Comparison of two different oxygen delivery methods in the early postoperative period: randomized trial

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Abstract
Title. Comparison of two different oxygen delivery methods in the early postoperative period: randomized trial.

Aim. This paper is a report of a study conducted to compare the effects of two different oxygen delivery methods on both patient peripheral oxygen saturation and patient satisfaction.

Background. One of the most serious problems encountered in the early postoperative period is hypoxemia. Giving oxygen to patients in the perioperative period reduces the incidence of hypoxemia. Oxygen is generally delivered to patients through oxygen masks or nasal cannulae. Previous studies have shown that face masks and nasal cannulae are effective in the early postoperative period.

Method. A randomized trial was conducted between 2007 and 2008 with patients undergoing thyroidectomy. In the early postoperative period, 5 L/minute of oxygen was given to patients via an oxygen mask (n = 53) or nasal cannulae (n = 53). Peripheral oxygen saturation were measured by pulse oxymeter every 5 minutes for a 30-minute period. The Postoperative Nausea Vomiting Scale was used and patient satisfaction was evaluated using a 10-point scale.

Results. Average peripheral oxygen saturation for the nasal cannulae group was statistically significant higher than that in the mask group. This difference arose from more frequent removal of the oxygen mask than the nasal cannulae by patients and healthcare professionals. Average satisfaction scores for patients in the nasal cannulae group were statistically significantly higher than those in the mask group.

Conclusion. During the early postoperative period, using nasal cannulae for patients undergoing thyroidectomy increases oxygenation.

Keywords: nasal cannulae, nursing, oxygen delivery, oxygen mask, patient satisfaction, postoperative, randomized trial

Introduction
One of the most serious problems encountered during the early postoperative period is hypoxemia (Morgan et al. 2008). Hypoxemia is seen in the majority of patients for whom oxygen is not delivered during transport to the postanaesthesia care unit (PACU) (Magnusson & Spahn 2003). Serious hypoxemia can cause brain damage and
It has been stated that mild-to-moderate hypoxemia can cause pathophysiological disorders and a consequent increase in mortality when occurring together with other problems, and it can produce other negative surgical results that cannot be measured (Strachan & Noble 2001). In addition, hypoxemia causes an increase in both time spent in the PACU and frequency of admission to intensive care units (Magnusson & Spahn 2003).

The purposes of nursing care in the postanaesthesia period are to identify existing and potential problems that can develop as a result of the anaesthesia and surgical intervention and to initiate the appropriate interventions. Hypoxemia risk is one of the nursing diagnoses related to potential changes in respiratory functions in the early postoperative period (Lewis et al. 2004). Prophylactic oxygen support to ensure adequate oxygenation of the patients in PACU has been described as a safe, simple and efficient method (Amanor-Boadu et al. 2006). The Turkish Anaesthesiology and Reanimation Association, in its postanaesthetic care protocols (TARD 2005), recommends oxygen delivery for all patients after anaesthesia. Some studies have shown that perioperative oxygen delivery reduces wound infection and the incidence of nausea and vomiting as well as hypoxemia (Laurer & Gombkoto 2006). Oxygen is generally delivered to patients via oxygen masks or nasal cannulae (Sasaki et al. 2003).

Background

Some studies on this topic show the efficiency of masks and nasal cannulae in the early postoperative period and no differences between the two methods with regard to efficiency (Scuderi et al. 1996, Loughnan et al. 2000, Bolton & Fanzca 2001). In others, difficulties encountered during the use of oxygen delivery methods were reported. However, the evaluation period in these studies covered only the first night following the surgery (Nolan et al. 1992, 1993).

In studies evaluating the use of oxygen delivery methods in the literature, it has been shown that masks induce a sense of claustrophobia; in addition, patients find the masks to be generally annoying. Masks are inadequate for oxygen delivery because they have to be removed when they create an obstacle to communication, mouth care and cause the patient to feel uncomfortable, and in the presence of nausea and/or vomiting (Nolan et al. 1992, 1993). It has also been reported that nasal cannulae are not suitable for patients breathing through their mouths, and that cannulae cause irritation and bleeding in the nasal mucosa when oxygen is given without being humidified (Ling et al. 2002, Dinesen et al. 2003). From these results, we conclude that oxygenation status is affected by oxygen delivery method. Therefore, hypoxemia and related complications might be prevented by use of the appropriate oxygen delivery method. However, studies supporting this view have not specifically included the early postoperative period and were not performed with specific patient groups.

