Does PEEP Improve Intraoperative Arterial Oxygenation in Grossly Obese Patients?

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Intestinal shortcircuiting is being performed more frequently to reduce weight in grossly obese patients. A multitude of challenging problems confronts anesthesiologists in the anesthetic management and postoperative care of these patients. One of the problems is the maintenance of adequate arterial oxygen tension. Recommended methods include controlled ventilation with large tidal volumes and high inspired oxygen mixture. This investigation was designed to evaluate the influence of positive end-expiratory pressure (PEEP) on arterial oxygenation during intermittent positive-pressure ventilation intraoperatively in patients with morbid obesity.

METHODS

Ten patients undergoing intestinal bypass operations were studied. Their mean age was 33.4 years (range 27 to 39) and mean weight was 155.4 kg (range 144.5 to 179). Premedication consisted of meperidine, diazepam and scopolamine. In addition to an iv line, percutaneous cannulation of a radial artery was performed upon arrival of the patient in the operating room.

Anesthesia was induced with thiopental, 400–600 mg, iv, after pretreatment with d-tubocurarine, 4 mg. Succinylcholine, 100–120 mg, was given to facilitate endotracheal intubation with a cuffed tracheal tube while cricoid compression (Sellick's maneuver) was applied by an assistant. Position of the tracheal tube was verified by auscultation and tracheal suction was performed. Anesthesia was maintained with enflurane, 1 to 2 per cent, in oxygen, and intermittent doses of d-tubocurarine as required. Ventilation was controlled at constant volume (1,000–1,200 ml) and rate (9 to 12/min) using an Air-Shields Ventimeter/Ventilator. Ventilatory adjustments were initially made to maintain Pao₂ between 30 and 40 torr. Arterial blood pressure and ECG were continuously displayed. Arterial blood was analyzed for pH, Paco₂, Pao₂, base deficit, and electrolytes.

After a clinically steady state was achieved, PEEP, 10 to 12 cm H₂O, was added utilizing a positive-expiratory-pressure valve (Model 4801, Boehringer Laboratories). The valve was placed on the expiratory side of the anesthesia machine for 35 to 50 minutes. Arterial blood samples were obtained in duplicate 5 minutes before PEEP was removed, thus serving as control. Samples were also obtained 2, 4, 20 and 30 minutes following discontinuation of PEEP. The study was performed while intestinal anastomosis was being done. From appropriate formulas, alveolar-to-arterial oxygen gradient [P(A-aD₀₂)] was calculated and compared with control values by means of the t test for paired data.

In three other obese patients undergoing ileojjunal bypass, the same anesthetic technique was used without PEEP. After a clinically steady state was achieved, [P(A-aD₀₂)] was measured every 20 minutes for 120 minutes.

Fluid administration consisted of 2,000–3,000 ml 5 per cent dextrose in lactated Ringer's solution. After completion of the operation, the effect of d-tubo-
curarine was antagonized with an atropine–neostigmine mixture. The patient was taken to the recovery room with the endotracheal tube in place and mechanical ventilation continued for the first 30 minutes of the immediate postoperative period.

RESULTS

Changes in [P(A-aD_{O_2})] are shown in figure 1. During application of PEEP, control [P(A-aD_{O_2})] was 367 torr (SEM ± 22). Two minutes after PEEP was removed, [P(A-aD_{O_2})] was 352 torr (SEM ± 24) (P < 0.05), while at 5 minutes it was 355 (SEM ± 23) (P < 0.05). At 20 minutes and 30 minutes, further decreases to 335 (SEM ± 20) and 323 torr (SEM ± 26) were observed, respectively. Values at 20 and 30 minutes were significantly lower than control values and values obtained 5 minutes after removal of PEEP, which was due to the increase in arterial oxygen tension. There was no significant change in pH, P_{ACO_2}, base deficit, or electrolytes.

In the three patients for whom PEEP was not used, no significant change in alveolar–arterial oxygen gradient or arterial oxygen tension was observed throughout the 120 minutes of observation.

DISCUSSION

Morbidly obese patients have FRC values below the closing volume, especially in the supine position. Dependent lung zones may be effectively closed throughout respiration, and inspired gas becomes distributed mainly to upper or non-dependent lung zones, resulting in a reduction in arterial oxygen tension. Consequently, severe reductions in arterial oxygenation may occur intraoperatively as well as postoperatively. Vaughan and Wise have recently shown that 40 per cent oxygen did not uniformly produce adequate arterial oxygenation during intra-abdominal surgery in otherwise healthy obese patients. Placement of a subdiaphragmatic pack or the head-down position resulted in reductions in P_{AO_2}. With the use of F_{IO_2} of more than 0.95 and high tidal volumes, arterial oxygen tension was well maintained in all our patients.

The finding that discontinuing PEEP resulted in a significant increase in arterial oxygen tension was surprising. This might be related to one or more of several factors. First, with the use of high tidal volumes, one might expect that superimposed PEEP would not have any added beneficial effect. Second, it is possible that an increase in lung volume with PEEP caused extensive redistribution of pulmonary blood flow to nonventilated regions, thus augmenting intrapulmonary shunt flow and venous admixture.

Third, reduction in cardiac output secondary to increased intrathoracic pressure might have contributed to the decrease in arterial oxygen tension with PEEP. Regardless of the mechanism, it is evident that the use of PEEP superimposed on high tidal volumes does not have any salutary effect on P_{AO_2} during the intraoperative management of grossly obese patients.

REFERENCES