Tracheal intubating conditions and apnoea time after small-dose succinylcholine are not modified by the choice of induction agent

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Background. In a randomized, double-blind clinical trial, we studied the effect of different i.v. induction drugs on tracheal intubation conditions and apnoea time after small-dose (0.6 mg kg\(^{-1}\)) succinylcholine used to facilitate orotracheal intubation at an urban, university-affiliated community medical centre.

Methods. One hundred and seventy-five ASA I and II adult patients scheduled to undergo surgical procedures requiring general anaesthesia and tracheal intubation were allocated to one of five groups according to i.v. anaesthetic induction drug used. General anaesthesia was induced by i.v. administration of lidocaine 30 mg and propofol 2.5 mg kg\(^{-1}\) (Group 1), thiopental 5 mg kg\(^{-1}\) (Group 2), lidocaine 30 mg and thiopental 5 mg kg\(^{-1}\) (Group 3), etomidate 0.3 mg kg\(^{-1}\) (Group 4), or lidocaine 30 mg and etomidate 0.3 mg kg\(^{-1}\) (Group 5). After loss of consciousness, succinylcholine 0.6 mg kg\(^{-1}\) was given i.v. followed by direct laryngoscopy and tracheal intubation after 60 s. Measurements included intubation conditions recorded during laryngoscopy 60 s after succinylcholine administration, and apnoea time.

Results. Overall, clinically acceptable intubation conditions were met in 168 out of the 175 patients studied (96%). They were met in 35/35 patients in Group 1, 33/35 patients in Group 2, 34/35 patients in Group 3, 33/35 patients in Group 4, and 33/35 patients in Group 5. Mean (SD) apnoea time was 4.0 (0.4), 4.2 (0.3), 4.2 (0.6), 4.1 (0.2) and 4.1 (0.2) min respectively in Groups 1–5. There were no differences in the intubation conditions or apnoea times between the groups.

Conclusions. The use of succinylcholine 0.6 mg kg\(^{-1}\) produced the same favourable intubation conditions and a short apnoea time regardless of the induction drug used.


Keywords: intubation, endotracheal; neuromuscular block, succinylcholine; small-dose succinylcholine

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Succinylcholine 1 mg kg\(^{-1}\) is commonly used for rapid sequence induction in healthy adults, but three recent reports have suggested that succinylcholine 0.6 mg kg\(^{-1}\) produces satisfactory tracheal intubation conditions\(^{1-3}\) and faster recovery.\(^{5,6}\) Propofol was used as the induction drug in all three of these studies. Some previous reports have suggested that the use of different induction drugs can affect intubation conditions,\(^{4,5}\) whereas others could not demonstrate any difference.\(^{6,7}\) If the intubation conditions after small-dose succinylcholine were found to be unpredictable or varied according to the induction drug used, the usefulness of small-dose succinylcholine might be limited to use with propofol induction.

The objective of this study was to examine whether the administration of different i.v. induction drugs can affect the 1-min intubation conditions and the apnoea time resulting when small-dose succinylcholine (0.6 mg kg\(^{-1}\)) is used to facilitate tracheal intubation.

Methods

After approval of the study by The Institutional Review Board of Advocate Health Care (Park Ridge, IL, USA), 175 healthy ASA I and II adult patients between the ages of 18 and 82 years were enrolled. All patients were scheduled for elective surgery requiring general anaesthesia and...
tracheal intubation. Written informed consent was obtained from all patients. Obese patients with a body mass index greater than 30 kg m$^{-2}$ and patients with a history of difficult intubation or with abnormal airway examinations were excluded, as were patients receiving medications known or suspected to affect neuromuscular physiology, patients with medical histories of neuromuscular disease and patients with family or past medical histories of abnormal response to succinylcholine. Using a computer-generated random number sequence, patients were allocated to one of five groups according to the drug(s) used for induction of general anaesthesia. After premedication with i.v. midazolam 2 mg, pre-oxygenation and i.v. fentanyl 1.5 μg/kg, patients in Group 1 received lidocaine 30 mg followed by propofol 2.0 mg kg$^{-1}$. Group 2 patients received thiopental 5 mg kg$^{-1}$, Group 3 patients received lidocaine 30 mg and thiopental 5 mg kg$^{-1}$, Group 4 patients received etomidate 0.3 mg kg$^{-1}$, and Group 5 patients received lidocaine 30 mg and etomidate 0.3 mg kg$^{-1}$ for anaesthesia induction. All drugs were administered via a freely flowing infusion of Ringer’s solution into a peripheral i.v. catheter. After loss of consciousness was ascertained, based on clinical signs (loss of both verbal contact and eyelash reflex) and a Bispectral Index® (BIS; Aspect Medical Systems, Newton, MA, USA) between 40 and 60, succinylcholine 0.6 mg kg$^{-1}$ was administered i.v. over 5 s. Sixty seconds later, laryngoscopy and orotracheal intubation were attempted by an experienced anaesthetist unaware of the drug used for induction. Blinding was accomplished by keeping the anaesthetist who performed laryngoscopy and tracheal intubation outside the operating suite and calling him in after induction of anaesthesia. Syringes used for i.v. induction were covered and any residual induction drug visible in the i.v. line tubing was eliminated by generous flushing. A Macintosh blade was used for laryngoscopy in all patients and size 7.0 and 8.0 tracheal tubes were used for all female and male patients, respectively. The same experienced anaesthetist graded the intubation conditions in all patients using the Copenhagen consensus conference criteria (Table 1).8

