

- Rydman H: Comparison of intramuscular and epidural morphine for postoperative analgesia in the grossly obese: Influence on postoperative ambulation and pulmonary function. *Anesth Analg* 63:583-592, 1984
20. Hjortso N-C, Lund C, Mogensen T, Bigler D, Kehlet H: Epidural morphine potentiates pain relief and maintains sensory analgesia during continuous epidural bupivacaine after abdominal surgery. *ANESTHESIOLOGY* 65:A178, 1986
21. Rucci FS, Cardamone M, Migliori P: Fentanyl and bupivacaine mixtures for extradural blockade. *Br J Anaesth* 57:275-284, 1985
22. Ramanathan S, Horn R, Parker F, Turndorf H: Naloxone infusion is ineffective in preventing the side effects of epidural morphine in post-caesarean section patients. *ANESTHESIOLOGY* 65:A367, 1986
23. Rawal N, Schott U, Dahlstrom B, Inturrisi CE, Tandon B, Sjostrand U, Wennhager M: Influence of naloxone infusion on analgesia and respiratory depression following epidural morphine. *ANESTHESIOLOGY* 64:194-201, 1986
24. Metzger WJ: *Urticaria, angioedema, and idiopathic anaphylaxis, Allergic Diseases, Diagnosis and Management*, 3rd edition. Edited by Patterson R. Philadelphia, J.B. Lippincott Co., 1985, pp 440-458
25. Gustafsson LL, Schildt B, Jacosen K. Adverse effects of epidural and intrathecal opiates: Report of a nationwide survey in Sweden. *Br J Anaesth* 54:479-486, 1982
26. Stenseth R, Skellevoid O, Breivik H: Epidural morphine for postoperative pain: Experience with 1085 patients. *Acta Anaesthesiol Scand* 29:148-156, 1985

Anesthesiology
66:830-831, 1987

Bronchial Obstruction and Hypoxia during One-lung Ventilation

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One-lung ventilation using a double lumen endobronchial tube is often indicated during thoracotomy for lung resection to facilitate an operative exposure.¹ Burton *et al.*² recommend that the bronchial cuff of double lumen tubes remain deflated until the institution of one-lung ventilation to prevent bronchial rupture from excess cuff pressure. We report a case of bronchial obstruction secondary to migration of necrotic tumor from the non-dependent lung to the dependent lung during thoracotomy, prior to the institution of one-lung ventilation using a double lumen tube with a deflated bronchial cuff.

CASE REPORT

A 65-yr-old, 200 cm, 100 kg man with a history of hypertension, chronic obstructive pulmonary disease, hypothyroidism, and arthritis was scheduled for right middle and lower lobectomy for resection of squamous cell carcinoma. Preoperative metastatic workup was negative. Bronchoscopy revealed external compression of the right middle lobe bronchus and complete obstruction of the right lower lobe bronchus by tumor. Medications included IV aminophylline, beclomethasone and albuterol inhalers, levothyroxine 0.1 mg daily, and ranitidine 150 mg bid.

The patient was brought to the operating room where a 16-gauge peripheral iv and a 20-gauge left radial artery catheter were inserted. Additional monitoring included EKG, esophageal stethoscope, pulse oximeter, temperature probe, and urinary catheter. Anesthesia was induced with thiopental 6 mg/kg, fentanyl 250 µg iv and inhalation of isoflurane 1-2%, and O₂. Following succinylcholine 200 mg iv, a 35 French left-sided PVC endobronchial tube was inserted without difficulty. After the correct position of the double lumen tube was confirmed by auscultation,³ the bronchial cuff was deflated, and the patient was positioned in the left lateral decubitus position. Correct position of the double lumen tube was again confirmed, the bronchial cuff deflated, and anesthesia maintained with 1-2% isoflurane and O₂.

Following thoracotomy, the surgeon requested that two-lung ventilation be maintained while pleural adhesions were lysed. During manipulation of the non-dependent lung, peak inspiratory pressure (PIP) increased from 35 cm H₂O to 45 cm H₂O. There were no concomitant changes in heart rate, arterial blood pressure, breath sounds, or pulse oximeter readings. Shortly thereafter, one-lung ventilation was attempted by inflating the bronchial cuff and clamping the tracheal lumen; however, we were unable to ventilate the dependent lung, and very high PIP was noted. The tracheal lumen was immediately unclamped, but severe resistance to ventilation was still present. The tube was then withdrawn 4 cm without improvement. The pulse oximeter showed a rapid decrease in arterial saturation from 100-70% with an FI_{O₂} of 1.0. The bronchial lumen was suctioned with catheters and *via* a pediatric flexible fiberoptic bronchoscope; plugs of necrotic tissue were removed with difficulty. This proved inadequate with continued high PIPs and arterial desaturation to 50%. We then elected to turn the patient to the supine position and perform bronchoscopy. The double lumen tube was removed, and ventilation *via* mask was undertaken with a FI_{O₂} of 1.0 and an improvement in arterial saturation to 60%. Rigid bronchoscopy followed by fiberoptic bronchoscopy through a 9.0 endotracheal tube was performed. The bronchial tree was cleared of necrotic tissue with improvement of arterial saturation to 100%. After discussion with the surgeon, the decision was made to proceed with the operation because of the perceived danger of recurrent tumor migration if the diseased lung was not resected. A 37 French

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Received from Thomas Jefferson University, Jefferson Medical College, Department of Anesthesiology, Philadelphia, Pennsylvania. Accepted for publication January 7, 1987.

