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Hemodynamic and catecholamine responses during tracheal intubation using a lightwand device (Trachlight) in elderly patients with hypertension

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Abstract
Purpose. Tracheal intubation using a lightwand device (Trachlight) should minimize hemodynamic change by avoiding direct-vision laryngoscopy. We evaluated hemodynamic and catecholamine responses during tracheal intubation using a Trachlight in elderly patients with hypertension.
Methods. Twenty-six hypertensive patients aged over 65 years undergoing orthopedic surgery were randomly divided into two groups, group L (n = 13) and group T (n = 13). Anesthesia was induced with fentanyl ($2 \mu g \cdot kg^{-1}$) and propofol ($1.5 mg \cdot kg^{-1}$), and then muscle relaxation was obtained with vecuronium ($0.15 mg \cdot kg^{-1}$). The trachea was intubated with either a Macintosh laryngoscope (group L) or a Trachlight (group T). Hemodynamics, plasma catecholamine concentrations, and arterial blood gases were measured before the induction of anesthesia (T0), before tracheal intubation (T1), immediately after tracheal intubation (T2), and 3 min after tracheal intubation (T3).
Results. The intubation time was shorter in group T than in group L (12.6 ± 1.7 vs 23.5 ± 2.9 s, mean ± SE; $P < 0.01$). Compared with the preinduction (T0) value, systolic blood pressure (SBP) showed a significant decrease at T1 and T3 in group L and at T1, T2, and T3 in group T. The heart rate (HR) and plasma norepinephrine (NE) concentration showed no change in either group throughout the time course, whereas the plasma epinephrine (E) concentration showed a significant decrease at T2 and T3 in both groups. The mean values of the rate-pressure product (RPP: HR × SBP) were less than 15 000 after tracheal intubation in both groups. There was no significant difference in hemodynamic or catecholamine responses between groups at any point. No patient had ischemic ST-T changes in either group.
Conclusion. A lightwand has no advantage over a laryngoscope in terms of hemodynamic and plasma catecholamine responses to tracheal intubation in elderly patients with hypertension, despite a shorter intubation time.

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Introduction

Tracheal intubation with a laryngoscope increases arterial blood pressure (ABP) and heart rate (HR), which might increase the risk of myocardial infarction or stroke in elderly patients with hypertension. These hemodynamic changes are caused by increased activity of the sympathetic nervous system [1–3].

Attenuation of hemodynamic changes following tracheal intubation with a lightwand device may be attributed to the lack of stimulation by a laryngoscope [4–6]. However, there is a controversy as to whether the lightwand technique significantly attenuates hemodynamic changes after tracheal intubation in comparison with the laryngoscopic technique in normotensive and hypertensive patients [6,7]. Similarly, a lightwand technique may be useful for tracheal intubation in hypertensive elderly patients in terms of the rate-pressure product (RPP) [8].

We compared the hemodynamic and plasma catecholamine responses with the use of a lightwand device (Trachlight, Laerdal Medical, Fukuoka, Japan) and a laryngoscope in elderly patients with hypertension.

Materials and methods

The protocol of the study was approved by the Institutional Ethics Committee. Informed consent was obtained from each patient. Twenty-six hypertensive patients, aged over 65 years, undergoing orthopedic surgery were divided into two groups by a sealed envelope technique, group L (n = 13) and group T (n = 13), to receive tracheal intubation using either a Macintosh laryngoscope (group L) or a Trachlight (group T). Patients with cardiopulmonary disease, cerebrovascular disease, a history of previous difficult intubation, cervical spine fracture, tumors or polyps in the upper airway, or medication with β-adrenergic blockers were excluded from the study. Hypertension was defined as a systolic blood pressure (SBP) of more than 160 mmHg or a diastolic blood pressure (DBP) of more than 95 mmHg on admission. All patients were treated by physicians with oral antihypertensive drugs, including calcium-channel blockers and angiotensin-converting enzyme inhibitors (ACEIs).

