

Anesthesiology  
50:174, 1979

## PEEP and Grossly Obese Anesthetized Patients

*To the Editor:*—Salem *et al.* have recently reported that discontinuance of 10–12 cm H<sub>2</sub>O PEEP from high-tidal-volume controlled ventilation in grossly obese anesthetized patients caused a decrease in A-aP<sub>O<sub>2</sub></sub>.<sup>1</sup> The abrupt (2 min) initial decrease in A-aP<sub>O<sub>2</sub></sub> from 365 to 350 torr was probably due to an increase in cardiac output following the removal of PEEP. The slower (5–30 min) subsequent decrease in A-aP<sub>O<sub>2</sub></sub> from 350 to 325 torr was probably due to the reversal of the PEEP-induced “redistribution of pulmonary blood flow to nonventilated regions, thus augmenting intrapulmonary shunt flow and venous admixture.”<sup>1</sup> There are quantitative data to support this contention.\* Salem *et al.* concluded “the use of PEEP superimposed on high tidal volumes does not have any salutary effect on Pa<sub>O<sub>2</sub></sub> during the intraoperative management of grossly obese patients.” We believe that their data do not warrant this conclusion.

First, Salem *et al.* imply by their conclusion that all levels of PEEP are ineffective in all obese patients undergoing surgical procedures. Surely with different age groups, position changes, presence of pulmonary disease, etc., the use of PEEP might be efficacious. Also, only one level of PEEP was used and, therefore, responses to lower or higher levels of PEEP were not determined. Kirby *et al.* have shown that high levels of PEEP are sometimes necessary to effect clinically significant decreases in intrapulmonary shunting.<sup>2</sup>

\* Moyce PR, Benumof JL, Wahrenbrock EA: Positive end expiratory pressure (PEEP) and hypoxic pulmonary vasoconstriction (abstract). American Society of Anesthesiologists Annual Meeting, 1977, pp 231–232.

Anesthesiology  
50:174–175, 1979

*In reply:*—Dr. Koehler states that contrary to the findings of our recently published report,<sup>1</sup> her experience has been that the application of PEEP is valuable in the anesthetic management of the morbidly obese. Her patients were anesthetized using a balanced technique while maintaining an inspired oxygen concentration (F<sub>I<sub>O<sub>2</sub></sub>) of 30 to 35 per cent. The use of an F<sub>I<sub>O<sub>2</sub></sub> of 0.3 to 0.35 seems inadvisable and may be dangerous to the grossly obese patient. Vaughan and Wise<sup>2</sup> have demonstrated that: 1) oxygen, 40 per cent, did not uniformly produce adequate oxygenation for intra-abdominal operations in otherwise healthy obese patients; 2) placement of a subdiaphragmatic pack resulted in a consistent decrease in Pa<sub>O<sub>2</sub></sub> in each patient to less than 65 torr even though F<sub>I<sub>O<sub>2</sub></sub> was 0.41; 3)</sub></sub></sub>

Additionally, the magnitudes of the changes in both cardiac output and intrapulmonary shunt flow due to PEEP, the balance between the two variables being a determinant of systemic arterial oxygenation, were not determined in the study of Salem *et al.* Although their patients received 2,000–3,000 ml dextrose, 5 per cent, in lactated Ringer's solution intravenously during the operation, the adequacy of this intravascular volume replacement was not determined particularly with respect to the application of PEEP. It would be of interest to know what happened to the A-aP<sub>O<sub>2</sub></sub> when PEEP was first applied. Using the mean data given for A-aP<sub>O<sub>2</sub></sub>, the calculated difference in total shunt fraction comparing control conditions with values 30 min after removal of PEEP is small (approximately 2–3 per cent of total cardiac output) and, therefore, is of questionable clinical significance.

RICHARD E. BERRYHILL, M.D.  
JONATHAN L. BENUMOF, M.D.  
*Anesthesia Research Laboratory  
University of California, San Diego  
School of Medicine  
La Jolla, California 92093*

### REFERENCES

1. Salem MR, Dalal FY, Zygmunt MP, et al: Does PEEP improve intraoperative arterial oxygenation in grossly obese patients? *ANESTHESIOLOGY* 48:280–281, 1978
2. Kirby RR, Downs JB, Civetta JM, et al: High level position end expiratory pressure (PEEP) in acute respiratory insufficiency. *Chest* 67:156–163, 1975

(Accepted for publication August 24, 1978.)

