Nebulized Lidocaine Decreases the Discomfort of Nasogastric Tube Insertion: A Randomized, Double-Blind Trial

**Study objective:** Nasogastric tube insertion is a common emergency department (ED) procedure that is associated with considerable patient discomfort. The safety and efficacy of nebulized lidocaine for upper airway anesthesia have previously been demonstrated. We determine whether nebulized lidocaine administered before nasogastric tube insertion significantly reduces patient discomfort.

**Methods:** A double-blind, placebo-controlled, randomized clinical trial of adult patients was conducted in the EDs of 2 university hospitals. Twenty-nine participants were administered nebulized lidocaine (4 mL 10%), and 21 participants received nebulized normal saline solution. Patient discomfort was measured using a 100-mm visual analog scale. The difficulty of nasogastric tube insertion was evaluated using a 5-point Likert scale.

**Results:** There was a clinical and statistical significant difference in patient discomfort associated with the passage of the nasogastric tube between nebulized lidocaine and placebo groups (mean visual analog scale score 37.7 versus 59.3 mm, respectively; difference between group means 21.6 mm; 95% confidence interval [CI] 5.3 to 38.0 mm). There was not a detectable difference in difficulty with the passage of the nasogastric tube between the 2 groups (median 2 versus 2; median difference 0; 95% CI –1 to 1). Epistaxis occurred more frequently in the lidocaine group (17% versus 0%; difference 17%; 95% CI 3.5% to 31%).

**Conclusion:** Nebulized lidocaine decreases the discomfort of nasogastric tube insertion and should be considered before passing a nasogastric tube. An increased frequency of epistaxis, however, may be associated with its use.

INTRODUCTION

Background

The insertion of nasogastric tubes is a common procedure in the emergency department (ED). It is among the most uncomfortable procedures performed on patients in the ED.1-9 Singer et al2 found that nasogastric tube insertion was the most painful procedure identified by patients and practitioners. The pain was worse than abscess drainage, fracture reduction, and urethral catheterization in the ED patient population studied.2

Procedural analgesia is a recognized core skill in emergency medicine.10 However, pain management in the ED is often suboptimal.10-12 The inadequacies may be the result of the lack of treatment options and lack of sufficient research into specific treatment options.13

Previous studies have documented the safety and efficacy of inhaled lidocaine delivered by atomization,1 nebulization,14-16 and intermittent positive pressure breathing.17 An atomizer uses compressed gas to produce a single or repeated single aerosol (1- to 5-μm particles) sprays, which can be directed toward the mouth or nose.18 A nebulizer is distinguished from an atomizer by the incorporation of baffles, which selectively remove large droplets from the outgoing spray. Additionally, most nebulizers use a continuous flow of compressed gas to produce a continuous flow of aerosol over several minutes.16,18 Other nebulizers use ultrasonography instead of compressed gas to produce an aerosol flow.14,15 By using a nose clip, the aerosol can be directed only to the mouth when an atomizer or nebulizer is used. Lidocaine has also been delivered by intermittent positive pressure breathing17 directly to the mouth using a nebulization technique. Significant reduction in the pain associated with nasogastric tube insertion has been achieved with atomized lidocaine.1

Kirkpatrick et al16 assessed the serum drug concentration after 400 mg of lidocaine was delivered to volunteers by a compressed gas-powered jet nebulizer using a mouth-breathing technique. They found that nebulized lidocaine could provide safe airway anesthesia with minimal drug absorption. MacIntyre et al19 studied the delivery of solutions by nebulization and found that 5% to 15% of a dose placed in a nebulizer was delivered to the patient’s lungs in usual operating conditions. Others have shown that the addition of nose breathing reduces the lung deposition of a nebulized solution by up to half.18

Goals of This Investigation

Nebulization of lidocaine with nose and mouth breathing before the insertion of a nasogastric tube has not been tested clinically. The technique of nebulization with breathing through the nose and mouth may anesthetize more of the upper airway, resulting in less discomfort with nasogastric tube insertion. We chose to investigate this method of local anesthetic delivery in the search for a simple but effective method for minimizing the discomfort of nasogastric tube insertion.

The aim of this study is to compare the level of patient discomfort between groups receiving nebulized lidocaine and nebulized saline solution before nasogastric tube insertion. We hypothesized that nebulized lidocaine would significantly decrease patient discomfort compared with placebo. We expected that there would be few significant adverse effects with nasogastric tube insertion using this technique for local anesthesia.

METHODS

Study Design and Setting

The study was a double-blind, placebo-controlled, randomized clinical trial. It was conducted in the EDs of 2 large metropolitan university hospitals in Australia with annual attendances of 50,000 and 65,000 between July 2000 and October 2002, respectively.

