# Hypoxaemia in adults in the post-anaesthesia care unit

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*Continuous pulse oximetry was performed on 173 adults after general anaesthesia for elective inpatient surgery, throughout their post-anaesthesia care unit (PACU) stay. Supplemental oxygen was administered for ≥30 min after arrival and subsequently discontinued before discharge to the ward. The mean and minimum oxyhaemoglobin saturation ($SpO_2$) after discontinuing oxygen were lower than those values achieved during oxygen administration and preoperatively ($P < 0.001$). At least one hypoxaemic episode ($SpO_2$ ≤90% for ≥15 sec) occurred in 70 subjects (41%) and 45 of these had a moderate-severe episode ($SpO_2$ ≥90% for ≤2 min or $SpO_2$ ≤85%). The hypoxaemic episodes began 20 ± 20 min (range 1–100; median 15) after discontinuing supplemental oxygen. Cyanosis was detected in only four of the 70 patients who desaturated. Factors associated with hypoxaemia were: ASA physical status class; surgical duration ≥90 min; and preoperative mean $SpO_2$ <95%. Factors not associated with hypoxaemia were: age, sex, % ideal body weight, smoking history, preoperative minimum $SpO_2$, premedication and type of surgery. In conclusion, after discontinuing supplemental oxygen in the PACU, hypoxaemia was common, difficult to detect clinically, and associated with ASA class, surgical duration and preoperative mean $SpO_2$.*

*Nous avons monitoré continuellement la saturation artérielle en oxygène par oxymétrie pulsée en salle de réveil chez 173 adultes hospitalisés pour une intervention chirurgicale élective. Les patients respiraient un supplément d'oxygène pendant les 30 premières minutes de leur séjour en salle de réveil. Les valeurs minimales et moyennes en oxyhémoglobine enregistrées après l'arrêt du supplément en oxygène diminuaient en dessous de celles de la période précédente et de celles mesurées avant l'intervention chirurgicale. Au moins un épisode d'hypoxémie ($SpO_2$ ≤90% durant au moins 15 sec) est survenu chez 70 patients (41%) et l'hypoxémie était importante ($SpO_2$ ≤90% pendant au moins 2 min ou $SpO_2$ ≥85%) chez 45 d'entre eux. Elle apparaissait de 1 à 100 minutes après l'arrêt du supplément en oxygène, moyenne : 20 min, écart-type : 20 min, médiane : 15 min. Seuls quatre des patients qui désaturaient arboraient de la cyanose. Les facteurs associés à la survenue de l'hypoxémie étaient la classe ASA, un intervention chirurgicale de plus de 90 min et une $SpO_2$ moyenne <95% avant l'intervention. L'âge, le sexe, le poids des patients de même qu'une histoire de tabagisme, la $SpO_2$ minimale préopératoire, la prémédication et le type d'intervention chirurgicale n'influençaient pas l'incidence d'hypoxémie en salle de réveil.*

**Key words**
HYPOXIA: postoperative;
MEASUREMENT TECHNIQUES: pulse oximetry.

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The immediate postoperative period is a potentially high-risk time for the occurrence of hypoxaemia. Consequently, supplemental oxygen is administered routinely in the initial post-anaesthesia care unit (PACU) stay in many institutions. For most patients, however, it is usually discontinued before discharge to the ward, based on clinical criteria such as being awake with normal vital signs and no respiratory distress. This practice assumes that patients who fulfill these criteria are no longer at risk of hypoxaemia. The validity of this assumption has not been established and the available literature suggests that it is not valid.[1-5]

Pulse oximetry, by providing accurate,[6-8] objective measurements of oxygenation continuously and noninvasively is a useful technique for assessing the incidence of hypoxaemia in the PACU. In this study, it was employed in a diverse group of adults following general anaesthesia for elective inpatient surgery, throughout their PACU stay. Only those patients who usually have the supplemental oxygen discontinued before leaving the PACU were included. The incidence, severity, and time of onset of hypoxaemia and the relationship to possible associated factors were examined.

