VOL. 16|NO. 4|ISSUE 64|OCT.-DEC. 2018

Awake Fiberoptic Intubation in Cervical Spine Injury: A Comparison between Atomized Local Anesthesia versus Airway Nerve Blocks

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Citation

Singh J, Shakya S, Shrestha B, Subedi B, Singh PB. Awake Fiberoptic Intubation in Cervical Spine Injury: A Comparison between Atomized Local Anesthesia versus Airway Nerve Blocks. *Kathmandu Univ Med J.* 2018;64(4):323-7.

ABSTRACT

Background

In cooperative patients with cervical spine injury, awake fiberoptic intubation is an excellent option for elective and semi urgent situations. It allows documentation of neurologic examination before and after intubation and surgical positioning. We have compared anesthesia of airway by nerve block and the local anesthesia atomizer undergoing awake fiberoptic intubation in cervical spine injury patients, in terms of the intubation time and discomfort.

Objective

To compare the intubation time and discomfort in patient with cervical spine injury with anticipated difficult airway potential to aggravate pre-existing injury undergoing awake fiberoptic intubation, based on cough and gag scores, between anesthesia of airway by (transtracheal and bilateral superior laryngeal) nerve block with local anesthetic agent and the local anesthesia atomizer.

Method

After institutional ethical approval and having informed written consent, 30 patients scheduled for elective surgery who require awake fiberoptic intubation, were included in the study. Patients were allotted by computer-generated random series into two groups; Group N received nerve block (transtracheal and bilateral recurrent laryngeal nerve block) and Group A received atomized lignocaine.

Result

The time taken for awake fiberoptic intubation was significantly lower in nerve blocks group as compared with the atomizer group [Group N: 90.2±11.7secs and Group A: 210.4±10.6 secs (p=0.041)]. Atomizer group had an increased coughing and gagging episodes than nerve block group [Group N: one patient, Group A: 11 patients (p=0.006)]. Ease of intubation and patient comfort were significantly better in nerve block group. Demographic and hemodynamic parameters were comparable in the two groups.

Conclusion

The nerve blocks (bilateral superior laryngeal and transtracheal recurrent laryngeal) provides adequate airway anesthesia, lesser patient discomfort, and faster intubation to aid in awake fiberoptic intubation in patients with anticipated difficult airway as compared to topical anesthesia using atomizer.

KEY WORDS

Awake fiberoptic intubation, Cervical spine injury, Laryngeal nerve block, Local anesthetic

INTRODUCTION

For awake patients with cervical spine injury, flexible fiberoptic bronchoscope for tracheal intubation is safe and relatively simple.[1-3] However, the prevention of discomfort and suppression of airway reflex during the intubation is required through appropriate airway anaesthesia. This can be achieved by a variety of techniques including topical anaesthesia or airway nerve blocks.[4] Because airway nerve blocks provide faster and deeper anaesthesia, they are considered to be the gold standard for awake fiberoptic intubation. However, airway anaesthesia can also be achieved without pain and comfortably with nebulization of local anaesthetics.[3,4]

Few studies have been conducted to compare on these methods.[5,6] We have compared the efficacy of atomized local anesthesia and airway nerve blocks for achieving airway anesthesia before awake fiberoptic bronchoscopy-guided intubation.

METHODS

This prospective, randomized, clinical study was done after obtaining institutional ethical approval and informed written consent. Thirty patients with American Society of Anesthesiologists - Physical status (ASA-PS) I-III, within age group of 18-60 years, with cervical spine injury scheduled for elective surgery that required awake fiberoptic intubation (AFOI) were included in the study. Exclusion criteria were patient refusal, pregnancy, patients with coagulopathy and those on anti-coagulants or antiplatelet agents. Patients were allotted by computer-generated random series into two groups. Group N received nerve blocks (transtracheal injection of 4 ml of 4% lignocaine and bilateral superior laryngeal with 2 ml of 2% lignocaine each). Group A received 4 ml of 4% lignocaine atomizer in each nostril by high flow oxygen @ 8-10 l per minutes by atomizer which were directed towards the soft palate and posterior pharynx in a controlled fashion during patients' inspiration to topicalise the airway. Patients in both the groups were given nasal mucosa lubrication with 2% lignocaine jelly by placing lubricated wendl's tube (nasopharyngeal airway) for 15 mins. Changes of voice to low pitch and/or back of tongue becoming numb is/were considered as signs of adequate topical anesthesia which were assessed after giving atomizer.

