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# Hemodynamic Responses to Tracheal Intubation in Elderly Patients: Intravenous or Spray of Lidocaine versus Fentanyl

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## ABSTRACT

**Introduction:** Laryngoscopy and tracheal intubation are known to increase sympathetic activity that may be detrimental to patients with preexisting ischaemic or hypertensive heart disease. **Aim:** The aim of this study was to compare of intravenous and oropharyngeal spray of lidocaine and high dose of fentanyl on systolic and diastolic blood pressures and heart rate of patients over 65 years during tracheal intubation. **Material and Methods:** In this clinical trial, 160 patients over 65 yrs who were randomly divided into five groups of 32 patients. For group one lidocaine spray 10%, group two intravenous lidocaine 1.5 mg/kg, group three lidocaine spray along with intravenous lidocaine 0.75 mg/kg, and for group four fentanyl 5μg/kg were administered and group five patients were controls which were given 1 mg of midazolam along with 2 μg/kg fentanyl. Systolic and diastolic blood pressures and heart rate were measured before and after anesthesia and intubation. ANOVA, Scheffe's and Repeated measure tests were used for data comparison and $P<0.05$ was considered significant. **Results:** No significant difference was detected in terms of gender among the understudy groups. The mean (SD) age of patients in all groups were 69 ±3.5 yrs. (65-80 yrs.) and there is no significant difference was detected between the mean age and other basic variables of under study groups ($P<0.328$). Study results showed that the kind of surgery hasn't different between groups. The table showed that no difference between male and female. No significant difference was observed between groups with different sizes of tracheal tube in terms of systolic and diastolic blood pressures and heart rate. No significant difference was detected in terms of systolic and diastolic blood pressures and heart rate among groups prior to the induction of anesthesia. **Conclusion:** All methods were effective for efficient blood pressure control during laryngoscopy and tracheal intubation.

**Keywords: Hemodynamics, intubation, Lidocaine, Fentanyl.**

## 1. INTRODUCTION

Laryngoscopy and tracheal intubation are known to increase sympathetic activity that may be detrimental to patients with preexisting ischaemic or hypertensive heart disease.(1) Aging is a continuous, gradual process during which body loses its compatibility capacity and function of most body organs decreases. There is no optimal anesthetic for the elderly (2-4). Hohnloser and co-workers written that Reid and Brace, as a first authors described hemodynamic response to laryngoscopy and intubation in 1940 (5). Laryngoscopy and tracheal intubation are known to cause sympathy -adrenal stimulation. This manifests as hypertension and tachycardia (6, 7). These transient changes have no deleterious consequences in healthy individual, but in some patients they can provoke left ventricular failure, myocardial ischemia and cerebral hemorrhage. These complications are more likely to occur in the presence of coronary or cerebral disease or preexisting hypertension. The present study was conducted to study the efficacy of intravenous infusions of nitroglycerin and esmolol in attenuating these responses (4, 8, 9).

Laryngoscopy and intubation are mandatory for most patients undergoing operation under general anesthesia, which is invariably associated with certain cardiovascular changes such as tachycardia or bradycardia, rise in blood pressure and a wide variety of cardiac arrhythmias. These effects are deleterious in susceptible individuals culminating in perioperative myocardial ischemia,

acute heart failure and cerebrovascular accidents. Various techniques have been used. Due to the cardiovascular changes in the advanced age and the effect of poor blood circulation/blood stasis on the pharmacokinetics of drugs, there is usually a minimum of 50% risk of cardiac ischemia in patients over 70 years of age (2, 6, 10). The anesthesiologist is required to secure an open airway, and maintain respiration and pulmonary ventilation during surgery. Tracheal intubation is among the safest, commonest methods for maintaining an open airway. Cardiovascular complications such as hypertension are the most important complications which may be tolerated by the healthy subjects but can result in ischemia and cardiac failure in patients with impaired or limited coronary/cardiovascular capacity (3, 4). Considering the characteristics of elderly patients, it is really important to stabilize the hemodynamic status of these patients (2, 8, 11) . Cardiovascular reflexes are initiated during laryngoscopy and tracheal intubation due to the stimulation of pharynx and larynx and function of sympathetic reflex (2, 6, 12, 13) . Several methods have been attempted in order to prevent hemodynamic changes in different patients during intubation but none of which measured up as a perfect method with minimal complications (4, 8, 9). Lidocaine has a great affinity for nerve fibers especially sympathetic fibers. This anesthetic drug is easily accessible and its spray form can be used in a conscious patient in order to anesthetize glottis area for laryngoscopy and intubation (14, 15).

