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Anesthesia for Laser Resection of a Tracheal Tumor in a Woman Pregnant with Twins

D. JILL ELLIS, M.D.,* WALTER L. MILLAR, M.D.,† THOMAS G. KARAGIANES, M.D.†

Bronchoscopic resection of airway tumors presents the anesthesiologist with special concerns of sharing the airway with the surgeon, maintaining ventilation and oxygenation in patients with airway obstruction, and avoiding incineration in the respiratory tract.[1] Caring for patients in the third trimester of pregnancy requiring general anesthesia necessitates avoiding aspiration of acidic gastric contents, ensuring optimal oxygenation of both mother and fetus, and maintaining a satisfactory intra-uterine environment.

Although diagnoses of tracheal tumors during pregnancy have been reported previously,[2–4] anesthetic considerations for surgery on these tumors during pregnancy have not been presented in the literature. We report a case of a patient undergoing tracheal tumor resection with a neodynium-yttrium-aluminum garnet (YAG) laser, during the third trimester of a twin pregnancy, and discuss many factors complicating the care of this patient.

CASE REPORT

A 26-yr-old woman was admitted to the hospital for bronchoscopy and laser resection of a tracheal tumor. For 2 yr she had been treated intermittently with theophylline and steroids for presumed asthma. Two months previously, she had developed increased shortness of breath refractory to medical management. One month later, a 5-cm polypoid tumor involving the left side of the distal trachea and carina was diagnosed by tomograms and bronchoscopy. Significant dyspnea after walking only 10 feet and newly exhibited stridor when supine prompted emergency admission for resection. She was pregnant with twins at 30–33 weeks gestation. Other medical history was significant only for obesity.

Physical examination revealed a 168-cm, 100-kg pregnant woman with a heart rate of 100 bpm, arterial blood pressure of 120/90 mmHg, temperature of 37.3° C, and respiratory rate of 20 breaths/min, sitting straight up in bed. Upper airway was normal except for a partial denture. Pulmonary examination was notable for prolonged inspiration. She could say only three to five words sequentially between breaths. Lungs were clear to auscultation. Cardiac exam was normal. Abdomen was gravid.

Hematocrit was 32.6%. With a FI_{O_2} of 0.21, pH_a was 7.41, Pa_{CO_2} 38 mmHg, Pa_{O_2} 94 mmHg, and arterial oxygen saturation 97.5%. EKG showed sinus tachycardia. Chest radiograph was normal, but tomograms demonstrated a 5 cm long segment of narrowing on the left side of the trachea. Biophysical profiles[5] revealed two active fetuses at 31–33 weeks gestation with estimated weights of 1700 and 1900 grams, and two equivalent placentas.

The presumptive diagnosis was a cylindroma with nearly critical obstruction of the trachea. Preparations were made for bronchoscopy and laser resection of the tumor. Methylprednisolone, 125 mg q 6°, was administered intravenously to decrease airway edema. After fasting for 13 h, the patient received sodium citrate 30 ml orally and metoclopramide 10 mg intravenously 30 min prior to induction of anesthesia. Monitoring included electrocardiogram, arterial and central venous pressures, precordial stethoscope, and axillary temperature. Oxygen saturation was monitored by a finger pulse oximeter. One fetal heart rate was continuously assessed with an external Doppler monitor.

An obstetrician and a thoracic surgeon were present in the event that an emergency cesarean section or thoracotomy was required. Two teams of neonatologists were available to resuscitate the twins, and heated isolettes with appropriate equipment and drugs were in the operating room.

