diograph, and 10 ml of bupivacaine 0.5% was injected on each side. This resulted in no untoward sequelae and was associated with good pain relief. The test dose was followed with 10 ml of a 6% aqueous phenol solution on each side. Temperatures of both great toes increased 5° C over the next 2 h; capillary refill improved again to less than 15 s.

Mild, transient orthostatic hypotension was the only side effect from the procedure. The symptoms of pain and cold sensitivity have abated. In addition, the ischemic ulcers have shown complete healing within 8 months following the blocks.

**DISCUSSION**

Microvascular abnormalities probably are caused by endothelial cell injury in small arteries of patients with scleroderma. Similarly, Raynaud's phenomenon is the result of structural abnormalities of the arteriolar vessel wall that predispose the digits to the exaggerated vasospasm and subsequent vasodilation. Several pathologic studies were unable to distinguish between the lesions of scleroderma and Raynaud's. Myointimal cell migration in response to endothelial cell injury with resultant vasmotor instability probably is the common pathophysiologic pathway of Raynaud's in the periphery and scleroderma systemically.

This case demonstrates a good response to the use of lumbar sympathetic block for the treatment of Raynaud's phenomenon of the lower extremity. The response to diagnostic sympathetic block was atypical in that the beneficial effects of sympathectomy were not realized for several hours but then lasted for a time period longer than the duration of the anesthetic. The reason for the delay in vasmotor blockade is not known, but is possibly related to the variable response of patients to cervical sympathetic block for upper-extremity Raynaud's. The success of sympathetic block in this case suggests a role for reversible vasospasm in the pathogenesis of Raynaud's. Raynaud's phenomenon may involve a continuum of vascular disease ranging from vasmotor hyperactivity, which would respond to chemical sympathectomy, to complete obliterative occlusion, which would not respond. Diagnostic blocks may aid in differentiation of these etiologies, while predicting the response to neurolytic sympathetic block.

As of this writing, beneficial effect from lumbar sympathetic block has lasted 8 months. Because the mechanism leading to vasospasm is not known, with disease progression the current perfusion improvement may not last, and long-term results are indeterminate. However, if vasospasm results in eventual obliterative changes, early permanent sympathetic block may represent optimal therapy.

This case suggests that neurolytic sympathetic blockade should be considered in the treatment of Raynaud's phenomenon of the lower extremity.

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**Laser Perforation of a Main Stem Bronchus**

**RICHARD E. EMERY, M.D.*

Airway perforation is a rare but potentially fatal complication following laser surgery. Perfusion of a main stem bronchus by a laser is described below.

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* Anesthesiology Resident.

Received from the Department of Surgery, Anesthesia and Operative Service, Brooke Army Medical Center, Fort Sam Houston, Texas 78234-6200. Accepted for publication August 26, 1985.

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Address reprint requests to Dr. Emery.

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**REPORT OF A CASE**

A 3-yr-old girl was admitted for excision of recurrent granulation tissue in her tracheobronchial tree. She had undergone 34 prior anesthetics for similar surgery, the most recent was 2 weeks before admission.

The child had nonspecific congenital granulation tissue on multiple areas of her trachea as well as a circumferential lesion of the left main stem bronchus 1 cm distal to the carina. On multiple previous occasions, bronchoscopy had led to spasm and swelling of the left bronchus with loss of breath sounds over the left chest. Breath sounds usually improved over the left chest within 45 min following completion of bronchoscopy. She received dexamethasone 1 mg every other day to diminish swelling in her tracheobronchial tree. No other medications or drug allergies
were reported. A review of systems was noncontributory. Physical examination revealed a small 13-kg girl in no distress. Respiratory rate was 24 breaths/min with a heart rate of 100 beats/min. Examination of the chest revealed decreased breath sounds on the left with minimal bibasilar stridor and late expiratory wheezes.

