The Effects of Xylocaine Spray for Pain Control Caused by Endotracheal Tube in Critical Care

Shih-Yi Lee 1,2*, Chien-Liang Wu 1,2, Li-Kuo Kuo 11, Chuan-Tsai Lai 2,3, Ching-Ping Hsu 2,4, Hwung-Ying Hwung 5, Yu-Wei Chen 2,3, Yueh-Hsiu Ho 5, Hui-Chuan Hsu 9, Fang-Ju Sun 7, Ping-Fang Yuan 8, Ivy Pan 1,2, Wen-Han Chang 2,9

1 Division of Pulmonary and Critical Care Medicine, Mackay Memorial Hospital, Main Branch Hospital, 2 Mackay Medicine, Nursing and Management College, 3 Division of Nephrology, Mackay Memorial Hospital, Main Branch Hospital, 4 Department of Family Medicine, Mackay Memorial Hospital, Main Branch Hospital, 5 Departments of Nursing, Mackay Memorial Hospital, Main Branch Hospital, 6 Clinical Pharmacotherapeutic Division, Department of Pharmacy, Mackay Memorial Hospital, Main Branch Hospital, 7 Department of Medical Research, Mackay Memorial Hospital, Main Branch Hospital, 8 Social Service Department, Mackay Memorial Hospital, Main Branch Hospital, 9 Department of Emergency Medicine, Mackay Memorial Hospital, Main Branch Hospital, Taipei, Taiwan

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SUMMARY

Background: The purpose of this study was to evaluate the efficacy and safety of Xylocaine spray for the pain caused by endotracheal tube, and its impact on patients’ satisfaction of intensive care.

Methods: A quantitative evaluation of the effect before and after Xylocaine spray on endotracheal tube pain relief, and a qualitative interview study of the impact of this intervention on patients’ satisfaction of intensive care in a prospective, clinical investigation. Those in the medical intensive care unit being endotracheal intubated and being able to clearly communicate with the caregivers were enrolled after providing their informed consent. We prescribed Xylocaine 10% pump spray as frequently as demanded.

Results: Nineteen patients were eligible for this study. The numerical rating scale of the throat pain before local Xylocaine spray were 8.82 ± 0.79, 7.98 ± 0.92, 7.07 ± 0.76, 6.37 ± 0.83 and 5.47 ± 1.23, sequentially, compared with after therapy results, which were 3.84 ± 0.86, 3.57 ± 0.74, 3.06 ± 0.70, 2.61 ± 0.77 and 1.96 ± 0.88 (p < 0.01). The interval between Xylocaine demanded gradually increased with time after endotracheal tube intubation, and was also different between the daytime and the night-time on the first day of admission (p < 0.001). Most of the patients suffered from throat pain due to endotracheal intubation, and they agreed their satisfaction was affected by the factors, the level of throat pain being controlled (correlation: 0.89, p < 0.01), and the caregivers’ attitude with regard to the pain control (correlation: 0.46, p < 0.05).

Conclusion: Xylocaine spray is demanded is an effective therapy to manage the pain caused by endotracheal tube, which is also crucial to meet patient satisfaction in intensive care.

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1. Introduction

One of the roles of palliative care in an intensive care unit (ICU) is to minimize discomfort to improve the quality of medical care. Patients in ICU who are at risk of death also have a number of considerably distressing symptoms. The psychological and physical adverse effects of such pain on patients is a concern. A life-sustaining procedure is one of the origins of this stress. The majority of patients in ICU experience considerable pain caused by the endotracheal tube (ETT). With the therapeutic action of blunting pain, the pulmonary, airway, cardiac, cognitive, and infectious complications caused by endotracheal tube use can be significantly reduced. However, to date there has been no article discussing pain control caused by ETT.

Several types of management of pain elimination in the ICU have been recommended, including lidocaine. Lidocaine is used as an analgesic and antiarrhythmic agent because it increases the threshold of electrical excitability by inhibition of the permeability of transient sodium influx. Although it can be used locally...
or systematically\textsuperscript{14}, topical application to control ETT-induced pain has never been evaluated. Since lower plasma lidocaine concentrations can have the same effect as intravenous methods\textsuperscript{15}, the considerable side effects in systemic administration\textsuperscript{14} and due to the benefits of the administration route, we prescribed Xylocaine pump spray 10% (50 ml/500 spray, AstraZeneca AB, Södertälje, Sweden) on the oropharyngeal wall for the conscious patients who were experiencing pain caused by ETT. This was done to evaluate the efficacy and safety of lidocaine, as well as to evaluate its impact on patient satisfaction.

