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Craniotomy for Tumor in a Patient with a Bronchopleural Fistula: Anesthetic Considerations

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Various alternatives for the anesthetic management of patients with bronchopleural fistulas have been discussed in the literature.[1–4] Major concerns include: 1) possible spillover of contaminated fluid to the healthy lung, and 2) possible gas leakage resulting in inadequate ventilation. Methods used to prevent these occurrences involve spontaneous respiration or controlled ventilation with positive pressure after proper positioning of the endotracheal tube. However, in a patient with a co-existing intracranial mass lesion and bronchopleural fistula, the techniques used to adequately protect the airway may increase intracranial pressure and cause neuronal damage.[5,6] Thus, the anesthetic management of a patient with both of these conditions presents a particularly difficult situation, and has not previously been reported. We describe here such a case.

REPORT OF A CASE

A 60-yr-old male was admitted to the hospital because of hemoptysis and a 5-kg weight loss over 2 months. He denied any history of cardiac or neurological disease. Chest radiogram showed a 10-cm mass in the right hilar region, and a biopsy of this area was interpreted as adenocarcinoma of the lung. Lung function studies included an FEV_1 of 1.9 l (63% of predicted), and FVC of 3.7 l (93% of predicted), and a diffusion capacity 43% of normal. An arterial blood gas while breathing room air revealed a Pa_{O_2} of 72 mmHg, Pa_{CO_2} 39 mmHg, and *p*Ha of 7.42.

The patient underwent a right pneumonectomy. One-lung ventilation was employed without difficulty, and the trachea was extubated in the immediate postoperative period. A palsy of the right recurrent laryngeal nerve was then noted. Postoperative complications included a fever and elevated white blood cell count that developed 13 days post-pneumonectomy. A chest radiogram showed an air-fluid level in the right hemithorax. Bronchoscopy revealed dehiscence of the right bronchial stump. A right-sided thoracotomy tube was inserted, and 200 cc of a purulent fluid was drained. Intravenous antibiotics, as well as antibiotic irrigations *via* the right-sided chest tube, were begun. On the 21st day following pneumonectomy, the patient unexpectedly had a grand mal seizure. Computed tomography of the brain (which was negative prior to the pneumonectomy) showed a 3-cm lesion in the left frontal horn with lack of a mass effect, and the patient was scheduled for a craniotomy.

On physical examination, the patient was an alert, cooperative, and cachectic-appearing individual, weighing 50 kg. Respirations were slightly labored at a rate of 24/min, temperature was 36°C, heart rate 76 bpm, and arterial blood pressure was 110/70 mmHg. Scattered wheezes were present over the left chest, and the right-sided chest tube had a gravity drain. Cardiac examination was normal. Neurologic examination revealed no deficits except a hoarse voice associated with the palsy of the right recurrent laryngeal nerve. He experienced headaches that were increasing in frequency and intensity. He did not complain of nausea, vomiting, or lethargy. Medications included: digoxin 0.25 mg p.o. q.d., furosemide 80 mg p.o. q.d., inhaled metaproterenol treatments q 4 h prn, phenytoin 400 mg p.o. q.d., dexamethasone 4 mg p.o. q 6 h, meperidine 75 mg im q 4 h prn, and ampicillin, clindamycin, and gentamycin. Laboratory data included: hematocrit 32%, serum sodium 138 mEq/l, serum potassium 4.4 mEq/l, serum chloride 88 mEq/l, and blood bicarbonate 36 mEq/l. Bedside pulmonary function tests showed an FEV_1 of 1.6 l and FVC of 1.8 l with the drainage tube clamped. No improvement was noted after treatment with bronchodilators. With a FIO_2 of 0.21, Pa_{O_2} was 49 mmHg, Pa_{CO_2} 46 mmHg, *p*Ha 7.49, and base excess +10 mEq/l.

