Chapter 24

# Management of Brain Tumor in Pregnancy — An Anesthesia Window

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Additional information is available at the end of the chapter

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## 1. Introduction

Brain tumor surgery during pregnancy has a great concern in Egypt now days. High prevalence of brain tumors during pregnancy y was noticed. There is no accurate statics for the prevalence. The most common tumors are pituitary tumors, menegioma, gliomas, metastis of breast carcinomas. Many problems affects anesthesia, as the interaction between many different factors, as the physiological changes during pregnancy, including, cardiovascular, respiratory changes [1]. Problems occur, during diagnosis, and treatment of tumors. Also problems during surgery are, drug interactions with the anesthesia drugs, blood loss and transfusion, prevention preterm labour, and anesthesia for urgent cesarean section during surgery for removal of brain tumor, in the chapter I tried to summary all these factors from anesthesia point of views did many cases for brain resection during pregnancy,I hope to give this experience for any young anesthesit how may facing such cases

### 1.1. Common tumors during pregnancy

#### *1.1.1. Meningiomas*

The incidence of meningiomas is approximately twice as high in women as in men. Specifically, intracranial meningiomas are twice as common and intraspinal meningiomas nine times as common in females [2]. Meningiomas also seem to have a relationship to sex hormones with accelerated growth of these tumors during the luteal phase of the menstrual cycle and during pregnancy [3]. There may also be an increased incidence of meningiomas in women with breast cancer, although one study contests this relationship. A large number of studies have examined the role of androgen, estrogen and progesterone receptors in meningiomas with most finding progesterone and androgen receptors in a high proportion and low levels of estrogen receptors

in a small proportion of meningioma specimens obtained at the time of initial surgery and at recurrence [4].

*1.1.2. Pituitary tumors*

Pituitary tumors account for approximately 15% of all primary intracranial neoplasms and occur in higher frequency in women, mainly in the child-bearing years [4].

The female preponderance of these tumors is due to the increased frequency of prolactinomas in women in the second and third decades. Women are affected four times as commonly as men and account for 78% of all prolactinomas [5].

### 1.2. Cranial metastases

*1.2.1. Breast cancer*

Breast cancer is the most common malignancy among women in North America accounting for 27% of all cancers. Approximately 181,000 new cases of breast cancer were diagnosed in 1992 and 46,000 women died from the disease the same year. Neurologic complications occur in approximately 25% of patients with metastatic breast cancer although autopsy studies have demonstrated central nervous system involvement in 31-57% of examinations [6,7].

## 2. Problems in management of brain tumors with pregnancy

### 2.1. Problems in diagnosis

Symptoms of increased intracranial pressure including headache, nausea and vomiting are similar to the symptoms of early pregnancy, or pregnancy related hypertensive diseases(eclampsia or preeclampsia ).

The use of Neuro imaging of the pregnant patient with these symptoms become necessary. In the first trimester it is preferred to be avoided.the MRI is the procedure of choice as there is no exposure to ionizing radiation. Although there is no evidence that MRI affects the fetus there is exposure to powerful electromagnetic fields and this imaging modality should be avoided if possible in the first trimester.Similarly, there is very little evidence regarding the safety of the ferromagnetic contrast agent gadolinium and this is not sanctioned for use in pregnancy and should be avoided if possible. In the patient with rapid neurologic deterioration computerized tomography (CT) may be necessary. This does involve radiation exposure of approximately 2.5 to 3 rads to the head of the patient and a fetal exposure estimated to be approximately 1 mrad or less per slice which can be reduced by appropriate shielding of the uterus with a lead apron. [9] At fetal exposures less than 10 rads no adverse effects in excess of the background rate of spontaneous abnormalities in 3% of livebirths and the spontaneous abortion rate of 30% in all pregnancies. Medically indicated exposures of up to 5 rads are considered acceptable in pregnancy when unavoidable. There has been limited experience

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with the use of iodinated contrast agents during pregnancy and the risks are not precisely defined. Such agents should be avoided in the first trimester.

### 2.2. Problems during treatment

Treatment of brain tumors or their complications may be necessary during pregnancy. Cerebral edema and increased intracranial pressure may require the use of glucocorticoids and mannitol. Glucocorticoids have been used during pregnancy for other reasons including the prevention of neonatal respiratory distress syndrome and there is no evidence of growth, physical, motor or developmental deficiencies within the first three years of life. However, fetal adrenal suppression may occur with long-term, high dose therapy during any part of pregnancy and necessitates the use of supplemental steroids in the peri-partum period. Although mannitol does cross the placenta and is excreted by the fetal kidney into the amniotic fluid no adverse effects have been reported [10].