Selection of Participants

All patients older than 18 years who required a nasogastric tube as part of their ED treatment were
eligible for enrollment. Exclusion criteria were inability to assess pain (altered mental state, language barrier, dementia), hemodynamic instability (systolic blood pressure <100 mm Hg), emergency indication for nasogastric tube placement (eg, major trauma), allergy to lidocaine, concurrent administration of intravenous lidocaine, pregnancy, weight less than 50 kg, preexisting impairment to gag reflex, and reactive airways disease (eg, asthma, chronic obstructive airway disease). Inhaled lidocaine has been reported to cause bronchoconstriction in patients with reactive airways disease.16,20

Interventions

The hospital pharmacy departments prepared the lidocaine (400 mg, 4 mL of 10% solution) and normal saline (4 mL) trial solutions, which were packaged identically. Patients, nurses, and treating physicians remained blinded to the identity of the solution used in particular cases during the trial.

Serially numbered, opaque, sealed envelopes each containing a vial of the trial solution (either lidocaine or normal saline solution) and accompanying documentation were sequentially allocated to consecutively enrolled patients. The vials were randomly distributed to the study packs using a random number table. Each of the 2 study hospitals set out to randomize 24 patients to ensure equal numbers of patients in the lidocaine and normal saline solution arms at each hospital. A single 24-patient block was initially chosen by each of the 2 study hospitals.

Four milliliters of the trial solution was administered using a face mask and a compressed gas-powered jet nebulizer (Hudson Respiratory Care Inc., Temecula, CA) with an oxygen flow rate of 6 L/min. The patient was instructed to breathe through his or her nose and mouth while the solution was being nebulized. Immediately after the nebulization was completed, the nurse removed the mask and inserted the nasogastric tube with the usual lubrication gel (KY Jelly) in the normal manner. The nasogastric tube used was an 18F Salem sump tube (Sherwood Medical, St. Louis, MO). Nasogastric tube placement was confirmed by auscultation, aspiration of gastric contents, or radiographic identification in the usual manner.

Outcome Measures

After the nasogastric tube was secured, patient discomfort was assessed using a visual analog scale. A 100-mm line with “no discomfort” and “severe discomfort” marked on either end was used. The patient was asked to indicate by a mark on the line where his or her level of discomfort was during the insertion of the nasogastric tube. The interval from the time the nasogastric tube was secured to the time the visual analog scale score was taken was not standardized but is estimated to be between 1 and 10 minutes.

The difficulty of nasogastric tube insertion was assessed using a 5-point Likert scale marked “minimal,” “slight (less difficult than usual),” “moderate (usual amount of difficulty),” “substantial (more difficult than usual),” and “extreme.” The nurse who inserted the nasogastric tube recorded how difficult he or she thought the insertion had been.

Nurses were requested to indicate whether they believed the trial solution assisted in the passage of the nasogastric tube and to guess which solution (lidocaine or normal saline solution) they believed they used with the particular patient. Complications during nasogastric tube insertion were identified and recorded using a checklist that included nasal or oropharyngeal bleeding, vomiting, incorrect placement or failed passage of the nasogastric tube, more than 3 attempts before correct placement, and patient refusal to further attempts. Nurses were encouraged to report other complications not on this list.

Data Collection and Processing

The treating emergency residents and attending physicians were responsible for patient identification, enrollment, and consent. They also collected clinical and demographic data. Nurses were responsible for the delivery of the trial solution by a nebulizer and placement of the nasogastric tube and the assessment of patient discomfort.

Primary Data Analysis

Our sample size calculation was based on the study by Wolfe et al.1 We estimated that 24 patients were required in each of the treatment and placebo groups to show a statistically significant difference of 20 mm in visual analog scale scores (estimated SD 25 mm,1 power 0.8, α .05 [2-tailed]). This difference was based on a study by Kelly,21 which suggested that a difference in visual analog scale score of less than 20 mm is unlikely to be clinically meaningful. An intention-to-treat analysis was performed. Differences between treatment and placebo groups were quantified using the mean, median, or proportionate differences with 95% confidence intervals (CIs; Confidence Interval Analysis, version 2.1, University of Southampton, UK).
The study was approved by the participating hospitals' clinical research and ethics committees. Patients gave informed written consent before enrollment into the study.

RESULTS

Characteristics of Study Subjects

A total of 50 patients were enrolled in the 2 study hospitals, with 11 patients participating in one and 39 patients participating in the other hospital. Twenty-nine and 21 patients were randomized to and received lidocaine and normal saline solution, respectively (Figure). The age and sex distributions, together with the indications for nasogastric tube placement, are given in Table 1.