Intubation time is defined as the time from passing the flexible fiberoptic bronchoscope tip through the nostril to the placement of Endotracheal Tube (ETT) after viewing the carina. The ETT placement was re-confirmed again by bronchoscopy. And then airway was secured. Scores for intubating conditions were noticed. (Table 1)

All the patients were assessed by experienced anesthesiologists (at least 10 years) for anticipated difficult airway by conventional laryngoscopy. After 6 hours fasting as per institutional protocol, the selected patients were given glycopyrrolate 0.2 mg and midazolam 1 mg intravenously (IV). While giving supplemental oxygen through oxygen catheter, fiberoptic bronchoscopy (FOB) guided intubation was performed. Baseline vital parameters, heart rate (HR), non-invasive blood pressure (NIBP) and oxygen saturation (SpO_2) were recorded and subsequently after 1, 3, 5, 7, and 9 min of intubation. Other parameters such as time to perform AFOI, gag/cough reflex, cord visibility (relaxed, partially relaxed or adducted on endoscopic view), and ease of intubation, as assessed base on the comfort score of the patients during intubation were also recorded. Comfort scores were assessed on a five point scale (excellent/ good/moderately comfortable/poor/agitated). Any sign of lignocaine toxicity such as ECG changes and seizures were also watched.

Table 1. Comparison of the cough and gag score and the patient comfort score

Factors	Scores	Group N n(%)	Group A n(%)	P
Cough and gag score	None	13(92.85)	4(26.66)	0.006
	Minimal coughing and gagging, <3 times, like clearing the throat	1(7.14)	7(46.66)	
	Mild cough and gag lasting for <1 min	0	2(13.33)	
	Persistent coughing and gagging	0	2(13.33)	
	Need of rescue topical anesthesia	0	0	
Comfort Score	Excellent, calm patient	12(85.71)	1(6.66)	0.001
	Good, comfortable patient	2(14.28)	2(13.33)	
	Moderately comfort-able, need to pacify the patient	0	9(60)	
	Poor, uncomfortable	0	3(20)	
	Agitated patient	0	0	

a. Based on a previous study by Gupta et al. the required sample size was calculated to be 30 patients (randomly divided into two groups) to demonstrate a 40% difference in intubation time with a power of 0.8 and type 1 error of 0.05.[7] Continuous variables are expressed in means, standard deviation (sd), and categorical variables was presented in proportions (%). Statistical analyses included using Student's t test for parametric data and Fisher's test was use for statistical analyses for categorical data. P values < 0.05 were considered to be statistically significant. The statistical analysis was done using SPSS software, version 21.

RESULTS

A total of 15 patients were enrolled in each group. One patient was excluded from nerve block group (group N), as nerve root block could not be negotiated for abnormality in the neck and vocal cord of the patient through bronchoscope. A total of 29 patients were available for the study. Patient demographics were similar between the two groups. [age: mean ± SD Group N: (41.6±11.3) and Group A: (43.4±9.9) years]. The ratio of male to female patients was 12:2 for Group N and 14:1 for Group A. The groups were also comparable in terms of airway difficulty, as all the patients recruited were cervical vertebra injury.

Attainment of endotracheal tube placement was achieved significantly faster in those receiving nerve block (90.2 ± 11.7 secs) compared with atomizer group (210.4 ± 10.6 secs) (p=0.041) (Table 1). Mean awake fiberoptic intubation time was statistically significant different between the two groups. The vocal cord visibility (fig. 1) was better in Group N as compared to Group A (p=0.003). Only three patients in Group A had complete relaxed vocal cords (completely abducted) as opposed to 12 patients in Group N. Partially relaxed vocal cords were observed in seven patients in Group N whereas only two in Group A. Complete adducted vocal cords were seen in five patients in Group A, whereas in only one patient of Group N (p=0.42).