## Methods

The study was performed in accordance with our institutional review board. Informed consent was obtained from

TABLE I Patient exclusion criteria

| |
|---|
| Supplemental oxygen is not usually discontinued |
| - severe cardiopulmonary disease |
| - morbid obesity* |
| - thoracic, airway, intracranial surgery |
| Positive pressure ventilation is usually required |
| - major vascular surgery |
| - cardiac surgery |
| A disorder of respiratory regulation |
| - sleep apnea syndrome |
| - any neurological disease |
| Pulse oximetry may be an unreliable indicator of arterial oxygenation |
| - anaemia† |
| - hypotension‡ |

*≥200% of the ideal body weight (IBW), as determined by the formulae:[19]
males: IBW (kg) = height (cm) − 100
females: IBW (kg) = height (cm) − 105
†Haemoglobin <100 $gl^{-1}$ preoperatively or <90 $gl^{-1}$ in the PACU.
‡Systolic blood pressure <100 mmHg preoperatively or <90 mmHg in the PACU.

174 subjects scheduled for elective inpatient surgery. The inclusion criteria were: ASA physical status class I–III; ≥40 yr old; and surgery requiring general anaesthesia with tracheal intubation and positive pressure ventilation. The exclusion criteria are indicated in Table I.

The anaesthetic management was left to the discretion of the attending anaesthetist. The management in the PACU was also not actively influenced and the PACU staff were kept unaware of the results unless a moderate-severe hypoxaemic episode occurred (see below for definition). All patients were transferred from the operating room to the PACU breathing room air. Upon arrival in the PACU, supplemental oxygen was administered by a Hudson face mask at 10 $L \cdot min^{-1}$. This was removed after at least 30 min at the PACU nurse's discretion according to our usual PACU criteria (awake, with normal strength and vital signs, and no respiratory distress). Discharge was also determined by the PACU staff but required at least 45 min after removing the oxygen.

The subjects were monitored continuously with a pulse oximeter (Nellcor N-100®) from five min after arrival in the PACU until discharge. The alarms on the machine were turned off. The sensor was placed on a finger of the arm opposite the blood pressure cuff. An investigator constantly observed the patient and monitoring apparatus to ensure the presence of an adequate pulse signal and to eliminate artifacts produced by such events as patient movement or sensor dislodgement. The oxyhaemoglobin saturation ($SpO_2$) was recorded manually every five min and any time it decreased below the preceding five min value. The five min values were used to calculate the mean $SpO_2$ and all were used to determine the minimum $SpO_2$. A hypoxaemic episode was defined as an $SpO_2$ ≤90% lasting at least 15 sec. During these episodes, the respiratory rate (RR), respiratory pattern, presence or absence of central cyanosis, minimum $SpO_2$, duration of episode and level of consciousness (LOC) were recorded. The respiratory pattern was determined by visual inspection of the subjects' chest and abdominal movements. The LOC was graded as: 1 = fully awake; 2 = drowsy/asleep but easily aroused; or 3 = asleep and difficult to arouse. A moderate-severe episode was defined as an $SpO_2$ ≤90% for at least two min or an $SpO_2$ ≤85% for any duration. When these occurred, the PACU staff were notified, the patient was stimulated and supplemental oxygen resumed. The oxygen was administered for the remainder of the PACU stay and continued until the next day. Supplemental oxygen was also administered at the time of discharge from the PACU if, in the ten min before discharge, any hypoxaemic episode occurred or the $SpO_2$ was consistently 91–92%. The blood pressure, RR and LOC were also recorded routinely every 15 min in all subjects. The latter two measurements were performed while the patients were undisturbed, before the blood pressure was obtained.

Preoperative pulse oximetry was performed on 116 of the subjects for 15 min while resting quietly the night before surgery. The $SpO_2$ was recorded at one-minute intervals and any time it decreased below the preceding one-min value. The mean preoperative $SpO_2$ was determined from the one-minute values and the minimum using all values. If the preoperative $SpO_2$ was <91% at any time the patient was excluded from the study. This resulted in one patient being excluded, leaving a total of 173 subjects.

After the PACU data were collected, the patients' charts were reviewed to obtain information regarding factors which may be associated with the occurrence of hypoxaemia.

