Endotracheobronchial Lidocaine Concentrations during Flexible Fiberoptic Bronchoscopy (FFB)

Hideo Kato, Hajime Goto, Kazumi Yuasa, Ryuji Ieki and Kaoru Shimada

Lidocaine concentrations in 49 endotracheobronchial aspirates ranged from 12,580 to 23 µg/ml. The aspirates taken from the larger airway contained higher concentrations of lidocaine than those obtained from the smaller airway. Of the aspirates collected before 10 minutes after the final lidocaine administration, the lidocaine concentration of 7 (24.1%) of 29 specimens was greater than 3,000 µg/ml, however, in the aspirates collected after 10 minutes, only 1 (5%) of 20 specimens showed a concentration greater than 3,000 µg/ml. Using the dilution technique method (DTM) of lidocaine in the fibrescope (FS) suction channel, gradual injection of a 2 ml saline solution into the suction channel and removal of the saline solution in the suction channel were performed immediately with a suction machine; the statistically significant differences (p < 0.001) between lidocaine concentrations in the specimens before and after the DTM procedure were determined.

Key words: transbronchoscopic microbiology, antimicrobial action of lidocaine, dilution technique method of lidocaine

Introduction

The quantitative and qualitative antimicrobial effects of lidocaine solution in connection with bronchoscopy were reported by Erlich in 1961 (1). Other techniques to prevent or reduce this side effect during flexible fiberoptic bronchoscopy (FFB) were also reported by Wanner et al in 1973 (2) and others. Here, we present further investigation of the varying levels of lidocaine concentration in tracheobronchial lumens during FFB, to facilitate better collection of microbiological specimens.

Lidocaine concentrations in the expectorated sputa, urine and blood samples were measured immediately after FFB.

Materials and Methods

Anesthesia

Two percent lidocaine solution was used for topical (surface) anesthesia for flexible fiberoptic bronchoscopy (FFB) by the typical technique. The pharyngo-laryngeal spaces were anesthetized, either by a Jabson type spray device or a motor driven spray machine. An ultrasonic nebulizer for airway anesthesia was not used in this study.

Lidocaine solution was instilled into the glottic and sub-glottic spaces, via the fibrescope (FS) channel under observation with the FS, or by lidocaine instillation using an injector with the help of indirect laryngoscopy, depending upon the condition of the patient. The lidocaine dose for the upper airway anesthesia of each patient was approximately 5 to 10 ml. Additional solution of about 1.0 to 2.0 ml was instilled separately into several tracheobronchial lumens via the FS channel. Lidocaine, in doses ranging widely from 9 to 30 ml, was administered to all 25 patients. Of these, the age of the males ranged from 34 to 81, and females from 27 to 84.

To prevent overuse of lidocaine solution during FFB in accordance with the individual patient’s condition, 0.5 mg of atropine sulfate (Atropine) and/or, a 25 mg of hydroxyzine (Atarax P) and/or, 25 mg of hydroxyzine hydrochloride (Sosegon) were injected intramuscularly, about 30 minutes prior to beginning FFB. Additional injections of the above two or three medicines are performed during FFB, due to hyper secretion in the airways and psychological upset or pharyngo-laryngeal pain during FFB. To avoid toxic reactions during FFB, the maximum lidocaine dosage which is thought to be around 400 mg (20 ml of two percent lidocaine), did not exceed 600 mg.

From the Department of Infectious Diseases, Institute of Medical Science, University of Tokyo, Tokyo
Received for publication May 23, 1991; Accepted for publication April 18, 1992
Reprint requests should be addressed to Dr. Hideo Kato, 1532 Issiki, Hayama-machi, Miura-gun, Kanagawa 240-01, Japan

Internal Medicine Vol. 31, No. 8 (August 1992) 961
**Material sampling**

Transoral insertion of an endotracheal (ET) tube method was used for simple material sampling from the airway. When necessary, alternate use of a different FS, to clear away mucus or blood on the surface of the FS, including the objective lens, was applied to ensure a better transfiberscopic view and oxygen inhalation during FFB.

