Evaluation of "no touch" extubation technique on airway-related complications during emergence from general anesthesia

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ABSTRACT

Background and Objectives: Awake "no touch" extubation requires performing extubations only when the patient spontaneously wakes up without any kind of stimulation during emergence from general anesthesia. The aim of this study was to evaluate absolutely awake extubation "no touch" technique in adult patients, scheduled for elective nasal and paranasal sinus surgeries under general anesthesia as regard to emergence airway complications. **Methods:** A total of 60 adult patients were randomly allocated into one of two equal groups according to the method of extubation: Group I: Standard fully awake, Group II: Absolutely "no touch" awake extubation (absolutely no stimulation "no touch" was allowed until patients were able to open their eyes). The incidence of laryngospasm and its grade according to a four-point scale was reported. Occurrence of airway events (excessive secretions, breath-holding, coughing, hoarseness, biting, as well as the number and severity of any desaturation episodes), oozing from the wound, and postoperative sore throat were also recorded. The heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure measured at the end of surgery served as baseline values, and subsequent measurements were taken within 30 minutes after the end of surgery. **Results:** There was absolutely no case of laryngeal spasm or episode of desaturation among patients who were extubated with the "no touch" technique. On the other hand, there were 3 cases of laryngeal spasm in standard fully awake group. Severity of coughing, excessive secretions and breath holding, hoarseness, biting, and occurrence of non-purposeful movements of the limbs were significantly less in the absolutely "no touch" awake technique. The changes in HR, SBP, and DBP during emergence extubation were significantly less in "no touch" technique group. However, oozing from the wound was significantly higher with standard fully awake extubation. However, there were no significant differences between the two groups regarding the incidence of postoperative sore throat (39 and 36%, respectively). **Conclusion:** The results of the present study showed that awake "no touch" technique for tracheal extubation produces less airway-related complications, as well as minimal hemodynamic response during emergence from general anesthesia in nasal and paranasal surgeries. It could be a safe alternative for tracheal extubation in airway surgery.

Key words: *Airway, awake, complication, emergence, extubation, nasal, sinus, surgery, technique, tracheal, "no touch"*

INTRODUCTION

Tracheal extubation can be performed while patients are awake or under deep anesthesia. Both techniques have their pros and cons.[1,2] Extubation in a light plane of anesthesia is the concern in awake extubation while leaving the patient with an unprotected airway is the reservation in deep extubation.

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Events such as laryngospasm, aspiration, airway obstruction, or inadequate ventilatory drive can result in hypoxemia. Mostly, such hypoxemia can be corrected immediately. Occasionally, postextubation hypoxemia can progress rapidly and result in serious complications.[3] Coughing is a common clinical problem in most patients during emergence from general anesthesia in the presence of a tracheal tube (TT).[4] Apart from respiratory events,

emergence from general anesthesia can result in a number of undesirable side effects, including agitation, hypertension, and tachycardia, which may cause bleeding from the surgical wound site and an increase in intracranial and intraocular pressures.[5]

Administration of local anesthetics or opioids and extubation in a deeper plane of anesthesia have been suggested to prevent such adverse emergence events.[2,6,7] The administration of opioids before emergence may be beneficial for preventing cough, agitation, and hemodynamic response but, it may cause unpredictable delayed emergence.[7] Unfortunately, in nasal and sinus surgery, the risk of aspiration after deep extubation is a big concern, and most of anesthesiologists prefer awake technique in such procedures.

Wakefulness is determined by the return of pharyngeal or laryngeal reflexes, eye opening, and grimacing, coughing, and purposeful movement, and in this situation, the patients are in full control of their airway reflexes and can maintain adequate ventilation.[1,2]

The decision on how awake the patient should be, if decided for awake extubation, is of utmost importance. Standard awake technique, which is commonly used for tracheal extubation, usually depends on using swallowing reflex as a clinical sign for extubation. However, the patients may be extubated in a light plane of anesthesia because swallowing may indicate the return of laryngeal reflexes, but it does not necessarily be a sign of consciousness.[1]

The "no touch" extubation technique has been suggested.[8] This technique avoids extubation under light anesthesia and ensures extubation only when consciousness is returned. It requires absolutely no stimulation during emergence and performing extubation only when the patient wakes up spontaneously and opens his eyes.