The patients received their antihypertensive drugs 6 h before the induction of anesthesia and were premedicated with atropine 0.5 mg and hydroxyzine 25 mg intramuscularly 30 min before the induction of anesthesia. After arrival at the operating room, an intravenous catheter was inserted for the administration of intravenous fluids and injection. Patients were continuously monitored with pulse oximetry and a three-lead electrocardiogram. A radial arterial catheter was inserted for continuous monitoring of ABP and to obtain blood samples. ABP, HR, ischemic ST-T change, and arrhythmias were automatically recorded (BSM-8500, Life Scope 12, Nihon Kohden, Tokyo, Japan). Each patient was preoxygenized by inhalation of 100% oxygen at a flow rate of $5\,l \cdot min^{-1}$ for 5 min. Anesthesia was induced with intravenous fentanyl $2\,\mu g \cdot kg^{-1}$, lidocaine 20 mg, and propofol $1.5\,mg \cdot kg^{-1}$, injected over 20 s in sequence. Vecuronium $0.15\,mg \cdot kg^{-1}$ was given after loss of consciousness, and then the lungs were manually ventilated via a mask with 100% oxygen.

Tracheal intubation was performed 5 min after the induction of anesthesia, and manual ventilation with 100% oxygen was continued until the end of the study. End-tidal carbon dioxide tension was maintained at 35 to 40 mmHg (Capnomac, Datex, Helsinki, Finland).

In group L patients, the spiral wire-reinforced tracheal tube was inserted orally with the Macintosh laryngoscope. In group T, the lightwand was introduced into the spiral tracheal tube, and the proximal end of the tube was bent to a 90° angle. The room lights were dimmed while the tracheal tube was introduced into the oral cavity and advanced until midline illumination was observed in the anterior neck. Jaw lift was applied. Then the stylet was withdrawn and the tracheal tube was advanced until the glow disappeared behind the sternum. After removal of the lightwand, the position of the tracheal tube was confirmed by auscultation and capnography.

The intubation time was defined as the time from the introduction of the device into the oral cavity until its removal. SBP and HR were measured and arterial blood gases were analyzed (ABL-4, Radiometer, Copenhagen, Denmark) before the induction of anesthesia (T0), before tracheal intubation (T1), immediately after tracheal intubation (T2), and 3 min after tracheal intubation (T3). RPP (HR × RPP) was calculated as an index of myocardial oxygen consumption at T0, T1, T2, and T3. Serum catecholamine [epinephrine (E) and norepinephrine (NE)] concentrations were measured at T0, T2, and T3 as follows. A 3-ml blood sample was withdrawn into a precooled plastic tube containing 30 μl of 0.2 M ethylenediaminetetraacetic acid-2Na and 0.2 M $Na_2S_2O_4$ and was centrifuged at 4000 rpm for 10 min at 4°C to separate the plasma. To the 1 ml of plasma, 33 μl of 60% perchloric acid was added, and the mixture was centrifuged at 10 000 *g* for 30 min at 4°C. The amount of dopamine in 500 μl of the deproteinized plasma was determined in a fully automated high-performance liquid chromatography-fluorometric system (model HLC-8030 Catecholamine Analyzer, Tosoh, Tokyo, Japan) using a diphenylethylene diamine condensation method [9]. The interassay and intraassay variations were less than 3%. Tracheal intubation on each patient was performed by the same experienced anesthesiologist.

The data are expressed as means ± SEM. Student's *t*-test for unpaired data was used for statistical analysis of the differences between the two groups. Differences among repeated measures were analyzed by analysis of variance and Scheffé's *F* test. $P < 0.05$ was considered to indicate statistical significance.

Results

The two groups were similar in demographic characteristics. The intubation time was shorter in group T than in group L ($P < 0.01$, Table 1). There was no hypoxemia or hypercapnia in either group throughout the study (Table 2).

SBP showed a significant decrease at T1 and T3 in group L, whereas it showed a significant decrease at T1, T2, and T3 in group T. HR showed no change in either group throughout the time course. RPP showed a significant decrease at T1 and T3 in group L, whereas it showed a significant decrease at T1 in group T (Fig. 1). Plasma E concentration showed a significant decrease at T2 and T3 in both groups, whereas plasma NE concentration showed no change in either group throughout the time

Table 1. Patient characteristics

Characteristic	Group L	Group T
Sex (M/F)	5/8	5/8
Age (yr)	72.4 ± 1.2	72.6 ± 1.0
Weight (kg)	58.5 ± 2.9	54.1 ± 2.5
Intubation time (s)	23.5 ± 2.9	12.6 ± 1.7*

Values are expressed as means ± SE
* $P < 0.01$ vs group L

Table 2. Changes in arterial blood gas

Measurement	Group	T0	T1	T2	T3
Pa_{CO_2} (mmHg)	L	37 ± 2	37 ± 2	39 ± 1	38 ± 1
	T	39 ± 1	39 ± 1	39 ± 1	39 ± 1
Pa_{O_2} (mmHg)	L	313 ± 20	432 ± 17*	467 ± 13*	481 ± 17*
	T	297 ± 15	438 ± 19*	474 ± 17*	486 ± 15*

