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Research Paper

Retrospective Study of Surgical Management of Carcinoma Esophagus By Orringer's 2 Phase Transhiatal Versus Mc Evans 3 Phase Esophagectomy (Study of 25 Cases Each).

Medical Science

KEYWORDS : Carcinoma of Esophagus, TTE, THE

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INTRODUCTION

Esophageal cancer is the 6th most common type of malignancy and the 6th most common cause of cancer mortality in the world1. In 2002, the amount of newly diagnosed patients worldwide was approximately 462.0001. The two most common histologic subtypes are esophageal squamous cell carcinoma (ESCC), arising from dysplastic squamous epithelium of the esophagus and esophageal adenocarcinoma (EAC), originating from dysplasia in columnar-lined esophagus with intestinal metaplasia (i.e.Barrett's esophagus)[2,3]. For the past decades the incidence of esophageal cancer has rapidly increased, particularly due to a rise in adenocarcinoma of the esophagus[4]. Yet, worldwide the incidence of ESCC is highest1. For patients diagnosed with locally advanced esophageal cancer, the best chance of cure is offered by radical surgical resection[5]. As symptoms, such as dysphagia and retrosternal discomfort, arise only when the tumor is large enough to obstruct the esophageal lumen, patients are frequently diagnosed at an advanced stage. Consequently, less than half of patients are eligible for surgery due to tumor ingrowth into adjacent structures or due to the presence of distant metastases[6,7].

Surgical treatment of esophageal cancer

As the esophagus has a unique longitudinal lymphatic drainage system in the submucosal layer, lymph node metastases of esophageal cancer can occur along the entire esophagus from the cervical to the abdominal part.8-11 The optimal treatment for esophageal cancer, therefore, consists of transhiatal esophagectomy limited lymph node dissection (LND) and transthoracic en bloc esophagectomy (TTE) with an extensive mediastinal and abdominal lymph node dissection (LND)[5].This approach through thoracotomy is accompanied by significant morbidity, which is predominantly due to cardiopulmonary complications[12,13]. To reduce the surgical trauma and thus the morbidity of open TTE, less invasive surgical techniques such as transhiatal esophagectomy (THE) have been introduced[14,15]. A randomized controlled trial on TTE versus THE has shown the latter to carry a lower complication rate[12]. However, since with THE the esophagus is stripped out of the mediastinum, only a limited LND can be carried out without dissection of the upper mediastinal lymph nodes[14,16]. Consequently, a trend towards a better survival for TTE over THE was detected[12,17]. Statistical significance was not reached, but this was most probably a result of the fact that the study was underpowered.

Neoadjuvant therapy

Due to the frequent occurrence of recurrent disease, the survival after esophagectomy is relatively poor. Tumor recurrence can be locally (i.e. at the anastomosis), regionally (i.e. the mediastinal lymph nodes) or systemically (i.e. organ metastases or distant lymph nodes). Locoregional recurrence is due to an

incomplete tumor resection and, thus, to inadequate surgery, whereas the latter is predominantly a consequence of early metastatic spread. A recent meta-analysis has revealed that neoadjuvant chemoradiotherapy improves the two-year survival rate of esophageal cancer patients by downstaging of the tumor and by early opposing metastatic spread[18]. Yet, it is unknown at what frequency neoadjuvant therapy is nowadays incorporated in the work-up of esophageal cancer patients. A disadvantage of chemotherapy is that it destructs all proliferating cells, including normal healthy cells leading to toxicity[19,20]. Hence, therapy has been developed that selectively acts on tumor cells by aiming at molecular characteristics of a tumor. Although various targets for molecular therapy have been identified in cancer and although some clinical studies with targeted therapy have been performed in esophageal carcinoma[21,22] it remains to be further elucidated which particular molecular markers to target in esophageal cancer.

Diagnostic imaging

Staging of esophageal cancer can be done with diagnostic modalities such as endoscopic ultrasonography (EUS), computed tomography (CT) scanning and ultrasonography (USG) of the neck[23,24].EUS has proven to be the most accurate tool for assessing the depth of tumor infiltration into the esophageal wall. Organ metastases can accurately be identified by CT-scanning, whereas US of the neck is the preferred diagnostic modality for the detection of supraclavicular lymph node metastases. It is, however, unknown in what frequency these different diagnostic modalities are currently being applied worldwide in the work-up of esophageal cancer patients. For patients without lymph node metastases in the resected specimen (pN0), the extensive LND turned out to be abundant. In these patients, the morbidity of esophagectomy could be improved by tailoring the extent of LND.After resection of the esophagus and cardia, the digestive tract is generally reconstructed with a gastric conduit. This conduit is created by means of linear staplers and is anastomosed in the neck or intrathoracically. An important cause of morbidity and mortality after esophagectomy is anastomotic leakage[25]. To assess the anastomotic integrity before oral intake is resumed, an aqueous contrast swallow examination is routinely performed around the 7th postoperative day in many centres[26]. In case

no radiological leakage is noticed, diet is gradually resumed; when a radiological leakage is detected, oral intake is prohibited for another week.

AIMS AND OBJECTIVES

The study was done in New civil hospital & Government Medical college -Surat, with the following aims and objectives:

1. To compare surgical management of carcinoma esophagus by Orringer's 2 phase transhiatal (THE) versus Mc Evans 3 stage esophagectomy (TTE).
2. To compare mortality and morbidity among these approaches.
3. To compare outcome and survival after these approaches.

REVIEW OF LITERATURE

HISTORICAL PERSPECTIVE

One of the current leaders in the field of thoracic surgery, **Mark B. Orringer, MD**, has focused much of his academic career on the diagnosis and treatment of benign and malignant esophageal disease[14]. He has developed two leading esophageal operations: the combined Collis-Nissen hiatal hernia repair and transhiatal esophagectomy without thoracotomy. Dr. Orringer has written or cowritten more than 200 journal articles and 110 book chapters and has edited five books. Also, he has served on the editorial boards of several journals and has been an invited speaker/participant or visiting professor throughout the country and the world. His commitment to residency education is documented nationally by his involvement with the Thoracic Surgery Directors Association, of which he is past President, and The American Board of Thoracic Surgery on which he served as a director from 1988 to 1995. He has played a major role in developing a structured curriculum and current efforts to implement innovative educational tools for thoracic surgery residents. He is a past President of the Society of Thoracic Surgeons and currently serves on the Board of Governors and the Advisory Council of Cardiothoracic Surgery of the American College of Surgeons, and as Chairman of the Finance Committee and Nominating Committee of the Society of Thoracic Surgeons[14].Dr. Orringer has received many honors and awards throughout his career: He is a member of many major national/international professional organizations including the American College of Surgeons, the Society of Thoracic Surgeons, The John Alexander Society, the American College of Chest Physicians, the American Association for Thoracic Surgery, The Society of University Surgeons, The Society for Surgery of the Alimentary Tract, The International Society of Surgery, The Central Surgical Association, The American Surgical Association, Thoracic Surgery Directors Association, and the Halsted Society.14 Dr. Orringer currently serves as the John Alexander Distinguished Professor and Head of the Section of Thoracic Surgery at the University of Michigan. He was a Phi Beta Kappa graduate of the University of Pittsburgh undergraduate school in 1963 and an Alpha Omega Alpha graduate of the University of Pittsburgh Medical School in 1967. He completed his general surgery and thoracic surgery residency training at The Johns Hopkins Hospital in 1973. During his surgery residency, while at the Frenchay Hospital in Bristol, England under the mentorship of Mr. Ronald Belsey, he gained additional exposure to the field of general thoracic surgery, particularly the surgical treatment of esophageal disease Esophagectomy without thoracotomy was originally proposed by Denk in 1913, and successfully performed in a patient of thoracic esophageal cancer by Grey-Turner in 1933. This procedure was forgotten until 1980s when Mark B.Orringer reintroduced and popularised this approach in a patient with cancer of thoracic esophagus16. The operation, pioneered by Orringer, is an alternative to the more traditional methods of esophageal resection for cancer which involve opening both the chest and abdomen. In Orringer's procedure, the esophagus is removed through the diaphragmatic hiatus working through an upper abdominal incision and a cervical incision without opening the chest. Alimentary continuity is re-established by mobilizing the stomach through the posterior mediastinum in the original esophageal bed and anastomosing the gastric fundus to the cervical esophagus above the level of the clavicles. Avoidance of a thoracotomy minimizes postoperative morbidity, and the cervical esophagogastric anastomosis virtually eliminates the risk of mediastinitis from an anastomotic leak inherent with a traditional intrathoracic esophagogastric anastomosis. Restoration of the ability to swallow a soft diet comfortably is generally achieved within one week[16].

ANATOMY OF OESOPHAGUS

INTRODUCTION

The oesophagus is a muscular tube connecting the pharynx to the stomach and measuring 25–30 cm in the adult. Its primary function is as a conduit for the passage of swallowed food and fluid, which it propels by antegrade peristaltic contraction. It also serves to prevent the reflux of gastric contents whilst allowing regurgitation, vomiting and belching to take place. It is aided in these functions by the upper and lower oesophageal sphincters sited at its proximal and distal ends.

Any impairment of oesophageal function can lead to the debilitating symptoms of dysphasia, gastro-oesophageal reflux or esophageal pain. The apparently simple basic structure of the oesophagus belies both its physiological importance and the dangers associated with surgical intervention. As a consequence of its location deep within the thorax and abdomen, a close anatomical relationship to major structures throughout its course and a marginal blood supply, the surgical exposure, resection and reconstruction of the esophagus are complex. Despite advances in perioperative care, esophagectomy is still associated with the highest mortality of any routinely performed elective surgical procedure. In order to understand the pathophysiology of esophageal disease and the rationale for its medical and surgical management a basic knowledge of oesophageal anatomy and physiology is essential[27].

Embryology

The esophagus comes from two sources of the primitive gut[31]. The cranial portion is derived from the pharyngeal gut or pharynx, and the caudal part from the pregastric segment of the foregut. With the growth of the embryo, the primitive gut lumen becomes almost filled but later, due to a process of epithelial layer vacuolization, hollows out again[31]. At about 4 weeks of embryonic development, the laryngotracheal groove appears, subsequently forming the tracheobronchial diverticulum on the ventral surface of the foregut, at the level of the fourth pharyngeal pouches. The diverticulum is gradually closed by the tracheoesophageal folds (internal ridges of the lateral esophageal groove), caudally first, forming the tracheoesophageal septum. The endoderm forms the mucosal epithelium and associated ducts and glands. The mesoderm forms the lamina propria, muscularis mucosa, and muscular coat; the branchial arches form the striated muscle; and the visceral splanchnic mesoderm forms the smooth muscle coat. Arterial and venous supply of the esophagus is segmental. The cranial arteries are derived from the branchial arches and the caudal arteries from branches of the aorta. With the unfolding and lengthening of the embryo, the esophagus also lengthens. The original cell lining of the esophagus changes from a two- to three-layer pseudostratified columnar epithelium via a stratified columnar stage to a stratified squamous epithelium by 90 to 130 mm embryo length[31].

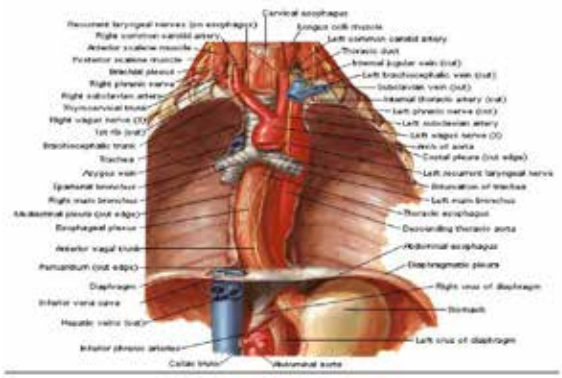
Esophageal anatomy

The esophagus is a muscular tube protected at its ends by the upper and lower oesophageal sphincters. It commences as a continuation of the pharynx at the lower border of the cricopharyngeus muscle, at the level of the sixth cervical vertebra (C6). The surface marking for this point is the lower border of

the cricoid cartilage. It enters the chest at the level of the suprasternal notch and descends through the superior and posterior mediastinum along the front of the vertebral column. It passes though the oesophageal hiatus in the diaphragm at the level of the tenth thoracic vertebra to end at the gastro-oesophageal junction. The surface marking for this point is the left seventh costal cartilage. The oesophagus measures 25–30 cm in length although this varies according to the height of the individual and in particular the suprasternal–xiphoid distance.

Anatomical relationsips of the oesophagus

The oesophagus can be artificially divided from proximal to distal into cervical, thoracic and abdominal segments.



