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Nutritional Considerations for Patients Undergoing Esophagectomy for Esophageal Cancer

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In esophageal cancer, an esophagectomy may be used as curative treatment in early stages or in conjunction with chemotherapy and radiation in more advanced stages of disease. Malnutrition is prevalent before and after an esophagectomy and is associated with increased postoperative complications and decreased survival. Traditionally, postoperative diet advancement after esophagectomy has been delayed for fear of eating with a newly created upper gastrointestinal anastomosis. However, early oral feeding protocols are becoming more commonplace. The placement of an intraoperative jejunostomy feeding tube is often performed to secure a reliable route for nutrition and hydration. Multidisciplinary nutritional care before and after an esophagectomy is important to help prevent and address nutrition concerns that may arise. This review will discuss some of the most important nutritional considerations for patients with esophageal cancer undergoing esophagectomy.

Case-Preoperative Course

A 70-year-old male with clinical stage III esophageal cancer and recent completion of chemoradiation presented to the thoracic surgery clinic for consideration of an esophagectomy. Before and during his initial treatment, he experienced an unintentional weight loss of 45 lbs. from his usual body weight of 185 lbs., which resulted in a nadir of 140 lbs. After completion of his chemoradiation, he achieved a 15 lbs. weight gain to reach 155 lbs. The patient was admitted for surgery and underwent an Ivor Lewis esophagectomy (ILE) with intraoperative placement of a jejunostomy feeding tube (J-tube).

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INTRODUCTION

Esophageal cancer accounts for 1.1% of new cancer cases annually in the United States.[1] The majority of malignant esophageal neoplasms stem from the histological type of adenocarcinoma or squamous cell carcinoma and treatment regimens may include chemotherapy, radiation, and/or surgery.[1] Due to the nature of the pathologies necessitating

esophageal resection, patients undergoing surgical resection with an esophagectomy have a complex array of nutritional needs and considerations. These patients are often malnourished at the time of diagnosis and the duration of this malnutrition is frequently chronic. The perioperative and long-term nutritional needs for these patients present unique challenges, underscoring the need for a good partnership between the surgeon and registered dietitian (RD). Using a case-based approach, this review will discuss the esophagectomy procedure, potential nutrition and surgical complications, and nutritional interventions for these complex patients.

Fundamentals of the Esophagectomy Procedure

Esophagectomy is the surgical resection of the esophagus by removing the distal esophagus and the proximal stomach.[2] Gastrointestinal (GI) reconstruction requires repurposing the remaining stomach to act as the new "esophagus" or "conduit," which is then connected to the proximal esophagus (**See Figure 1**). Most esophagectomies are performed for malignancies at the esophagus and gastroesophageal junction. However, occasionally the procedure is performed for benign conditions such as end-stage achalasia, caustic injury, and trauma. In most cases, immediate reconstruction is performed to reestablish continuity of the GI tract, but occasionally in the acute setting for caustic and other traumatic injuries, delayed reconstruction is performed.

The method of esophagectomy can be broadly divided into transthoracic or transhiatal surgical approaches, the main difference being whether the chest is entered during surgery (transthoracic) or not (transhiatal).[3] The decision regarding what approach to undergo largely depends on the disease process, tumor location and surgeon preference. There is no consensus for the best approach and typically the surgeon uses clinical judgment based on the individual needs of the patient.

The stomach is the preferred reconstructive conduit to replace the esophagus in most cases, as a gastric conduit is easy to create, is generally less susceptible to ischemia, and requires only one surgical anastomosis. In cases where the stomach is not available for a conduit, such as prior injury or surgery, other conduit options include the colon or jejunum.[4] Colonic or jejunal conduits are more prone to ischemia, however.

