**Oesophagectomy Guidelines**

1. **INTRODUCTION :**

Oesophagectomy by open surgery is the conventional treatment for patients with resectable cancer of the oesophagus. It is also the treatment option for patients with other severe benign or pre-malignant disease. Depending on the type, location and extent of the disease, the procedure may involve total (complete) or sub-total (partial) resection of the oesophagus, with or without dissection of regional lymph nodes (NICE, 2018) .

There are different open surgical approaches including two stage, three-stage, trans-hiatal, and left thoraco-abdominal with or without left neck anastomosis. The procedure is usually performed through two main incisions: thoracotomy to mobilise the oesophagus and laparotomy to dissect and prepare the stomach (or sometimes intestine) for oesophageal reconstruction. The new oesophagus is then drawn up into the chest and connected to the remaining healthy oesophageal stump, via an incision in the neck or chest. Anaesthetic management includes one-lung-ventilation to allow good surgical access to the thorax. Minimally invasive surgical techniques, including thoracoscopy and laparoscopy, have been developed with the aim of reducing peri-operative morbidity and improving quality of life compared with open surgery (Biere et al, 2012, Masset et al, 2015).

The Upper Gastrointestinal (GI) Service performs a significant numbers of subtotal oesophagectomies each year at the RVI. Routinely all these patients will be admitted to ward 38 critical care postoperatively, predominantly as level 2 patients. Most commonly these patients have undergone a sub-total oesophagectomy (STO) via a two-stage approach including laparotomy and a minimally invasive laparoscopic or open thoracotomy. Some of these patients will undergo a 3 stage oesophagectomy or significant neck dissection and in a subset of this group may require elective tracheostomy due to the risk of vocal cord dysfunction.

Routinely all post-STO patients will arrive with a variable number of important drains that may include chest/mediastinal drains and a venting nasogastric tube into the neo-oesophagus. It is important that these drains and tubes are only removed under guidance of the Critical Care and Upper GI Consultant. Feeding post operatively is achieved initially using a feeding jejunostomy that is placed surgically. Analgesia is multimodal and predominantly consists of intrathecal diamorphine, paravertebral catheter, wound catheters, fentanyl PCA and paracetamol.

An enhanced recovery after surgery (ERAS) protocol provides clear daily goals for the STO patients that begins on arrival to critical care and continues through to ward discharge. This is in concert with daily clinical review by the critical care and surgical team.

Due to the nature of the disease process, premorbid state of this group of patients and extent of surgery there is a high risk of morbidity in this patient group. For this reason a proportion of STO patients will have a protracted critical care stay requiring multiple organ support, weaning from ventilation and extensive rehabilitation.

1. **GUIDELINE SCOPE :**

This document is an aide- memoire for the management of patients post oesophagectomy in both ITU and HDU.

1. **MAIN BODY**

**3.1 DEFINITION:**

Around 13,000 people are diagnosed with oesophago-gastric (OG) cancer each year within England and Wales. It is the fifth most common type of cancer, and patients are often diagnosed with more advanced disease compared with other cancers. As a result, prognosis is relatively poor, with only 15% of oesophageal cancer patients and 19% of gastric cancer patients surviving 5 years after diagnosis (National Oesophago Gastric Cancer Audit, 2014).

There are 2 main types of cancer:

* Adenocarcinomas develop in gland cells which make the mucus in the lining of the oesophagus. They mainly start in the lower part of the oesophagus and are the most common type of oesophageal cancer. They accounted for more than half (55%) of cases in England between 2008-2010 (National Oesophago Gastric Cancer Audit, 2014).
* Squamous cell carcinoma develops from cells that make up the inner lining of your oesophagus. They tend to develop in the upper and middle part of the oesophagus and account for more than a quarter (28%) of all oesophageal cancer cases (National Oesophago Gastric Cancer Audit, 2014).

Risk factors include:

* smoking
* high alcohol consumption
* Gastro-oesophageal reflux disease can result in Barrett’s oesophagus, a condition in which the lining of the lower oesophagus becomes more like the lining of the stomach progressing to high-grade dysplasia, which is a pre-malignant condition

Signs and Symptoms:

* difficulty and pain in swallowing
* weight loss
* hoarseness
* coughing and regurgitation
	1. **PRE OP ASSESSMENT**

Patients with oesophageal cancer often have comorbidities, suffer from significant weight loss, poor nutritional state, and may be current or recent ex-smokers (Robinson et al 2013). Within the RVI patients with a diagnosis of oesophageal cancer undergo early preoperative assessment. This includes routine blood tests such as clotting, iron studies and replacement if needed, ECG, pulmonary function tests, cardiopulmonary exercise tests (CPET) and consultant anesthetic review. This information guides shared decision making and treatment planning of the upper GI oncology MDT.