The patient was given no premedication other than his usual doses of phenytoin, dexamethasone, and antibiotics. On arrival in the operating room, sodium citrate 30 cc p.o. was given. He was positioned on the operating table with his head up and right side down 30°. Oxygen was supplied *via* nasal cannulae. A Pleur-Evac circuit was connected to the right thoracostomy tube with a waterseal of 15 cm and without external suction. Monitoring before tracheal intubation included ECG and blood pressure *via* a radial arterial catheter. Diazepam 1 mg, droperidol 1.25 mg, and fentanyl 50 μg were slowly given iv, without obtunding the patient or increasing headache. Topical application of 4% lidocaine and superior laryngeal nerve and transtracheal blocks were performed gradually over a period of 30 min to minimize gagging and coughing. Awake laryngoscopy was well tolerated by the patient with minimal hemodynamic response, and a 7.5-mm endotracheal tube was inserted past the vocal cords with ease. The cuff was left deflated, and a fiberoptic bronchoscope was then passed through the endotracheal tube. The remnant of the carina was easily identified, as was an open right mainstem bronchial stump. The tip of the endotracheal tube was passed into the left mainstem bronchus. The bronchial carina was observed, and the single-lumen tube was positioned and cuff inflated without obstructing the left upper lobe. The patient was given 200 mg thiamylal iv, and anesthesia was maintained with iv fentanyl and inhalation of isoflurane. Breath sounds were equal in the left upper and lower lung fields, and no breath sounds were heard on the right. With positive pressure ventilation, there was no evidence of a leak through the right-sided thoracostomy tube. The patient underwent a resection of his left frontal lobe lesion (tumor) that proceeded uneventfully, and he awoke at the end of the procedure on the operating room table. He was transported to the intensive care unit (ICU) breathing spontaneously with the left mainstem bronchus intubated. Upon arrival in the ICU, lung function studies showed a negative inspiratory force of −50 cm H_2O, FEV_1 was 1.0 l, and FVC 1.5 l. Extubation occurred shortly after arrival in the ICU and the patient was transferred to the ward the following day.

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Discussion

This case presents the previously unreported and unique challenge of anesthetizing a patient with an intracranial mass lesion and a bronchopleural fistula. Several possible methods were considered for the induction of anesthesia: 1) inhalation induction with spontaneous ventilation, 2) rapid sequence induction with insertion of a left-sided double lumen endotracheal tube, and 3) awake tracheal intubation under fiberoptic guidance.

Inhalation induction with spontaneous ventilation would minimize gas leakage through the right thoracostomy tube and allow for ventilation of the left lung. However, this was considered unacceptable for two reasons. First, we feared that aspiration would occur despite precautions to maximally drain the right thoracostomy tube before induction and positioning the patient with the head tilted up and leaning toward the right side.[1,2] Second, spontaneous ventilation with volatile anesthetics will lead to hypercarbia, which may be particularly marked in patients with lung disease.[7] In a patient with a mass lesion, any further increase in intracranial pressure caused by inhaled anesthetics and hypercarbia may lead to cerebral ischemia and neuronal damage.[5]

A rapid sequence induction using correct doses of barbiturates and muscle relaxants[8] could probably have been performed with minimal increases in intracranial pressure. Following intubation of the trachea, positive pressure ventilation has been recommended as a means of preventing spillover of fluid from the area of a small fistula to the healthy lung.[1] However, in our case, a rather large fistula was present, and positive pressure ventilation would direct gas through the fistula, causing underventilation of the left lung. Thus, selective intubation of the left lung was considered necessary to establish effective ventilation. With a rapid sequence induction and resulting muscle paralysis, only a limited amount of time would be available to position an endotracheal tube in the left mainstem bronchus. We did not feel confident that an endotracheal tube could be accurately placed *via* fiberoptic guidance in such a short time interval. Alternatively, a left-sided double-lumen endotracheal tube could have been placed in a "blind" fashion. Our major concerns in using this technique were incorrect placement and the possibility of aggravating the bronchial dehiscence, even with correct tube placement. Indeed, blind placement of a double-lumen endobronchial tube is not always successful,[9] and fatalities have resulted from attempts to blindly intubate the left main bronchus in patients with a right-sided bronchopleural fistula.[1]