The diameter of the ET tube, selected according to the gender of the patient, was disinfected or sterilized before FFB, then a sterilized or disinfected FS was inserted into the ET tube, and the ET tube was attached to the most proximal (flexible) part of the FS, with adhesive tape. After intubation of the FS into the trachea, the adhesive tape was removed. The ET tube was inserted gently and cautiously into the trachea, with a twisting action as a guide to the FS. The insertion of the ET tube continued until the tip reached the center of the trachea. The FS was then withdrawn and the ET tube was fixed at that position with adhesive tape attached to the patient's perioral area.

The total of 112 endotracheobronchial specimens included 49 secretion aspirates, 20 washing aspirates from the tracheobronchial lumens, one bronchoalveolar lavage fluid (BALF) and four brushing specimens taken from peripheral airways during FFB. After brushing within the lesion, to obtain brush specimens, the brush was extracted until the proximal part of the brush reached about 1 cm from the suction channel exit of the FS, then the FS and brush were together withdrawn carefully from the airway. Only the brush part was soaked and mixed well with 1 ml of saline solution in a test tube.

The effects of the dilution technique method (DTM) in four in vitro and 14 in vivo specimens were examined, following serial procedures (Fig. 1).

**DTM in vitro study**

Procedure A. (contamination of lidocaine in the FS suction channel): 1 ml of 2% lidocaine solution was instilled into the suction channel of the FS, via a proximal suction channel exit, and after a short interval, disposal of the lidocaine solution in the suction channel was achieved. Procedure B. (dilution of lidocaine solution in the suction channel): gradual instillation of 2 ml saline solution was administrated into the suction channel of the FS, and immediately after this procedure, suction in the channel content and its disposal, was carried out. Procedure C. (suction for sampling): after procedure B, suction of 2 ml of saline solution in a test tube was aspirated via suction channel of the FS, and lidocaine concentration in the specimen was measured by gas chromatography (Fig. 1, top).

**DTM in vivo study**

Procedure A. (contamination of lidocaine in the suction channel): this is thought to have occurred spontaneously, during FFB without any manipulative procedure. Procedure B. (dilution of lidocaine in the suction channel): the same procedure as in procedure B of the in vitro study was carried out. Procedure C. (suction for sampling): this procedure was performed in the same wasy as procedure C of the in vitro study. However, the sample was taken from the airway of the patient during FFB, rather than from the saline solution in the test tube (Fig. 1, bottom). The handling of the FS used for this in vitro study was nearly the same as a real FFB.

Lidocaine concentrations in the nine blood and urine specimens each and two sputa specimens were measured immediately after FFB. All nine patients for the precise lidocaine contamination examination of the urine specimen,
were asked to completely empty their bladder, just before the beginning of local anesthesia by lidocaine solution.

**Lidocaine concentration**

A total of 112 specimens were examined as already mentioned earlier. Four in vitro DTM specimens and 14 in vivo DTM specimens, nine each of blood and urine, and two sputa specimens were also examined. A Machida FBS 6TL was used for this study. In each experiment, a lidocaine-free and clean suction channel FS was prepared for endotracheobronchial aspirate collection. However, for the DTM specimens, the same FS was used for both routine FFB sampling and the aspirate collection via the FS suction channel after the DTM procedure. Lidocaine concentration in the specimens were measured by gas chromatography using a Hewlett-Packard 5890 A gas chromatograph with a flame ionization detector.

**Results**

1) **Lidocaine concentrations in secretion aspirates via FS channel** (Table 1)

Lidocaine concentrations in 49 secretion aspirates from the trachea and lobar bronchi were highly variable, as shown in Table 1. Aspirates obtained from the trachea, bilateral main and lobar bronchi contained unfavorably high concentrations of lidocaine (12,580, 10,954, 9,520, 8,182, 8,010, 6,356, 3,587 and 3,436 μg/ml). However, all four aspirates obtained from the segmental lumens contained less than 2,600 μg/ml of lidocaine.

2) **Lidocaine concentrations in washing aspirates via FS channel** (Table 2)

All 20 washing aspirates, obtained from several areas in tracheobronchial lumens, contained lower concentrations of lidocaine than those obtained by secretion aspirates. The highest lidocaine concentration (9,280 μg/ml) in this group was taken from the right main bronchus. The other two high specimens (4,400 and 4,100 μg/ml) were taken from the trachea and right main bronchus, respectively.