This study aimed to evaluate the effect of intravenous lidocaine and its spray form on preventing cardiovascular and hemodynamic changes in the elderly during Laryngoscopy and intubation and to compare it with fentanyl which is another available anesthetic whose effectiveness in high doses was reported by previous studies (16).

## 2. MATERIALS AND METHODS

This clinical trial was approved by the ethics committee of our university and was conducted after obtaining a written consent from all under study patients. Our under study population comprised all patients over 65 years of age who referred to our hospital for elective organ, general or eye surgeries.

The inclusion criteria were as follows: Patients must be over 65 years of age and candidates for elective surgery, Physical status of ASA I, II or III, non-smoker and requiring intubation through direct Laryngoscopy. The exclusion criteria were as follows: patients who could not be intubated on the first attempt, intubation took longer than 15 seconds, patients with ASA IV and V, patients who had a history of hypertension and were on antihypertensive drugs, obesity (BMI >30) and difficult intubation. Qualified patients who presented to the operating room sequentially were randomly divided into 5 groups.

Based on similar studies and the confidence interval of 95%, number of subjects in each group was calculated to be 25 but in order to increase the precision of the study, we studied 32 cases in each group. A total of 160 qualified patients were evaluated in 5 groups. For group 1, 2 puffs of lidocaine 10% was sprayed on Supraglottis area 3 minutes prior to Laryngoscopy. For the second group lidocaine 1% 1.5 mg/kg was injected intravenously 3 minutes prior to Laryngoscopy. In group 3, 1 puff of lidocaine 10% spray (Eachpuff was 10 mg) and intravenous lidocaine 1%, 0.75 mg/kg, were both used for patients 3 minutes before Laryngoscopy. For group 4, high dose fentanyl (5 μg/kg) was administered 3 minutes prior to Laryngoscopy. Group 5 was the control group.

In the operating room, an IV line was obtained from patients and 3cc/kg normal saline was administered. Afterwards, 1 mg midazolam and 2μg/kg fentanyl were injected as premedication and then anesthesia was induced using 3-5 mg/kg Nesdonal. For muscle relaxation, atracurium 0.5 mg/kg was administered. After 3 minutes of pre-oxygenation and positive ventilation by an expert anesthesiologist, patient was intubated under direct vision using Macintosh laryngoscope and SUPA tracheal tubes number 7, 7.5 and 8. Systolic and diastolic blood pressures and heart rate were measured before (basic) and after induction of anesthesia and 1, 3 and 5 minutes following tracheal intubation using non-aggressive monitoring (SA-Iran, model X110). Data were entered into the questionnaires which contained demographic characteristics of patients, and questions related to hemodynamic variables at different times following tracheal intubation. Data entry was performed by one person who was not aware of grouping of patients. Presence or absence of cardiac dysrhythmia was also noted by observing the ECG monitor. For quantitative variables inside each group paired t-test and for comparison of different groups repeated measure and ANOVA statistical tests were used. For qualitative variables chi-square test or non-parametric statistical tests were used. $P<0.05$ was considered significant.

## 3. RESULTS

No significant difference was detected in terms of gender among the understudy groups. The mean age of patients in all groups was 69 ±3.5 yrs (range 65-80 yrs) and no significant difference was detected between the mean age and other basic variables of under study groups ($P<0.328$) showed in Table 1. Mean differences of the Systolic and diastolic blood pressures and heart rate of patients in different groups prior to the induction of anesthesia and after tracheal intubation are showed in Table 2 and 3. Our study showed that the kind of surgery hasn't different between groups. The table showed that no difference between male and female. Tracheal tube (SUPA Company, Iran) were used. No significant difference was observed between groups with different sizes of tracheal tube in terms of systolic and diastolic blood pressures and heart rate.

