Perioperative Management of Two Patients with Respiratory Problems Undergoing Abdominal Surgery with High Spinal Anesthesia

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Choice of anesthetic technique; regional anesthesia vs. general anesthesia is still controversial in patients with impaired pulmonary function undergoing laparotomy. We are often concerned that positive pressure ventilation or endotracheal inhalation of dry anesthetic gases may exacerbate preexisting respiratory problems. For a patient breathing by himself preoperatively, it is the most undesirable consequence to be forced to leave an endotracheal tube for mechanically assisted ventilation for an extended time in the postoperative course.

The present report describes successful perioperative management of two patients with respiratory problems undergoing abdominal surgery. We administered a combination of high spinal anesthesia for surgery and epidural analgesia for postoperative pain for the patients. Monitorings of arterial oxygen saturation with a pulse oxymeter (Sp_{O_2}) and endo-tidal carbon dioxide (ET_{CO_2}) were essential for the successful management.

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Case Reports

Case 1: A 64 year-old man (weight 41 kg, height 159 cm) was diagnosed as having early gastric cancer (IIc). At the time of diagnosis, he was already hospitalized for dyspnea and was not able to walk. He had undergone left thoracoplasty for pulmonary tuberculosis 32 years before and had complained of progressive dyspnea on exertion for the past 5 years. Chest X-ray revealed a cardiothoracic ratio of 59.2% and multiple giant bullae of the right lung. A pulmonary function test showed a vital capacity (VC) of 1400 ml (% VC 44.4%) and a forced expiratory volume $(FEV)_{1.0}$% of 44%. Arterial blood gas (ABG) analysis ($F_{I_{O_2}}$ 0.2) manifested extreme hypoxemia (Pa_{O_2} 38.6 mmHg) with moderate hypercarbia (Pa_{CO_2} 58.7 mmHg). Since these laboratory data were highly suggestive of an acute exacerbation of chronic congestive heart disease, it was decided at a preoperative joint conference to postpone the case until the cardiac function would be improved.

The enlarged cardiac shadow returned to normal size and dyspnea on exertion was alleviated after 1 month

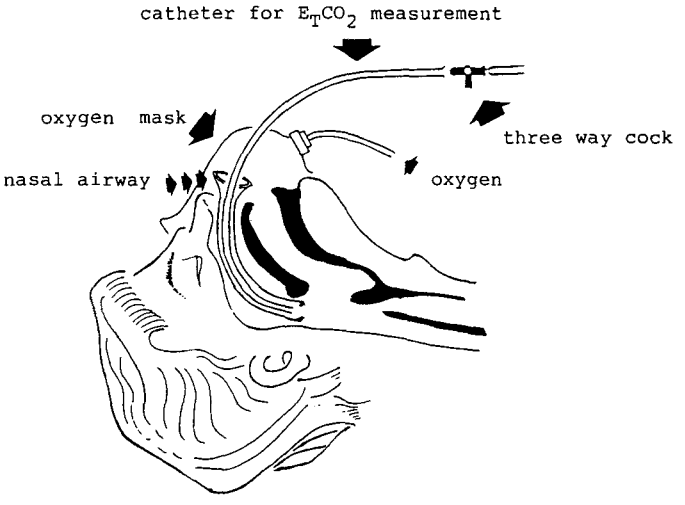

Fig.

of treatment. VC increased to 1770 ml (% VC 54.6%), while $FEV_{1.0}$% remained at 46%. ABG (FI_{O_2} 0.2) also improved (Pa_{O_2} 67.6 mmHg, Pa_{CO_2} 46.7 mmHg). At this point, we agreed to the surgeons' evaluation that he had recovered physical strength to bear the surgical stress. The time required for the gastrectomy was estimated to be about 2 hours. We planned high spinal anesthesia which would be easy, because he was relatively thin. A Sp_{O_2} probe was placed on the right fingertip, and the left radial artery was cannulated for continuous pressure monitoring and blood sampling. A soft nasal airway (7 Fr) containing a suction catheter with an external diameter (E.D.) of 2.1 mm for ET_{CO_2} monitoring was introduced through one nostril (fig.). The mouth and the nose were covered with a face mask for oxygen administration (3 $l \cdot min^{-1}$). A three way stopcock was placed on the main capnograph suction line to clear water drops by intermittent wall suction. ET_{CO_2} was measured continuously with a capnograph (POET, Critical Care Systems Inc., USA).