Furthermore, it is important to determine the best use of existing resources, because the costs of health care are gradually increasing. Patient satisfaction, which is an important criterion, must also be considered in the assessment of healthcare services (Yilmaz 2001). It has also been stated that patient satisfaction increases compliance and has a potentially positive effect with regard to outcomes (Tukel et al. 2004). Although some previous researchers have evaluated patient satisfaction with regard to oxygen delivery methods, only patients with chronic obstructive lung diseases or healthy volunteers have been included in these studies (Ling et al. 2002, Dinesen et al. 2003, Sasaki et al. 2003).

Therefore, we decided to examine the effects of masks and nasal cannulae on oxygen saturation status, difficulties encountered during mask/cannulae use, and patients’ opinions. In addition, our study was unique in the fact that it addressed the early postoperative period and was designed for patients having operations in a single surgical region using a standard anaesthesia method.

The study

Aim

The aim of this study was to compare the effects of two different oxygen delivery methods (masks and nasal cannulae) on both patient peripheral oxygen saturation (SpO₂) and patient satisfaction.

Design

An experimental study was carried out in Turkey between November 2007 and April 2008.

Sample size calculation

The size of the groups was calculated using an online program (http://www.stat.ubc.ca/~rollin/stats/ssize/b2.html) to be 101. We used a 4% desaturation rate in patients with nasal cannulae and a 14% desaturation rate in patients with masks to obtain a difference of 10% between the two methods, and we chose 80% strength and 5% statistical significance level.
Randomization
Patients were randomized an hour before the thyroidectomy, when the researcher used a closed envelope ballot to determine the postoperative oxygen delivery method.

Participants
The participants were 106 patients who underwent thyroidectomy. They were between 18 and 65 years of age and had been classified as American Society of Anaesthesiologists (ASA) classifications I–II. They had no cognitive disabilities that could prevent communication, no respiratory problems (e.g. asthma, obstruction) and no difficulties in nasal breathing. All patients approached agreed to participate in the study. Figure 1 shows that 53 composed of the mask group (MG), and the remaining 53 composed of the nasal cannulae group (NCG).

Data collection
This study was implemented in three periods (i.e. preoperative, intraoperative and postoperative). To reduce bias, PACU nurses were not informed about the purpose of the study. In addition, the researcher only made observations and did not participate in the postoperative care of the patients.

Preoperative period
After visiting patients meeting the criteria for the study and providing information about the study, we obtained patient consent, along with data from the preoperative period (age, gender, medical diagnosis, height, weight, ASA classification, chronic diseases and history of smoking). In addition, SpO₂ levels were measured by the researcher in the ambient atmosphere using Novametrix pulse oxymeter (Model 513; Medical Systems, Wallingford, CT). The same pulse oxymeter was used in the PACU. Patients replied that, 30 minutes after the operation, we would ask them to score their levels of satisfaction between 0 and 10 (0, not satisfied at all; 10, very satisfied) with regard to the method used for oxygen delivery.

Body mass index (BMI) values were obtained and evaluated according to the World Health Organization (WHO 2004) classification.

Intraoperative period
A premedication of midazolam (2 mg i.v.) was given by the anaesthesia and surgical teams to all patients 30 minutes before the induction of anaesthesia. All operations were performed under general anaesthesia and standard monitors were used. All patients breathed 100% oxygen for 3 minutes before the induction of anaesthesia, which was induced with 5 mg/kg thiopentone, 0·1 mcg/kg fentanyl and 0·1 mg/kg vecuronium. After tracheal intubation, anaesthesia was

Postoperative period
Obtaining the satisfaction scores

Figure 1 Flowchart of patients through the trial.
On admission to the PACU, initial SpO2 values were recorded. During the maintenance period, ventilation was controlled to maintain normocapnia (P_{E}CO_2 30–35 mmHg). Patients who could not be intubated at the first attempt were considered difficult to intubate and were excluded from the study.