Atropine 0.1 mg iv was given 1 h before induction. Anesthesia was induced by inhalation of halothane, nitrous oxide, and oxygen. Bronchoscopy was initiated using a 4.0 ventilating bronchoscope and controlled ventilation. Breath sounds diminished over the left chest after 5 min. She received dexamethasone 4 mg iv. Laser excision of extensive granulation tissue in the distal trachea and left main stem bronchus continued for 90 min. The extent of granulation tissue made identification of normal anatomy more difficult. Anesthesia was maintained with 2-4% inspired halothane. One brief run of ventricular bigeminy 30 min after induction quickly resolved with repositioning of the bronchoscope, improved ventilation, and lidocaine 10 mg iv. Even though there were no manifestations of an accidental bronchial perforation, a chest film and bronchogram were performed during the procedure. There was no evidence of a bronchial tear or leak.

At the conclusion of bronchoscopy, the trachea was intubated with a soft 4.0 uncuffed oral preformed endotracheal tube. The tube passed easily and was secured to the lower lip. Breath sounds were good on the right but reduced on the left side. The trachea was extubated after the return of normal spontaneous ventilation. The patient was observed for several minutes before transport to the recovery room. She had good tidal volumes, maintained her airway without assistance, and was responding appropriately to stimulation.

Shortly after her arrival in the recovery room, peripheral cyanosis was evident. She appeared to have adequate tidal volumes with minimal airway obstruction. Breath sounds were minimal on the left and present but coarse on the right. A jaw lift was performed to clear her airway, which initiated a cough. Immediately, her neck began to swell. Oxygen was administered by mask. With prompt resolution of the cyanosis, subcutaneous emphysema developed in her neck and agitation increased. Her trachea was intubated with a 4.0 oral tracheal tube. A chest film was taken. Subcutaneous emphysema with marked swelling progressed to involve the entire head, chest, abdomen, and extended to the proximal portion of all limbs. Bilateral needle thoracentesis using 14-gauge canules was performed in the second intercostal space at the midclavicular line. A soft whistle was noted with needle placement. Initially, pH was 7.15; PaCO₂ 67 mmHg; PaO₂ 69 mmHg; and base excess –6.9 mEq/l while breathing 100% oxygen. Dramatic clinical improvement occurred following placement of thoracostomy tubes.

Repeat arterial blood gas values showed a pH of 7.21, PaCO₂ 44 mmHg, PaO₂ 75 mmHg, and base excess of –9.2 mEq/l.

The child was returned to the operating room, and anesthesia was induced using spontaneous ventilation with halothane and oxygen. Fiberoptic bronchoscopy revealed a 1-2-mm hole in the left main stem bronchus through which lung tissue could be seen. There also was a flap tear extending from the perforation for several additional millimeters, but the decision was made not to attempt surgical repair. The anesthetic proceeded without incident. The child was transported to the intensive care unit, and her trachea was extubated a short time later. Arterial blood gases before extubation were pH 7.30, PaCO₂ 42 mmHg, PaO₂ 145 mmHg, and base excess –4.8 mEq/l with an FiO₂ of 0.9.

Postoperative management included dexamethasone 1 mg iv daily along with penicillin and gentamicin sulfate iv. Oral cefazolin was begun on day 2; the penicillin and gentamicin discontinued. Six days following surgery a repeat bronchoscopy demonstrated healing of the area of bronchial perforation. Areas of granulation tissue on the opposite side of the bronchus were excised using the CO₂ laser without complications. The chest tubes were removed the following day. The child was discharged a day later.

**DISCUSSION**

The CO₂ laser has become a frequently used surgical tool for lesions of the aerodigestive tract. Its use permits good hemostasis with minimal postoperative edema, and it has become the treatment of choice for many airway lesions. However, lasers are not without complications. Injury to operating personnel and patients, including airway fires and damage caused by misdirected laser beams have been reported. Reviews of anesthetic technique and special considerations during laser surgery have been discussed elsewhere. Healy et al., in a study of 4,416 cases, reported an incidence of complications directly attributable to the laser of 0.2%.

Coupling of the CO₂ laser to a ventilating bronchoscope allows the surgeon to eradicate lesions of the trachea and bronchi. Unfortunately, the optics used with rigid bronchoscopy are not as refined as those available with the operating microscope. Additionally, pediatric bronchoscopes have narrow diameter tubes, limiting the field of vision. Smoke may obscure the visual field. The line between lesion and normal tissue may be less distinct, making the risk of injury to normal tissue higher.