3) **Saline solution doses and the resultant lidocaine concentrations in washing aspirates and one BALF via FS channel** (Table 3 and Fig. 2)

Lidocaine concentrations of 20 washing aspirates and one BALF were classified according to the saline solution doses administered. As shown in Table 3 and Fig. 2, the 2 ml or more saline solution dosage groups showed a better effect of lidocaine dilution in the FS channel, compared to the 1 ml saline solution dosage group. Three specimens contained 9,280, 4,400 and 4,100 μg/ml of lidocaine, all belonged to the group washed with 1 ml saline solution doses. Considering saline solution doses and the resultant lidocaine concentrations in bronchoscopic washing aspirates, more than 2 ml saline solution group showed a better effect of lidocaine dilution in the fiberscope suction channel.

*Denotes BALF sample.

**Table 1. Lidocaine Concentrations in Secrretion Aspirates Via Fiberscope Suction Channel**

<table>
<thead>
<tr>
<th>Location (n = 49)</th>
<th>Lidocaine concentration (μg/ml)</th>
<th>Max</th>
<th>Min</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trachea &amp; Main Br (n = 41)</td>
<td>10,954</td>
<td>23</td>
<td>2,006 ± 414</td>
<td></td>
</tr>
<tr>
<td>Lobar Br (n = 4)</td>
<td>12,580</td>
<td>109</td>
<td>344 ± 3,048</td>
<td></td>
</tr>
<tr>
<td>Segmental Br (n = 4)</td>
<td>2,600</td>
<td>1,969</td>
<td>2,320 ± 133</td>
<td></td>
</tr>
</tbody>
</table>

Among the 49 secretion aspirates, 5 (10.2%) contained more than 8,000 μg/ml, and another 3 (6.1%) more than 3,000 μg/ml of lidocaine. These 8 (16.3%) specimens were obtained from the trachea, bilateral main and lobar bronchi.

**Table 2. Lidocaine Concentrations in Washing Aspirates Via Fiberscope Suction Channel**

<table>
<thead>
<tr>
<th>Location (n = 20)</th>
<th>Lidocaine concentration (μg/ml)</th>
<th>Max</th>
<th>Min</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trachea &amp; Main Br (n = 11)</td>
<td>9,280</td>
<td>130</td>
<td>2,568 ± 805</td>
<td></td>
</tr>
<tr>
<td>Lobar Br (n = 5)</td>
<td>2,500</td>
<td>100</td>
<td>444 ± 467</td>
<td></td>
</tr>
<tr>
<td>Segmental Br (n = 4)</td>
<td>191</td>
<td>6</td>
<td>81 ± 47</td>
<td></td>
</tr>
</tbody>
</table>

Among the 20 washing aspirates, 1 (5%) contained more than 8,000 μg/ml, and another 2 (10%) specimens contained more than 3,000 μg/ml of lidocaine. These 3 (15%) specimens were obtained from the trachea and right main bronchus.

**Table 3. Saline Solution Doses and the Resultant Lidocaine Concentrations in Washing Aspirates and Bronchoalveolar Lavage Fluid (BALF) Via Fiberscope Suction Channel**

<table>
<thead>
<tr>
<th>Saline solution dose (n=21)</th>
<th>Lidocaine concentration (μg/ml)</th>
<th>Max</th>
<th>Min</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ml (n = 9)</td>
<td>9,280</td>
<td>130</td>
<td>2,795 ± 972</td>
<td></td>
</tr>
<tr>
<td>2 ml (n = 10)</td>
<td>2,900</td>
<td>29</td>
<td>763 ± 369</td>
<td></td>
</tr>
<tr>
<td>3 ml (n = 1)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 ml (n = 1)*</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The three specimens containing 9,280, 4,400 and 4,100 μg/ml of lidocaine, all belonged to the group washed with 1 ml saline solution doses. Considering saline solution doses and the resultant lidocaine concentrations in bronchoscopic washing aspirates, more than 2 ml saline solution group showed a better effect of lidocaine dilution in the fiberscope suction channel.

*Denotes BALF sample.

**Fig. 2. Saline solution doses and the resultant lidocaine concentrations in washing aspirates and bronchoalveolar fluid via fiberscope suction channel.** Saline solution dosage groups of 2 ml or more showed a better effect of lidocaine dilution in the fiberscope suction channel, compared to the 1 ml saline solution dosage group. *BALF sample.
taining 9,280, 4,400 and 4,100 µg/ml of lidocaine all belonged to the group which had been washed with 1 ml saline solution dosage. Specimens washed with more than 2 ml saline solution showed a lidocaine concentration of 2,900 g/ml or somewhat less and the variance of lidocaine concentrations in this group was also smaller than that in the 1 ml saline solution dosage group.

