Anti-reflux surgery and its effect on progression of Barrett's metaplasia to esophageal carcinoma

essay
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List of abbreviations

- BE : Barrett's esophagus
- CFM : Cardiac-fundic mucosa
- EAC : Esophageal adeno-carcinoma
- EE : Erosive esophagitis
- EMG : Electro-myogram
- GEJ : Gastro-esophageal junction
- GERD : Gastro-esophageal reflux disease
- GERD-HRQOL : Gastro Esophageal Reflux Disease-Health Related Quality Of Life
- H^+/K^+ ATPase: Hydrogen/Potassium Adenosine tri-phosphatase.
- HGD : High grade dysplasia
- HPZ : High pressure zone
- HPZ : High pressure zone
- IEM : Ineffective esophageal motility
- LES : Lower esophageal sphincter
- LESP : Lower esophageal sphincter pressure
- LNF : Laparoscopic Nissen fundoplication
- NSAID : Nonsteroidal anti-inflammatory drugs
- PACU : Post anesthesia care unit
- PDT : Photodynamic therapy
- PPI : Proton pump inhibitors
- PUD : Peptic ulcer disease
- QOL : QUALITY OF LIFE
- RF : Radio-frequency
- SCJ : Squamo-columnar Junction
- TLESR : Transient lower esophageal sphincter relaxations

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INTRODUCTION

Gastro-esophageal reflux disease (GERD) is among the most common GI problems seen in primary care settings. In the United States, 44% of the adult population reported experiencing heartburn at least once a month, 14% weekly, and 7% daily ***(Fass and ofman, 2002).***

The management of gastro-esophageal reflux disease has gained increasing attention during the past two decades due to a high prevalence in Western societies, new insights in pathophysiology, new potent antisecretory drug therapy, and the advent of minimal invasive surgery ***(Fuchs and Freys, 2003).***

The burgeoing field of laparoscopic surgery has transformed the field of anti-reflux surgery. Short- and medium-term follow up of operated patients show comparable surgical outcomes to those achieved with the open operation. Because of the well-documented benefits of the laparoscopic approach over an open operation, including shorter hospitalization, and an attenuated inflammatory response, patient interest in laparoscopic anti-reflux surgery has been considerable ***(Alex, 2004).***

The incidence of esophageal adenocarcinoma is increasing rapidly in many countries. Gastro-esophageal reflux is considered to be the main causal factor of esophageal adenocarcinoma. Barrett's esophagus, a columnar-lined, specialized metaplasia of the distal esophageal mucosa, is a link between reflux and this tumor. It is possible that effective anti-reflux surgery prevents esophageal adenocarcinoma, at least if this surgery is conducted before any tumor progression, since such surgery is

thought to prevent reflux by mechanical means ***(Jesper and pernilla, 2007).***

Cancer registries of Western countries have evidenced a rising incidence of esophageal adenocarcinoma in the distal esophagus over the past 20 years. Similar to adenocarcinoma of the colon, the tumor is understood to be the result of a multi-step degeneration, known as the metaplasia-dysplasia-carcinoma sequence. The first step of the escalation is the development of Barrett's esophagus. Experimental and clinical studies have shown a synergistic effect of refluxed gastric and duodenal juice in the development of esophageal adenocarcinoma. Gastro-esophageal reflux can be influenced by both medical and surgical therapy. Under medical therapy, regurgitaton of modified gastro-duodenal contents still occurs. Only effective anti-reflux surgery provides a radical protection against all forms of reflux and potentially reduces the risk of malignancy in the distal esophagus ***(Christian et al., 2002).***

In patients without any metaplastic lesion undergoing surgery for reflux symptoms, a prophylactic effect can be expected as reflux of gastric contents into the lower esophagus is entirely suppressed. Accordingly, there is no case in the literature presently showing new development of Barrett's mucosa after successful surgery. On the other hand, development of Barrett's metaplasia under medical treatment has been reported ***(Wetscher et al., 2001).***

AIM OF THE WORK

The aim of our research is to clarify the effect of surgical anti-reflux procedures over the progression of the metaplastic Barrett's esophagus to frank esophageal carcinoma and the possibility of regression of the condition in patients with gastro-esophageal reflux disease, as a preventive measure.