After orotracheal intubation, ventilation was gently assisted manually to maintain end-tidal carbon dioxide between 4.7 and 5.3 kPa. During the apnoeic period, anaesthesia was maintained with isoflurane 0.75%, nitrous oxide 60% and oxygen 40%. The abdomen was inspected, and we recorded the times to first visible diaphragmatic contraction (apnoeic time) and to resumption of spontaneous breathing (first reservoir bag movement that was followed by regular spontaneous bag movements producing well-formed end-tidal carbon dioxide waveforms).

If tracheal intubation proved impossible, an additional dose of succinylcholine 0.5 mg kg$^{-1}$ could be given and the patient was ventilated by the face-mask for 1 min, after which tracheal intubation would be re-attempted. Patients requiring additional doses of succinylcholine were excluded from the study. In all patients, ventilation was gently and intermittently assisted as needed to keep the oxygen saturation above 96%.

### Statistical analysis

Sample size estimation was based on previous studies that examined the influence of various i.v. anaesthetics on tracheal intubation conditions during laryngoscopy using rocuronium or succinylcholine. A power analysis revealed that approximately 35 patients in each group would be required to identify a statistically significant difference between the intubation conditions with 80% power and $P=0.05$ and correction for multiple (four) comparisons. One-way analysis of variance and the Student–Neuman–Keuls (for continuous variables) and Kruskal-Wallis (for discrete variables) tests were used to identify statistically significant differences between the five groups. Statistical significance was accepted when $P<0.05$. Data are given as mean (SD).

### Results

There was no difference in gender, ASA physical status distribution, age, weight or height among the patients in the five groups. The patients’ characteristics are shown in Table 2.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Intubation conditions*</th>
<th>Clini$\text{c}$$\text{ally acceptable}$</th>
<th>Clini$\text{c}$$\text{ally unacceptable}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of laryngoscopy</td>
<td>Easy</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Vocal cord position</td>
<td>Abducted</td>
<td>Intermediate</td>
<td>Closed</td>
</tr>
<tr>
<td>Vocal cord movement</td>
<td>None</td>
<td>Moving</td>
<td>Closing</td>
</tr>
<tr>
<td>Airway reaction</td>
<td>None</td>
<td>Diaphragm</td>
<td>Sustained</td>
</tr>
<tr>
<td>Movement of limbs</td>
<td>None</td>
<td>Slight</td>
<td>Vigorous</td>
</tr>
</tbody>
</table>

There was no statistically significant difference in the duration of apnoea after succinylcholine administration between the groups (Fig. 1). The mean (SD) time to initial diaphragmatic movement was 3.4 (0.4), 3.4 (0.5), 3.5 (0.3), 3.3 (0.2) and 3.3 (0.2) min after succinylcholine administration for groups 1–5 respectively. Regular spontaneous
breathing resumed in 4.0 (0.4), 4.2 (0.3), 4.2 (0.6), 4.1 (0.2) and 4.1 (0.2) min in Groups 1–5 respectively.

