Clinical Case Report

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Neurosurgical anesthesia for a pregnant woman with macroprolactinoma

A case report

Yimeng Xia, MD, PhD[a], Xin Ma, MD[a], Brian B. Griffiths, PhD[b], Yan Luo, MD, PhD[a,*]

Abstract

Rationale: Being required to perform neurosurgery on a pregnant woman is rare, but occasionally unavoidable. In these cases, clinical anesthesiologists are confronted with conflicting information and few evidence-based guidelines.

Patient concerns: Here, we describe the successful anesthetic management of a 24-week pregnant woman with macroprolactinoma who underwent endonasal transsphenoidal resection of pituitary adenoma.

Diagnoses: According to the prolactin (PRL) level and magnetic resonance imaging (MRI) results, the patient was diagnosed with macroprolactinoma and kept stable after taking the regular bromocriptine treatment. However, after stopping the drug by herself because of pregnancy, her tumor increased in size and she suffered from vision loss. Surgery was recommended as soon as possible to lessen the compression in the eye. However, the anesthetic management was a considerable risk due to the increased chance of maternal mortality, intrauterine growth restriction, or preterm labor.

Interventions: We held a multidisciplinary meeting before the operation and made a detailed plan for how to proceed. During the operation, our team ensured intensive monitoring, provided adequate oxygen, and achieved haemodynamic stability. Anesthetics like sufentanyl, rocuronium, propofol, and desflurane were carefully chosen in order to ensure the safety of both the mother and fetus.

Outcomes: Under the careful and successful anesthetic management, the pregnant woman underwent the surgery smoothly and neither the mother nor baby experienced any pre- or postoperative complications. At the 38th week of gestation, the patient received a cesarean section and the baby had developed normally.

Lessons: Neurosurgeries in pregnancy are sparse, and careful planning with cross-disciplinary specialists was needed in advance of the operation. Moreover, when dealing with such surgeries, we should consider the safety of both the mother and fetus, which is challenging but important.

Abbreviations: BPM = beats per minute, CPP = cerebral prefusion pressure, ECG = electrocardiogram, ICP = intracranial pressure, MAP = mean arterial pressure, MRI = magnetic resonance imaging, PetCO2 = end tidal carbon dioxide tension, PRL = prolactin, SPO2 = percutaneous oxygen saturation.

Keywords: intracranial pressure, macroprolactinoma, neurosurgical anesthesia, pregnancy

1. Introduction

Pituitary tumors represent from 10% to 25% of all intracranial neoplasms,[1] which can be sorted by size as microadenomas (<10 mm diameter) or macroadenomas (>10 mm diameter), or sorted by hormone secretion as functional or nonfunctional.[2] The most common type of pituitary adenoma is prolactinoma,[3] which produces the hormone prolactin (PRL) and makes up 32% to 66% of all pituitary tumors.[4] Symptoms of prolactinoma are excessive PRL in the blood (hyperprolactinemia) and pressure from the tumor on surrounding tissues can cause secondary symptoms. Treatments involve drug therapies, radiotherapy, and transsphenoidal resection.[5]

Currently, the literature on neurosurgical anesthetic management in gravid patients is sparse[6–11] and focuses on theoretical principles rather than practice.[12] Anesthesiologists need evidence-based solutions for the inherent challenges in performing neurosurgery during pregnancy.

To our knowledge, we are the first to share the successful experience in anesthetic management of a pregnant woman with macroprolactinoma who received endonasal transsphenoidal resection under general anesthesia. Moreover, our case report will add to the literature about neurosurgical anesthesia in pregnant patients.

The patient approved the publication of the following case report.

2. Case report

The patient was a 25-year-old woman (167 cm, 55 kg) with macroprolactinoma at 24 weeks of gestation. Two years prior to

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[a] Department of Anesthesiology, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, People's Republic of China, [b] Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Stanford, CA.

[*] Correspondence: Yan Luo, Department of Anesthesiology, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, No. 197, RuijinEr Road, Shanghai 200025, People's Republic of China (e-mail: ly11087@rjh.com.cn).