The objective of this study was to evaluate the "no touch" tracheal extubation technique as regards to emergence airway-related complications and hemodynamic responses.

PATIENTS

In this prospective, randomized, single-blinded, comparative study, following Ethics Committee approval and written informed consent, 60, ASA physical status I–II, adult patients, of both genders, aged between 18 and 35 years, scheduled for elective nasal and paranasal sinus surgery, were randomly assigned to one of two groups using the sealed opaque envelope technique based on computer-generated random numbers.

Exclusion criteria

Included treatment with sedatives, antitussives, or angiotensin-converting enzyme inhibitors, history of current or chronic upper airway disease, asthma, chronic obstructive lung diseases, airway reactive diseases, and chronic cough.

All patients were premedicated with 10 mg diazepam orally 2 hours before surgery. Patients received an intravenous induction with propofol 2 to 2.5 mg/kg, fentanyl 2 ug/kg, and 0.15 mg/kg cisatracurium to facilitate tracheal intubation. The TT size was chosen 7 to 7.5 mm internal diameter in female and 8 to 8.5 mm internal diameter in male, and the cuff was inflated with air, and cuff-pressure was monitored and maintained at 20 mbar throughout the procedure.

The use of oral airway during induction was at the discretion of the attending anesthesiologist. Topical nasal application of 1% (10 mg/ml) lidocaine with 1: 200 000 adrenaline was used for all patients to reduce bleeding during surgery and moistened gauze throat pack was inserted under vision by direct laryngoscope in each patient.

Eye lubricant was applied and the patients were placed in a head-up position in order to provide optimum conditions for nasal and sinus surgery and all the surgical procedures were performed by the same surgeon.

Anesthesia was maintained with 2 to 2.5% sevoflurane in a mixture of 50% nitrous oxide in oxygen. Additional doses of fentanyl were given intravenously as needed. No intravenous or intratracheal lidocaine was allowed. Monitoring consisted of invasive blood pressure measurement, heart rate (HR), electrocardiograph, pulse oxygen saturation (SpO_2), bispectral index of the electroencephalogram (BIS monitoring; Aspect A-2000, Aspect Medical Systems Inc., Natick, Massachusetts, USA), end-tidal CO_2 values, inspiratory and expiratory oxygen concentrations, and train-of-four monitoring. Also, monitoring of exhaled anesthetic was done using an infrared analyzer (Datex Ultima; Datex-Engstrom, Inc., Tewksbury, MA). Ventilation was controlled to maintain normocapnia ($ETCO_2$ 32-38 mm Hg) intraoperatively. Labetalol 5 to 10 mg was given intravenously when needed to keep mean arterial blood pressure between 60 and 70 mmHg.

Thirty minutes before the end of surgery, all patients received 1 g of intravenous. paracetamol for postoperative analgesia, and intravenous ondansetron 4 mg for the prevention of postoperative nausea and vomiting.

In both groups, during the last 20 minutes of the operative

procedure, any residual neuromuscular blockade, as determined by train-of-four monitoring, was reversed by intravenous neostigmine 50 μg/kg (to a maximum of 5 mg) plus glycopyrrolate 10 μg/kg. Nitrous oxide was discontinued and the patient was allowed to breathe spontaneously sevoflurane and oxygen in air 40%. At the end of surgery, the nose was packed by a nasal packing, and patients were randomly allocated into one of the following two groups according to the method of extubation:

In group (I) (control group; standard awake extubation), after completion of the procedure, sevoflurane was immediately discontinued and fresh gas flow was increased. Throat pack was removed, any blood and secretions in the pharynx were carefully suctioned, and the patients were then turned to the lateral (recovery) position. If the patient did not breathe spontaneously, positive pressure ventilation was continued with 100% oxygen until spontaneous ventilation returned. Tracheal extubation was performed when the patient regained consciousness, had sufficient spontaneous breathing, intact gag reflex, purposeful movement, and spontaneous eye opening.