For those patients recommended for surgery a significant proportion will receive neoadjuvant chemotherapy or chemo-radiotherapy prior to STO which is associated with deconditioning and may impact on cardiac function. All patients will be reviewed again by the preassessment team prior to surgery and usually will be admitted the night before.

* 1. **INTRA-OPERATIVE MANAGEMENT**

This will vary slightly depending upon the patient’s premorbid status, co morbidities and extent of planned surgery.

Broadly speaking, all patients will receive neuroaxial blockade, usually spinal diamorphine, followed by a general anaesthetic. At this stage a Nasogastric tube is placed followed by a double lumen endotracheal tube that will facilitate one-lung-ventilation during the thoracoscopic/thoracic stage of the operation. The patient has large drips placed, arterial monitoring and in some cases a central line, and urinary catheter.

The operation proceeds and depending on complexity is often long and involves a period supine for the intraabdominal stage and a period in the left lateral position to allow access to the right thoracic cavity. Minimising fluid overload is important during one lung ventilation as the lung is susceptible to acute lung injury.

Once completed a surgical paravertebral catheter is placed, along with wound catheters, surgical/chest drains, and the NG tube in the neo-oesophagus is bridled in place. If there are concerns about injury or neuropraxia to the recurrent laryngeal nerve after neck dissection a surgical or percutaneous tracheostomy may be performed at this stage.

The patients are usually extubated and managed in recovery with a fentanyl PCA before being discharged to ward 38 critical care once stable.

**3.4 ERAS**

The initial enhanced recovery after surgery (ERAS) protocol was developed by the ERAS study group in 2010. The protocol focused on the importance of a multidisciplinary team collaboration to apply concepts which would maximize the efficiency of surgical recovery. Specific goals included utilizing multimodal systems to minimize complications, initiate and maintain evidence-based practice. ERAS programs have been shown to predictably improve short term outcomes associated with surgical procedures (Martin et al, 2016).The oesophagectomy ERAS guideline was published in 2018.

**3.5 POST OP**

**3.5.1 Airway –**

* The majority of patients will return from theatre extubated and maintaining their own airway
* Some will return intubated and ventilated if their surgery has been protracted or complex
* Infrequently they will return with a tracheostomy in situ
* Recurrent laryngeal nerve paralysis (RLNP) may be apparent post operatively due to the dissection of cervical paraoesophageal and thoracic paratracheal lymph nodes, especially along the recurrent laryngeal nerve (RLN).
	+ Thermal injury, stretching, compression, or vascular compromise, all raise the risk of injury.
	+ The RLN innervates not only the larynx but also the crico-pharyngeal muscle which forms the upper esophageal sphincter, hereby playing a central role in swallowing.
* Signs of RLNP include:
	+ Hoarseness of voice
	+ Bovine cough
	+ Dyspnea during speech
	+ Aspiration
* If the patient does need to be re-intubated they are at higher risk of aspiration as they no longer have a lower oesophageal sphincter. It is safer to perform in the semi-upright position +/- cricoid pressure with adequate decompression of the neo-oesophagus via the nasal drain.

**3.5.2 Breathing –**

* One lung ventilation (OLV) during surgery can lead to issues with deoxygenation and hypercapnia secondary to shunting and atelectasis the occurrence of which is extremely common postoperatively, with an incidence of up to 85% (Ferguson et al, 2011).
* A chest X- ray (CXR) is required on arrival to the unit to exclude complications of central line placement if this occurred in theatre and to asses for potential complications from one lung ventilation.
* Non-invasive ventilation is NOT recommended due to concerns that it may increase stress on surgical suture lines as well as exacerbate the possibility of a bronchopulmonary fistula.
* Heated humidified high-flow nasal cannula oxygen (HFNC) is an alternative as it provides many of the same respiratory advantages. It has been used successfully to reduce rates of re-intubation in a low-risk mixed medical/surgical ICU population and shown to be non-inferior to non-invasive ventilation in preventing re-intubation in high-risk ICU patient (Brainard et al, 2017). There should be a low threshold for the use of HFNC in the immediate post op period.
* Chest drains are placed surgically to ensure the complete drainage of the pleura, to monitor blood loss, fluid loss or chyle leakage and to prevent compression atelectasis of the lung. (Refai et al, 2012).
* They should be assessed on return from theatre ensuring they are labelled (apical or basal or left ), if they are bubbling, swinging or static
* Fluid volume and colour should be noted and drainage recorded
* Chest drains are removed only on direct instructions from the consultant surgeons



