COMPARATIVE STUDY OF NEBULISATION, AIRWAY NERVE BLOCK AND ATOMISATION WITH LIGNOCAININE IN TOPICAL AIRWAY ANAESTHESIA FOR AWAKE FIBRE-OPTIC INTUBATION

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ABSTRACT

BACKGROUND

Anaesthesia for flexible fibre-optic bronchoscope guided awake intubation of the trachea can be achieved by nebulization with local anaesthetic, airway nerve blocks or by atomization with local anaesthetic.

METHODS

A prospective, randomized, open label study was conducted on 63 patients, divided into three groups, Group A (Nebulisation), Group B (Airway Nerve Block), Group C (Atomization). Time for intubation, ease of intubation, cord visibility, grade of intubating condition, patients comfort score and vital parameters were recorded.

RESULTS

Group A patients had more increase in hemodynamic variables than Group B and Group C. More time was spent for intubation in Group A. Group B had best cough & gag scores among all groups. Patients of group B were the most comfortable with nearly 90% of them having comfort scores 1 or 2. Group B patients had the most optimal intubating condition grading with 66.6% having optimal grades. The best cord visibility and most relaxed vocal cords were observed in group B patients.

CONCLUSIONS

Airway nerve blocks provide more adequate airway anaesthesia in respect of cough and gag scores, comfort score, cord visibility, intubating condition grade and hemodynamic condition to aid in awake FOB guided intubation than atomization and nebulization with local anaesthetics. Atomization technique also provides more hemodynamic stability, less cough and gag score, greater comfort score and good intubating condition than nebulization technique.

KEYWORDS

Nebulisation, Airway Nerve Blocks, Atomization, Fibre-Optic Intubation, Lignocaine.


BACKGROUND

Flexible fibre-optic bronchoscope (FOB) guided intubation in an awake, spontaneously ventilating patient is the gold standard1 for the management of the difficult airway. It is essential to anaesthetize the upper airway prior to awake FOB guided intubation, ensuring patient comfort.2,3 There are three ways to achieve this:

(a) Nebulisation with local anaesthetic (LA)
(b) Airway nerve block
(c) Atomization with LA

Aims and Objectives

To compare patient reaction, duration of procedure, efficacy, hemodynamic changes during awake fibre-optic intubation done under nebulization, airway nerve blocks and atomization.
Inclusion Criteria
i. ASA I and II.
ii. Age: 18 to 60 years.
iii. Scheduled for elective non-cardiac surgery requiring general anaesthesia and endotracheal intubation.
iv. Patient given consent for fibre optic intubation.
v. Known or anticipated difficult airway.

Exclusion Criteria
i. Patient refusal, uncooperative and mentally retarded patients
ii. Bleeding disorder, epistaxis and active oral bleeding
iii. Active cough or respiratory tract infection, bronchial asthma and upper airway obstruction or stenosis
iv. Lignocaine hypersensitivity patient
v. Full stomach patient
vi. Raised intra cranial pressure or intracranial pressure
vii. Cerebral aneurysm
viii. History of recent Acute myocardial infarction or cerebrovascular accident

METHODS

Study Design
Prospective, randomized, open label study.

Source Population
Patients attending pre-anaesthetic check-up clinic of our Institution.

After approval by the Institutional Ethics and Scientific Committee, 63 adult patients with anticipated difficult airway requiring FOB guided intubation were recruited for the study. Patients were allotted by computer-generated random sequence into three groups.

Group A: Randomized to receive Nebulisation with Lignocaine.

Group B: Randomized to receive Airway nerve block with Lignocaine.

Group C: Randomized to receive Atomization with Lignocaine.

