Anaesthesia for oesophagectomy

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Oesophageal carcinoma
The two main types of oesophageal carcinoma are:

1. Squamous cell carcinoma
   - This is usually seen in patients who smoke and those who abuse alcohol.
   - The patients usually are cachectic and commonly have poor lung function, due to chronic obstructive pulmonary disease (COPD) and pulmonary sepsis caused by recurrent aspiration.

2. Adeno carcinoma
   - This is usually found in patients with a Barrett’s oesophagus secondary to gastrooesophageal reflux disease (GORD).
   - The incidence of this type of malignancy is increasing due to obesity and GORD; it is currently the sixth most common cancer in the USA.

Surgical procedures offered to patients with oesophageal carcinoma
1. Palliative surgery.
   - Patients with advanced disease often have procedures done that will make feeding possible. These include gastrostomy feeding tubes and the insertion of oesophageal prostheses.

2. Oesophagectomy.
   - This is usually a curative procedure and entails removing the part of the oesophagus that contains the tumour, plus creating an oesophageal conduit.

An oesophagectomy is typically done as a two-stage procedure. During stage one (laparotomy phase), a gastro-oesophagectomy is performed, and during the second phase a right-sided thoracotomy is done, with removal of the tumour and a lymph node dissection. As an alternative to avoid thoracotomy, a trans-hiatal oesophagectomy or a thoracoscopic oesophagectomy (minimally invasive surgery) can be attempted.

Patients with oesophageal carcinoma often present late with advanced disease. Patient selection for curative surgery is therefore very important. Factors that are known to increase surgical mortality include advanced age, pre-existing pulmonary dysfunction, cardiac disease, impaired liver function, diabetes, as well as advanced tumour staging.

Anaesthetic management

Preoperative evaluation
These patients often have co-morbid diseases that need to be identified preoperatively. Squamous cell cancer sufferers often have weight loss, malnutrition, COPD and pulmonary sepsis (recurrent aspiration often occurs due to difficulty in swallowing). Patients with adeno carcinoma are often overweight (with all the associated problems like hypertension, diabetes, dyslipidaemias, obstructive sleep apnoea, ischemic heart disease, etc.) and have gastrooesophageal reflux disease (GORD).

An interesting clinical dilemma is whether or not patients with ischemic heart disease should have prophylactic percutaneous stenting done. Although this seems intuitively advantageous to the patient, studies have failed to show improved outcome. Recently inserted stents have a high risk of occluding in the perioperative period due to enhanced coagulation at this time. To prevent stent occlusion, the patient needs to be treated with aspirin and clopidogrel. Neuraxial anaesthesia is contraindicated in patients using clopidogrel due to a high risk of haematoma formation.

In patients who received preoperative chemotherapy, enough time must be allowed for the patient to recover from the side effects of the chemotherapy. Chemotherapy can also cause bone marrow suppression with anaemia and a low platelet count, which also contraindicates neuraxial anaesthesia.

Intraoperative management

Haemodynamic monitoring
Full haemodynamic monitoring is indicated due to large fluid shifts and significant bleeding that can occur. During the thoracotomy, pressure can be applied to the large vessels, including the inferior vena cava, decreasing venous return to the heart. This decreased preload can cause a severe decrease in cardiac output.

Aspiration risk
Aspiration is a major concern in these patients. Food that is situated proximal to the oesophageal obstruction will not clear during the fasting period. It is therefore prudent to do a rapid sequence intubation. Aspiration after intubation and inflation of the ETT cuff may also occur. One study showed that up to 50% of patients that were placed in the left lateral decubitus position had fluid aspiration past the ETT cuff. This may be due to “channels” forming in the cuff because it is inflated with air; the authors suggested that inflating the cuff with a liquid would reduce the incidence of aspiration.

Outcome
It has been suggested that anaesthetic management can directly contribute to the operative outcome of these patients:

- Gastro-oesophageal anastomotic leakage can cause mediastinitis, which has a high mortality rate.
- Perfusion of the anastomosis is crucial and can be affected by anaesthetic technique; epidural anaesthesia will cause vasodilatation and this can improve the blood flow to the anastomosis, but if the blood pressure decreases too much there will not be adequate perfusion and therefore an increase in the chance of anastomotic breakdown.
- One-lung ventilation (OLV), which is needed during thoracotomy, can also influence the outcome
- OLV can precipitate acute lung injury (ALI) and ARDS via different mechanisms, including volutrauma, barotrauma, atelectrauma and biotrauma.
- Problems with positioning of the double lumen endotracheal tube (DLT) may also contribute to morbidity.
One-lung ventilation (OLV)

Because this anaesthetic technique may directly contribute to patient mortality, it is appropriate to discuss a few basic guidelines to OLV.

Indications
- Absolute: Separation of the lung to prevent contamination with blood or pus from the opposite lung, large bronchopulmonary fistulae that will make IPPV impossible, during bronchopulmonary lavage to prevent drowning of the opposite lung, and thoracoecopic surgery.
- Relative: The relative indications are aimed at enhancing surgical exposure during lobectomy, pneumonectomy or oesophagectomy.