The data are presented as mean ± SD and range unless otherwise indicated. One-way repeated measures ANOVA was used to analyze the mean and minimum $SpO_2$ values preoperatively, while receiving supplemental oxygen in the PACU and after its removal. *Post-hoc* analyses using univariate F-tests were performed to compare the $SpO_2$ values at individual times. The fractions of desaturating and non-desaturating patients with a RR <10 bpm were compared by the Fisher exact test. The potential associated factors were examined by multiple logistic regression analysis. The analysis of the age group data from the Moller *et al.*[5] study reported in the Discussion was performed with Chi-square tests. All analyses were performed using the Systat® and Systat-Logit® (Systat, Evanston, Illinois) computer software programs. A $P$ value <0.05 was considered statistically significant for all the analyses except the F-tests. For these, $P < 0.001$

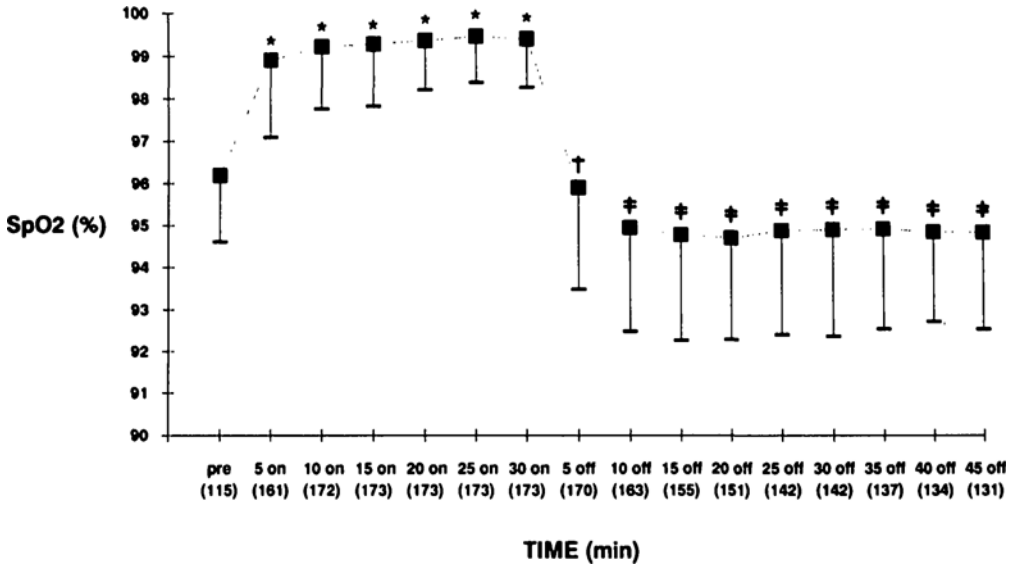


FIGURE 1 Average mean $SpO_2$ (mean ± SD) preoperatively (preop); during the first 30 min of supplemental oxygen administration in the PACU (5 on – 30 on); and during the first 45 min after discontinuation of the oxygen therapy (5 off – 45 off). The numbers in brackets indicate the number of patients included in the calculation of the $SpO_2$ at each time interval. *$P < 0.001$ vs preop and 5 off – 45 off. † $P < 0.001$ vs 10 off – 45 off. ‡$P < 0.001$ vs preop.

was required, using the Bonferroni correction due to the multiple comparisons performed.

## Results

Of the 173 subjects examined in this study, 77 were male and 96 were female. The mean age was 59.3 ± 11.7 yr (40–92) and % ideal body weight was 119 ± 25 (73–189). All patients except one received a "balanced" anaesthetic, with intravenous agents, $N_2O$ (60–70%) and isoflurane or halothane. The exception had a narcotic-based anaesthetic with no potent inhalational agents. No subjects were withdrawn from the study due to anaemia or hypotension in the PACU.

The subjects were monitored in the PACU for 57 ± 27 min (30–170) while receiving supplemental oxygen and 49 ± 27 min (5–130) after its removal. An $SpO_2$ value was not obtainable in 12 subjects at 5 min after arrival in the PACU and in one subject at 10 min after arrival, due to patient movement or peripheral vasoconstriction. In 131 patients, $SpO_2$ values were recorded for at least 45 min after discontinuing the supplemental oxygen. For the other 42 subjects, values were not available for the entire 45 min because the supplemental oxygen was resumed due to the occurrence of a moderate-severe hypoxaemic episode. The number of subjects included in the data analysis at each 5 min interval is indicated in Figure 1.