First, an epidural catheter (E.D. 0.9 mm) was introduced at Th_{9-10}, which was prepared in case of prolonged surgery and for postoperative abdominal pain. The subarachnoid space was then punctured at L_{1-2} and 1.7 ml of hyperbaric solution, which contained 1.5 ml of 0.3% dibucaine (Percamine S®) and 0.2 ml of 0.1% epinephrine, was injected. Ten minutes later, analgesia extended from the S_5 up to the Th_6 dermatomes. Though analgesia and muscle relaxation were sufficient to allow the gastrectomy to be perfomed, he complained of nausea during manipulation of the stomach. Therefore we asked the surgeons to infiltrate 1% lidocaine around the vagal nerve trunk in the cardia. Hypoxemia was easily avoided by merely increasing the oxygen supply to the face mask. However, this way always accompanied by an accumulation of CO_2 in a dose-dependent manner, the so called oxygen paradox. Since the ET_{CO_2} was lower than the Pa_{CO_2} by approximately 15 mmHg when beginning the case, we tried to keep Sp_{O_2} at 94–95% and ET_{CO_2} at 25–30 mmHg by adjusting the oxygen supply to the face mask. When ET_{CO_2} exceeded this value, the patient was encouraged to take a deep breath. Despite these efforts, Pa_{CO_2} increased temporarily up to 60.6 mmHg. After beginning clo-

sure of the abdominal wall, respiratory movements gradually recovered with improvement of the ABG. The surgery was completed in 2 hours and 7 min.

The patient was observed in the recovery room for about 30 min. Respiration was smooth and regular, and respiratory rate was 16/min. He received 2 $l \cdot min^{-1}$of oxygen via nasal cannula after returning to the ward. Three to four ml of 1% lidocaine was injected intermittently through the epidural catheter for relief of abdominal wound pain and did not result in respiratory depression. He recovered enough to walk around the ward by the 5th postoperative day. Pa_{O_2} was 71.0 mmHg and Pa_{CO_2} was 43.3 mmHg under spontaneous air breathing.

Case 2: A 57 year-old woman (weight 47 kg, height 149 cm) was diagnosed as having early hysterocervical carcinoma (Ib). She was in the hospital at the time of diagnosis and was receiving oxygen insufflation therapy for primary interstitial pneumonia. She had complained of dyspnea for the previous 11 months. Because of the pneumonia, the pros and cons of surgical therapy were carefully compared with those of radiation therapy in a preoperative joint conference. Although the patient was made aware of the potential complications of surgery and her present condition, she chose the surgical procedure, even though statistical data showed no significant difference in results between the two therapies.

The respiratory rate was 20/min and breathing was quiet, deep and regular. A pulmonary function test showed a %VC of 80% and an $FEV_{1.0}$% of 97%. However, dry rales were present on both lung fields. ABG analysis (FI_{O_2} 0.2) manifested severe hypoxemia (Pa_{O_2} 55.4 mmHg) with normocarbia (Pa_{CO_2} 41.7 mmHg). Mask inhalation of 3 $l \cdot min^{-1}$oxygen was continued during transport to the operating theater and the following preoperative preparations. The radial artery was cannulated after placing a Sp_{O_2} probe. The subarachnoid space was punctured with a 25 gauge spinal needle at the L_{2-3} interspace, through which a 32 gauge (E.D. 0.24 mm, I.D. 0.19 mm) Micro Spinal® catheter (TFX Medical, USA) was introduced 8 cm from the skin. An epidural catheter was also placed at the L_{1-2}. With the patient in the Trendenburg position, two ml of hyperbaric solution (1.8 ml of 0.3% dibucaine and 0.2 ml of 0.1% epinephrine) were injected into the subarachnoid space through the micro catheter. Five minutes later, the sensory block extended from the S_5 up to the Th_{10} dermatomes. Two additional ml of 2% lidocaine were injected into the subarachnoid space to elevate the rostral margin of analgesia from Th_{10} to Th_6.

