

Intraoperative fetal heart rate monitoring during emergency neurosurgery in a parturient

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Abstract

Malignant brain tumors during pregnancy are rare, and these patients seldom require immediate surgical intervention. A 27-year-old pregnant woman underwent emergency craniotomy. Anesthesia was induced with intravenous thiopental-fentanyl; it was maintained with isoflurane in oxygen and continuous intravenous remifentanyl infusion. We used full stomach precautions but omitted succinylcholine for fear of increasing the intracranial pressure during induction of anesthesia. To detect fetal hypoxia and the effects of anesthesia on fetal hemodynamics, the fetal heart rate (FHR) was monitored using a fetal Doppler ultrasonography unit fixed to the mother's abdominal wall. Intraoperative and recovery periods were uneventful. Use of an isoflurane and remifentanyl combination provided stable hemodynamics with adequate arterial blood pressure to avoid uterine hypoperfusion and fetal hypoxia. In this case, using FHR monitoring we found that craniotomy can be performed safely under isoflurane/remifentanyl based-general anesthesia during the second trimester of pregnancy.

Key words Pregnancy · Glioblastoma multiforme · Isoflurane · Remifentanyl · Fetal heart rate monitoring

Introduction

Brain tumors during pregnancy are rare, and these patients seldom require immediate surgical intervention. In two studies that included 126413 and 312645 pregnancies, respectively, only 7 and 8 women with associated brain tumors were reported, respectively, and only one patient was operated on before giving birth [1,2].

Although neurosurgery during pregnancy has been reported with various surgical techniques for aneurysm,

tumor, or cerebral arteriovenous malformation, reports evaluating the effects of various anesthetics on fetomaternal hemodynamics during neurosurgery are infrequent [3].

We present the anesthetic management of a pregnant woman for emergency craniotomy under isoflurane/remifentanyl-based general anesthesia with the use of fetal heart rate (FHR) monitoring.

Case report

A 27-year-old 60-kg woman was admitted to our institute while in the second trimester of her first pregnancy. According to ultrasonography (US) examination, the gestational age was 24 weeks. She was complaining of headache, vomiting, and weakness on the right side of her body beginning at approximately the 18th gestational week. Computed tomography (CT) revealed a thalamic mass with a cystic component (Fig. 1). The patient was taken to the neurosurgery ward, where on the following day her condition deteriorated. She began experiencing confusion, and her deep tendon reflexes increased with a positive right Babinsky reflex. Therefore, it was decided to remove the intracranial mass with surgery.

When she came to the operating room, she was confused and had a Glasgow Coma Scale (GCS) score of 11. A wedge was placed under the right hip to displace the uterus to the left and increase vena caval blood flow. Standard monitoring was used, electrocardiography, including pulse oximetry, end-tidal CO₂ concentration, urine output, esophageal temperature, invasive blood pressure, and central venous pressure. The FHR was monitored using a fetal Doppler US unit fixed to the mother's abdominal wall. After preoxygenation, anesthesia was induced with fentanyl 0.1 mg i.v. and thiopental 125 mg i.v. with rocuronium 60 mg i.v. to facilitate intubation using the Sellick maneuver. Anesthesia was

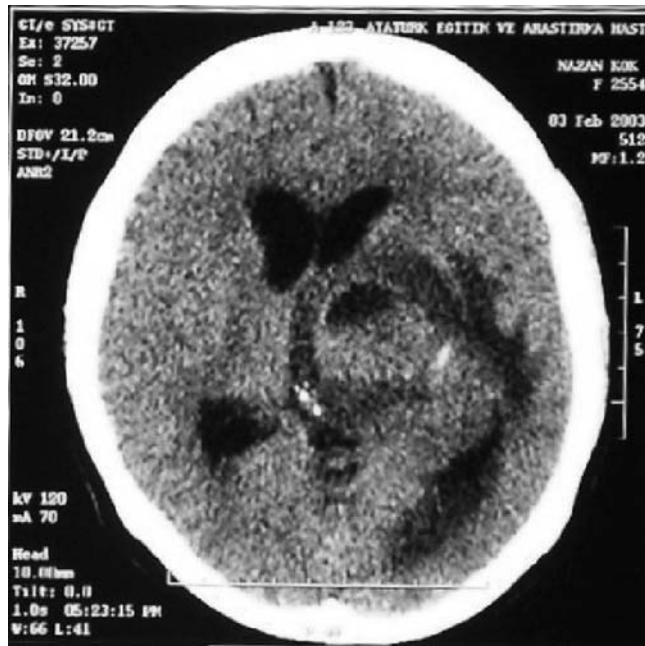


Fig. 1. Preoperative computed tomography revealed a thalamic mass with a cystic component

maintained with isoflurane (0.7%–0.9%) in oxygen and remifentanyl $0.10\text{--}0.25\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ i.v. continuous infusion. A nasogastric tube was placed.