In group (II) (no touch" awake extubation), at the end of the procedure, while the patient was still adequately anesthetized, throat pack was removed, any blood and secretions in the pharynx were carefully suctioned under direct visualization in order to confirm that secretion clearance was complete and to avoid trauma to the mucosa, the TT cuff was deflated, and then the patients were turned to the lateral (recovery) position. Only after this, sevoflurane was discontinued and fresh gas flow was increased, and if the patient did not breathe spontaneously, positive pressure ventilation was continued with 100% oxygen until spontaneous ventilation returned. Tracheal extubation was performed when patients had same criteria of group (I), but absolutely no stimulation "no touch" was allowed until patients spontaneously woke up and were able to open their eyes, the anesthetist was only allowed to call their name or give a simple verbal command to open their eyes, without physically stimulating the patient.

Differently from group (I), in this technique, we avoided any stimulation such as oropharyngeal suctioning, head turning, pillow removal, and bodily movement, which all serve to reduce tracheal irritation from the endotracheal tube.

After extubation in both groups, the patients breathed 40% oxygen by face mask until they were able to maintain a patent airway, and consequently they were transported to the postanesthesia care unit (PACU).

Forty percent oxygen by facemask or "blow by" oxygen was given until judged not necessary by the PACU nursing staff. Pulse oximetry was provided continuously, intraoperatively, during transport, and throughout recovery period.

Measurements

The time from the end of surgery till patients spontaneously opened their eyes was measured in both groups. (HR), systolic (SBP) and diastolic (DBP) blood pressures were measured at the end of surgery, which served as baseline values. Subsequent measurements were taken at 2, 4, 5, 10, 15, 20, 25, and 30 minutes after the end of surgery.

The incidence and severity of laryngospasm according to a four-point scale (0 = no laryngospasm, 1 = stridor on inspiration, 2 = total occlusion of the vocal cords (silence with no air movement), or 3 = cyanosis) was reported.[9]

Severity of coughing was defined as 0 if no coughing occurred; 1 if a single cough occurred and SpO_2 ≥95%; 2 if multiple coughs occurred and SpO_2 ≥95%; 3 if multiple coughs occurred and SpO_2 <95%; and 4 if multiple coughs occurred, SpO_2 <95%, and coughing required administration of i.v. medication.[10]

The occurrence of non-purposeful movement of the limbs was observed, oozing from the wound was graded on a scale of 1 to 3 (1 = nasal pack tinged with blood, 2 = nasal packs soaked with blood, 3 = blood leakage from the nose and postnasal space, respectively).

The use of airway adjuncts, the need for airway support, and the occurrence of airway events (excessive secretions, breath-holding, number and severity of any desaturation episodes, as determined by a pulse oximetry reading) were also reported within 30 minutes following tracheal extubation. The incidence of vomiting in the recovery room was reported. The incidences of hoarseness of voice and sore throat were also reported in the first 24 hours postoperatively.

All data were recorded by an anesthetist until the patient was transferred to the recovery room. Thereafter, patient assessment and data collection were carried by the recovery room nurse and another nurse in the ward further reported the incidence of hoarseness and sore throat (both nurses were blinded to the study groups).

Statistical analysis

The incidence of coughing after general anesthesia was previously reported as 76%.[4] Based on the assumption that 50% reduction would be clinically significant, 30 patients in each group would be required (α=0.05 and β=0.2). Statistical analysis was performed with

the statistical software package (SPSS version 17.00). Parametric data were analyzed by using student *t*-test. Nonparametric data were analyzed by using the Mann-Whitney test. Category data were analyzed by using the χ^2 test. *P* values <0.05 were considered significant. Data are presented as mean ± SD, number (n) or percentage (%) when appropriate.