The average mean and minimum $SpO_2$ values preoperatively, while receiving supplemental oxygen in the PACU and after its discontinuation, are shown in Figures 1 and 2. The minimum $SpO_2$ while receiving supplemental oxygen occurred at 21 ± 21 min (5–168; median 15) after arrival in the PACU. The minimum $SpO_2$ while off oxygen occurred at 26 ± 18 min (2–110; median 23) after discontinuing the supplemental oxygen and 82 ± 32 min (32–218; median 75) after arrival in the PACU.

At least one hypoxaemic episode occurred in 70 (41%) of the subjects. A moderate-severe episode occurred in 45 of these desaturators (64% of those who desaturated; 26% of all patients). Supplemental oxygen was administered at discharge to the ward in 59 (34%) of all subjects (including the 26% with a moderate-severe episode). All hypoxaemic episodes occurred after the supplemental oxygen was discontinued. Every moderate-severe episode was managed successfully by resuming the oxygen therapy. The hypoxaemic episodes started 20 ± 20 min (1–100; median 15) after discontinuing the supplemental oxygen and 83 ± 31 min (32–185; median 80) after entering the PACU. The number of patients who started to desaturate during each 5 min epoch is shown in Figure 3.

For those subjects who desaturated, the number of hypoxaemic episodes per patient was 5 ± 5 (1–24; median 3), with mean and maximum durations of 93 ± 78 sec (15–310; median 70) and 146 ± 96 sec (15–357; median 140), respectively. The minimum $SpO_2$ during the episodes was 86.8 ± 2.1% (81–90; median 87). These values probably underestimate the number and severity of the episodes that would have been attained without the intervention of this study because the supplemental

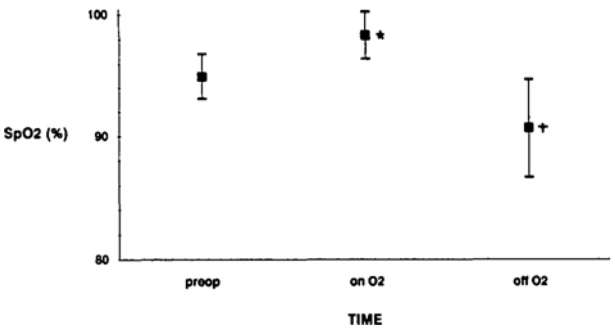


FIGURE 2 Average minimum $SpO_2$ (mean ± SD) preoperatively (preop); while receiving supplemental oxygen in the PACU (on $O_2$); and after discontinuation of the supplemental oxygen (off $O_2$). *$P <$ 0.001 vs preop and off $O_2$. †$P < 0.001$ vs preop.

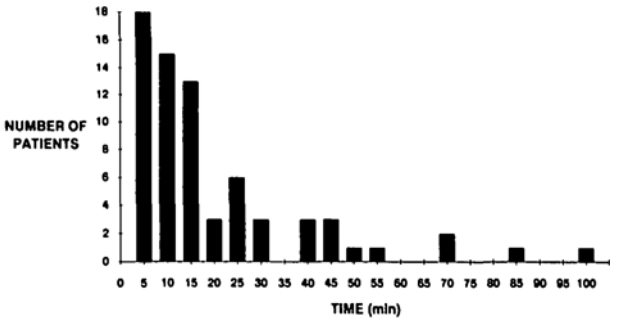


FIGURE 3 The number of patients who started to desaturate during each five-min epoch after discontinuation of the supplemental oxygen in the PACU.

oxygen was resumed immediately when a moderate-severe episode occurred. The RR was <10 bpm (6–8 bpm) in seven patients during at least one of their hypoxaemic episodes. Four patients who did not desaturate also had at least one recorded RR <10 bpm during the routine assessment of RR every 15 min. These fractions (7/70 vs 4/103) were not significantly different. Respiratory pattern abnormalities were present in 36 patients while hypoxaemic, including: partial upper airway obstruction (21); forced expiration (6); shallow respirations (5); and Cheyne-Stokes breathing (4). Since the presence or absence of these abnormalities was only recorded by the investigator during hypoxaemic episodes, it is not known whether they occurred in the same patients when they were not hypoxaemic or in those subjects who did not desaturate. All patients except one had a LOC score of 2 while hypoxaemic. The exception had a score of 1. However, all patients, whether hypoxaemic or not, had a score of 2 for the majority of their PACU stay. Cyanosis was detected by the investigator in only four subjects during their hypoxaemic episodes. It was noted by the attending PACU nurse in only one patient.

