A comparison of sevoflurane induction versus propofol induction for laryngeal mask airway insertion in elderly patients

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ABSTRACT

الأهداف: عمل مقارنة بين طريقة تحفيز التخدير بالبروبوفول وطريقة تحفيزه بما يعادل 5% أو 8% من السيفوفلوران، وآثار هاتين الطريقتين على سهولة إدخال القناع الحنجري الهوائي وديناميكية الدم لدى المرضى المسنين.

الطريقة: أُجريت هذه الدراسة في مستشفى نيومون للدراسات والأبحاث، أنقرة، تركيا وذلك خلال الفترة من أكتوبر 2008م إلى مايو 2009م، وشملت الدراسة 90 ذكراً مسناً لم يتعاطوا أياً من الأدوية المُمهدة للتخدير (ASA physical status I-III) وتتجاوز أعمارهم 65 عاماً، وكان المشاركين سيخضعون لعملية جراحية عصبية تحت التخدير العام. لقد تم إعطاء المرضى 5 ميكروجرام/كجرام من الفينتانيل قبل تحفيز التخدير، ومن ثم تم تقسيمهم إلى 3 مجموعات وهي كالتالي: مجموعة (P) وتم تحفيز التخدير فيها بواسطة حقنها بما يعادل 1.5 ملجرام/كجرام من البروبوفول عبر الوريد (العدد=29)، المجموعة (8) وتم إعطاؤها 8% من السيفوفلوران (العدد=28)، والمجموعة (5) وأعطيت 5% من السيفوفلوران (العدد=28)، ولقد تم خلط السيفوفلوران بما يعادل 60% من أكسيد النيتروز و 40% من الأوكسجين وذلك بواسطة طريقة الحجم المدي للتنفس (tidal-volume-breath).

النتائج: أشارت الدراسة إلى أن نتائج مدة تحفيز التخدير كانت كالتالي: مجموعة P = 54.76 ± 12.29 ثانية، المجموعة (8)= 69.63±18.76 ثانية، المجموعة (5)= 92.14±27.68 ثانية ($p<0.01$). لقد كانت مدة انقطاع التنفس في المجموعة P (6.55±4.07 دقيقة) أطول من مدة انقطاع التنفس في المجموعة (8) (1.73±2.49 دقيقة) والمجموعة (5) (1.12±1.12 دقيقة) ($p<0.01$). وكان معدل انخفاض الضغط الشرياني قبل حقن الفينتانيل وبعد تحفيز التخدير مختلفاً كثيراً بين المجموعات الثلاثة.

خاتمة: قد يستفيد المسنين الذين سيخضعون للتخدير العام من حقن ما يعادل 5 ميكروجرام/كجرام من الفينتانيل ومن ثم أخذ 5% من السيفوفلوران لتحفيز التخدير بواسطة طريقة الحجم المدي وذلك لتأثيره الطفيف على ديناميكية الدم، وبهذا يمكن اعتماد هذه الطريقة بدلاً من تحفيز التخدير بواسطة البروبوفول.

Objectives: To compare 8% or 5% sevoflurane and propofol induction according to the ease of laryngeal mask airway (LMA) placement and hemodynamic effects in elderly patients.

Methods: Ninety unpremedicated American Society of Anesthesiologists (ASA) I-III male patients >65 years, undergoing day case urological surgical intervention under general anesthesia at the Numune Education and Research Hospital, Ankara, Turkey between October 2008 to May 2009 were studied. The patients were group into 3 and were administered intravenous (intravenous) 5 µg/kg alfentanil before induction. Patients in group propofol (P) (n=29), anesthesia was induced 1.5 mg/kg propofol intravenous; in Group 8 (n=28) and Group 5 (n=28) anesthesia was induced with 8% and 5% sevoflurane in 60% nitrous oxide, and 40% oxygen with tidal-volume-breath (TVB).

Results: Induction times were as follows: in Group P = 54.76 ± 12.29 sec; Group 8 = 69.93 ± 18.76 sec, and in Group 5 = 92.14 ± 27.68 sec ($p<0.01$). Apnea duration was longer in Group P (6.55 ± 4.07 min.) than in group 8 (1.73 ± 2.49 min), and group 5 (1.12 ± 1.12 min) ($p<0.01$). The decrease in mean arterial pressure (MAP) before alfentanil (control) and after induction was significantly different between the groups.