In addition to the above, Cefazolin (1 g) was given to all patients for infection prophylaxis. Metoclopramide (10 mg) was given for nausea–vomiting prophylaxis. Dexamethasone (4–8 mg) was used to prevent inflammation in the surgical area, and an H_2 receptor antagonist (ranitidine hydrochloride, 50 mg i.v.) was given to prevent the gastric side-effects of dexamethasone. Tramadol (50 mg infusion) was given for analgesia.

At the end of the surgical procedure, the residual neuromuscular blockade was reversed with neostigmine (0.04 mg/kg) and atropine (0.02 mg/kg). Controlled ventilation with 8 L/minute of oxygen was continued until the end-tidal nitrous oxide concentration was <10%. The endotracheal tube was removed when the patient showed purposeful movement of all extremities, grimaced, coughed or gagged.

After patients had breathed 100% oxygen for 5–8 min following extubation, they were transported to the PACU in the 25–30° head-up position. They were accompanied by the anaesthesiologist for the journey, which lasted <2 min without oxygen administration. Drugs used during this period and during the time of anaesthesia were recorded.

**Postoperative period**

On admission to the PACU, initial SpO2 values were recorded with a pulse oxymeter before initiating the oxygen delivery method. Basal oxygenation status on arrival at the PACU was recorded.

A mask or nasal cannulae was positioned by the researcher an hour before the thyroidectomy according to the oxygen delivery method determined with the closed envelope method. The oxygen flow rate was used was 5 L/minute and this was intended to ensure similar oxygen concentrations in all patients. Subsequent postoperative care and follow-up were performed by PACU nurses, who did not know the purpose of the study.

SpO2 values were monitored at 5-minute intervals by the researcher and recorded for a period of 30 minutes. Previous researchers have noted that hypoxemia develops between the first 15–60 minutes after surgery (Xue et al. 1996, 1999). Therefore, we monitored patients for an average period of 30 minutes.

In addition, removal of the oxygen delivery method during these 30 minutes, along with the person removing it and the reason for removal, was also recorded. Nausea/vomiting status was evaluated using the Postoperative Nausea–Vomiting (PONV) Scale.

Sedation scoring was performed by the researcher using Modified Wilson Sedation Scale. Satisfaction scores with regard to the oxygen delivery method used were also obtained by the researcher.

**Outcome measures**

Our primary outcome was the SpO2 value. SpO2 levels <95% at admission to the PACU were considered evidence of hypoxemia (Daley et al. 1991, Smith 2005, Urschitz et al. 2005, Marcondes et al. 2006, Aslan et al. 2007). Two consecutive SpO2 measurements within the interval of 94–90% or a single measurement less than 90% was taken as evidence of desaturation (Bolton & Fanzca 2001). Average SpO2 values were calculated at the end of the 30-minute period.

The PONV Scale was used to determine the effect of postoperative nausea/vomiting on the removal of the oxygen delivery device and consequently on SpO2 (Bhatnagar et al. 2005, B. Mercangöz, Dr. Lütfi Kirdar Eğitim ve Araştırma Hastanesi, İstanbul, unpublished specialty thesis).

Our secondary outcome was patient satisfaction. This was assessed using a 10-point scale (0 – not satisfied at all; 10 – very satisfied) (Egan & Ready 1994, Darkow et al. 2001, Rodriguez et al. 2007, Aksu et al. 2008). We did not locate any validity or reliability studies for the scales used to determine patient satisfaction and the nausea/vomiting status, although the scales were used in the studies identified above.

At the end of the 30 minutes, the sedation status of each patient was evaluated using the Modified Wilson Sedation Scale (Nemethy et al. 2002). Patients with sedation scores of 1 were considered able to respond to oral questions, and were asked to score their satisfaction levels. The Wilson Sedation Scale was used for this purpose (I. Bolukbasıoglu, Dr. Lütfi Kirdar Eğitim ve Araştırma Hastanesi, İstanbul, unpublished specialty thesis, Chao-Zhi & Qian 2007, Chao-Zhi & Yang 2007). Validity and reliability studies for this scale were performed by Nemethy et al. (2002). Patients with sedation scores of 1 were considered to be capable of communicating their satisfaction scores.