Main Results

The mean visual analog scale score for patients' discomfort during nasogastric tube insertion was 37.7 mm (SD 27.0 mm) for the lidocaine group and 59.3 mm (SD 29.3 mm) for the placebo group. The difference between the group means was 21.6 mm (95% CI 5.3 to 38.0 mm). The median score for nurses' perceived difficulty in nasogastric tube insertion was 2 for each of the 2 groups, with a median difference of zero (95% CI –1 to 1).

There was a trend toward nurses believing that the blinded lidocaine solution assisted in the passage of the nasogastric tube compared with the blinded normal saline solution, although this was not statistically significant (62% and 43%, respectively; difference 19%; 95% CI –8% to 47%). There was not a detectable significant difference between the lidocaine and placebo groups with regard to nurses correctly guessing which solution was used (62% versus 57%, respectively; difference 5%; 95% CI –23% to 33%).

The complications associated with the nebulized trial solutions and nasogastric tube insertions are listed in Table 2. Epistaxis occurred in 5 of the 29 patients who received lidocaine and in none of the 21 patients who received normal saline solution (17% versus 0%, respectively; difference 17%; 95% CI 3.5% to 31%).

LIMITATIONS

This study has several limitations. The trial required more than 2 years to enroll 50 patients in 2 busy EDs. At the completion of the trial, we estimated that 100 patients would have been eligible for enrollment during the study period. It suggests that the patients enrolled were non-consecutive but dependent on emergency staff identification, thus leading to convenience sampling and assembly bias, which may affect the generalizability of the findings because certain patients may have been more readily enrolled than others in a busy ED. However, patient randomization occurred after enrollment, thus protecting the study against selection bias and so preserving its validity, even though the findings may not be generalizable to other settings.

A smaller number of patients were enrolled in one hospital than planned because of the expiration of trial solutions at that hospital. To compensate, a larger number of patients were enrolled in the other hospital, which led...
to the uneven numbers of patients in each of the lidocaine
and normal saline solution groups because the random-
ization blocks that we initially chose were too large.

Nurses were, strictly speaking, the unit of analysis
because they were the ones placing the nasogastric tube,
de spite the fact that the patients were randomized. The
research design is actually that of patients clustered within
nurses. Our sample size calculation did not take this fact
into consideration, which would have been more impor-
tant if the study did not find a difference in visual analog
scale scores between the treatment and placebo groups.
The study did not identify the individual nurses who
passed the nasogastric tube. We are thus unable to present
data to show possible associations between patients’
discomfort and complications with individual nurses.

No attempt was made to standardize the method of
nasogastric tube placement, which may have led to some
variation in technique, causing increased discomfort or
complications by individual nurses, although the per-
ceived difficulty in nasogastric tube insertion was the
same. This omission, however, is likely to be representa-
tive of practice in most EDs. The time the visual analog
scale score was taken after the nasogastric tube was
secured was not standardized.

**DISCUSSION**

This study identified a simple and efficacious method for
easing the discomfort of nasogastric tube placement using
nebulized lidocaine as measured by visual analog scale
scores. There has been concern and disagreement, how-
ever, as to what differences in pain scores translate into
an actual clinical benefit for the patient. Todd et al.\(^\text{22}\)
suggested that the minimally clinically significant change
in pain severity scores is 13 to 15 mm. Kelly\(^\text{21}\) suggested
that a change in visual analog scale pain score of less
than 20 mm is unlikely to reliably translate into effective
pain relief for the patient. These differences are not exactly
the same as what this study is measuring because we are
examining the difference between 2 groups in a single
pain measurement. On the basis of these reported differ-
ences, nevertheless, our finding of a mean difference in
visual analog scale score of 21.6 mm is clinically
significant. The lower limit of the 95% CI for the median
difference is above zero, so the finding is also statistically
significant. However, this lower limit is 5.3 mm, which is
below the clinically significant mark suggested by Todd
et al\(^\text{22}\) or Kelly.\(^\text{21}\) Therefore, although our study is
positive, it is not definitive.

There was no detectable difference in the difficulty of
nasogastric tube insertion between the treatment and
placebo groups. Assessment of difficulty was made to
ensure that the insertion was not more difficult in one
group, thus causing greater discomfort in that group and
so biasing the results. Nurses were unable to correctly
guess which solution they used with particular patients,
thus supporting the maintenance of blinding in this study.

There were more complications in the lidocaine group.
Five of the 29 patients who received lidocaine experi-
enced nasal bleeding, whereas none of the patients in the
normal saline solution group had this adverse event. The
17% (95% CI 3.5% to 31%) difference is significant.
Lidocaine has not been shown to cause nasal bleeding.
However, the anesthetized turbinates may be more likely

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### Table 1.