Prior to induction of anesthesia, the patient inhaled 100% oxygen for 10 min in the semi-sitting position. A rolled blanket under the right hip provided left uterine displacement. As cricoid pressure was applied, anesthesia was induced with a slow iv infusion of 375 mg of thiamylal, followed by spontaneous inhalation of halothane up to 2% inspired in oxygen. When the patient was adequately anesthetized, the head of the bed was lowered to facilitate laryngoscopy. The proximal trachea was sprayed with 4% lidocaine, followed by introduction of a rigid bronchoscope. Gases were delivered through a Bain circuit attached to the side arm of the bronchoscope. Anesthesia was maintained with spontaneous inhalation of isoflurane up to 1.6% inspired, topical tetracaine 0.5%, and small iv increments of thiamylal. During resection of the tumor, isoflurane was delivered in 50% oxygen and 50% nitrogen. Whenever oxygen saturation decreased below 95%, resection was halted temporarily, while ventilation was gently assisted with 100% oxygen.

Oxygen saturation never fell below 94%. With a FI_{O_2} that varied between .5 and 1.0, Pa_{O_2} was 130–206 mmHg and Pa_{CO_2} between 37 and 40 mmHg. Arterial blood pressure remained 100–125/60–75 mmHg; heart rate was 100–140 bpm. The fetal heart rate lost beat-to-beat variability with the induction of anesthesia, but there were no decelerations. At the end of the 90-min procedure, oxygen saturation was 100% and respirations were 16 and unlabored. In the recovery room, the patient was awake and talking without stridor or dyspnea. Both fetal heart rates exhibited good beat-to-beat variability. The patient was observed overnight in the intensive care unit. The day after surgery, she was discharged from the hospital. The pregnancy continued until term, when the patient delivered two healthy infants.

DISCUSSION

Cylindromas, also called adenoid cystic carcinomas, account for approximately 30–40% of tracheal

* Resident in Anesthesiology.
† Assistant Clinical Professor.

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Address reprint requests to Dr. Karagianes: UCSD Medical Center, H-770, 225 Dickinson Street, San Diego, California 92103.

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tumors.[6] They are very vascular and are prone to bleeding during resection. Natural history is characterized by very slow progression with local recurrences over 10–15 yr.[6,7]

The rapid deterioration in this patient's status may have been precipitated by the physiologic changes of pregnancy. First, the degree of tracheal obstruction may have been increased significantly by capillary engorgement of the respiratory tract mucosa. Second, uterine enlargement and obesity limited diaphragmatic excursion. Third, minute ventilation was elevated by progesterone's effect on the respiratory center.[8] Thus, increased respiratory requirements coincided with worsening mechanical obstruction to ventilation.

Hypoxemia under anesthesia was of great concern. Functional residual capacity is decreased during late pregnancy,[9] and alveolar collapse is especially likely to occur in the supine position in a patient with a large uterus.[10,11] These elements of respiratory restriction, in combination with the increased oxygen consumption of pregnancy, made this patient especially prone to hypoxemia. To minimize the effects of these factors, anesthesia was induced with the patient in a semi-sitting position after 10 min of pre-oxygenation. Halothane, supplemented with increments of thiamylal, was selected because it is not irritating to the airway and permitted a smooth induction without laryngospasm or coughing.

Maintenance of spontaneous ventilation was chosen during the resection because negative intrathoracic pressure increases the diameter of the distal trachea,[12] which was the location of the nearly critical obstruction. However, tumor obstruction of the airway and respiratory depression caused by inhalational anesthesia made hypercarbia and ventricular dysrhythmias distinct possibilities. For this reason, halothane was discontinued and isoflurane employed for maintaining anesthesia.

Consideration was given to the possibility of regurgitation and aspiration of gastric contents during the surgery, which, by its nature, precluded the use of a cuffed endotracheal tube. Pregnancy increases the risk for aspiration of gastric acid.[13] Elevated levels of placental gastrin increase the acidity of the stomach contents. Gastric emptying is delayed by a progesterone-induced decrease in smooth muscle motility and by upward displacement of the pylorus by the gravid uterus. The angle of the gastro-esophageal junction is also altered, increasing the risk of reflux.[14] A non-particulate antacid to reduce gastric acidity, and metoclopramide to improve gastric motility, were administered preoperatively.[15] In retrospect, a histamine-2 blocker such as cimetidine would also have been warranted prophylaxis.[16,17] Cricoid pressure was maintained throughout the induction of anesthesia.