4) Lidocaine concentrations in brushing specimens via FS channel (Table 4)

Lidocaine concentrations in all four brushing specimens were up to 524 µg/ml or less. The minimum concentration in this group was 4 µg/ml. The concentrations in the brush specimens were much lower than those in the aspirate specimens.

5) Lidocaine concentrations in secretion aspirates via FS channel by time interval (Table 5)

The collected secretion aspirates were divided into two groups. The early aspirates (29) were collected within 10 minutes of the final lidocaine administration, the late aspirates (20) were collected after 10 minutes.

Regarding the lidocaine concentrations, five (17.2%) of the 29 early aspirates contained more than 8,000 µg/ml (12,580, 10,954, 9,520, 8,182 and 8,010 µg/ml); however, only one (5%) specimen of the 20 late aspirates contained an unexpectedly high concentration of lidocaine (6,356 µg/ml) which was obtained at an interval of 16 minutes. Unfortunately, similarities in the variances of these two groups were not proven. Therefore, statistical analysis was impossible.

6) Effect of lidocaine DTM in a FS channel (in vitro study) (Fig. 1 top and Table 6)

Lidocaine concentrations in four in vitro specimens, after DTM procedure, showed marked dilution. Almost 98% of the remaining lidocaine solutions in the FS channel of both specimens A and B were washed out by this procedure, as shown in Table 6. These post-DTM lidocaine concentrations

<table>
<thead>
<tr>
<th>Patient (n = 4)</th>
<th>Lidocaine concentration (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>514</td>
</tr>
<tr>
<td>2</td>
<td>259</td>
</tr>
<tr>
<td>3</td>
<td>152</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mean ± SE</td>
<td>240 ± 100</td>
</tr>
</tbody>
</table>

All brushing specimens were soaked and stirred well with a brush in a test tube containing 1 ml saline solution. Lidocaine concentrations in these brush specimens were much lower than those in the secretion aspirate specimens.

Table 4. Lidocaine Concentrations in Brushing Specimens Via Fiberscope Suction Channel

<table>
<thead>
<tr>
<th>Time interval* (n = 49)</th>
<th>Lidocaine concentration (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
</tr>
<tr>
<td>Early aspirates (10 minutes ≥ ) (n = 29)</td>
<td>12,580</td>
</tr>
<tr>
<td>Late aspirates (10 minutes &lt; ) (n = 20)</td>
<td>6,356</td>
</tr>
</tbody>
</table>

Among all 29 early aspirates, 5 (17.2%) contained more than 8,000 µg/ml, and another 2 (6.9%) more than 3,000 µg/ml of lidocaine. However, among the 20 late aspirates, only 1 (5%) specimen contained more than 5,000 µg/ml. This specimen was obtained 16 minutes after the final lidocaine administration.

*Time after final lidocaine administration.

Table 5. Lidocaine Concentrations in Secretion Aspirates Via Fiberscope Suction Channel by Time Interval

<table>
<thead>
<tr>
<th>Patient (n = 7)</th>
<th>Aspirates, before DTM</th>
<th>Aspirates, after DTM</th>
<th>Differences</th>
<th>Ratio of dilution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8,127</td>
<td>819</td>
<td>7,308</td>
<td>89.9</td>
</tr>
<tr>
<td>2</td>
<td>11,995</td>
<td>6,549</td>
<td>5,446</td>
<td>45.4</td>
</tr>
<tr>
<td>3</td>
<td>12,798</td>
<td>5,041</td>
<td>7,757</td>
<td>60.6</td>
</tr>
<tr>
<td>4</td>
<td>11,097</td>
<td>3,787</td>
<td>7,310</td>
<td>65.8</td>
</tr>
<tr>
<td>5</td>
<td>11,289</td>
<td>6,220</td>
<td>5,069</td>
<td>44.9</td>
</tr>
<tr>
<td>6</td>
<td>15,630</td>
<td>2,902</td>
<td>12,728</td>
<td>81.4</td>
</tr>
<tr>
<td>7</td>
<td>17,853</td>
<td>6,467</td>
<td>11,386</td>
<td>63.7</td>
</tr>
</tbody>
</table>

Lidocaine dosages in the airway of the patients ranged from 3.5 to 15 ml. Statistical analysis before and after DTM proved significant differences between mean values (p<0.001).

