

The first
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Critical Care News

Thoracic surgical patients – Addressing the peri-operative ventilatory challenges in this high-risk group

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Cardio-thoracic surgery underway in the Cardio-thoracic Surgical Center, Sahlgrenska University Hospital, Gothenburg, Sweden

Thoracic surgical patients – Addressing the peri-operative ventilatory challenges in this high-risk group

Thoracic surgical patients are recognized as belonging to a high-risk patient group in anesthesia. In March, CCN had the privilege of visiting Sahlgrenska University Hospital in Gothenburg, Sweden. Sahlgrenska is a university hospital and has a cooperation program with the Sahlgrenska Academy of the Gothenburg University's Health Sciences department. They together account for more than 300 research projects. The hospital's lung transplantation program began in 1990 with the first heart-lung transplantation. Since 1990 when the program began, more than 300 procedures have taken place. Sahlgrenska and Lund hospitals are the only centers in Sweden for heart and lung transplantations. Approximately 30 lung transplant cases are done each year, 10 of which are in need of a heart-lung machine.

The purpose of our visit was to speak to a few clinicians working with this speciality and to look in on a couple of ongoing lung surgery procedures.

We met with Jan-Olof Berglund, nurse anesthetist responsible for medical devices in the Department of Thoracic surgery to learn about the demands clinicians have on anesthesia machines in this field. We also spoke to Dr Anne Westerlind of the Department of Anesthesiology for the Cardio-thoracic Surgical Center, to learn about the anesthetic considerations of lung transplantation.



Jan-Olof Berglund, Nurse anesthetist at the Cardio-thoracic Surgical Center, Sahlgrenska University Hospital

Most of the patients in need of lung transplants are patients with severe pulmonary hypertension, COPD, cystic fibrosis, silicosis, bronchiolitis obliterans and retransplantation after organ rejection, to name a few.

How old are most of the patients undergoing a lung transplantation?

Jan-Olof Berglund, nurse anesthetist:

Many patients are between 50 and 60 years of age; we do have the occasional child or teenager, but this is quite rare.

Could you tell us about your experience of this procedure? Are all procedures quite alike?

I personally think that lung transplantation has become very routine-like. We follow a certain pre-operative routine, the same as the one for heart-lung procedures: the patient takes a shower, is scrubbed and shaved. The induction phase is done according to a specific protocol, which Dr Westerlind will describe later; the patient is positioned in lateral decubitus. The actual procedure can take from 3-4 hours, to sometimes much longer, due to certain complicated surgical aspects: it takes time to see how to put the different anatomical parts together.

With the anesthesia systems you are using, do you find that they can have certain shortcomings, or do they fulfill your needs for these procedures?

When the patient is in the lateral position,



Dr Anne Westerlind, MD, PhD, Department of Anesthesia for Cardio-thoracic Surgery, Sahlgrenska University Hospital

lying on the remaining lung which often is also sick, although healthier than the one being replaced, there are a few challenges; one obtains very high airway pressures, high resistances. This definitely challenges the machine that we have, which can only go up to 80 cmH₂O, as this gives a pressure inside the patient of 50-60 cmH₂O. This is not always sufficient for our patients in some extreme situations. Every now and then we have had to bring in an ICU ventilator.

You had the chance to see and hear about MAQUET's FLOW-i anesthesia system in Uppsala. What did you think about its potential?

The technical capacity is very similar to an ICU ventilator, it is as powerful. And I like the design, it seems very easy to use.

We have learned what the chronic indications are for lung transplantation. Are there any emergency indications?

Dr Anne Westerlind, MD, PhD:

No, there are no emergency indications for lung transplantation.

Do you have any specific demands from a ventilator during a lung transplantation procedure?

In the past, we used to do sequential lung transplantation with a heart-lung machine. Nowadays the transplantation often is done without a heart-lung machine and therefore we have high expectations of a ventilator

as the "remaining" lung is also often very ill. Sometimes we have brought the SERVO 900 in to the operating room for this procedure.

Patients suffering from chronic pulmonary disease necessitating lung transplantation must logically have an advanced respiratory insufficiency. How do you prepare these patients in the pre-operative period?

We require that these patients quit smoking if they are smokers; we also teach them CPAP with which they must train up their respiratory function, learn how to cough effectively without damaging the anastomosis. These patients must also learn how to inhale: they are given Nitric oxide or Prostacyclin via a nebulizer for the purpose of pulmonary vasodilatation. In terms of the most important medication, we start these patients on immune-suppressive anti-rejection drugs.

Are there any contra-indications to lung transplantation or any age limit?