Surgical Chest drain

* Acute respiratory distress syndrome (ARDS) or acute lung injury (ALI) after oesophagectomy is high with a reported incidence of 16% up to 33%. (Chau et al, 2014). The use of lung protective ventilation strategies such as the use of smaller tidal volumes (6 mL/kg), plateau pressures below 30 cmH2O and the application of PEEP has been shown to decrease the inflammatory response and improve oxygenation and resulted in shorter times until extubation and pulmonary complications.(ardsnet,2018). [[https://www.ficm.ac.uk/sites/default/files/ficm\_ics\_ards\_guideline\_-\_july\_2018.pdf]](https://www.ficm.ac.uk/sites/default/files/ficm_ics_ards_guideline_-_july_2018.pdf%5D)
* Chylothorax has a reported incidence of 0.4–4% (Miao et al, 2015).It generally occurs secondary to injury of the thoracic duct or lymphatic tributaries. In adults, the thoracic duct can transport up to 4 L of chyle daily, rich in fluid, lipid, protein, and lymphocytes. Persistent chyle loss leads to hypovolemia, malnutrition, and immunosuppression. If a leak is suspected it is not always necessary to give sulphonamide prophylaxis for PJP in the first instance, monitor the lymphocyte count in the chyle fluid.

**3.5.3 Circulation –**

* Post op monitoring as standard includes heart rate and rhythm via ECG, blood pressure monitoring via an arterial line and possibly central venous pressure monitoring via an internal jugular line.
* Atrial fibrillation (AF) after non-cardiac thoracic surgery occurs between 12 and 44% (Fernando et al, 2011). Although the evidence base and expert consensus opinion for the management of AF has been summarised in several international guidelines, there are no specific guidelines for critically ill patients.

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| **Factors contributing to Post Op Atrial Fibrillation**  |
| * Uncontrolled pain
 | * Infection
 |
| * Electrolyte imbalance
 | * Anaemia
 |
| * Missed medication
 | * Hypovolaemia
 |
| * Hypoxia
 | * Heart failure
 |
| * Hypotension
 | * Hypothermia
 |

* + Treatment of AF:
		- * Optimise electrolytes, potassium > 4.5mmols, magnesium > 1.0mmols and a normal phosphate.
			* Pharmacological treatment of AF: A study by Chean et al (2017) found considerable disparity in contemporary practice in the management of new-onset AF in ITU with Amiodarone and beta-blockers (80.9% and 11.6%) the most commonly used.
			* β-blockers have direct antiarrhythmic activity on stimulus conduction and myocardial cells and are classified as class II antiarrhythmic agents. Acute intravenous rate control is with metoprolol, 2.5- 10mg bolus doses (total daily dose 200mg). Bronchospasm is rare in people with asthma, more commonly bradycardia and hypotension occur. Bisoprolol is the drug of choice for longer term rate control titrated up slowly to effect (max dose 10mg daily).
			* Amiodarone is a Class III antiarrhythmic agent, it is a multichannel blocker possessing α, β, potassium (K+) channel, sodium (Na+) and calcium (Ca2+)-blocking actions. Acute management is delivered by a bolus dose of 300mg which is given over an hour followed by an infusion if required of 900mgs over 23hours, through a central line. Hypotension and bradycardia remain the common side effects with pulmonary toxicity and thyroid dysfunction much rarer.
* Ideally haemoglobin levels should be maintained Hgb >70. However it has long been postulated that transfusion-related [immune suppression](https://www.sciencedirect.com/topics/medicine-and-dentistry/immunosuppressive-treatment) increases the risk of [post-operative infections](https://www.sciencedirect.com/topics/medicine-and-dentistry/postoperative-infection) and increased [tumour recurrence](https://www.sciencedirect.com/topics/medicine-and-dentistry/tumor-recurrence) after surgical resection (Towe et al, 2018). A recent metanalysis by Boshier et al (2018) concluded that blood transfusions are associated with significantly worse long-term survival in patients undergoing oesophagectomy for esophageal cancer. The decision to transfuse post op is usually made at senior level and after discussion with the surgical team.
* Maintenance IV fluid should be 1ml/kg but not to exceed 80mls/hr whatever the patients weight. A retrospective study in a mixed cohort of 1,442 patients undergoing either oesophageal or pulmonary resection showed that fluid restriction did not lead to postoperative acute kidney injury. Be aware of extra hidden fluid eg. IV Magnesium (100mls per dose), IV Omperazole (100mls) and IV Paracetamol (100mls per dose), IV Phosphate (100mls per dose).
* Hypotension can be a significant issue post op as the newly formed gastric tube depends only on the right gastro-epiploic artery leaving the fundus (and future anastomosis) dependent on passive diffusion of blood. Poor local perfusion is thought to be the main etiologic factor in development of anastomotic leakage.
* Accurate assessment of intravascular volume remaining one of the most challenging tasks for post op oesophagectomy patients. Fluid management in this patient group focuses on restricting fluid administration to prevent pulmonary and cardiac complications.
* Fundamentally, the only reason to give a patient a fluid challenge is in an attempt to increase the stroke volume (SV; by at least 10–15%) and improve organ perfusion. When dosing intravenous fluids, three key clinical questions should be asked:

(1) What is the current state of the patient’s intravascular volume?