Conclusion: In elderly patients who will be administered day case anesthesia, in the placement of LMA, 5 µg/kg alfentanil followed by 5% sevoflurane induction by TVB method with minimal hemodynamic changes could be an alternative to propofol induction.

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Propofol is an induction agent widely used to facilitate insertion of a laryngeal mask airway (LMA) as it has a short duration of action and a rapid recovery. In addition, the pharyngeal and laryngeal reflexes have been suppressed.[1-3] Propofol directly suppresses peripheral vascular resistance and decreases myocardial contractility and sympathetic tone for that blood pressure and heart rate (HR) decreases.[3] Sevoflurane is a nonpungent inhaled anesthetic with a low blood gas partition coefficient and minimal respiratory irritant characteristics that make it suitable for inhaled induction of anesthesia and insertion of the LMA.[4,5] Furthermore, sevoflurane allows rapid smooth inhalational induction with excellent recovery characteristics and good cardiovascular stability in ambulatory anesthesia.[5,6] As sevoflurane is used more commonly and is considered a safe inhalation agent, it has started to be used as induction agent in an increasing number of patients, and it was demonstrated to be used successfully in the induction of anesthesia in elderly patients.[6-9] In the comparison of the induction of anesthesia with sevoflurane and propofol, it was demonstrated that sevoflurane maintains mean arterial pressure (MAP) better,[6] and decreases the mechanical performance of the left ventricular at a lesser degree.[7] An increased life expectancy and a reduction in mortality chronic diseases continues to enlarge the fraction of the surgical population considered elderly. More extensive and an increased number of surgeries are performed in these patients owing to progress in anesthetic and surgical techniques, and studies on this issue increasingly gain importance. Anesthetic agents exert increasing depression on cardiovascular and respiratory function in the elderly.[6,8] Patient's age is one of the risk factor for perioperative myocardial ischemia. Anesthetic techniques used in these patients should avoid episodes of excessive hypotension after induction of anesthesia, or the combination of hypertension and tachycardia.[6,9] The aim of this prospective, randomized, double-blind study was to compare the conditions for insertion of LMA and hemodynamic changes in unpremedicated patients using 8% or 5% sevoflurane or propofol.

Methods. After obtaining approval from the Ankara Numune Educational and Research Hospital's Ethics Committee and informed patient consents, 90 patients (ASA physical status I-III, aged ≥65 years) undergoing minor urological surgery between October 2008 to May 2009 were studied. Patients with a difficult airway (Modified Mallampatti Test scores III or IV), history of gastroesophageal reflux, allergy, sensitivity to volatile anesthetics or to propofol, those with a body mass index more than 1.5 times normal patients, heavy smokers (≥20 cigarettes per day), asthma with an attack and severe respiratory disease with pulse oxygen saturation (SpO_2) of less than 94% (while breathing room air), as well as patients taking any sedative or beta blockers medication, who has coronary heart disease were excluded from the study. The criteria for withdrawn from the study were determined as an unexpected fall in SpO_2 values during the course of the study and the failure to insert LMA even after third attempt. After drawing allocation group codes from a sealed envelope, patients were randomly allocated into 3 groups: Group P (GP) (propofol [n=30]), Group 5 (G5) (5% sevoflurane [n=30]), and Group 8 (G8) (8% sevoflurane [n=30]). The patients did not receive any premedication. On arrival in the operating room, an intravenous cannula was inserted, standard non-invasive monitoring was established, and baseline values were recorded (Dräger Julian Plus Vitara 8060, ARRL- 0127, Germany).

Techniques of induction. For GP: after pre-oxygenation with 100% oxygen at 6 L/minute for 3 minutes and 5 μg/kg alfentanil, all patients received propofol 1.5 mg/kg intravenous over 30-45 seconds to achieve induction of anesthesia. Propofol 200 mg in 20 ml was mixed with 1 ml of 2% lignocaine to reduce pain on injection.

