COMPARISON OF NASAL CANNULAE WITH FACE MASK FOR OXYGEN ADMINISTRATION TO POSTOPERATIVE PATIENTS

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SUMMARY
Thirty postoperative patients were allocated randomly to receive oxygen by Hudson face mask at 4 litre min⁻¹ (group I) or 2 litre min⁻¹ (group II) via nasal cannulae. From 22:00 on the first night after operation, the position of the nasal cannula or face mask was observed for 8 h using video and oxyhaemoglobin saturation (SpO₂) recorded simultaneously. In group I the mask remained on and positioned correctly in five patients. In the 10 other patients it was removed a total of 28 times, 17 for nursing tasks, for a median time of 2 min 39 s (range 30 s to 7 h 40 min 40 s). In group II the nasal cannula was removed once in one patient for 16 min 38 s and eight times in another for a total of 1 h 18 min 7 s. Average SpO₂ with mask on was 98% (range 96.1–99.9%), with mask off 95% (range 89.8–98.8%) and with cannula 97% (range 90.8–99.3%). We conclude that nasal cannulae are more likely to remain in position than face masks and maintain an adequate saturation in most patients. (Br. J. Anaesth. 1993; 70: 440-442)

KEY WORDS

Some patients experience episodes of hypoxaemia after abdominal surgery [1, 2] and supplementary oxygen by face mask may prevent these episodes [3]. However, in a previous study [4] we showed that a face mask is often removed for routine nursing tasks, and patients are frequently hypoxaemic during these periods of mask removal. When nasal cannulae are used, many nursing tasks, such as mouth care and temperature measurement, do not interfere with the delivery of oxygen. We therefore determined if nasal cannulae are more likely than face masks to remain positioned correctly and ascertained the effect of mask or cannula position on oxyhaemoglobin saturation (SpO₂).

METHODS AND RESULTS
After Ethics Committee approval and patient consent to video observation and pulse oximetry, 30 ASA I–III patients (six men) undergoing elective abdominal surgery were allocated randomly to two equal groups. Group I received oxygen by Hudson face mask at 4 litre min⁻¹ and group II received oxygen 2 litre min⁻¹ by nasal cannulae. In group I, mean age was 67 yr (range 47–82 yr) and mean weight 66 kg (range 49–102 kg). In group II, mean age was 50 yr (range 26–75 yr) and mean weight 72 kg (range 48–105 kg). Anaesthetic technique and postoperative analgesia were not standardized, but the majority of patients in each group (60–80%) received i.m. opioids. Correct placement of the mask or cannula was confirmed at the start of the 8-h period from 22:00 on the first night after operation and neither the patient nor the ward staff was aware of the purpose of the study. The technique used was identical to that of the previous study [4]. A video camera operating in ambient light was used to record the patient’s face, the position of the mask or cannula and the time as indicated by a clock within the field of view. SpO₂ was recorded with an Ohmeda 3700e pulse oximeter. The oximeter reading was sampled approximately every 15 s and the digital value placed into a computer spreadsheet. Patients were asked also if they found the mask or cannula comfortable, uncomfortable or a nuisance. The following were determined from review of the video recordings:
(1) The number of times that the nasal cannula or mask was removed or replaced and the associated events.
(2) The duration of time for which the cannula or mask was on or off.
(3) Changes in SpO₂ with alterations in cannula or mask position.

In group I, the mask remained on continuously and positioned correctly in five patients. In the 10 other patients it was removed a total of 28 times (range 1–6 times per patient) and remained off for median time of 2 min 39 s (range 30 s to 7 h 40 min 40 s). In five patients on eight occasions, the mask was off for more than 10 min (median 54 min 47 s; range 13 min 26 s to 7 h 40 min 40 s). In group II, the nasal cannulae remained positioned correctly in 13 patients and were removed once in one patient for 16 min 38 s and eight times in the other for a total of 1 h 18 min 7 s (median 3 min 32 s; range 1 min 0 s to 50 min 8 s). One patient in group I had a lesser average SpO₂ (85%) with the mask on than with it off.
POSTOPERATIVE OXYGEN THERAPY

Table 1. Events associated with oxygen mask removal

<table>
<thead>
<tr>
<th>Event</th>
<th>Total times mask removed (No.)</th>
<th>Average (range) time mask off for this event (h:min:s)</th>
<th>Time mask off for this event (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth care</td>
<td>13</td>
<td>0:01:49 (0:00:30-0:04:48)</td>
<td>2</td>
</tr>
<tr>
<td>Removed by patient</td>
<td>9</td>
<td>01:00:00 (0:01:46-07:40:40)</td>
<td>46</td>
</tr>
<tr>
<td>Temperature observation</td>
<td>4</td>
<td>02:17:24 (0:01:15-06:18:48)</td>
<td>46</td>
</tr>
<tr>
<td>Vomiting/retching</td>
<td>2</td>
<td>0:35:16 (0:02:01-01:08:31)</td>
<td>6</td>
</tr>
</tbody>
</table>