(2) If the patient receives continued fluid resuscitation or a fluid bolus, will physiological variables such as blood pressure, tissue perfusion, and urine output improve?

(3) Conversely, is there a risk of harm with an additional fluid bolus?

* Passive Leg Raise (PLR) has been confirmed in several studies to be a useful technique to predict fluid responsiveness. With a PLR, there is gravitational transfer of blood from the legs to the intrathoracic cavity with resultant increases in PCWP and LV preload.

PLR is best performed by both elevating the lower limbs to 45 degrees, while at the same time lowering the patient into the supine position from a semi-recumbent position. This technique has the advantage of both increasing cardiac preload from the shift of venous blood from the legs as well as the abdominal compartment. PLR leads to rapid changes in venous return, and thus, a rapid, reversible, real time method to assess changes in SV or CO.



* Lactate measurement can be used in conjunction with PLR to assess the patients fluid state. A lactate >2 would normally be of concern and should be investigated and managed. Consideration to volume status, fluid tolerance and fluid responsiveness should be explored in the presence of a high lactate. A fluid bolus may be required in the presence of hypovolaemia, however, alternative causes of a raised lactate should also be considered.
* [Vasopressors](https://www.sciencedirect.com/topics/medicine-and-dentistry/hypertensive-factor) either peripherally (phenylephrine or metaraminol) or centrally (noradrenaline) are given to maintain adequate perfusion pressure when [hypotension](https://www.sciencedirect.com/topics/medicine-and-dentistry/hypotension) is not fluid responsive. The use of vasopressors has been identified as a potential risk for decreased conduit circulation but limited studies have shown that they can increase MAP to >65 and maintain conduit perfusion as long as the patient is otherwise hemodynamically stable.
* Phenylephrine is a potent, directly acting sympathomimetic with strong α-stimulating and weak β-receptor activity. It produces a marked increase in SVR, with a reflex decrease in heart rate.
* Metaraminol has both direct and indirect actions. It acts predominantly at α-receptors but it has weak β- activity as well. It produces similar haemodynamic effects to phenylephrine. It is prescribed as a misc additive on e-record (base solution normal saline, usually 20mg of metaraminol in 40mls at rate 0-20mls/hr).
* Which is used is often clinician preference but both drugs cost the same per ampule; however tachyphylaxis can develop with phenylephrine.
* Noradrenaline is a naturally occurring catecholamine. It is the chemical neurotransmitter liberated by postganglionic adrenergic neurons. It produces direct activation of both α and β receptors in a dose-dependent manner.
* VTE prophylaxis – Malignancy induces a hypercoagulable state that can increase the risk of venous thromboembolism (VTE). Major surgery and chemotherapy are also recognized risk factors for developing VTE but the risk after oesophagectomy is higher than in other gastroenterological cancer surgery (Mantziari et al, 2016). As part of the ERAS protocol VTE prophylaxsis is 1 mechanical method usually TED stockings and 1 pharmacological method either tinzaparin or enoxaparin. The TEDS should be prescribed on e-record. The prophylactic enoxaparin or tinzaparin should be given on the 1st post op night usually 4 hours post op and once blood results have been reviewed. [**https://www.nice.org.uk/guidance/ng89**](https://www.nice.org.uk/guidance/ng89)
* Usual medications should be reviewed and suspended as appropriate; meds should not be given orally but be aware that some formulations cannot be crushed or given via a tube and the prescription may need to be changed. In the early post op period essential medications only should be given via jej.

**3.5.4 Neurological/ Pain Control**

ERAS uses a multimodal approach to postoperative pain management using a combination of different classes of analgesia. While opioids are effective and continue to be a mainstay of postsurgical pain management, opioid-related adverse events are common, and the clinical and economic consequences associated with these events are significant.