Factors associated with the occurrence of at least one hypoxaemic episode are shown in Table II. Those not associated were: age (40–64 yr 49/114; ≥65 yr 21/59); sex (male 32/77; female 38/96); smoking history (current 12/31; past 27/51; never 31/91); % ideal body weight (<120% 31/97; ≥120% 39/76); premedication (yes 52/123; no 18/50); surgical site (peripheral 28/59; perineal 5/33; lower abdominal 12/35; upper abdominal 25/46); and preoperative minimum $SpO_2$ (<95% 25/45; ≥95% 19/68). The lack of an association persisted when the variables were redefined as: premedication – narcotic vs benzodiazepine vs none; smoking history – current vs past and never or current and past vs never; and surgical site – peripheral and perineal vs lower abdominal vs upper abdominal or peripheral and perineal vs lower and upper abdominal.

TABLE II Factors associated with hypoxaemia

| | *Number of patients* | *% patients with ≥1 hypoxaemic episode* | *P value* |
|---|---|---|---|
| ASA physical status class | | | |
| I | 39 | 26 | <0.01 |
| II | 104 | 37 | |
| III | 30 | 73 | |
| Surgical duration | | | |
| <90 min | 77 | 27 | <0.05 |
| ≥90 min | 96 | 51 | |
| Preoperative mean $SpO_2$ | | | |
| ≥95% | 98 | 32 | <0.01 |
| <95% | 15 | 87 | |

## Discussion

The potential for hypoxaemia during the early recovery period following general anaesthesia has been known for decades. In the 1960's and early 1970's, several studies reported an average decrease in $PaO_2$ in the first two hours after surgery of 0.9–2.4 kPa (7–18 mmHg), obtained by one to three discrete blood gas analyses per subject.[9–10] More recently, pulse oximetry has been used to assess oxygenation in the PACU. Due to its continuous and noninvasive qualities, the pulse oximeter is well suited to monitoring large numbers of patients over time.

Previous PACU pulse oximetry studies have usually concentrated on one of two time periods: at arrival in the PACU; and during the PACU stay. The current study is an example of the latter because five minutes elapsed after arrival in the PACU (while subjects breathed supple-

TABLE III Previous pulse oximetry studies involving adults in the PACU

| *Subjects* | *Monitoring* | *Age* | *ASA class* | *In- or out-patients* | *Type of anaesthesia* | *Type of surgery* | *Incidence of hypoxaemia* | *Authors* |
|---|---|---|---|---|---|---|---|---|
| 161 | Intermittent | Paediatric and adult | I–III | In- and out- | General | Various (104 peripheral) | 0.6% ($SpO_2$ < 90%)* | Hudes ET *et al.*[14] |
| 164 | Continuous | Adult | I–II | Out- | General | Mostly gynecological | 7% ($SpO_2$ ≤ 92%)<br>4% ($SpO_2$ ≤ 90%) | Murray RS *et al.*[1] |
| 10 | Continuous | Adult | I | NA | General | Gynecological and peripheral | NA<br>(mean minimum $SpO_2$ 90 ± 3%) | Lim G *et al.*[2] |
| 241 | Intermittent | NA | I–IV | 147 in-<br>92 out- | 165 general<br>76 regional | Various | 14% inpatients ($SpO_2$ ≤ 90%)<br>1% outpatients ($SpO_2$ ≤ 90%) | Morris RW *et al.*[3] |
| 101 | Continuous | Paediatric and adult | I–IV | NA | NA | Various | 18% ($SpO_2$ < 90%) | Nakatsuka M *et al.*[4] |
| 200 | Continuous | Adult | I–IV | NA | General and regional | Various | 55% ($SpO_2$ ≤ 90%) | Moller JT *et al.*[5] |

NA = information not supplied by authors.
*Data obtained only while patients received supplemental oxygen.