Cranial irradiation exposes the fetus to higher doses of radiation than diagnostic imaging. In general, radiation exposure in utero carries a risk of adverse fetal outcomes including spontaneous abortion, anatomic malformation, growth and mental retardation and possibly childhood cancer with the latter risk highest in the first trimester The exposure to the fetus from scatter is low when conventional radiation therapy is delivered to parts distant from the uterus and such exposure carries low risk. Strategies to reduce fetal exposure include the use of focal rather than whole brain irradiation, radiation dose reduction, substitution of heavy charged particles for photons and deferring radiation until after delivery [11].

Chemotherapy typically involves agents which are teratogenic in the first trimester and associated with adverse fetal outcomes. Properties of chemotherapeutic agents which improve permeability across the blood brain barrier also facilitate transport across the placenta making these drugs especially hazardous. Although there is data to suggest that certain chemotherapeutic agents are associated with minimal risk in the second and third trimesters, chemotherapy for malignant brain tumors should be avoided during pregnancy. Meningiomas are tumors that are thought to arise from meningothelial cells which make up the arachnoid villi of the meninges. These lesions account for approximately 20% of all intracranial and 25% of all intraspinal tumors and the incidence increases with age [11].

### 2.3. Problems during anesthesia for brain tumor surgery

**Altered maternal physiology.**

**Respiratory system and acid-base balance changes**

**a.** Alveolar ventilation increases 25% by the fourth month of gestation and 45% to 70% by term. This results in a chronic respiratory alkalosis, with a $Paco_2$ of 28 to 32 mm Hg, a slightly alkaline pH (e.g., approximately 7.44), and decreased levels of bicarbonate and buffer base.

**b.** oxygen consumption increases during gestation, $Pao_2$ usually increases slightly or remains within the normal range.

**c.** Functional residual capacity (FRC) decreases by approximately 20% as the uterus expands, which results in decreased oxygen reserve and the potential for airway closure.

**d.** obesity; perioperative intraabdominal distention; placement of the patient in the supine, Trendelenburg, or lithotomy positions), airway closure may be sufficient to cause hypoxemia

**e.** Failed intubation (which is the leading cause of maternal death from anesthesia) is as much a risk during nonobstetric surgery as it is during cesarean section.

**f.** rapid development of hypoxemia and acidosis during periods of hypoventilation or apnea due to decreased FRC, increased oxygen consumption, and diminished buffering capacity.

**g.** induction of general anesthesia occurs more rapidly during pregnancy, because alveolar hyperventilation and a decreased FRC allow faster equilibration of inhaled agents.

**h.** Acceleration in the induction of anesthesia is the approximately 30% decrease in the minimum alveolar concentration (MAC) for volatile anesthetic agents that occurs even during early gestation.

**Cardiovascular system changes**

**a.** Cardiac output increases by 30% to 50% during pregnancy because of increases in heart rate and stroke volume; both systemic and pulmonary vascular resistance decrease.

**b.** By eight weeks' gestation, 57% of the increase in cardiac output, 78% of the increase in stroke volume, and 90% of the decrease in systemic vascular resistance that typically are achieved by 24 weeks' gestation.

**c.** During the second half of gestation, the weight of the uterus compresses the inferior vena cava when the mother lies supine; this decreases venous return and cardiac output by approximately 25% to 30%.

**d.** Although upper extremity blood pressure may be maintained by compensatory vasoconstriction and tachycardia, uteroplacental perfusion is jeopardized whenever the mother lies supine.

**e.** Frank hypotension also can occur in the supine parturient, especially when regional or general anesthesia attenuates or abolishes normal compensatory mechanisms. is essential to displace the uterus laterally during any operation performed after the twentieth week of pregnancy.

**Factors that can alter uteroplacental blood flow**

**1.** Uterine Contraction

**2.** Decreased Uterine Blood Flow

**3.** Pathological Conditions

**4.** Pharmacological Agents

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Intravenous induction agents

5. Inhalation agents (Desflurane and sevoflurane)
6. Antihypertensive agents
7. b-adrenergic blocking drugs
8. Tocolytic drugs
9. Epidural and subarachnoid opiates
10. Local anesthetics
11. Pharmacological agent added to the local anesthetic
12. Vasopressors

Maintenance of uteroplacental blood flow is the hallmark for fetal well-being; hence an in-depth knowledge of this subjectis essential for individuals taking care of pregnant women.