ANATOMY OF THE ESOPHAGUS

The esophagus is not simply a conduit to allow passage of food and drink from the mouth to the stomach. It is an intensely complex part of the gastrointestinal tract. Cranially the esophagus is a continuation of the hypopharynx and caudally it continues into the cardia of the stomach. ***(Toni Lerut et al., 2007)***

Embryology:

The esophagus comes from two sources of the primitive gut. The cranial portion is derived from the pharyngeal gut or pharynx, and the caudal part from the pre-gastric 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. 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 tracheao-esophageal folds (internal ridges of the lateral esophageal groove), caudally first, forming the trachea-esophageal 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 pseudo-stratified columnar

epithelium via a stratified columnar stage to a stratified squamous epithelium by 90 to 130 mm embryo length ***(Toni Lerut et al., 2007.)***

Gross Anatomy

The esophagus is a muscular tube about 25 cm (10 inches) long, connecting the pharynx to the stomach.

The length of the esophagus varies with age, sex and height of individuals. It is found that in men that the length of the esophagus varies from 23 to 30 cm with an average of 25 cm and in women it ranges from 20 to 26 cm with an average of 23.2 cm ***(Lerche, 1950)***.

Liebermann-Meffert and Duranceau in ***1994*** found that the length of the esophagus is related to the subject's height rather than to sex.

It begins in the neck, at the level of the lower border of the cricoid cartilage and the sixth cervical vertebra; descending anterior to the vertebral column through the superior and posterior mediastina. It traverses the diaphragm, at the level of the tenth thoracic vertebra, and ends at the gastric cardiac orifice level with the eleventh thoracic vertebra. Generally vertical in its course, it has two shallow curves. At its beginning it is median but inclines to the left as far as the root of the neck, gradually returns to the median plane near the fifth thoracic vertebra, and at the seventh deviates left again, finally turning anterior to traverse the diaphragm at the tenth. The tube also bends in an antero-posterior plane to follow the cervical and thoracic curvatures of the vertebral column. It is the narrowest part of the alimentary tract, except for the vermiform appendix, and is constricted:

- At its commencement, 15 cm (6 inches) from the incisor teeth

- Where crossed by the aortic arch, 22.5 cm (9 inches) from the incisor teeth
- Where crossed by the left principal bronchus, 27.5 cm (11 inches) from the incisors
- As it traverses the diaphragm, 40 cm (16 inches) from the incisors.

These data are important clinically with regard to the passage of instruments along the esophagus **(*Gray, 2000*).**

The most useful reference point during upper gastro-intestinal tract endoscopy is the upper incisors which are approximately 13-16 cm above the pharyngo-esophageal junction, 23-26 cm above the tracheal bifurcation, and 38-44 cm above the gastric opening ***(Peters and Demeester, 1997)***.

Supporting and anchoring structures:

The esophagus, both proximally and distally, is stabilized by bony, cartilaginous or membranous structures. At the cranial end, the esophageal musculature is firmly inserted on the posterior margin of the cricoid cartilage with the help of the crico-esophageal tendon. There are minute membranes that anchor the esophageal wall to the trachea, pleura, pre-vertebral fascia and surrounding tissue of the posterior mediastinum ***(Enterline and Thompson, 1994)***.