Cervical oesophagus

This begins at the lower border of the cricoid cartilage (C6) and ends at the level of the thoracic inlet or jugular notch (T1). It lies between the trachea anteriorly and the prevertebral layer of cervical fascia posteriorly, deviating slightly to the left at the level of the thyroid gland before returning to enter the thorax in the midline. The recurrent laryngeal nerves run in a caudal direction either side of the oesophagus in the tracheo-oesophageal groove. They innervate the laryngeal muscles and surgical trauma to the nerve at this point results in ipsilateral vocal cord palsy. More laterally lies the lobes of the thyroid gland with the inferior thyroid artery and the carotid sheath containing the carotid vessels and the vagus nerve.

Thoracic oesophagus

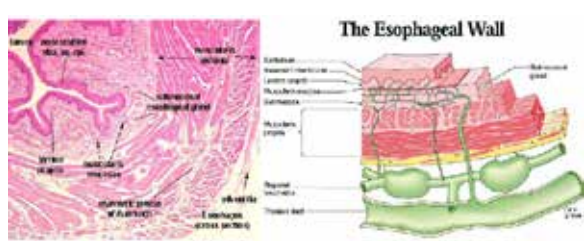
The upper thoracic oesophagus extends the length of the superior mediastinum between the thoracic inlet and the level of the carina (T5). The middle and lower thoracic oesophagus lies in the posterior mediastinum subdivided by the midpoint between the tracheal bifurcation and the oesophagogastric junction. In the superior mediastinum the upper thoracic oesophagus maintains close contact with the left mediastinal pleura and posteriorly with the prevertebral fascia. At this level the oesophagus is indented by the arch of the aorta on its left side and crossed by the azygos vein on its right side. As it descends into the posterior mediastinum it is also crossed anteriorly and indented by the left main bronchus and crossed by the right pulmonary artery. Below this level the pericardium and left atrium lie anterior to the oesophagus. The middle thoracic oesophagus deviates to the right, coming into close apposition with the right mediastinal pleura, which covers its right side and posterior aspect. It also moves forward with a concavity more marked than the vertebral column, allowing the azygos vein, the thoracic duct, the right upper five intercostal arteries and the descending aorta to all pass posteriorly during its course. The azygos vein originates in the upper abdomen and enters the mediastinum via the aortic opening in the diaphragm. It ascends along the right posterolateral aspect of the oesophagus before arching over the root of the right lung to enter the superior vena cava. Resection of this arch allows improved surgical access to the oesophagus via the right chest. The thoracic duct originates in the cisterna chyli anterior to the second lumbar vertebra and passes through the diaphragmatic hiatus on the right side of the aorta posterior to the right crus. It provides lymphatic drainage for the lower body and the left half of the upper body. The duct lies on the right lateral aspect of the descending thoracic aorta in the inferior mediastinum. It is here that the duct or its radicals may be inadvertently damaged during mobilisation of the oesophagus, resulting in a chylothorax. The duct then ascends, passing behind the oesophagus to lie on its left side in the superior mediastinum. The oesophagus initially lies to the right of the descending aorta but crosses it during its descent to lie anterior and on its left side as it approaches the diaphragm.

Abdominal oesophagus

The lower oesophagus comprises the lower thoracic oesophagus together with the short intraabdominal portion of oesophagus. The oesophageal opening in the diaphragm lies within fibres of the left crus inside a sling of fibres passing across from the right crus. At this point the vagal trunks lie on the anterior and posterior surface of the oesophagus having emerged from the oesophageal plexuses on its lower surface. The oesophageal branches of the left gastric artery with associated veins and lymphatics also accompany the oesophagus. The intra-abdominal portion of the oesophagus extends from the diaphragm to the gastro-oesophageal junction. It is covered by peritoneum and lies posterior to the left lobe of the liver. It is usually 1–2 cm in length although even in the normal individual this varies according to the muscle tone, degree of gastric distension and respiration. Although essentially a midline structure, these deviations of the oesophagus to the left in the neck, to the right in the posterior mediastinum and left and anteriorly towards the diaphragmatic hiatus have important clinical consequences. This course must be considered carefully when the surgical approach to the oesophagus is determined. For optimum exposure the cervical oesophagus should be approached from the left side of the neck, the thoracic oesophagus from the right side of the thorax and the lower oesophagus and the gastro-oesophageal junction from the abdomen or by a left thoraco-abdominal approach[27,28,29].

Histology

The esophagus is a muscular tube, approximately 25 cm in length, that conveys the bolus (masticated food) from the oral pharynx to the stomach.30 Along its entire length, its mucosa presents numerous longitudinal folds with intervening grooves that cause the lumen to appear to be obstructed; however, when the esophagus is distended the folds disappear and the lumen becomes patent.



Mucosa

The esophageal mucosa is composed of a stratified squamous epithelium, fibroelastic lamina propria, and a smooth muscle layer that is the longitudinally disposed muscularis mucosae. The mucosa of the esophagus is composed of three layers: epithelium, lamina propria, and muscularis mucosae . The lumen of the esophagus, lined by a 0.5-mm-thick, stratified squamous nonkeratinized epithelium, is usually collapsed and opens only during the process of swallowing.

The epithelium presents a well-developed rete apparatus as it interdigitates with the underlying connective tissue. The epithelium is regenerated at a much slower rate than the remain-

der of the gastrointestinal tract; the newly formed cell in the basal layer of the epithelium reaches the free surface in about 3 weeks after formation. Interspersed within the keratinocytes of the epithelium are antigen-presenting cells, known as Langerhans cells, which phagocytose and degrade antigens into small polypeptides known as epitopes. These cells also synthesize major histocompatibility complex (MHC) II molecules, attach the epitopes to these molecules, and place the MHC II-epitope complex on the external aspect of their plasmalemmae. Langerhans cells then migrate to lymph nodes, where they present the MHC II-epitope complex to lymphocytes. The lamina propria is unremarkable. It houses esophageal cardiac glands, which are located in two regions of the esophagus, one cluster near the pharynx and the other near its juncture with the stomach. It also houses occasional lymphoid nodules, members of the MALT

system. The muscularis mucosae is unusual in that it consists only of a single layer of longitudinally oriented smooth muscle fibers that become thicker in the vicinity of the stomach. The esophageal cardiac glands produce mucus that coats the lining of the esophagus, lubricating it to protect the epithelium as the bolus is passed into the stomach. Because these glands resemble glands from the cardiac region of the stomach, some investigators suggest that they are ectopic patches of gastric tissue[30].

Submucosa

The submucosa of the esophagus houses mucous glands known as the esophageal glands proper. The submucosa of the esophagus is composed of a dense, fibroelastic connective tissue, which houses the esophageal glands proper. The esophagus and the duodenum are the only two regions of the alimentary canal with glands in the submucosa. Electron micrographs of these tubuloacinar glands indicate that their secretory units are composed of two types of cells, mucous cells and serous cells. Mucous cells have basally located, flattened nuclei and apical accumulations of mucus-filled secretory granules. The second cell type is serous cells, with round, centrally placed nuclei. The secretory granules of these cells contain the proenzyme pepsinogen and the antibacterial agent lysozyme. The ducts of these glands deliver their secretions into the lumen of the esophagus. The submucosal plexus is in its customary location within the submucosa, in the vicinity of the inner circular layer of the muscularis externa[30].

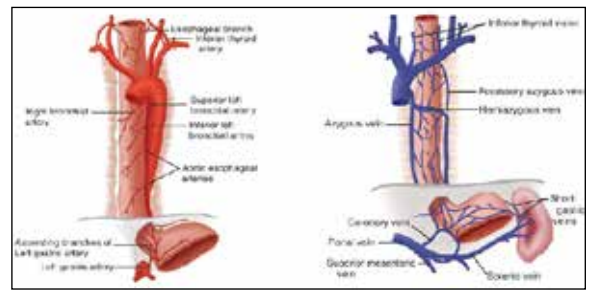
Muscularis Externa and Adventitia

The muscularis externa of the esophagus is composed of both skeletal and smooth muscle cells. The muscularis externa of the esophagus is arranged in two layers, inner circular and outer longitudinal. However, these muscle layers are unusual in that they are composed of both skeletal and smooth muscle fibers. The muscularis externa of the upper third of the esophagus has mostly skeletal muscle; the middle third has both skeletal and smooth muscle; and the lowest third has only smooth muscle fibers. Auerbach's plexus occupies its usual position between the inner circular and outer longitudinal smooth muscle layers of the muscularis externa. The esophagus is covered by an adventitia until it pierces the diaphragm, after which it is covered by a serosa[30].

Endoscopic anatomy

Esophgeal relations are also important when we consider the endoscopic anatomy of the oesophagus. By consensus endoscopic landmarks are identified by their distance in centimeters from the incisor teeth, measured with the flexible videoendoscope. The narrowest point of the oesophagus is its commencement at the level of cricopharyngeus, 15 cm from the central incisors. Further indentations are caused by the aortic arch at 22 cm, the left main bronchus at 27 cm and the diaphragm at 38 cm. All distances vary according to the height of the individual. An enlarged left atrium may also indent the anterior aspect of the lower oesophagus. The gastro-oesophageal junction is defined endoscopically as the upper margin of the proximal gastric folds. On average this is at 37 cm in females and 40 cm in males although it migrates proximally in the case of a sliding hiatus hernia. The squamocolumnar junction is also visible endoscopically as the z-line and usually coincides with the gastro-oesophageal junction, although it may be more proximal in the presence of barrett's oesophagus where there is columnarisation of the lower esophagus[28].

Blood supply : The cervical part, including segment up to arch of aorta is supplied by inferior thyroid arteries. The thoracic part is supplied by oesophageal branches of aorta. The abdominal part is supplied by oesophageal branches of the left gastric artery.



Venous drainage : Blood from upper part of the oesophagus drains into the brachiocephlic veins. From middle part it goes to the azygos veins. From the lower part it goes to the left gastric vein.

Lymphatic drainage : The cervical part drains to deep cervical nodes. Thoracic part drains to posterior mediastinal nodes. Abdominal part drains to the left gastricnodes.

Nerve supply

Parasympathetic nervres : The upper half of oeosophagus is supplied by recurrent laryngeal nerves, and the lower half by the oesophageal plexus formed mainly by the two vagi. Parasympathetic nerves are sensory, motor and secretomotor to the oesophagus.

Sympathetic nervres : For the upper half of the oesophagus the fibers come from the middle cervical ganglion and run on the inferior thyroid arteries. For the lower half the fibers come directly from the upper four thoracic ganglia, and take part in forming the esophageal plexus before supplying the oesophagus. Sympathetic nerves are vasomotor[27,28,29] .

CARCINOMA OF ESOPHAGUS

Background

Esophageal cancer is the fastest growing cancer. It remains the sixth most common malignancy with an incidence of 20 per 100,000 and represents 4% of newly diagnosed cancers. Worldwide, esophageal cancer is even more prevalent, reaching an incidence of 160 per 100,000 in parts of South Africa and China and 540 per 100,000 in Kazakhstan. Squamous cell carcinoma still accounts for most esophageal cancers diagnosed. However in U.S, esophageal adenocarcinoma is noted in up to 70% of patients presenting with esophageal cancer. The distribution of esophageal cancer across gender, age, and race is affected by the cell type. Squamous cell cancer is seen rarely before the age of 30 years, with the highest mortality rates seen among men between ages 60 and 70 years. Adenocarcinoma is seen infrequently before the age of 40 years and increases in incidence with age. Racial discrepancies are observed. Adenocarcinoma is a disease affecting white men, whereas squamous cell carci-

noma predominantly affects Indian and African- American men. 32 Squamous cell carcinomas arise from the squamous mucosa that is native to the esophagus.This type of cancer is due to exposure to environmental factors. Smoking and alcohol both increase the risk for foregut cancers by 5-fold. Combined, the risk increases from 25- to 100-fold. Food additives, including nitrosamines found in pickled and smoked foods, long-term ingestion of hot liquids, and vitamin (vitamin A) and mineral deficiencies (zinc and molybdenum) have been implicated. Other disorders that expose the esophagus to mucosal trauma including caustic ingestion, achalasia, bulimia, tylosis (an inherited autosomal dominant trait), Plummer-Vinson syndrome, external-beam radiation, and esophageal diverticula all have known associations with squamous cell cancer.Once a relatively unusual disease, esophageal adenocarcinoma now increasing in incidence and there are a number of factors that are responsible for this shift in cell type: 1) Increasing incidence of GERD 2) Western diet 3) Increased use of acid-suppression medications.32 Intake of caffeine, fats, and acidic and spicy foods all lead to decreased tone in the LES and an increase in reflux. As an adaptive measure, the squamous-lined distal esophagus changes to become lined with metaplastic columnar epithelium

(Barrett's esophagus). Progressive changes from metaplastic (Barrett's esophagus) to dysplastic cells may lead to the development of esophageal adenocarcinoma. Histologically, esophageal adenocarcinoma arises from one of three places: 1) Submucosal glands of the esophagus 2) Heterotopic islands of columnar epithelium 3) Malignant degeneration of metaplastic columnar epithelium (Barrett's esophagus)32 There are several intrinsic diseases of the esophagus that are considered premalignant. Patients with Plummer-Vinson syndrome, a disease of iron and vitamin deficiency that results in atrophy of the oropharyngeal and esophageal mucosa, have an increased risk for developing squamous cell cancers of the cervical esophagus. Tylosis, an uncommon familial syndrome characterized by thickening of the skin of the soles and palms, has an estimated 40% increased risk for developing squamous cell carcinoma that appears to be genetically linked. Achalasia, a disorder of esophageal motility is associated with a 16-fold increased risk for squamous cell cancer in late-stage disease. Both esophageal strictures and diverticula have been reported to be associated with a small but increased risk for esophageal cancers. Patients with aerodigestive tract cancers are also at an increased risk for developing esophageal squamous tumors. Barrett's esophagus, or metaplastic columnar epithelium in the esophagus, is associated with a 40-fold increased risk for adenocarcinoma of the esophagus. No specific infectious agents have been identified as a cause of esophageal cancer, but many remain under investigation. Genetic alterations accounting for cellular and molecular changes (as in the *p53* gene) have been associated with an increased risk for esophageal cancer. Regardless of the cell type, esophageal cancer asserts aggressive biologic behavior. With only two layers to the esophageal wall, tumors rapidly infiltrate through the muscular wall into surrounding structures. The rich vascular and lymphatic supply facilitates spread to regional lymph nodes. Advanced disease is common at the time of presentation and contributes to the high mortality rate. Spread of disease follows lymphatic drainage patterns so that drainage tends to be to local, regional, and then to distant lymph node beds[32].