Uterine blood flow is determined by the equation.Hence any condition that will significantly decrease mean [14,15]

$$\frac{\text{Uterine arterial pressure} - \text{Uterine venous pressure}}{\text{Uterine vascular resistance}} \quad (1)$$

So when maternal arterial pressure decreases or significantly increase uterine vascular resistance will decrease utero placental blood flow and, ultimately, umbilical blood flow.At term, 10% of the cardiac output (700 mL/min) supplies the uterus. The placental vasculature remains maximally [16,17,18].

**Changes in blood volume and blood constituents**

- Blood volume expands in the first trimester and increases 30% to 45% by term. A smaller increase in red blood cell volume than in plasma volume results in a dilutional anemia.
- moderate blood loss is well tolerated during pregnancy, preexisting anemia decreases the patient's reserve when significant hemorrhage occurs. Fresh blood transfusion is needed to compensate blood loss during brain tumor surgery [18].
- Pregnancy induces a hypercoagulable state, with increases in fibrinogen; factors VII, VIII, X, and XII; and fibrin degradation products. Pregnancy is associated with enhanced platelet turnover, clotting, and fibrinolysis, and there is a wide range in the normal platelet count; thus pregnancy represents a state of accelerated but compensated intravascular coagulation. During the postoperative period, pregnant surgical patients are at high risk for thromboembolic complications.
- It is great challenge to Induce hypotensive technique and to maintain the placental perfusion pressure [19].

**Gastrointestinal system changes**

- Incompetence of the lower esophageal sphincter and distortion of gastric and pyloric anatomy result in an increased risk of esophageal reflux and aspiration pneumonitis.
- It seems prudent to consider any pregnant patient at risk for aspiration after 18 to 20 weeks' gestation.
- Rapid sequence induction to avoid aspiration and deep anesthesia to prevent increase in the intracranial pressure during brain tumor surgery is another problem.
- preoperative antiacid,sodium citreate, meteclopramid,muscle relaxant as rocuronium.
- complete recovery is needed before extubation.

**Altered Responses to Anesthesia**

- The decrease in MAC for inhaled anesthetic agents,
- thiopental requirements begin to decrease early in pregnancy.
- Plasma cholinesterase levels decrease by approximately 25% from early in pregnancy until the seventh postpartum day. Cautions in use of remifentanil and succinylcholine.
- *The anesthesiologist should monitor neuromuscular blockade with a nerve sti*mulator to ensure adequate reversal before extubation.
- Decreased protein binding associated with low albumin concentrations during pregnancy may result in a greater fraction of unbound drug, with the potential for greater drug toxicity during pregnancy.
- Antiepileptic drugs as **Carbamazepine** and, Phenytoin may potentiate effects of anesthestic drug used [20,21,22].

**Risk of teratogenicity**

- *Teratogenicity* has been defined as any significant postnatal change in function or form in an offspring after prenatal treatment. Concern about the potential harmful effects of anesthetic agents stems from their known effects on mammalian cells. These occur at clinical concentrations and include reversible decreases in cell motility, prolongation of DNA synthesis, and inhibition of cell division.Despite these theoretical concerns, no data specifically link any of these cellular events with teratogenic changes.

**Anticonvulsants**

- All anticonvulsants cross the placenta. Pregnant women with epilepsy who ingest anticonvulsant drugs have a fetal congenital anomaly rate of 4% to 8%, which is higher than the 2% to 3% background incidence quoted for the general population.
- **Carbamazepine**
- **Phenobarbital** is used in the treatment of partial and generalized tonic-clonic seizures and status epilepticus

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- **Valproic acid** (Depakene, Depakote) is used to treat absence and generalized tonic-clonic seizures [23,24,25].

Tranquilizers

Some studies have suggested that first-trimester exposure to diazepam increases the risk of cleft lip.

**Lithium**

In the International Registry of Lithium Babies, (11.5%) of 217 infants exposed to lithium during the first trimester of pregnancy were malformed.Eighteen infants had cardiovascular anomalies.

**Antidepressants**

The selective serotonin reuptake inhibitors include sertraline (Zoloft), paroxetine (Paxil), fluoxetine (Prozac), and citalopram (Celexa). No increased risk of major malformations or developmental (language and behavior) abnormalities has been identified.

**Nitrous oxide**

In vivo and embryo culture studies in rats have confirmed that nitrous oxide produces several adverse reproductive effects, each of which results from exposure at a specific period of susceptibility [21].

