Effect of Superior Laryngeal Nerve Block on Hemodynamic Changes during Endotracheal Intubation

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Abstract
32 patients undergoing elective orthopedic surgery under general anesthesia were randomly divided into 2 groups. 15 patients received bilateral superior laryngeal nerve block (SLNB) prior to the induction of general anesthesia (Group B), and the other 17 patients did not (Control: Group C). After induction of anesthesia with 2.0 mg/kg of propofol and 0.2 mg/kg of vecuronium, tracheal intubation was performed using a direct laryngoscope. Systolic blood pressure (SBP) and heart rate (HR) were recorded at 6 points (pre-induction, after-induction, immediately after intubation, and 1, 3, and 5 min after intubation).

In Group C, SBP increased just after intubation compared to baseline values, and was significantly higher than in Group B. HR was significantly elevated just after intubation and 1 min after intubation in Group C, but remained stable for the entire period of the study in Group B. No subjects developed complications such as hematoma in the neck, aspiration or toxic reactions to local anesthetics.

The present study demonstrated that SLNB attenuates circulatory responses due to endotracheal intubation using a direct laryngoscope, without minimal complications. This simple and safe method should be acquired by anesthesiologists in addition to traditional methods, to blunt hypertension and tachycardia related to endotracheal intubation.

Key words
superior laryngeal nerve block, endotracheal intubation, cardiovascular response

Introduction
Endotracheal intubation using a direct laryngoscope after induction of general anesthesia often provokes increases in both blood pressure and heart rate. Although these brief responses are inconsequential for most cases, the patients with coronary artery or cerebrovascular diseases such as aneurysm or elevated intracranial pressure are at increased risk of myocardial ischemia, arrhythmias or stroke. To avoid such catastrophic consequences, pharmacotherapies such as narcotic agents, β-blockers, vasodilators, and inhalation anesthetics have been utilized for induction to attenuate these cardiovascular responses. However, such agents exert undesirable effects such as hypotension, bradycardia, extra-pyramidal symptoms or unexpected postoperative respiratory depression. Circulatory deterioration primarily results from mechanical stimulation of the supraglottic region by the blade of the direct laryngoscope. Providing analgesia to this area and thus blocking afferent stimuli may attenuate these responses. The present study examined the effects of superior laryngeal nerve (SLN) block (SLNB) on hemodynamic changes during endotracheal intubation.

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Materials and Methods

The subjects comprised 32 patients with an ASA (American Society for Anesthesiologists) physical status of 1 or 2 who were undergoing elective orthopedic surgery under general anesthesia. The mean age of the subjects was 49 years (range, 20–69 years). Approval was obtained from the Ethics Committee and written informed consent was provided by all subjects prior to enrollment in the study. The patients with a history of cardiac, pulmonary and cerebral disease, coagulation disorder, risk of gastric aspiration, obesity (BMI > 30) or anticipated difficult endotracheal intubation (Malanpati classification 3 or 4) were excluded from the study. The patients were randomly divided into 2 groups: Group B underwent bilateral SLNB; Group C did not. SLNB was performed using 3 ml of 1% mepivacaine injected bilaterally just below the greater horn of the hyoid bone at 20 min prior to induction of anesthesia.

Routine monitoring was applied on arrival in the operating room including electrocardiography, non-invasive blood pressure, pulse-oxymetry and end-tidal CO₂ monitoring. Systolic blood pressure (SBP) and heart rate (HR) were recorded at 1-min intervals throughout the study. Anesthesia was induced using 2.0 mg/kg of propofol and 0.2 mg/kg of vecuronium, and ventilation was performed via a mask with 100% O₂. End-tidal CO₂ concentration was maintained at 30–40 mmHg. Tracheal intubation was initiated using a direct laryngoscope (Macintosh type) at 2 min after induction. Soon after intubation, anesthesia was maintained using 50% N₂O in O₂ and 1% of sevoflurane for the entire procedure. SBP and HR were recorded at 6 points (pre-induction, after-induction, immediately after intubation, and 1, 3, and 5 min after intubation). All procedures were performed by an anesthesiologist (M.T.) with considerable experience at Keiyu Orthopedic Hospital. Data are expressed as means (± standard deviation). Statistical analysis was performed using repeated measures analysis of variance, and values of p < 0.05 were considered statistically significant.