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admission, she experienced irregular menstruation and received no medical treatment. In 2016, the clinical manifestation had worsened and a laboratory test in one of the top hospitals showed that her PRL levels were 3640 uIU/mL (normal values 100–500 uIU/mL). Magnetic resonance imaging (MRI) of her brain revealed a space-occupying lesion in the sphenoid area with an area of 1.54 cm^2 (1.4 × 1.1 cm). In response, the woman began taking the standard bromocriptine treatment until she confirmed that she was pregnant on January 30, 2017. Her last menstruation date was December 30, 2016. During the period of bromocriptine treatment, additional laboratory tests revealed a smaller tumor with an area of 0.66 cm^2 (0.6 × 1.1 cm) and lower PRL levels of 168.4 uIU/mL. At the end of May 2017, the patient came to our hospital due to decreased visual acuity in the left eye and a progressive headache. At that time, additional MRI of her brain revealed that the tumor had reached 3.78 cm^2 (2.1 × 1.8 cm; Fig. 1). Her PRL levels were over 200 ng/mL (normal level ranges from 5 to 25 ng/mL in our hospital). A visual field test also revealed a vision loss of 3/19 in the left eye and no loss in the right eye. In the course of our observations, the right eye also began to suffer vision loss.

Because of the rapidly worsening vision, neurosurgeons decided to carry out the endonasal transsphenoidal resection of her pituitary adenoma in order to lessen the compression on her eyes. However, they considered her "high risk" because both the patient and the unborn fetus in utero would require careful consideration. Therefore, a multidisciplinary meeting of neurosurgeons, obstetricians, endocrinologists, and anesthesiologists was held before the operation. Based on the consensus of the specialists, a detailed plan was made with the aim of ensuring maternal safety, maintaining the pregnancy, and achieving the best possible fetal outcome.

Upon the patient's arrival to the operating room, noninvasive monitors were connected. Her blood pressure was 105/70 mm Hg, heart rate was 90 beats per minute (BPM), and arterial oxygen saturation was 98% when breathing normal atmospheric air. General anesthesia was intravenously induced with sufentanyl (20 μg), rocuronium (33 mg), and propofol (60 mg) to facilitate tracheal intubation and was maintained with 70% oxygen (1.5 L/min) and desflurane (7%). After the smooth induction, the ultrasound operator closely examined the fetus (Fig. 2) and confirmed the fetus's well-being. Neuromuscular blockade was maintained with intermittent rocuronium. The monitored parameters included electrocardiogram (ECG), capnography, and pulse oximetry. After negotiating with neurosurgeons, the position of left lateral tilt to minimize aortocaval compression was applied. When the operation had finished, the ultrasound doctor examined the unborn fetus again and confirmed that the fetus was healthy (Fig. 3). The patient's intraoperative systolic blood pressure was 90 to 120 mm Hg, her heart rate was 60 to 100 BPM and $PetCO_2$ ranged from 30 to 35 mm Hg. Surgery was completed without any complications. The durations of surgery and anesthesia were 30 and 90 minutes, respectively. Intraoperatively, total blood loss was 80 mL, urine output was 100 mL, and total infusion volume was 1250 mL (lactated Ringer's solution).

