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# Comparison of Local Anesthetic Transcricothyroid Membrane Injection With Local Anesthetic Spray 'as you go' in Diagnostic Bronchoscopy

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## Abstract

**Background:** Chemical warfare victims with pulmonary injuries require frequent bronchoscopy, and most of these diagnostic procedures are performed using deep sedation and local anesthetic "spray as you go" technique. The aim of the study was to compare spray as you go and trans-cricothyroid membrane injection.

**Methods:** In this clinical trial, all candidates for diagnostic bronchoscopy were divided to 2 groups. In group 1, after intravenous injection of 1 mg midazolam and 50 mcg fentanyl and intravenous injection of 20mg propofol, 3 cc of 4% lidocaine was injected into the trans-cricothyroid membrane. In group 2, after passing the bronchoscope through the nose, the clinicians proceeded to spray 6 cc of 2% lidocaine (spray as you go technique) with bolus doses of propofol, intravenously. The total dose of propofol, the convenience of the physicians, and cough episodes were recorded. The patients were monitored in terms of vital signs before and during bronchoscopy. Moreover, according to the discharge criteria, the time of discharge from the recovery room and side effects were recorded. Using SPSS-21, the data were analyzed and P values of $< 0.05$ were considered as significant.

**Results:** In the present study, 80 patients (2 groups of 40) were evaluated. The patients in both groups were not significantly different regarding age, gender, and duration of bronchoscopy. In group 1, the rate of satisfaction of the physician was significantly higher than that of group 2. In group 2, the average cough episodes, mean dose of anesthetic, and the average time of recovery were higher than that of group1. Both groups were comparable with respect to hemodynamic stability. No side-effects, i.e. hematoma, lung inflation or subcutaneous emphysema, were observed.

**Conclusions:** Trans-cricothyroid injection anesthesia is a safe method for anesthesia of the respiratory mucosa, tolerable for patients without major side-effects.

*Keywords:* Fiber-Optic Bronchoscopy, Trans Cricothyroid Injection, Local Anesthesia

## 1. Background

Fiber-optic bronchoscopy for airway examination is a medical diagnostic and therapeutic procedure performed by pulmonologists and anesthesiologists (1).

It is associated with discomfort and most patients express fear of pain, breathing problems, nasopharynx irritation, coughing and sore throat; and 40% to 60% of patients consider this procedure unbearable (2, 3).

Topical anesthesia for fiber-optic bronchoscopy, may be done through transcricothyroid membrane injection or by a nebulizer or directly through the bronchoscope (spray as you go technique) (4). According to a study published in 2011, in cricothyroid membrane injection (compared with the spray as you go technique) less patients were coughing and a lower dose of lidocaine was used; the duration of bronchoscopy was also shorter. Furthermore, this method was more tolerable for patients, and physicians were satisfied (1). Currently, there is a wide variation in the use of local anesthesia during fiberoptic bronchoscopy as a local anesthetic with minimal cardiotoxicity must be used (2, 5). Moreover, using topical anesthesia may lead to cardiotoxicity because of the higher dosage requirement of local anesthetic in this method (spray) compared to the dose of anesthetic used in cricothyroid membrane injection (6, 7).

The recommended concentration in the spray as you

go method is 1% to 2% (8, 9). Williams et al. showed that lidocaine with dosage of 9 mg/kg, did not cause toxic plasma concentrations (10).

Chemical warfare victims with pulmonary injuries need frequent bronchoscopy, and most of these diagnostic procedures are performed using deep sedation and local anesthetic spray "spray as you go" technique. The purpose of this study was to compare the spray as you go technique with trans-cricothyroid membrane injection.