Results

In all cases, induction of anesthesia and mask ventilation were uneventful. Endotracheal intubation was completed within 20 s. No significant differences in demographic characteristics, baseline SBP or HR were noted between groups (Tables 1, 2). After induction, SBP significantly decreased to 80.4% of baseline value in Group C and 85.8% of baseline value in Group B. In Group C, endotracheal intubation was associated with increased SBP just after intubation compared to baseline values, and SBP was significantly higher than in Group B. HR was significantly elevated just after intubation and 1 min after intubation in Group C, but remained stable for the entire period of the study in Group B. No subjects developed complications such as hematoma in the neck, aspiration or toxic reactions to local anesthetics.

Discussion

The SLN arises from the vagus nerve and runs with the internal carotid artery toward the thyroid cartilage. After branching from the vagus nerve, the SLN divides into external and internal branches. The external branch supplies motor function to the cricothyroid muscle, while the internal branch passes through the thyrohyoid membrane to provide sensory innervation to the epiglottis, piriform fossa, base of the tongue, and mucosa of the true vocal cords. SLNB is a percutaneous block that focuses on the internal branch at the level of thyrohyoid membrane (Fig. 1).

This procedure was first described in the early 1900s for a patient with laryngeal tuberculosis to relieve throat pain, and has since been performed in numerous clinical situations. Most reports have described use of the procedure to relieve patient discomfort during tracheal intubation or instrumentation such as endoscopy and transesophageal echocardiography. Hunt and Boyd described the usefulness of SLNB for insertion of a rigid Laser bronchoscope in a patient with myasthenic syndrome without use of a muscle relaxant. Abrao and Khabbaz et al. reported successful removal of an unusual foreign body (table fork) from the esophagus using a laryngoscope and SLNB in an awake patient. Furthermore, SLNB is considered as a useful method for treating or preventing postoperative laryngospasm.

The technique of SLNB is quite simple. The patient is positioned in a supine position with the head slightly extended. A 25-gauge needle is used to inject 2–3 mL of local anesthetic just below the greater horn of the hyoid bone. Occasionally, a
## Table 1. Patient Demographics

<table>
<thead>
<tr>
<th></th>
<th>Group C (n=17)</th>
<th>Group B (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50±11</td>
<td>49±11</td>
</tr>
<tr>
<td>Gender (M:F)</td>
<td>13:4</td>
<td>10:5</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165±10</td>
<td>162±9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65±11</td>
<td>59±10</td>
</tr>
<tr>
<td>ASA PS (1;2)</td>
<td>10;7</td>
<td>10;5</td>
</tr>
</tbody>
</table>

Group C : Control,  Group B : SLNB  
ASA : American Society for Anesthesiologists  PS: physical status  
Values are mean±SD

## Table 2. Changes in Systolic Blood Pressure (SBP) and Heart Rate (HR)

<table>
<thead>
<tr>
<th></th>
<th>Pre-induction</th>
<th>Post-induction</th>
<th>Just after intubation</th>
<th>1 min after intubation</th>
<th>3 min after intubation</th>
<th>5 min after intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP(mmHg)</td>
<td>143±19</td>
<td>115±13**</td>
<td>161±19**</td>
<td>144±22</td>
<td>131±19*</td>
<td>119±13**</td>
</tr>
<tr>
<td>HR(bpm)</td>
<td>73±14</td>
<td>78±9</td>
<td>94±9**</td>
<td>87±10**</td>
<td>82±13</td>
<td>74±12</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP(mmHg)</td>
<td>148±19</td>
<td>127±19**</td>
<td>140±14#</td>
<td>125±16**</td>
<td>119±16**</td>
<td>113±16**</td>
</tr>
<tr>
<td>HR(bpm)</td>
<td>74±15</td>
<td>81±14</td>
<td>85±13#</td>
<td>81±13</td>
<td>79±12</td>
<td>75±12</td>
</tr>
</tbody>
</table>

Group C : Control,  Group B : SLNB  
Values are mean ± SD  
*:Significantly different from the pre-induction value; p<0.05  
**:Significantly different from the pre-induction value; p<0.01  
#:Significantly different from the group C value; p<0.05

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**Fig. 1.** Anatomical view of the larynx indicating the relation of superior laryngeal nerve to the hyoid bone and thyroid cartilage.
slight sensation might be felt by the operator when the needle reaches the thyrohyoid ligament.