Preoperative Nutrition Evaluation

Poor nutritional status due to arising symptoms, such as dysphagia often caused by obstruction of the esophageal lumen by tumor, is associated with an increase in postoperative complications as well as decreased tolerance of chemotherapy.[5,6] Compared to other cancers, patients with esophageal cancer are at a higher risk of weight loss on presentation, with the majority (>60%) presenting with severe malnutrition and an average weight loss of 10-15% from baseline.[7,8] A significant reduction in overall survival has been reported in patients with esophageal cancer who have lost ≥10% of their baseline weight by the time of surgery.[9]

Oral intake in patients presenting to the clinic with an esophageal mass for consideration of surgery is often found to have been suboptimal for weeks to months. Early nutritional assessment of patient tolerance to oral intake (solids vs. soft foods vs. liquids), extent of weight loss, presence of dysphagia, current appetite, with utilization of physical assessment of fat and muscle wasting helps guide nutritional therapy. The RD can work with the patient to improve oral intake by using oral nutrition supplements (ONS), modifying the consistency of food, and educating on increased caloric intake. However, in patients with signs of malnutrition or unable to make changes in diet, it is likely advantageous to establish enteral access preoperatively for supplemental feeding.[10]

It is important to consider if a patient is undergoing chemoradiation treatment before surgical restaging, as these treatments could make oral intake more problematic, especially until the esophageal mass decreases in size or in cases where the patient develops significant radiation esophagitis. Preoperative jejunostomy (J-tube) or gastrostomy (G-tube) could be used as appropriate enteral access. These decisions are often best done with a specialized RD in the clinic, which has been shown to improve patient outcomes.[11] In our own clinic, having a dedicated RD in clinic resulted in improved preservation of weight postoperatively as well as for earlier J- tube removal, with a trend toward decreased readmissions.[12] Many patients with esophageal malignancies will receive induction

chemoradiation or chemotherapy before surgery. Close nutrition monitoring during treatment with ongoing re-evaluation for enteral nutrition (EN) should take place.

Postoperative Feeding Modalities

Traditionally, enteral feeding access is established in patients undergoing esophagectomy and enteral nutrition begins within a day of surgery.[13] Jejunal feeding may be needed to supplement oral intake anywhere from a few weeks to a few months, depending on how quickly the patient rebounds postoperatively.[12] More recently, with increased minimally invasive robotic and laparoscopic approaches and the development of Enhanced Recovery after Surgery (ERAS) pathways, some surgeons are omitting the practice of routine jejunostomy tube placement.[13,14] This could become problematic in the case of the patient that has postoperative complications preventing oral intake and occasionally enteral access must later be established. The timing and resumption of oral intake after esophagectomy also varies by practice, with some centers allowing oral intake within days of surgery and others may delay oral diet for weeks postoperatively.

In 2019, ERAS guidelines for esophagectomy surgery were published, and although they provide some strong nutritional perioperative recommendations, their postoperative nutritional advancement recommendation remained vague.[14] See **Table 1** for a summary of the guidelines. Davies et al. examined the effect of perioperative nutrition support and weight loss to outcomes, with their protocol safely implementing earlier diet advancement to a pureed diet by postoperative day 5.[15] Another group published three studies investigating early feeding after minimally invasive ILE, including high volume centers in the Netherlands (N=114), international centers (N=148), and a single Netherlands center in attempts for a more controlled surgical technique (N=196). All studies here compared limited liquids on post operative day (POD) 1 that progressed to 1500mL liquids by POD 5, the centers allowed solid foods on various later post op days, also evaluating using or not using supplemental EN. In aggregate, these studies demonstrated the safety of various early feeding protocols after esophagectomy.[16–18]

Due to the high prevalence of either surgical or nutritional tolerance complications causing patients to be unable to abide by early feeding protocols,