For G5 and G8: After 3 minutes pre-oxygenation and administration of 5 μg/kg alfentanil, the circuit was primed with sevoflurane 5% or 8% in 60% N_2O and 40% O_2 at 6 L/minute for 60 seconds. Each patient was asked to breathe normally and the face mask, connected to the primed circuit, was placed over the mouth and nose (tidal volume breath [TVB]).

In all 3 groups, the anesthesia induction has been started 2 minutes after alfentanil administration. A sufficient anesthesia level was confirmed by loss of consciousness (LOC); no response to the verbal "open your eyes" command, and loss of eyelash reflex.[10,11] From the time to successful insertion of LMA and the number of attempts were noted. After LOC in all groups, patients were ventilated via face mask for one minute and then LMA was inserted. If the first attempt was unsuccessful, patients in GP would receive 0.5 $mg.kg^{-1}$ intravenous propofol and patients in the sevoflurane groups were allowed to continue spontaneous, assisted ventilation on sevoflurane 8% or 5% in 60% N_2O and 40% O_2 an additional one minute. Patients were withdrawn from the study if they needed third attempts. In sevoflurane groups (G5 and G8), if LMA could not be inserted successfully at the first attempt, ventilation was assisted with mask, and sevofluran 5% or 8% was continued for one minute. If a second attempt failed as well, 0.5 $mg.kg^{-1}$ propofol was administered. In case of failure at the third attempt, the patient was excluded from the study. The independent investigator noted the presence of complications related to anesthetic induction and LMA insertion, which included involuntary movements, coughing, gagging

and laryngospasm.[12] Apnea time (defined as absence of spontaneous respiration after induction up to start of spontaneous respiration) and from the time to successful insertion of LMA were recorded. A size 4-5 LMA (LMA Co. Limited, UK) was prepared with the cuff fully deflated and well lubricated. In all groups, the LMA's were inserted by the same anesthetist who was blinded to the induction drugs used. Sivalingam score has been used for evaluation of patient movements and ease of LMA insertion.[12] The HR and MAP were noted at the following stages: baseline (t_0), after alfentanil (t_1), one minute after induction (t_2), every minute until insertion of LMA, immediately after insertion of LMA 1 minute (LMA+1), 2 minutes (LMA+2), and 5 minutes (LMA+5). After loss of consciousness and if the MAP decreases more than 20% from t_0, ephedrine 10 mg intravenous was used. Bradycardia, defined as heart rate less than 50 beats per minute, was treated with intravenous atropine 0.5 mg. Following successful LMA insertion, anesthesia was maintained with 1-2% sevoflurane and 50% N_2O/O_2. Patients who were apneic were ventilated to maintain a pulse oximetry reading of >95% and the end-tidal carbon dioxide level of 35-40 mm Hg. Five minutes before the end of the surgery, inhalation anesthesia was turned off and LMA removed under deep anesthesia with 8 L/min 100% O_2. Before discharged from the unit, patients were asked their induction experience. Also, a follow-up regarding postoperative nausea and vomiting (PONV) during postoperative 24 hours was conducted.

Statistical analysis was performed using the SPSS for Windows Version 13.0. The mean and standard deviation (SD) in percentages were given as summary statistics for the variables. In the statistical evaluation of demographic data, hemodynamic parameters, induction times, and apnea duration, LMA insertion times were analyzed using Analysis of Variance; for multiple comparisons Least Square Difference (LSD, post hoc test) test, and Kruskal Wallis were used. For the evaluation of the categorical variable of the ease of insertion of LMA, chi square analysis and to support these results non-parametric (Kruskal Wallis) was employed. The sample size of the study was determined on the basis of the sample sizes of the previous studies.[12,13] The results of the present study analysis have demonstrated a power of 98% for the 3 groups with n=30 in each group (±[SD]:20.49, Δ(d): 22.21, 2-tailed-α: 0.05).

Results. Ninety patients were included in the study, 5 of them withdrew from the study. One patient in GP and 2 patients in G8 and 2 patients in G5 were withdrawn from the study. The reason for excluding 4 patients from the study because the LMA could not be successfully inserted even after a third trial. And one patient had SpO_2 of <90% after induction and then sevoflurane and N_2O was discontinued, and the patient was ventilated with 100% O_2. In G8, one of 2 patients had SpO_2 of <90% after induction and then sevoflurane and N_2O was discontinued, and the patient was ventilated with 100% O_2. There was no significant difference between the groups with respect to age, weight, modified mallampatti test scores, and ASA grade distribution (**Table 1**).