Also, significant difference was not observed among groups in terms of gender, size of tracheal tube, and type of surgery. No significant difference was detected in terms of systolic and diastolic blood pressures and heart rate among groups prior to the induction of anesthesia. According to our study results, no dysrhythmia was observed before or after anesthesia induction in patients. In all study groups, systolic and diastolic blood pressures

| Variables | G1 | G2 | G3 | G4 | G5 | P value |
|---|---|---|---|---|---|---|
| Age(yr.) | 69± 3.4 | 68 ± 3.5 | 68 ± 3 | 70 ± 4.4 | 69 ± 3.4 | 0.328 |
| Sex M/F | 19 / 13 | 13 / 19 | 17 /1 5 | 18 / 14 | 17 / 15 | 0.911 |
| ASA I/II | 17 / 15 | 17 / 15 | 14 / 18 | 21 / 11 | 18 / 14 | 0.502 |
| Size of ETT (%) | | | | | | |
| 7 mm | 1( 3.1) | 0 | 0 | 0 | 0 | |
| 7.5 mm | 12(37.5) | 19(59.4) | 16(50) | 15(46.9) | 16(50) | 0.64 |
| 8 mm | 19(59.4) | 13(40.6) | 16(50) | 17(53.1) | 16(50) | |
| Kind of surgery (%) | | | | | | |
| Eye | 16(50) | 14(43.8) | 15(46.9) | 12(37.5) | 15(46.9) | |
| General | 16(50) | 15(46.9) | 16(50) | 13(40.6) | 13(40.6) | 0.103 |
| Orthopedic | 0 | 3(9.3) | 1(3.1) | 7(21.9) | 4(12.5) | |

**Table 1. Comparison of basic data in the five groups. Groups (G1= Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combine of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Routine control group (fentanyl 2-3 µg/kg)**

significantly decreased after the induction of anesthesia and before tracheal intubation. One minute after the intubation an increase was observed in BP in all groups compared to BP prior to intubation but no rise in BP was observed compared to BP before the induction of anesthesia. The highest increase was observed in the control group.

Our study showed that the highest rise in systolic and diastolic blood pressures and heart rate of elderly patients happened before medical intervention and tracheal intubation. The above mentioned 3 hemodynamic indices had a relative rise in all groups after the intubation compared to their values after the induction of anesthesia and prior to intubation. However, this increase was transient and after 3 minutes returned to its normal value. post hoc analysis and Scheffe tests showed a difference among groups in terms of systolic blood pressure immediately after anesthesia induction. This difference was especially significant between the fentanyl and the control groups (P<0.001). Other differences between two groups were not statistically significant.

Statistical tests showed differences in diastolic blood pressure after anesthesia induction among different groups and this difference between group 3 (spray along with intravenous injection) and the control group was statistically significant (P<0.001). The difference between other groups in other stages was not significant. In general, the mean systolic pressure drop after the induction of anesthesia was 17.5±11.4 mmHg (range 15-46 mmHg). The highest systolic pressure drop after anesthesia induction occurred in group 5 (27±7 mmHg) and the lowest pressure drop belonged to the high dose fentanyl group (11±8 mmHg). A significant difference was observed in pressure drop among different groups (p<0.001). ANOVA test showed that the highest rise in systolic BP in the first minute following laryngoscopy and tracheal intubation occurred in group 5 which was the control group and the lowest rise occurred in the fentanyl group. Systolic BP raise in the IV lidocaine plus spray group was 15±10 mmHg. This rate was 20±12 mmHg in the IV lidocaine and 17±15 mmHg in the spray group. This increase in BP in the first minute was statistically significant among groups (P<0.001).