**Ethical considerations**

This study was approved by the appropriate ethics committee.

**Data analysis**

The Statistical Package of Social Sciences (SPSS) 15.0 package (SPSS Inc., Chicago, IL, USA) was used to
analyse the data. Descriptive statistics are shown as
figures and percentages (%) for variables determined by
counting and as mean ± SD for those determined by
measurements. Compliance of the measurement values with
the normal distribution was investigated with the Single
Sampling Kolmogorov-Smirnov test. A Student’s t-test
was used to investigate differences between the two groups
for variables meeting parametric test assumptions; the
Mann–Whitney U-test, which is the nonparametric coun-
terpart to the t-test, was used for those not meeting these
assumptions.

ANCOVA was used to compare two mean values in the
presence of a variable thought to affect the difference
between the two mean values, notwithstanding the affecting
variable. The chi-squared test was used to analyse the
relationship between two variables. P values < 0.05 were
accepted as statistically significant.

Results
This study was performed with 106 patients, as shown in
Figure 1. Descriptive characteristics of patients in the two
groups, along with their distribution according to risk factors
related to hypoxemia, are shown in Table 1. These data
reveal that the majority of patients were female (79.2%) and
under 60 years of age (86.8%). Patients in both groups were
similar with regard to descriptive characteristics and risk
factors related to hypoxemia, with the exception of ASA
classification and mean BMI (P > 0.05).

Mean oxygen saturation values in the early postoperative
period are shown in Table 2. There were no differences
between these values during admission to the PACU in the early
postoperative period. At other measurement points, however,
the mean oxygen saturation values of patients in the NCG were
higher than those of patients in the MG (P < 0.01).

Table 1 Distribution of patients in the
mask and nasal cannulae groups according
to identifying characteristics and risk
factors related to hypoxemia

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mask group (n = 53)</th>
<th>Nasal cannulae group (n = 53)</th>
<th>Statistics</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>46.38 ± 12.202</td>
<td>41.66 ± 13.52</td>
<td>t = 1.87</td>
<td>0.06</td>
</tr>
<tr>
<td>n (%)</td>
<td>44 (83.0)</td>
<td>47 (86.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 60</td>
<td>9 (17.0)</td>
<td>7 (13.2)</td>
<td>χ² = 0.29</td>
<td>0.59</td>
</tr>
<tr>
<td>Gender</td>
<td>Men</td>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>42 (79.2)</td>
<td>11 (20.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>12 (22.6)</td>
<td>19 (35.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Multi-nodular goitre</td>
<td>Other*</td>
<td>χ² = 0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>History of chronic disease</td>
<td>Absent</td>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>34 (64.2)</td>
<td>19 (35.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of chronic disease</td>
<td>38 (71.7)</td>
<td>26 (49.0)</td>
<td>χ² = 4.48</td>
<td>0.034</td>
</tr>
<tr>
<td>I</td>
<td>32 (60.4)</td>
<td>42 (79.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>21 (39.6)</td>
<td>11 (20.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of smoking</td>
<td>Not smoking</td>
<td>Give up smoking</td>
<td>χ² = 1.05</td>
<td>0.6</td>
</tr>
<tr>
<td>n (%)</td>
<td>31 (58.5)</td>
<td>8 (15.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of smoking</td>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>14 (26.4)</td>
<td>16 (30.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of smoking</td>
<td>&lt; 2.5</td>
<td>≥ 2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>46 (86.8)</td>
<td>7 (13.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sd, standard deviation; t, Student’s t-test; χ², chi-squared test.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
* Nodular goitre, recurring nodular goitre, Grave’s disease, thyroid papillary cancer, follicular-cell neoplasm, toxic goitre.
+ Anxiety, pollen allergy.
nausea/vomiting was more frequent in NCG patients (MG: between groups was not statistically significant. Although the statistical significance value.