Clinical presentation

The symptoms of esophageal cancer vary with the stage of the disease. Early-stage cancers may be asymptomatic or mimic symptoms of GERD. Heartburn, regurgitation, and indigestion are symptoms of reflux, but cancer may be lurking within. Most patients with esophageal cancer present with dysphagia and weight loss. These symptoms usually indicate advanced disease. Because of the distensibility of the esophagus, a mass can obstruct two thirds of the lumen before symptoms of dysphagia are noted. Furthermore, the symptoms of dysphagia and weight loss may be slowly progressive and well compensated for over a period of months. It is not until the esophageal lumen is narrowed from an average of 24 mm to 12 mm that dysphagia is noted. Many patients will be symptomatic before narrowing occurs to this degree, but medical treatment is often not sought until the symptoms are disabling. Effortless weight loss is welcomed by most, although its true significance goes unappreciated. Choking, coughing, and aspiration from a tracheoesophageal fistula, as well as hoarseness and vocal cord paralysis from direct invasion into the recurrent laryngeal nerve, are ominous signs of advanced disease. Systemic metastases to liver, bone, and lung can present with jaundice, excessive pain, and respiratory symptoms[32].

Diagnosis and Management

There are variuos modalities available to diagnose and stage esophageal cancer. Radiologic tests, endoscopic procedures, and minimally invasive surgical techniques all add value to a solid staging workup in a patient with esophageal cancer[32].

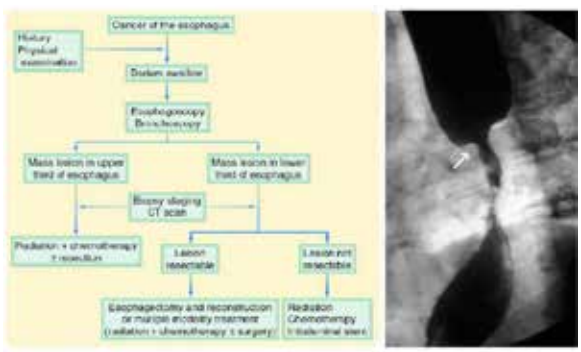


Fig 1: Management algorithm for cancer of the esophagus. CT, computed tomography.

Fig 2: Double-contrast barium swallow shows abrupt shouldered narrowing (*arrow*) at the transition between normal-appearing esophagus and the esophageal cancer.

Esophagram

A barium esophagram is recommended for any patient presenting with dysphagia. The esophagram gives an overview of anatomy and function. It is able to differentiate intraluminal from intramural lesions and to discriminate between intrinsic (from a mass protruding into the lumen) and extrinsic (from compression of a structures outside the esophagus) compression. The classic finding of an apple-core lesion in patients with esophageal cancer is recognized easily (Fig.). Although esophagram will not be specific for cancer, it is good first test to perform in patients presenting with dysphagia and a suspicion of esophageal cancer[32].

Endoscopy

The diagnosis of esophageal cancer is made best from an endoscopic biopsy. During endoscopy, it is critical to document the following:

1. Location of the lesion (with respect to distance from the incisors)
2. Nature of the lesion (friable, firm, polypoid)
3. Proximal and distal extent of the lesion
4. Relationship lesion to cricopharyngeus muscle, the GEJ, and the gastric cardia

Each of these points is important in the management of esophageal cancer and helps to guide surgical therapy. Incontrovertibly, any patient undergoing surgery for esophageal

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cancer must have an endoscopy performed by the operating surgeon before entering the operating room for a definitive resection[32].

Computed Tomography

There are additional diagnostic modalities that are used for accurate staging. A CT scan of the chest and abdomen is important to assess the length of the tumor, thickness of the esophagus and stomach, regional lymph node status (including cervical, mediastinal, and celiac lymph nodes), and distant disease to the liver and lungs. It is also helpful in determining T4 lesions where the lesion is invading surrounding structures. It may identify a fistula or other anatomic variations such as a deviated trachea. Its accuracy is only 57% for T staging, 74% for N staging, and 83% for M staging. Many unresectable tumors by CT scan are deemed resectable at the time of surgery. It is an important piece of diagnostic workup, but its findings must be interpreted judiciously and only as a part of the total picture[32].

Positron Emission Tomography

A positron emission tomography (PET) scan evaluates the primary mass, regional lymph nodes, and distant disease (Fig.). Its sensitivity and specificity slightly exceed those of CT; however, they remain low for definitive staging. The sensitivity and specificity of PET for evaluating metastatic disease are as high as 88% and 93%, respectively. For evaluation of lymph node disease, PET has a sensitivity (72%), specificity (86%), and accuracy (76%) on par with what CT can offer. As with CT, the ability of PET to evaluate local and regional lymph node disease is dependent on the location of the tumor, the size of the lymph node, and technique of the scanner. Although its role is evolving, PET appears to be an important piece of the diagnostic workup but is not reliable enough as a single diagnostic modality[32].

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is not performed routinely and adds to the staging of esophageal cancer in few circumstances. To identify involvement of vascular and neural tissues, MRI is helpful. It can accurately detect T4 lesions and metastatic lesions in the liver; however, it overstages T and N status with only 74% accuracy.

Endoscopic Ultrasound

EUS is the most critical component of esophageal cancer staging. The information obtained from EUS will help guide both medical and surgical therapy. The experienced endoscopic ultrasonographer can identify the depth of the tumor, the length of the tumor, the degree of luminal compromise, the status of regional lymph nodes, and involvement of adjacent structures. In addition, biopsy samples can be obtained of the mass and lymph nodes in the paratracheal, subcarinal, paraesophageal, celiac, lesser curvature, and gastrohepatic regions. EUS tends to overstage T status and understage N status. The accuracy of EUS for T staging correlates directly with increasing T stage. For T1 lesions, EUS is 84% accurate, and it approaches 95% accuracy in estimating T4 lesions. Size and location of the lymph node influence the accuracy, so that lymph nodes smaller than 1 cm tend to be less accurately evaluated. The overall sensitivity (78%) and specificity (60%) of EUS for evaluating lymph nodes are poor but improve dramatically for evaluating celiac lymph nodes, for which the sensitivity and specificity are 72% and 97%, respectively[32].

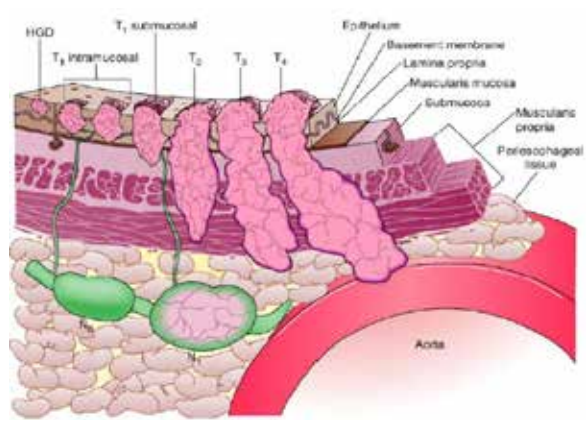
Staging

The staging of esophageal cancer has morphed through a variety of systems and remains controversial. The American Joint Committee on Cancer (AJCC) staging criteria were instituted in 1988 and are currently the most widely adopted staging system (Table). The AJCC classification uses the TNM (tumor, lymph node, metastasis) system to stratify patients and estimate prognosis. In the AJCC system, the T represents the depth of the tumor (T1, submucosal; T2, muscularis propria; T3, adventitia; T4, surrounding structures), the N represents involvement of lymph nodes (N0, none; N1, any), and the M represents metastatic disease to nonregional lymph nodes or distant sites (M0, none; M1a, regional lymph nodes; M1b, distant lymph nodes) [32].

Table -- Tumor-Node-Metastasis (TNM) Staging of Esophageal Carcinoma

T: Primary Tumor	
Tx	Tumor cannot be assessed
T0	No evidence of tumor
Tis	High-grade dysplasia
T1	Tumor invades lamina propria, muscularis mucosae, or submucosa; does not breach the submucosa
T2	Tumor invades into but not beyond the muscularis propria
T3	Tumor invades the paraesophageal tissue but does not invade adjacent structures
T4	Tumor invades adjacent structures
N: Regional Lymph Nodes	
Nx	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastases
N1	Regional lymph nodes metastases
M: Distant Metastases	
Mx	Distant metastases cannot be assessed
M1a	Upper thoracic esophageal lesion metastatic to cervical lymph nodes
	Midthoracic esophageal lesion metastatic to mediastinal lymph nodes
	Lower thoracic esophageal lesion metastatic to celiac lymph nodes
M1b	Upper thoracic esophageal lesion metastatic to mediastinal or celiac lymph nodes
	Midthoracic esophageal lesion metastatic to cervical or celiac lymph nodes
	Lower thoracic esophageal lesion metastatic to cervical or upper mediastinal lymph nodes

STAGE GROUPINGS	T	N	M
Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage IIA	T2	N0	M0
	T3	N0	M0
Stage IIB	T1	N1	M0
	T2	N1	M0
Stage III	T3	N1	M0
	T4	Any N	M0
Stage IVA	Any T	Any N	M1a
Stage IVB	Any T	Any N	M1b



Treatment

Traditionally, staging systems have been used to guide therapy and assess longterm outcomes. As technology, medical therapy, and knowledge of the biology of tumors continue to advance, staging systems are changing and becoming less functional. When a patient presents with esophageal cancer, the following variables are considered: 1) Histology, location, and local extent (depth of invasion) of primary tumor 2) Status of the local and regional lymph nodes 3) Presence of distant lymph nodes