After fasting for 6 hours or more patients were taken to operating room. Inside the operating room, standard monitoring including non-invasive blood pressure (NIBP), pulse oximetry (SPO$$_2$$) and electrocardiography (ECG), were applied in all patients. An 18G intravenous (IV) cannula was secured and Ringer Lactate was started. After recording the baseline heart rate (HR), BP and SPO$$_2$$, injection midazolam 1-2$$_{mg}$$ and injection glycopyrrolate 0.2 mg$$_{kg}$$ intravenously (IV) were given to all patients, injection fentanyl 0.5-2 μg/kg IV and injection glycopyrrolate 0.2 mg$$ ^{2}$$ were given to obtain a cooperative, oriented and tranquil patient. Patients in all three groups were given two sprays of 10% Lignocaine into each nostril and 1 ml of 2% Lignocaine jelly. Patients in all three groups were given two sprays of 10% Lignocaine into each nostril and 1 ml of 2% Lignocaine jelly. Patients in Group A were nebulized 10 ml of 4% Lignocaine by ultrasonic nebulizer (ROSSMAX NA100 VA tech. Switzerland.) for 15 minutes. Group B patients received bilateral superior laryngeal nerve blocks by 2 ml of 2% Lignocaine$^{6,7,8}$ for each nerve, bilateral glossopharyngeal nerve blocks by 2 ml of 2% Lignocaine$^{1,2}$ for each nerve and trans tracheal instillation of 2 ml of 4% Lignocaine$^{6,7}$ along with viscous Lignocaine gargles twice. Heaviness or numbness of tongue and hoarseness of voice confirmed adequate effect of local anaesthesia. Group C patients were given 10 ml of 4% atomized Lignocaine using Atomizer (MADgic Laryngo-Tracheal Mucosal Atomizer, Teleflex, USA).This atomizer works on Ventura principle and is used to deliver the atomized LA in a controlled fashion during inspiration with all the advantages of fine particle size and low-dosage requirement in addition to better and rapid action. The glass reservoir was filled with 10 ml of 4% Lignocaine and was connected to the oxygen tubing. Fine mist of the Lignocaine obtained from the atomizer by intermittently blocking the pre-made perforation in the oxygen tubing, at a flow rate of 8–10 L/min, was directed towards the soft palate and posterior pharynx in a controlled fashion during patients' inspiration to tropicalize the airway. Patients were asked to take full vital capacity breaths of atomized Lignocaine contained oxygen to anaesthetize the pharynx, glottis and subglottic structures. Change of voice to low pitch and/or back of tongue becoming numb was/were considered as sign(s) of adequate topical anaesthesia, which was assessed after giving four puffs, rechecked thereafter every two puffs. Fibre-optic bronchoscopy (KARL STORZ SE & Co. KG, Germany) was performed by expert anaesthesiologist after 3 minutes of obtaining optimal topical anaesthesia in all the groups while giving supplemental oxygen through nasal cannula. Supplemental LA was given as 1 ml aliquots of 2% Lignocaine through the working channel of FOB (next aliquot given only after waiting for 30-60s). FOB guided intubation was performed to secure the airway. Size 7.0-7.5 mm internal diameter nasal endotracheal tube was used for male patients and 6.5-7.0 mm for female patients. The time for intubation was calculated as the time taken from the beginning of the bronchoscopy from the nostril to the confirmation of the tube in the trachea by end-tidal capnography. Vital parameters (HR, SBP, DBP, MAP, and SpO2) were also recorded during intubation and at 1 min and 3 min post intubation. Other parameters such as ease of intubation, cord visibility (relaxed, partially relaxed or adducted on endoscopic view), grade of intubating condition and patients comfort score were recorded. The maximum dose of lignocaine for application to the airway is not well established; different sources suggest total dosage in the range of 4-9 mg/kg.$^{5,7,9,10}$ Monitoring for signs and symptoms of lignocaine toxicity, including tinnitus, peri-oral tingling, metallic taste, light headedness, dizziness, and sedation is important. Severe Lignocaine overdose can cause hypertension, tachycardia, seizures and cardiovascular collapse.$^{5,11}$ These signs of lignocaine toxicity were noted. After the airway was secured, general anaesthesia was administered with protocol 1-2.5 mg/kg$^{12}$ and rocuronium 0.3 mg/kg$^{13,14,15}$

Statistical Analysis

Collected data was tabulated in Microsoft Excel Worksheet of Windows software package in computer and analysed by SPSS 20.0 version. The quantitative variables were analysed by using one-way ANOVA test. The categorical variables were analysed by using Chi-Square test. P value was considered significant if <0.05 and highly significant if <0.01.

RESULTS

Demographic parameters (Age, Sex and Weight) and ASA grading of all groups (mean±SD) were comparable & statistically not significant (P > 0.05).