observed in NCG patients, it was not possible to determine not become desaturated. Because no desaturation was

Mask group (n = 53) = 0)
P 

Table 2 Distribution of mean peripheral oxygen saturation values in the mask and nasal cannulae groups

<table>
<thead>
<tr>
<th>Peripheral oxygen saturation</th>
<th>Mask group (n = 53)</th>
<th>Nasal cannulae group (n = 53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>96.66 ± 0.67</td>
<td>96.66 ± 0.73</td>
</tr>
<tr>
<td>Baseline</td>
<td>92.89 ± 3.89</td>
<td>93.17 ± 3.52</td>
</tr>
<tr>
<td>5. minutes</td>
<td>96.70 ± 2.53</td>
<td>97.75 ± 1.27</td>
</tr>
<tr>
<td>10. minutes</td>
<td>96.58 ± 2.77</td>
<td>98.09 ± 1.27</td>
</tr>
<tr>
<td>15. minutes</td>
<td>96.62 ± 2.54</td>
<td>98.23 ± 1.17</td>
</tr>
<tr>
<td>20. minutes</td>
<td>96.91 ± 1.83</td>
<td>98.26 ± 1.11</td>
</tr>
<tr>
<td>25. minutes</td>
<td>96.30 ± 2.15</td>
<td>98.26 ± 1.11</td>
</tr>
<tr>
<td>30. minutes</td>
<td>96.26 ± 2.96</td>
<td>98.42 ± 0.98</td>
</tr>
<tr>
<td>Mean</td>
<td>96.56 ± 1.68</td>
<td>98.17 ± 1.00</td>
</tr>
</tbody>
</table>

sd, standard deviation; z, Mann–Whitney U-test.

When we examined the removal of oxygen delivery devices in patients in the two groups, we found that the oxygen delivery devices were removed in most patients in the MG group (75.5%). The percentage in the NCG was 3.8%, and the difference between groups was statistically significant (P < 0.01).

When average SpO2 values in the groups were compared via ANCOVA without considering the removal of oxygen delivery devices (MG: 97.03 ± 1.66, NCG: 97.70 ± 1.66), the difference was not statistically significant (t = 1.771, P = 0.79).

The effect of removal of oxygen delivery devices on saturation status between the groups is shown in Table 3. About half of patients in the MG (40%) who removed their oxygen mask were desaturated. In the same group, removal of the oxygen delivery device had a statistically significant effect on desaturation (P < 0.01). In the NCG, however, patients who removed the oxygen delivery devices (n = 2) did not become desaturated. Because no desaturation was observed in NCG patients, it was not possible to determine the statistical significance value.

When nausea/vomiting was examined, the difference between groups was not statistically significant. Although nausea/vomiting was more frequent in NCG patients (MG: 32%, NCG: 43.4%), the difference was not statistically significant (P > 0.05).

The relationship between nausea/vomiting status and removal of the oxygen delivery devices for patients in each group is seen in Table 4. This shows that oxygen masks were removed in 94.1% of those in whom nausea/vomiting occurred and 66.7% of those in whom nausea/vomiting did not occur. The presence of nausea/vomiting was thus an important factor in removal of the oxygen mask (P < 0.05). In the NCG, however, the nasal cannulae were not removed in most patients regardless of nausea/vomiting; the presence of nausea/vomiting was thus not an important factor in removal of the nasal cannulae (P > 0.05).

When characteristics related to the removal of the oxygen delivery devices were examined (Table 5), we observed that oxygen masks were removed by the majority of patients (n = 19). The primary reason for removal was a feeling of distress (68.3%). While the primary reason for removal by the nurse was vomiting (47.1%), the reason for removal by the doctor was to assess the patient’s speech quality (66.7%). However, nasal cannulae were removed by only two patients caused by nose pain.