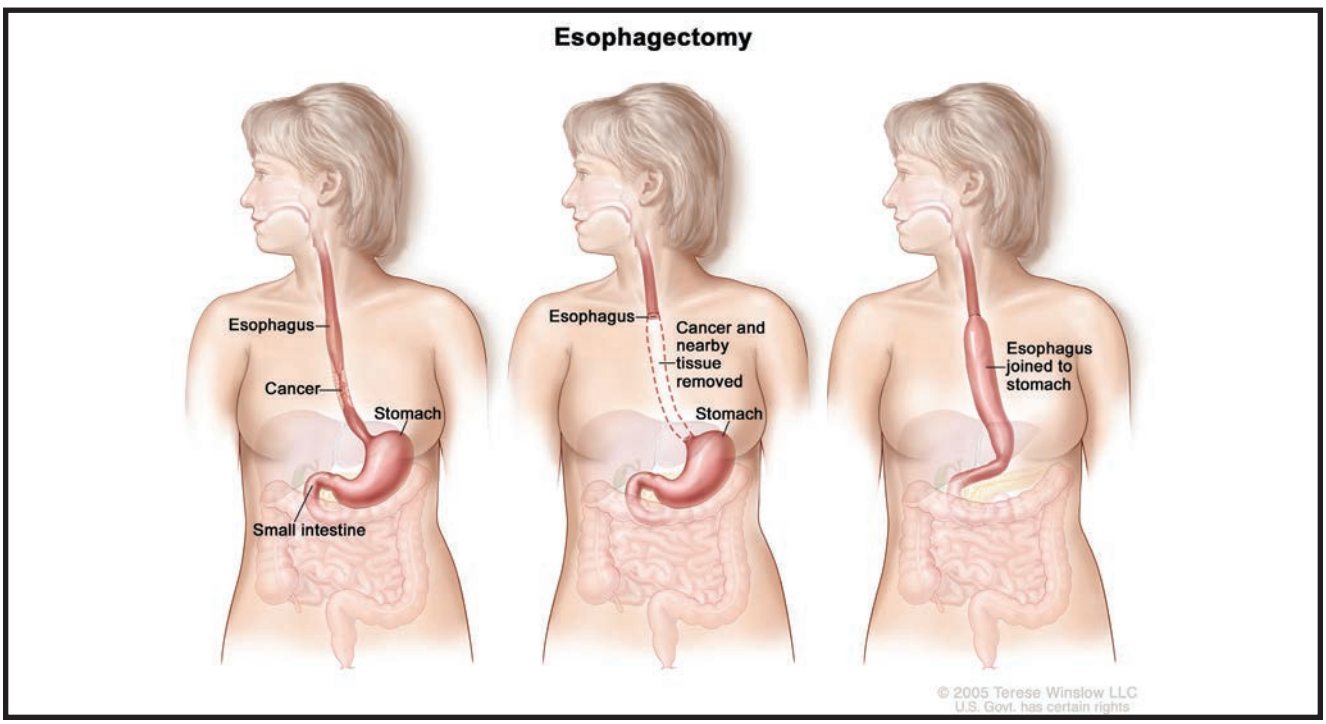

Figure 1. Esophagectomy
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Table 1. ERAS Society Recommendations for Perioperative Nutritional Care in Esophagectomy Surgery[14]

Element	Recommendation	Recommendation Grade*
Preoperative Nutritional Assessment and Treatment	Nutritional assessment should be undertaken in all patients to detect malnutrition (risk) and optimize nutritional status prior to surgery	Strong
Preoperative Nutritional Intervention	In high-risk cases enteral support is indicated using the GI tract with selective use of feeding tubes	Strong
Routine Use of Enteric Feeding Tubes	Early enteral feeding (should be strongly considered). Either feeding jejunostomy or nasojejunal/ nasoduodenal tubes may be used	Moderate
Preoperative Fasting	Prolonged fasting should be avoided, and clear liquids should be allowed until 2 hours prior to surgery	Strong
Postoperative Early Nutrition: oral vs jejunostomy	Introduction of early enteral nutrition is beneficial in patients undergoing surgery for esophageal cancer	Strong

*Strength of recommendations based on Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system.[36]

consideration should be given to placement of a J-tube at the time of surgery. J-tubes are generally safe, and while complications do occur, including displacement, clogging, leaking around the tube, and infections, major complications remain low at 1.5%.[6] Due to the low complication rate of J-tubes, they should be considered for all patients status post esophagectomy who are at nutritional risk, as these patients may need to continue feeding after discharge.[19,20] The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines recommend consideration for intraoperative placement of an enteral tube for patients who are estimated to meet less than half of their nutritional needs in the first week after surgery, those who are malnourished at the time of surgery, and those undergoing major GI surgery for cancer.[6]