2. Participants and methods

This prospective clinical investigation was held at a 10-bed ICU belonging to an academic, university-affiliated, tertiary-care, urban medical center from April 1, 2009, through May 31, 2009. Except for the patients with history of lidocaine-induced adverse effects or lidocaine allergy, conscious patients suffering from pain caused by the ETT without demand for other sedatives and analgesics were eligible for this study after obtaining informed consent. The study was approved by the Institutional Review Board (reference code MMH-I-S-567).

2.1. Investigation

The treatment prescribed to patients enrolled involved Xylocaine 10% pump spray (50 ml/500 spray, AstraZeneca AB) with no more than three puffs each time, and it could be used as frequently as demanded. The severity of the pain was recorded using a self-reporting numerical rating scale, each time before and 5 minutes after the spray\textsuperscript{16}. If any adverse effects of lidocaine usage were noted, including conscious change, seizure\textsuperscript{14,17–19}, mucous irritation, cyanosis\textsuperscript{14}, and electrocardiography change, we would record them, promptly discontinue drug delivery, and treat the patients promptly. Before the patients left the ICU, they were asked to complete the questionnaire.

2.2. Xylocaine 10% pump spray

Xylocaine 10% pump spray containing 10 mg lidocaine hydrochloride with each spray can be applied topically for local anesthesia. When it is sprayed on the oropharyngeal area, it has the characteristics of rapid onset of action (3 to 5 minutes)\textsuperscript{14}, short duration (elimination half-life: 1.6 hours in healthy patients, 6.6 hours in patients with liver disease\textsuperscript{20}, dose-dependent serum concentration\textsuperscript{21}, and concentration-dependent toxicity\textsuperscript{22} (safe and toxic if the dosage is correctly applied, potentially caused by endotracheal intubation; endo size – the size of endotracheal tube; ICU day – the duration of intensive care unit stay; Xylocaine hour – the duration of Xylocaine.

2.5. Statistical analysis

A pretest investigation was held to determine the patient numbers for evaluation. As the power was set at 0.8, and since the data was being analyzed by repeated analyses of variance (ANOVA), 10 patients were required. Descriptive statistics for continuous variables were calculated and were reported as mean ± standard deviation (SD). Categorical variables were described using frequency distributions and were reported as number and percentage (n%). As the power was set at 0.8, and since the data was being analyzed by repeated analyses of variance (ANOVA), 10 patients were required.

Table 1

Patient characteristics in the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>SEM</th>
<th>T</th>
<th>p value</th>
<th>Posthoc test*</th>
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</thead>
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<tr>
<td>Age 65</td>
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<td>0.38</td>
<td>0.04</td>
<td>0.97</td>
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<tr>
<td>&lt; 65</td>
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<td></td>
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<tr>
<td>APACHE score</td>
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<td>0.32</td>
<td>1.42</td>
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<td></td>
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<tr>
<td>BMI</td>
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<td>0.07</td>
<td>0.95</td>
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<tr>
<td>Endo size</td>
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<td>0.81</td>
<td>1.50</td>
<td>0.18</td>
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<tr>
<td>Endo day</td>
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<td>0.23</td>
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<td>0.70</td>
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<tr>
<td>ICU day</td>
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<td>0.24</td>
<td>0.27</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>Time</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time-2</td>
<td>-0.57</td>
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<td>-2.42</td>
<td>0.02</td>
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<tr>
<td>Time-3</td>
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<td>-4.15</td>
<td>p &lt; 0.01</td>
<td>Time-1 &gt; Time-4</td>
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<tr>
<td>Time-4</td>
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<td>-5.20</td>
<td>p &lt; 0.01</td>
<td>Time-1 &gt; Time-5</td>
</tr>
<tr>
<td>Time-5</td>
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<td>0.23</td>
<td>-6.26</td>
<td>p &lt; 0.01</td>
<td>Time-2 &gt; Time-5</td>
</tr>
</tbody>
</table>

Table 2

The influence factors related to the effects of the xylocaine spray on the pain control caused by endotracheal tube.