A rare but serious complication of airway surgery involves airway disruption. Ganfield and Chapin reported a 1.5-cm linear perforation of the anterior trachea, which lacerated two tracheal rings in a 4-yr-old patient. The injury was presumably caused by laser overshoot while working on laryngeal lesions. This type of injury is extremely unusual, since the laser generally is focused to a high degree and regions beyond the focus point receive a diffuse beam unlikely to result in significant damage. In the case studied by Ganfield and Chapin, an attempt to pass a 6.0 styleted Norton tube with an attached cuff was unsuccessful and may have contributed to injury.

Regardless of the cause of the injury, when airway disruption occurs, it can be a life-threatening event requiring immediate intervention. In the lower airway, perforation can lead to pneumomediastinum, bronchopleural fistulae, tension pneumothorax, and potential violation of the aorta or pulmonary vasculature, which lie in close proximity to the main-stem bronchus.

In this case the airway perforation was not clinically evident until the patient's arrival in the recovery room. The high airway pressures generated by coughing may have created a flap tear in the left main stem bronchus in areas weakened by the laser. Peritracheal and mediastinal air with subcutaneous emphysema resulted. The peritracheal air could dissect along the right bronchus, creating bilateral tension pneumothoraces.

Airway perforation and tension pneumothorax resulting from laser surgery is an unusual complication. Decompression of the tension pneumothorax must be accomplished promptly, initially with needle thoracentesis,
then chest tubes. Ideally, ventilation should be spontaneous before decompression of the tension pneumothorax. Positive airway pressure and controlled ventilation can increase the pneumothorax, resulting in cardiovascular collapse. Recovery room personnel must be alert and prepared to initiate immediate therapy.

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Postoperative Hepatic Dysfunction after Halothane or Enflurane Anesthesia in Patients with Hyperthyroidism

**HIDEKO SEINO, M.D.,* SHUJI DOHI, M.D.,† YUJI AIYOSHI, M.D.,‡ TARO Mizutani, M.D.,§ KOUICHI NAKAMURA, M.D.,§ HIROSHI NAITO, M.D.¶

Increasing experimental evidence indicates that the hyperthyroid state enhances hepatotoxicity by volatile anesthetic agents in rodents. The incidence of liver lesion after exposure to halothane in hyperthyroid rats is approximately four times more than that after enflurane or isoflurane. Patients with hyperthyroidism usually come to anesthesia and surgery in an euthyroid state by taking antithyroid drugs. Perhaps the hypermetabolic state of the liver in such patients has not returned to normal by antithyroid drugs. In addition, antithyroid drugs can be hepatotoxic. Thus, patients with hyperthyroidism, even in an euthyroid state, could have a significant risk of developing postoperative hepatic dysfunction when they are anesthetized by inhaled anesthetics, especially halothane.

We, therefore, retrospectively investigated whether there is a higher incidence of early postoperative hepatic dysfunction in patients with hyperthyroidism when compared with patients with nonfunctional thyroid tumors. Second, we sought to determine whether halothane is more likely to produce hepatic dysfunction in patients with hyperthyroidism when compared with enflurane following thyroid surgery.

**MATERIALS AND METHODS**

From September 1980 to August 1984, 183 patients underwent elective thyroid surgery for both hyperthyroidism and nonfunctional thyroid tumors. Of these, 66 patients had hyperthyroidism, and the remaining had nonfunctional thyroid tumor (simple or nodular goiter, carcinoma, adenoma). Halothane was used in 78 patients (31 with hyperthyroidism and 47 with normal thyroid function), and enflurane was used in 105 patients (55 with hyperthyroidism and 70 with normal thyroid function) (table 1).

All patients with hyperthyroidism had been rendered euthyroid by use of antithyroid drugs (propylthiouracil or methimazole, Lugol's solution, or a combination of propylthiouracil and Lugol's solution). In some of these patients, a hyperkinetic circulatory status was controlled with oral propranolol in doses of 30–60 mg/day (12 pa-