A right parietotemporal craniotomy was performed with the patient supine on a slightly left-tilted operating table. Because the dura was stretched and the brain was swollen, mannitol 35 g was administered intravenously. The tumor, including multiple black venules, was reached at approximately 4 cm depth by cortical incision and could be removed subtotally. The pathology examination confirmed a diagnosis of glioblastoma multiforme.

The maternal blood pressure (Fig. 2a) and heart rate and the FHR (Fig. 2b) remained stable during the operation and the recovery period. Arterial blood gases were assessed periodically; the pH, Pa_{O_2} , Pa_{CO_2} , hemoglobin, and plasma electrolyte concentrations remained within normal limits throughout the operation.

The surgical procedure was completed in 5 h. Before tracheal extubation, the patient's protective reflexes, such as coughing and swallowing, were present. Recovery from anesthesia was uneventful. The patient was transferred to the neurosurgical ward 2 h after the op-

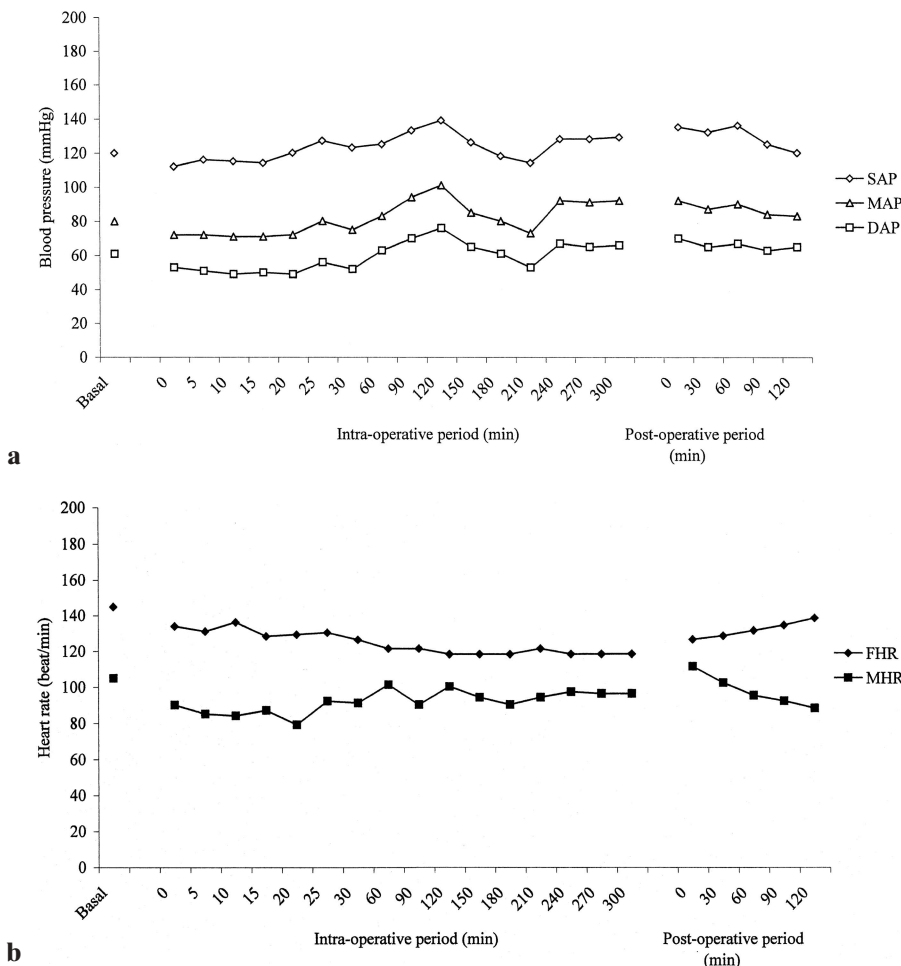


Fig. 2. **a** Maternal blood pressures. During surgery. *SAP*, systolic arterial pressure; *MAP*, mean arterial pressure; *DAP*, diastolic arterial pressure. **b** Maternal and fetal heart rates during surgery. *FHR*, fetal heart rate; *MHR*, maternal heart rate

eration. Confusion was present, and the GCS score was 13 despite confirmation on the control CT that the tumor had been removed subtotaly. Because the patient's condition deteriorated on postoperative day (POD) 28 during gestational week 28, cesarean section was performed under general anesthesia. The baby was a 750-g girl with no congenital abnormalities. The baby was transferred to the pediatric intensive care unit (ICU). Her ventilation was spontaneous with no need for mechanical ventilation. The mother died on POD 60. The baby is now 22 months old with no medical problems.