## 2. Methods

All patients aged 20 to 90 years admitted to the researcher's hospital for diagnostic fiber-optic bronchoscopy were examined, after ethical committee approval. The exclusion criteria included presence of coagulopathy, electrolyte abnormalities, severe anemia (Hb < 7), sensitivity to lidocaine and propofol drugs, and requirement for checking of the vocal cords movement. Informed consent was obtained from the patients before inclusion. Patients were randomly assigned to 2 groups: 1) transcricothyroid membrane injection, and 2) local anesthetic spray method upon entering the trachea (spray as you go technique). Initially, all patients were monitored with respect of $SPO_2$, BP, and HR; the vital signs of the patients were recorded and they were then injected with 1 mg of midazolam and 50 $\mu$g of fentanyl. In group 1, and after positioning the head properly, 3 cc of 4% lidocaine filled in 5 cc syringes and administered with a 22-gauge needle; initially, 2 cc of intravenous propofol was injected (reducing the risk of coughing) and then local anesthetic was injected in the trachea. Next, the nasal mucosa was anaesthetized with 2% lidocaine gel and the physician was able to perform bronchoscopy. During bronchoscopy, propofol (doses of 10 mg bolus) was injected and the total dose was recorded. Furthermore, cough episodes and the satisfaction of the physician were recorded in the questionnaire.

In group 2, initially, 1 mg of midazolam and 50 $\mu$g of fentanyl were injected, and then nasal mucosa was anaesthetized with 2% lidocaine gel, and 6 cc of 2% (120 mg) lidocaine was sprayed and propofol was injected with 10 milligram bolus doses, if required. The total dose of propofol, the convenience of physician, and cough episodes were recorded. the name of the physician was recorded in the files. The patients were monitored every 5 minutes for vital signs and oxygen saturation before and during bronchoscopy. Moreover, according to the discharge criteria, the time of discharge from recovery and any side effects were recorded. Using SPSS 21, and descriptive statistical methods (mean, standard deviation, percentages and diagrams) and inferential statistics (analysis of variance (ANOVA), chi square, and t-test), the data were analyzed ($\alpha$ = 0.05) and P < 0.05 was considered significant. Using the Kolmogorov-Smirnov, the normal distribution of data and abnormality were determined using equivalent nonparametric tests.

## 3. Results

In the present study, 80 patients (2 groups of 40) were evaluated. According to the results of the chi square test, gender, age, weight and Body Mass Index (BMI) distribution of the patients and time duration of bronchoscopy were not significantly different (Tables 1 and 2). According to the average time of bronchoscopy, there was no significant difference between the 2 methods and the average time was 7 minutes in both groups. As shown in Table 3, with respect to physician satisfaction, there was a significant difference between the 2 methods with a significant increase in method 1. According to Table 4, the number of coughs in method 2 ($4.07 \pm 1.45$) was significantly higher than that in method 1 ($1.45 \pm 1.41$). Comparing the 2 groups (Table 5), the patients of method 2 ($60.12 \pm 22.03$) received more of the drug than those of method 1 ($22.75 \pm 13.95$). As shown in Table 6, the average recovery time in method 1 ($7.77 \pm 2.45$) was significantly lower than that of method 2 ($9.49 \pm 2.32$). The average difference of MABP, PR, and $SPO_2$ was not significant (Table 7). The results of the ANOVA test revealed that the average difference of Mean of Arterial Pressure (MABP) (at different intervals) was not significant (P = 0.579) (Table 8). The MABP in method 1 was lower at all time intervals (Figure 1).

The PR at all times in method 1 was higher (Figure 2). The mean difference of $SPO_2$ at different times was not significant (P value = 0.303) (Figure 3). Subcutaneous emphysema or other side effects were not observed.

## 4. Discussion

Today, bronchoscopy specialists are able to perform more complicated processes, including removal of a foreign object, resection of airways, and bronchial stent placement rather than only basic fiberoptic bronchoscopy techniques, such as to wash alveoli bronchioles and bronchioles biopsy. A thorough knowledge of the patient's medical history, risk factors for cardiovascular and pulmonary diseases and drugs are important factors that should be considered before fiberoptic bronchoscopy (11). Lidocaine is a local anesthetic for airway mucosal anesthesia. There are also other anesthetics, including 2% tetracaine, 10% to 20% benzocaine, and 10.4% cocaine. However, lidocaine is preferred because it is less toxic and more available and