or systemic disease 4) Overall condition of the patient (including nutritional status and ability to swallow) 5) Intended goal of treatment—curative or palliative. Histology, Location and Local Extent of the Primary Tumor : There are two predominant cells types of esophageal cancer: adenocarcinoma and squamous cell carcinoma. Worldwide, it is squamous cell cancers that dominate than adenocarcinoma . The histology of the tumor is important because it guides treatment in two ways: (1) squamous cell tumors are more sensitive to chemoradiotherapy and are treated aggressively with nonsurgical therapy; (2) adenocarcinomas are not as sensitive to chemoradiotherapy and are often imbedded in long segments of Barrett's esophagus, necessitating a more aggressive surgical approach. Patients with squamous cell tumors may achieve a complete response to chemoradiotherapy, making the need for surgical intervention uncertain and not very compelling. However, most of the literature supports multimodality therapy for treatment of squamous cell tumors. Surgery is strongly advocated for most patients with adenocarcinoma because a complete response to chemotherapy is seen only 25% of the time in this cell type. The location of the tumor also directs the management of esophageal cancer. Eight percent of all esophageal tumors present in the cervical esophagus and are almost always squamous cell cancers. These tumors may be locally aggressive and are managed with chemoradiotherapy followed by segmental resection of the cervical esophagus. Upper and mid thoracic tumors account for 3% and 32% of esophageal tumors, respectively, and may be either squamous cell cancers or adenocarcinomas. Near-total esophagectomy through a thoracotomy is usually required to remove all the disease in this part of the esophagus. The remaining tumors are found in the lower esophagus (25%) and the cardia of the stomach (32%) and tend to be adenocarcinomas. Distal esophagectomy (through a transabdominal or transthoracic approach) in patients with no known Barrett's esophagus or total gastrectomy in those with Barrett's esophagus is appropriate for early disease. Near-total esophagectomy (through a transhiatal or transthoracic approach) is recommended for patients who have tumors within segments of Barrett's esophagus or tumors of considerable length. The depth of invasion of a tumor, the T status, is another important variable in determining stage and treatment of esophageal cancer. T1 lesions are divided into intramucosal and submucosal lesions that are associated with lymph node metastasis 18% and 50% of the time, respectively. Conservative esophageal resections, such as vagal-sparing, transhiatal, or minimally invasive esophagectomy, are recommended for any T1 lesion. There is almost no role for chemoradiotherapy in the treatment of T1 lesions. Surgical or endoscopic resection alone carries a good long-term survival, as high as 88% in some series. Treatment of lesions that extend into the muscularis propria, T2 lesions, remains controversial. The rate of lymph node metastasis is up to 60%, making the need for chemoradiotherapy or a radical lymphadenectomy actively debated. Aggressive surgical resection stands alone well, but outcomes may improve if chemoradiotherapy is added. Advocates of a less invasive resection for T2 lesions argue that the transhiatal resection obtains an adequate radial margin with less morbidity. Treatment of lesions that extend into the adventitia, T3 lesions, usually includes chemoradiotherapy and surgery. Radiation therapy controls the primary tumor and may reduce the extent of surgical resection margins. Chemotherapy controls tumor spread to local and regional lymph nodes that occurs up to 80% of the time with T3 lesions. Neoadjuvant chemoradiotherapy followed by surgery may improve survival for T3 lesions with known lymph node involvement but adversely affects surgical morbidity and mortality. Lesions that extend beyond the adventitia, T4 lesions, require aggressive multimodality therapy. Neoadjuvant chemoradiotherapy followed by surgical resection removing all tissues involved with tumor is recommended. Lesions with any known lymph node disease are not considered for surgical resection and are treated definitively with chemoradiotherapy.32 Status of the Local and Regional Lymph Nodes : The status of local and regional lymph nodes is critical information needed to guide treatment for esophageal cancer. There are two factors that influence the probability of involved local and regional lymph nodes: location of the tumor within the esophagus and depth of tumor penetration (T stage). Lesions located in the cervical esophagus most often drain to cervical and mediastinal lymph nodes (46% of the time) and less often to abdominal lymph nodes (12% of the time). In contrast, midesophageal tumors drain most often to mediastinal lymph nodes (53% of the time) and abdominal lymph nodes (40% of the time) and less often to cervical lymph nodes (29% of the time). Not surprisingly, lower esophageal and cardia tumors most often drain into abdominal and mediastinal lymph nodes (74% and 58% of the time, respectively) and less often to cervical lymph nodes (27% of the time). Involved lymph nodes that reside next to the primary tumor are considered local, whereas those that reside one nodal basin away from the primary tumor are considered regional lymph nodes. Patients known to have involved local or regional lymph nodes remain acceptable surgical candidates but also need chemotherapy to address involved lymph nodes[32].

The depth of tumor penetration (T stage) affects lymph node involvement (LNI) in the following manner: intramucosal T1 lesions (18% LNI), submucosal T1 lesions (55% LNI), T2 lesions (60% LNI), and T3 lesions (80% LNI). Patients who are at low risk (<50% LNI) for regional lymph node involvement are not given chemotherapy and are not likely to benefit from a radical lymphadenectomy. Conservative esophageal resections such as the vagal-sparing, transhiatal, or minimally invasive esophagectomy with a limited lymph node dissection are adequate for these patients. If the surgical specimen reveals involvement of lymph nodes, adjuvant chemotherapy is given in an attempt to treat regional and possible distant lymph nodes that may be involved. Patients who are at risk (>50% LNI) for regional lymph node involvement are given neoadjuvant chemotherapy followed by esophageal resection. Advocates of aggressive surgical resection with en bloc esophagectomy and radical lymphadenectomy argue that patients at risk for regional or distant lymph node metastasis can be cured with surgery alone and do not require adjuvant chemotherapy. Advocates of neoadjuvant therapy and conservative esophageal resection without a radical lymphadenectomy argue that even with meticulous surgical technique, it is not possible to remove every last lymph node. Instead, chemotherapy for treatment of nodal disease is recommended, not radical lymphadenectomy[32].

Evidence of Distant Lymph Node or Systemic Disease : A lymph node that is more than one nodal basin away from the primary tumor is considered a distant lymph node. If a distant lymph node is involved with tumor the patient is considered to have advanced disease. Patients presenting with involved distant lymph nodes or metastatic disease are treated with definitive chemoradiotherapy. If advanced disease is found at the time of surgery, resection is aborted, and a feeding jejunostomy tube is placed. Palliative resection may be considered if a patient with complete obstruction desires alimentary continuity to facilitate eating.

Condition of the Patient: It is well established that age, comorbidities, and nutritional status affect the ability of many patients to tolerate treatment for esophageal cancer. Although age alone is not a barrier to treatment, in the face of advanced disease, it may alter the choice of therapy. Patients older than 75 years have a higher operative risk and a shorter life expectancy, so that aggressive surgical intervention is rarely indicated. Regardless of age, patients must be carefully evaluated for underlying cardiac, pulmonary, endocrinologic, hepatic, and renal conditions that can affect their ability to undergo surgical resection. Preoperative tests to assess cardiopulmonary status, including

a pulmonary function test (PFT) and a cardiac stress test, are imperative. There are no absolute contraindications to surgical resection; however, it is reserved for those in a reasonable state of health. Many patients presenting with esophageal cancer have been nutritionally depleted for some time. More than a 10% weight loss is associated with a significant increase in operative morbidity and usually correlates well with the advanced nature of the disease. Patients presenting with a serum albumin of less than 3.4 g/dL have an increased risk for surgical complications, including anastomotic breakdown. In patients who are otherwise fit and eligible to undergo surgical resection, efforts are directed toward improving nutritional status before surgery by placing a stent or feeding jejunostomy tube. Preoperative efforts toward improving nutrition will be rewarded. Treatment Intended to Be Curative or Palliative : Determining the appropriate treatment for a patient with esophageal cancer is multidimensional and complex. Upon evaluating the variables as outlined in this section, the final decision to make is whether or not a curative or palliative treatment program is in the patient's best interest. To properly inform and help guide patients in this difficult decisionmaking process, all consultants need to provide expert opinions if indicated before a surgical recommendation is made. Pulling all the pieces together—depth, location and type of tumor, lymph node and distant organ involvement, nutritional status, and underlying medical condition of the patient—a curative or palliative treatment plan can be created.

Treatment for Cure: Fewer than half of patients presenting with esophageal cancer are eligible for surgical resection. In patients for whom a cure is possible, treatment may include chemotherapy, radiation therapy, surgical resection, or a combination of these modalities. In patients with local tumor that does not involve other vital structures, who bear no evidence of distant disease, and whose clinical and nutritional status are adequate, curative treatment is implemented. Those patients with significant comorbidities, evidence of advanced or distant disease, or poor nutritional status are considered for palliation. Using the AJCC staging system, surgery is considered for any patient presenting in stage 1 through stage 3. Patients with stage 4 cancer are recommended to undergo definitive treatment with chemoradiotherapy. Although controversy surrounds both the medical and surgical treatment of esophageal cancer, there are some general guidelines upon which most physicians will agree. The treatment for patients presenting with stage I cancer, T1 N0, is surgical resection only. If the surgical specimen reveals more advanced disease, adjuvant chemotherapy is considered. The treatment of patients presenting with stage II disease (T2 Nx, T3 N0) is the most controversial. Surgical resection is indicated, but opinions vary as to the type of surgical resection that is best and if there is a need for chemotherapy. If chemotherapy is recommended, it is given in the neoadjuvant setting. Treatment of patients presenting with stage III disease (T3 N1, T4 N0) is also debated, but a little less so. Most physicians agree that multimodality therapy is needed, but the timing and type of surgical resection remains unresolved. Advocates of aggressive surgical resection (three-field en bloc esophagectomy with a radical thoracic and abdominal lymphadenectomy) stand in opposition to those who advocate multimodal therapy with neoadjuvant chemoradiotherapy followed by a more conservative surgical approach (transhiatal or transthoracic esophagectomy). Scientific evidence supporting the benefit of one over the other is lacking[32].

Chemotherapy

The concept that tumors begin in a particular location and spread by vascular and lymphatic channels is accepted. In the earliest days of treatment, the only chance for cure was surgical excision of the primary tumor and regional tissues that may be involved. With the advent of chemotherapy, the management of cancer has changed dramatically, with surgery playing a less aggressive role. However, in the case of many cancers for which surgery is no longer a central theme, the chemotherapy that is available to treat those tumors is effective and able to control and often eradicate both local and distant tumor. Unfortunately, in esophageal and gastric tumors, this is not the case. Although some improvements have been made, chemotherapy for gastric and esophageal cancers remains poor for control of both local and distant disease. The best complete response rate for adenocarcinomas is 25% when chemotherapy is given in combination with radiation. Squamous cell cancers respond more favorably than adenocarcinomas, but without surgery or radiation therapy, chemotherapy is limited in its ability to achieve a cure. However, the addition of radiotherapy to a neoadjuvant chemotherapeutic regimen has shown a slight improvement in long-term survival. The type of chemotherapy used is dependent on a number of factors: mechanism of action, drug side effects, and drug cost all play a role. There are six major categories of chemotherapeutic agents as defined by their mechanism of action that are used in esophageal cancers. The response to single-agent therapy (20%-30%) is lower than with combination therapy (45%-55%), and the response of metastatic disease (25%-35%) is lower than that of locoregional disease (45%-75%). Since its introduction in 1980, cisplatin has emerged as the cornerstone of combination therapy in esophageal cancer. As a single agent, it has a response rate of 25% to 30%. Given in combination with 5-fluorouracil, a response rate of 50% may be achieved, and this is an established chemotherapeutic regimen for esophageal cancer. Administered once a week over a period of 2 to 10 weeks, up to eight cycles of chemotherapy are infused. Neoadjuvant treatment is usually limited to four cycles, whereas definitive therapy can be administered up to 3 months if the patient tolerates the side effects. The addition of a third agent, including (but not limited to) mitomycin C, etoposide, or paclitaxel, is gaining favor and showing some improvement in locoregional control and short-term survival[32].

Radiation Therapy

Radiation therapy is used to control the tumor locally but is rarely administered alone. Given as definitive treatment, a total dose of 6000 to 6400 cGy in 180 to 200 cGy fractions is given 5 days a week for a period of 6 to 7 weeks. Studies have demonstrated that there is no survival benefit to neoadjuvant radiotherapy alone; however, in combination with chemotherapy, a trend toward improved survival is noted. A neoadjuvant regimen that is showing some promise is induction cisplatin and paclitaxel followed by combination chemoradiotherapy with 5-fluorouracil, cisplatin, and paclitaxel and 4500 cGy of external-beam radiation. When followed by surgical resection, the 2-year survival approaches 76% for stage II and III esophageal adenocarcinomas. Neoadjuvant radiation must be limited to 4500 cGy to avoid the surgical morbidity associated with extensively radiated tissue beds. Injury to the airway and great vessels and poor tissue healing are associated with high-dose radiation. Preserving the gastric conduit for replacement of the esophagus is critical and is kept in consideration as the radiation field is prepared[32].

Surgical Resection

There are a plethora of esophageal resections that are used to treat esophageal cancer, and no one technique has established dominance. In contrast, with better understanding of tumor biology, improved chemotherapy, and advanced technology, more surgical techniques are emerging. There are several factors that affect surgical decision making and subsequent operative and long-term outcomes:

1) Location of the tumor 2) Surgical approach 3) Location of the anastomosis 4) Anastomotic technique 5) Type of replacement conduit 6) Position of the conduit[32]

Location of the Tumor: Approach to Cervical Tumors Most tumors of the upper esophagus above the level of the carina are

squamous cell carcinomas. Surgical excision with immediate reconstruction significantly improves survival over radiation therapy alone for patients with upper esophageal tumors. Every attempt is made to stage these tumors properly because invasion into the trachea, vocal cords, or recurrent laryngeal nerves or positive surgical margins significantly alter outcomes. Tumors that do not invade the trachea, spine, larynx, or vessels are resected primarily. Tumors adjacent to the cricopharyngeus muscle or the larynx are treated with two to three cycles of chemotherapy and up to 3500 cGy before surgical resection. To be sure that the tumor is resectable, surgery is initiated with endoscopy, bronchoscopy, and cervical exploration. Interval resection of tumor and esophagus with forearm free-graft reconstruction or

transhiatal esophagectomy with a gastric pull-up may then be performed. Lesions that extend into the thoracic inlet are treated with a near-total esophageal resection through the transhiatal or transthoracic approach to ensure a safe and complete resection. Under these circumstances, a gastric conduit is used. In circumstances in which it is not available or offers inadequate length, alternative conduits are considered.

