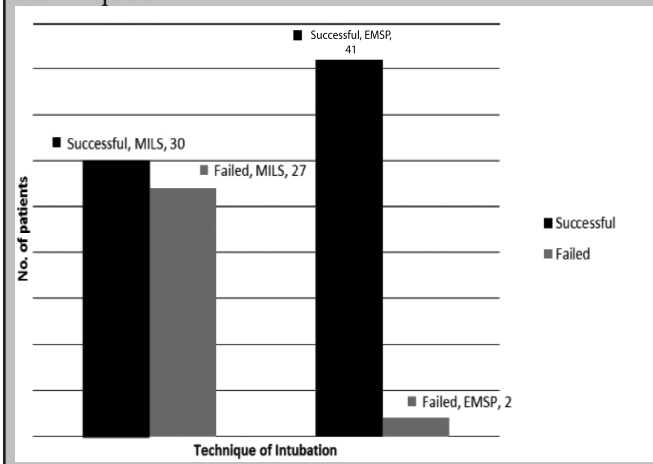

Table 2. Cormack and Lehane grade between MILS 1st attempt and EMSP technique.

GRADE	MILS IST ATTEMPT	EMSP	P-VALUE
1	18(31.6%)	24(58.5%)	1.00
2	16(28.1%)	14(34.1%)	1.00
3	20(35.0%)	2(4.9%)	0.05
4	3(5.3%)	1(2.4%)	0.58

Table 3. Cormack and Lehane grading between failed MILS group and when MILS was removed and the patients were intubated with EMSP technique.

GRADE	EMSP(MILS REMOVED)	FAILED MILS	P-VALUE
1	7(25.9%)	1(3.7%)	0.37
2	19(70.4%)	3(11.1%)	0.15
3	1(3.7%)	20(74.1%)	0.025
4	0(0%)	3(11.1%)	0.24

With a p-value of 0.001 there were significantly more failed intubations in the MILS group 27(47.4%) than the EMSP 2(4.7%) group (Figure 1). Twenty (35.0%) patients in the MILS group had a Cormack and Lehane's (C&L) score of 3 and 3(5.3%) had a C&L score of 4. (Table 2) It showed that the rate of laryngoscopic view of 3 between the two groups was significantly different (p=0.05).

There was a significant difference between the C&L grade 3 view obtained when patients who had failed MILS were converted to EMSP technique.(p-value =0.025) Only one patient (3.7%) had a C&L view of 3 out of twenty(20) patients from failed MILS at a second intubation attempt. With EMSP applied 20(74.1%) and 3(11.1%) patients who had a C&L score of 3 and 4 respectively were improved to a view of 1 {7(25.9%)} and 2{19(70.4%)} (Table 3).

Discussion

Goutcher et al describe the goal of inline manual stabilization as a procedure which applies sufficient forces to the head and neck to limit the movement which might result during medical intervention most notably airway management (7). During laryngoscopy the assistant applies forces that are equal and opposite in the direction to that being generated by the laryngoscopist to keep the head and neck in a neutral position.

Failed intubation occurred significantly more in the MILS group 47.4% than in the EMSP group which recorded 4.7% failed intubations (p=0.001). Our result is comparable with the 50% failed intubation attempts in the MILS group and 5.7% failed intubation in the control group by Thiboutot et al in a similarly conducted study using normal subjects for both MILS and the control group (8). Other studies related to the possibility of increased incidence of difficult and failed intubation when MILS was applied have been carried out with many of these studies agreeing to the aforementioned (7-8, 10). The incidence of C&L grade 3 view was 35 % in the MILS group and 4.9% in the EMSP group in our study, these results were comparable to those obtained by Robitaille et al in a recent study where he obtained 35% C&L grade 3 view in his MILS group however he compared his MILS group with subjects undergoing video laryngoscopy (10). Watts et al also measured a reduction of spinal movement when MILS was applied during tracheal intubation in patients with normal spines under general anaesthesia (11). These desired restrictions in spinal movement in a patient with suspected cervical spinal injuries might have contributed to increase incidence of failed intubation recorded in the MILS group in this study. However Lennarson et al were unable to demonstrate that application of MILS resulted in any significant reduction in movement during intubation in a cadaver model with a posterior column injury (12). They reported that MILS minimized distraction and angulation at the injured level but had no effect on subluxation at the site of the injury. It was concluded that manual inline stabilization may be effective in reducing overall spinal movements recorded during airway manoeuvres but may have lesser restraining effects at the actual point of injury.

Thirty-five per cent of MILS patients had a C&L score of 3 compared to only 4.9% in the EMSP group. Impact of MILS on the view obtained at laryngoscopy may result due to a decrease in overall spinal movements, evidence also suggest modest if any effect at individual motion segments (11,12). Heath examined the effect on laryngoscopy of two different immobilization techniques in 50 patients (13). A grade 3 or 4 laryngoscopic view was obtained in 64% of patients immobilized with collar tape and sand bags and 22% in those who had MILS. The authors identified the main contributory factor to be the reduced mouth opening.

Our study supported these studies and further showed that laryngoscopic view is worsened by MILS. All patients who had laryngoscopic view of grade 3 and 4 improved to 1 and 2 when MILS was removed in this study

Numerous intubating devices are available which may enhance ease of intubation in this category of patients without further compromising the cervical spine leading to secondary cervical injury. During MILS and cricoid pressure, the laryngeal view with a McCoy blade will be equivalent or better than with the same size Macintosh blade. Backward, upward and rightward pressure on the thyroid cartilage may also improve the view. If the laryngeal view is C&L grade 3 or 4, a gum elastic bougie may aid intubation. Laryngoscopy with a Miller straight blade may produce less vertebral movement than an equivalent Macintosh or McCoy blade. In addition, transmitted force from the laryngoscope to the cervical spine may also be reduced by using the least force required to obtain a grade 2 views and inserting an elastic bougie. Railroading a tube over a bougie is easier if the laryngoscope is left in the mouth and the tube is rotated 90° anticlockwise. Small internal diameter (7.0 mm) intubating LMA (ILMA) or Mallinckrodt reinforced tubes are easier to railroad but restrict the passage of larger suction catheters. Good indirect laryngeal views may be obtained with minimal neck movement using a flexible fibreoptic intubating laryngoscope, rigid fibreoptic Bullard laryngoscope and angulated video-intubating laryngoscope provided their optical systems remain clean. However, successful use of these instruments may take time and requires training (14).

We therefore suggest that adequate alternative intubating aids should be available in the emergency room, theatres and Intensive care unit ensuring our ability to improve C&L view of 3 and 4 to 1 and 2 respectively in suspected cervical vertebrae injuries.

The Difficult Airway Society of the United Kingdom has suggested that no more than four intubation attempts are warranted under normal circumstances and that it is difficult to justify the use of the same laryngoscope more than twice. If optimal external laryngeal manipulation, an appropriate length McCoy laryngoscope blade and a gum elastic bougie have been used unsuccessfully at the first attempt, a more experienced intubator may make a difference (14).

Conclusion

We have shown that the use of MILS significantly increases the incidence of difficult intubation in adult Nigerian patients. This may result in difficult airway management in patients with cervical spine injury. We therefore recommend that whenever MILS is to be employed, airway adjuncts should be made available so that the airway can be rapidly secured.

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