



# Anesthesia for the Pregnant Patient with Intrathoracic Tumor

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## 16.1 Introduction

Intrathoracic tumors can be divided into subclasses as either primary or secondary lung tumors or pleural or mediastinal tumors. Among these lung cancers, the most frequent type of tumor group is the intrathoracic tumor. Pleural and mediastinal masses are relatively rare. The frequency of lung cancer increased throughout the twentieth century, and it has become the most common cancer type among all cancers. Lung cancer is also the leading cause of cancer-related mortality worldwide which is typically diagnosed in the late decades of life. However, its frequency is also increasing in people younger than 40 years, thus including the woman of child-bearing age. The aim of this chapter is to focus and give a compiled information on the pregnant with lung/thoracic tumors. Hereby, typical sources of problems in the management of these patients, anesthetic challenges, and experiences are summarized.

## 16.2 Lung Tumors in Pregnancy and Treatment Approach

Cancer in pregnancy is a rare occasion affecting about 17–38 of every 100,000 births. Most common cancers diagnosed during pregnancy are breast cancer, cervical and ovarian cancer, Hodgkin and non-Hodgkin lymphomas, leukemias, and malignant melanoma [1]. Lung tumor in the pregnant patient is an exceedingly rare

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occasion, and it is not possible to give out a true frequency of it. There are about 60 reported cases of lung cancer during pregnancy in the last two decades [2].

Reasons of this gradual increase possibly might be related to increased awareness, increased chance of diagnosis, increasing trend of smoking among young women, and the advanced maternal age. Majority of the lung tumors are non-small cell lung cancer type in the nonpregnant population; similarly, the pregnant patients share the same diagnosis distribution [3]. Non-small cell lung cancer diagnosis constitutes approximately 80% of the lung cancers, and the rest of the cases are mainly small cell cancers [3].

In case of confirming lung tumor diagnosis in the early stages of a pregnancy, therapeutic choices depending on the gestational week, tumor type, and patient's preferences are considered. There is no definitive knowledge on how pregnancy affects the prognosis of lung tumor or how the lung tumor affects pregnancy. It is wise to terminate pregnancy if the patient is diagnosed in early weeks and expected to get high benefit from chemotherapy. Almost all of chemotherapeutics are known to be teratogenic. However, most of the patients have grade III or IV lung tumors at the time of their diagnosis, and the efficiency of terminating pregnancy is not known [4, 5]. Therapeutic options for pregnant patients with lung cancer are chemotherapy, targeted agents, and radiotherapy [5, 6]. Both chemotherapy and radiotherapy carry significant risks for the fetus. Radiotherapy is generally reserved for the palliation of symptoms during pregnancy and for the treatment of distant lesions such as brain or bone metastases. Chemotherapy is the cornerstone of therapy in pregnancy for malignancies during gestation. Due to the teratogenic effects of chemotherapeutics, physicians must respect to the preferences of an individual patient [7].

In a case series of eight parturients with thoracic tumors, authors noted that the patients who underwent surgery, radiation, and chemotherapy had good maternal neonatal outcomes [6]. Patients in this report had both malignant and benign tumor diagnoses with multiple types of tumors in origin. These authors recommended an aggressive approach for these patients [6]. Unfortunately such successful similar case series are lacking in the literature.

Utilization of targeted agents is an evolving issue with a yet unknown results and safety concerns [7]. They are not recommended until any evidence of safety appears.