* Thoracic epidural had been the standard of care for transthoracic oesophagectomy patients since the 1990s and whilst it can provide excellent pain control, it may inhibit early postoperative recovery by causing hypotension and reducing mobilization. With this in mind there has been a shift in practice towards paravertebral catheters (PVC) and rectus sheath catheters (RSC).
	+ Of note: If an epidural has been placed which does occur on occasion it is important that the trust epidural monitoring/prescription form is used. This has guidance on the monitoring of sensory and motor block and the actions required if the patient develops heavy legs. The concern here is the potential for a time critical complication such as an epidural haematoma or abscess that requires immediate investigations and management from a spinal surgeon.
* A PVC is placed under direct vision to the right side during surgery. The paravertebral spread of local anaesthetic results in continuous extra-pleural ICN block. Systematic reviews suggest that thoracic epidural or a paravertebral catheter have equal outcomes in analgesia effectiveness in patients who have had a thoracotomy (Baidya et al, 2014). The PVC stays in for 5 days typically and it is attached to a pre filled ball of local anesthetic which runs at a constant rate. Top up doses can be delivered but by trained staff, either anaesthetic/pain nurses or PINC or ORANGE (out of hours).
* Rectus Sheath Catheters (RSC) are placed, one on either side of the mid-line wound then local anaesthetic is infused through them. This provides analgesia to the central abdominal wall in the region of the T7-T11 dermatomes. Again top up doses can be administered.
* The main potential complication of their use is Local anaesthetic toxicity which is rare but can occur. Signs of toxicity include:

**Mild -** Restlessness / confusion

* + Light-headedness
	+ Numbness of tongue and lips (lip smacking)
	+ Tinnitus
	+ Double vision, blurred vision

**Moderate** - Heaviness of limbs

* + Muscular twitching
	+ Convulsions

**Severe** - Cardiac arrhythmias

* + Hypotension
	+ Respiratory arrest
	+ Cardiac arrest

If concerned seek senior help immediately and refer to the guideline re management of LA toxicity (see link below)

<https://anaesthetists.org/Portals/0/PDFs/Guidelines%20PDFs/Guideline_management_severe_local_anaesthetic_toxicity_v2_2010_final.pdf?ver=2018-07-11-163755-240&ver=2018-07-11-163755-240>

* Patient Controlled Analgesia (PCA) aims to provide a safe and effective analgesic regime that is applicable to the individual and allows them to play an active role in the management of their pain. Usually the patient will receive a fentanyl PCA instead of morphine because they will have had a spinal anaesthetic containing intrathecal diamorphine intraoperatively.
* Paracetamol is administered q6 hourly intravenously and is safe provided the dose does not exceed 4 g in 24 h. It has analgesic, anti-inflammatory and antipyretic activity. The intravenous route enables rapid attainment of blood levels and is particularly useful during surgery and in the immediate postoperative period when the enteral route can be difficult in oesophageal patients; however, it is more expensive.

**3.5.5 Gastro- Intestinal:**

An NG tube is positioned with surgical guidance during conduit formation and traverses the esophageal anastomosis; thus, if they are inadvertently removed, they should be reinserted only under fluoroscopic or endoscopic guidance and under the direction of the surgeon.

* The nasogastric tubes should initially be placed on free drainage with 2 hourly aspirations**.** This allows for the identification of any bleeding and to monitor gastric secretion volume. Fluid accumulation and gastric distention might increase the risk of aspiration and anastomotic leakage when the gastric conduit is not routinely decompressed postoperatively.
* Adequate nutritional support is essential post op and this is done by a jejunostomy feeding tube placed through the skin directly in the proximal jejunum during surgery.



Jej Tube

* The overall complication rate of a surgically placed jejunostomy is 13–38%, and serious complications requiring a re-laparotomy occur in 0–3% of the patients (Weijs et al, 2015). Sterile water is started via the jejunostomy on the first post op night at 25mls/hr and once started the maintenance IVT should be decreased by the same volume. Feed is usually commenced the day after once the patient has been reviewed by the surgeon. The rate is gradually increased as per ERAS protocol with added laxatives again as per the ERAS protocol.
* If the JEJ blocks it is usually in the proximal 5 cm. Trust guidelines advocate the use of a Creon/Bicarbonate solution as 1st line action in unblocking tubes (Nurse in Charge has the guideline ). This must be prescribed on e-record. If this fails to work (often more than 1 attempt is needed) then the upper GI surgical team need to be informed ASAP. A feeding JEJ should not be removed without the explicit instructions from a senior surgeon as a blocked or fractured JEJ may be saved radiologically- reinsertion once removed may not be possible.
* IV Omeprazole is given on return from theatre and daily thereafter before being converted to the enteral route. Lansoprazole is the drug of choice enterally but is given as a FASTAB which dissolves in mouth. DO NOT GIVE LANSOPRAZOLE VIA THE JEJ AS IT WILL BLOCK IT. Proton Pump inhibitors irreversibly block the gastric hydrogen potassium adenosinetriphosphatase ATPase (H+/K+ ATPase) and thus inhibit gastric acid secretion. The denervated stomach used as an oesophageal substitute often retains or spontaneously recovers acid production.
* Liver Function Tests (LFTs) should be monitored as liver dysfunction may occur post op even in the absence of pre-existing liver disorders. This dysfunction usually results from hepatic ischemia caused by reduced hepatic blood flow due to traction on abdominal viscera during surgery. A Cochrane review by Chughlay et al, 2016 concluded that current available evidence was limited and does not allow for any firm conclusions to be made regarding the role of NAC in acute liver injury. If NAC is to be used it is on e-record 10gms in 50mls and is given at a rate of 2mls/hr.