| Groups | mean (SD) SBP | mean (SD) DBP | mean (SD) Pulse rate |
|---|---|---|---|
| Group 1 (n=32) | 19±9.6 | 7±5.6 | 4±3.9 |
| Group 2 (n=32) | 17±13 | 10±8 | 2.5±3 |
| Group 3 (n=32) | 12±10 | 6±5.9 | 5±10 |
| Group 4 (n=32) | 11±8 | 6±3.7 | 2±14 |
| Group 5 (n=32) | 27±7 | 15±8 | 6±5 |
| P value | P<0.001 | P<0.001 | P<0.2 |

**Table 3. Mean differences ±SD drop in systolic and diastolic blood pressures and heart rate in the groups after induction of anesthesia. Groups (G1= Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combine of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Routine control group (fentanyl 2-3 µg/kg)**

| Groups | mean (SD) SBP | mean (SD) DBP | mean (SD) Pulse rate |
|---|---|---|---|
| Group 1(n=32) | 146.8±13.5 | 84±8.4 | 83.4±10.7 |
| Group 2(n=32) | 146.5±13.3 | 84.6±9.5 | 83.2±12.2 |
| Group 3(n=32) | 145.8±13.7 | 83.8±8.3 | 82.9±9.2 |
| Group 4(n=32) | 147.8±9.8 | 83±5.3 | 83.1±16.6 |
| Group 5(n=32) | 146.4±11.8 | 84.3±5.7 | 83.6±6.6 |
| P value | P<0.972 | P<0.923 | P<0.999 |

**Table 2. Mean (SD) systolic and diastolic blood pressures and heart rate of patients before the induction of anesthesia in the groups. Groups (G1= Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combine of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Routine control group (fentanyl 2-3 µg/kg)**

The highest rise in SBP 3 minutes following intubation was observed in the control group. In the remaining groups, BP slightly decreased compared to its value prior to intubation. This drop was greatest in the IV lidocaine plus spray group. In the control group, only the systolic BP increased for up to 3 minutes after intubation and in the other groups the increase was only observed in the first minute post intubation. Overall, we can say that we had a transient increase in BP in our understudy groups.

Five minutes after intubation, systolic blood pressure decreased to a level lower than its value before intubation and the highest drop occurred in lidocaine spray plus IV lidocaine group (19±7 mmHg) DBP drop after induction of anesthesia showed a significant difference among study groups (P<0.001). The greatest drop occurred in the control group (an average of 15±8 mmHg and the smallest drop occurred in the lidocaine spray plus IV lidocaine. The highest rise in DBP in the first minute following intubation occurred in the control group and the smallest rise belonged to the high dose fentanyl group. A significant difference was observed between study groups in terms of DBP rise in the first minute following intubation (P<0.001). DBP decreased in all groups 3 and 5 minutes following intubation except for