Complications of Esophagectomy and Nutritional Consequences

Complications following esophagectomy are frequent and can be separated into short- and long-term complications, many of which impact the nutrition of the patient. One study found that 59% of patients did not remain on their postoperative early oral nutrition advancement pathway.[21] The main cause of deviation was postoperative complications specifically, anastomotic leak, chyle leak, and acute respiratory distress. Additionally, 58% of patients complained of feeding intolerances such as nausea, vomiting, early satiety, and dysphagia, which was found to be most common in patients with a cervical anastomosis.[21] Common surgical complications include pneumonia (14.6%), arrhythmias (14.5%), other infections such as wound infections and sepsis (14.2%), delayed conduit emptying (6.7%) and thoracic wound dehiscence (1.5%). Anastomotic leaks are a frequent occurrence after an esophagectomy, reported to occur in 11.4% of patients.[22] Conduit ischemia or necrosis are rarer events, occurring in approximately 1.3% of patients. Chyle leaks, which have unique surgical and nutritional considerations, occur at a rate of 4.7%.[22]

These complications can take a toll on nutritional status. A systematic review of 18 studies found over half of esophagectomy patients were malnourished at 6 and 12 months postoperatively (defined as losing >10% of their body weight), and noted many patients were unable to return to their preoperative weight over time.[23] Weight loss has an impact on survival and has been associated with increased mortality at 90-days and one year after esophagectomy, underscoring the importance of pre- and post-operative nutrition interventions.[15]

Anastomotic leaks – managing an anastomotic leak depends on the location and size of the leak as well as the overall condition of the patient. After a leak has been identified or suspected, an upper endoscopy is usually performed to evaluate the location and extent of the leak and evaluate the conduit for signs of ischemia. The chest tube remains in place as a drain for the leak, and feeding

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should be administered via the distally placed J-tube when one has been placed. If a patient lacks enteral access, then parenteral nutrition (PN) would be considered. Small anastomotic leaks can usually be managed endoscopically with either placement of a covered self-expanding stent, which is removed after several weeks, or an intraluminal wound vac placement via a nasoenteric approach (endoscopic vacuum therapy or EVT).[24,25] In the case of stenting, oral intake can sometimes be resumed if exclusion of the leak can be confirmed radiographically. A post-stent diet includes soft foods and liquids, to avoid stent migration. If the anastomotic leak is large, the anastomosis has dehisced, or the conduit shows evidence of ischemic necrosis, a re-operative approach is usually mandatory. If the conduit has extensive necrosis or the anastomosis cannot be salvaged, a diverting cervical esophagostomy (spit fistula) is constructed, and the stomach brought back down into the abdominal cavity until the appropriate time of reoperation to restore gastrointestinal continuity. In these settings, patients are dependent on EN until continuity can be reestablished.

Chyle leaks – can arise due to direct injury to the thoracic duct, which courses near the esophagus inside the chest, from smaller branches of the thoracic duct, or more rarely from lymph node removal.[26] In patients who are consuming an oral diet or receiving EN, a common sign is a milky appearance of the chest tube output, high in volume. However, occasionally chyle leaks do not demonstrate a milky appearance of the pleural drainage, especially when fats have not been reintroduced into the diet, and high volume of chest tube output may be the only sign. In fact, Maldonado et al. found milky drainage was not a sensitive marker for chyle leak.[27] Laboratory confirmation of a chyle leak can be done by sending the chest tube output for chylomicrons or triglycerides. A triglyceride level of >110mg/dL is indicative of a chyle leak and anywhere from 500-1000mL/day is considered "high output". [26,28] Urgent intervention is important when a chyle leak is identified, as delayed treatment leads to significant dehydration, compounds the already present malnutrition, and has effects on immune function and wound healing. Chyle leaks of <1000mL/day can often be managed by decreasing oral or enteral intake of long chain triglycerides (LCT) which are broken down into chylomicrons and enter the circulation via lymphatics. If a patient is maintained on an oral diet, it is imperative to counsel the patient to maximize calories while restricting fat.[29] If the patient is receiving EN, the enteral formula most often utilized is Vivonex RTF by Nestle®, which only contains 6.5g of LCT per liter of formula; other formulas with comparable lipid profiles could be tried as well.[30] Use of medium chain triglycerides (MCTs) may help increase calories in this patient population. MCTs are absorbed directly into the portal vascular system, unlike long-chain fatty acids, and do not add to the chyle load of the lymphatic system. However, MCTs do not supply essential fatty acids and a patient can develop EFA deficiency in as little as 2-4 weeks unless 2-4% of total calories are supplied from linoleic acid.[29] PN should be reserved for cases when low-LCT EN has failed, as macronutrients are supplied directly to the bloodstream, which can include IV lipids which provides EFA, and completely bypass the lymphatic system.