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Key words: Airway: double lumen tube; obstruction. Surgery: thoracic.

left-sided double lumen tube was then inserted and its position confirmed using flexible fiberoptic bronchoscopy. The bronchial cuff was left inflated during patient positioning, and subsequent lung resection was carried out using one-lung ventilation without difficulty.

DISCUSSION

One-lung ventilation using a double lumen endobronchial tube is recommended during thoracotomy for lung resection to improve operative conditions.¹ Burton *et al.* recommend deflating the bronchial cuff until the onset of one-lung ventilation to prevent bronchial rupture secondary to excessive cuff pressure.² We feel this recommendation may not be prudent during lung resection for obstructing endobronchial tumors.

Double lumen endobronchial tubes are recommended to prevent transbronchial spread of secretions due to tuberculosis with cavitation, long standing saccular bronchiectasis, chronic lung abscess, suppuration behind a bronchial carcinoma, other bronchial tumors, and sudden intrabronchial hemorrhage.^{4,5} Moody⁶ found that the incidence of ipsilateral and contralateral spread of bronchial secretions during 125 thoracotomies for pulmonary resection was 21.6%, including five deaths, all attributed to transbronchial spread of bronchial secretions. With continued advances in preoperative preparation and antibiotic therapy,⁷ these complications are increasingly rare; however, they may still occur, as evidenced by this report.

During this case, manipulation of the non-dependent lung expressed necrotic tumor tissue, which subsequently migrated to and obstructed the dependent lung bronchi. Several factors contributed to this event. First, a 35-French double lumen tube is small for a man of this patient's stature. A larger double lumen tube may have formed a more occlusive seal in the left mainstem bronchus and reduced the severity of, or prevented, the tumor migration we experienced. The use of small double lumen tube does not, however, preclude satisfactory tube placement and effective one-lung ventilation. Second, had the bronchial cuff been inflated at the time of lung manipulation, it presumably would have protected the dependent lung and prevented the near catastrophic bronchial obstruction and hypoxia that followed. Whether the same problem would have occurred at the end of the surgical procedure had the bronchial cuff been kept inflated is difficult to determine. We routinely suction the lumen supplying the non-dependent lung prior to removal of the double lumen tube; therefore, we presumably would have recognized the tissue in the trachea, been able to remove it prior to deflating the bronchial cuff and removal of the double lumen tube, and prevented the problems we encountered.

Based on the above case, we make the following recommendations relating to the use of double lumen tube.

First, a double lumen tube should be inserted during lung resection for patients with obstructing endobronchial lesions. The largest tube able to be accommodated by the larynx should be inserted and tube position should be verified by fiberoptic bronchoscopy, provided the appropriate equipment and trained personnel are available. By separating the lungs, the double lumen tube will avoid dependent lung contamination, as well as facilitating the operative exposure. Second, the bronchial cuff should be kept inflated following correct tube placement. To prevent bronchial rupture secondary to overdistension of the bronchial cuff, the bronchial cuff should be inflated using the least occlusive volume as described by Alfrey and Benumof.⁸ If nitrous oxide is used as part of the anesthetic, bronchial balloon pressure should be determined at regular intervals to prevent overdistension of the bronchial balloon⁹ and bronchial rupture.^{1,10} Third, prior to deflating the bronchial cuff at the time of extubation, the lumen supplying the non-dependent lung should be suctioned and cleared of all secretions; again, to prevent contamination of the dependent lung.

In summary, we present a case of bronchial obstruction secondary to tumor migration from the non-dependent lung to the dependent lung during thoracotomy, using a double lumen tube where the bronchial cuff was deflated prior to institution of one-lung ventilation. We feel that, by following the above recommendations, such an occurrence can be avoided in the future.

REFERENCES

1. Wood RE, Campbell D, Razzuk MA, Paolson DL, Urschel HC: Surgical advantages of selective unilateral ventilation. *Ann Thorac Surg* 14:173-180, 1972
2. Burton NA, Fall, SM, Lyons T, Graeber GN: Rupture of the left main-stem bronchus with a polyvinylchloride double lumen tube. *Chest* 83:928-929, 1983
3. Brodsky JB, Shulman MS, Mack JBD: Malposition of left-sided double lumen endobronchial tubes. *ANESTHESIOLOGY* 62:667-669, 1985
4. Bjork VO, Carlens E, Friberg O: Endobronchial anesthesia. *ANESTHESIOLOGY* 14:60-72, 1953
5. Bjork VO, Carlens E: The prevention of spread during pulmonary resection by the use of a double lumen catheter. *J Thorac Surg* 20:151-157, 1950
6. Moody JD: Endobronchial occlusion during pulmonary resection. *J Thorac Surg* 18:82-89, 1949
7. Pappin JC: The current practice of endobronchial intubation. *Anesthesia* 34:57-64, 1979
8. Alfrey DD, Benumof JL: *Anesthesia for Thoracic Surgery*, Anesthesia, Vol. 2. Edited by Miller RD. New York, Churchill Livingstone, 1981, pp 943-945
9. Bernhard WN, Yost LC, Turndorf H, Cottrell TE, Pagel RD: Physical characteristics of and rates of infusion of nitrous oxide diffusion into tracheal tube cuffs. *ANESTHESIOLOGY* 48:413-417, 1978
10. Foster JM, Ran OJ, Alimo EB: Ruptured bronchus following endobronchial intubation. *Br J Anaesth* 55:687-688, 1983