For the purpose of uniformity among subjects of the three study groups, the blocks were performed at the completion of surgery. In clinical practice, however, it may be more appropriate to place the blocks before the start of surgery, but following anesthesia induction, in order to reduce the general anesthetic requirements, obviate the need for endotracheal intubation, and possibly shorten recovery and discharge time.

In conclusion, we found that both ilioinguinal/iliohypogastric nerve blocks and caudal blocks administered following inhaled anesthesia for orchiopexy are safe, and effective in controlling the postoperative pain of children. The administration of a small (1–2 mcg/kg) iv dose of fentanyl is an acceptable alternative for relief of the pain which usually accompanies orchiopexy.

The authors would like to thank Urs E. Ruttimann, Ph.D., for performing the statistical analysis in this study.

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Anesthesiology
66:834–836, 1987

Oxygen Saturation during Preinduction Placement of Monitoring Catheters in the Cardiac Surgical Patient

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Preoperative arterial hypoxemia in patients undergoing surgery for myocardial revascularization could increase the risk of myocardial ischemia and infarction. The contribution of premedication, such as morphine and scopolamine, to arterial hypoxemia preoperatively is unclear.[1,2] However, excessive sedation from premedication in such patients may depress ventilation with resultant hypoxemia. In addition, the effect of the head-down position used during insertion of monitoring catheters may adversely affect an already compromised cardiovascular system with the potential for resultant hypoxemia. Therefore, supplemental oxygen *via* nasal cannulae is often given during the placement of invasive monitoring catheters.

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Received from the Department of Anesthesia, The Pennsylvania State University College of Medicine, PO Box 850, Hershey, Pennsylvania 17033. Accepted for publication January 15, 1987. Presented in part at the American Society of Anesthesiologists Meeting, Las Vegas, Nevada, October, 1986. Supported by the Department of Anesthesia.
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Key words: Analgesics: morphine. Measurement techniques: pulse oximetry. Premedication: scopolamine.

We examined the requirement for supplemental oxygen during monitoring catheter insertion in premedicated, unanesthetized patients. Our results strongly support the need for supplemental oxygen and/or continuous monitoring of arterial hemoglobin oxygen saturation (SaO_2) during insertion of monitoring catheters in these patients.

Methods

With Clinical Investigation Committee approval, we studied 38 patients, (ages 42–74 yr) presenting for elective myocardial revascularization operations. Patients having combined valve and coronary bypass operations, as well as those receiving supplemental oxygen prior to surgery, were excluded.

Each patient's baseline SaO_2 was determined on the day prior to surgery in the supine position while breathing room air. Morphine sulphate, 0.1 mg/kg, and scopolamine, 0.4 mg, were administered to each patient IM 60–90 min before transport to the operating room. Immediately after arrival in the operating room and continuously throughout placement of intravenous, radial arterial, and internal jugular pulmonary artery catheters, beat-to-beat measurement of SaO_2 was obtained by pulse oximetry.* All patients were placed in the head-down position to facilitate cannulation of the internal jugular vein. The degree of head-down position was variable. Nasal cannulae were placed immediately after arrival in the operating room. However, no oxygen was administered routinely. If any patient's SaO_2 dropped below 90%, then oxygen was administered in a step-wise incremental fashion. Oxygen administration was initiated with $2\ l \cdot min^{-1}$ and increased in increments of $1\ l \cdot min^{-1}$ until the SaO_2 was ≥95%. Additional sedation was administered during the study period if needed for patient comfort. Sedation consisted of up to 5 mg of diazepam iv or up to 2.5 mg of midazolam iv, and/or up to 100 μg of fentanyl iv. The study was completed with the commencement of anesthetic induction. Hypoxemia was defined as an $SaO_2 < 90\%$.

Preoperative pulmonary risk factors were defined as: 1) greater than 40 pack/yr smoking history, 2) pulmonary symptoms other than shortness of breath related to angina, or 3) chest radiographic findings consistent with chronic obstructive pulmonary disease. Poor ventricular function was defined as a cardiac index of $<2.5\ l \cdot min^{-1} \cdot m^{-2}$ and left ventricular end diastolic pressure of >18 mmHg, and abnormal ventricular contraction on ventriculography.

The relationships of pulmonary risk factors and additional sedation to supplemental oxygen requirements were analyzed using the Chi-square Test. The relationship of patient age to supplemental O_2 requirements and the comparison of preoperative SaO_2 with initial operating room SaO_2 were analyzed using the Student's *t* test. The relationships of height/weight ratio and body surface area to supplemental oxygen requirements were analyzed using the Mann-Whitney Test. Values are presented as mean ± SEM. Statistical significance was defined as $P < .05$.

Results

Eighteen patients (47%) had discernible pulmonary risk factors. Four patients (11%) demonstrated preoperative angiographically documented poor ventricular function. Two of these four patients developed hypoxemia during monitoring line insertion.

The mean preoperative SaO_2 while breathing room air was 96.3 ± .3%. The mean initial operating room SaO_2 was 95.1 ± .4% ($P = .0026$). An $SaO_2 < 90\%$ occurred in 20/38 (53%) of patients breathing room air during placement of invasive monitoring catheters. Nineteen out of 20 patients were given supplemental oxygen.