The option we chose, awake endobronchial intubation, gave us maximal control with regard to airway management. However, when using this approach, caution was required to prevent an increase in intracranial pressure associated with increased arterial blood pressure and coughing. Of major importance in preventing hypertension was that the patient understood the procedure to be performed and was very cooperative, and, thus, only a minimal amount of sedative medication was needed to control anxiety. To minimize coughing, topical lidocaine spray was applied in a slow and methodical manner. The large amount of lidocaine administered for the procedure (total dose > 500 mg) was given over a relatively long period (>30 min), and there were no signs of lidocaine toxicity. With transtracheal block, only weak coughs were elicited, probably secondary to the palsy of the recurrent right laryngeal nerve and to the thorough topical application of lidocaine. Furthermore, if coughing did occur, gas would escape *via* the low-resistance fistula pathway, preventing an elevation in intrathoracic pressure. We chose to use a single-lumen endotracheal tube for this procedure, since it could be easily passed under fiberoptic guidance and provided a larger lumen than a double-lumen tube, allowing for relative ease of suctioning. Of note, however, was that the tube was just long enough to reach the left mainstem position. (The average distance from the lips to the carina is 28 cm in the adult.[10])

Another alternative for the anesthetic management of this case would have been to use high-frequency ventilation following intubation of the trachea. In the presence of a bronchopleural fistula, high-frequency ventilation can maintain adequate oxygenation and reduce gas leak through the fistula,[3,11] and may cause minimal changes in intracranial pressure.[12] Nevertheless, with tracheal intubation, the possibility of spillover would still be present.

In summary, we have presented the only reported case of a patient with a bronchopleural fistula and an intracranial mass lesion, and have outlined the pertinent anesthetic considerations. Successful management of this difficult combination of anesthetic problems was accomplished with an awake endobronchial intubation using fiberoptic visualization.

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Neuromuscular Interaction of Magnesium with Succinylcholine-vecuronium Sequence in the Eclamptic Parturient

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Succinylcholine-vecuronium sequence has been safely used to provide neuromuscular blockade in parturients undergoing cesarean section under general anesthesia.[1] Succinylcholine provides a rapid onset of profound muscular relaxation that facilitates tracheal intubation, while the nondepolarizing relaxants, such as vecuronium, can be used to maintain muscular relaxation.[2]

We found that eclamptic parturients receiving magnesium treatment demonstrate the interaction of magnesium with both succinylcholine and vecuronium neuromuscular blockade. We also compared the neuromuscular response to that achieved when the same doses of succinylcholine and vecuronium were used in a control group of noneclamptic parturients having no magnesium therapy.

MATERIALS AND METHODS

The neuromuscular blockade of succinylcholine-vecuronium sequence was investigated in six eclamptic parturients, aged 25–32 yr, undergoing cesarean section at 34–40 weeks gestation. Preoperatively, all the eclamptic parturients were given 4 gm of magnesium sulphate iv, to be followed by an infusion at a rate of 2 gm $\cdot$ h^{-1}. The serum level of magnesium at the time of cesarean section ranged from 4.1–6.0 mEq/L. The neuromuscular blockade was compared to that achieved in a control group of six noneclamptic parturients, aged 23–37 yr, undergoing elective repeat cesarean section at 37–40 weeks gestation.

Neuromuscular blockade was investigated by a Datex Relaxograph® monitor. The ulnar nerve was stimulated supramaximally at the wrist every 20 s, and the electromyographic response was displayed. The monitor uses the train-of-four principle at a stimulus rate of 2HZ, and features an automatic search for the supramaximal current level.

All patients were premedicated with im glycopyrrolate 0.2 mg. After patients were breathing oxygen, anesthesia was induced with thiopental 3 mg $\cdot$ kg^{-1} iv. Succinylcholine 1.5 mg $\cdot$ kg^{-1} was then injected iv, and its neuromuscular effect was monitored. When complete neuromuscular blockade was achieved, the trachea was intubated, and anesthesia was maintained with nitrous oxide:oxygen (2:1) supplemented by 100 μg fentanyl iv following delivery of the baby.

When 75% recovery of succinylcholine block was reached, a bolus of vecuronium 25 μg $\cdot$ kg^{-1} was injected and its neuromuscular blockade was monitored. At 75% recovery of the twitch response, incremental doses of 12.5 μg $\cdot$ kg^{-1} of vecuronium were injected to maintain relaxation throughout surgery. The neuromuscular blockade acheived by the initial bolus of vecuronium, and the number of incremental doses re-

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