The remaining option of therapy in pregnant patients with lung cancer is surgery. There is a paucity of literature about thoracic surgery for lung cancer during gestation probably because majority of the cases are at advanced stage of the disease at the time of diagnosis [8]. There is at least one successful case of video-assisted thoracoscopic surgery (VATS) in a pregnant patient [9]. In this case report, a parturient at 24 weeks' gestation having a thoracic mass in her right lower lobe underwent a successful surgery including right lower lobectomy and lymph node dissection. Both maternal and fetal outcomes were uncomplicated in this report. There were no details of anesthesia, but it is well known that VATS necessitates one lung ventilation using double-lumen endotracheal intubation or endobronchial blockers. Airway edema in pregnant patient may preclude the use of smaller-size double-lumen endotracheal tubes. Another concerns for the anesthesiologist is the position of the patient and monitoring of fetal well-being during surgery. Right lateral position for

a left-sided thoracic intervention would probably increase the pressure on inferior vena cava of a term pregnant which should be best avoided. Theoretically, periods of decreased oxygen partial pressures during one-lung ventilation may compromise fetal status and lead to changes in fetal heart rate. Continuous monitoring of fetal heart rate would be wise in such cases.

The second case underwent surgical intervention for treatment of a tracheal carcinoma [10]. The parturient was at 27 weeks' gestation when admitted to the emergency department for hemoptysis. The first endobronchial intervention for this patient was for urgent control of bleeding, and the second attempt was for the resection of the tumor, where both procedures were performed under general anesthesia. Argon plasma laser coagulation with cycling 30–100% FiO<sub>2</sub> periods was used for tumor resection. Patient and fetus well tolerated the procedure, and tracheal resection was completed. Remaining of pregnancy was uneventful, and healthy newborn was delivered with cesarean section. At 3 years follow-up, the patient had no signs of recurrence, and no neonatal anomaly developed. This case represents the second successful intervention for an intrathoracic mass during pregnancy. It is possible that with the evolution of surgical and anesthetic techniques, more cases will be witnessed in the following years.

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### 16.3 Anesthesia Challenges

In principle, all preoperative patients with pre-existing comorbidities are consulted with the appropriate medical specialties, and physicians aim to operate these patients at the best medical situation that can be achieved. The same principles are applied to those pregnant patients having a thoracic mass or lung cancer diagnosis. It is well known that pulmonary complications are observed in patients who underwent anesthesia even in those without pre-existing pulmonary disorders. If there is an inadequately treated pulmonary disorder preoperatively, frequency of pulmonary complications increases. Pregnancy leads to certain well-known physiologic changes in the respiratory system. One of the most important of these changes for the anesthesiologists is the 20% decrease in functional residual capacity in the pregnant [11]. Supine position during the surgery further decreases the functional residual capacity. Secondly, oxygen consumption in the pregnant rises about 75% in the second trimester, and metabolic oxygen need exceeds maternal supply in the laboring woman. Associated medical diseases such as preeclampsia may further increase the airway edema in the term pregnant. Coupling these changes with pulmonary functional losses in pregnant woman with lung tumor makes the parturient more susceptible to periods of apnea and concomitant oxygen reserve depletion. Moreover, these group of patients may present within a severe medical condition to the anesthesiologists. Despite the increased rate of diagnosis of lung tumors in the last few decades, physicians may be reluctant to use valuable diagnostic tests in pregnant patients with respiratory symptoms mainly for the concerns about fetal radiation exposure. This approach may delay the diagnosis of the cases, and anesthesiologist may face with an