RESULTS

A total of 60 patients with age ranging from 18 to 35 years were enrolled in the study protocol. Groups were comparable with respect to ASA status, gender, age, weight, number of smokers, and type of surgery [Table 1] ($P > 0.05$).

There was no significant difference among groups as regards the duration of anesthesia or the number of patients who received intraoperative fentanyl, or in the total dose of fentanyl administered intraoperatively (including induction dose); the mean end-tidal concentration of sevoflurane at the time of extubation (%) but the time from end of surgery to eye opening was significantly longer in group II [Table 2] ($P < 0.05$).

Airway-related complications at extubation are shown in Table 3. Severity of coughing, excessive secretions, and breath holding were significantly less in the absolutely "no touch" awake group in comparison with the control group ($P < 0.05$) [Table 3]. Most of patients who cough in standard fully awake group were grade 2, whereas most of patients who cough in "no touch" awake group were grade 1.

There was absolutely no case of laryngeal spasm among patients who were extubated with the "no touch" technique. On the other hand, there were 3 cases of laryngeal spasm in standard fully awake extubation group. According to a four-point scale, two cases were grade 1 (stridor on inspiration) and were successfully managed by suction and positive pressure ventilation; however, one case were grade 2 (total occlusion of the vocal cords) and required an intravenous succinylcholine (0.25 mg/kg) and positive pressure ventilation. None of the laryngeal spasm cases that occurred in the control group required reintubation.

There was a higher statistical incidence among the control group as regards to the number and severity of desaturation episodes, incidence of non-purposeful movement, biting, and hoarseness [Table 3] ($P < 0.05$).

Significant oozing from the wound (grade 2 or 3) was significantly less in absolutely "no touch" awake group [Table 3] ($P < 0.05$).

Hemodynamic response (HR, SBP, and DBP) to extubation were significantly less ($P<0.05$) in the "no touch" technique group in comparison with the control group [Figures 1-3].

Table 1: Patients demographic data

	Group (I)	Group (II)
Number	30	30
ASA stratus (I/II)	24/6	25/5
Gender (M/F)	18/12	20/10
Age (years)	24 ± 2.3	23 ± 3.2
Weight (kg)	74 ± 19.2	72 ± 21.8
No. of smokers (%)	8 (26.7)	7 (23.3)
Type of surgery		
Rhinoplasty (%)	22 (73.3)	21 (70.0)
FEES (%)	8 (26.7)	9 (30)

Data are presented as mean ± SD or number of the patients (%)

Table 2: Intraoperative data

	Group (I)	Group (II)
Duration of anesthesia (min)	140 ± 22.2	138 ± 26.6
Intraoperative narcotics (%)	30 (100)	30 (100)
Total intraoperative fentanyl (μg/kg)	2.9 ± 0.2	2.8 ± 0.3
End-tidal concentration of sevoflurane at time of extubation (%)	0.24 ± 0.12	0.21 ± 0.13
End of surgery to eye opening (min)	8.3 ± 2.6	14.2 ± 2.4*

Data are presented as mean ± SD or number of the patients (%).
*Significant difference $P < 0.05$

Table 3: Airway-related complications

	Group (I) (%)	Group (II) (%)
Coughing		
Grade 0	0 (0)	2 (6,7)
Grade 1	3 (10)	24 (70)*
Grade 2	22 (73.3)*	4 (13.3)
Grade 3	5 (16.6)*	0 (0)
Grade 4	0 (0)	0 (0)
Excessive secretions	15 (50)*	4 (13.3)
Breath holding	14 (46.7)*	2 (6.7)
Laryngeal spasm	3 (10)*	0 (0)
All desaturation episodes (SpO_2 < 95%)	5 (16.6)*	0 (0)
Severe desaturation episodes (SpO_2 < 90%)	3 (10)*	0 (0)
Non-purposeful movement	18 (60)*	4 (13.3)
Biting	9 (11.1)*	3 (33.3)
Hoarseness	5 (16.6)*	0 (0)
Oozing from the wound		
Grade 2	16 (53.3)*	5 (16.7)
Grade 3	8 (26.7)*	2 (6.7)

