University of California–San Diego Medical Center
Mail Code 8870
225 Dickinson Street
San Diego, California 92103

REFERENCES

1. Rosenbaum SH, Rosenbaum LM, Cole RP, Askanazi J, Hyman AI: Use of the flexible fiberoptic bronchoscope to change endotracheal tubes in critically ill patients. ANESTHESIOLOGY 54: 169–170, 1981
2. Watson CB, Prough DS, Balestrier FJ: Bronchoscopic tube changes in critically ill patients. Crit Care Med 8:246, 1980
3. Bedger RC, Chang JL: A jet stylet catheter for difficult airway management. ANESTHESIOLOGY 66:221–223, 1987
4. Williams RT, Maltby JR: Airway intubator. Anesth Analg 61:309, 1982
5. Rogers SN, Benumof JL: New and easy techniques for fiberoptic endoscopy–aided tracheal intubation. ANESTHESIOLOGY 59: 569–572, 1983
6. Gaughan S, Ozaki G, Benumof JL: Quantification of the jet function of a jet stylet (abstract). ANESTHESIOLOGY 75:A119, 1991
7. Benumof JL, Gaughan S, Ozaki G, Rusk R: Connecting a jet stylet to a jet injector (correspondence). ANESTHESIOLOGY 74:963–964, 1991
8. Cahen CR: An aid in cases of difficult tracheal intubation (correspondence). ANESTHESIOLOGY 74:197, 1991
9. Dogra S, Falconer R, Latto IP: Successful Difficult Intubation: Tracheal tube placement over a gum-elastic bougie. Anaesthesia 45:774–776, 1990
10. Schwartz KD, Johnson C, Roberts J: A maneuver to facilitate flexible fiberoptic intubation. ANESTHESIOLOGY 71:470–471, 1989

(Accepted for publication August 12, 1991.)

Anesthesiology
75:922–923, 1991

Perioperative Management of Patients Receiving a Lung Transplant

To the Editor:—Recently, Smiley *et al.*[1] described the use of independent lung ventilation following single lung transplantation for emphysema. Since 1989 we have provided perioperative care for 84 patients undergoing lung transplantation. Of these, 42 received a single lung, with 22 performed for end-stage emphysema. As the authors point out, the observed phenomenon of air-trapping with cardiovascular compromise had previously been the primary reason for considering emphysema a contraindication for single-lung transplantation. However, world-wide experience has demonstrated efficacy of the procedure in many patients,[2,3] and thus, at our institution, the most frequent lung transplant procedure has become single lung for emphysema.

Our accumulated experience has led us to believe that profound air-trapping in the native lung coupled with cardiovascular compromise is related primarily to two factors: 1) technical imperfections affecting the airway or venous anastomosis (producing a stiff, noncompliant transplanted lung), and 2) donor/recipient size mismatching. We have experienced this complication on two occasions, with one attributed to a stenotic left atrial cuff anastomosis and the other to a low donor/recipient predicted vital capacity ratio. The patient with pulmonary venous obstruction required retransplantation and has subsequently done well. In the second case we used differential ventilation postoperatively. Under this circumstance the transplanted lung was conventionally ventilated while the native lung was jet ventilated to minimize airway pressures. This patient subsequently died of an unrelated cause.

In our management of patients undergoing lung transplantation, we frequently use some form of differential lung ventilation (*i.e.*, high-frequency jet, continuous positive airway pressure, or oxygen insufflation applied to the nonventilated lung) to minimize intrapulmonary shunt. On two occasions we have used differential ventilation intraoperatively to improve secretion clearance and oxygenation during dissection of a lung in patients with cystic fibrosis. Under these circumstances the humidified gas jet mobilized tenacious secretions and improved oxygenation in patients who could not tolerate single lung ventilation.