(91%). This patient’s \(\text{SpO}_2\) was satisfactory at the start of the study period when the mask was on. After the patient was turned, \(\text{SpO}_2\) decreased and remained less than 90%, for approximately 4 h, despite the mask being positioned correctly. The patient slept for part of this time and was examined also by a doctor who auscultated the chest. When the mask was removed, \(\text{SpO}_2\) increased and remained between 90% and 95% when the mask was again replaced. One possible explanation is that the mask may have become disconnected from the oxygen source when the patient was turned initially. The oxygen outlet was, unfortunately, not within the view of the video. This patient has been excluded from analysis of \(\text{SpO}_2\) values. In the other patients, mask removal resulted in a median decrease in \(\text{SpO}_2\) of 2% (range 0–8%). In the two patients in whom the nasal cannula became displaced, \(\text{SpO}_2\) decreased by 1.3% in the patient with a single removal and by a median of 2.3% (range 0–5.5%) in the other patient. Average \(\text{SpO}_2\) with the mask on was 98% (range 96.1–99.9%) and with the mask off 95% (range 89.8–98.8%). Average \(\text{SpO}_2\) with the cannula on was 97% (range 90.8–99.3%). In the two patients in whom the cannulae were removed, average \(\text{SpO}_2\) were 92% and 99% with the cannulae on and 91% and 95% with the cannulae off. In group I, \(\text{SpO}_2\) was \(\leq 89\%\) for 2.4% of the study period and the mask was off for 99.5% of this time. In group II, \(\text{SpO}_2\) was \(\leq 89\%\) for 2% of the study and the nasal cannulae were off for 0.7% of this time. In group I, \(\text{SpO}_2\) was \(\geq 95\%\) for 87% of the study time and the mask was on for 97.9% of this time. In group II, \(\text{SpO}_2\) was \(\geq 95\%\) for 82.6% of the study time and cannulae were on for 100% of this time. The events associated with mask removal are shown in table 1.

The mask was removed for mouth care and temperature measurement on 17 occasions and accounted for approximately 50% of the total time that the mask was off. The nasal cannulae were removed once for mouth care, seven times by the patient and once for the patient to get out of bed.

**COMMENT**

Hypoxaemia is a frequent occurrence in the 24 h after abdominal surgery [1, 2]. Supplementary oxygen by face mask can prevent these episodes of hypoxaemia [3]. However, in a previous study we observed that patients do not always receive the oxygen prescribed because the mask is often removed for routine nursing tasks such as mouth care and temperature measurement [4]. In this study, we have shown that nasal cannulae are more likely to remain in position than face masks. They do not have to be removed for mouth care and oral temperature measurement and can remain in situ during retching and vomiting. The duration of time that the mask remained off for nursing care was variable, ranging from 30 s to 6 h 18 min 48 s and accounted for approximately 50% of the total time that the mask was off. Patient removal accounted for most of the remaining time that the mask was off. This was not reflected in the patients' assessment of mask comfort, as no patient found the mask uncomfortable, although 13% of patients thought it a nuisance.

This study was carried out on the same wards as our earlier work [4] in which the mask remained on continuously and positioned correctly in only one of 20 patients. The nursing staff were unaware of the purpose of the studies and the improvement seen in mask placement in the present study may reflect a growing awareness of the importance of administering oxygen after operation. Specific instructions on the importance of mask placement may further improve mask positioning and this is now being investigated.

The average \(\text{SpO}_2\) with the cannulae on was 97% and the average \(\text{SpO}_2\) for each patient was always greater than 90% (range 90.8–99.3%), so we can conclude that oxygen administered via nasal cannulae maintained an adequate \(\text{SpO}_2\) in the majority of patients. Previous work has shown that face masks, nasal catheters and nasal cannulae prevent postoperative hypoxaemia with equal success and that there is no significant difference between nasal cannula and mask [5]. The percentage of oxygen delivered to our two groups was not identical, but probably reflected clinical practice. An oxygen flow of 2 litre min\(^{-1}\) via mask or nasal catheter delivers a mean oropharyngeal oxygen concentration of 28% and at 4 litre min\(^{-1}\) a mean concentration of 38% [6].

Sixty percent of patients found the nasal cannula comfortable and 87% of patients said the mask was comfortable. The cannulae used were simple plastic nasal prongs and the addition of a foam collar at the anterior nares, as described in a previous study [6], may increase patient acceptability. This study confirms that administering oxygen by face mask is unreliable. Nasal oxygen is of no benefit in patients with obstructed nasal passages. We did not attempt to assess nasal patency in our patients and nasal
cannulae proved to be an effective way to deliver oxygen. They are cheaper than most masks and are acceptable to the majority of patients.

REFERENCES