Successful OLV implies that you achieve complete lung collapse in order to maximise surgical exposure, but this must be done without the patient becoming hypoxic. To achieve these goals you need to have optimal positioning of the DLT, functional lung separation and adequate ventilation and oxygenation.

Methods that are available to achieve lung separation are the double lumen tube (DLT), bronchial blockers and the Univent tube.

The DLT is the most commonly used device for lung separation in our unit and I would like to address a few issues surrounding its use:

a. Right-sided vs. left-sided DLT:
   - With a right-sided DLT there is a high incidence of obstructing the right upper main stem bronchus, which will cause hypoventilation of the upper lobe of the right lung.
   - Selecting the correct size tube:
     Due to the fact that there are individual variations in patient airway size and variations in the diameter of the DLT between manufacturers and even within the same company, there is no foolproof formula to determine which tube will fit correctly. As a general guide, a no. 37 F will fit most adult females and a no. 39 F (Mallinckrodt) will fit most males. It is very important that the endobronchial part of the DLT allows an air leak when the cuff is not inflated and that the minimum amount of air that allows a complete seal be used in an attempt to prevent pressure necrosis of the bronchus.

b. Confirmation of lung separation:
   - After positioning the patient, it is important to confirm lung separation because if deflation of the lung occurs slowly, after opening the thorax, your attention should be focussed on factors that will improve surgical exposure, like manual compression or CO₂ insufflation, and not on checking the position of the tube.

Ventilator settings during OLV

Traditionally, the following settings were used in an attempt to decrease the incidence of hypoxemia: a tidal volume of 10–15 ml/kg, inspired oxygen concentration of 100% and plateau pressures of less than 40 cm H₂O. These settings can induce acute lung injury and it is suggested that lung protective strategies should be implemented. These include the following: tidal volume of 6–8 ml/kg and adjusting the respiratory rate to maintain normocarbia. The plateau pressure should also be kept below 30 cm H₂O. This should minimise the incidence of volutrauma and barotraumas. An FiO₂ of 100% can cause absorption atelectasis, with intrapulmonary shunting and a decreased PaO₂. Applying PEEP to the ventilated lung may help to prevent this. Applying CPAP plus insufflating O₂ at 3–4 l/min to the non-ventilated lung will allow this lung to partake in gas exchange and thus help to prevent hypoxemia. It is good practice to institute CPAP early in the course of OLV, because once the lung collapse has occurred, a higher pressure is needed to open the atelectatic alveoli.

Complications of OLV

Hypoxemia is the most common complication and the following attempts should be made to reverse the decreased PaO₂:
- Firstly check the patient’s haemodynamic status, as surgical intervention can cause mediastinal shift with impaired venous return to the heart and decreased cardiac output. This will manifest as a low blood pressure, low CO₂ and hypoxemia.
- Confirm correct positioning of the DLT (preferably with a bronchoscope). It is very common for the DLT to shift during repositioning of the patient and with surgical manipulation.
- Increase FiO₂. As a general guide, the lowest FiO₂ that provides adequate saturation should be used in an attempt to reduce oxygen toxicity and atelectasis.
- Apply PEEP to the dependent lung and CPAP to the non-dependent lung.
- Intermittent two-lung ventilation should be done if all the above-mentioned interventions fail to reverse the hypoxemia.

The second most common complication is adult respiratory distress syndrome (ARDS). The incidence of acute lung injury and ARDS can be reduced by implementing lung protective strategies.

Postoperative management

ICU

These patients have had extensive surgery and have a high risk of postoperative complications; ICU admission is therefore indicated.

Ventilation

Early extubation is advocated to reduce complications like ventilator-acquired pneumonia, barotrauma, etc. Extubation should be done as soon as the patient is normothermic, haemodynamically stable and has a normal acid base status.

Analgesia

Epidural analgesia is a good option because it helps to reduce the surgical stress response, allows deep breathing and effective coughing (thereby helping to reduce atelectasis) and there is also a lower incidence of chronic post-thoracotomy pain.

Nutrition

Early enteral nutrition helps to maintain the integrity of the intestinal mucosa, thus preventing translocation of bacteria and reducing sepsis. It also enhances the function of GALT.

Postoperative complications

1. Recurrent laryngeal nerve paralysis
2. Gastro-oesophageal anastomotic leakage
   - This is often difficult to diagnose clinically. These patients often present with ARDS or sepsis.
3. Postoperative pulmonary complications
Registrar

These include pneumothorax, empyema, pneumonia, ARDS.

- Development of any of these lung problems is a major predictor of mortality.
- Factors that are associated with an increased incidence of lung complications are:
  - Preoperative: chemotherapy; age above 60; COPD and malnutrition.
  - Intraoperative: Blood transfusion; immunomodulation may increase the incidence of infection; position of tumour (especially proximally situated tumours); surgical time and operative approach.
- Postoperative: Pneumodynamic dysfunction may lead to aspiration due to poor swallowing and poor airway protective reflexes.

References
4. Tandon, Batchelor, Bullock. Peri-operative risk factors for ALI after oeso-

Packet insert (See page 47)