mental oxygen) before monitoring was initiated. Although no studies have addressed the issue, it is probably appropriate to consider the two time periods as separate entities with potentially different causes and frequencies of hypoxaemia. For example, diffusion hypoxaemia and post-hyperventilation hypoxia may be important at the time of arrival in the PACU, but not during the later PACU stay. Several studies have reported hypoxaemia as a frequent occurrence on arrival in the PACU. Defining hypoxaemia as an $SpO_2$ < 90%, incidences of 19–61% have been noted in adult or teenager-adult populations[11–13] The incidence during the PACU stay has been less extensively studied. Previous pulse oximetry studies which examined this period in adults are summarized (Table III).

In this study, hypoxaemia was not detected during supplemental oxygen administration. This supports the usual clinical assumption and agrees with most previous studies.[14] However, Moller *et al.*[5] reported at least one hypoxaemic episode in 32% of a diverse group of adults. This may have been due to their use of nasal oxygen at ≥3 $L \cdot min^{-1}$. Williams *et al.*,[15] comparing different modes and rates of administration of supplemental oxygen in the PACU, noted a mean $PaO_2$ of 12.1 kPa (91 mmHg) with oxygen at 3 $L \cdot min^{-1}$ by nasal cannula and 21.5 kPa (162 mmHg) with 9 $L \cdot min^{-1}$ by Hudson face mask.

Analyzing the average mean $SpO_2$ over time revealed an increase above the preoperative value during oxygen therapy, a decrease to a level similar to that preoperatively at five minutes after discontinuation of the oxygen and a further decrease below the preoperative value at 10 min off oxygen and later. The mean $SpO_2$ values at 10 to 45 min off oxygen were similar. However, it must be noted that throughout the period off supplemental oxygen, progressively more patients were removed from the study due to moderate-severe hypoxaemic episodes. Therefore the average mean $SpO_2$ values at these times did not include the more severe desaturators and are probably higher than they would have been without the intervention of this study. The time course noted by Lim *et al.*[2] showing a progressive decrease in $SpO_2$ in the first hour after discontinuation of the supplemental oxygen and then a progressive increase, may more closely approximate the natural, undisturbed situation (at least in healthy adults after gynaecological or peripheral surgery).

At least one hypoxaemic episode occurred in 41% of the subjects after removal of the supplemental oxygen and 64% of these had a moderate-severe episode. This incidence is higher than we expected, especially since we included only those patients whom we usually considered to be at low risk of desaturating. It is also higher than most of the previous studies in this field. This disparity may be attributed to the use of only intermittent monitoring,[3] selection of only ASA I–II patients,[1] and/or inclusion of younger subjects[1–4] in these other studies. Our incidence is closer to, although slightly lower than, the 55% reported by Moller *et al.*[5] However, a direct comparison with our data is not appropriate since this 55% included an 8% incidence of hypoxaemia on arrival in the PACU and a 32% incidence while receiving supplemental oxygen (as discussed above).

The time of onset of hypoxaemic episodes was variable, with a mean of 20 min and median of 15 min after removal of the supplemental oxygen. For most patients the onset was within the first 30 min while off oxygen but in six cases the episodes started after 45 min. Since discharge to the ward was permitted at ≥45 min after discontinuation of the supplemental oxygen, our inci-

dence of hypoxaemia after this time may be an underestimate. Studies using more extended periods of monitoring are required to address this issue.

Cyanosis was detected in only four (6%) of the desaturating patients. This is similar to the 5% previously reported by Moller's group[5] and supports the classical observations of Comroe and Botelho that "visual impressions of cyanosis are unreliable."[16]

Although the aetiology of the hypoxaemic episodes was not directly addressed in this study, several observations were noted which may aid in designing future studies to assess this. The RR was <10 bpm in only 10% of the patients when hypoxaemic which was similar to the incidence in non-hypoxaemic patients. This suggests that a low RR per se is an insensitive and nonspecific predictor of hypoxaemia. The aetiological role of hypoventilation, however, cannot be assessed without concomitant measurement of tidal volumes. Respiratory pattern abnormalities, especially partial upper airway obstruction, were noted frequently during the hypoxaemic episodes. However, because of the subjective method of assessment and the lack of information whether such abnormalities occurred at other times, it is not appropriate to suggest a causal relationship. Continuous objective respiratory pattern monitoring is necessary to address this issue properly. Although our institution's official criteria for discontinuation of supplemental oxygen required the patients to be awake, all subjects had a LOC score of 2 (drowsy/asleep but easily aroused) for the majority of their PACU stay. The LOC score therefore did not differ between subjects during the hypoxaemic episodes and the same patients when not hypoxaemic or the non-desaturating patients. However, the scale used to assess this was quite gross, containing only three categories. A scale with more categories may have detected more subtle differences in LOC.