**3.5.6 Genito- urinary**

* Release of antidiuretic hormone is a natural response to perioperative stressors, thus it should be *expected* that urine output will decrease during and after major surgery. Hypoperfusion and inflammation are the major mechanisms affecting renal function with hypovolemia reducing the mean arterial pressure (MAP), resulting in renal hypoperfusion.
* If the patient is warm peripherally, euvolaemic, has an adequate blood pressure and a normal lactate then do not chase urine output.

**References**

Baidya, D.K., Khanna, P. and Maitra, S., 2014. Analgesic efficacy and safety of thoracic paravertebral and epidural analgesia for thoracic surgery: a systematic review and meta-analysis. *Interactive cardiovascular and thoracic surgery*, *18*(5), pp.626-635.

Batchelor, T.J., Rasburn, N.J., Abdelnour-Berchtold, E., Brunelli, A., Cerfolio, R.J., Gonzalez, M., Ljungqvist, O., Petersen, R.H., Popescu, W.M., Slinger, P.D. and Naidu, B., 2018. Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS). *European journal of cardio-thoracic surgery*, *55*(1), pp.91-115.

Biere, S.S., van Berge Henegouwen, M.I., Maas, K.W., Bonavina, L., Rosman, C., Garcia, J.R., Gisbertz, S.S., Klinkenbijl, J.H., Hollmann, M.W., De Lange, E.S. and Bonjer, H.J., 2012. Minimally invasive versus open oesophagectomy for patients with oesophageal cancer: a multicentre, open-label, randomised controlled trial. *The Lancet*, *379*(9829), pp.1887-1892.

Brainard, J., Scott, B.K., Sullivan, B.L., Fernandez-Bustamante, A., Piccoli, J.R., Gebbink, M.G. and Bartels, K., 2017. Heated humidified high-flow nasal cannula oxygen after thoracic surgery—A randomized prospective clinical pilot trial. *Journal of critical care*, *40*, pp.225-228.

Boshier, P.R., Ziff, C., Adam, M.E., Fehervari, M., Markar, S.R. and Hanna, G.B., 2017. Effect of perioperative blood transfusion on the long-term survival of patients undergoing esophagectomy for esophageal cancer: a systematic review and meta-analysis. *Diseases of the Esophagus*, *31*(4), p.dox134.

Chean, C.S., McAuley, D., Gordon, A. and Welters, I.D., 2017. Current practice in the management of new-onset atrial fibrillation in critically ill patients: a UK-wide survey. *PeerJ*, *5*, p.e3716.

Chughlay, M.F., Kramer, N., Werfalli, M., Spearman, W., Engel, M.E. and Cohen, K., 2015. N-acetylcysteine for non-paracetamol drug-induced liver injury: a systematic review protocol. *Systematic reviews*, *4*(1), p.84.

Ferguson, M.K., Celauro, A.D. and Prachand, V., 2011. Prediction of major pulmonary complications after esophagectomy. *The Annals of thoracic surgery*, *91*(5), pp.1494-1501.

Fernando, H.C., Jaklitsch, M.T., Walsh, G.L., Tisdale, J.E., Bridges, C.D., Mitchell, J.D. and Shrager, J.B., 2011. The Society of Thoracic Surgeons practice guideline on the prophylaxis and management of atrial fibrillation associated with general thoracic surgery: executive summary. *The Annals of thoracic surgery*, *92*(3), pp.1144-1152.

Maas, K.W., Cuesta, M.A., van Berge Henegouwen, M.I., Roig, J., Bonavina, L., Rosman, C., Gisbertz, S.S., Biere, S.S.A.Y. and Van Der Peet, D.L., 2015. Quality of life and late complications after minimally invasive compared to open esophagectomy: results of a randomized trial. *World journal of surgery*, *39*(8), pp.1986-1993.

Mantziari, S., Gronnier, C., Pasquer, A., Gagnière, J., Théreaux, J., Demartines, N., Schäfer, M., Mariette, C., Dhahri, A., Lignier, D. and Cossé, C., 2016. Incidence and risk factors related to symptomatic venous thromboembolic events after esophagectomy for cancer. *The Annals of thoracic surgery*, *102*(3), pp.979-984.

Martin, T.D., Lorenz, T., Ferraro, J., Chagin, K., Lampman, R.M., Emery, K.L., Zurkan, J.E., Boyd, J.L., Montgomery, K., Lang, R.E. and Vandewarker, J.F., 2016. Newly implemented enhanced recovery pathway positively impacts hospital length of stay. *Surgical endoscopy*, *30*(9), pp.4019-4028.