Discussion

When brain tumors are managed during pregnancy, certain factors must be taken into consideration, including the patient's physical condition; the gestational age; the site, size, and type of tumor; the neurological signs; and the patient's wishes [4]. Every attempt is usually made to bring the fetus to term. If the patient's condition worsens, the tumor should be excised. The second half of gestation places the clinicians in a conundrum because the fetus may be either previsible or extremely premature. Fetal maturation can be accelerated with corticosteroids. If a delay in surgery increases the risk of maternal hypotension, hypoxia, or sepsis, such a delay can be expected to worsen the prognosis for both mother and fetus. Therefore, when clinical evidence suggests the need for an urgent or emergent operation in a pregnant patient, the pregnancy should not affect the decision to proceed [5]. Because our patient was at 24 weeks' gestation and her condition deteriorated acutely, we proceeded with emergency surgery. Unfortunately, the patient died on POD 60 owing to a malignant tumor (glioblastoma multiforme) despite surgical removal. However, because there were symptoms of increased intracranial pressure just after surgery, treatment with corticosteroid and mannitol was maintained to diminish brain edema. These interventions yielded 28 extra days for the development of fetal lung maturity. As a result, the baby never required mechanical ventilation after cesarean section.

When a pregnant woman presents for surgery, it is a stressful event for everyone involved [6]. There is a risk of aortocaval compression during the second half of gestation, which must be prevented with a left uterine displacement device such as a wedge [7]. A wedge was placed under the right hip of our patient to displace the uterus to the left and increase vena caval blood flow, and the operating table was slightly left-tilted during the operative procedure. Pregnant women after the 20th gestational week are at increased risk for gastric acid aspiration during anesthetic induction, so we used precautions for a full stomach but omitted succinylcholine

for fear of increasing the intracranial pressure [8]. The risks of nonobstetric surgery also include teratogenic consequences as well as the onset of premature labor and delivery. It must be remembered that no anesthetic agent has yet been proven to be teratogenic in humans except nitrous oxide, which should be avoided during the first and second trimesters. However, all anesthetic agents and adjuvants must be used attentively [8]. The likelihood of premature labor and delivery following a neurosurgical procedure is less than with an intra-abdominal procedure, and the risk of teratogenicity has generally passed after the 12th week [3]. In this case, we preferred to use isoflurane, a halogenated anesthetic, to decrease uterine contractility during surgery. Moreover, use of an isoflurane-remifentanyl combination provided stable hemodynamics with adequate arterial blood pressure to avoid uterine hypoperfusion and fetal hypoxia.

Although there have been no large systematic studies of intraoperative FHR and subsequent events after nonobstetric surgery during pregnancy, most respected obstetric anesthesia texts advocate continuous intraoperative and postoperative FHR monitoring during nonobstetric surgery once the fetus has reached a gestational age of viability [3]. FHR monitoring may be useful for identifying intraoperative conditions leading to impaired uteroplacental blood flow and fetal oxygenation [7]. In a review, Rosen advocated fetal monitoring whenever possible [8]. However, intraoperative FHR monitoring requires the presence of additional trained personnel, and there should also be a plan regarding how to proceed in the event of persistent fetal distress, including whether to perform an emergency cesarean delivery [9]. Moreover, misinterpretations of FHR monitoring can lead to unsafe interventions [10]. Some obstetricians believe that the fetus would not be compromised so long as the maternal oxygenation and circulation remain normal. Horrigan and coworkers [11] concluded that there is no documented evidence that FHR monitoring is required during nonobstetric surgical procedures in the pregnant patient, provided the mother is not hypoxic or hypotensive. Balki and Manninen [9] reported successful management of a case similar to our patient without FHR monitoring. A recent case report demonstrated intraoperative fetal bradycardia, requiring urgent cesarean delivery despite textbook optimization of maternal health. Under anesthesia, the fetus may come to lie on the umbilical cord against the uterine wall. The combination of increased vascular resistance from the tightly coiled state and further external compression may cause marked reduction of the umbilical circulation. Impaired umbilical blood flow may lead to fetal hypoxia even if the maternal oxygenation and circulation are normal [12]. Liu et al. [13] reported on five patients who demonstrated loss of

variability following induction of anesthesia, with two of the five demonstrating a reduction in the baseline FHR with no detectable maternal changes. These changes were related to the effect of the inhalational anesthetic on the fetus. In our case, anesthetic management with isoflurane and remifentanyl reduced short-term variability following induction of anesthesia.

Conclusions

This case showed that neurosurgery can be performed uneventfully under isoflurane/remifentanyl-based general anesthesia during the second trimester of pregnancy. We believe that continuous monitoring of both mother and fetus is essential not only for providing fetal well-being but also for understanding the effects of various anesthetics on fetal hemodynamics during neurosurgery.

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