### Table 1. Shows Comparison of Comfort Score Between the Three Groups. (Mean ± SD)

<table>
<thead>
<tr>
<th>Score</th>
<th>Value</th>
<th>Group A n (%)</th>
<th>Group B n (%)</th>
<th>Group C n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent, calm patient</td>
<td>1(4.7%)</td>
<td>1(4.6%)</td>
<td>2(9.5%)</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>Good, comfortable patient</td>
<td>3(14.2%)</td>
<td>5(23.8%)</td>
<td>13(61.9%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moderately comfortable, need to pacify the patient</td>
<td>12(57.1%)</td>
<td>2(9.5%)</td>
<td>6(28.5%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Poor, uncomfortable</td>
<td>5(23.8%)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Agitated patient</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Shows Comparison of Intubating Condition Grade Score Between the Three Groups. (Mean ± SD)

<table>
<thead>
<tr>
<th>Score</th>
<th>Value</th>
<th>Group A n (%)</th>
<th>Group B n (%)</th>
<th>Group C n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Optimal</td>
<td>3(14.3%)</td>
<td>14(66.6%)</td>
<td>6(28.5%)</td>
<td>0.005</td>
</tr>
<tr>
<td>2</td>
<td>Suboptimal</td>
<td>17(79.9%)</td>
<td>7(33.3%)</td>
<td>15(71.4%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>1(4.76%)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Shows Comparison of Cough and Gag Score Between the Three Groups. (Mean ± SD)

<table>
<thead>
<tr>
<th>Score</th>
<th>Value</th>
<th>Group A n (%)</th>
<th>Group B n (%)</th>
<th>Group C n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>2 (9.5%)</td>
<td>6 (28%)</td>
<td>3 (14.28%)</td>
<td>0.008</td>
</tr>
<tr>
<td>2</td>
<td>Minimal coughing and gagging, &lt;3 times, like clearing throat</td>
<td>5 (23.8%)</td>
<td>13 (61%)</td>
<td>5 (23.8%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mild cough and gag lasting &lt;1 min</td>
<td>7 (33.3%)</td>
<td>2 (9.5%)</td>
<td>8 (38.09%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Persistent Coughing &amp; Gagging</td>
<td>5 (23.8%)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. Shows Comparison of Cord Visibility Score Between the Three Groups. (Mean ± SD)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cord Visibility Score</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relaxed</td>
<td>Partially Relaxed</td>
</tr>
<tr>
<td>Group A</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Group B</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Group C</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