Factors associated with the occurrence of at least one episode of hypoxaemia were: ASA physical status class; surgical duration ≥90 min; and preoperative mean $SpO_2$ < 95%. The association with ASA class and surgical duration support the results of previous studies.[3,4] The association with the preoperative $SpO_2$ is not surprising, but differs from one previous study[1] which examined this. That study, however, examined only healthy outpatients, all of whom had a preoperative $SpO_2 \geq 95\%$.

Factors not associated with the occurrence of hypoxaemia were: age, sex, % ideal body weight, smoking history, preoperative minimum $SpO_2$, premedication, and surgical site. The lack of association with sex, ideal body weight, premedication and surgical site has been noted in most previous studies.[4,5] Morris *et al.*,[3] however, reported obesity and body cavity surgery as predictive factors. Their statistical analysis may have accounted for the discrepancy because they: used no method to compensate for relationships between associated factors; and accepted a $P$ value $<0.05$ for significance despite performing multiple comparisons, which would more appropriately require a lower $P$ value (using the Bonferroni correction). The association with age has varied in previous studies. The association noted in some of these may be explained by differences in the age groups examined. For example, closer analysis of the Moller *et al.*[5] data reveals that although the 18–39 yr group had a lower incidence of hypoxaemia than those ≥40 yr, there was no difference between the 40–60 yr and >60 yr groups, which are similar to the ages examined in the current study. Similarly, Morris's group[3] reported an association with age, but only examined the ≤40 yr and >40 yr groups. This suggests that although adults <40 yr have a lower risk of developing hypoxaemia than those >40 yr, age beyond 40 yr is not an important predictive factor. The role of a smoking history is also controversial. This may be at least partly due to differences in the severity of chronic lung disease between the populations studied. In the current study, for example, subjects with severe lung disease were excluded. In addition, studies failing to distinguish between hypoxaemia on arrival in the PACU and during the PACU stay when assessing potential risk factors[4,5] are difficult to interpret, as discussed above. The association noted by Nakatsuka's group[4] is also questionable because their statistical analysis has the same deficiencies as the Morris *et al.*[3] study.

Although the pulse oximeter may have limitations, especially in the presence of peripheral vasoconstriction, it appeared to function well. It failed to provide data in just 12 patients for only the first five to ten minutes after arrival in the PACU. The instrument used (Nellcor N-100®) has an accuracy of approximately ±2% in the $SpO_2$ range examined in this study.[7,8] We acknowledge that a more sophisticated model with such features as a plethysmographic display, EKG synchronization and improved software, would have been preferable.

The clinical importance of the hypoxaemic episodes detected in this study is unknown. The occurrence of moderate-severe episodes in 26% of the subjects is a potential concern and most clinicians would consider similar findings during the intraoperative period to be unacceptable. However, there is no evidence to suggest that such episodes in the PACU period effect morbidity or mortality. To the contrary, evidence of similar episodes during sleep in normal healthy adults suggests that they may simply reflect respiratory events occurring in normal sleep. Block's group,[17,18] for example, have noted at

least one episode of $SpO_2 < 90\%$ in 43% of adult males and 40% of postmenopausal females during nocturnal sleep. Further investigations including preoperative monitoring during sleep and outcome analysis will be necessary to assess the significance of postoperative hypoxaemia.

In conclusion, 41% of the adult population studied had at least one episode of hypoxaemia during their PACU stay. A moderate-severe episode occurred in more than 50% of the desaturating subjects. Cyanosis was detected in only 6% of the patients while hypoxaemic. ASA physical status class, preoperative mean $SpO_2$ and surgical duration were associated with the occurrence of hypoxaemia.

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