Lung Wedge Resection:

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VATS Modality

Introduction

The lung wedge resection procedure is the surgical removal of a wedge-shaped portion of tissue from one, or both, lungs. The least invasive and the more beneficial modality for the patient (in terms of trauma to the body) is the Video-Assisted Thoracoscopic Surgery (VATS) Modality. The utilization of a thoracoscope is required to perform a VATS procedure (videoscope) along with several small access incisions used as access points for the surgical instrumentation. (Cleveland Clinic, 2020)

There are various reasons in which a wedge procedure may be performed. "The wedge procedure is performed on patients with peripheral "non-small-cell tumors", who have pulmonary reserve limited to the point that they are unable to tolerate lobectomy." (Jaffe et al., 2014)

The primary rationale for the surgery is a patient with a thoracic or pulmonary cancer diagnosis. Further indications and patient history for this surgery will be discussed more in-depth in this article. Per the indications for the procedure, this article will also discuss the anesthetic and physiological implications that the anesthesia care team should be aware of along the entire perioperative spectrum. With that being said all anesthetic concerns discussed in this article revolve around the certified anesthesia technologist's role on the anesthesia care team.

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Indications for Procedure

Typical pre-op diagnoses include but are not limited to a positive metastatic tumor in the lung; primary lung cancer (usually requires a lobectomy); and unknown pulmonary lesions. The VATS portion of the procedure is preferred in the event the patient exhibited one of the following pre-op diagnoses. Possible diagnoses requiring a VATs procedure include: pleural disease (effusions); chronic emphysema; recurrent localized lung masses, achalasia; sequestration, pulmonary infiltrates, and reflex sympathetic dystrophy, also known as RDS. (Jaffe et. Al, 2014) Other associated conditions with patients of this population include cardiovascular issues; Chronic Obstructive Pulmonary Disease (COPD); infections (cases of pneumonia); and other malignancies. (Cleveland Clinic, 2020)

Patient Information

The patient undergoing this procedure is a 56-year old female that exhibited symptoms of moderate-COPD (audible wheezing/ shortness of breath present during the patient interview), with no known allergies. The patient has not taken any medications before surgery. The patient has had no previous surgical history. In preparation for the operation, she underwent a 90-day cycle of chemotherapy in an attempt to reduce the size of the mass. Additional etiology include a history of smoking (the patient stated a smoking cessation of six months), and repeated episodes of pneumonia. The patient was NPO for approximately 13 hours before surgery. Preoperative monitoring and maintenance include oxygen saturation of 89% on 7-liters per minute, heart rate of 78 beats per minute, blood pressure of 110/65, a height of 167cm, and a BMI of 25; the patient was calm.

The key to the entire procedure is maintaining the ability to ventilate a single functional lung while the malignant lung is operated on under thoracoscopy.

The patient received numerous preoperative evaluations before surgery, including preoperative Pulmonary Function Test (PFT), arterial blood gas (ABG), three-view chest x-ray, and computed tomography (CT) of the chest. The PFT spirometry test is used to evaluate a patient's lung function, focusing on compliance. The PFT is typically performed on patients with underlying structural or mucosal COPD. ABGs were drawn due to the patient's chronically low peripheral oxygenation saturation, which can lead to intraoperative hypoxia if the underlying causes are not managed. The chest x-rays performed included three views, anteroposterior, posteroanterior, and lateral views meant to map the location of the mass. Finally, the 3-D chest CT was done to provide further information about the mass and to rule out any potential airway anomalies that could potentially impact the placement of a Double-lumen Tube (DLT). The patient was also checked for any jewelry or metal that may interfere with the electrocautery devices.

The computed tomography results came back and indicated that there was some evidence of a potential extra lobar sequestration (ELS) in the left lower lobe of the lung. The recurrent episodes of pneumonia are to be expected after this finding. (Sakuma et al, 2004). Once all preoperative tests were complete, surgery of the Left Lower Lobe under Video-Assisted Thoracoscopy with wedge resection for possible Pulmonary Sequestration, with resection of malignant tissue, was confirmed.