* Posthoc test: Adjustment by Bonferroni Multiple Comparisons.
The influence of xylocaine spray for the ETT-induced throat pain on patient satisfaction of intensive care.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
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<td>5</td>
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<td>−0.34</td>
<td>0.46</td>
<td>0.89</td>
<td>1.00</td>
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<td>6</td>
<td>−0.15</td>
<td>−0.43</td>
<td>0.02</td>
<td>0.40</td>
<td>0.49</td>
<td>1.00</td>
</tr>
</tbody>
</table>

1 Questionnaire:
1. How many times have you been intubated with ETT? Never (0), once (25), twice (50), three times (75), more than three times (100).
2. Did the ETT cause the throat pain this time? Agree strongly (100), agree slightly (75), neutral (50), disagree slightly (25), disagree strongly (0).
3. Did you agree that the caregivers have treated your throat pain aggressively? Agree strongly (100), agree (75), neutral (50), disagree slightly (25), disagree strongly (0).
4. Were the medications sufficient to control your throat pain caused by the ETT? Agree strongly (100), agree (75), neutral (50), disagree slightly (25), disagree strongly (0).
5. Did you satisfy to this ICU care? Agree strongly (100), agree (75), neutral (50), disagree slightly (25), disagree strongly (0).
6. Would the level of the throat pain being controlled influence your satisfaction of the ICU care? Agree strongly (100), agree (75), neutral (50), disagree slightly (25), disagree strongly (0).

ETT = endotracheal tube.

Pearson’s correlation coefficient, |p| < 0.05, |p| < 0.01.

Table 3

<table>
<thead>
<tr>
<th>Mean ± SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
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</thead>
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<tr>
<td>(1)</td>
<td>0.47 ± 0.90</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>(2)</td>
<td>88.16 ± 15.29</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>(3)</td>
<td>94.74 ± 10.47</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>(4)</td>
<td>86.84 ± 21.03</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>(5)</td>
<td>88.16 ± 15.29</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>(6)</td>
<td>88.16 ± 17.42</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

The severity of the throat pain caused by the endotracheal intubation, the size of the ETT, and the duration of the ICU stay (Table 2), but the effect of pain relief declined related to time (p < 0.01, Fig. 1). Two patients enrolled each required xylocaine four and three times with the scale before spray each time: 8 and 8, 7 and 8, 6 and 6, and the scale after spray each time: 3 and 3, 3 and 3.5, 2 and 3.1. The pain severities before management declined gradually with time (p < 0.01, Fig. 1). The pain relieving effect of xylocaine was not affected by sex, age, disease severity, body mass index, ETT size, the duration of the endotracheal intubation, or the duration of the ICU stay (Table 2), but the effect of pain relief declined related to time (p < 0.01, Fig. 1 and Table 2). Expect for one patient that needed the lidocaine for 121 hours, most of the patients stopped requesting it within 48 hours. In addition, the interval between the previous use of xylocaine and following use gradually increased from 4.31 ± 1.68, 6.07 ± 2.88, and 6.88 ± 3.86 to 6.24 ± 2.28 (Fig. 2). The intervals of the demand of the pain relief were also different between the daytime and the nighttime on the first day of admission (p < 0.001, Fig. 3).

Most of the patients experienced throat pain due to endotracheal intubation for the first time. Most patients agreed that the
caregivers had an aggressive attitude to manage their pain, and the medications worked well. Most of them were satisfied with the ICU care, and they agreed that the level of the throat pain control would influence their satisfaction with regard to ICU care (Table 3). The level of the throat pain being controlled by the medications in the ICU was correlated well with the degree of patient satisfaction of the ICU care [correlation: 0.89 (p < 0.01), Table 3]. The caregivers’ attitude regarding pain control and the level of the throat pain caused by the ETT being controlled are the part of the consideration of their ICU satisfaction [correlation: 0.46 (p < 0.05) and 0.49 (p < 0.01) respectively]. The results are shown in Table 3.