Approach to Thoracic and Cardia Tumors

There are a variety of surgical resections for tumors of the thoracic esophagus and cardia. The transhiatal esophagectomy (THE), the transthoracic esophagectomy (TTE), the three-field en bloc esophagectomy (EBE), the vagal-sparing esophagectomy (VSE), and the minimally invasive esophagectomy (MIE) are all applied. They vary with regards to size and number of incisions, location of the anastomosis, extent of lymphadenectomy, need for a pyloroplasty and preservation of the vagus nerves. They each have distinct advantages and disadvantages and the risks and benefits remain aggressively debated.

Surgical Approaches :

1) Transhiatal Esophagectomy

The transhiatal esophagectomy has gained popularity in the past 20 years. It was developed to reduce the morbidity from respiratory failure and intrathoracic leak that is associated with transthoracic esophageal resections. The transhiatal resection requires two incisions: left neck and abdomen. The stomach and esophagus are mobilized through an upper midline abdominal incision, avoiding a thoracotomy. Mobilization of the esophagus is done blindly with manual manipulation through a widened hiatus. The stomach is tubularized and gently passed through the posterior mediastinum, and a cervical esophagogastric anastomosis is performed. Accessible lymph nodes in the neck, lower chest, and abdomen are removed, but there is no additional attempt to perform an extensive lymphadenectomy. There are several distinct advantages and disadvantages to THE. Advantages include a decreased anastomotic leak rate, a less morbid cervical leak if a leak does occur, and a lower mortality rate that compares favorably against the higher rates seen with TTE. Reduced operative times, less blood loss, and fewer cardiorespiratory complications have all been reported with THE. Disadvantages include a higher rate of postoperative strictures, injury to great vessels, and airway structures secondary to a blind transhiatal dissection, and an inability to perform a complete lymph node dissection. Despite these disadvantages, the literature supports that THE remains the safest esophageal resection[32].

2) Transthoracic Esophagectomy

TTE was the first operation designed to resect the diseased esophagus with the intent of curing cancer. The procedure requires two incisions: right chest and abdomen. Surgery is initiated through an upper midline laparotomy incision. After the stomach and lower esophagus are mobilized, a feeding jejunostomy tube is placed, and the patient is repositioned on the left side. A thoracotomy incision is made, and the esophagus is mobilized. The esophagus is transected at the level of the azygos vein, and an intrathoracic esophagogastric anastomosis is performed. No additional attempt is made to perform a radical lymphadenectomy or preserve an additional envelope of tissue around the tumor bed. The risks and benefits of the transthoracic resection are well established. The overall morbidity and mortality rates are slightly higher than seen with THE. The morbidity includes pneumonia, effusions, respiratory failure, atrial fibrillation, and myocardial ischemia. Because of the improved blood supply to the midstomach where the anastomosis is placed, the rate of anastomotic leak is the lowest of all esophageal resections. When an anastomotic leak does occur, it may be difficult to control and lead to an intrathoracic infection, sepsis, and death. Significant reflux may occur in patients that have undergone a transthoracic resection and in the face of Barrett's esophagus may lead to the development of recurrent disease and metachronous cancers[32].

3) En Bloc Esophagectomy

EBE is an aggressive resection that aims to achieve an R0 resection. The key components of the EBE that separate it from the other esophageal resections are the addition of a radical thoracic and abdominal lymphadenectomy and a wide local resection of tissues enveloping the tumor. It is the most extensive of all esophageal resections and requires three incisions: left neck, right chest, and abdomen. Surgery is initiated through a right thoracotomy incision. The healthy tissues surrounding the esophagus are mobilized so that the tumor bed is not disturbed. The venous and lymphatic vessels, including the azygos, hemiazygos, and intercostal veins, are ligated and divided and removed en bloc with the specimen. A radical thoracic lymphadenectomy is performed, and all mediastinal (including the right paratracheal, subcarinal, paraesophageal, and right and left inferior pulmonary ligament nodes) and diaphragmatic lymph nodes, as well as the lymphatic tissues associated with the thoracic duct, are removed. An upper midline abdominal incision is made, and the stomach is mobilized. A radical abdominal lymphadenectomy is performed that includes removal of paracardial, left gastric, portal, common hepatic, celiac, splenic, and lesser and greater curvature lymph nodes. The gastric conduit is brought up through the posterior mediastinal space, and a cervical esophagogastric anastomosis is performed. Most postoperative complications are pulmonary[32].

4) Vagal-Sparing Esophagectomy

It is similar to the transhiatal resection facilitating a limited nodal dissection and is advocated for treatment of intramucosal tumors. The technique varies from THE only in the method of removing the esophagus without severing the vagus nerves. The esophageal resection is performed by stripping the esophagus away from the vagus nerves, performing a highly selective vagotomy, and preserving the function of the pylorus so that a pyloroplasty is not needed. It can be done using minimally invasive techniques. Results show improved gastric function over esophageal resections that include a vagotomy and pyloroplasty. Incomplete resection of the esophagus is a concern, especially if multiple biopsies have been performed and scarring or tethering to surrounding structures has occurred. The morbidity and mortality are otherwise comparable to THE[32].

5) Minimally Invasive Esophagectomy

In the past 10 years, MIE has gained popularity. Thoracoscopy or transcervical mediastinoscopy are substituted for a thoracotomy, whereas laparoscopy is substituted for a laparotomy. The short-term outcomes have shown that the thoracoscopic-laparoscopic technique is safe and effective and offers comparable results to THE dissection with the benefits of less pain and a shorter hospital stay.

Although these minimally invasive approaches are not aimed at achieving a radical resection, a recent study demonstrated the

attempt of a hand-assisted minimally invasive approach to a radical thoracic lymphadenectomy. As these techniques are refined and taught in surgical training programs, the learning curves will fade, and the long-term outcomes will be established[32].

Location of the Anastomosis

Although the location of the anastomosis is determined by the type of surgical resection performed, the success of the anastomosis is not. As with any gastrointestinal anastomosis, good blood supply and a tension-free repair will result in success. In esophageal surgery, this is often difficult to ensure. Patients who have comorbid conditions such as diabetes, hypertension, or a history of tobacco abuse have compromised microvascular circulation that may affect the viability of the gastric conduit. In addition, radiation injury induces vascular changes that prevent proper tissue healing. An intrathoracic esophagogastric anastomosis has a slightly better chance of healing. The cervical gastroesophageal anastomosis, on the other hand, is fraught with the dangers of necrosis of the tip of the tubularized stomach due to compromised blood flow from compression of the conduit in the mediastinum. Anastomotic leaks that occur before 48 hours are due to graft ischemia as a consequence of inadequate arterial blood supply to the graft. Leaks that occur from 7 to 9 days are due to graft ischemia as a consequence of venous compromise. A reduction of cervical anastomotic leaks has occurred with newer anastomotic and reconstructive techniques[32].

Anastomotic Technique

There are two techniques for performing an anastomosis: hand sewn and stapled. A hand-sewn anastomosis is performed using a single-layer of interrupted 4-0 absorbable suture. The stapled anastomosis uses a linear stapling device to create the posterior layer and a hand-sewn or stapled technique to complete the anterior layer. The stapled technique has been shown to reduce the rate of postoperative strictures and cervical anastomotic leaks. If an intrathoracic anastomosis is required, an end-to-end anastomosis may be accomplished by a hand-sewn technique or a stapled technique with equivalent postoperative results[32].

Replacement Conduits

There are several methods for re-establishing gastrointestinal continuity after esophageal resection for cancer. In most cases, the stomach can be used and is the conduit of choice. Short interpositions can be accomplished with either a free jejunal flap or a free forearm graft. The vascularity of the free flap is maintained with a microvascular anastomosis to the internal mammary artery and vein or available cervical vessels. For longer segments, a supercharged jejunal (pedical flap with an additional microvascular anastomosis) and colonic interposition are both good alternatives. Over time, long segments of jejunum or colon may assume a sigmoidal shape in the distal portions of the graft and result in obstructions that often require surgical revision. With the exception of the gastric pull-up, all conduits require an additional enteroenteric anastomosis, which increases the risk for leaks and subsequent morbidity[32].

Conduit Position

There are several routes along which the replacement graft may be placed: subcutaneously, substernally, in the right pleural space, or in the posterior mediastinum. The posterior mediastinal space is the shortest route between the stomach and the cervical esophagus, but it is often inaccessible. Patients undergoing resection of the esophagus with immediate reconstruction will have an opened posterior mediastinal space, which should be amenable to placement of any type of replacement conduit. A substernal route is preferred if there is evidence of fibrosis or tumor in the posterior mediastinum. It is a slightly longer route, and there is a small decrease in function over the posterior mediastinal route, but overall, a conduit in the substernal position has good functional results. The subcutaneous route is also an option, although it is cosmetically unappealing and functionally challenged. It also requires a slightly longer conduit and is used only as a last resort. A gastric pull-up in the posterior mediastinal position has the best functional result, and every effort is made to preserve and use this successful combination[32].

Treatment for Palliation

Palliative measures include chemotherapy, radiation therapy, photodynamic therapy, laser therapy, esophageal stenting, feeding gastrostomy or jejunostomy, and esophagectomy. These measures are aimed at either reducing tumor burden or restoring nutritional access and should be considered in any patient who either has no chance for cure or would not withstand the rigors of treatment for cure. Chemotherapy will treat systemic disease and help reduce the overall tumor burden. However, it usually needs to be given in combination with radiation therapy so that control of the local tumor is obtained. Percutaneous dilational tracheostomy (PDT) is an alternative palliative treatment that provides relief from dysphagia for an average of 9.5 months. Endoscopic laser therapy is an additional palliative measure that may be employed. It is effective in restoring luminal patency with low morbidity and mortality rates (<5%). Endoscopy with dilation and stent placement maintains patency of the lumen enough to handle swallowed saliva.[41] The patient is counseled for an esophagectomy before dilation because perforation occurs up to 10% of the time. A feeding tube may still be needed to restore nutritional access. The average survival after placement of a palliative stent is less than 6 months. Many patients are interested in nontraditional treatment options such as herbal medicines, acupuncture, and chelation therapy. Some, such as acupuncture, may offer some palliation to pain, whereas others, such as herbal remedies, help to abate side effects from conventional medical treatment. There is limited scientific understanding of the plethora of alternatives that are available, and their use must be encouraged with caution[32].

Transhiatal Esophagectomy (Orringer's 2 phase approach)[33]

Introduction :

The surgical trauma of the transhiatal approach is less pronounced as compared to transthoracic approach. On the other hand, the lymphatic clearance is less radical, at least for the mid and upper mediastinum. This is the reason why some surgeons are in favor of the transthoracic approach even for distal adenocarcinoma. Subtotal transhiatal esophagectomy is indicated for benign conditions and for distal carcinoma[33].

Indications :

- Adenocarcinoma of distal esophagus (>T1 stage)
- Intraepithelial squamous cell neoplasia
- Poor risk patients
- Extensive stricture (stenosis) due to erosion (chemical burns) unresponsive to nonsurgical treatment including bougienage
- Extensive peptic stricture (stenosis)
- Relapse of megaesophagus after surgical repair of cardiospasm combined with peptic strictures and failure of dilatation
- Extensive benign esophageal tumors (exceptional cases, usually local excision)
- Esophageal rupture or iatrogenic perforation with mediastinitis (primary repair not feasible)

Contraindications

- Florid gastroduodenal ulcer
- Infiltration of aorta
- Distant metastasis

Preoperative Investigation/Preparation for the Procedure :

History: Previous gastric or colonic surgery

Risk factors: Alcohol, nicotine, gastroesophageal reflux disease (GERD), Barrett's esophagus

Clinical evaluation: Recurrent laryngeal nerve status, cervical

lymphadenopathy

Laboratory tests: CEA, liver function tests, coagulation test

Endoscopy: Esophagogastroduodenoscopy with biopsy to exclude gastric infiltration

Colonoscopy: If colonic interposition is likely

CT scanning Staging (thorax + abdomen):

Abdominal ultrasound: Staging

Esophageal endosonography: Staging, r/o aortic infiltration

Bronchoscopy : (if tumor is r/o bronchial infiltration localized in mid-third)

Bowel cleansing: (If colonic interposition is likely)

Respiratory therapy

Procedure
Access : Upper midline laparotomy.

STEP 1: Laparotomy and inspection of the stomach, distal esophagus, liver and regional lymph nodes. Placement of self-retaining retractor system for exposure of the epigastric region (**A**). Mobilization of the left lateral liver by transection of the left triangular ligament. To prevent injury of adjacent structures, a pack is placed under the left lobe of the liver.