Values are expressed as means ± SE
$*P < 0.01$ vs T0

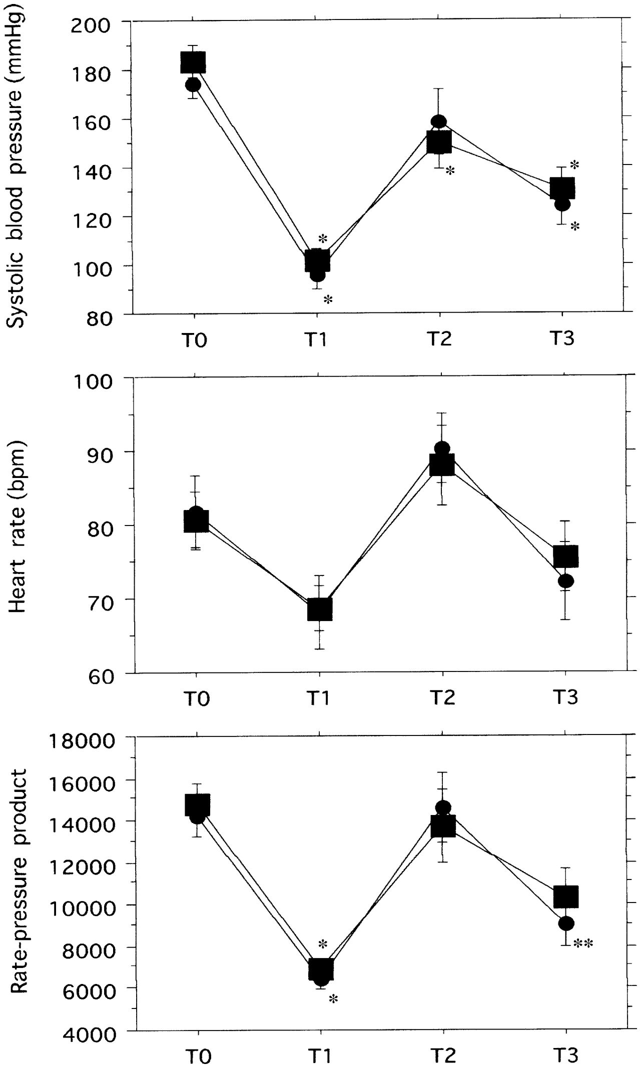

Fig. 1. Changes in systolic arterial pressure, heart rate and rate-pressure product in group L (*circles*) and group T (*squares*). *T0*, before induction of anesthesia; *T1*, before tracheal intubation; *T2*, immediately after tracheal intubation; *T3*, 3 min after tracheal intubation. $*P < 0.01$ compared with T0; $**P < 0.05$ compared with T0

course (Fig. 2). There was no significant difference between the groups in SBP, HR, RPP, or plasma NE or E concentration at any point. The mean values of RPP were less than 15 000 at T2 and T3 in both groups.