SLNB is considered a relatively safe invasive procedure. Literature review of more than 300 SLNBs identified only 1 case of a minor complication (small hematoma in the neck, which was controlled by manual compression). Moreover, this procedure has been performed with high reliability. Clinical studies on the effectiveness of this block has described success rates of 92–97.5%. Furlan performed an anatomical examination on fresh cadavers to clarify relationships between the SLN and other structures in the neck. The SLN was found within 9.3 mm of the greater horn of the hyoid in the vast majority of cases (98%), and the high success rate of SLNB might be attributable to this low level of anatomical variation.

Hemodynamic stress responses after endotracheal intubation are primarily related to laryngoscopic stimulation of the pharyngeal structures. To attenuate this hemodynamic response, application of topical anesthetic to the upper airway by spray or nebulizer has been described by many authors. However, the effectiveness of this method remains controversial, given the technical difficulty in applying anesthetic to this area before laryngoscope insertion. Moreover, the high concentration of local anesthetic (≤10%) that must be delivered to the orolaryngeal mucosa has raised concerns about the increased risk of local anesthetic toxicity. Sucena and Cachapuz et al. investigated plasma concentrations of lidocaine during bronchoscopy using 10% spray solutions in 30 patients. After the administration of lidocaine (mean total dose: 746 mg), plasma lidocaine levels exceeded the toxic level of 5 μg/ml in 6 patients. Smith and Wolfran reported a 5-month-old infant who developed seizures following administration of oral viscous lidocaine. Since the total amount of anesthetic injected in the present study was far below the toxic level for carbocaine, this procedure seems unlikely to result in local anesthetic toxicity unless accidental direct injection into an artery occurs.

Contraindications for SLNB include infection and tumor at the block site or coagulation disorder, as with conventional blocks. In addition, full stomach and risk of gastroesophageal regurgitation also represent contraindications due to the risk of aspiration through the anesthetized larynx. The patients in the present study were selected from among elective cases who had received nil by mouth for 12 h, and narcotics or tranquilizers that may impair pharyngeal function were not used as premedications. Close observation throughout the perioperative period revealed no patient who experienced aspiration after SLNB.

In conclusion, the present study demonstrated that SLNB attenuates circulatory responses due to endotracheal intubation using a direct laryngoscope, without minimal complications. This simple and safe method should be acquired by anesthesiologists in addition to traditional methods, to blunt hypertension and tachycardia related to endotracheal intubation.

References
10) Hunt LA and Boyd GL. Superior laryngeal


上喉頭神経ブロックが気管挿管時の循環動態に及ぼす効果

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抄 録

上喉頭神経ブロック (superior laryngeal nerve block: SLNB) は下咽頭全体の知覚を遮断することから、意識下での気管挿管や内視鏡挿入時の反射、不快感軽減に用いられている。本研究では SLNB が気管挿管時の循環動態に及ぼす効果を調べた。全身麻醉で手術を受ける 32 例について 15 例を B 群 (SLNB 施行)、17 例を C 群 (対照) とした。SLNB は麻醉導入前に 1％メピバカイン 3 ml で左右に施行した。気管挿管はベクロニウム 0.2 mg/kg、プロポフォール 2 mg/kg 投与後、血圧、心拍数を導入前から挿管 5 分後まで測定した。

結果: 両群ともに導入前に比較して導入後、血圧は低下した。C 群では挿管直後に血圧は上昇したが B 群では認めなかった。心拍数は C 群では挿管直後、1 分後に増加したが、B 群では変化しなかった。全症例で SLNB による合併症 (血腫、誤嚥、局所麻醉薬中毒) は見られなかった。

気管挿管に伴う高血圧、頚脈を抑制するため血管拡張薬、β遮断薬や麻薬など様々な薬物的手法も試みられているが、予期しない低血圧、徐脈や頸延する呼吸抑制などの問題もある。挿管による循環変動は主に喉頭鏡による舌根部への物理的刺激が原因とされるが、本研究では SLNB による同部位の知覚遮断によって挿管時の循環変動が抑制された。本法は簡便で合併症も殆どないことから挿管による高血圧・頚脈を抑制する方法として有用と考えられた。

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