untreated term pregnant in a severe medical condition [12, 13]. Especially bronchogenic tumors and mediastinal masses challenge anesthesiologists. Regional anesthesia seems a rational choice in these patients, but it is not without problems [8, 11]. If the regional anesthesia reaches to middle or upper thoracic dermatomes, spinal or epidural anesthesia may interfere with respiratory muscle functions. Normally well-functioning respiratory system in upright position of daily life might become inefficient with combination of supine position and the added effects of partially anesthetized respiratory muscles. Then, special caution should be taken for exclusion of high thoracic dermatomal involvement under regional anesthesia. Since epidural block provides segmental anesthesia which might be titrated to the desired dermatomal level by administration of fractional doses, it can be easier to control the sensory block height. Precise determination of highest dermatomal level of anesthesia is somewhat more difficult with spinal anesthesia in comparison to epidural, although spinal anesthesia has the advantage of providing dense block and full sacral anesthesia. Alternatively, combined spinal epidural technique provides both dense block with sufficient sacral involvement, and anesthesia might be advanced to higher dermatomes if needed [14]. Other features of parturients presenting with mediastinal masses are the potential of these intrathoracic tumors to compress nearby structures such as trachea, left or right bronchus, anterior aspect of heart, lung, pulmonary arteries, or superior vena cava. In a spontaneously breathing parturient, the effect of mass on the trachea may not collapse the airway; her respiratory symptoms such as dyspnea might be easily overlooked. Dyspnea in a parturient extending beyond the second trimester of pregnancy which worsens with the progression of the pregnancy should alert the clinician about the possibility of mediastinal mass. Other symptoms depend on the place where the tumor tissue compresses on. If the tumor depresses one of the main bronchi or tracheas, then airway's circumferential area may decrease and wheeze, and/or tachypnea might be seen in the parturient [15]. Atelectasis or pleural effusion might be detected on X-ray examinations [16]. Mediastinal mass may also compress on the superior vena cava or brachiocephalic trunk. The superior vena cava may easily be compressed as intramural pressure inside the veins is lower in this region compared to the nearby heart chambers and great vessels [17, 18]. Bilateral swelling of the neck, upper extremities, head, and upper body parts can be observed. Pleural and pericardial effusion and pulmonary edema may also complicate the presentation of parturients [15, 19].

True frequency of mediastinal masses during pregnancy is not known. In a literature search with PubMed interface (2017), we have encountered only ten cases during pregnancy with the search terms as anesthesia, cesarean, and mediastinal mass. Majority of the mediastinal masses during pregnancy are lymphomas with predominant Hodgkin's lymphoma. Preoperative evaluation of these patients should be performed with a multidisciplinary team since the lesion severely effects multiple systems. This team should involve cardiologists, cardiovascular surgeons, obstetricians, and anesthesiologists. A preoperative echocardiogram would be useful for detection of pericardial effusions and evaluation of cardiac output. Ideally,

cardiovascular surgeons should be ready to start an immediate cardiopulmonary bypass in case of a sudden cardiac deterioration. It is advised that femoral veins should be cannulated before the surgery under local anesthesia in case of emergency need for cardiopulmonary bypass [16, 20].

However, even cannulation of femoral veins in pregnant patients may not be a sufficient precaution since aortocaval compression exists in the term parturients. Placement of multiple intravenous cannulas with large bores both from upper and lower extremities is necessary. Invasive arterial measurement of blood pressure is mandatory in such cases. In a few reports, prior to application of anesthesia, patients were cannulated through femoral arteries and veins as a precautionary measure for the possibility of sudden cardiopulmonary or tracheobronchial collapse during surgery [17, 21, 22]. All of these reports were uneventful without the need for emergent cardiopulmonary bypass. There is at least one review/opinion in the literature indicating that cardiopulmonary bypass on standby is unnecessary in the management of such cases [23]. It is speculated that in the event of a cardiopulmonary deterioration, either at the induction or maintenance of anesthesia, initiation of a cardiopulmonary bypass will necessitate at least 5–10 min to start, which will lead to neurologic injuries [26]. It is advised to have rigid bronchoscope and the presence of a staff in the operation room ready to manipulate it in case of airway collapse or loss of spontaneous ventilation. Appropriate readiness for such surgery depends on the condition of individual patient and the center's preferences. Another consideration point for the anesthesiologist in patients with intrathoracic tumor is the possibility of brain, vertebral, or distant metastases presence in the parturient. Lung tumors frequently make metastases to brain tissue [3–6]. In a parturient with advanced stage of the disease, a metastatic possibility is important for the anesthesiologist. Obviously most of the anesthesiologists would prefer regional anesthesia for a parturient with lung/thoracic tumor, but a raised intracranial pressure is a contraindication for neuraxial blocks. In addition such metastases might be found at the thoracic, lumbar vertebral levels of patients with lung carcinoma. There is at least one report in the literature describing a lung cancer parturient presenting with seizures discovered later to have brain metastases [24]. Initially seizures were attributed to eclampsia; in this case, cesarean section was performed under regional anesthesia. Postoperatively they have discovered the presence of brain metastases with signs of raised intracranial pressure (midline shift) together with a large bronchogenic adenocarcinoma [24]. Such a coincidence of metastases in the lung and brain in a pregnant patient has also been reported for a primary alveolar sarcoma tumor [25]. Regional anesthesia was performed for cesarean section, and 3 days later neurosurgical removal of brain metastases was performed with uneventful general anesthesia. Initial clinical presenting feature of this patient was headache and vomiting history which was attributed to other reasons that could occur during pregnancy. Therefore, a headache, seizure, vomiting, or other neurologic manifestations should be carefully evaluated in a parturient with lung tumor, and a multidisciplinary team approach involving neurosurgeons should be instituted for these patients.