**Table 1.** Comparison of Gender Distribution in the Two Methods; Method 1: Local Anesthetic Trans Cricothyroid Membrane Injection, and method 2: Local Anesthetic Spray as you go

| Variable | | Method | No | P Value* |
|---|---|---|---|---|
| Gender | Female | 1 | 12 | 0.478 |
| | Male | | 28 | |
| | Female | 2 | 15 | |
| | Male | | 25 | |

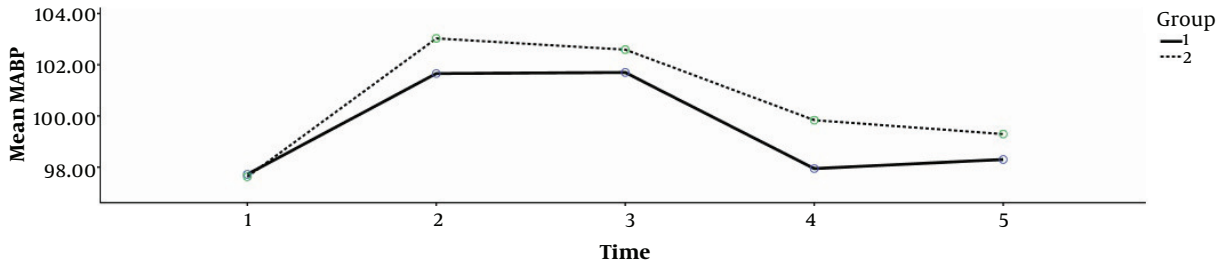


**Figure 1.** The Process of Changes of the Mean of Initial Arterial Pressure (MABP) at Different Times With the Two Methods (mmHg)

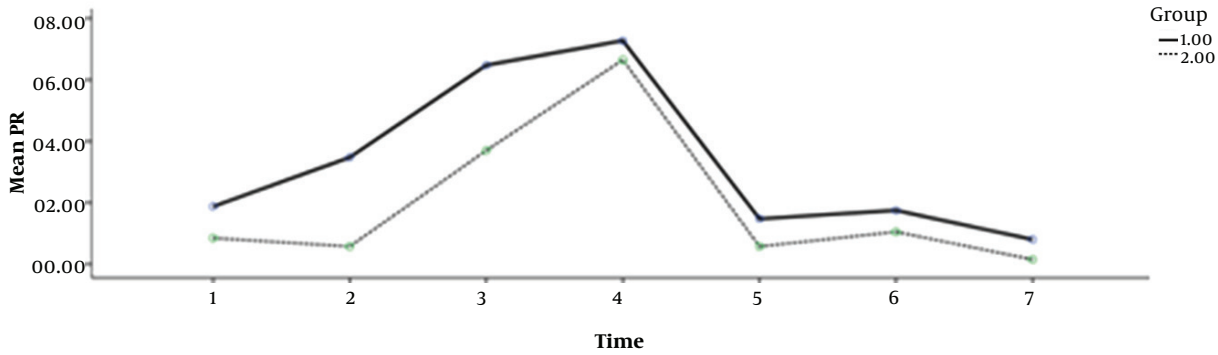


**Figure 2.** The Process of Change of Pulse Rate (PR) at Different Times (Minutes) With the Two Methods

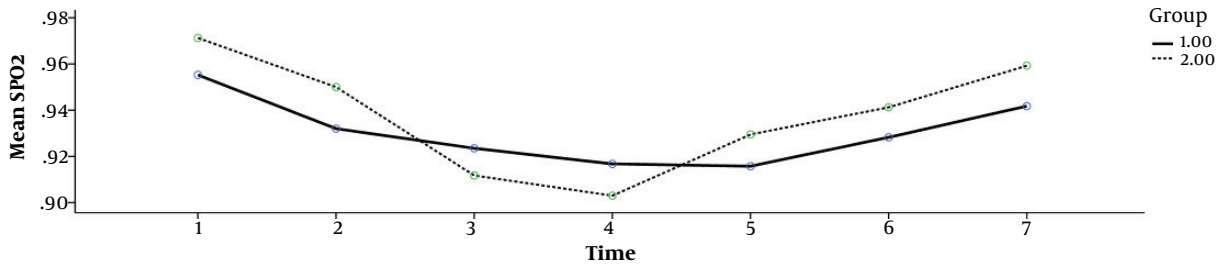


**Figure 3.** The Process of Change of $SPO_2$ at Different Times in the Two Methods

duration of its effect is shorter than cocaine or tetracaine. The liver metabolizes lidocaine and if the serum level exceeds 5 $\mu$g/mL, it may lead to adverse effects (12). The control of coughing is of paramount importance for the quality of bronchoscopy as this facilitates ease of viewing the bronchial tree and obtaining satisfactory biopsy sam-