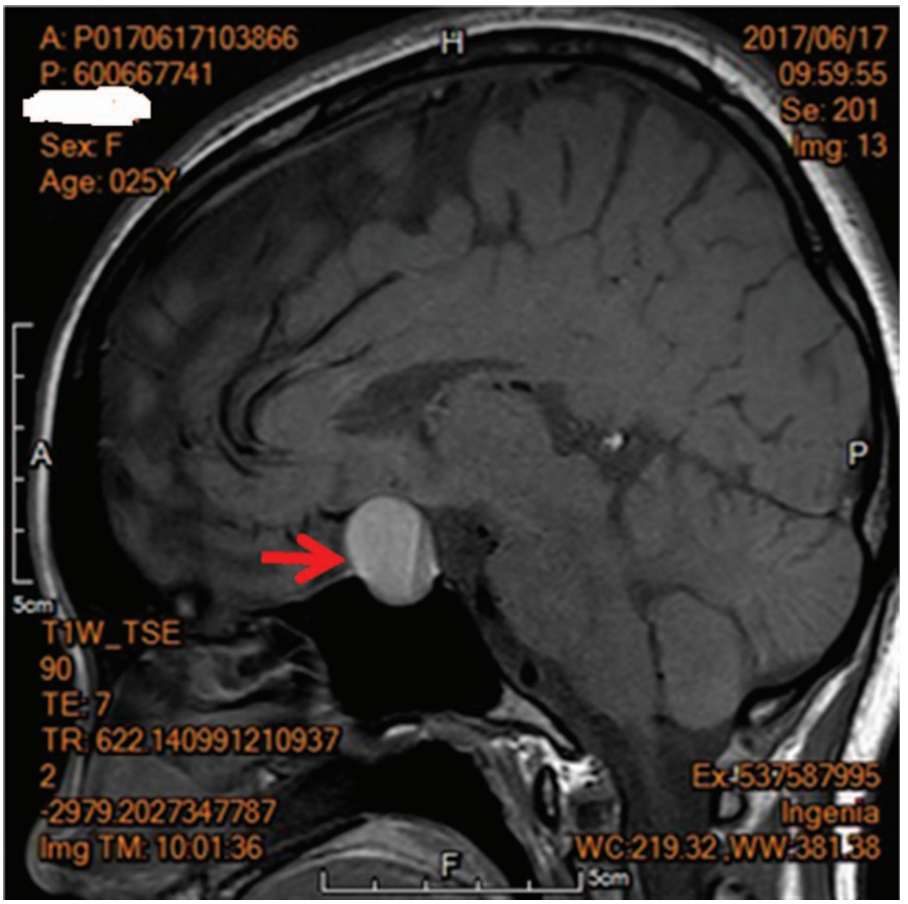

Figure 1. MRI of the patient's brain shows the location and size of prolactinoma (arrow).

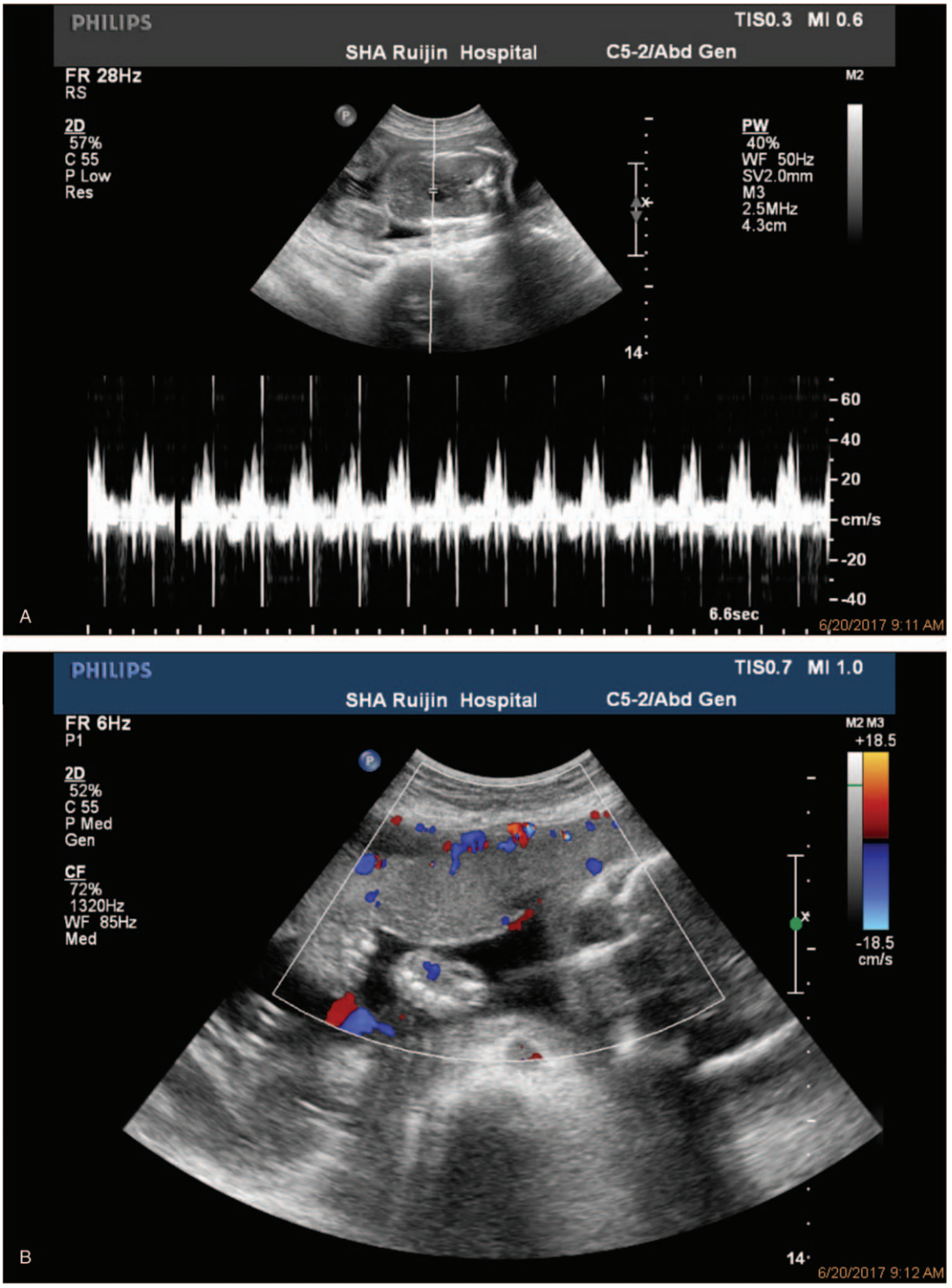

Figure 2. Ultrasound image shows fetus heart rate and uteroplacental circulation after the intubation of anesthesia.