Miao, L., Zhang, Y., Hu, H., Ma, L., Shun, Y., Xiang, J. and Chen, H., 2015. Incidence and management of chylothorax after esophagectomy. *Thoracic cancer*, *6*(3), pp.354-358.

National Institute Clinical Excellence: Oesophageal Guideline 2018. Available online @ [**https://www.nice.org.uk/guidance/ng83/resources/oesophagogastric-cancer-assessment-and-management-in-adults-pdf-1837693014469**](https://www.nice.org.uk/guidance/ng83/resources/oesophagogastric-cancer-assessment-and-management-in-adults-pdf-1837693014469)

National Institute Clinical Excellence: Venous Thrombosis Guideline 2019. Available online @ **https://www.nice.org.uk/guidance/ng89**

National Oesophageal Gastric Cancer Audit, online at: **https://digital.nhs.uk/data-and-information/clinical-audits-and-registries/national-oesophago-gastric-cancer-audit**

Refai, M., Brunelli, A., Salati, M., Xiumè, F., Pompili, C. and Sabbatini, A., 2011. The impact of chest tube removal on pain and pulmonary function after pulmonary resection. *European Journal of Cardio-Thoracic Surgery*, *41*(4), pp.820-823.

Robinson, T.N., Wu, D.S., Pointer, L., Dunn, C.L., Cleveland Jr, J.C. and Moss, M., 2013. Simple frailty score predicts postoperative complications across surgical specialties. *The American Journal of Surgery*, *206*(4), pp.544-550.

Towe, C.W., Gulack, B.C., Kim, S., Ho, V.P., Perry, Y., Donahue, J.M. and Linden, P.A., 2018. Restrictive transfusion practices after esophagectomy are associated with improved outcome: a review of the society of thoracic surgeons general thoracic database. *Annals of surgery*, *267*(5), pp.886-891.

Weijs, T.J., Berkelmans, G.H., Nieuwenhuijzen, G.A., Ruurda, J.P., v Hillegersberg, R., Soeters, P.B. and Luyer, M.D., 2015. Routes for early enteral nutrition after esophagectomy. A systematic review. *Clinical nutrition*, *34*(1), pp.1-6.

Yoshida, N., Baba, Y., Shigaki, H., Harada, K., Iwatsuki, M., Kurashige, J., Sakamoto, Y., Miyamoto, Y., Ishimoto, T., Kosumi, K. and Tokunaga, R., 2016. Preoperative nutritional assessment by controlling nutritional status (CONUT) is useful to estimate postoperative morbidity after esophagectomy for esophageal cancer. *World journal of surgery*, *40*(8), pp.1910-1917.

**Enhanced Recovery after Surgery Pathway (Oesophagectomy)**

Patient Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ MRN: \_\_\_\_\_\_\_\_\_\_\_\_ Date of surgery: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
| **Post-Operative Day (POD)** | **POD** **Date:\_\_\_\_\_\_\_\_\_\_\_\_** | **POD 1** **Date:\_\_\_\_\_\_\_\_\_\_** | **POD 2** **Date:\_\_\_\_\_\_\_\_\_\_\_** |
| **Medications** | * IV omeprazole at 20:00 □
* Tinzaparin 3,500IU s/c, consider dose adjustment if weight