Physiological Considerations

The key to the entire procedure is maintaining the ability to ventilate a single functional lung while the malignant lung is operated on under thoracoscopy. Single lung ventilation affords the surgeon an open immobilized surgical field to work in, which helps reduce surgical complications. One lung ventilation (OLV) is typically accomplished in one of two ways. One, the use of a double-lumen endotracheal tube (DLT), where the anesthesia provider and technologist use a video-scope to secure the distal end of the tube beyond the carina in the left or right bronchus. Second, the anesthesia provider and technologist can place an endobronchial blocker (EBB) through a single-lumen endotracheal tube using balloons on the EBB to prevent airflow into the immobilized lung. Additionally, contemporary research into the VATs procedure indicates the efficacy and feasibility of a third option referred to as non-intubated thoracic Surgery (NITS).

In 2017 a paper published in *The Journal of Visualized Surgery* titled: "Anesthesiology for Uni-portal VATS: Double Lumen, Single Lumen and Tubeless" suggested that there is a less common third option for a VATS procedure. The paper stated that "there is evidence demonstrating the feasibility

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of NITS for minor procedures such as talc pleurodesis, mediastinal biopsies, and managing pericardial effusions; However, the application of NITS for major lung resection continues to be elucidated." (Zhao et al, 2017). For this paper, the provider will be utilizing a DLT to achieve OLV.

Cert.A.T.T. Role

As an Anesthesia Technologist, a critical skill to have is the ability to properly and efficiently size a double-lumen tube for the patient. According to Miller et al., there is no consensus as to the ideal method for sizing a double-lumen tube (Miller et al, 2018). According to *Basics of Anesthesia* Seventh Edition, proper sizing of the DLT requires a knowledge of the patient's height and sex (refer to figure 1). Based on this table, our patient required a 37Fr double-lumen tube.

It is crucial to remember that some of the insufflation gas (CO2) will be absorbed by the patient; thus, causing hypercarbia in some magnitude.

With a VATS procedure, the insufflation of the chest cavity will be required typically using Carbon Dioxide (CO2) (Jaffe et al, 2014). With that in mind, it is crucial to remember that some of the insufflation gas (CO2) will be absorbed by the patient; thus, causing hypercarbia in some magnitude. Insufflation does one of two things: it aids the surgeon in being able to visualize the surgical field, and it aids in the deflation of the operative lung. Lung deflation is accomplished via direct suctioning to the lung. According to Jaffe et al., it should also be noted that insufflation should be done at a slow rate. Insufflating the thoracic cavity space too quickly can result in cardiovascular collapse because of the increased intra-thoracic pressure, decreased BP, decreased HR, and hypoxemia (Jaffe, 2015).

The anesthesia care team should be careful to compensate for deficits, surgical volume loss, and insensible loss, avoiding overloading the patient with crystalloids and colloids.

As far as supplies are concerned (aside from the DLT), the patient may or may not require an arterial line. According to the *Anesthesiologist's Manual of Surgical Procedures*, "arterial catheters use is generally not required, unless indicated by patient's medical condition (Jaffe et al., 2015)." With the procedure taking approximately two-three hours, fluid warming is indicated to counteract peripheral cooling and to warm blood products for potential transfusion.

The patient will be positioned laterally, with the right side down on the operating room table. Therefore, padding materials are required to prevent pressure/ nerve injuries taking careful consideration for the *down* axillary region, eyes, ears, genitals, and in this case, breasts as well.

The *Anesthesiologist's Manual of Surgical Procedures* Fifth Edition advises using one 16-18 ga IV with normal saline or lactated ringers solution (Jaffe et al. 2014). Anecdotally, The University of Oklahoma Medical Center (OUMC) prefers Plasmalyte (Normosol-R) for most procedures unless sensitivity to acidosis and elevated potassium levels contraindicate its use. The paper's author recommends placing a second intravenous catheter with a preferred gauge between 16-18 gauge. The rationale is derived from the surgical instrumentation making it challenging to secure a secondary line intraoperatively if the initial IV fails. The provider will typically calculate fluid deficit utilizing the 4:2:1 fluid deficit ratio. However, it is essential to note that the anesthesia care team should be careful to compensate for deficits, surgical volume loss, and insensible loss, avoiding overloading the patient with crystalloids and colloids. This is a necessary precaution to prevent postoperative edema, which can lengthen the recovery time for the patient and can adversely affect the patient's hemodynamic stability.