Data are presented as number of the patients (%).
*Significant difference $P < 0.05$

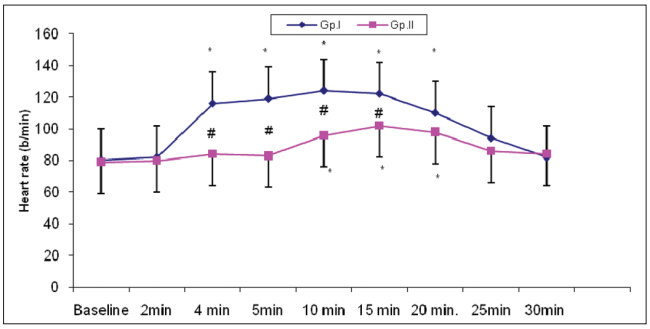

Figure 1: Changes in heart rate, 30 minutes after the end of surgery; *Significant from baseline in the same group. #Significant between the two groups at the same time

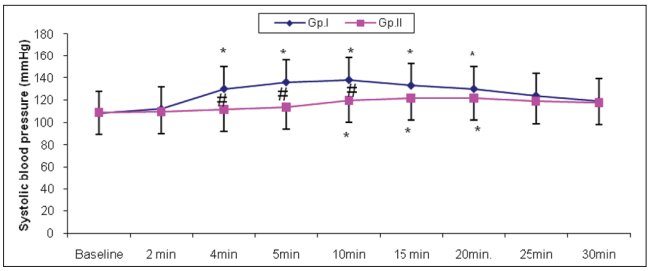

Figure 2: Changes in systolic blood pressure, 30 minutes after the end of surgery; *Significant from baseline in the same group. #Significant between the two groups at the same time

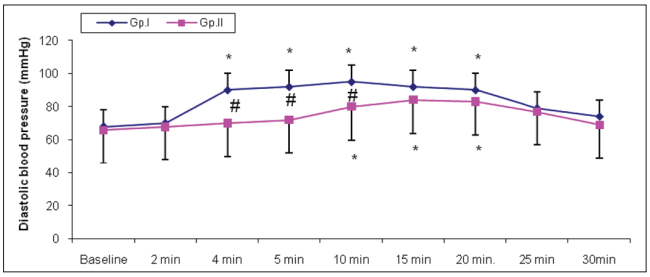

Figure 3: Changes in diastolic blood pressure, 30 minutes after the end of surgery; *Significant from baseline in the same group. #Significant between the two groups at the same time

Four patients in this study (two in each group) vomited within the first 30 minutes after extubation. There was no significant difference between groups regarding the incidence of postoperative sore throat (39 and 36%, respectively).

DISCUSSION

In nasal and paranasal sinus operations, a smooth emergence from general anesthesia is preferred because coughing and bucking during awakening often stimulate the oozing of blood, which may lead to more airway stimulation and accordingly to more bucking and coughing.[1]

The incidence of coughing on emergence from general anesthesia in the presence of TT has been estimated as ranging between 38 and 96%.[11,12] Coughing and bucking induced by TT can complicate emergence from general anesthesia and may be associated with Valsalva maneuver and breath-holding which may cause a decrease in oxygen saturation (SpO_2),[13] and explain high incidence of desaturation in standard awake extubation group. Moreover, coughing and bucking can participate in serious bronchospasm in patients with hyperreactive airways.[14,15]

In our study, all patients received the same premedication. Most importantly, both groups received almost equal doses of fentanyl. Therefore, we presumed that the antitussive effects were similar in both groups.