At the end of the surgery, neuromuscular blockade was reversed with neostigmine. The mother was extubated in the operating theater once fully awake and reported no new neurological deficits. She was transferred to the intensive care unit for recovery and observation. No evidence of postoperative complications or worsening neurological or obstetric symptoms were observed. With an uneventful recovery, the patient was discharged on the 7th postoperative day after the fetus was evaluated to be healthy via ultrasound.

3. Discussion

Although not common, it is estimated that the incidence of nonobstetric surgeries in pregnant patients accounts for 1% to

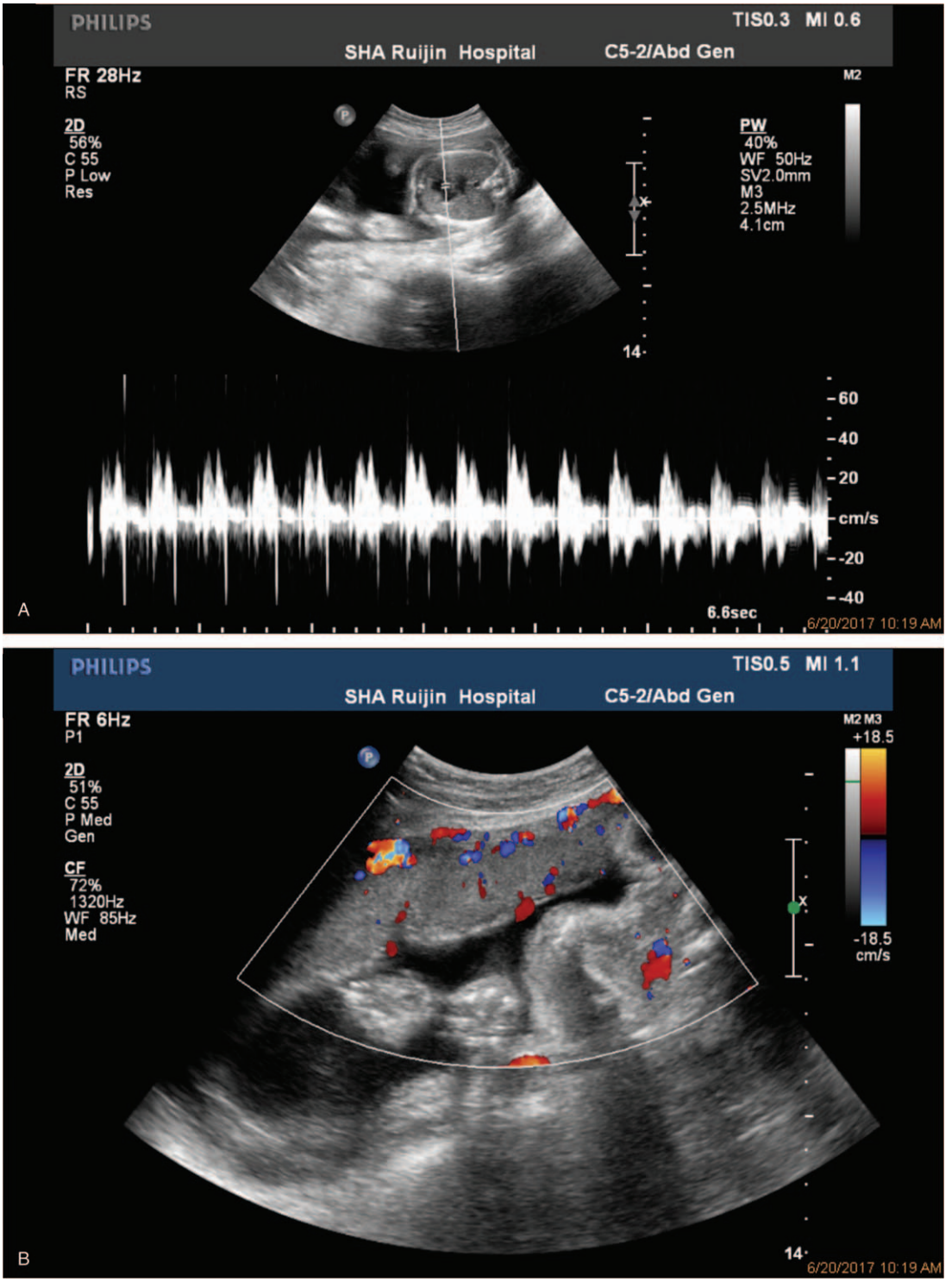

Figure 3. Ultrasound image shows fetus heart rate and uteroplacental circulation after surgery accomplishment.