**Patient characteristics and indications for nasogastric tube placement.**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lidocaine (N=29)</th>
<th>Normal Saline Solution (N=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>67</td>
<td>55</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>53–71</td>
<td>42–77</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>15 (52)</td>
<td>10 (48)</td>
</tr>
<tr>
<td>Indications for nasogastric tube placement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>Vomiting</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Gastric dilatation</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Gastrointestinal bleeding</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Preoperative</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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### Table 2.

**Complications associated with the nebulized trial drug solutions and nasogastric tube insertion.**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Lidocaine, No. (%) (N=29)</th>
<th>Normal Saline Solution, No. (%) (N=21)</th>
<th>Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal bleeding</td>
<td>5 (17)</td>
<td>0</td>
<td>17% (3.5–31)</td>
</tr>
<tr>
<td>Vomiting*</td>
<td>3 (10)</td>
<td>0</td>
<td>10% (–0.7 to 2.1)</td>
</tr>
<tr>
<td>Unable to pass nasogastric tube</td>
<td>2 (6.9)</td>
<td>2 (9.5)</td>
<td>–2.6% (–4.3 to 1.7)</td>
</tr>
<tr>
<td>Chest tightness and dyspnea</td>
<td>1 (3.4)</td>
<td>0</td>
<td>3.4% (–3.2 to 1.0)</td>
</tr>
</tbody>
</table>

*Diagnoses of patients who vomited: 1 bowel obstruction (not stated whether small or large bowel obstruction), 1 small bowel obstruction, 1 pancreatitis.
to be injured by the passage of a nasogastric tube because they are relatively insensate. The addition of vasoconstrictors, which were not used in this study, may decrease the incidence of epistaxis. One patient who received nebulized lidocaine developed dyspnea and chest tightness, resolving with cessation of nebulization of the trial solution. This patient had no history of reactive airways disease. There are reports of nebulized lidocaine causing bronchoconstriction in patients with known asthma and chronic obstructive airway disease, however, it has not been reported in patients without these conditions. In support of previous studies, we did not find that this technique of topical anesthesia resulted in inadvertent tracheal placement.

A recent study by Ducharme and Matheson comparing atomized lidocaine, atomized cocaine, and topical lidocaine gel identified the 2% lidocaine gel as the best option for topical anesthesia during nasogastric tube insertion. Previous studies by Wolfe et al., Singer and Konia, and Nott and Hughes investigated the use of lidocaine delivered by atomization and topical application of a gel. Our study is similar in design to that conducted by Wolfe et al., but we used the technique of nebulization rather than atomization and omitted the intranasal lidocaine gel in the treatment and placebo groups. The theoretical advantage of nebulization is that the delivery of a smaller-droplet mist may allow greater delivery of lidocaine to the nasopharynx and oropharynx, thus providing better topical anesthesia. Our research has identified an alternative, effective delivery method for lidocaine before nasogastric tube placement. A study directly comparing lidocaine delivered by nebulization, atomization, and topical application of a gel will clarify the best method of topical anesthesia. The use of a gel formulation in addition to nebulization or atomization may also improve the anesthesia compared with each delivery method alone. Future study would also allow further assessment of complication rates, particularly the incidence of epistaxis.

Equipment costs for nebulization (mask, nebulizer bulb, and oxygen tubing) are approximately US$1.90. The drug acquisition cost comparison of lidocaine solution and lidocaine gel is US$0.95 per vial for lidocaine 10% (50-mL flip-top vial; Abbott Hospital, Abbott Park, IL) versus US$8.29 per tube of xylocaine (2% jelly, 5-g tube; AstraZeneca, Wilmington, DE). Comparison of the cost of the 2 techniques shows that there is a substantial savings using a nebulization technique.

In summary, the use of nebulized lidocaine (4 mL of 10%) is an efficacious method for easing the discomfort of nasogastric tube placement that should be considered for patients requiring this painful procedure. The possibility of an increased frequency of epistaxis being a consequence of the insensate turbinates and nasal mucosa, however, may complicate its use.

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Author contributions: LC, DT, and ST conceived the study and designed the trial. LC obtained all research funding. LC, DT, and KC supervised the conduct of the trial and data collection. LC, DT, and KC undertook evaluation of the trial and recruitment at participating centers. LC, DT, and KC managed the data, including quality control. DT and KC were responsible for data analysis. LC drafted the manuscript, and all authors contributed substantially to its revision. LC takes responsibility for the paper as a whole.


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REFERENCES