To provide an optimal intra-uterine environment for the fetuses, adequate placental flow of well-oxygenated blood was necessary. Left uterine displacement was maintained with a hip roll to prevent aorto-caval compression by the gravid uterus. To avoid fetal and maternal myocardial depression and to maintain adequate placental blood flow, the amount of isoflurane administered was limited by supplementation with small intravenous doses of thiamylal and topical anesthesia with tetracaine. Epinephrine was omitted from the local anesthetic mixture to avoid vasoconstriction of the uterine arteries. One fetal heart rate was monitored at all times. It was felt by the obstetricians that any significant detrimental change in the fetal environment would be reflected by a change in heart rate of either, since both fetuses and placentas were comparable in size. Although, as expected, beat-to-beat variability was lost as anesthesia was induced,[18] no fetal tachycardia or bradycardia occurred during the procedure, and variability returned to normal as the anesthetic concentrations decreased in the fetal circulation.

During the resection, two life-threatening complications were possible: acute airway obstruction by the tumor, and massive hemorrhage into the tracheobronchial tree. A thoracic surgeon was in attendance should surgery have been required to relieve airway obstruction or to control hemorrhage. In the event that unremitting hypoxemia or hypotension ensued, an emergency cesarean section was planned. An obstetrician was present, and neonatologists were available to resuscitate the infants if necessary.

Ventilation with 100% oxygen would have increased the margin of safety for the patient and fetuses during surgery;[19] however, concurrent operation of a neodymium-YAG laser prohibited this. An inspired oxygen concentration of 50% or less is recommended during laser resection to avoid uncontrolled combustion in the airway.[20] Close attention to the oximeter reading, communication with the surgeon, and the use of high gas flows were all essential to prevent episodes of hypoxemia. Rapid conversion from 50% inspired oxygen to 100% oxygen was facilitated by the Bain modification of the Mapleson D system. Assisted ventilation caused expired gases to be quickly flushed from the system, and allowed rapid response to changes in the patient's oxygen saturation.[21]

In summary, a case of anesthesia for bronchoscopy and laser resection of a tracheal tumor in a pregnant woman is described. The crucial clinical issues were maintenance of a difficult airway in a patient at risk for aspiration, the needs for optimal placental oxygen saturation and uterine perfusion, preparation for potential emergency resuscitation of both the mother and fe-

tuses, and optimizing conditions for laser resection in the trachea. Preparation and cooperation by many physicians of different specialties were essential for proper care of this patient.