2% of total surgeries.[13] Among them, neurosurgery presents substantial challenges to anesthesiologists and requires appropriate changes in management plans before operation.[14] To accomplish this, it is vital to consider both the patient herself and the unborn fetus *in utero*. Therefore, our goal was to maintain the pregnancy, ensure the patient safety, and achieve the best possible outcome for the fetus.

Evidence-based recommendations for neuroanesthetic management in pregnancy are rare. The important concerns include maternal safety, fetal safety, and avoidance of preterm labor and delivery. Therefore, a successful anesthetic management plan relies on the general principles of obstetric and neurosurgical anesthesia. Based on published reviews[15–17] and our previous experience, close attention should be paid to the following challenges.

The first challenge is the timing of the surgery. It is commonly accepted that the decision whether or not to attempt neurosurgery depends on the mother's condition, the predicted outcome of the procedure, and the gestational age of the fetus.[18] Neurosurgery is usually recommended and safe during the second trimester since teratogenicity and fetal congenital malformations more commonly occur in the first trimester, and emergency delivery should be taken into consideration during the third trimester.[18] Fortunately, the woman in this case study was in the second trimester when her tumor let to visual deterioration and needed urgent surgical intervention.

The second, once the decision to perform surgery has been made, is to maintain hemodynamic stability. How to balance the adequate cerebral perfusion pressure (CPP) and adequate uteroplacental perfusion pressure (UPP) represents a significant challenge. On one hand, since cerebral perfusion pressure requires maintenance of adequate mean arterial pressure (MAP) and reduction of intracranial pressure (ICP, ICP = MAP-CPP), it should be optimized by avoiding acute increases in ICP.[18] In our case, the woman with macroprolactinoma had reported a headache, indicating high ICP before operation. During surgery to remove a large tumor, intracranial bleeding and higher ICP are not uncommon. The common methods to reduce ICP include hyperventilation or the use of mannitol. However, any perturbances in maternal blood pressure, such as hypotension, hypovolemia, or hyperventilation, will affect the uteroplacental circulation, leading to fetal ischemia due to the lack of autoregulation in the placenta. Therefore, we applied mild to moderate hyperventilation ($PetCO_2 = 30–35$ mm Hg), prepared low dose of mannitol (2 cases reported mannitol is safe in low doses during pregnancy[6,10]), and measured the blood pressure every 3 minutes in order to deal with raised ICP and maintain the balance between CPP and UPP during surgery. Additionally, avoiding caval venous compression to maintain UPP is also important after 20 weeks of gestation[18] and we made use of a left lateral tilt during the surgery.

Third, anesthetic agents were chosen carefully. Currently, no anesthesia agent has been definitively proven to be harmful to the human fetus because of the limitations of animal models in fully representing human biology and the ethical concerns of drug tests on a human fetus. Anesthetics such as desflurane, propofol, sufentanyl, rocuronium, neostigmine, atropine, etc., were reported to be safe during pregnancy.[15] However, 1 report[19] suggested that total intravenous anesthesia is ideal since unlike volatile anesthetics, it does not interfere with uterine tone and is a cerebral vasoconstrictor, which could help reduce ICP.

Last but not the least, close monitoring of the fetus's well-being is strongly recommended. For the current case, ultrasound was conducted pre-, peri-, and postoperationally to ensure the fetus's health. In addition, other fetal monitoring like fetal heart rate and uterine contractions are recommended during surgery.[16]

4. Conclusions

We are the first to report a successful application of general anesthesia for a 24-week pregnant woman for an endonasal transsphenoidal resection of macroprolactinoma. Neurosurgeries in pregnancy are rare and careful planning with cross-disciplinary specialists was needed in advance. Moreover, when dealing with such surgeries, we should keep in mind the safety of mother and fetus, which is both challenging and important in clinical practice.

Author contributions

Data curation: Yimeng Xia.
Methodology: Yimeng Xia.
Resources: Xin Ma.
Supervision: Yan Luo.
Writing – original draft: Yimeng Xia.
Writing – review & editing: Brian B. Griffiths, Yan Luo.

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