A nasal airway containing a suction catheter for ET_{CO_2} monitoring was plased in this case, as in case 1. An additional injection of 1.0 ml of 0.3% dibucaine was enough to provide satisfactory muscle relaxation and anâlgesia throughout the 250 min required for the radical hysterectomy. The patient was encouraged to breathe deeply, when the ET_{CO_2} occasionally increased above 50 mmHg. Spontaneous respiration was preserved throughout the laparotomy without mechanical assistance. The patient resumed a quiet, smooth and deep respiration, after closure of the abdominal wall. After completion of the surgery, the micro catheter was carefully removed with the patient in the lateral position. Postoperative pain was effectively controlled with intermittent injection of 1% lidocaine via the epidural catheter. The patient did not require any postoperative respiratory support except oxygen insufflation. There was no further deterioration of the interstitial pneumonia.

Discussion

When we have a patient with respiratory problems undergoing an elective abdominal surgery, it is very useful for perioperative respiratory management to hold a preoperative joint conference between the anesthesiologists and surgeons. We proposed a two-step anesthesia plan for the present patients: ① surgery can be started under regional anesthsia. ② In case of any difficulty during surgery, regional anesthsia is quikcly switched to endotracheal general anesthesia. It is of particular importance to have informed surgeons and patients of the advantages of regional anesthesia beforehand. Fortunately, both cases were completed without switching to general anesthesia. We administered high spinal anesthesia in order to preserve spontaneous breathing and sufficient muscle relaxation for intraabdominal surgery. However, respiratory movements during surgery were apparently impaired by blockade of the intercostal nerves, or by surgical procedures such as opening the abdominal wall and rostral displacement of the diaphragm by a retractor, which presumably resulted in reduction of functional residual capacity (FRC).

Both Sp_{O_2} and Et_{CO_2} monitorings were essential for safe management of respiration. Efforts to encourage the patients to inspire deeply were clinically useful. At the same time, the patient's position was changed a little so that the abdomen was the lowest point by bending the table in the middle. This simple change often produces beneficial effects on pulmonary gas exchange and also on abdominal muscle relaxation and venous return. Perioperative administration of drugs, which might cause respiratory depression, were avoided or given as little as possible. Body temperature was maintained normal, because oxygen consumption increases approximately 10% per degree Celcius elevation in body temperature[1]. Conversely if body temperature decreases and shivering occurs, augmented venous extraction of oxygen will further decrease Pa_{O_2}. Blood loss was less than 300 ml in both of the cases, so blood transfusion to maintain blood oxygen carrying capacity was not necessary. Abdominal wound pain is assumed by most to be the principal cause of postoperative reduction of FRC. Epidural injection of a local anesthetic through the indwelling catheter effectively relieved the pain while preserving deep and regular spontaneous respiration.

Continuous spinal anesthesia with a micro-catheter[2,3,4] employed in case 2 has several advantages: ① minimizing the local anesthetic dose; ② easier titration of the sensory block level than single-injection spinal anesthesia; ③ more satisfactory muscle relaxation compared with epidural anesthesia; and ④ minimal incidence of postspinal headache[3]. We recently found that a stainless steel stylet installed in the wall of the catheter was useful as a recording electrode for spinal evoked potentials (unpublished). The continuous spinal anesthesia using a micro catheter will be beneficial for a patient undergoing laparotomy, who has problems about the delivery of endotracheal general anesthesia.

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