Ratio of dilution = Lidocaine concentration in the aspirate before DTM – after DTM (%)
These side effects, particularly the antimicrobial effect, occur proportionally to the density and time of exposure to the lidocaine solution in the tracheobronchoalveolar lumens, and are dependent upon the capabilities of both lidocaine absorption through the mucus membrane and the abilities of mucociliary transport (MCT) function of the patients.

From the viewpoint of transbronchoscopic microbiology, contaminations of both bacterial flora and lidocaine may occur within the endobronchial secretions during bronchoscopy are unavoidable problems (24). Usually, normal bacterial floras in the samples obtained are differentiated from the causal microorganisms, in relation to the clinical manifestation. And also, the causal microorganisms can be identified by means of transbronchial selective culture from the lesion with a significant growth of the microorganisms at 10^7/ml colony forming unit (25–27).

In reports describing the obtaining of transbronchoscopical specimens from localized lesions without normal bacterial floral contamination, the use of various devices were discussed (2, 28–31). In obtaining microbiological specimens from the localized bronchopulmonary lesions by a routine FS, the following important point must be considered; exact sampling from the lesion while excluding significant microbiological and lidocaine contamination during the procedure is very important.

Furthermore, it is important to consider several factors relating to the variety of lidocaine concentrations in the obtained specimens from the airway during FFB, such as concentrations and doses of lidocaine solutions for local anesthetic use; the dose of lidocaine remaining in the suction channel of the FS; the quantity and nature of coexisting mucus, blood or other secretions in the airway; capabilities of both lidocaine absorption and MCT function of the involved mucus membrane; and time interval between final lidocaine administration and sampling the mucus through the suction channel of the FS.

According to Erlich (1), Schmidt and Rosenkranz (19), Bartlett et al (20), Ravin et al (21), Kvale et al (23) and our previous study results (22), the concentrations of lidocaine having a significant antimicrobial effect are thought to range from 3,000 μg/ml (0.3% lidocaine solution) to 5,000 μg/ml; and bacteriocidal effect, around 8,000 to 10,000 μg/ml or more. Therefore, the lidocaine concentration in the transbronchoscopic microbiological samples might be less than 3,000 μg/ml.

To explain why the aspirates obtained from the larger airways contained more lidocaine than those obtained from the smaller airways, the following reasons were considered: Most of the aspirates containing high concentrations of lidocaine in this study belonged to the early aspirates group, more varied than those in the in vitro study. However, statistical analysis of these clinical results proved significant differences between both mean values (p<0.001).

### 7) Effect of lidocaine DTM in a FS channel (in vivo study) (Fig. 1 bottom and Table 7)

Lidocaine concentrations in the in vivo samples after the DTM procedure also showed marked dilution. For example, between 89.9% (patient no. 1) and 44.9% (patient no. 5) of the remaining lidocaine in the FS suction channel was washed out by this procedure, as shown in Table 7. Lidocaine concentrations in the in vivo study specimens were more varied than those in the in vitro study. However, statistical analysis of these clinical results proved significant differences between both mean values (p<0.001).

### 8) Lidocaine concentrations in the specimens immediately after FFB (Table 8)

Lidocaine concentrations in expectorated sputa of the patients after an interval of 60 to 130 minutes from the initial lidocaine administration in patients who received a total dose of 20 to 24 ml of 2% lidocaine solution, contained between 3.4 and 310 μg/ml. Lidocaine concentration in blood, after a 70 to 126 minute interval with 2% lidocaine doses of 10.4 to 31.4 ml, were 0.36 to 2.64 μg/ml. In urine, after a 65 to 155 minute interval with 2% lidocaine doses of 10.4 to 31.4 ml, the concentrations ranged from 1.6 to 35.3 μg/ml. The mean value of lidocaine concentration in each category was: 156.5 μg/ml in sputum, 1.39 μg/ml in blood and 8.6 μg/ml in urine specimens.