Standard ASA monitors are required, and special consideration should be given to their placement. Electrocardiogram electrodes should be placed properly to capture all three bipolar leads (I, II, and III) and the two unipolar leads (aVR and aVL). However, the patient's lateral position needs to be considered as it relates to electrode placement. The RA and RL electrodes can irritate the skin

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and cause compression due to the lateral position, which can lead to decubitus ulcers. Furthermore, the placement of the NIBP needs to be considered in relation to oscillometric readings. According to a 2006 study on pregnant women in a lateral recumbent position published in *The International Journal of Obstetric Anesthesia*, found that NIBP placement on the 'up-arm' while in lateral positon was lower "by a mean 10mmHg or more" systolic compared the supine position (Kinsella, 2006). Meaning that if a noninvasive blood pressure cuff is the primary use for blood pressure monitoring a systolic artifact is to be expected. Practically speaking, if during induction, the patient is maintaining a pressure of 120/80, it is reasonable to expect a pressure of 110/80 when the patient is in a lateral position, barring no other influences on the patient's habitus. Pulse-oximetery should also be considered, and placement on the opposite limb of the NIBP is recommended. Finally, monitoring the patient's Capnography is essential, but OLV ventilation can lead to inaccurate values of ETCO2 compared to PaCO2, so evaluations of PaCO2 via ABG is recommended (Cox and Tobias, 2007). Interestingly, an article published in 2007 by Paul Cox and Joseph Tobias in the *Journal of Minimal Access Surgery* suggested the use of transcutaneous Carbon Dioxide (TC-CO2) monitoring as a way of compensating for erroneous ETCO2 while under OLV (Cox and Tobias, 2007). TC-CO2 relies on the diffusion of O2 and CO2 through the skin and is typically reserved for neonates in the ICU (Tobias, 2004).

The Estimated Blood Loss (EBL) noted by Jaffe et al. is minimal. However, a technologist should always be made aware of rapid transfusion devices and rescue RBCS/FFP in the rare event of massive blood loss. Though intra-operative complications are rare they can still occur. Complications that a technologist should be aware of are: pneumothorax, air embolism, intra thoracic structure injury during surgery, and possible hemorrage (chest tube drainage should be observed for any abnormalities).

Upon completion of the operation, the patient shall receive a postoperative chest x-ray (CXR) to rule out foreign bodies, or tension pneumothorax. The patient should be extubated in the operating room, and transported to PACU with a simple face mask, or non-rebreather if the patient requires levels of oxygen around 40-60 percent at 6-10 liters/minute (HealthLine, 2020).

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Continuing Education Quiz

To test your knowledge on this issue's article, provide correct answers to the following questions on the form below. Follow the instructions carefully.

1. What does *The Journal of Visualized Surgery's* article, "Anesthesiology for Uni-portal VATS: Double Lumen, Single Lumen and Tubeless," reference as a third option for ventilation for a VATS procedure?
a) NITS
b) DLT
c) EBB
d) BITS

2. According to the paper patients in a lateral positon can generate an artifact in NIBP monitoring measured from the elevated arm. What is the systolic mean deviation?
a) 10mmHg or >
b) 5mmHg or >
c) 10mmH2O or >
d) 5mmH2O or >

3. All are possible complications of a VATS procedure EXCEPT.
a) Venous air embolism
b) Pneumothorax
c) Hemmorage
d) Pheochromocytoma

4. Commonly used on neonates in the ICU _____________, has been shown to compensate for erroneous ETCO2 readings during OLV.
a) Transcutaneous Carbon Dioxide monitoring
b) Sidestream carbon dioxide monitoring
c) Direct carbon dioxide monioting
d) Percuteanous Carbon Dioxide monitoring

5. What are the two parameters used to size a DLT? *(Select two)*
a) Height
b) Sex
c) Age
d) Weight
e) Glasgow coma scale
f) LeFort classification

6. The tipification of calculating fluid deficits relies the utilization of what ratio?
a) 4:2:1
b) 2:1:1
c) 10:5:1
d) 6:3:1

7. What position is the VATS procedure performed in?
a) Lateral
b) Semi Fowler
c) Supine
d) Prone

8. Wedge prodecures are preferred over total lobectomies in patients that present with __________________________.
a) Limited pulmonary reserve
b) Exacerbated tidal volumes
c) Alveolar Dysfunction Syndrome
d) Pulmonary Rhabdomyolysis

9. What test is performed to evaluate the effects of structural or mucosal COPD on a patient's pulmonary system witrh regards to lung compliance?
a) PFT
b) ABG
c) TEG
d) ACT
e) EEG

10. Utilizing insufflation gas in VATS procedures always results in some magnitude of _____________________.
a) Hybercarbia
b) Hypocapnia
c) Pseudocholinesterase inhibition
d) Hypotension
e) Hypertension
f) Phospholipidase membrane secreation

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