Case-Postoperative Course

Postoperatively, a standard polymeric EN formula was initiated via his J-tube while he was kept *nil per os* (NPO). On POD 4, the volume of his chest tube output increased to > 500mL in 24 hours and became milky in color, concerning for a chyle leak. A triglyceride level was obtained from his pleural fluid, which was elevated at 707 mg/dL. At this time, his EN was changed to a very low-fat elemental formula. Unfortunately, the volume of output from his drain continued to increase and rose to 1200mL/day. Therefore, EN was stopped, and PN was initiated due to history of malnutrition and prolonged NPO status.

Anastomotic strictures – are generally ischemic in nature or are associated with a previous anastomotic leak. Upper endoscopy is an important part of the diagnosis and treatment; to visualize the stricture, rule out recurrence of cancer, and perform a dilation. Often several dilations are needed, repeated at intervals, to improve oral intake. When strictures occur, the RD must ensure the patient receives

Table 2. Nutrition Recommendations Status Post Esophagectomy[10,13,29]

Complication	Nutrition Recommendations
Dysphagia or Food Feeling "Stuck"	• Chew all foods well • Take small bites • Soft/moist foods are best tolerated • Evaluate for strictures or delayed emptying from the conduit
Chyle Leak	• If oral intake-requires very low-fat diet • If on enteral feeding- adjust feeding to very low-fat elemental feeding • If chyle leak refractory to fat restriction, PN may be indicated • If prolonged >2-4 weeks, may require supplemental LCT to avoid EFAD as well as water soluble forms of Vitamins A, D, E, K • Ensure adequate protein intake
Dumping Syndrome	• Avoid simple sugars in foods • Drink sugar free beverages and diluted juices • Separate fluids from solids during meals to slow intestinal transit • Limit foods rich in simple sugars and eat slowly
Early Satiety	• Consume small portions consumed frequently • Choose high calorie, nutrient dense foods • Liquids (ONS or blenderized smoothies) empty more easily from the stomach and may be better tolerated • Sit upright while eating and for an hour afterwards; take a short walk after eating • Limit carbonation, initially • Evaluate for prokinetic therapy to enhance conduit emptying
Reflux	• Ensure foods are well chewed • Take small bites and eat slowly- allow time for the sensation of fullness • Start with smaller amounts of foods consumed at one time. Advance as tolerated. • Sit upright while eating and for an hour afterwards; take a short walk after eating • Limit carbonation, initially • Avoid constipation • Block gastric acid with PPI or H2 blocker

ONS: oral nutrition supplement; PN: parenteral nutrition; LCT: long chain triglycerides; EFAD: essential fatty acid deficiency; PPI: proton pump inhibitor; H2 blocker: histamine-2 receptor antagonist

adequate nourishment via liquids and soft foods until a durable solution is achieved.

Dumping syndrome – may occur with rapid emptying of gastric conduit contents into the small bowel, causing diarrhea, flushing, and discomfort.[31] This can occur within 3 months postoperatively and may resolve within a year. Two forms of dumping have been observed: early and late dumping. Early dumping occurs immediately after a meal and include bloating, nausea, diarrhea, flushing, fatigue, and hypotension.[31] Late dumping occurs up to 3 hours after a meal, and mainly includes vasomotor symptoms such as perspiration, weakness, hunger, shakiness, and hypoglycemia.[32] Sun et al. found that emptying of liquids from the gastric conduit

can be accelerated postoperatively compared to preoperative emptying rates.[33]

Other concerns – reflux may occur frequently with the lack of a gastroesophageal sphincter. Early satiety can be related to the narrower dimensions of the conduit compared to the native stomach. Early satiety is the primary nutritional factor hindering adequate intake and advancement. Delayed conduit emptying can occur and present early, causing early satiety and nausea. Delayed conduit emptying warrants an evaluation including fluoroscopic swallow study, CT scan and/or upper endoscopy which can treat this with dilation. Other attempted treatments for the above include prokinetic agents. Malabsorption is a potential long-term consequence of esophagectomy. This can occur from poor mixing of pancreatic enzymes with nutrients in the intestinal lumen, causing a functional exocrine pancreatic insufficiency (EPI).