DISCUSSION

Awake tracheal intubation with the aid of a fibre-optic device was first described by Murphy in 1967[10] who used a choledochoscope to facilitate nasotracheal intubation in patients with difficult airway. There are multiple ways of anaesthetizing the airway to facilitate the performance of awake FOB guided intubation. Among them, topical anaesthesia with nebulized LA, gargles, lozenges, sprays, airway blocks, atomized LA and LA through the working channel of FOB are commonly used. The topical anaesthesia of airway mucosa using atomizers, nebulizers, ‘spray as you go’ technique are alternatives to the complex nerve block techniques for aiding awake fibre-optic intubation in patients with anticipated difficult airway.[17] Although the above mentioned techniques can be combined in various ways, we chose three exclusive techniques to compare their efficacy and patient comfort. There is a paucity of literature comparing the efficacy and safety for such methods in a population with difficult airway. Administration of lignocaine through nebulization for anaesthesia of upper airway and larynx has been previously studied. In their study Cullen et al[18] found that lignocaine nebulization decreased the discomfort of nasogastric tube insertion. In 2007, Techanivateet al[19] found adequate upper airway anaesthesia with 2% lignocaine nebulization for fibre-optic nasotracheal intubation. Williams KA et al[20] successfully performed fibre-optic nasotracheal intubation by combined nebulization and spray-as-you-go technique in 25 adult patients. In our study, we found that there was no significant difference between three groups when demographic parameters and baseline hemodynamic parameters were compared. Hemodynamic parameters (HR, SBP, DBP and MAP) during intubation were statistically significant. Airway nerve block group and atomization group patients have less increase in HR, SBP, DBP and MAP than nebulization group patients. In our study, time taken to perform FOB guided intubation was significantly more in nebulization group than airway nerve block group and atomization group. Gupta B et al[21] and Vasu KB et al[22] in their study also found time taken to perform FOB guided intubation was significantly more in nebulization group. Our study correlated with this study though Reasoner et al[23] in their study, did not find any difference in time taken for FOB guided intubation. When we compared hemodynamic parameters at 1 min and 3 min after intubation, we found nebulization group patient has more increase in HR, SBP, DBP and MAP than airway nerve block group and atomization group. Whereas, airway nerve block...
group patients had lowest increase in HR, SBP, DBP and MAP. Kendra P et al\(^2\) also found the mean HR and BP was significantly higher in nebulization group. Pirlich N et al\(^3\) concluded that the atomizer was superior in respect to comfort, cough and time taken for intubation than bolus application for awake fibre-optic intubation. Vasuet al\(^4\) in their study compared trans-tracheal injection versus atomization and they found no significant differences in HR, SBP, DBP and MAP in 1 min. and 5 min. after intubation. They also compared cough and gag score between trans-tracheal injection and atomization and found atomization group patients to have higher cough and gag score than airway nerve block group patients. Cough and gag reflex scoring was used in this study to assess the effectiveness of the block. Several other researchers have also used cough and gag reflexes as a tool to study the efficiency of topical anaesthesia.\(^5\) Regional blocks were considered adequate if there was no event of cough or gag during the procedure and was considered the best with a score of 1. Need for rescue topical anaesthesia spray was considered as the worst in the efficiency of the topical anaesthesia with a score of 5. This scoring was close to what Malcharek et al\(^6\) had used. Most of the patients in both groups scored 1-3 and no one in either group required rescue measures. In our study two patients of nebulization group had score 5 and most of the patients had score 2-4 but in airway nerve block group &atomization group no patient had score 5, most of the patient had score 1-2. Our study corroborates with above mentioned study. Patient comfort was better in the airway nerve block group as compared with the atomization group and nebulization group in our study. Most of the patient of nebulization patients had comfort score 3 (57.1%) and atomization group had comfort score 2 (61.9%) and most patients of Airway nerve block group had score 1 (66.6%). These findings are similar to those reported by Graham et al,\(^7\) Reasoner et al\(^8\) and Gupta B et al,\(^9\) Wieczorek PM et al\(^10\) compared lignocaine 2% and 4% for atomization used in morbidly obese patients for awake fibre-optic intubation where 2% lignocaine provided acceptable intubating condition with lower plasma lignocaine level. Woodruff C et al\(^11\) compared lignocaine 1% and 2% for atomization used in awake fibre-optic intubation in morbidly obese patients and found 2% lignocaine to be superior than 1% lignocaine. In our study, vocal cord visibility and ease of intubation, as assessed and it was better in the airway nerve block group as compared with the nebulization group and atomization group. Among the airway nerve block group patients 13 patients was found relaxed vocal cord and only 2 patients had adducted vocal cord but in nebulization group only 3 patients had relaxed and 12 patients had adducted vocal cord. This finding is similar to that observed by et al.\(^2\) They reported that the bronchoscopes preferred Transtracheal instillation of LA as compared to LA nebulization or LA instillation through the working port of FOB. However, Reasoner et al\(^8\) did not find any difference in the quality of airway anaesthesia between nebulized LA and nerve blocks as assessed by a blind-observer/bronchoscopes. Gupta B et al\(^9\) also observed intubating condition grading in their study between nerve block and nebulization. They found that most of the patients of nerve block group had optimal condition and only one patient had difficult condition. Similarly, in our study, most of the airway nerve block group patients (66.6%) have optimal condition, atomization group patients (71%) have suboptimal condition and nebulization patients (80%) have suboptimal condition and one patient have difficult condition for intubation. So in respect of intubating condition grading, our study corroborate with the Gupta B et al.\(^2\) None of the patient had desaturation, laryngospasm or regurgitation during the procedure. Cough was more in nebulization group and 2 patients needed rescue topical anaesthesia with spraying of LA through the fibre-optic bronchoscope. Although the increase in HR, SBP, DBP and MAP was statistically significant in nebulization patients, it did not bear any clinical significance. All procedures were done by experienced anaesthesiologists who practice all three techniques routinely. This could be a reason for the absence of any notable complications in all the groups and may not be reproducible by novices.

**Limitations**

The limitation of the study is that it is not a blinded study allowing some amount of bias. Furthermore, we did not calculate the serum lignocaine level in our study due to non-availability of this facility in our centre. Another limitation of this study 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. The differences in the pharyngeal space might have influenced the atomised lignocaine reaching the desired area including the subglottic regions.

**CONCLUSIONS**

Bilateral superior laryngeal nerve blocks, recurrent laryngeal nerve blocks and trans-tracheal injection provide more adequate airway anaesthesia in terms of hemodynamic parameters, cough and gag score, comfort score, cord visibility and intubating condition grade, to aid in awake FOB guided intubation than atomization and nebulization with local anaesthetics. Atomization technique also provides more hemodynamic stability, less cough and gag score, greater comfort score and well intubating condition than nebulization technique in awake FOB guided intubation in difficult airway cases.

**REFERENCES**