Use of electronic fetal monitoring for assessing fetal well-being has become universal, used by both physicians and nurses. Monitoring the fetal heart rate is used to determine adequate cerebral oxygenation of the fetus. As the brain modulates the heart, a decrease in fetal heart rate is believed to reflect inadequate fetal cerebral oxygenation.External fetal heart ratemonitors use a Doppler detective device with computerized logic to interpret,and count the Doppler signals,whereas internal fetal heart rate monitors involve placement of an electrodeon the fetal scalp. The presenceof fetal heart tones as well as their rate and rhythm are well-recognized indicators of fetal well-being. A normal fetal heart rate tracing reveals a rate of 110–160 beats/min with minimal to moderate beat-to-beat variability with or without accelerations. Apretermfetus is expected to have a more rapid rate with little or no beat-to-beat variabilityand no accelerations (an increasein fetal heart rate over baseline, usually occurring with fetal movement.

The goal of antepartum fetal surveillance is to document fetal wellbeing,allowing the pregnancy to continue without concern for fetal death.Several antepartum techniques in use include fetal movement, nonstress test, contraction stress test, biophysical profile, and umbilical artery Dopplerflow velocimetry [26,27,,28,29,30]

Prevention of preterm labor

Fetal movement is the easiest means for documenting fetal well-being. The mother can perceive fetal movements,which serve as a basis for assessment.A diminution in the perception of fetal movement often precedes fetal death. Perception of 10 distinct movements in a period of up to 2 hours is considered reassuring. Heart rate reactivity is thought to be a good indicator of

normal fetal autonomic function. Loss of reactivity is associated most commonly with fetal sleep but also may result from any central nervous system depression. A nonstress test involves connecting themother to the fetal heart rate monitor and observing. Non stress test results can be categorized as reactive or nonreactive.

The non stress test is considered *reactive* (normal) if two or more fetal heart rate accelerations are observed within a 20-minute period. The non stress test is considered *nonreactive* when no accelerations are observed [32,33]

Guidelines for the management of preterm delivery.

- Confirm diagnosis of preterm labor
- Exclude contraindications to expectant management and/or tocolysis
- Administer corticosteroids, if indicated
- Group B *Streptococcus* chemoprophylaxis, if indicated
- Pharmacologic tocolysis
- Consider transfer to tertiary care center

There is increased incidence of abortion and preterm delivery. volatile halogenated agents depress myometrial irritability The prophylactic use of tocolytic agents is controversial; they are not without risk, and it is unclear whether they affect outcome. Selective administration to those patients at greatest risk (e.g., those undergoing cervical cerclage) has been suggested [34,35].

**Anesthetic management**

1. Unlike other operations wherein thepatient is primarily concerned with him or herself, the pregnant woman usually is concerned for her baby'swelfare.
2. The anesthesia provider must beaware of the various physiologic changes of pregnancy and incorporatethem into the anesthetic plan.
3. These physiologic changes have implications for various diseases and must be considered.
4. The central nervous system effect of pregnancy include a reduced local anesthetic requirement when these agents are given intrathecally or epidurally.
5. Pregnant patients are at increased risk for aspiration during general anesthesia.
6. There is some suggestion that surgery during the first trimester is linked to central nervous defectsduring surgery.
7. Fetal heart rate monitoring is possible during some surgical procedures but is not universally used in theUnited States.
8. Preterm delivery remains the leading cause of perinatal morbidity and mortality in the United States. Preterm labor is difficult to control with medication; the most promising medications are the calcium channel-blocking drugs. Magnesium sulfate is frequently

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used and is associated with prolonged depolarizing and nondepolarizing neuromuscularblockade.

9. The etiology of preeclampsia remains to be elucidated but is believedto be triggered by a paternal antigen in a susceptible mother.
10. Magnesium sulfate is the most effective medication for the prevention of seizures in women with preeclampsia.
11. Labetalol is the preferred medicationfor the control of blood pressure in mothers with preeclampsia.
12. The two causes of antepartum hemorrhage are placenta previa and placental abruption. Associated with the increase in cesarean sections isa high risk of placenta accreta in patients with placenta previa.
13. Perinatal transmission of HIV is low if the viral load is <1,000 copies/mL, and patients with these levels do not require cesarean section. If theviral load is greater, cesarean section may decrease the risk of perinatal transmission [36,37].

## 3. Preoperative management

Premedication may be necessary to allay maternal anxiety. Precautions against acid aspiration should include administration of an $H_2$-receptor antagonist and 30 mL of a clear antacid before the induction of anesthesia.