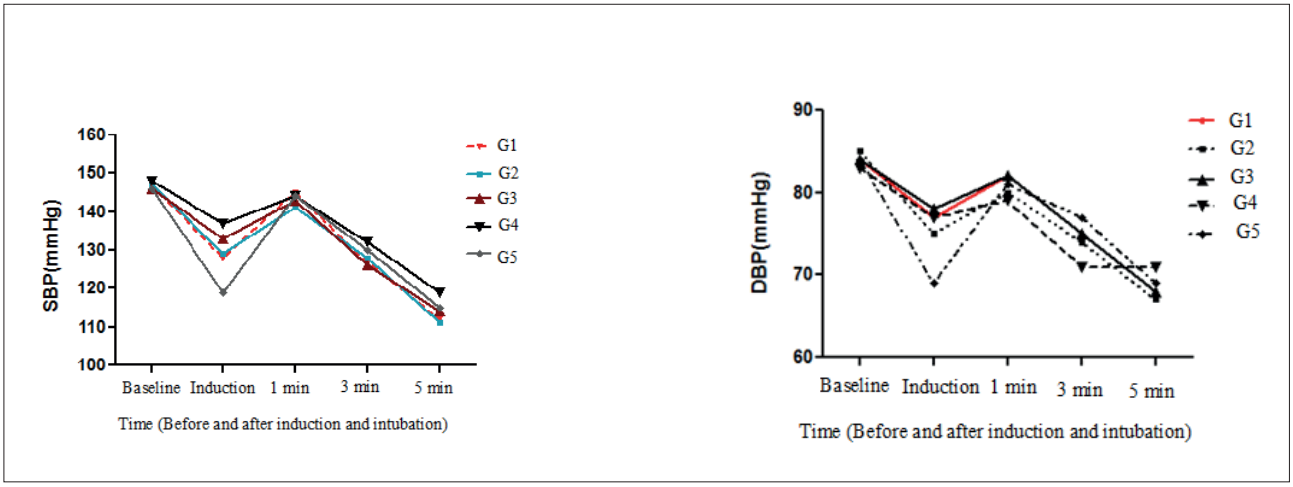


**Figure 1. Comparison of the systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after induction and tracheal intubation between groups (G1= Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combination of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Control routine group (fentanyl 2-3 µg/kg). Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combine of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Routine control group (fentanyl 2-3 µg/kg)**

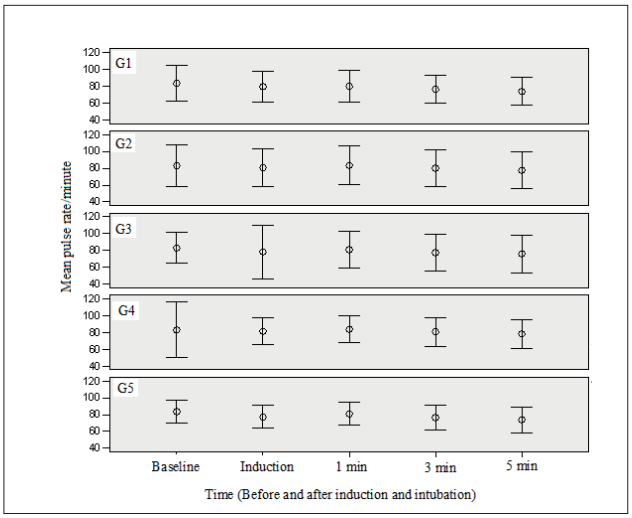


**Figure 2. Comparison of the pulse rate before and after induction and tracheal intubation between groups (G1= Lidocaine 10% spray, G2= Lidocaine 1mg/kg IV, G3= Combination of Lidocaine 10% spray and intravenous Lidocaine 1%, 0.75 mg/kg, G4= fentanyl (5 µg/kg), G5= Control routine group (fentanyl 2-3 µg/kg)**

the control group compared to its level after the induction of anesthesia. This decrease was the greatest in the fentanyl group. An increase was observed in the control group. However, 5 minutes following intubation DBP dropped to a level lower than its level after anesthesia induction and this decrease was the greatest in the lidocaine spray plus IV lidocaine group/ Systolic and diastolic blood pressures and heart rate of patients in different groups prior to the induction of anesthesia and different stage after tracheal intubation are showed in Figure 1, 2. No significant difference was observed when comparing SBP in the first minute following intubation with its basic value in all groups (P<0.88). A 3-5 mmHg decrease was observed in SBP of all groups. Three and 5 minutes after intubation SBP dropped for about 15-20 mmHg compared to its basic value in the operating room.

## 4. DISCUSSION

This study showed that SBP and DBP significantly decreased immediately after anesthesia induction in all study groups and the difference between groups at this time was statistically significant. The highest difference was observed between the fentanyl (group 4) and the control groups. Although heart rate and DBP decreased after anesthesia induction, these values significantly increased immediately after intubation. However, no significant difference was observed among study groups in this respect.

After anesthesia induction, the mean drop in heart rate (compared to its basic value) was greatest in the control group (6±5 beats/min). However, no significant difference was observed between study groups in this regard. Although a slight decrease in heart rate was observed in all study groups, this drop was not clinically significant. The increase in heart rate in study groups first minute after intubation was not statistically significant either. The highest mean increase in heart rate was 3 beats/min which was not clinically significant. Heart rate in other stages was not different from its value after the induction of anesthesia.