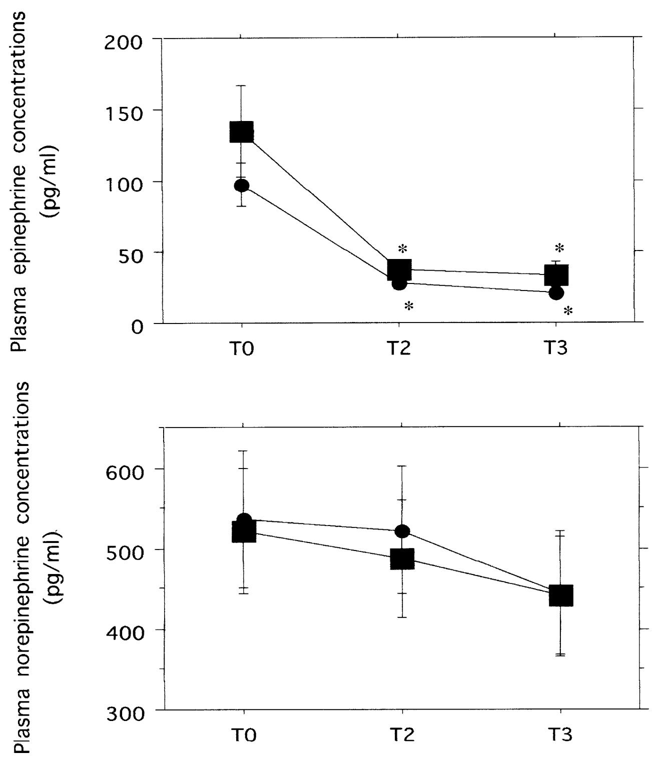

Fig. 2. Changes in plasma catecholamine concentrations in group L (*circles*) and group T (*squares*). *T0*, before induction of anesthesia; *T2*, immediately after tracheal intubation; *T3*, 3 min after tracheal intubation; $*P < 0.01$ compared with T0

No patient had ischemic ST-T changes or arrhythmias throughout the study or complained of hoarseness postoperatively.

Discussion

No difference in hemodynamic or catecholamine response was found between a lightwand and a laryngoscopic technique in elderly patients with hypertension, although the intubation time with the lightwand technique was significantly shorter than that with the laryngoscopic technique.

We adopted the induction doses and injection velocity of propofol from a previous study [10] showing that propofol at doses of 1.5–1.75 $mg \cdot kg^{-1}$ was adequate to induce anesthesia, and that side effects, e.g., hypotension and apnea, were more marked with rapid injection and with doses in excess of $1.75\,mg \cdot kg^{-1}$ in patients older than 60 years. Previous studies [11–13] showed that fentanyl could attenuate the hemodynamic responses associated with tracheal intubation. In the present study, the patients received fentanyl $2\,\mu g \cdot kg^{-1}$ in addition to suitable propofol.

It has been reported that patients with essential hypertension have increased activity of the sympathetic nervous system [1–3] and show an exaggerated hemodynamic response to the induction of anesthesia compared with normotensive patients [14]. Low et al. [14] reported that there was a marked increase in NE concentration after laryngoscopy in hypertensive patients. However, Nakamura et al. [15] and Matsumoto et al. [16] demonstrated that rapid sequence induction of anesthesia with propofol or fentanyl suppressed the sympathoadrenal response to tracheal intubation in hypertensive patients. In the present study, laryngoscopic technique under induction of anesthesia with propofol and fentanyl did not produce exaggerated hemodynamic or catecholamine responses.

Nishikawa et al. [6] reported that hemodynamic changes during the induction of anesthesia with propofol and fentanyl in hypertensive patients following tracheal intubation were similar with the use of the lightwand technique without a jaw-lift technique and with the use of the laryngoscopic technique, and suggested that perilaryngeal stimulation by the tip of the lightwand or a longer duration of tracheal intubation than with the laryngoscopic technique may be sufficient to produce a hyperdynamic response in hypertensive patients. Takahashi et al. [17] studied the differences in hemodynamic responses between lightwand intubation using a jaw-lift technique and laryngoscopic intubation and laryngoscopy alone and showed that direct stimulation of the trachea appeared to be a major cause of the hemodynamic changes associated with tracheal intubation.

In the present study, we used a jaw-lift technique for tracheal intubation with a lightwand device and a spiral wire-reinforced tracheal tube because the technique has been recommended for easier and faster tracheal intubation, and the tube has a blunt and tender tip, resulting in attenuation of perilaryngeal stimulation. In consequence, we succeeded in intubating the trachea using a lightwand on the first attempt in a short time and did not observe perilaryngeal tissue injury or hoarseness after surgery. However, there was no difference between the two techniques in hemodynamic or catecholamine responses. It seems probable that the major cause of hemodynamic or catecholamine responses during tracheal intubation is direct stimulation of the trachea by the tracheal tube [17].

Maintenance of therapy with ACEIs in hypertensive patients until the day of surgery may increase the probability of hypotension at the induction of anesthesia [18]. The mechanism may involve interactions between ACEIs and anesthesia in hypertensive patients undergoing vascular surgery. In the present study, the hypertensive patients had no peripheral vascular disease, and marked hypotension ($SBP < 90\,mmHg$) was not observed during the induction of anesthesia. Although all patients received atropine for premedication, the effect of intramuscular injection on hemodynamic responses would have been less than that of intravenous injection. We administered lidocaine 20mg before propofol injection to minimize the pain caused by propofol. Although lidocaine has been reported to limit airway reactivity, as measured by the cough reflex, the minimum dose required for this effect is $1.5\,mg \cdot kg^{-1}$ [19]. Thus, lidocaine could not have had a significant influence on the present results.