The distal esophagus traverses the diaphragm through the esophageal hiatus, which is bounded by the two diaphragmatic crura, their insertion on the anterolateral surface of the first two or three lumbar vertebrae

and the organization of their fibers may give a varying shape to the hiatus. This shape is influenced by respiration, swallowing and altered thoraco-abdominal pressure ***(Postlethwait, 1987).***

The Phreno-esophageal membrane: also known as Laimer`s ligament or Allison`s membrane, is an important anatomical structure. Macroscopically, the Phreno-esophageal membrane can be recognized by its well defined lower edge and its slightly yellow color, even in severe peri-esophagitis. The membrane is composed of equal proportion of elastic and collagenous fibrous element which guarantees sufficient pliability. The Phreno-esophageal membrane splits into two sheets. One sheet extends upward 2-4 cm through the hiatus, where elastic and collagenous fibers traverse the esophageal musculature to insert on the submucosa. The other sheet passes across the cardia down to the level of the gastric funds to blend into gastric serosa, the gastro-hepatic ligament and the dorsal gastric mesentery ***(Eckhard et al., 1998).***

The gastro-hepatic ligament: This is the proximal portion of the lesser omentum (that is the embryonic ventral mesentery), which extends from the porta hepatis to the lesser curvature of the stomach and the abdominal esophagus. It contains the following structures: the left gastric vessels, the hepatic division of the left vagal trunk, lymph nodes and in some cases, both vagal trunks, branches of the right gastric vessels, and the left hepatic artery if it arises from the left gastric artery ***(Skandalakis and Ellis, 2000)***.

The gastro-lienal ligament: It is formed on the left side of the gastro-esophageal junction, when the leaves of the gastro-hepatic ligament rejoin. It forms the embryonic dorsal mesentery, behind which lies the lesser sac. The ligament contains the short gastric vessels and lymph nodes. The vessels are always ligated and divided in order to mobilize the fundus and proximal part of the stomach ***(Martin, 1992)***.

The gastro-phrenic ligament: This is the superior part of the dorsal mesentery. It arises from the gastric fundus to the left of the gastro-esophageal junction and abdominal esophagus and extends upwards to the diaphragm. The upper part of this ligament is transparent and vascular; it is the area through which a surgeon may pass a finger to insert in a Penrose drain around the cardia, a useful maneuver in truncal vagotomy ***(Skandalakis and Ellis, 2000)***.

REGIONAL ANATOMY

Cervical esophagus:

Cervical esophagus starts as a continuation of the pharynx, at the lower margin of the cricoid cartilage opposite the six cervical vertebrae. It passes into the chest at the level of the sternal notch ***(Akiyama, 1998).***

The cervical part of the esophagus has the following relations:

Anteriorly: lies the trachea. The recurrent laryngeal nerve ascends one on each side, in or slightly in front of the groove between the trachea and esophagus.

Posteriorly: it adjoins the vertebral column, the longus colli and the prevertebral layer of the deep cervical fascia.

Laterally: on each side, lie the corresponding common carotid artery and the posterior-part of the lobe of the thyroid gland; in the lower part of the neck, where the esophagus projects to the left side, it has a

closer relation to the carotid sheath and the thyroid gland than that on the right side. The thoracic duct ascends for a short distance along the left side of the esophagus. **(*Peter et al., 1995*)**

Thoracic esophagus:

Is at first situated in the superior mediastinum between trachea and the vertebral column, a little to the left of the median plane. It passes behind and to the right of the aortic arch and descends in the posterior mediastinum along the right side of the descending thoracic aorta. Below, as it inclines to the left, it crosses in front of the aorta, and enters the abdomen through the diaphragm at the level of tenth thoracic vertebra. It is in relation:

Anteriorly: (from above downwards), with the trachea, the right pulmonary artery, the left principal bronchus, the pericardium (separating it from the left atrium), and the diaphragm.

Posteriorly: are the vertebral column, the longus colli muscles, the right posterior (aortic) intercostal arteries, the thoracic duct, the azygos vein and the terminal parts of the hemiazygos and accessory hemiazygos veins, and inferiorly, near the diaphragm, the front of the aorta. In the posterior mediastinum, an elongated recess of the right pleural sac intervenes between the esophagus and the vena azygos and vertebral column. **(*Peter et al., 1995*)**

On its left side: in the superior mediastinum the terminal part of the aortic arch, the left subclavian artery, the thoracic duct, and left pleura are immediate relations, while the left recurrent laryngeal nerve runs upwards in, or just in front of the groove between it and the