The induction times were significantly shorter in GP than G5 and G8. Also, this parameter was significantly shorter in G8 than G5 (**Table 2**). The duration of apnea was significantly longer in GP than G5 and G8. There were no significant differences between G5 and G8 (**Table 2**).

Laryngeal mask airway insertion conditions. There were no significant differences in LMA insertion conditions. From the time to insertion of LMA was significantly shorter in GP versus G8 and G5. Also, the insertion time was significantly different between the G8 and G5. The LMA was inserted at the first attempt in 21 patients in GP, 25 patients in G8, and 22 patients in G5 (**Tables 2 & 3**).

Hemodynamic changes. In 3 groups, no significant difference was found in terms of HR at t_0, t_1, t_2, LMA+1, LMA+2, LMA+5 (**Table 4**, p>0.05). When MAP was

Table 1 - Demographic data of patients.

Demographic data	Group P (n=29)	Group 8 (n=28)	Group 5 (n=28)
Age (years, mean±SD)	73.9 ± 5.4	74.9 ±6.6	72.8 ±5.6
Body weight (kg, mean±SD)	75.5 ± 9.4	77.2 ±10.5	76.3±3.8
Height (cm, mean±SD)	170.2 ± 6.1	169.5 ±5.8	169.2 ±6.2
ASA (I/II/III) (number)	0/23/6	1/23/4	2/21/5
MMT (I/II/III) (number)	4/20/5	0/14/14	0/18/10
Time to anesthesia (minute)	34.2 ± 19.2	33.5 ± 16.1	33.6 ± 17.0

MMT - Modified Mallampati Test: I. visualization of soft palate, uvula and tonsillar fauces; II. pillars obscured by base of tongue; III. soft palate and base of uvula visible; IV. soft palate not visible.
ASA - The American Society of Anesthesiologists classification of physical status: I. Healthy patient, II. Mild systemic disease-no functional limitation, III. Severe systemic disease-definite functional limitation.

Table 2 - Additional features of laryngeal mask airway (LMA) insertion.

Duration	GP (n=29)	G8 (n=28)	G5 (n=28)
Induction time (second, mean±SD)	54.76 ± 12.29*,†	69.93 ± 18.76†	92.14 ± 27.68*
Time taken for LMA insertion (seconds, mean±SD)	137.0 ± 5.6*,†	152.7 ± 7.8†	174.1± 4.7*
Apnea duration (minute, mean±SD)	6.55 ± 4.07*,†	1.73 ± 2.49	1.12 ± 1.12

GP - Group propofol, G8 - 8% sevoflurane, Group 5 - 5% sevoflurane. *p<0.05 versus G8, †p<0.05 versus Group 5.

Table 3 - Grading of conditions for laryngeal mask airway (LMA) insertion comparison between groups.

Conditions	Grade	Description	GP (n=29)	G8 (n=28)	G5 (n=28)	*P*-value
Jaw opening	3	Full	27	27	26	>0.05
	2	Partial	2	1	2	
	1	Nil	0	0	0	
Ease of LMA	3	Easy	24	25	25	>0.05
Insertion	2	Difficult	5	3	3	
	1	Impossible	0	0	0	
Coughing	3	Nil	28	29	27	>0.05
	2	+	0	0	1	
	1	++	0	0	1	
Gagging	3	Nil	29	28	27	>0.05
	2	+	0	0	1	
	1	++	0	0	1	
Laryngospasm	3	Nil	29	28	27	>0.05
	2	Partial	0	0	1	
	1	Total	0	0	0	
Patient movements	3	Nil	24	21	18	>0.05
	2	Moderate	3	6	8	
	1	Vigorous	2	1	2	

GP - Group propofol, G8 - Group 8% sevoflurane, G5 - Group 5% sevoflurane.
+ = mild, ++ = moderate

Table 4 - Hemodynamic data between groups.