Patients in the two groups were similar with regard to their levels of education and sedation scores (P > 0.05). The mean

<table>
<thead>
<tr>
<th>Saturation status</th>
<th>Normal</th>
<th>Desaturated</th>
<th>( \chi^2 )</th>
<th>d.f.</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of oxygen delivery device according to group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mask group (n = 53)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removed</td>
<td>24 (60.0)</td>
<td>16 (40.0)</td>
<td>7.45</td>
<td>1</td>
<td>0.006</td>
</tr>
<tr>
<td>Not removed</td>
<td>13 (100)</td>
<td>0 (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal cannulae group (n = 53)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removed</td>
<td>2 (100)</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not removed</td>
<td>51 (100)</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( \chi^2 \), chi-squared test; d.f., degrees of freedom.

Table 3 Relationship between removal of oxygen delivery device and patient saturation status

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Comparison of oxygen delivery methods

Table 4 Relationship between nausea–vomiting status and removal of the oxygen delivery device in patients in the mask and nasal cannulae groups

<table>
<thead>
<tr>
<th>Removal of oxygen delivery device according to the groups</th>
<th>Status of nausea–vomiting (n (%)</th>
<th>Chi-squared test (v, P value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask group (n = 53)</td>
<td>Not seen: 24 (66.7)</td>
<td>4.77 0.03</td>
</tr>
<tr>
<td></td>
<td>Seen: 16 (94.1)</td>
<td></td>
</tr>
<tr>
<td>Not removing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal cannulae group (n = 53)</td>
<td>Removing: 1 (3.3)</td>
<td>1.04 0.85</td>
</tr>
<tr>
<td></td>
<td>Not removing: 29 (96.7)</td>
<td></td>
</tr>
</tbody>
</table>

\( \chi^2 \), Chi-squared test.

Table 5 Distribution of characteristics related to the removal of oxygen delivery devices

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mask group (n = 40)</th>
<th>Nasal cannulae group (n = 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Removing person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient</td>
<td>19 (47.5)</td>
<td>2 (100)</td>
</tr>
<tr>
<td>Nurse</td>
<td>17 (42.5)</td>
<td>–</td>
</tr>
<tr>
<td>Doctor</td>
<td>12 (30)</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>48*</td>
<td>2 (100)</td>
</tr>
<tr>
<td>Reasons for removal by the patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling of distress</td>
<td>13 (68.3)</td>
<td>–</td>
</tr>
<tr>
<td>Feeling of nausea</td>
<td>4 (21.1)</td>
<td>–</td>
</tr>
<tr>
<td>To talk</td>
<td>1 (5.3)</td>
<td>–</td>
</tr>
<tr>
<td>Expectoration</td>
<td>1 (5.3)</td>
<td>–</td>
</tr>
<tr>
<td>Hurting their noses</td>
<td>–</td>
<td>1 (50)</td>
</tr>
<tr>
<td>Disturbing</td>
<td>–</td>
<td>1 (50)</td>
</tr>
<tr>
<td>Total</td>
<td>19 (100)</td>
<td>2 (100)</td>
</tr>
<tr>
<td>Reasons for removal by the nurse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td>8 (47.1)</td>
<td>–</td>
</tr>
<tr>
<td>To understand what patient says</td>
<td>6 (35.3)</td>
<td>–</td>
</tr>
<tr>
<td>Nausea</td>
<td>1 (5.9)</td>
<td>–</td>
</tr>
<tr>
<td>To moisten the patients’ lips</td>
<td>1 (5.9)</td>
<td>–</td>
</tr>
<tr>
<td>Oral medication</td>
<td>1 (5.9)</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>17 (100)</td>
<td>–</td>
</tr>
<tr>
<td>Reasons for removal by the doctor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To assess the patient’s speech quality</td>
<td>8 (66.7)</td>
<td>–</td>
</tr>
<tr>
<td>To understand what the patient says</td>
<td>4 (33.3)</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>12 (100)</td>
<td>–</td>
</tr>
</tbody>
</table>

* n was increased as oxygen mask was removed multiple times.

Discussion

Systemic reviews indicate that head and neck surgery is often accompanied by postoperative pulmonary complications (Qaseem et al. 2006, Smetana et al. 2006). Patients in our study had undergone thyroidectomy, which is included in this classification.