### Discussion

Lidocaine solution is one of the safest and most widely used anesthetics for bronchoscopic examination (3–5). However, it has several unfavorable side effects, such as cardiac and central nerve system toxicity (6–15), bronchoconstriction in asthmatic patients (16), immunocompetent cell population changes in the bronchoalveolar lavage fluid (17) and antimicrobial action (1, 8–23).

---

**Table 8. Lidocaine Concentrations in Specimens Immediately after Flexible Fiberoptic Bronchoscopy (FFB)**

<table>
<thead>
<tr>
<th>Specimens (n = 20)</th>
<th>Lidocaine concentration (μg/ml)</th>
<th>Total lidocaine dose (ml)/ Total time interval (min)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sputa (n = 2)</td>
<td>310</td>
<td>24/130</td>
<td>156.5</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>20/60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>156.5</td>
<td>22/95</td>
<td></td>
</tr>
<tr>
<td>Blood (n = 9)</td>
<td>2.64</td>
<td>31.4/126</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>0.36</td>
<td>10.4/70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.39</td>
<td>17.8/93.4</td>
<td></td>
</tr>
<tr>
<td>Urine (n = 9)</td>
<td>35.30</td>
<td>31.4/155</td>
<td>8.60</td>
</tr>
<tr>
<td></td>
<td>1.60</td>
<td>10.4/65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.60</td>
<td>17.8/107.2</td>
<td></td>
</tr>
</tbody>
</table>

as expected, did not have any meaningful antimicrobial effect.
which contained bacteriocidal effect of lidocaine density and another two samples which contained bacteriostatic effect of lidocaine density, all belonged to early aspirates group. However, one (5%) sample which contained an intermediate effect between bacteriocidal and bacteriostatic lidocaine densities belonged to the late aspirates group. Thus, based on the lidocaine concentrations in the aspirates obtained through the FS suction channel, the time interval from the final lidocaine administration is thought to be a more important factor than the diameter of the airways. Consequently, microbiological examination of samples through the FS channel, was possible with the late aspirates. This is because with an interval of 10 minutes or more, spontaneous lidocaine drainage from the FS suction channel to the airway may occur, and the suction of mucus from the airway, to ensure a clear view through the FS, also decreases the remaining lidocaine in the FS suction channel.

Lidocaine concentrations in all four brushing specimens, which were soaked and mixed with 1 ml saline solution in a test tube contained $10^2$ $\mu$g/ml or less of lidocaine. This was a favorable result from the viewpoint of lidocaine contamination; however, microbiological contamination was nearly consistently unfavorable by this procedure. In general, therefore, this procedure is not recommendable for transfiberscopic microbiology, except with the use of an uncontaminated sheathed brush or other protected devices for microbiology (26–31).

The absorption of administrated lidocaine solution in the airway was fairly rapid, and at around 15 to 45 minutes after administration, blood levels continued to increase until maximum concentration; from 60 to 120 minutes, the lidocaine concentration in blood gradually decreased (32–38).

In the present study, most of the specimens containing a lidocaine concentration of $10^3$ to $10^4$ $\mu$g/ml belonged to the early aspirates group, and with timing of FFB, the lidocaine concentrations gradually decreased to 10 to $10^2$ $\mu$g/ml. Nearly the same results were reported by Strange et al (39).

These data were indirectly affirmative for safety sampling of late aspirates under sufficient local anesthetic condition. The mean duration of local anesthetic effect of 4% lidocaine is 15.2 minutes (3, 4). In the present study, a longer duration of local anesthetic effect of 2% lidocaine of between 30 to 58 minutes was obtained. These data show that, it is really possible to obtain endotracheobronchial late aspirates for a microbiological examination under satisfactory anesthetic condition. However, lidocaine contamination in the aspirates occurs, almost always during FFB (24). Therefore, it is very important that the microbiological specimens obtained transbronchoscopically are stained and cultured, as quickly as possible (22).

To obtain a better microbiological specimen, it is important that, frequent and effective suctioning through the suction channel of the FS during FFB, and DTM procedures immediately before sampling is one of the most simple and reliable procedures for decreasing the remaining lidocaine solution in the suction channel of the FS (40).

**Acknowledgments:** The authors wish to express appreciation to Mr. Roy Bates, for his assistance in the preparation of the English manuscript.

**References**

Endotracheobronchial Lidocaine Density