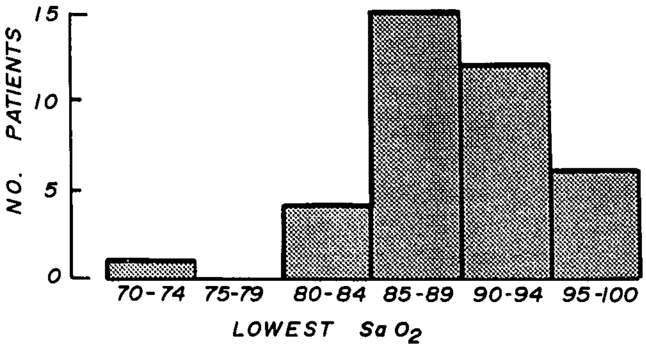

FIG. 1. A range of the lowest SaO_2 (%) for the study group.

One patient had a very transient fall in SaO_2 below 90% which recovered before oxygen flow could be initiated. The maximum O_2 flow necessary to increase the SaO_2 to ≥ to 95% for any patient was $4\ l \cdot min^{-1}$. The range of the lowest SaO_2 values for each patient during insertion of invasive monitoring catheters while breathing room air is shown in the figure. Fifteen patients' lowest SaO_2 ranged between 85–89%, four patients' lowest SaO_2 was between 80–84%, and one patient's minimum SaO_2 was 74%. This latter patient had angiographically documented poor ventricular function and had symptomatic congestive heart failure. His baseline SaO_2 determined on the day prior to surgery was 97%. Thus, this patient exhibited a decrease in SaO_2 of 23% (absolute) during insertion of monitoring catheters.

Thirteen of the 19 patients with hypoxemia were in the head-down position when oxygen was required. Ten of 13 patients in the head down position who required oxygen also had received additional sedation. Fourteen (78%) of the 18 patients who received additional sedation in the operating room became hypoxemic ($SaO_2 < 90\%$) and required supplemental oxygen (table 1). All patients who did receive additional iv sedation were easily arousable.

Individual factors not associated with the need for supplemental oxygen were pulmonary risk factors, patient age, patient height/weight ratio, and body surface area.

TABLE 1. Relationship of Additional Sedation in the Operating Room to Supplemental Oxygen Requirement

		Supplemental O_2 Required	
		No	Yes
Additional sedation in or	No n = 20	15 (75%)	5 (25%)
	Yes n = 18	4 (22%)	14 (78%)

$P < .005$ (Chi-square test).

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Discussion

Other groups have examined the effects of morphine and scopolamine premedication on oxygenation in patients undergoing myocardial revascularization, with conflicting results.[1,2] Dissimilar patient populations, nonuniform doses of morphine and scopolamine, and the limitations of intermittent static blood gas measurement may have contributed to the different results. Our study was performed to examine the need for supplemental oxygen in the operating room during insertion of invasive monitoring catheters in the premedicated, unanesthetized patient. The isolated effects of a morphine/scopolamine premedication on SaO_2, apart from the effects of monitoring line insertion and supplemental sedation, were not addressed in this study.

Although a statistically significant difference between the preoperative baseline and initial operating room SaO_2 existed, this difference of 1.2% SaO_2 (absolute) did not, in our opinion, warrant clinical intervention. The initial SaO_2 measurement was obtained after movement of the patient to the operating room table. This stimulation and arousal may have transiently increased SaO_2 secondary to a temporary increase in alveolar ventilation. However, our results do indicate that between 37% and 69% (95% confidence interval) of patients breathing room air in the operating room prior to myocardial revascularization operations will develop hypoxemia ($SaO_2 < 90\%$) during insertion of invasive monitoring catheters. These percentages may reflect the amount of premedication used. Also, since the largest decrease in SaO_2 occurred in the one patient with active congestive heart failure, a population of patients with a higher incidence of failure than this study may manifest more hypoxemic events during monitoring catheter insertion.

Additional sedation is sometimes given after these patients come to the operating room, and, indeed, this study demonstrates a strong association between additional sedation and an increased risk of hypoxemic episodes. Concomitant $PaCO_2$ was not measured at the time of desaturation to determine if hypoxemia was in part attributed to hypoventilation. A high incidence of patients (68%) who required supplemental oxygen were in the head-down position when the hypoxemic event occurred. The concomitant application of sterile drapes during internal jugular pulmonary artery catheter insertion, compression of the diaphragm by abdominal contents, and changes in left ventricular compliance of an ischemic myocardium precipitated by preload increases may all have contributed to the detrimental effects of the head-down position.

Lack of a relationship of supplemental oxygen requirements to age, body height/weight ratios, body surface area, and preexistent pulmonary risk factors make it difficult to identify any particular patient sub-groups at risk.

Slogoff and Keats have shown that patients coming to the operating room for myocardial revascularization operations manifest an 18% incidence of new ischemic changes by ECG on arrival.[3] The hypoxemia shown in our study could predispose these patients to additional ischemia before induction of anesthesia. Further studies to examine the incidence of hypoxemia after premedication in the patient's room prior to transport to the operating room would be clinically relevant. Additionally this risk of hypoxemia could be extrapolated to other patients similarly premedicated undergoing a variety of other noncardiac procedures.

In summary, we found a high incidence of hypoxemia in patients during insertion of monitoring lines after morphine/scopolamine premedication. Factors associated with these hypoxemic events included the head-down position and administration of supplemental iv sedation in the operating room. Therefore, it is our recommendation that SaO_2 be monitored continuously during the preoperative insertion of monitoring catheters, and/or supplemental oxygen routinely be administered during this vulnerable time period.

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