Table 3. Studies on Early Diet Advancement Post Esophagectomy[33,37-43]

Study	Surgery Characteristics	Early Diet Advance Protocol	Results of Earlier Feeding
Li (2012)	Mix of MI & open ILE, thoracoabdominal transabdominal, 3 field	POD 3-4 - sips of liquids POD 5 - clear liquids POD 6 - soft foods (as part of an ERAS program)	Decreased LOS, no difference in rate of complications/ readmission
Ford (2014)	Two stage IL esophagectogastrectomy	POD 6 - full liquid diet (if approved by RD) Trophic jejunal feeding POD 0 Discharged on tube feeding (as part of an ERAS program)	Decreased LOS, no difference in post op complications or 30-day readmissions
Sun (2015)	Thoracolaparoscopic esophagectomy	POD 1- full liquid diet -Gastric emptying of liquids WNL per study on POD 1 -No reports of n/v or fullness If liquids were tolerated, patients were advanced to soft food diet	Faster return to bowel function and decreased LOS, no increase in post op complications
Weijs (2016)	MI ILE	POD 0 - clear liquids POD 1 - any liquids POD 7- solids Supplemental EN if PO intake <50% at POD 5	No difference in complications with early feeding *38% of patients unable to take po orally d/t post op complications
Giacopuzzi (2017)	Mix of MI & Open McKeown and ILE or a modification per surgeon preference	Early: POD 1-3 - clear liquids POD 4 - soft foods Standard: POD 6 - clears post swallow POD 8 - soft foods EN POD 1 if access in place (PN POD 1-3 if no EN access)	No difference in post op complications
Sun (2018)	McKeown MIE	Initially sips of clears to assess for aspiration POD 1- full liquid diet POD 2- soft diet	Shorter return to bowel function and decreased LOS
Liao (2020)	MI ILE	Oral liquid diet POD 4 vs POD 7 Both groups maintained on EN	Decreased LOS in early fed group, no differences in complications
Li (2021)	Mix of MI & Open McKeown and ILE	Oral liquid (& PN) by 48 hours, semifluid POD 4, PN stopped POD 6-8	No differences in complications, earlier return of bowel function

MI: Minimally invasive; ILE: Ivor Lewis Esophagectomy; POD: post op day; LOS: length of stay; RD Registered Dietitian; WNL: within normal limits; ASGS: Accordion Severity Grading System; PO: oral intake; ERAS Enhanced Recovery After Surgery; EN: enteral nutrition; PN: parenteral nutrition

This has been reported in both esophagectomy and total gastrectomy patients.[34] Small bowel bacterial overgrowth and bile acid malabsorption has also been reported in this patient population.[35] Clinicians following these patients long-term should be aware of these potential complications. See **Table 2** for further nutritional interventions post esophagectomy.

Case Completion

Once the patient's chest tube output started declining, the surgical team approved re-initiation of a very low-fat elemental EN formula. The patient's EN was started, and the volume of drain output was monitored closely. The EN resulted in no increased output with gradual decreases in volume. From there, the EN was advanced to goal rate and PN was discontinued. The chyle leak resolved, the chest tube was removed, and the patient was discharged 14 days after surgery on a clear liquid diet and EN. Within two weeks of discharge, his weight was stable, a regular solid food diet had been resumed, and his EN was decreased to 50% of his needs, cycled overnight. He tolerated his diet well thus his J-tube was removed a few weeks later.

CONCLUSION

Esophagectomy is a complicated surgery performed in patients with esophageal cancer. Multiple studies have now shown the safety of early oral advancement postoperatively in patients who are status post esophagectomy. See **Table 3** for further studies. Even then, a high rate of preoperative malnutrition and postoperative complications delaying oral intake may require alternative and/or supplemental nutrition. Therefore, J-tubes placed during surgery continue to be an effective way to improve nutrition in this population. As more early oral feeding studies are conducted, there may be potential for selective J-tube placement at the time of surgery. Most importantly, strong collaboration between the surgical team and the RD is imperative to achieve optimal outcomes. ■

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