## 4. Choice of anesthesia

The choice of anesthesia should be guided by maternal indications and should take into consideration the site and the nature of the surgery. No study has correlated improved fetal outcome with any anesthetic technique. When possible, local or regional anesthesia (with the exception of paracervical block) is preferred; this permits the administration of drugs with no laboratory or clinical evidence of teratogenesis. In addition, maternal respiratory complications occur less frequently with local and regional anesthetic techniques. These techniques are suitable for cases involving cervical cerclage, urologic or lower extremity procedures, and operations on the arm or hand. Most abdominal operations require general anesthesia, because the incision typically extends to the upper abdomen, which creates an unacceptable risk of aspiration in a pregnant patient with an unprotected airway [38,39].

## 5. Prevention of aortocaval compression

Beginning at 18 to 20 weeks' gestation, the pregnant patient should be transported on her side, and the uterus should be displaced leftward when she is positioned on the operating table.

## 6. Monitoring

Maternal monitoring should include noninvasive or direct blood pressure measurement, electrocardiography, pulse oximetry, capnography, temperature monitoring, and the use of a nerve stimulator. The FHR and uterine activity should be monitored both during and after surgery when technically feasible.

## 7. Anesthetic technique

General anesthesia mandates endotracheal intubation beginning at approximately 18 to 20 weeks' gestation or earlier if gastrointestinal function is abnormal. Denitrogenation (i.e., preoxygenation) should precede the application of cricoid pressure, rapid-sequence induction, and endotracheal intubation. Drugs with a history of safe use during pregnancy include thiopental, morphine, meperidine, fentanyl, succinylcholine, and most of the nondepolarizing muscle relaxants. Many obstetric anesthesiologists would now add propofol to the list of "safe" drugs for use during pregnancy.

A commonly used technique employs a high concentration of oxygen, a muscle relaxant, and an opioid and/or a moderate concentration of a volatile halogenated agent. Scientific evidence does not support avoiding nitrous oxide during pregnancy, particularly after the sixth week of gestation. Omission of nitrous oxide may increase fetal risk if inadequate anesthesia results or if a high dose of a volatile agent results in maternal hypotension. A cautious approach would restrict nitrous oxide administration to a concentration of 50% or less and would limit its use in extremely long operations. Hyperventilation should be avoided; rather, end-tidal $CO_2$ should be maintained in the normal range for pregnancy.

Before the administration of spinal or epidural anesthesia, rapid intravenous infusion of 1 L of crystalloid seems prudent, although the anesthesiologist should not assume that this will prevent maternal hypotension. Appropriate vasopressors should be available to treat hypotension if it occurs. The usual precautions must be taken to guard against a high block and systemic local anesthetic toxicity.

Regardless of the technique used, avoidance of hypoxemia, hypotension, acidosis, and hyperventilation are the most critical elements of anesthetic management.

## 8. Postoperative management

### 8.1. Postoperative management

The FHR and uterine activity should be monitored during recovery from anesthesia. Adequate analgesia should be obtained with systemic or spinal opioids. Prophylaxis against venous thrombosis should be considered [38,39,40,41].

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**Case study:**

- Pregnant woman 30 weeks of pregnancy, she was complained from multiple menegiomas, conservative treatment was used throughout pregnancy period. this patient developed sever continuous vomiting,and rapid deterioration of nutritional status,neuro surgery team decided urgent operation for decompression of the brain, the patient was referred for obstetric,and anesthesia consultant.
- Anesthesia examination revealed that :

Patient 35 years old 65 Kg, this the first baby,she complained from infertility for 15 years,she was hypertensive 150/90 on aldomit.anticovasant drugs was admintsred,liver enzymes was 2 folds,albumen was 2,5, prothrombin was 65% kidney function within normal range. Hb was 6,5gm/dl, Obesteric examination revealed that baby nearly mature,his weigt is under weight.

- Preoperative preparation:

Anesthesia consultant recommended blood transfusion for 4 units of packed RBCs,4 units of human albumen, 4 units of fresh plasma 2 days before surgery. Preparations of another for units of fresh blood were for intraoperative losses Preoperative antacid was administered. Obstetric Preparations was for urgent cesarean section. Pediatric preparing to receive the premature neonate if urgent cesarean section was needed

- Anesthesia management:
- Monitoring:

Invasive blood pressure, ECG,endtidal CO2,pulse oximetry, uterine contraction monitor, fetal Doppler. Postioning: Supine with left lateral tilt,

### 8.2. Induction of anesthesia

3-5 mg/kg sodium thiopental, rocuronium 04 meg/kg, fentanyl 1mg/kg. Intubation by rapid sequence, the precautions mentioned above were considered

The operation was long 5 hours, blood loss was replaced, fetal heart was declined at third hour,urgent cesarean section was done,the pediatric consultant intubated the neonate,and he was incubated,for 2 weeks,he extubated and he is still living.mother was in intensive care unit for 3 days.

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