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Pulmonary edema after laparoscopic adrenalectomy in a pregnant patient with Cushing's syndrome

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Introduction

Pregnancy is rare in patients with Cushing's syndrome because of its association with infertility. Excess glucocorticoids suppress gonadotropin secretion, resulting in amenorrhea or oligomenorrhea in 75% of premenopausal women with Cushing's syndrome [1]. For these reasons, only 63 pregnancies were reported in women with Cushing's syndrome up to 1990 and 69 cases up to 1994 [2,3], and only a few papers describe anesthetic considerations for a pregnant woman with Cushing's syndrome [4–6]. Once patients become pregnant, however, various complications occur, including persistent hypertension, hyperglycemia, and pulmonary edema [2,5,7]. At this point, there is no report of critical complications after laparoscopic adrenalectomy for those patients. We present a pregnant woman with Cushing's syndrome who had life-threatening pulmonary edema after laparoscopic adrenalectomy.

Case report

A 31-year-old woman (161 cm, 54 kg) had hypertension (184/105 mmHg) and edema of her face at 16 weeks of gestation. She had no history of hypertension. At the age of 29 she had a vaginal delivery at term without problems. Preeclampsia was suspected at this point in a private hospital. She moved to our hospital at 25 weeks of gestation. Because she had central obesity, endocrinological studies were performed. Laboratory studies revealed abnormally high levels of serum cortisol (58.6 μg·dl^{-1}), urinary 17-OHCS (18 mg·day^{-1}), and urinary cortisol (1860 μg·day^{-1}) and a low level of ACTH (5.5 pg·ml^{-1}). Furthermore, MRI revealed a left adrenal tumor 3 cm in diameter. Cushing's syndrome was diagnosed from these data at 28 weeks of gestation. Arterial hypoxia was not observed (PaO_2 = 96 mmHg, FiO_2 = 0.21). Because the hypertension could not be controlled by medications (α-methyldopa and furosemide), she was scheduled for laparoscopic adrenalectomy at 31 weeks of gestation. She was premedicated with diazepam (5 mg, p.o.) and famotidine (20 mg, p.o.) 4 h before anesthesia. In the operating room, an epidural catheter was placed 5 cm cephalad via the T9–10 interspace with a Tuohy needle (17 G) using the saline loss of resistance technique in the lateral position. As a test dose, 3 ml of 2% mepivacaine was injected through the epidural catheter, and no hypesthesia was observed after 10 min of injection. An additional 10 ml of 2% mepivacaine was injected, and the hypesthesia level was obtained from T4 to T11 after 10 min of injection. Before induction, the blood pressure was 180/100 mmHg. Anesthesia was induced with 175 mg thiamylal and 0.1 mg fentanyl with cricoid pressure. The patient was intubated easily with 6 mg vecuronium. After intubation, the blood pressure was 168/92 mmHg, and no secretion could be aspirated through the endotracheal tube. Anesthesia was maintained with sevoflurane (1%–3%) and epidural infusion of 2% mepivacaine (5 ml·h^{-1}). She was placed in the flexed lateral position and underwent laparoscopic adrenalectomy. The intraperitoneal pressure during laparoscopy was less than 10 mmHg. The blood pressure was almost stable (130–170/80–100 mmHg) before isolation of the adrenal gland and changed dynamically (85–190/55–100 mmHg) during isolation of the tumor. The total operating time was two and a half hours. Pathohistological study revealed that the adrenal tumor was an adenoma. During emer-

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gence from anesthesia, the blood pressure rose to 190/110 mmHg from 160/70 mmHg, and the heart rate also rose to 140 beats per minute (bpm) from 100 bpm. The patient showed excitatory movements and began to cough. At this point, arterial blood gas analysis revealed impaired arterial oxygenation (PaO_2 = 210 mmHg, FiO_2 = 1.0), and a chest X-ray showed an increment of opacity in the right lung. She was sent to the ICU without extubation. Three hours later, a chest X-ray showed a prominent butterfly-like shadow, suggesting pulmonary edema. She also produced pink, frothy sputum at that time. The total IV infusion was 2150 ml during the operation. The total blood loss and urine output were 400 and 1100 ml, respectively. There are no findings of left atrial or ventricular enlargement (LAD 2.9 cm, LVD_d 5.1 cm) by echocardiogram. The fetal heart rate was between 120 and 160 bpm and revealed no critical condition of the fetus.

In the ICU, PaO_2 was 42–65 mmHg with 100% oxygen on the day of surgery. She was treated with diuretics and 100% oxygen with positive end-expiratory pressure (PEEP) (12 cm H_2O), and PaO_2 improved gradually. At 5 POD, PaO_2 was 165 mmHg (FiO_2 = 0.6). The patient lost 6 kg of her body weight, and she was extubated. She showed no further complications after these treatments. The blood pressure was also well controlled after adrenalectomy. She delivered a 2408-g female infant at 36 weeks of gestation without any problem.