Fig. shows patients position in THE and vertical anterior abdominal wall incision

STEP 2 : Preparation and mobilization of the stomach with epigastric lymphadenectomy including para-aortic lymphatic tissue. Dissection of the greater curvature is commenced from below, thoroughly sparing the origin of the right gastroepiploic vessels and the arcade between left and right gastroepiploic vessels up to the level of the splenic hilum (**C**). Dissection of the greater curvature is continued towards the spleen. The left gastroepiploic artery is transected directly at its origin at the splenic artery. Transection and ligature of the short gastric vessels is performed, thus mobilizing the fundus and the greater curvature completely. For esophageal carcinoma the parietal peritoneum is incised at the upper pancreatic margin and lymphadenectomy is begun along the splenic artery. The flaccid part of the lesser omentum is dissected. The cranial part of the hepatogastric ligament (hepatoesophageal ligament) is dissected from the diaphragm. An accessory left liver artery with strong caliber should be preserved. In this case the left gastric artery has to be diverted distally to the origin of this accessory liver artery .

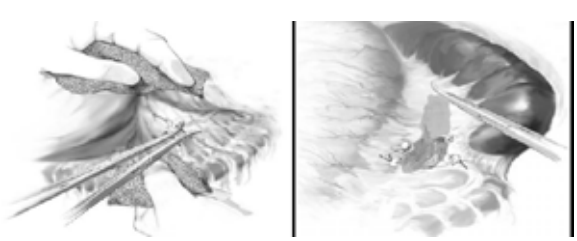


Fig. C FIg.D

Lymphadenectomy of the hepatoduodenal ligament is performed. Remove all lymphatic tissue around the hepatic artery up to the celiac trunk, of the portal vein and as well as the lymphatic tissue around the common bile duct. Ligature and diversion of the right gastric artery are carried out close to its origin below the pylorus (**EC-1, C-2**). Transection of the left gastric artery. All lymph nodes along the left gastric artery, the splenic artery, the common hepatic artery, the celiac trunk, and para-aortic lymph nodes are removed (**F**). In benign diseases, blunt dissection of the esophagus is performed without lymphadenectomy. The right gastric artery may be ligated below the pylorus. The blood supply of the gastric tube after preparation is exclusively provided by the right gastroepiploic artery.

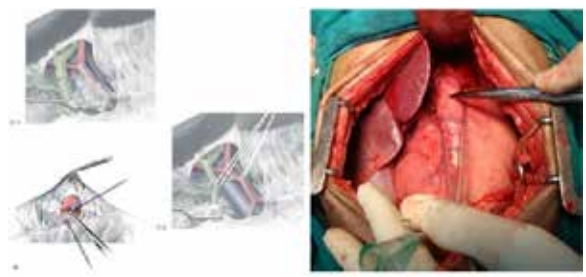


Fig. E (C1,C2) and F (D)

STEP 3: Mobilization of abdominal esophagus and incision of esophageal hiatus Lymph node dissection is continued along celiac trunk to para-aortic region. Lymphatic tissue is transposed to lesser curvature and is later resected en bloc with tumor. For better exposure diaphragmatic crura are incised with diathermia and stumps may be ligated. Blunt mobilization of esophagus is done with index finger. During this maneuver connective tissue fibers between esophagus, diaphragmatic crua and abdominal aorta must be removed carefully . Abdominal esophagus is mobilized and pulled caudally with rubber tube. Hiatus is incised ventrally following transection of left inferior phrenic vein between ligatures . The retrocardial lymphatic tissue is removed en bloc with the specimen .

STEP 4 **:** Transhiatal esophageal dissection in the posterior mediastinum including para-aortic lymphadenectomy: mobilization of the distal esophagus

Dissection of the distal esophagus is performed by detachment of its anterior surface from the pericardium. Infiltrated pericardium can be resected en bloc. Sharp dissection is continued anteriorly up to the tracheal bifurcation and completed by blunt dissection upwards. The trachea and the brachiocephalic trunk are palpable anteriorly. Severe damage of the trachea, the azygos vein, the pulmonary vessels or the aorta, respectively, may occur especially in the case of extensive local tumor growth.

After complete anterior and posterior mobilization, the esophagus is pulled caudally. The ligament like so-called lateral "esophageal ligaments" consisting of branches of the vagus nerves, pulmonary ligaments and esophageal aortic branches should be transsected sharply between clamps (clips may be used alternatively), thus avoiding bleeding, chylothorax or chyloperitoneum. Excision of parietal pleura, in the case of tumor infiltration of the pleura or lung, en-bloc resection of adherent tissue can be performed following enlargement of the diaphragmatic incision if needed . Further dissection up to the tracheal bifurcation by division of the lateral ligaments. This step includes lymphadenectomy of the posterior mediastinum and posterior to the tracheal bifurcation. For blunt dissection

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of the esophagus proximal to the tracheal bifurcation, the lateral ligaments should be pulled down and consecutively ligated. If possible, blunt dissection is completed up to the upper thoracic aperture.

STEP 5: Construction of the gastric tube

Starting at the fundus, the lesser curvature is resected using a linear stapler device. It follows the direction to the pylorus. Shortening of the gastric tube can be avoided by stretching the stomach longitudinally (**G**). The stapleline is oversewn by seromuscular interrupted sutures. The diameter of the gastric tube should be 2.5–3cm following this procedure (**H**).

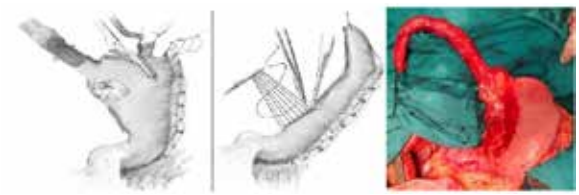

Fig.G Fig.H **Fig.O**

Fig.G Fig. shows gastric tube

STEP 6: Mobilization and dissection of the cervical esophagus; resection of the esophagus For better exposure the patient's head is turned to the right. A skin incision is performed along the anterior edge of the sternocleidomastoid muscle.Dissection of the platysma and blunt dissection between the straight cervical muscles and the sternocleidomastoid muscle are done followed by lateral retraction of the sternocleidomastoid muscle. Sharp dissection of the omohyoid muscle enables exposure of the lateral edge of the thyroid, the jugular vein and the carotid artery by retracting the strap muscles medially. Displacement of the esophagus using a curved instrument. Dissection of the cervical esophagus and upper thoracic esophagus is completed by blunt dissection with the finger or dissector. The nasogastric tube is removed. Transection of the esophagus is performed with a scissors, or with stapler, after ligation of the aboral part of the esophagus. A strong thread or a rubber band is fixed at the aboral stump of the esophagus before the esophagus is transposed into the abdominal cavity. This eases later transposition of the gastric tube to the neck.

STEP 7: Reconstruction

Gastric tube pull-through. Optional methods of placement : (a) Esophageal bed (b) Retrosternal (c) Presternal

STEP 8: Cervical anastomosis

A two-layer anastomosis of the gastric tube and the esophageal stump is performed. The first seromuscular sutureline is performed in an interrupted fashion. The protruding parts of the esophagus and the gastric tube are resected. The second inner sutureline of the posterior wall can be performed as a running suture (**H**). An enteral three-lumen feeding tube is then inserted over the anastomosis and placed into the first jejunal loop for postoperative enteral nutrition. The anterior wall is completed with interrupted or running sutures. The second suture of the anterior wall can be performed in a U-shaped fashion. This may provide an inversion of the anastomosis into the gastric tube (**I**).

Fig. H Fig. I

STEP 9: Final situs : A soft drainage is placed dorsal to the anastomosis, followed by closure of the skin. Drainage of the mediastinum is warranted by two intercostals drains in chest[33].

Transthoracic Esophagectomy: (Mc Evans 3 phase approach)34

Introduction : The goal of this operation is to remove an esophageal cancer with the widest possible lymphatic clearance (two-field lymphadenectomy),which comprises upper abdominal lymphadenectomy and lymphatic clearance of the posterior and mid mediastinum. Reconstruction is accomplished by either gastric tube or colonic interposition[34].

Indications

- Thoracic esophageal carcinoma
- If transhiatal resection is ill-advised (e.g., adherence to trachea)

Contraindications

- as mentioned in Transhiatal Esophagectomy
- High risk patients

Preoperative Investigation/Preparation for the Procedure

as mentioned in Transhiatal Esophagectomy

Procedure

Access

- Patient in left lateral positioning for the thoracic part of the operation
- Anterolateral thoracotomy through the 5th intercostal space (ICS)
- Re-positioning to a supine position as in the transhiatal approach
- Upper midline incision as in the transhiatal approach

STEP 1 : Thoracotomy and incision of the pleura along the resection line Thoracotomy through the 5th ICS with skin incision from the apex of the scapula to the submammarian fold (**J**). Two retractors are positioned stepwise. Single left lung ventilation is performed. The mediastinal pleura is incised along the resection line for the en bloc esophagectomy. Incision starts from the pulmonary ligament, circumcising the dorsal part of the right hilum of the lung and along the right bronchus. It follows the right main bronchus at the lateral margin of the superior vena cava up to the upper thoracic aperture. Then the incision line changes direction caudally along the right lateral margin of the spine, down to the diaphragm along the azygos vein. It is of the utmost importance to identify the right phrenic nerve (**K**).

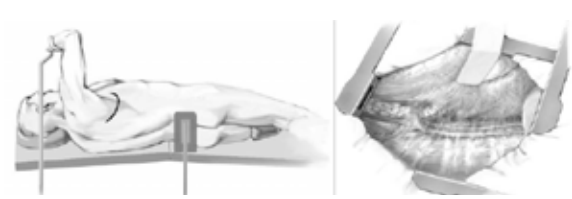

Fig. J Fig. K

STEP 2: Division of the pulmonary ligament (L)
For exposure of the pulmonary ligament the lung is pushed cranially and laterally. All lymphatic tissue should be moved towards the esophagus. Care has to be taken not to injure the vein of the lower lobe of the right lung.

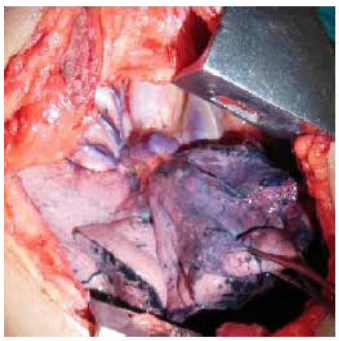

Fig. L
STEP 3 : Ligation of the azygos vein (L)
The superior vena cava and the azygos vein are dissected. Suture ligation towards the vena cava and ligation of the azygos venal stump are performed.

STEP 4 : Radical en bloc lymphadenectomy
Lymphadenectomy starts from the superior vena cava up to the confluence of the two vv. anonymae.Dissection of the bracheocephalic trunk and right subclavian artery is followed by dissection of the right vagal nerve and identification of the right recurrent laryngeal nerve. Caudal to the branching of the recurrent laryngeal nerve, the vagal nerve is transected and the distal part is pushed towards the en bloc specimen. Then lymphadenectomy is performed continuously along the dorsal wall of the superior vena cava. After having completed preparation of the superior vena cava, the trachea and the rightand right-sided main bronchus are completely freed from lymphatic tissue. The preand paratracheal fat and lymphatic tissue are dissected towards the esophagus. Dissection of the retrotracheal lymph nodes is then performed. Injury of the membranaceous part of trachea has to be carefully avoided while removing these nodes towards the esophagus.

Lymph node dissection continues with the upper paraesophageal lymph nodes. All intercostal veins that drain into the azygos vein are ligated and divided. Lymphadenectomy of the subcarinal lymph nodes is then performed with dissection of the left main bronchus. Para-aortic lymphadenectomy is performed. The esophageal branches of the thoracic aorta have to be dissected very carefully and should be ligated with suture ligation. Identification and careful dissection of the thoracic duct is done with double ligations directly above the diaphragm and at the level of the main carina .

Fig. M Fig shows sophagus lifted with IFT Mediastinal lymphadenectomy is completed with the removal of the left sided paraaortic and retropericardial lymph nodes, as well as the intermediate and lower lobe bronchus down to the esophageal hiatus (L). After complete mobilization of the esophageal specimen, thoracic drainage is placed in the right thoracic cavity.After closure of the thoracic incision the patient is repositioned for the abdominal part[34].

For the abdominal and cervical parts: see the transhiatal approach.

Fig shows removed specimen of esophagus showing growth at lower 1/3rd part.(arrow)

MATERIALS AND METHODS
This retrospective comperative study was done in the Department of Surgery at New civil hospital, Surat, in which operated cases included from November 2009 to November, 2013. A total of 50 patients were included in this study, 25 cases each of transhiatal esophagectomy two phase approach and transthoracic esophagectomy three phase appoach for esophageal resection in proved cases of carcinoma of esophagus and most of which are referred from ENT department and LCDC (Lions cancer detection centre), New civil campus, Surat.