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REFERENCES

1. Wong KC, Dykman PF: Anesthetic considerations for laser surgery, Surgical Application of Lasers. Edited by Dixon JA. Chicago, Year Book, 1983, pp 29–40
2. Dieter RA, Livermore J, Tu R, Pichietti J: Mucoepidermoid tracheal adenoma during pregnancy. Int Surg 68:271–272, 1983
3. Benisch BM, Abt AB, Abramson A: Granular cell myoblastoma of trachea associated with pregnancy. Chest 63:832–833, 1973
4. Millard CE: Malignant tumors of the trachea: A new outlook. Postgrad Med 55:117–119, 1974
5. Manning FA, Platt LD, Sipos L: Antepartum fetal evaluation: Development of a fetal biophysical profile. Am J Obstet Gynecol 136:787–795, 1980
6. Houston HE, Payne WS, Harrison EG Jr, Olsen AM: Primary cancers of the trachea. Arch Surg 99:132–140, 1969
7. Pearson FG, Thompson DW, Weissberg D, Simpson WJK, Kergin FG: Adenoid cystic carcinoma of the trachea. Ann Thorac Surg 18:16–29, 1974
8. Bonica JJ: Principles and Practice of Obstetric Analgesia and Anesthesia (Vol 1). Philadelphia, Davis, 1969, pp 13–39
9. Pernoll ML, Metcalfe J, Kovach PA, Wachtel R, Dunham M: Ventilation during rest and exercise in pregnancy and postpartum. Respir Physiol 25:295–310, 1975
10. Russell IF, Chambers WA: Closing volume in normal pregnancy. Br J Anaesth 53:1043–1047, 1981
11. Bevan DR, Holdcroft A, Loh L, Mac Gregor WG, O'Sullivan JC, Sykes MK: Closing volume and pregnancy. Br Med J 1:13–15, 1974
12. Fishman AP: Pulmonary Disease and Disorders. New York, McGraw-Hill, 1980, p 367
13. Roberts RB, Shirley MA: Reducing the risk of acid aspiration during cesarean section. Anesth Analg 53:859–868, 1974
14. Bonica JJ: Principles and Practice of Obstetric Analgesia and Anesthesia (Vol 1). Philadelphia, Davis, 1969, pp 673–688
15. Cohen SE, Jasson J, Talafre M-L, Chauvelot-Moachon L, Barrer G: Does metoclopramide decrease the volume of gastric contents in patients undergoing cesarean section? ANESTHESIOLOGY 61:604–607, 1984
16. Hodgkinson R, Glassenberg R, Joyce TH III, Coombs DW, Ostheimer GW, Gibbs CP: Comparison of cimetidine (Tagamet®) with antacid for safety and effectiveness in reducing gastric acidity before elective cesarean section. ANESTHESIOLOGY 59:86–90, 1983
17. Solanki DR, Suresh M, Ethridge HC: The effects of intravenous cimetidine and metoclopramide on gastric volume and pH. Anesth Analg 63:599–601, 1984
18. Katz JD, Hook R, Barash PG: Fetal heart rate monitoring in pregnant patients undergoing surgery. Am J Obstet Gynecol 125:267–269, 1976
19. Ramanathan S, Gandhi S, Arismendy J, Chalon J, Turndorf H: Oxygen transfer from mother to fetus during cesarean section under epidural anesthesia. Anesth Analg 61:576–581, 1982
20. Vourc'h G, Tannieres M, Toty L, Personne C: Anaesthetic management of tracheal surgery using the neodymium-yttrium-aluminum-garnet laser. Br J Anaesth 52:993–997, 1980
21. Sykes MK: Rebreathing circuits: A review. Br J Anaesth 40:666–674, 1968

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Anesthesia in Familial Dysautonomia

FELICIA B. AXELROD, M.D.,* ROGER F. DONENFELD, M.D.,† FRED DANZIGER, M.D.,‡
HERMAN TURNDORF, M.D.§

Familial dysautonomia, or the Riley Day syndrome, is a rare genetic disorder affecting nervous system development.[1] Autonomic dysfunction and decreased sensation present unique problems to the anesthesiologist, and have resulted in reports of increased morbidity and mortality.[2–5]

Recent analysis of survival probability for dysautonomic patients reveals an improved prognosis.[6] Centralization of care and the development of treatment-oriented literature for physicians and patients have been significant factors. Elective surgical procedures requiring anesthesia are now performed, because risks can be reduced with appropriate anticipatory management.

Over a 16-yr period, 127 surgical procedures were performed on 81 patients with familial dysautonomia at New York University Medical Center (table 1). Regardless of the type of surgery, certain features of anesthetic care applied to all patients. The purpose of this paper is

* Professor, Department of Pediatrics.
† Fellow, Department of Anesthesiology.
‡ Associate Professor of Clinical Anesthesiology.
§ Professor and Chairman, Department of Anesthesiology.

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Address reprint requests to Dr. Axelrod: Department of Pediatrics, New York University Medical Center, 550 First Avenue, New York, New York 10016.

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