Another facet of patient management we find important in minimizing hemodynamic and ventilatory complication is postoperative positioning. It is unclear from the case report whether this patient was supine or laterally positioned. It has been our experience that patients receiving a single lung transplant for emphysema or pulmonary hypertension do better with the transplanted side up, whereas the opposite is true for those with fibrosis.

Smiley *et al.*[1] appropriately pointed out the relative lack of information regarding anesthetic management for patients undergoing lung transplantation. We have recently described our experience with the first 51 lung transplants performed at our institution.[4] Our general approach to management of patients for single-lung transplantation differs in some respects to that described both by Smiley *et al.*[1] and others,[5,6] particularly with regard to placement of invasive monitors and selection of an endotracheal tube. We routinely place a pulmonary artery (PA) catheter *prior to* induction of anesthesia. While this approach may be more difficult due to orthopnea, tachypnea, and venous collapse, we believe that the benefit of central pressure monitoring during induction, initiation of positive pressure ventilation, intubation, and mechanical ventilation more than offsets the disadvantages. In addition, hypotension secondary to air-trapping, a phenomenon evident in the case report and one we have come to call "pulmonary tamponade," occurs, to some degree, in virtually every emphysematous patient, and prior to insertion of a PA catheter permits us to focus attention on stabilizing the patient's condition and initiating the surgical procedure, rather than on placing invasive monitors, during this vulnerable period. As pointed out by Smiley *et al.*,[1] periods of apnea may be required to restore cardiovascular stability. Knowledge of PA pressures along with hemoglobin oxygen saturation helps to determine what level of hypoventilation and hypercarbia can be tolerated without dramatic increases in PA pressure and systemic hypoxemia.

Differing opinions have been expressed regarding conventional endotracheal tubes with bronchial blocking balloon catheters or double-lumen endobronchial tubes for lung transplantation. Initially, we were placing a single-lumen endotracheal tube and bronchial blocker for left single-lung transplants; we now use a left endobronchial tube for both single and bilateral single procedures. Our surgical colleagues find this quite acceptable, and manually guide any required tube ma-

nipulation. Upon conclusion of the procedure, unless there are specific concerns about reintubation or differential lung ventilation, the endobronchial tube is replaced with an endotracheal tube.

In conclusion, as the field of lung transplantation continues to evolve, so must our therapeutic options for treatment of these exceptionally complex patients. While our approach to the patient described by Smiley *et al.*[1] may have been somewhat different, their success and experience provides valuable information.

PAUL M. HEERDT, M.D., PH.D.,
ANASTASIOS TRIANTAFILLOU, M.D.
Department of Anesthesiology
Division of Cardiothoracic Anesthesia
Washington University School of Medicine
660 South Euclid, Box 8054
St. Louis, Missouri 63110

REFERENCES

1. Smiley RM, Navedo AT, Kirby T, Schulman LL: Postoperative independent lung ventilation in a single-lung transplant recipient. ANESTHESIOLOGY 74:1144–1148, 1991
2. Mal H, Andreassian B, Pamela F, Duchatelle J-P, Rondeau E, Dubois F, Baldeyrou P, Kazis M, Sleiman C, Pariente R: Unilateral lung transplantation in end stage pulmonary emphysema. Am Rev Respir Dis 140:797–802, 1989
3. Trulock EP, Egan TM, Kouchoukos NT, Kaiser LR, Pasque MK, Ettinger N, Cooper JD, Washington University Lung Transplant Group: Single lung transplantation for severe chronic obstructive pulmonary disease. Chest 96:738–742, 1989
4. Triantafillou AN, Heerdt PM: Lung transplantation. Int Anesthesiol Clin 29:87–109, 1991
5. Conacher ID, McNally B, Choudry AK, McGregor CGA: Anesthesia for isolated lung transplantation. Br J Anaesth 60:588–591, 1988
6. Conacher ID: Isolated lung transplantation: A review of problems and a guide to anesthesia. Br J Anaesth 61:468–474, 1988

(Accepted for publication August 14, 1991.)