Inclusion criterias
1 Operable Lower 1/3rd And Middle 1/3rd carcinoma of esophagus
2 Weight above 30 kg
3 Age less than 80 years
Exclusion criterias
1 Upper 1/3rd Esophageal malignancy
2 Etiology other than malignancy
3 Inoperable Advanced malignancy with distant metastasis
4 Weight below 30 kg
5 Age more than 80 years

The details of the pateints was collected from Record room of hospital where case papers of patients are submitted. Other details related to chemotheapy and radiotherapy given was collected from LCDC centre records. The personal details of the patient in the form of Name, Age/Sex, weight, Address, Occupation, Income and Marital Status were noted. Furthermore, the Date of Admission, Date of Operation, Date of Discharge, hospital Registration number and LCDC registration number were noted too. A detailed history taking ensued thereafter in the form of elaboration of the origin, duration and progress of the illness, past history, family history and treatment history in form of any previous gastric or colonic surgery if any. History of alcohol consumption and smoking is elicited. A complete physical examination was performed and the vital data and other physical findings were noted. A clinical examination for recurrent laryngeal nerve status and cervical lymphadenopathy is done. Also, a thorough systemic examination of the Abdomen, Respiratory, Cardiovascular and Central Nervous systems was performed and a Provisional Diagnosis was reached upon.

Pre-operative Investigation
Investigations like haemoglobin, total WBC count, differential count, ESR, random blood sugar, liver function tests and coagulation profile, blood urea, serum creatinine, serum electrolytes, serum proteins, urine routine and micro examination, X-Ray abdomen and chest, ultrasonography of abdomen, CT Scan of abdomen and others as may be deemed necessary to reach upon a final diagnosis. In this study, the diagnosis of carcinoma of esophagus was made using upper GI endoscopy and punch biopsy from visible growth in esophagus. Investigations like barium swallow and CT scan of the chest and upper abdomen were helpful in location, size, extent and surrounding infiltration and

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preservation of fat plane with descending thoracic aorta and trachea. Biopsy was sent for histopathological examination for confirmation of malignancy and its type.

Esophagogastroscopy with biopsy: During endoscopy, it is critical to document the following: 1) Location of the lesion (with respect to distance from the incisors) 2) Nature of the lesion (friable, firm, polypoid) 3) Proximal and distal extent (if possible) of the lesion 4) Relationship lesion to cricopharyngeus muscle, the GEJ, and the gastric cardia. Biopsy taken to exclude gastric infiltration. These points are important in management of esophageal cancer to help guiding surgical therapy.

Fig shows GI scope trolly, Olympus endoscope and patients position during the procedure (below).

Fig shows esophageal growth as seen in GI scopy (above) and biopsy forcep and procedure (below).

Pre-operativev Preparation for Surgery :
Respiratory therapy in form of regular chest physiotherapy given and balloon blowing exercise done in ward. Pulmonary function test done to assess chest condition. Central line for iv fluids inserted in patient and total parental nutrition given for build up of the patient. Nutrition included Aminovan, Lipofundin, Dipeptivan, Omegavan, Albumin started via central line.

Intra-operative details : Intra-operative details like duration of surgery, blood loss, blood transfusion, any iatrogenic injury like tracheal and splenic injury noted.

Post-operative details : Total parental nutrition continued post-operatively till patient started orally and total days of TPN noted. Ventilator support if required noted in days. Surgical ICU stay if required noted in days. Intercostal drain and abdominal drain kept in situ on either side is noted in days. On discharge of the patient, total hospital stay in days noted in which expired patients were excluded. Early mobilization in days were also recorded. This is mentioned in sequence in the proforma attached below. On around eighth post-operative day Dye study procedure using oral Gastrografin to rule out cervical anastomotic leak is done after allowing patient to take dye orally and taking radiographic image following deglutition with ryle's tube in situ. If there is no leak seen then similar image repeated after removing ryle's tube. If no leak then patient is started clear liquids orally and corrugated drain in cervical region is removed. Complications if occurred are also mentioned in sequence in the proforma attached below. Mortality with its cause and any resuscitative measure given before death is noted.

Post-operative management : After histopathological confirmation of malignancy, its type, differentiation, margins patient was given adjuvant chemotherapy in form of Cisplatin and Flurouracil for 6 cycles each at 21 days interval issued from LCDC centre after their registration after blood parameters and ECG are within normal limits. Radiotherapy given in adjusted grays and divided fractions accordingly for 1 month 5 days a week in the same centre by radiotherapy delivery system. Radiotherapy was given by cobalt -60 source radiation as external beam radiotherapy in 3 dimensions AP and PA (40 Gy dose) and oblique view (10 Gy dose). Records of whether patient completed the course or remained incomplete is taken from LCDC.

Follow up details: Weight gain or loss was noted in the patients in OPD clinic at 3months and 6 months in first year. After first year, follow-up data were obtained by telephone from the patient or his or her family practitioner. Recurrence of disease was diagnosed on clinical grounds. However, whenever a relapse was suspected, radiologic, endoscopic, or histologic confirmation was sought. Any recurrence if any noted and the procdure done if any noted along with its result and any re-exploration of cervical, thorax and abdomen required and intra-operative findings were noted. Survival measured after the patients were discharged at 3 months, 6 months, 1 year, 2 year and 3 year.

Proforma for Retrospective study of surgical management of carcinoma
esophagus by Orringer's 2 phase transhiatal versus Mc Evans 3 phase
esophagectomy– study of 25 cases each

BIODATA
- Name :
- Age/Sex :
- Weight :
- Occupation :
- Social Status:
- Address and Contact No. :
- OPD No.:
- IPD No.:
- DOA:
- DOO:
- DOD:
- LCDC No.:

HISTORY
Chief complaints:
C/o dysphagia for solids or liquids or both
C/o vomiting
C/o burning epigastric pain
C/o palpitation
C/o weight loss
C/o decreased appetite
C/o change in voice
Present history:
Past history: H/o Anti Retroviral Therapy

H/o PPI ingestion
H/o Corrosive poisoning
H/o Upper GI instrumentation
H/o DM/HT/TB/Jaundice/Asthma/Cardiac
H/o any Surgery / Blood transfusion
H/o Chemotherapy/ Radiotherapy given
Family history:
Other history/menstrual history/ obstetric history:
Personal history:
Diet:
Avg Calorie Intake:
Apetite :
Sleep:
Bowel:
Bladder:
Habits:
Alcohol:
Tobacoo:

GENERAL EXAMINATION:
Patient is conscious cooperative well oriented to time place and person
Built:
Nutrition:
Clubbing:
8Sclera:
Pallor:
Icterus:
Edema:
Lymphdenopathy:
Vitals:
Temp:

Pulse:
BP:
RR:
Hair Distrbution:
Eyes:
Ear:
Nose:
Oral Cavity:
Neck:
Hernial Sites:
External Genitalia:
Bones/ Joints/ Spine:

SYSTEMIC EXAMINATION:
Per abdomen:
Respiratory system:
Air entry:
crepts:
rhonchi:
Cardiovascular System:
S1 S2 Murmur:
Central nervous System:
GCS:
E M V
PROVISIONAL DIAGNOSIS:
INVESIGATIONS: RADIOLOGY:
X-ray chest PA view:
Barium swallow study:
CT Scan (Location of tumor and length and regional lymph node involvement) :
USG Abdomen :
Upper GI Endoscopy Findings:
Biopsy:
Histology : Adenocarcinoma / Squamous:
Differentiation: Well /Moderate /Poor :
Tumor margin : Proximal and Distal :
Staging: TNM and staging groups :
Blood Investigations :

DATE					
Hb					
TLC					
PLT					
HCT					
RBC					
BLOOD GROUP					
PT-PATIENT					
PT CONTROL					
INR					
APTT-PT/ CONTROL					
ALT					
BILIRUBIN-TOTAL					
BILIRUBIN DIRECT					
BILIRUBIN INDIRECT					
ALK PHOSPHATASE					
AMYLASE					
LIPASE					
TOTAL PROTIEN					
ALBUMIN					
ALBUMIN					
CREATININE					
NA+					
RBS					

ASA CLASS:
PRE-OP PREPERATION: Chest physiotherapy

Nebulisation

Pre-op parental nutrition (days)

SURGICAL APPROACH AND INTRA-OPERATIVE FINDINGS:
OPERATING SURGEONS:
DURATION OF SURGERY:
TOTAL BLOOD LOSS :
BLOOD TRANSFUSION:
IATROGENIC INJURIES :
POST OP ORDER:
POST OPERATIVE :
Drain in situ (days):
ICD in situ (days): Right: Left:
Corrugated drain in situ (days):
Post-op total parental nutrition (days):

Ventilation time (days):
ICU stay (days):
Hospital stay (days):
Hospital mortality :
Early mobilization (days):
Weight on discharge :
Weight after 3 months:
Weight after 6 months:
Re-exploation : cervical/ abdomen/ thorax :
EARLY POST OP COMPLICATIONS:
Wound infection :
Anastomotic leak :
Vocal cord paralysis :
Pneumonia :
Pleural effusion : right/left/both
Pyothorax :
Pulmonary embolism :
Respiratory failure :
Psychosis :
Myocardial infarction ;
Deep vein thrombosis :
Hypotension :
Heart failure :
Renal failure :
Ileus :
Subphrenic abcess :
Chylothorax:
Tracheo-esophageal fistula :

LATE POST OP COMPLICATIONS:
Chronic diarrhea :
Anastomotic stricture :
Chemotherapy: Neo-adjuvant chemotherapy:

Adjuvant chemotherapy :
Completed/ Incomplete :
Regimen given :
Radiotherapy: Neo-adjuvant radiotherapy:

Adjuvant radiotherapy :
Completed/ Incomplete :
Dose in fractions given :

Recurrance and Further intervention if any :
+RESULTS AND ANALYSIS
1) Age at presentation in Esophageal malignancy :

AGE AT PRESENTATION	No. of Patients	% of Patients
21-30	1	2
31-40	4	8
41-50	11	22
51-60	22	44
61-70	10	20
71-80	2	4
Total	50	100
AVG.AGE	55.2	

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The presentation of patients of Esophageal malignancy occurs more in 6th decade

of life. The youngest was a female aged 27 year and oldest was 80 year male.

2) Sex Distribution in Esophageal malignancy

SEX DISTRIBUTION	No. of Patients	% of Patients
Male	29	58
Female	21	42
Total	50	100

The incidence of Esophageal malignancy occurs more in males than females. This is contributed to alcohol consumption and smoking which is more in male gender.

3)Weight at presentation in Esophageal malignancy

WEIGHT AT PRESENTATION	No. of Patients	% of Patients
30-40	15	30
41-50	25	50
51-60	10	20
Total	50	100
AVG.AGE	45.4	

Average weight at first presentation of the patient and history of weight loss noted. This is mainly attributed to dysphagia due to mechanical obstruction to food passage which causes vomiting on eating and thus causing loss of apetite.

4) Clinical Presentation and Associated illness in Esophageal malignancy :

Clinical Presentation And Associated Illness	No. of Patients	% of Patients
DYSPHAGIA FOR SOLIDS	45	90
DYSPHAGIA FOR LIQUIDS	24	48
VOMITING	29	58
WEIGHT LOSS	42	84
PALPITATION	5	10
CHANGE IN VOICE	7	14
DECREASED APETITE	41	82
DIABETES	5	10
HYPERTENSION	7	14

The clinical symptoms with which such pateints presents are usually dysphagia for food which is observed in almost all patients causing loss of apetite thus,loss of weight. Change in voice or hoarseness is suggestive of involvement of recurrent laryngeal nerve. Associated illness like Diabetes mellitus and Hypertension did not affect the outcome of the patients.

5) Tumor location

TUMOR LOCATION	THE %	TTE %
MIDDLE 1/3rd	0	28
MID TO LOWER	16	20
LOWER 1/3rd	84	52

The location of tumor is very important to decide type of approach for surgery. Transhiatal approach was not used in mid-esophageal cancers for which transthoracic approach was used.

6) Histology and differentiation

HISTOLOGY AND DIFFERENTIATION	THE %	TTE %
ADENO-CARCINOMA	24	24
SQUAMOUS CELL CA	76	76
WELL DIFFERENTIATED	28	32
MOD. DEFFERENTIATED	44	40
POORLY DIFFERENTIATED	28	28

On histological typing, squamous cell carcinoma was found in more patients than adenocarcinoma. On the basis of differentiation, moderately differentiated tumor are more seen. Both proximal and distal margin of removed specimen of esophagus show tumor free margin in all cases.

7) Stage of the tumor

STAGING	THE %	TTE %
STAGE I	0	4
STAGE II A	28	12
STAGE II B	40	52
STAGE III	32	32

According to staging, maximum patients showed stage II B disease and only one case showed stage I disease.