Hemodynamic data	Mean arterial blood pressure (mm Hg)			Heart rate (bpm)		
	Group propofol (n=29)	G8 (n=28)	G5 (n=28)	GP (n=29)	G8 (n=28)	G5 (n=28)
t_0	109.1 ± 15.2	110.6 ± 18.9	108.2 ± 14.8	73.2 ± 13.7	77.9 ± 17.5	74.3 ± 12.9
t_1	103.7 ± 14.2	106.7 ± 20.4	104.4 ± 16.1	71.4 ± 13.2	75.2 ± 17.3	72.5 ± 13.5
t_2	75.9 ± 19.6*,†	91.8 ± 18.6	91.5 ± 1 9.16	69.0 ± 12.1	71.7 ± 16.1	67.9 ± 11.8
LMA+1	81.3 ± 23.0 *,†	92.6 ±2 0.5	97.0 ± 17.8	68.7 ± 12.2	73.7 ± 17.0	71.3 ± 13.6
LMA+2	82.6 ± 14.1†	90.6 ± 21.4	92.3 ± 18.4	66.4 ± 9.6	71.7 ± 15.1	67.9 ± 12.6
LMA+5	82.0 ± 13.4 †	85.75 ± 15.4	89.9 ± 12.6	65.2 ± 9.3	68.8 ± 15.9	68.3 ± 12.4

GP- Group propofol, G8 - Group 8% sevoflurane, G5 - Group 5% sevoflurane. *p<0.05 versus G8, †p<0.05 versus G5,
t_0 - baseline, t_1 - after alfentanil, t_2 - one minute after induction, LMA+1 - one minute after LMA insertion, LMA+2 - 2 minutes after LMA insertion, LMA+5 - 5 minutes after LMA insertion.

compared; no significant difference was found between the groups at the time of t_0 and t_1 values (p>0.05). Compared to intravenous induction with propofol, inhalation induction with sevoflurane was associated with lower MAP values in the immediate post-induction period. Mean arterial pressure values after induction (t_2), the decrease in GP was significantly higher than the other 2 groups (p<0.05) while no significant difference was found between G8 and G5 (p>0.05). One minute after the placement of LMA, significant difference was found between MAP values (p<0.05) in group GP compared with the other 2 groups. The decrease in MAP, at the time of administration before alfentanil (t_0) and after induction (t_2) was significantly different (GP=30%, G8=16.2%, G5=14.8%) (GP-G8 and GP-G5 = p<0.05, G5-G8 = p>0.5, **Table** 4].

During the induction, one patient in GP, 4 patients in G8 and 2 patients in G5 had HR of less than 45/minute and the patients received atropine 0.5 mg intravenous (p>0.05). The MAP had dropped more than 20% from the baseline values (GP=6, G8=2 and G5=1) and the patients required intravenous 10 mg ephedrine (p>0.05). In GP, 2 patients had nausea and one patient had vomiting. While none of the patients had nausea and vomiting in G8. In G5, 3 patients had slightly nausea and one patient had vomiting (p>0.05). Patients were generally satisfied with their method of induction. The patient satisfaction was not significantly different between the groups.

Discussion. In this study, it was shown that 5 μg.kg^{-1} alfentanil plus 1.5 mg.kg^{-1} propofol, and 5% or 8% sevoflurane induction methods were all effective in LMA insertion in elderly patients. It was established that although induction was more rapid in propofol group, the duration of apnea was longer and the decrease in arterial pressure was greater. It was also established that 2 different concentrations of sevoflurane (8% and 5%) were similarly influenced the hemodynamic and the duration of apnea, but with 5% concentration, a significantly longer duration of induction was required.

