Local anaesthesia to the airway reduces sedation requirements in patients undergoing artificial ventilation†

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Summary

Patients in the intensive care unit require large doses of sedative/analgesic drugs to tolerate the presence of a tracheal tube and other unpleasant stimuli. The ideal regimen for sedatives and analgesics has not yet been found. We have investigated the effects of topical local anaesthesia to the pharynx and airway on sedative/analgesic requirements in 30 ICU patients (25–75 yr old) with no obvious brain injury, undergoing mechanical ventilation. Oral tracheal tubes were changed to a modified tube which allowed instillation of local anaesthetic solutions onto the pharyngeal, laryngeal and tracheal mucosa. Lignocaine 1% (5 ml) or 5 ml of 0.9% saline were instilled hourly for 12 h each for a total of 24 h, in a double-blind, randomized crossover design. Baseline sedation was maintained with propofol or alfentanil infusions, or both, which were titrated to patient comfort and to maintain an optimum sedation score throughout. Twenty-five patients completed the study. Mean total propofol and alfentanil, requirements were 766 (SD 524) mg and 17 (7.6) mg, respectively, during 12 h of lignocaine instillation, and 1321 (862) mg and 25 (11.4) mg, respectively, during 12 h of saline instillation. There was a significant reduction (P < 0.05) in the requirements for both agents during the period of lignocaine instillation. (Br. J. Anaesth. 1996; 77: 731–734)

Key words

Translaryngeal tracheal intubation is the standard technique for early airway management of patients requiring assisted ventilation. Most patients require anaesthesia or significant amounts of sedatives/analgesics to tolerate a tracheal tube for the first few days in the ICU.1,2 This requirement is unimportant during surgery but is often a major drawback in patients requiring intensive care as these drugs often accumulate in the critically ill patient, and may increase the length of stay, morbidity and mortality.3

Tracheal intubation can be performed in awake patients using topical local anaesthesia to the airway in difficult intubation situations.4 We were interested to determine if topical lignocaine delivered via a modified tracheal tube (LITA tube—laryngotracheal instillation of topical anaesthesia) to the pharyngeal, laryngeal and tracheal mucosa could improve comfort, and thereby reduce requirements of sedative and analgesic drugs in ICU patients. Topical lignocaine via an LITA tube has been reported to reduce the incidence of tracheal tube-induced coughing during emergence from general anaesthesia.5 The use of this tube has not been described previously in patients requiring intensive care.

Patients and methods

After obtaining approval from the local Ethics Committee and written informed consent from the patients’ relatives, we enrolled 30 patients (23 males) requiring ventilatory support in the ICU. We excluded patients requiring analgesia in the immediate postoperative period and those with obvious brain injury. Oral tracheal tubes were changed to an LITA tube of 8 mm id in females and 8.5 mm id in males (fig. 1) after administration of an i.v. bolus of propofol 0.5–1.5 mg kg⁻¹ and atracurium 0.5 mg kg⁻¹. The study began 2 h later.

The LITA tube (Sheridan Catheter Corp., Argyle, NY, USA) differs from a conventional tracheal tube only in that it contains an additional small-bore channel incorporated into the wall of the lesser curvature of the tube (fig. 1). The proximal end of this channel has a Luer-lock syringe connector and has 10 small perforations on its distal segment. Local anaesthetic, injected under pressure, sprays the mucosa both proximal and distal to the inflated tube cuff. It is designed so that the spray of local anaesthetic deflects off the anterior wall of the larynx and trachea and by gravity runs down to bathe the entire circumference of the mucosa.

Syringes containing 5 ml of either 1% lignocaine or 0.9% saline were prepared by the hospital pharmacy. The authors and the nursing staff were blinded to the nature of the solutions.

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Randomization was carried out by the pharmacy according to a computer-generated table so that each patient received an hourly instillation via the LITA tube of either 1% lignocaine for the initial 12 h and saline for the ensuing 12 h or vice versa. Each patient acted as their own control. We chose the 1% lignocaine solution as we know that this acts on bronchial mucosa during fibreoptic bronchoscopy and we wished to avoid potential local anaesthetic toxicity from absorption of more concentrated solutions.