4. Discussion

Endotracheal intubation is a general life-sustaining therapy; however, it is also the most common and the most painful origin of patient stress in the ICU7,8,10,25,27. In the literature review, the severity of the throat pain was high, but varied in the intubated patients in ICU7,10,25,28. The phenomenon depends not only on the extent of the tissue injury, but also on patient idiosyncratic appraisal, which is influenced by current mood, symptoms interpretation, and response expectation25,28–30. The gate control theory has supplied a firm physiologic basis for the phenomenon, and it has subsequently been proved in many experiments31–33. Patients in the ICU who are stressed by physiologic, psychological and environmental stress, such as dyspnea, communication difficulty, anxiety, and noise would aggravate their experience when intubated2,25,26. Because of the inability of verbal communication, therefore, the throat pain caused by ETT is usually unexpectedly and requires special care provided by the medical professionals25. The discomfort has been seriously considered in the pediatric field38.

In this study, the pain perception also showed the high variety among the participants who have the initial severity scale ranged from 8 to 10, the last scale before stopping request ranged from 4 to 6, and minimal request of three sprays, while one patient took 122 hours to treat the throat pain until the scale reached 1.

Clinically, pain in the ICU was controlled by opioids, nonsteroidal anti-inflammatory drugs, and acetaminophen2,34. Lidocaine is another type of analgesia that has been topically applied for airway management to prevent discomfort induced by laryngeal mask airway in rapid sequence intubation35, as well as to prevent the airway effects of endotracheal intubation, such as cough, laryngospasm36, and tachycardia37. This study further proved that topical lidocaine spray was effective to relieve the pain caused by the ETT without obvious side effects. In the view of the fact that the ETT is one of the stressors in the ICU7,8,10, we suggested lidocaine spray as an option for pain control caused by ETT.

Although the previous studies have shown lidocaine spray to have the pharmacokinetics of rapid onset of action14, short duration in healthy38, dose-dependent serum concentration39, and concentration-dependent toxicity40, how to apply it to control pain for a period of time does not seem to have been established. In addition, central gate control and neuroplasticity can modify the pathologic pain31–33. In this study, the severity of throat pain caused by ETT was positively correlated to the patients’ consciousness level, but it was inversely correlated to the time sequence after the intubation or the number of lidocaine spray; nevertheless, was not related to the age, sex, disease severity, body weight, or the size of ETT. The results have shown prescription of lidocaine spray on demand was the suitable way to treat throat pain caused by the ETT.

The patients’ impression of the aggressiveness of the caregivers attitude toward the pain was moderately correlated to their satisfaction of the care, which could be the cause of the pain severity decline with the time via the mechanism of central neuroplasticity32, a dynamic pain shaping according to the new signals, including behavior and the stress. These results are quite comparable with the gate control theory of pain, which proposed that the transmission of nerve impulse from afferent fibers to spinal cord is modulated by gating mechanism in the spinal cord. The spinal gating mechanism is influenced by the brain, the body-self neuromatrix that is composed of sensory, affective, and cognitive neuromodules33. In view of the physiologic and psychological effects of lidocaine spray on the pain control of ETT, which could prevent the viscous cycle between the stress and the pain severity33, and the unpredictable individual dynamic requirement of a pain reliever, giving lidocaine on demand should be the best method of clinical prescription.

Quality of care of patient and family satisfaction of the intensive care unity survey of ICU care has been receiving attention from specialists in critical care10,30,37–39. This study further demonstrated that the care of patient throat pain induced by the ETT was one point of consideration in their satisfaction of ICU care. In addition, not only the effectiveness of ETT induced pain controlled by the lidocaine, but also the perception of their caregivers’ attitude and action toward the issue of pain control itself would significantly influence their satisfaction.

4.1. Study limitations

This study was not placebo controlled because of the difficulty of the manufacture preparation process approved by the company.
However, the physical and psychological effects of lidocaine spray on ETT-induced pain control has been proven in this pilot study, which was a randomized, double blinded, large population study that compared the effect on this issue between Xylocaine 10% spray to traditional management is recommended.

5. Conclusion

Xylocaine spray administration on demand is an effective way to control the pain caused by ETT. Applying this medication for the stress commonly occurred in the ICU could also increase patient satisfaction of the intensive care.

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References