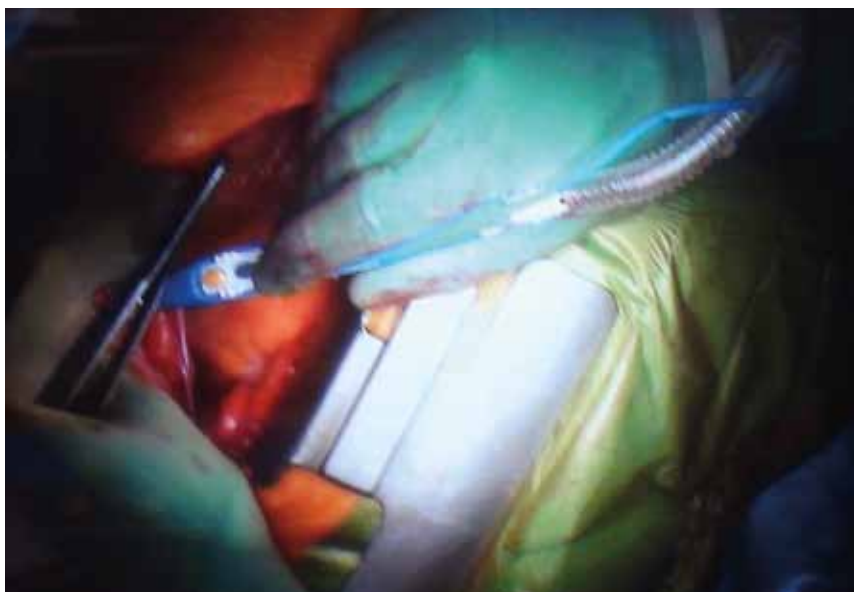
We would normally not accept a patient weighing 300 kilos, they should otherwise be quite healthy to be able to go through such a demanding procedure, and these patients do have complicating factors due to their obesity. There is no age limit either, it is co-morbidity which indicates whether or not this patient is a good candidate; therefore in practice, an 80-year old patient will not pull through this procedure, so that would be, in practice, a given age limit.

Could you please describe the settings you use on the anesthesia machine during lung transplantation?

With lung surgery, we set a fresh gas flow of 2 to 3 liters/minute, but it all depends on how much leakage there is; we often try to go even lower. It is important for us to be able to perform rapid changes so as to better be able to regulate the depth of anesthesia. Our general lung-surgery patients can have leaks of up to 5-6 liters. In the case of lung transplantation, there is a



A patient undergoing lung surgery, lying in lateral decubitus position, Sahlgreńska University Hospital



Surgeon in the chest cavity during thoracic surgery, Sahlgreńska University Hospital

situation of forced open pneumothorax and in this case, we do not use inhalation anesthesia as the agents would then contaminate the operating room air. We intubate the patient with a double-lumen endotracheal tube; this has the advantage of rapid inflation and deflation of either lung. The oxygen is set at no more than 60% in order to prevent atelectasis. Induction is produced routinely with either Pentothal or Propofol, Fentanyl and a muscle relaxant; often fiber-optic bronchoscopy is used for controlling the appropriate position of the tube.

We proceed systematically to lung recruitment manually with the APL valve at 50-60 cmH₂O during short intervals. We do not allow our patients to have high pressures; the PEEP level is set between 5 and 10 cmH₂O, even with our heart patients. Patients may need a lengthened Insp/Exp ratio as they have such low compliance due to their stiff lungs. Higher tidal volumes combined with lesser respiratory rates are preferred today; this was an inverted pattern in the past. You will find this in the scientific literature today. The aim is also to keep

the patient normoventilated, so we often observe cerebral oximetry. Of course, in extreme cases with lung volume reduction and lung transplantation, a degree of hypercapnia may be accepted.

Is there some special fluid administration protocol for your patients?

The adopted lateral decubitus position can compromise pulmonary and cardiovascular physiology. Moreover, with one-lung ventilation and perfusion of a non-ventilated lung, the patient is positioned on the steep side of the oxygen dissociation curve. Our lung transplant patients remain very "dry"; receiving crystalloids, as ventilation is favored over perfusion; this prevents the occurrence of shunts. We want to prevent the lung oedema which puts the success of the procedure at risk; they are thus given diuretics as well as Mannitol so that the excess fluid can be excreted.

Is there any important post-operative protocol you wish to mention?

Yes, adequate analgesia post-operatively is of the utmost importance in order to optimize the patient's respiratory function and facilitate coughing up secretions from the lungs. We like to keep the patient's Visual Analog Scale (VAS) level between 1 and 2. Thoracic epidural with a mixture of bupivacain and opioids is usually given.

What are the most common complications of lung transplantation?

Hemorrhaging is the most common, followed by loosening of the anastomosis sutures.

What is it that you find of importance with an anesthesia system?

We have a great need for an excellent ventilator. When we saw and received information about the MAQUET FLOW-i, we found that it was easy to understand and powerful; we like the leakage compensation via the circular circuit; today, we sometimes underventilate our

patients because of lack of ventilatory power; what consequences does this have for our patients? The volume reflector is, theoretically, a very attractive feature as one does not need to interrupt ventilation, as it is the case in a leaking bellow. It is important that we have an alarm when the oxygen level begins to increase, in leak situations. The challenge will be to educate users in not seeing a moving bellow and relying on the safety feature of this technology. ■

Biographies

Dr Anne Westerlind, MD, PhD is former Chief of the Department of Cardio-thoracic Anesthesia and Intensive Care at Sahlgrenska University Hospital, in Gothenburg, Sweden. She is clinically active in the department and she has also held, since 2007, the position of

Representative of the Swedish Association for Anesthesia and Intensive Care (SFAI) at EACTA (European Association for Cardio-thoracic Anesthesia), and has thereby worked on the European guidelines within thoracic anesthesia and thoracic intensive care.

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