Sedation was maintained with baseline infusions of propofol 0.2–1 mg kg\(^{-1}\) h\(^{-1}\) or alfentanil 10–20 \(\mu\)g kg\(^{-1}\) h\(^{-1}\), or both. We chose these particular agents for their short duration of action and ability to rapidly titrate doses for a desired effect. The level of sedation was monitored hourly using a sedation scale (table 1) with six levels of cognitive neurological function, similar to the Ramsay sedation scale.\(^6\) Monitoring of sedation and adjustment of propofol and alfentanil infusions to maintain a target score of 3–4 (table 1) were carried out throughout the entire study. If at any time sedation was assessed to be outside the target level, nurses achieved the target sedation levels either by administering additional boluses of either propofol 10 mg or alfentanil 200 \(\mu\)g or by altering the infusion rates. Episodes of coughing and gagging, desaturation (\(\text{Sa}_\text{O}_2 < 90\%\)) and hypertension (increase in systolic arterial pressure > 20% above baseline) were recorded during the study. Patients who were awake enough were questioned about the discomfort caused by the presence of the tracheal tube or by pulmonary suctioning. The paired \(t\) test in SPSS version for MS Window release 6.1 was used to assess statistical significance between sedation requirements during the different periods, and significance was taken at \(P < 0.05\).

Results

We studied 30 patients, aged 25–75 yr; the male:female ratio was 3.3:1. Patients were of a mixed group (table 2) and they had no significant organ dysfunction except respiratory failure. No problems were encountered during change of the tracheal tube to an LITA tube. Five patients were excluded from subsequent analysis because the study was not completed: in two of these the trachea was extubated, one after 3 h and a second after 8 h from the start of the study, one required neuromuscular block 5 h after the beginning of the study because of deterioration in oxygenation, one was transferred to another hospital and another developed bronchospasm during the period of saline instillation. Thirteen of the remaining patients received lignocaine instillations for the initial 12 h followed by 12 h of saline instillation. The remainder started with saline instillation. Eight patients received a propofol infusion, eight patients an alfentanil infusion and another nine patients received both concurrently during the study. The total amount of propofol and alfentanil used for each patient was recorded for the 12-h pre-study period, for lignocaine instillation and for the 12 h of saline instillation. Mean requirements of propofol and alfentanil are shown in table 3. There was a significant reduction (30–40%) in the requirements of both drugs during lignocaine instillation compared with the pre-study and saline periods. There was no significant difference between the requirements for
**Discussion**

Patients undergoing mechanical ventilation are subjected to many noxious stimuli attributable to diagnostic, therapeutic and physical nursing interventions. The presence of a tracheal tube and frequent tracheal suctioning are very unpleasant. An optimal level of sedation is a fundamental requirement to facilitate delivery of ICU care. Although essential, sedation and analgesia in this group of patients produce many side effects; cardiovascular instability, delayed weaning from mechanical ventilation, impaired tolerance of enteral feeding, tolerance and withdrawal symptoms, and other complications of immobility. These effects may persist because of accumulation of the parent drugs and their metabolites in critically ill patients.

Various strategies have been adopted to reduce sedative and analgesic requirements, and hence their side effects, without compromising patient comfort. These include tracheotomy, non-invasive ventilation, regional nerve block to wounds whenever appropriate, and synchronization of mechanical ventilation. Tracheotomy is generally claimed to be tolerated better in patients undergoing ventilation. Non-invasive ventilation in patients with respiratory failure has a better outcome compared with intubation and conventional IPPV. However, at the present time, most patients in the ICU require a tracheal tube in order to achieve adequate ventilation and provide access to the lower airway for removal of secretions.

In this study, we have demonstrated that propofol and alfentanil requirements were significantly lower (overall reduction 30–40%) during the period of hourly laryngotracheal instillation of lignocaine via an LITA tube than during the period of saline instillation. The results in a subgroup of 13 COAD patients showed more marked reduction in the total amount of sedatives during 12 h of lignocaine instillation. We believe this could be ascribed to the absence of any major stimuli (e.g. wounds) in these patients other than the tracheal tube and frequent tracheal suction.

During awake tracheal intubation and bronchoscopy, a higher concentration (4% or 10%) of local anaesthetic is used for airway anaesthesia. Lignocaine 1% instilled via an LITA tube has been shown to decrease the incidence of coughing and bucking during emergence from general anaesthesia. A survey of the literature gives very little information on topical airway anaesthesia, including optimal choice of drug, dose and frequency of administration. This study was the first of its type and so we had to choose the doses empirically. We used 1% lignocaine to reduce potential lignocaine toxicity and to instill a larger volume (5 ml hourly) to allow spread throughout the tracheal and laryngeal mucosa. This would not have been possible with a smaller volume of 4% lignocaine.