Similar studies, by Hohnloser et al., Feng and Fassoulaki evaluated the effect of esmolol and nitroglycerin on patients during tracheal intubation. They concluded that these drugs can prevent the increase in blood pressure of patients. However, Tam and co-authors in their study on Esmolol and Nicardipine could not control the increase in heart rate of patients during tracheal intubation (1, 5, 17, 18).

Feng et al. (1996) compared the effect of lidocaine, fentanyl and esmolol on the SBP and heart rate of patients during intubation and the results showed that SBP and heart rate significantly increased in 40% and 55% of patients in the fentanyl group respectively and this rate was higher than the normal rate (1). Their results were different from those of our study which may be due to the age range of patients. Their under study patients were younger than this study and they used a lower dosage

of fentanyl in their study (15). Talebi et.al (2010) in their study evaluated the effect of oral clonidine premedication on hemodynamic response to Laryngoscopy and tracheal intubation and recorded that orally administration of 0.2 mg clonidine provides hemodynamic stability and attenuates the stress response to Laryngoscopy and intubation. In this study patients had no obvious coronary artery disease (4) .

In this study, SBP, DBP and heart rate increased significantly compared to its value after induction of anesthesia. However, no increase was observed compared to the basic hemodynamic changes and all of this applied methods were efficient for controlling hemodynamic changes. On the other hand, no dysrhythmia was observed in this study during Laryngoscopy and intubation. This indicates that mentioned methods do not carry any cardiovascular risk during intubation. These are simple methods and since lidocaine is easily accessible, it could be a good choice.

We desensitized the tracheal mucosa 3 minutes prior to Laryngoscopy and intubation and it seems that 3 minutes' time is enough to desensitize supraglottic mucosa. Some studies reported desensitizing the mucosa 1 minute prior to the procedure and were satisfied with the results (1, 14). Results obtained by Billard and colleagues were in accord with those of ours regarding high dose fentanyl indicating that the higher the dosage of fentanyl, the better it prevents the increase in blood pressure during intubation (19) .

Study results of Andrea and coworkers were also similar to this study results. They found that remifentanil can successfully control sympathetic stimulation due to tracheal intubation. However, their understudy population was slightly different than that of ours in that they were younger than 65 years (20).

Although tracheal intubation caused an increase in SBP and DBP in all study groups and this increase was the highest in the control group, BP was unchanged when compared with its mean level prior to the induction of anesthesia. BP even decreased 3 and 5 minutes after Laryngoscopy and intubation when compared to its level prior to anesthesia induction in the operating room. Therefore, we can conclude that these are efficient methods for anesthesia in the elderly. All anesthesia methods applied in different study groups were actually efficient for controlling SBP in the elderly during intubation. Basic BP of patients taken in the operating room also showed an increase. This rise in BP just before anesthesia induction was most probably caused by stress due to surgery.

DBP in the first minute following intubation was not significantly different than its level prior to anesthesia induction in all groups. In other words, tracheal intubation did not cause any rise in DBP 1, 3 and 5 minutes after intubation. DBP even decreased 3 minutes after the intubation compared to its basic level prior to anesthesia induction. No significant difference was observed between study groups in terms of this drop.

Heart rate of patients did not increase 1 minute after the procedure when compared to its basic value prior to anesthesia induction. No significant difference was reported in this regard between study groups.

Repeated measure test showed a significant difference in SBP before and after intubation. Significant differences were also observed in DBP and heart rate in various stages of evaluation.

## 5. CONCLUSION

Considering the increase in SBP, DBP and heart rate after intubation compared to these values prior to the procedure and a greater rise in the control group, it seems that methods applied to this study groups are actually efficient and should be applied to the control group as well to prevent further stimulation and hemodynamic changes caused during intubation in the elderly patients.

Also, the mean SBP and DBP of patients before the induction of anesthesia were higher compared to other stages of measurement which might be caused by the stress due to the surgical operation. However, more attention should be paid in order to control BP of patients prior to anesthesia induction.

These are simple, practical methods that can be used for elderly patients who are at a greater risk of hemodynamic changes. These methods were proved to be efficient in preventing cardiac dysrhythmia during intubation as well. It is recommended to take some measures in order to control hemodynamic changes in the operating room before the induction of anesthesia.


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