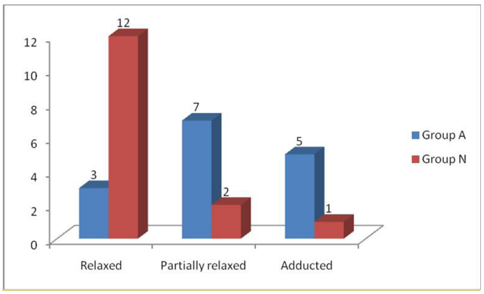

Figure 1. **Comparison of vocal cord visibility between the groups**

Intra-group comparison of heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation, with readings obtained 1 and 3 minutes after awake fiberoptic intubation, revealed a significant increase in heart rate and blood pressure in Atomizer group patients (p= 0.001) than Group N, which returned to near baseline in subsequent readings taken at 5, 7, and 9 minutes after intubation. However, there were no significant intergroup differences in the changes of blood pressure (fig 2) or heart rate from baseline at any point during intubation. Group A had higher cough and gag scores affecting eleven patient, while in Group N, only one patient was affected (p=0.006) (Table-2) . Two patients in Group A had prolonged cough but none in the Group N. The patient comfort scoring was significantly better in Group N with 12 calm patients, whereas in Group A only one patient was calm during intubation. Two patients in Group A showed poor comfort whereas none in Group N (p=0.001). Majority of the patients in the Group N showed good or moderate comfort with p value on 0.001.

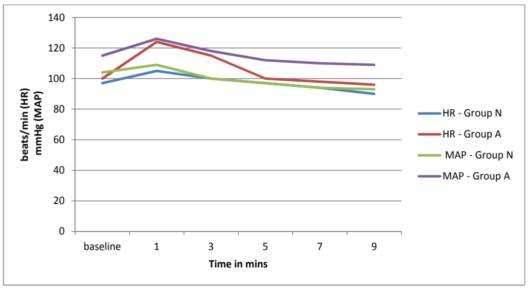

Figure 2. **Comparison of hemodynamic parameters between nerve block and atomizer groups. HR: heart rate, MAP: mean arterial pressure.**

Table 2. **Demographic data and time taken for AFOI**

	Group N	Group A	P value
	Mean±SD	Mean±SD	
Age (Years)	41.6±11.3	43.4±9.9	0.123*
Sex (M/F)	12/2	14/1	0.218**
Weight (Kg)	62.4±4.8	56.1±5.6	0.420*
AFOI time in seconds	90.2±11.7	210.4±10.6	0.041*

Note: * Student t test; **fisher's test

DISCUSSION

Due to the potential consequences for patients and society, traumatic injuries of the cervical spine constitute an important health problem. Complex cervical spine injuries are exhibited by 5-10% of the emergency room patients who are unconscious after trauma.[8]

Cervical spine injury from trauma or disease can lead to devastating effect on spinal cord. It is estimated, cervical spine injury affects 2-5% of blunt trauma patients. The risk of cervical spine injury rises dramatically in blunt trauma patients, in the presence of head or facial injury, decreased level of consciousness or focal neurological deficit.[9-11] Patients with possible cervical spine injury may require urgent or emergent airway intervention. The intervention is needed for airway protection and for the management of hypoxia, hypoventilation or hypotension which are the consequences of spinal cord injury or head or other bodily injury. Patients with known cervical spine injury or disease may also be encountered in elective situations such as planned cervical spine surgery. Health care providers should be familiar with techniques to minimize the risk of spinal cord injury during airway management. It includes personals in pre-hospital settings and in emergency departments, anesthesiology and intensive care units.

Intubation of cervical injury patients demands a high grade of sensitivity of the involved professionals due to fear of causing greater neurological damage. Protocols have been established that include manual in-line immobilization of the cervical spine during airway manipulation.[12] Recently, the safety of manual in-line immobilization with respect to the integrity of the injured spine has been questioned. The major issue with this technique is the worsened view of the vocal cords with direct laryngoscopy.[13,14] There have been remarkable improvements in various aspects of airway management in the field of anesthesia. Since the invention of flexible fiberoptic bronchoscope in 1966 by Dr. Shigeto Ikeda and its subsequent use for endotracheal intubation by Dr. Peter Murphy in 1967, regional anesthesia for the airway has rendered awake fiberoptic intubation comfortable and acceptable for patients. It has also helped anesthesiologists for better control over intubation conditions.[15,16]

This study was undertaken to compare two different methods of instituting local anesthesia for fiberoptic aided intubation. The complex nerve block techniques is an alternative to the topical anesthesia of airway mucosa using atomizers, nebulisers, 'spray-as-you-go' technique and transtracheal injections for aiding AFOI in patients with anticipated difficult airway.[17] All of the patients in our study had cervical spine injury and most of them had unstable cervical vertebral fractures, potential to aggravate, the airway directly or indirectly after a surgery.