We chose propofol or alfentanil, or both, as the sedative/analgesic agents in this study to allow rapid titration of the level of sedation when used as an i.v. infusion, either alone or in combination. Propofol potentiates the analgesic effects of alfentanil and the latter potentiates the sedative action of propofol. Infusion of alfentanil was used alone in eight patients who were haemodynamically unstable and propofol infusion was used alone in another eight patients in whom nasogastric aspirate was high and who showed intolerance to nasogastric feeding.

The patients’ levels of sedation and anxiety were

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**Table 1** Patient data including primary diagnosis, day of stay when the study was undertaken, duration of ventilatory support and ICU stay, and overall survival of 25 patients. *Includes all patients. †Respiratory failure developed after postoperative day 4. ITP = Idiopathic thrombocytopenic purpura.

<table>
<thead>
<tr>
<th>n</th>
<th>Age (yr)</th>
<th>Sex (M/F)</th>
<th>Diagnosis</th>
<th>Day of study</th>
<th>Duration of ventilation (days)</th>
<th>ICU stay (days)</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>62.5 (55–75)</td>
<td>9/4</td>
<td>COAD, respiratory failure</td>
<td>2nd</td>
<td>4.5 (1.5)*</td>
<td>5.3 (2.5)*</td>
<td>88%*</td>
</tr>
<tr>
<td>9</td>
<td>53 (45–65)</td>
<td>7/2</td>
<td>Postop. resp. failure†</td>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>55, 62</td>
<td>2/0</td>
<td>Pulmonary oedema</td>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>0/1</td>
<td>ITP, respiratory failure</td>
<td>3rd</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2** Propofol and alfentanil requirements (mean (sd)) by periods of saline and lignocaine instillations in 25 patients and in a subgroup of 13 patients with COAD. *P<0.05, **P<0.01, ***P<0.001

<table>
<thead>
<tr>
<th>Total (mg)</th>
<th>Pre-study (12 h)</th>
<th>Lignocaine (12 h)</th>
<th>Saline (12 h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients (n=25)</td>
<td>1573 (632)</td>
<td>766 (524)**</td>
<td>1321 (862)</td>
</tr>
<tr>
<td>Propofol (n=17)</td>
<td>30.8 (8.75)</td>
<td>17.5 (7.6)***</td>
<td>25 (14.4)</td>
</tr>
<tr>
<td>Alfentanil (n=17)</td>
<td>34.5 (7.95)</td>
<td>17 (9.3)*</td>
<td>28 (11.6)</td>
</tr>
</tbody>
</table>

**Table 3** Patient data including primary diagnosis, day of stay when the study was undertaken, duration of ventilatory support and ICU stay, and overall survival of 25 patients. *Includes all patients. †Respiratory failure developed after postoperative day 4. ITP = Idiopathic thrombocytopenic purpura.
assessed using a six-point scale similar to the Ramsay sedation scale. Monitoring the degree of sedation in the ICU is inexact. However, the Ramsay scale is the most widely used scoring system in clinical studies in critically ill patients. This scale evaluates the patient either in the awake or asleep state but does not convey information on the quality of sedation. Other authors have commented on the need for a new validated tool and scale to measure the efficacy of sedation in the ICU.12

Saline may not be a true control as patients cough and become restless for a few minutes in response to its instillation. However, it did not increase the requirement of sedatives during the period of saline instillation compared with the pre-study period. Bronchospasm developed in one patient who had an acute exacerbation of COAD during the period of saline instillation and this may have been precipitated by the saline. Hence, we felt that it was reasonable to use saline as a control as otherwise it would have been difficult to carry out the study in a blinded fashion.

The total dose of lignocaine was 600 mg over 12 h. The dose of lignocaine used for treatment of ventricular arrhythmias is significantly greater13 and we believe it is unlikely that toxicity would occur given the dose and duration of this study. Lignocaine is known to be absorbed rapidly from the tracheobronchial mucosa. We cannot exclude the effect of systemically absorbed lignocaine from our findings. However, studies investigating the effects of i.v. lignocaine as an antitussive and an agent to attenuate the cardiovascular response to intubation are inconclusive.1415 The short period of this study did not allow us to assess if tolerance to the local anaesthetic occurred. Local anaesthetics with a longer duration of action (e.g. bupivacaine) may be beneficial but there is a paucity of data on the mucosal use of such drugs.

References