**Table 2.** Comparison of the Mean of Patients' Demographic Variables in the Two Methods: Method 1: Local Anesthetic Trans Cricothyroid Membrane Injection, and Method 2: Local Anesthetic Spray as you go

| Variable | Method | Mean ± SD | P Value[a] |
|---|---|---|---|
| **Age** | 1 | 63.17 ± 13.20 | 0.303 |
| | 2 | 60.35 ± 11.08 | |
| **Weight, kg** | 1 | 72.17 ± 12.68 | 0.337 |
| | 2 | 69.77 ± 9.27 | |
| **Height** | 1 | 167.40 ± 9.66 | 0.913 |
| | 2 | 167.62 ± 8.69 | |
| **BMI** | 1 | 25.74 ± 3.99 | 0.195 |
| | 2 | 24.79 ± 2.33 | |

[a]Type of test: t test.

**Table 3.** Comparison of the Satisfaction of Bronchoscopist in the Two Methods; Method 1) Local Anesthetic Trans Cricothyroid Membrane Injection, 2) Local anesthetic Spray as you go

| Satisfaction (0 - 10) | Method 1 | Method 2 | P Value[a] |
|---|---|---|---|
| | Number | Number | |
| **Low (0 - 3)** | 0 | 0 | 0.000 |
| **Average (4 - 7)** | 4 | 23 | |
| **Good (8>)** | 36 | 17 | |

[a]Test: chi square.

**Table 4.** comparison of the Coughing Frequency of the Patients in the Two Methods; Method 1) Local Anesthetic Trans Cricothyroid Membrane Injection 2) Local Anesthetic Spray as You Go

| Cough | Deviation Criteria ± Mean | P Value[a] |
|---|---|---|
| **Method 1** | 1.45 ± 1.41 | 0.000 |
| **Method 2** | 4.7 ± 1.45 | |

[a]Test: Mann Whitney.

**Table 5.** Comparison of the Average Dose of Extra Propofol in the Two Methods; Method 1) Local Anesthetic Trans Cricothyroid Membrane Injection and 2) Local anesthetic Spray As You Go

| | Consumed Dose of Propofol, mg | |
|---|---|---|
| Type of Method | Deviation Criteria ± Mean | P Value[a] |
| **Method 1** | 22.75 ±13.95 | 0.000 |
| **Method 2** | 60.12 ±22.3 | |

[a]Test: Mann Whitney.

**Table 6.** Comparison of the Average Recovery Time (Minutes) in the Two Methods; Method 1: Local Anesthetic Trans Cricothyroid Membrane Injection, and method 2: Local Anesthetic Spray As You Go

| Type of Method | Recovery Time, min | |
|---|---|---|
| | Deviation Criteria ± Mean | P Value[a] |
| **Method 1** | 7.77 ± 2.45 | 0.002 |
| **Method 2** | 9.49 ± 2.32 | |

[a]Test: t- test.

**Table 7.** Comparison of Mean Arterial pressure (MABP), Mean Pulse Rate (PR) and Mean $SPO_2$ in the Two Methods; Method 1: Local Anesthetic Trans Cricothyroid Membrane Injection, and method 2: Local Anesthetic Spray As You Go[a]

| Under Review Variable | Method 1 | Method 2 | P Value[b] |
|---|---|---|---|
| **MABP** | 100.48 ± 13.36 | 99.09 ± 8.35 | 0.587 |
| **PR** | 79.73 ± 14.03 | 79.17 ± 14.77 | 0.865 |
| **$SPO_2$** | 0.965 ± 0.045 | 0.975 ± 0.016 | 0.210 |

[a]Values are expressed as mean ± SD.
[b]Type of test: T test.