<50kg or >100kg □ / TEDs □ | * IV omeprazole at 06:00 □
* IV antibiotics □
* Identify & give essential medication via Jejunostomy tube (Be cautious with ACE Inhibitors) □
* Tinzaparin at 18:00 □ / TEDs □
 | * IV omeprazole at 06:00 □
* Give essential medication via jejunostomy tube □
* Tinzaparin at 18:00 □ / TEDs □
* 15mg Senna via jejunostomy tube at 22:00 □
 |
| **Pain Control** | * Regular IV paracetamol □
* Epidural/Multi modal/PCA observations as per trust policy □
* Pain controlled to enable deep breathing & coughing □
 | * Regular IV paracetamol □
* Epidural/Multi modal/PCA observations as per trust policy □
* Pain controlled to enable deep breathing, coughing & mobilising □
 | * Regular IV paracetamol □
* Epidural/Multi modal/PCA observations as per trust policy □
* Pain controlled to enable deep breathing, coughing & mobilising□
 |
| **Fluid Management** | * Intravenous Therapy 1ml/kg/hr (Max 80mls/hr) □
* Fluid balance completed hourly □
* Oral fluids 25mls/hour of water □
 | * Intravenous Therapy 1ml/kg/hr (Max 80mls/hr) □
* Fluid balance completed hourly □
* Oral fluids 25mls/hour of water □
 | * Intravenous Therapy (+ feed + oral intake = patients weight) □
* Fluid balance to be completed 2 hourly □
* Oral fluids 25mls/hr of water □
* Remove central line if not needed □
 |
| **Physiotherapy**  | * Head of bed >45 degrees at all times □
* Sit patient over edge of bed if hemodynamically stable □
* Encourage active cycle of breathing with support cough □
* Encourage circulatory exercises □
 | * Head of bed >45 degrees at all times □
* Sit out in chair □
* Walk 50-100ft on ITU/HDU □
* Safe transfer to ward 36 □
* Ambulate 2-3 times on ward 36 □
* Breathing and circulatory exercises as DPO 0 □
 | * Head of bed >45 degrees at all times □
* Ambulate 3-4 times, increasing distance □
* Breathing and circulatory exercises as DPO 0 □
 |
| **Nutrition**  | * Start 25mls/hr of sterile water via Jejunostomy tube from 22:00 □
 | * Commence Nutrison 1.0 25mls/hr via jejunostomy tube □
 | * Increase Nutrison 1.0 to 35mls/hr □
 |
| **Drains and tubes** | * Aspirate nasogastric tube (NG) 2 hourly & leave on free drainage □
* Record chest drain output at midnight □
 | * Aspirate NG 2 hourly & remain on free drainage □
* Record chest drain output at midnight and change all bottles □
 | * Aspirate NG 4 hourly & remain on free drainage □
* Record chest drain output at midnight □
 |
| **Post-Operative Day (POD)** | **POD 3** **Date:\_\_\_\_\_\_\_\_\_\_\_\_** | **POD 4** **Date:\_\_\_\_\_\_\_\_\_\_** | **POD 5-Discharge** **Date:\_\_\_\_\_\_\_\_\_\_\_** |
| **Medications** | * IV omeprazole at 06:00 □
* Give essential medication via Jejunostomy tube (Be cautious with ACE Inhibitors) □
* Tinzaparin at 18:00 □ / TEDs □
* Sodium docusate 200mg BD via jejunostomy tube □
* 15mg Senna via jejunostomy tube at 22:00 □
 | * Orodispersible lansoprazole 30mg □
* Give essential medication via jejunostomy tube □
* Tinzaparin at 18:00 □ / TEDs □
* Sodium docusate 200mg BD via jejunostomy tube □
* 15mg Senna via jejunostomy tube □
* X1 sachet of movicol TDS via jejunostomy tube □
* Glycerine suppository □
 | * Orodispersible lansoprazole 30mg □
* Give essential medication via jejunostomy tube □
* Tinzaparin at 18:00 □ / TEDs □
* Laxatives via jejunostomy tube as POD 4 & continue as required □
* Enema if bowels still not opened POD 5 □
* Review medication that remains suspended on e-record □
 |
| **Pain Control** | * Regular IV paracetamol □
* Epidural (change to bolus only) □
* Remove pain buster □
* PR Diclofenac 50mg TDS (Check renal function and history) □
* Pain controlled to enable deep breathing, coughing & mobilising □
 | * Regular paracetamol via jejunostomy tube □
* Epidural/Paravertebral block/PCA to be removed □
* PR diclofenac 50mg TDS (check renal function) □
* Oramorph PRN via jejunostomy tube□
 | * Regular paracetamol via jejunostomy tube □
* PR diclofenac 50mg TDS (check renal function) □
* Oramorph PRN via jejunostomy

tube □ |
| **Fluid Management** | * Intravenous Therapy (+ feed + oral intake = Patients weight) □
* Fluid balance chart completed 2 hourly □
* Oral fluids 50mls/hr of water □
 | * Stop intravenous therapy if consultant agree □
* If bowels opened 50’s & ½ cups □
* Remove urinary catheter if epidural has been removed □
 | * Free fluids (FF) POD 5 □
 |
| **Physiotherapy**  | * Head of bed >45 degrees □
* Up in chair 80% of the day □
* Ambulate 4-6 times □
* Breathing and shoulder exercises□
 | * Head of bed >45 degrees □
* Up in chair 80% of the day □
* Ambulate 5-8 times □
* Breathing and shoulder exercises□
 | * As POD 4 □
 |
| **Nutrition**  | * Increase Nutrison 1.0 to 50mls/hr □
 | * See dietitian regime □
* Commence jejunostomy education & give information leaflets □
 | * See dietitian regime □
* FF/Soup & Smooth pudding

POD 6 □* FF/Soft Diet POD 7 □
 |
| **Drains and tubes** | * Aspirate NG 4 hourly and remain on free drainage □
* Remove basal chest drain if output <250ml/24hrs
* Record chest drain output at midnight □
 | * Remove NG if aspirates

<100ml/24 hrs □* Record chest drain output at midnight □
 | * Remove apical drain once oral fluids established □
 |