In sevoflurane induction, 2 different techniques can be used-namely, TVB and vital-capacity breath (VCB). Elderly patients are usually unable to hold a VCB for a sufficient length owing to their inadequate cardiovascular and respiratory reserve.[16] Patient's acceptance of TVB method is at a higher level. Alveolar sevoflurane concentration increases more gradually and the duration of induction is prolonged, which minimizes the hemodynamics effects of sevoflurane.[14,15] In the study of Yamaguchi et al[16] on cases between the ages of 70-79 years; anesthesia was induced with Propofol 2 mg.kg^{-1} (group profol) and 2% sevoflurane (Group II), and 8% sevoflurane (Group III); and sevoflurane using a gradual reduction technique (8%, 6%, 4% for each minute). It was determined that the duration of time required for loss of consciousness was markedly shorter in propofol with 2% sevoflurane group. Shao et al[13] study on cases >60 years old comparing propofol (16 mL.min^{-1} until anesthesia induction), using VCB method 8% sevoflurane induction, and TVB method 8% sevoflurane induction, established a shortest time to induction in propofol group and longest in TVB group. The duration of apnea was found to be longer in propofol group. Siddik-Sayyid et al[17] compared VCB method 8% sevoflurane induction, 3 mg.kg^{-1} propofol induction, and VCB method 8% sevoflurane with 1.5 mg.kg^{-1} propofol in cases between the ages of 18-65 years. From the time to disappearance of lash reflex was found to be significantly longer in sevoflurane and sevoflurane with propofol group compared to propofol group. The shortest period of time required for successful placement of LMA was in sevoflurane with propofol group. In groups containing sevoflurane postoperative PONV and in the propofol group, the patient movement during LMA insertion was found to be significantly higher. The results of the present study support shorter time to induction in the propofol group while data does not support a higher rate of PONV in patient's groups or a higher rate of patient movement in propofol group. In another study with cases aged ≥60 years using VCB method, 4% sevoflurane induction was compared with 8% sevoflurane induction and there were no significant difference was found between 4% sevoflurane and 8% sevoflurane groups in terms of time to induction and side effects during LMA placement.[18] Unlike the results obtained in this study, we found a significant difference between sevoflurane groups with respect to time of induction. Although rapid induction is something desirable, the quality of induction is also important. Rapid induction of anesthesia is usually associated with hemodynamic alterations, which may create problems in elderly patients. In the study of Yamaguchi et al,[16] no significant changes were found in HR during induction in all groups. In propofol groups with 2% sevoflurane and 8% sevoflurane, we observed a decrease of ≥30 mm Hg from baseline values in MAP. In sevoflurane group with gradual reduction of concentration, MAP decreased by 20 mm Hg. The reason for the decrease of MAP values probably due to the high doses of propofol use in addition to sevoflurane. Shao et al[13] study, established a significant decrease in propofol group (MAP values 3 minutes, 4 minutes, and 5 minutes after induction compared to VCB and TVB groups). The smallest amount of decrease in MAP was found in TVB group. The fact that the smallest amount of maximal decrease was seen in TVB group,

in our study as well, supports the aforementioned study. In studies with elderly[13,16] and young patients,[17] no significant difference was found between sevoflurane and propofol groups in terms of the adverse effects that may occur during LMA insertion. Likewise, we did not find a significant difference between groups with respect to adverse effects and the ease of LMA insertion. In a meta-analysis comparing anesthetic induction between sevoflurane and propofol, it was found that sevoflurane induction was associated with a trend toward more frequent patient dissatisfaction and more frequent PONV.[19] Our results, as regards to patient satisfaction, are similar to those of Yamaguchi et al.[16] In the study of Siddik-Sayyid et al[17] while there was no difference in terms of patients satisfaction, PONV was found at a higher rate in sevoflurane induction. The reason why we found differences between the groups in terms of PONV may be that our study had an older patient population, duration of operation was shorter, and maintenance was made with sevoflurane all of the 3 groups.[20-22]

Limitation of this study were some anesthetist in the operating room could not be blinded due to the smell of sevoflurane, unstable blood pressure of the patients, and the depth of anesthesia was not monitored.

In conclusions, in elderly patients, sevoflurane induction with TVB is a practical and safe method that is tolerated by the patients. In patients that to be administered in a day case anesthesia, sevoflurane induction with TVB method may be a powerful alternative to propofol induction in LMA insertion with its minimal hemodynamic changes. To summarize results, there was no difference among the 3 groups regarding the LMA insertion conditions. However, the time from loss of consciousness and the time to LMA insertion were shorter in the propofol group than the sevoflurane groups, and shorter in sevoflurane 8% group versus sevoflurane 5% group. Advantages in the sevoflurane groups over propofol group were better hemodynamic changes and the shorter duration of apnea.

In conclusion, sevoflurane at 5% concentration can be safely used in elderly patients for insertion of LMA.

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