Discussion

We have investigated the possibility that the choice of induction drug may affect (improve or worsen) the intubation conditions achieved when small-dose succinylcholine is used to facilitate tracheal intubation. An induction drug might affect intubation conditions in several ways, such as selective airway and jaw muscle relaxation produced by one induction drug and not another, potentiation of the action of the neuromuscular blocking drug by one drug more than another, and favourable haemodynamic effects of one drug compared with another.6

The addition or omission of a small dose of i.v. lidocaine to the i.v. induction drug that we used during induction did not result in any significant differences in intubation conditions. In contrast to our findings, however, lidocaine was found to improve intubation conditions when intubation was attempted 1 min after rocuronium 0.6 mg kg\(^{-1}\).10 Others could not demonstrate such a salutary effect.11 The discrepancy between these different reports may be due to the difference in the dose of lidocaine given and the timing of its administration in relation to the time of tracheal intubation. We used a small dose of lidocaine (30 mg) immediately before i.v. drug injection only for the purpose of preventing injection pain during i.v. propofol administration. We chose this dose based on earlier recommendations.12 Since we preferred not to administer propofol without lidocaine, we evaluated the contribution of lidocaine to intubation conditions in patients induced with thiopental (Group 3) and etomidate (Group 5). Whether increasing the lidocaine dose or the timing of its administration could have resulted in different results was not investigated in our study.

Our results indicate that the tracheal intubation conditions 1 min after administering succinylcholine 0.6 mg kg\(^{-1}\) were similar, regardless of the induction drug used. Fuchs-Buder and colleagues,7 in agreement with our results, did not find a significant difference between the intubation conditions

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Table 2 Comparison of demographic data. Data are mean (range), or mean (SD) or count

<table>
<thead>
<tr>
<th>Induction drug</th>
<th>Lido+propofol</th>
<th>Thiopental</th>
<th>Lido+thiopental</th>
<th>Etomidate</th>
<th>Lido+etomidate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>41 (18–82)</td>
<td>43 (22–80)</td>
<td>41 (20–66)</td>
<td>42 (20–60)</td>
<td>41 (18–60)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>16</td>
<td>17</td>
<td>17</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Females</td>
<td>19</td>
<td>18</td>
<td>18</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164 (8)</td>
<td>166 (9)</td>
<td>167 (9)</td>
<td>168 (14)</td>
<td>168 (8)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72 (11)</td>
<td>76 (11)</td>
<td>74 (12)</td>
<td>76 (11)</td>
<td>73 (11)</td>
</tr>
<tr>
<td>ASA physical status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>19</td>
<td>18</td>
<td>18</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>II</td>
<td>16</td>
<td>17</td>
<td>17</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 3 Intubation conditions recorded during laryngoscopy after administration of succinylcholine 0.6 mg kg\(^{-1}\).

<table>
<thead>
<tr>
<th>Intubation conditions</th>
<th>Induction drug</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lido+propofol</td>
</tr>
<tr>
<td>Impossible</td>
<td>0</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>6</td>
</tr>
<tr>
<td>Excellent</td>
<td>29</td>
</tr>
</tbody>
</table>
produced when either thiopental or etomidate was used with rocuronium for rapid sequence induction. Similar findings were reported when either propofol or thiopental was used for induction with rocuronium.\(^{11}\) Although propofol was found to produce better jaw and pharyngeal muscle relaxation than thiopental in one study,\(^{12}\) the authors intentionally did not use any neuromuscular blocking drug during induction. In addition, since their objective was to only assess ease of laryngoscopy, no tracheal intubation was attempted in that study. When propofol was compared with thiopental for tracheal intubation with no muscle relaxant in another study,\(^{13}\) neither drug ensured acceptable conditions. Adding a neuromuscular blocking drug to facilitate tracheal intubation during induction, however, minimizes the role played by induction drug choice on intubation conditions. It also explains our results as well as those of other workers that the apnoea resulting when equipotent doses of propofol, thiopental or etomidate were given was not found to be short-lived\(^{20}\) and is outlasted by the peripheral apnoea produced by the neuromuscular blockade. This might explain the lack of any effect on the duration of the succinylcholine-induced apnoea in our study. The apnoea time reported in our study is similar to earlier findings.\(^{3,21}\) It should be noted that although small doses of succinylcholine are associated with a short apnoea time in most patients, individual variations in the response to succinylcholine do exist, and in some patients in our study the duration of apnoea was as long as 6 min. However, in most patients the duration of apnoea was short, and it seems likely that the period of time for which favourable conditions for intubation was obtained was shorter than would be expected with higher-dose succinylcholine. Thus, the trade-off might be a short duration of apnoea vs a short window for intubation.

We considered both excellent and good intubating conditions to be clinically acceptable. In clinical situations where intense paralysys is desired at the time of intubation, small-dose succinylcholine may not be ideal. The dose must always be individualized according to the clinical situation. However, we must keep in mind that succinylcholine doses as high as 1.5 mg kg\(^{-1}\) i.v. was used to facilitate tracheal intubation.

In conclusion, we found that the choice of induction drug had no effect on intubation conditions or apnoea time when succinylcholine 0.6 mg kg\(^{-1}\) i.v. was used to facilitate tracheal intubation.

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