We conclude that hemodynamic and catecholamine responses to tracheal intubation with a lightwand device are similar to those to intubation with a laryngoscope in elderly patients with hypertension.

References

1. Manger WM, Frohlich ED, Gifford RW, Dustan HP (1976) Norepinephrine infusion in normal subjects and patients with essential or renal hypertension: effect on blood pressure, heart rate, and plasma catecholamine concentrations. J Clin Pharmacol 16:129–141
2. Chobanian AV, Gavras H, Gavras I, Bresnahan M, Sullivan P, Melby JC (1978) Studies on the activity of the sympathetic nervous system in essential hypertension. J Hum Stress 4:22–28
3. Schütz W, Hörtnagl H, Magometschnigg D (1986) Function of the autonomic nervous system in young, untreated hypertensive patients. Int J Cardiol 10:133–140
4. Hung OR, Stewart RD (1995) Lightwand intubation: I. A new lightwand device. Can J Anaesth 42:820–825
5. Hung OR, Pytka S, Morris I, Murphy M, Stewart RD (1995) Lightwand intubation: II. Clinical trial of a new lightwand for tracheal intubation in patients with difficult airways. Can J Anaesth 42:826–830
6. Nishikawa K, Omote K, Kawana S, Namiki A (2000) A comparison of hemodynamic changes after endotracheal intubation by using the lightwand device and the laryngoscope in normotensive and hypertensive patients. Anesth Analg 90:1203–1207
7. Hirabayashi Y, Hiruta M, Kawakami T, Inoue S, Fukuda H, Saitoh K, Shimizu R (1998) Effects of lightwand (Trachlight) compared with direct laryngoscopy on circulatory responses to tracheal intubation. Br J Anaesth 81:253–255
8. Nishikawa K, Kawamata M, Namiki A (2001) Lightwand intubation is associated with less hemodynamic changes than fibreoptic intubation in normotensive, but not in hypertensive patients over the age of 60. Can J Anesth 48:1148–1154
9. Yamatodani A, Wada H (1981) Automated analysis for plasma epinephrine and norepinephrine by liquid chromatography, including a sample cleanup procedure. Clin Chem 27:1983–1987
10. Dundee JW, Robinson FP, McCollum JSC, Patterson CC (1986) Sensitivity to propofol in the elderly. Anaesthesia 41:482–485

11. Dahlgren N, Messeter K (1981) Treatment of stress response to laryngoscopy and intubation with fentanyl. Anaesthesia 36:1022–1026
12. Martin DE, Rosenberg H, Aukburg SJ, Bartkowski RR, Edwards MW Jr, Greenhow DE, Klineberg PL (1982) Low-dose fentanyl blunts circulatory responses to tracheal intubation. Anesth Analg 61:680–684
13. Ko SH, Kim DC, Han YJ, Song HS (1998) Small-dose fentanyl: optimal time of injection for blunting the circulatory responses to tracheal intubation. Anesth Analg 86:658–661
14. Low JM, Harvey JT, Roberts CP, Dagnino J (1986) Studies of anaesthesia in relation to hypertension. VII: Adrenergic responses to laryngoscopy. Br J Anaesth 58:471–477
15. Nakamura T, Fukusaki M, Sakamoto A, Miyako M, Niiya S, Sumikawa K (2002) Hemodynamic and catecholamine responses during rapid sequence induction with propofol in hypertensive patients. Circ Cont 23:420–424
16. Matsumoto M, Fukusaki M, Iwanaga S, Tomiyasu S, Morooka H, Sumikawa K (1997) Effects of fentanyl on cardiovascular response during rapid sequence induction in hypertensive patients. J Anesth 11:10–13
17. Takahashi S, Mizutani T, Miyabe M, Toyooka H (2002) Hemodynamic responses to tracheal intubation with laryngoscope versus lightwand intubating device (Trachlight) in adults with normal airway. Anesth Analg 95:480–484
18. Coriat P, Richer C, Douraki T, Gomez C, Hendricks K, Giudicelli JF, Viars P (1994) Influence of chronic angiotensin-converting enzyme inhibition on anesthetic induction. Anesthesiology 81:299–307
19. Yukioka H, Hayashi M, Terai T, Fujimori M (1993) Intravenous lidocaine as a suppressant of coughing during tracheal intubation in elderly patients. Anesth Analg 77:309–312