Airway nerve blocks are used for awake fiberoptic intubation. It include glossopharyngeal nerve blocks, which anesthetize the oropharynx and block the gag reflex; bilateral superior laryngeal nerve blocks, which anesthetize the larynx above the level of the vocal cords and block glottic closure reflex; and transtracheal nerve blocks, which anesthetize the trachea and larynx below the level of the vocal cords and abolish the cough reflex. Even small doses of local anesthetic for these nerve blocks can provide deep and rapid anesthesia, with the knowledge of regional anatomy and operator's skill.

Fine droplets of local anesthesia can be deposited directly over the mucosa by atomization, obtaining the desired anesthetic effect and obviating the need for multiple injections. Because the procedure is relatively easy, less knowledge of anatomy, less skill and experience is required. It can be used where nerve blocks are not possible, like in massive neck swelling. However, for this procedure, large dose of local anesthetic are required due to wastage during administration and also there is a higher chance of failure, with delayed onset of action.

In our study, we used 4 ml of 4% lignocaine (160 mg) for transtracheal injection and 2 ml each of 2% lignocaine for superior laryngeal nerves because of abnormal airway and the study intention was to have a better understanding of the comparative efficacy of the topical anesthesia by two different methods and not to exceed the toxic dose of the drugs. Similar dose and concentration of lignocaine have been used by several others as well. Similarly for the atomization, we used 8 ml of 4% lignocaine depending on the body weight. Because there was no way to measure plasma lignocaine concentrations in our study, we limited the maximum dose of lignocaine to 400 mg. Hence, we deemed it sufficient to use a maximum concentration of lignocaine of 4%, in a possible volume of 8 ml, to produce effective anesthesia without causing lignocaine toxicity.

In our study, there was one failure of intubation in nerve block group due to technical difficulty and hence excluded from the study. The mean intubation time was significantly shorter in the nerve block group than in the atomization; this was in contrast to the findings of Pirlich et al. who reported a mean intubation time of 123±46.7 sec in a nerve block group and 200.4±72.4 sec in a nebulisation group (p=0.047).[18] However, Reasoner et al. found no significant difference in intubation time between nerve block and topical anesthesia group and in both of their groups the intubation time was longer than in any other study.[19] In contrast to our study, the degree of operator skill with awake fiberoptic intubation was not specified in any previous report.

We observed that most patients of nerve block group showed a significant reduction in the cough and gag reflex on passing the scope to the trachea compare to atomizer group. 92.85% of patients in Group A had no incidence of cough and gag reflex in comparison to 26.66% in Group A, (p=0.006), Table 2. Though most patients on both groups had narrow space in the pharynx due to airway pathology and limited neck movements, topical anesthesia was not efficient in atomization group as the raining down effect of local anesthetic into trachea during atomization might have been suboptimal. This might have been the reason for lesser comfort observed in the patients of atomization group.

Some studies had patients comfort assessed through feedback by contacting them at a later date after the procedure. Since all the patients, in our study were electively mechanically ventilated in the post operative period for 24 to 48 hours, under midazolam and fentanyl sedation, it was not possible to get clear reply from all patients uniformly regarding their experiences. Hence, objective assessment of patient comfort levels was made by the researcher when the patients were undergoing awake intubation (Table 2)

Both nerve block group and atomization group had no statistically significant changes in heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure and oxygen saturation but there was increase in systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP) in both the groups, immediately after intubation in 1, 3 and 5 minutes relative to baseline, probably due to sympathetic stimulation after the tip of scope passed beyond the vocal cord up until the carina is visualized. However these changes were transient and normalized within 5-9 minutes after fiberoptic intubation. Between the two groups, atomization group had a larger increase in the SBP, DBP and MBP than nerve block group. (fig 1) Kundra et al. also reported higher grimace scores, mean HR and BP during insertion of endotracheal tube in patients who received lignocaine via nebulization as compared to nerve blocks.[20]

The limitations of our study are that it is not blinded study, and was related to the difficulty in assessing the complexity of airway and the pharyngeal space of each patient beforehand, which often gives difficulty during navigation. Some of our patients in both groups had unstable cervical fracture that accelerated the discomfort due to inability to atomize properly.

CONCLUSION

Nerve blocks (bilateral superior laryngeal and transtracheal recurrent laryngeal) provide adequate airway anesthesia, lesser patient discomfort, and faster intubation to aid in AFOI in patients with anticipated difficult airway as compared to topical anesthesia using atomizer.

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