77 per cent of these patients had Pa<sub>O<sub>2</sub></sub> values of less than 80 torr at F<sub>I<sub>O<sub>2</sub></sub> 0.4. On the other hand, with the use of high F<sub>I<sub>O<sub>2</sub></sub> and high tidal volumes, Pa<sub>O<sub>2</sub></sub> values were well above 100 torr in all patients intraoperatively.<sup>1</sup></sub></sub>

Dr. Koehler does not provide any evidence derived from a prospective study, but rather a simple observation that when a Pa<sub>O<sub>2</sub></sub> value below 100 torr was encountered, the application of PEEP resulted in improvement in arterial oxygenation. We do not think that the difference between her observations and our findings could be attributed to either the surgical procedure or the myocardial depression resulting from the combined effect of enflurane and PEEP. We have not observed any increase in arterial oxygenation dur-

ing gastric bypass operations when PEEP was applied. Similarly, in patients anesthetized with narcotic drugs and nitrous oxide, 50 per cent, PEEP failed to increase  $Pa_{O_2}$ . The observed increase in  $Pa_{O_2}$  values (at  $F_{I_{O_2}}$  0.3) with PEEP in Dr. Koehler's cases might have resulted from altered ventilation-perfusion relationships. In our cases, the failure of PEEP to increase  $Pa_{O_2}$  values in grossly obese patients might be explained either by redistribution of pulmonary blood flow to nonventilated regions or by alterations in cardiac output.<sup>1</sup> Similar results have been previously seen in anesthetized patients when a resistance to exhalation was imposed.<sup>3</sup>

A valid criticism to our Clinical Report is that responses to different levels of PEEP were not determined. The clinical limitations did not permit us to study various levels. As Drs. Berryhill and Benumof have indicated, in certain situations high PEEP might be necessary to decrease intrapulmonary shunting effect. However, this does not seem to be efficacious in the anesthetized obese patient.

When PEEP was first applied in our patients, there was no significant alteration in alveolar-arterial oxygen tension differences. Furthermore, in a few patients, we observed that even with 15-17 cm  $H_2O$  PEEP, there was no concomitant increase in  $Pa_{O_2}$  values. Assuming that a certain level of PEEP may be effective in increasing  $Pa_{O_2}$  values, it would be rather difficult to find such "suitable PEEP" in the anesthetized obese patient. Acceptable levels of arterial oxygen tension could be obtained with ease in these patients simply by the use of large tidal volumes and high  $F_{I_{O_2}}$ . Recently, Eriksen *et al.*<sup>4</sup> found that PEEP was not superior to large tidal volumes in improving arterial oxygenation in anesthetized obese patients. Eriksen also found significant decreases in oxygen delivery (to 88 per cent of control) after 30 min of PEEP

ventilation, compared with those ventilated with large tidal volumes.<sup>4</sup>

One has to differentiate between the cardiorespiratory effects of PEEP in obese patients ventilated with small tidal volumes and in those for whom large tidal volumes are used. Our data indicate that when large tidal volumes and high  $F_{I_{O_2}}$  are used in anesthetized obese patients, adequate arterial oxygenation can be obtained. The use of PEEP superimposed on high tidal volumes does not seem to have any further salutary effect.

M. RAMEZ SALEM, M.D.  
*Professor and Assistant Chairman*  
MICHAEL P. ZYGMUNT, M.D.  
*Clinical Assistant Professor*  
MALI MATHRU, M.D.  
*Clinical Assistant Professor*  
*Department of Anesthesiology*  
*Stritch School of Medicine*  
*Loyola University*  
*Maywood, Illinois 60153*

#### REFERENCES

1. Salem MR, Dalal FY, Zygmunt MP, et al: Does PEEP improve intraoperative arterial oxygenation in grossly obese patients? *ANESTHESIOLOGY* 48:280-281, 1978
2. Vaughan RW, Wise L: Intraoperative arterial oxygenation in obese patients. *Ann Surg* 184:35-42, 1976
3. Cheney FW, Hornbein TF, Crawford EW: The effect of expiratory resistance on the blood gas tensions of anesthetized patients. *ANESTHESIOLOGY* 28:670-676, 1967
4. Eriksen J, Andersen J, Rasmussen JP, et al: Effects of ventilation with large tidal volumes or positive end-expiratory pressure on cardiorespiratory function in anesthetized obese patients. *Acta Anaesthesiol Scand* 22:241-248, 1978

(Accepted for publication August 24, 1978.)