8) Operative details

OPERATIVE DETAILS	THE	TTE
ASA CLASS (Avg)	3.36	3.68
SURGERY DURATION (hrs)	4.12	4.35
BLOOD LOSS (in Litre)	0.834	0.876
BLOOD TRANSFUSED(in U)	2.08	2.16
SPLENIC INJURY (%)	4	0
TRACHEAL INJURY (%)	0	4
RECURRANT LARYNGEAL NERVE INJURY	0	0

The ASA class given pre-operatively according to general condition of the patient was class 3 to maximum patients in THE and class 4 for TTE. Duration of surgery in one patient for TTE was 5 hours 15 min which was the maximum recorded time duration as mass was adherant to surrounding structure and shortest duration of 3 hours 15 min was noted in one patient of THE as mass was endoluminal with no adherance. Similar patient's total blood loss noted was 1000 ml for which 3 units of blood was transfused. Splenic injury was occurred in one patient during THE for which splenectomy was done and tracheal injury was seen in one patient during TTE which was primarily repaired with prolene successfully.

9) Post-operative details

POST OPERATIVE DETAILS	THE (in days)	TTE (in days)
POST OP TPN	7.68	7.91
VENTILATOR SUPPORT	2.6	3.14
ICU STAY	1.8	3.04
ICD –RIGHT	5.48	6.5
ICD –LEFT	6.92	7
ABDOMINAL DRAIN	5.08	5.3
HOSPITAL STAY	14.85	16.7
EARLY MOBILIZATION	1.76	2.65

The total parental nutrition was given for 14 days in one female patient of THE post-operatively which was maximum days noted. Maximum ventilatory support of 4 days was required by one patient of TTE who was expired on 5th postoperative day. Ventilatory support was required in 5 cases of THE and 7 cases of TTE. Two patient required 7 days of ICU stay in THE and three cases in TTE which was maximum days noted. Maximum hospital stay was noted in one patient of TTE of 20 days which contributed mainly to pulmonary complication.

10) Early Complications

EARLY COMPLICATIONS	THE %	TTE %
WOUND INFECTION	12	16
VOCAL CORD PARALYSIS	0	0
ANASTOMOTIC LEAK	8	12
PNEUMONIA	16	24
PLEURAL EFFUSION-RIGHT	32	40
PLEURAL EFFUSION-LEFT	32	24
PYOTHORAX	8	4
PULMONARY EMBOLISM	0	0
RESPIRATORY FAILURE	12	12
PSYCHOSIS	4	8
MYOCARDIAL INFARCTION	4	4

DEEP VEIN THROMBOSIS	0	0
RENAL FAILURE	4	0
ILEUS	4	4
SUBPHRENIC ABCESS	4	0
HYPOTENSION	4	8
HEART FAILURE	4	8
CHYLOTHORAX	0	4
TRACHEO-ESOPH FISTULA	0	4

Early complications were those occurring within 7 days of post-opeative period. No incidence of iatrogenic injury to recurrent laryngeal nerve, pulmonary embolism and deep vein thrombosis is seen in any patients. Partial anastomotic leak was noted in one patient which was managed conservatively by compressing over the local site over the cervical region during deglutition which was healed after few days. Only right sided ICD was inserted in TTE cases and left sided was inserted when there was left sided effusion. In cases of THE bilateral ICD was inserted. ICD no. 28 was used. In one patient of THE ICD was kept for 8 days on both the sides for pyothorax drainage. Due to respiratory complications, repiratory failure occurred in 3 patients which resulted in death of these patients. Postoperative psychosis is seen in 3 patient which was contributed to electrolyte imbalance which improved after the correction was given. One case of TTE developed subphrenic abcess which was managed by open approach. One patient each in THE and TTE developed post-operative paralytic ileus thus delaying oral intake. Chylothorax was noted in one patient and was managed by keeping ICD in situ till output is lowered.

11) Late complications

LATE COMPLICATIONS	THE %	TTE %
CHRONIC DIARRHOEA	4.76	4
ANASTOMOTIC STRICTURE	9.52	16

Late complications includes chronic diarrhoea occurred in one patient each in THE and TTE which was managed in ward by intravenous fluid and antibiotics. Anastomotic stricture in cervical region was managed by esophagoscopy and bollon dilatation and one patient required cervical exploration and anastomotic repair.

12) Mortality and Recurrance

	THE %	TTE %
MORTALITY	16	20
RECURRANCE	9.52	10

Mortality was mainly due to respiratory complications while some developed postoperative hypotension for which ionotropic support in form of dopamine and noradrenaline was started but did not recover and resulted in death of the patient. One patient was died immediately post-operatively due to sudden cardiac arrest. Four patients of THE and five patients of TTE expired within one month after surgery and was included in mortality. Recurrence of disease was diagnosed on clinical grounds. However, whenever a relapse was suspected, radiologic, endoscopic, or histologic confirmation was sought.

13)Weight gain post-operative

POST-OP WEIGHT AVG. GAIN	THE (in Kg)	TTE (in Kg)
ON DISCHARGE	-0.9	-0.45
AFTER 3 MONTHS	0.95	1.94
AFTER 6 MONTHS	1.66	2.84

Weight gain or loss was noted in the patients in OPD clinic at 3months and 6 months in first year post-operatively. One patient of TTE noted 7kg weight gain at 6 month follow up.

14) Survival

SURVIVAL	THE %	TTE %
3 MONTH SURVIVAL	95.23	89
6 MONTH SURVIVAL	85.71	68.42
1 YEAR SURVIVAL	56.25	60
2 YEAR SURVIVAL	50	54.54
3 YEAR SURVIVAL	37.5	42.85

Post-operative survival measured after the patients were discharged at 3 months, 6 months, 1 year, 2 year and 3 year. This shows to reverse of graph after one year favoring TTE for better survival.

15) Chemotherapy

CHEMOTHERAPY	THE %	TTE %
PRE-OP GIVEN	24	28
POST-OP GIVEN	95.23	89
COMPLETED	80	76.47
INCOMPLETE	20	23.54

Chemotherapy is improves outcome of the patient and thus increase survival rate. Neo-adjuvant chemotherapy was given for reducing mass size and control spread of the disease and clears the plane for resection of tumor. Two patients were kept on observation and were not given chemotherapy. Patients were given adjuvant chemotherapy in form of Cisplatin and Flurouracil for 6 cycles each at 21 days interval.

16) Radiotherapy

RADIOTHERAPY	THE %	TTE %
PRE-OP GIVEN	0	0
POST-OP GIVEN	95.23	68.42
COMPLETED	61.9	76.92
INCOMPLETE	38.1	23.08
AVG. DOSE (in Grays)	48.57	52.69
AVG. FRACTIONS (in Fr)	26.14	27.3

Radiotherapy is improves outcome of the patient and thus increase survival rate. Radiotherapy reduces mass size and control spread of the disease. Neo-adjuvant chemotherapy was not given in any of the patients. Post-operatively adjuvant radiotherapy was not given in some cases of adenocarcinoma for which close follow up was adviced.

DISCUSSION

The two most frequently performed operations for esophageal cancer are transthoracic and tranhiatal esophagectomy. These operations require large thoracotomy or xifoumbical midline surgery and cervical incision for esophagogastric anastomosis. There are no significant morbidity, mortality or survival rate differences between classic transhiatal and open transthoracic esophagectomy. Although the transthoracic technique is associated with a higher rate of respiratory complications, bleeding, chylothorax, and operative mortality, the transhiatal technique presents a higher risk for vocal cord paralysis and haemorrhage. THE is a blind procedure for dissecting the middle/lower third of the esophagus with an increased risk of damage to the nearby structures and inadequate lymph node dissection at this level and hence, it may not be considered as an oncologic procedure, as compared with the open transthoracic approach. Comparisons of the results for the two procedures are controversial. According to the study transhiatal resection was associated with a shorter median duration of surgery (4h vs 4.5 h for transthoracic resection), lower blood loss (800 vs 850 ml), fewer respiratory complications, less chylous leakage, shorter duration of mechanical ventilation, shorter intensive care unit and hospital stay, and lower mortality. This study shows minimal difference in postoperative morbidity between the two procedures in terms of respiratory complications (20% vs 28%), cardiovascular compli-

cations (4% vs 8%), wound infection (12% vs 16%) or chylothorax (0% vs 4%). The TTE group presented a higher incidence of anastomotic leakage (8 % vs 12%), anastomotic strictures (10% vs 16%) and no recurrent laryngeal nerve damage and postoperative mortality was 16% after the transhiatal operation, as compared with 20% after the transthoracic approach. The overall 3-year survival rate was similar for the two groups (37.5% and 42.8%, respectively). We conclude that TTE are feasible and reliable for esophageal and lymph node dissection under direct view control. The intraoperative complications of THE are minimal, and the postoperative complications are less than with TTE. The most important factor for esophageal carcinoma prognosis was the possibility of early diagnosis.The surgical approach must be chosen according to preoperative staging, and the minimally invasive procedure can be as safe when it is adequately indicated and performed in centers with large experience in esophageal surgery and by surgeons trained in advanced surgeries.

CONCLUSION

There is no significant overall survival benefit for either approach. Moreover, patients with a limited number of positive lymph nodes in the resection specimen seem to benefit from an extended transthoracic esophagectomy.Although the best approach to esophagectomy remains controversial, the 2 most frequently performed operations are transthoracic (TTE) and blunt transhiatal esophagectomy (THE). The transthoracic approach allows the surgeon to perform a wide mediastinal lymphadenectomy and provide adequate hemostasis that cannot be ensured by THE. However, THE avoids a thoracotomy and therefore reduces associated pulmonary complications.

ABBREVIATIONS

% - Percentage
AJCC - American Joint Committee on Cancer
ARDS- Acute Respiratory Distress Syndrome
AP – Anteroposterior
APTT - Activated partial thromboplastin time
ASA - American Society Of Anesthesiologists
Avg – Average
BP- Blood pressure
C – Complete
C6 - sixth cervical vertebra
Ca- Carcinoma
CBC- Complete Blood Count
CEA - Carcinoembryonic antigen
CHOP - Cyclophosphamide, Hydroxydaunorubicin Oncovin, and Prednisone
CGy - Centigray
cm- Centimeter
COPD- Chronic Obstuctive Pulmonary Disease
C/o – compliants of
CRE- Controlled Radial Expansion
CT Scan- Computed Tomography scan
Dr – Doctor
DM – Diabetes mellitus
DOA – Date of admission
DOOP – Date of operation
DOD – Date of discharge
DVT – Deep vein thrombosis
EBE - Three-field en bloc esophagectomy
ECG- ElectroCardiogram
ENT – Ear, nose, troat
ESCC - esophageal squamous cell carcinoma
EUS- Endoscopic Ultrasound
EAC - esophageal adenocarcinoma
F-J- Feeding Jejunostomy

Fr - Fraction
FU- fluorouracil
GCS – Glasgow coma scale
GE junction- Gastroesophageal junction
GERD - gastroesophageal reflux disease
GI- Gastro Intestinal
G-J – Gastrojejunostomy
GMC – Government medical college
Gy- Gyration
H/o – history of
Hb – Hemoglobin
HCT- Hematocrit
Hrs - Hours
HT – Hypertension
I - Incomplete
ICD- Intercostal Drainage
ICU – Intensive care unit
INR - International normalized ratio
IFT- Infant Feeding Tube
IPD – In patients depatment
Kg – Kilogram
L - Litre
LCDC – Lions cancer detection centre
Leuco - Leucovorin
Lt- Left
LND - Lymph node dissection
L/3 – Lower one third of esophagus
M/3 – Middle one third of esophagus
M-L/3 – Mid to lower esophagus
MALY - Mucosa-associated lymphoid tissue
MHC - Major histocompatibility complex
MI – Myocardial infarction
MIE - Minimally invasive esophagectomy
Mm - Millimeter
Mod – Moderate
MRI - Magnetic resonance imaging
N – No
NA – Not applicable
No. - Number
OPD – Out patients department
PA – Posterioanterior
PDT - Percutaneous dilational tracheostomy
PET - Positron emission tomography
PFT - Pulmonary function test
P-F – Cisplatin and Flurouracil
Plt – Platelet count
PT – Prothrombin time
RBC – Red blood corpuscles
Rt- Right
RR – Respiratory rate
Sr No – Serial number
T1 – First thoracic vertebra
T5 – Fifth thoracic vertebra
TE - Tracheo-esophgeal fistula
THE – Transhiatal 2 phase esophagectomy
TTE - Transthoracic 3 phase esophagectomy
TLC – Total leucocyte count
TPN – Total parental nutrition
TB- Tuberculosis
TNM – Tumor nodal metastasis
U - Units
U/3 – Upper one third of esophagus
USG – Ultrasonography
U.S – United states of America
VSE - Vagal-sparing esophagectomy
Y- Yes

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