**Table 8.** Comparison of Mean Arterial Pressure (MABP) at the Initial Stage, While Practicing Techniques, and During Recovery in the Two Methods; Method 1: Local Anesthetic Trans Cricothyroid Membrane Injection, and Method 2: Local Anesthetic Spray As You Go[a]

| Time | Method 1 | Method 2 | P Value |
|---|---|---|---|
| **Arterial pressure (MABP) at the initial stage (mean)** | 100.48 ± 13.36 | 99.09 ± 8.35 | 0.587 |
| **Practicing techniques(mean)** | 100.24 ± 9.29 | 101.08 ± 7.46 | 0.682 |
| **Recovery (mean)** | 98.29 ± 8.75 | 100.22 ± 6.13 | 0.265 |
| **Total mean** | 99.46 ± 7.35 | 100.47 ± 7.32 | 0.579 |

[a]Values are expressed as mean ± SD.

ples. Various local anesthetic techniques can be used to anaesthetize the respiratory mucosa for fiberoptic bronchoscopy. The choice of local anesthetic technique should require a lower dose of local anesthetic. It should be safe and pleasant for the patient and at the same time provide acceptable conditions for the bronchoscopist (13). Graham et al. used 2.5% cocaine (13) and Rajan et al. 2% lidocaine (12); the current researchers used 4% lidocaine in this study while midazolam, fentanyl and propofol (20 mg) were used to reduce the discomfort caused by the transcricoid injection. This method, by preventing the patient's cough, did not cause any complications associated with trans-cricothyroid injection.

The results revealed that trans-cricothyroid anesthesia is preferred because it reduces coughing frequency, anesthetic drug dose, and recovery time.

In the study of Antoniades, which was performed in 2009 on 49 patients, who underwent the fiberoptic bronchoscopy procedure, and were divided to 2 groups of bronchoscope normal saline and 2% lidocaine sowed to vocal cord, it was concluded that 2% lidocaine would significantly reduce the rate of sedative drug consumption and the frequency of coughing (14).

The results of a similar study by "Dr. Alkachandra"

(2011) showed that the total necessary dose of lidocaine in the "spray as you go" group was higher than that of the trans-cricothyroid group. Furthermore, trans-cricothyroid anesthesia led to reduction of coughing frequency without any adverse effects (1).

In 2014, a research paper done by Rajan was published on 40 patients, who had undergone an operation of brachial plexus with general anesthesia. The patients were classified to 2 groups of 20; group 1 received 4 mL of 4% lidocaine by trans-tracheal injection, before anesthesia and group 2 received the placebo; both groups were compared with regards to the amount of Propofol upon operation and hemodynamic parameters. The study showed that the group, which received trans-tracheal lidocaine required less propofol and were more stable during the operation compared with the groups that did not receive transtracheal lidocaine. Although this study did not aim at performing bronchoscopy, it signified that trans-tracheal injection in a patient, who is operated with tracheal tube, is accompanied with reduction in sedative drug dosage (7).

Studies have shown that trans-cricothyroid injection, when compared with anesthetic spray, brings about less coughing and lacks consequences. Transtracheal injection is associated with a high level of local anesthesia and also good reception and patient convenience (15).

The positive results of the current study included reduction in the frequency of coughs, drug dose, recovery time, and increased physician satisfaction of transcricothyroid anesthesia.

In the current research, the average of MABP in method 1 was lower than that of method 2. Furthermore, at all times, the average of PR in method 1 was higher than that of method 2. Moreover, there were no side effects, including hematoma, local inflation or subcutaneous emphysema.

Conclusions

The positive results of the current study included reduction in the number of coughs, drug dose, recovery time, and increased physician satisfaction using transcricothyroid anesthesia. Thus, this method is an appropriate method for fiberoptic bronchoscopy. The researchers recommend this method in therapeutic bronchoscopy rather than the methods using lidocaine spray.

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