Discussion

Pregnancy is accompanied by various physiological changes, including increased cardiac output, heart rate, blood volume, and capillary permeability and decreased plasma colloid oncotic pressure [8–12]. Cushing's syndrome can augment these changes. These physiological alterations can predispose a pregnant woman to acute pulmonary edema [12,13]. Pulmonary edema was reported in 0.05% of a general obstetric population [14]. The incidence of pulmonary edema in pregnant women with Cushing's syndrome is reported to be very high (11.1%) [2]. Its incidence is much higher in patients with adrenal adenoma (25.9%) [2]. Adrenalectomy during pregnancy is recommended because of its effectiveness in reducing the incidence of fetal death, neonatal complications, and maternal complications [5]. The incidences of fetal death and spontaneous abortion among patients treated with adrenalectomy during pregnancy and after pregnancy are 14% and 32%, respectively. The fetal survival rate without complications is 86% in patients treated during pregnancy, but only 37% in patients treated after pregnancy [5]. For these reasons, we planned adrenalectomy during pregnancy. However, adrenalectomy during pregnancy does not decrease the incidence of pulmonary edema (28.6%) compared with adrenalectomy after the completion of pregnancy (26.3%) [5].

To prevent these adverse complications, we planned laparoscopic adrenalectomy expecting less invasion and epidural analgesia to minimize catecholamine release during and after surgery. This schedule worked very well during surgery. However, the arterial oxygen tension decreased during emergence from anesthesia, and the patient was diagnosed with pulmonary edema by the specific findings of pink, frothy sputum and the prominent butterfly-like shadow on the chest X-ray. There was no evidence of cardiac enlargement on echocardiogram performed immediately after surgery (LAD 2.9 cm, LVD_d 5.1 cm). We do not believe these findings are compatible with aspiration pneumonia (Mendelson's syndrome), because nothing could be aspirated through the endotracheal tube immediately after intubation, and the pH of the pink, frothy sputum was higher than 6.

We have no exact explanation for this pulmonary edema other than the usual physiological changes in a pregnant woman discussed previously. The possible explanations are as follows:

Hypertension: Even after adrenalectomy, the systemic vascular resistance might have been increased because of the increased catecholamine released during surgical manipulation of the adrenal gland, and the increase of cardiac output by the excitement during emergence from anesthesia easily increased the blood pressure. Glassford et al. described severe hypertension during tracheal intubation leading to pulmonary edema in a pregnant woman with Cushing's syndrome [4]. In this case, the blood pressure rose to 190/110 mmHg from 160/70 mmHg during emergence from anesthesia. Since this blood pressure does not seem to be so different from the preoperative blood pressure (160–180/70–110 mmHg), it might be hard to say that this high blood pressure led to pulmonary edema. However, controlling blood pressure during the whole period of operation is important.

Increased airway pressure: High alveolar pressure, especially that caused by a cough during emergence from anesthesia, might have increased pulmonary capillary permeability. Zlatnik reported that intubation during general anesthesia in a pregnant woman could easily increase pulmonary capillary permeability because of damage to the pulmonary capillary endothelium [12]. Since the capillary endothelium can easily be damaged during pregnancy, a sudden increase in airway pressure during coughing might amplify these damages.

Fluid overload: Considering that the plasma volume increases by 40% to 50% during pregnancy [8], the calculated fluid intake of 650 ml during operation might be too much for this patient, even though the findings

from the echocardiogram suggested no left atrial and ventricular enlargement. Administration of diuretics until this patient lost 6 kg of her body weight improved pulmonary edema in the ICU. This result also suggests that the relative fluid overload could cause pulmonary edema.

Surgical procedure: Laparoscopy can also increase the intraabdominal pressure and airway pressure and lead to pulmonary congestion. In this case, the intraperitoneal pressure was set to less than 10 mmHg during laparoscopy. However, the flexed lateral position in a pregnant patient may increase the intraabdominal pressure and lead to increased airway pressure.

Only a few papers have described anesthetic considerations in a pregnant woman with Cushing's syndrome [4–6]. Glassford et al. described a variety of clinical and technical difficulties for the anesthetist, which include control of airway and prevention of aspiration, postoperative respiratory insufficiency as a result of decreased respiratory muscle mass, hypertension, electrolyte abnormalities, and hyperglycemia [4]. However, no paper emphasized the importance of anesthetic management for preventing pulmonary edema during operation. We planned the anesthetic management considering the possibilities of various maternal and fetal complications. The incidence of pulmonary edema in pregnant patients with Cushing's syndrome is more than 2000 (5000 in adrenal adenoma) times higher than that in normal pregnant women [2,14]. However, we were not aware of such a high incidence of pulmonary edema in pregnant women with Cushing's syndrome [2]. Here, we would like to emphasize the importance of very careful anesthetic management in a pregnant woman with Cushing's syndrome to reduce the risk of pulmonary edema.

Although we still do not have a perfect anesthetic plan for preventing pulmonary edema in a pregnant woman with Cushing's syndrome, we believe the following considerations might be helpful:

1. Control blood pressure, especially during induction and emergence from anesthesia.
2. Avoid sudden changes in airway pressure, such as that produced by coughing.
3. Control intravascular volume by diuretics if needed, preoperatively, and avoid excessive fluid infusion.
4. Try to minimize the increase in intraabdominal pressure by keeping the patient flat. The intraabdominal pressure should be less than 12 mmHg [15].

We also have to take care with general problems such as control of perioperative complications, including hypertension, hyperglycemia, and aspiration, and perform careful monitoring of the fetus during the operation.

We have presented a pregnant patient with Cushing's syndrome who developed pulmonary edema after laparoscopic adrenalectomy. We always have to be aware of pulmonary edema in pregnant patients with Cushing's syndrome because of its very high incidence in such patients.

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