## 16.4 Anesthesia Practice in Pregnant Patients with Lung Tumor

The available information about the lung/thoracic tumors and pregnancy comes from occasional case reports. According to a study of Burlacu et al. [26], only 35 cases of pregnant patients with lung tumors were identified starting from 1953 until 2007. According to his study, only 11 of the cases delivered vaginally, and the rest of them underwent cesarean section. Anesthetic technique was documented in only five of these cases that underwent cesarean. One patient had spinal, three had epidural, and one had general anesthesia [26].

When key words such as “lung cancer,” “pregnancy,” and “mediastinal mass” were searched in PubMed interface between 2008 and the end of 2017, additional 34 parturients with lung cancer were identified within this period. Since we have determined almost identical number of cases within 10 years of duration, it seems that thoracic/lung cancer reports during pregnancy are increasing gradually. After eliminating 5 out of 34 reports written in languages other than English, 29 of them were reviewed. One of the reports was a case series including nine cases, but it was focused on the therapeutic choices in these patients and data about surgery/anesthesia without presenting outcome data [2]. On one occasion the mode of delivery was not indicated, whereas the remaining 27 of the cases had cesarean delivery.

In other reports, maternal age of the parturients was between 19 and 42 years, and the gestational age of delivery was varying between 30 and 42 weeks. There were three reports describing general anesthesia management for cesarean section [25, 27, 28]. The first case [27] was already intubated in the intensive care unit to control pulmonary bleeding, the second case [28] was an emergency cesarean section, and the third case who was a term parturient [25] had an intracranial tumor metastases at the time of diagnosis. In one of these reports, anesthesia-related complications were presented. In 8 of the 27 cases, method of anesthesia was regional anesthesia. There are at least five cases with epidural anesthesia [19, 21, 29–31]; two of the cases had combined spinal-epidural anesthesia [15, 32], and one case had spinal anesthesia [33]. The type of anesthesia for cesarean section was not documented in the remaining reports. Fortunately, except for a single case described earlier, all of the mothers have survived [34].

In summary, clinicians prefer cesarean delivery in parturients with intrathoracic tumors because of already increased intra-abdominal pressure and possible negative effects of increased intrathoracic pressure during pushing efforts in labor. Anesthesiologists already prefer regional anesthesia in parturients who are candidates for cesarean section because of increased risk of airway and respiratory problems due to general anesthesia. Therefore, regional anesthesia techniques are commonly offered to parturients with thoracic/lung tumor. Sudden cardiorespiratory deterioration at induction of anesthesia for a mediastinal mass had been described before. A special cautious multidisciplinary approach is very valuable particularly in the parturients with mediastinal masses. This approach should include a second plan in case of failed regional anesthesia, difficult airway, or development of a sudden intraoperative catastrophe [31].

### Key Learning Points

- Anesthesia in a pregnant with intrathoracic tumor is a great challenge for anesthesiologists.
- Neuraxial anesthesia is the preferred method of delivery in pregnant with thoracic mass, but anesthesiologist should have extra precautions other than routine in order to manage unexpected intraoperative events.

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