Increasing the alveolar oxygen concentration increases the oxygen diffusion pressure against the pulmonary capillary blood flow (Strachan & Noble 2001). Because it has been shown that therapeutic oxygen delivery in the early postoperative period increases oxygen saturation, prophylactic oxygen is currently delivered to most postoperative patients (Russel & Graybeal 1993). A study by Magboul et al. (1998) examining 300 patients with ASA classification I–II during the time they spent in PACU showed that mean SpO2 values in 10% of patients were <95%, even though the recovery scores of the patients were high; oxygen delivery during this period was therefore recommended. In Turkey, giving oxygen to all patients in the PACU is also recommended by Turkish Anaesthesiology and Reanimation Association (TARD 2005). Although the above researchers support oxygen delivery to patients in PACUs, oxygen delivery to patients during transport to the PACU is an issue still under discussion (Siddiqui et al. 2006). It has been reported from some studies that giving oxygen to patients during transport to the PACU decreases the incidence of hypoxemia (Tyler et al. 1985, Meiklejohn et al. 1987, Pullerits et al. 1987). However, Scuder et al. (1996) reported that oxygen delivery during transport was not capable of eliminating desaturation, even in healthy patients. In addition, a study by Mathes et al. (2001) showed that the majority of patients undergoing ambulatory surgery under general anaesthesia on a day care basis (other than those aged ≥60 years and weighing ≥100 kg) can safely be transported to the PACU while inhaling room air. In the institution in which our study was performed, the operating rooms are close to the PACU. Transport takes less than 2 minutes, and patients are therefore transported without oxygen.

In our study, mean SpO2 values in the NCG were higher than those in the MG. In addition, we found that oxygen delivery devices were more frequently removed in the MG than NCG. It is therefore thought that removal of the device effectively reduces oxygenation by interrupting the inhalation of oxygen. Therefore, SpO2 values in both groups were compared, again without considering removal of the oxygen delivery devices. In this comparison, we observed no differences between groups. The results in other existing studies were similar to this study (Nolan et al. 1992, Kobayashi et al. 1996). We therefore concluded that nasal cannulae were
What is already known about this topic

- Giving oxygen to patients in the postoperative period reduces the incidence of hypoxemia.
- Oxygen is generally delivered to patients through a face mask or nasal cannulae.
- Oxygen delivery methods are effective in maintaining the oxygenation of patients in the early postoperative period.

What this paper adds

- During the early postoperative periods, nasal cannulae are more efficient than oxygen masks in maintaining the oxygenation of patients undergoing thyroidectomy.
- Oxygen masks are more frequently removed than nasal cannulae by patients and healthcare personnel for various reasons during the early postoperative period.
- Patient satisfaction is higher for patients with nasal cannulae in the early postoperative period.

Implications for practice and/or policy

- Results of this study provide nurses with data for evidence-based applications in the selection of the correct oxygen delivery during the early postoperative period.
- Postanaesthesia care unit nurses should use of nasal cannulae to provide uninterrupted oxygen delivery in the early postoperative period for patients who have undergone thyroidectomy.
- Future studies should include cost analyses of the use of different oxygen delivery methods in the early postoperative period.

Studies evaluating the saturation status of patients using arterial blood gases analysis while maintaining the use of the oxygen delivery methods have shown that both methods are effective in improving patient oxygenation status (Loughnan et al. 2000, Baser et al. 2006). We also found that both methods were effective in delivering oxygen when the use of both methods was maintained.

Our study showed that oxygen masks were removed by almost all patients who became desaturatated. Patients did not become desaturatated unless the oxygen delivery device was removed, and removal of the oxygen mask was effective in allowing patients to become desaturatated. Similar to our study, Daley et al. (1991) found that 41% of patients inhaling oxygen through masks (10 L/minute) became desaturatated in the PACU. The reason for this desaturatation was removal of the oxygen delivery device.