The TT and its cuff stimulate the rapidly acting irritant and the stretch receptors in the trachea.[16] Those irritant receptors are assumed to be the receptors involved in the cough reflex.[17,18] The blockade of these receptors is the theoretical reason behind inhibition of the cough reflex during extubation by topical application of local anesthetics.[6] The same concept can be applied to the "no touch" technique. There, we avoided excessive tracheal irritation by early deflation of the cuff of the endotracheal tube. Similarly, any stimulation such as oropharyngeal suctioning, head turning, pillow removal, and bodily movements that causes tracheal irritation and awakening in our patients were not allowed. Therefore, severity of emergence-related coughing in patients extubated with this technique was significantly less.

Although the severity of coughing in the "no touch" group was low, it did not result in a significant lower incidence of sore throat, in comparison with standard awake group. Postoperative sore throat may relate not only to the anesthesia technique, but also to patients' factors and type of surgical procedures.[19] Besides laryngoscopy and endotracheal intubation, in certain surgical procedures, sore throat can occur as a consequence of localized trauma secondary to surgery itself, throat packing, and excessive oral suction.[20]

The changes in HR, SBP, and DBP during emergence extubation were significantly less in "no touch" technique group. The stimulation of the sympathetic adrenal system and the release of catecholamines are the possible mechanism responsible for hypertension and tachycardia after tracheal extubation.[1,21] Removal of the TT by "no touch" technique was more effective than standard awake extubation in controlling HR and BP in this study. The previous result may be attributed to the inhibition of catecholamine release which was a direct result of not disturbing the patients' tracheas, less airway-related events, and smoother emergence with the "no touch" technique.

Deep extubation might prevent the problem of straining and cough,[1] as opposed to awake extubation, and avoid the likelihood of laryngospasm and oxygen desaturation.[1,2] Nonetheless, deep extubation technique has the potential of exposing the patients to the risk of aspiration or airway obstruction as it prolongs the time from tracheal extubation to return of protective airway reflexes, which is always a great concern after general anesthesia, particularly, in nasal and paranasal sinus operations. In the present study, four patients (two in each group) vomited in the first 30 minutes after extubation, all were awake and they were able to protect their own airway, with no evidence of aspiration. This emphasizes the importance of delaying extubation until patients are sufficiently awake to voluntarily protect their airways.

With strict "non touch" technique used in the present study, there was no case of laryngeal spasm or severe desaturation episodes. In contrary, there were 3 cases of laryngeal spasm in patients who had their trachea extubated with standard awake technique. Less airway stimulation and smooth recovery adopted by "non touch" technique can again explain the lower incidence of laryngeal spasm. Another explanation is lesser oozing from the wound. Bleeding from surgical sites and leakage of blood through postnasal space can contaminate the vocal folds, potentially giving rise to laryngeal spasm.[9]

In accordance to the results of the present study, a case series study that examined the incidence of laryngospasm using "non touch" tracheal extubation technique after tonsillectomy with or without adenoidectomy in children reported no incidence of laryngospasm, severe coughing, or desaturation with the technique.[8] A limitation in the previous case series study,[8] indicated by the author, is that he did not involve a control extubation group. In the present study, a control group (standard awake) was included. It significantly served to show up our primary target which was the evaluation of the "no touch" extubation technique against the standard practice of awake extubation.

Prolonged duration of emergence from general anesthesia encountered in the "no touch" technique may be considered as a drawback. However, when it comes to patient safety, it is probably a minor concern. As shown in the present study, the technique produces fewer airway-related complications, as well as minimal hemodynamic response, and most importantly is the absence of laryngeal spasm or severe desaturation episodes. Alternatively, as compared with deep tracheal intubation, the latter delay emergence time even more,[22] and unfavorably prolongs the time from tracheal extubation to return of protective airway reflexes. Therefore, this technique is a safe alternative for tracheal extubation and it may be favored as extubation technique of choice, particularly in airway surgery or when the patient or surgical risk factors require that coughing and hypertension during emergence from anesthesia is minimized.

CONCLUSION

The results of the present study showed that awake "no touch" technique for tracheal extubation produces less airway-related complications, as well as minimal hemodynamic response during emergence from general anesthesia in nasal and paranasal surgeries. It could be a safe alternative for tracheal extubation in airway surgery.

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