Postoperative Nausea–Vomiting is still a frequent problem of anaesthesia and surgery, despite the use of various antiemetic drugs with prophylactic and therapeutic objectives (Purhonen et al. 2003, 2006). The incidence of PONV was reported by Turan et al. (2006) to be 10–80%. It has been reported that PONV incidence is particularly high following head and neck surgery (Alanoglu et al. 2003, Cekmen et al. 2003).

‘Aspiration risk related to PONV’ is a common nursing diagnosis during the early postoperative period (Lewis et al. 2004). In the animal study by Alwood et al. (2006), PONV or regurgitation developed in 38 out of the 162 dogs who underwent laparotomy. Postoperative pulmonary complications including hypoxemia (SpO₂ < 94%, PaO₂ < 85 mmHg) developed in 36.8% of these dogs. PONV incidence was measured in our study because we hypothesized that it leads to the removal of the oxygen mask to prevent aspiration as a result of nausea and vomiting. We found that nausea/vomiting led to removal of the oxygen mask in the MG. When the two groups were compared, the oxygen delivery device was removed in virtually no NCG patients but almost all MG patients with nausea/vomiting. The oxygen mask has to be removed to prevent aspiration in patients with nausea/vomiting. Therefore, using nasal cannulae in patients with a high potential for nausea/vomiting appears to be advantageous for providing uninterrupted oxygen delivery.

We found that the oxygen mask was removed by patients caused by a feeling of distress. The mask removed by nurses and doctors because of patient nausea/vomiting or to assess the patient’s speech quality respectively. The reason for checking speech quality was to assess whether there was recurrent laryngeal nerve damage, which is one of the major complications of thyroidectomy. This is a potential operative complication specific to thyroidectomy, and consequently, mask removal to assess this is not an issue with most other surgical procedures. Nasal cannulae were not removed by doctors and nurses, however, as they formed no obstacle to their interventions. In other studies similar to ours performed during the late postoperative period, oxygen masks were mostly removed and replaced with nasal masks because patients found them distressing and/or they caused difficulties in nursing care (Nolan et al. 1992, 1993, Zevola & Maier 2001). Similar to the studies mentioned above, no marked difficulties in patient care or communication were observed with the use of nasal cannulae in our study.

One of the approaches used today to evaluate healthcare quality involves monitoring patient satisfaction. Patient
satisfaction brings together patient compliance and a factor that might have positive effects on the outcome (Yılmaz 2001, Tükel et al. 2004). Therefore, patient satisfaction with regard to the oxygen delivery method was also determined in our study. We found that patient satisfaction was higher in the NCG than MG. Similar to this study, studies with different patient groups have also shown that patient satisfaction was greater when oxygen was delivered through nasal cannulae rather than masks (Gift et al. 1995, Zevola & Maier 2001, Sasaki et al. 2003, Eastwood et al. 2004, Baser et al. 2006).

Study limitations

The ASA classification and BMI were not similar between groups and this was a limitation of the study. The lack of validity and reliability studies on the scales used in the assessment of nausea/vomiting and patient satisfaction may also be considered a limitation. However, these scales have been widely used in many studies and applications. Transporting the patients to the PACU without oxygen is another limitation. This is still a controversial topic in the literature. As there were no differences in the oxygenation status of the two groups before oxygen delivery, this limitation did not affect our results.

We recommend that the future researchers take these limitations into consideration and examine different patient populations as well as different types of surgery. In additional, future studies should include cost analyses for the use of oxygen delivery methods in the early postoperative period.

Conclusion

Patient saturation status is affected by the oxygen delivery method. Therefore, characteristics of the patients and the type of surgery must be taken into consideration when selecting the oxygen delivery method. Both methods are effective when the correct method is used for the correct patient. We recommend the use of nasal cannulae in the early postoperative period for patients who have undergone thyroidectomy.

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Conflicts of interest

No conflicts of interest has been declared by the authors.

Author contributions

HA, EI, MEO and EO were responsible for the study conception and design. HA, EI, ST and EO performed the data collection. HA and EI performed the data analysis. HA, EI and MEO were responsible for the drafting of the manuscript. HA, EI, ST and MEO made critical revisions to the paper for important intellectual content. HA, EI and ST provided statistical expertise. EI supervised the study.

References


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