Surgical Gastroenterology

Volume - 1

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Contents

Volume - 1

Esophagus

1.	Anatomy & Physiology of Oesophagus	1
2.	Benign Oesophageal Lesions	10
3.	Achalasia Cardia	14
4.	Corrosive Oesophageal Injury	33
5.	Esophageal Diverticula	36
6.	Gastro Esophageal Reflux Disease	44
7.	Paraesophageal Hernias	60
8.	Barrett Oesophagus	69
9.	Esophageal Cancer	76
10.	Management of Esophageal Cancer	87
11.	Nonreflux Esophagitis	100
12.	Oesophageal Perforation	105
13.	Diagnostic Workup of Oesophagus	113

Stomach and First Duodenal Segment

14.	Anatomy and Physiology of Stomach	120
15.	Peptic Ulcer Disease	123
16.	Gastrointestinal Stromal Tumors	135
17.	Gastric Lymphomas	148
18.	Gastric Neuroendocrine Tumors	152
19.	Gastric Cancer	157
20.	Gastrinoma	173
21.	Post Gastrectomy Syndromes	183
22.	Miscellaneous Topics	191
23.	Operative Surgery and Conduits	198

Malignant Colon and Rectum

24.	Surgical Anatomy of Colon : I	209
25.	Surgical Anatomy of Colon : II	230
26.	Surgical Anatomy of Colon : III	246
27.	Colonic Bleeding : I	256
28.	Colonic Bleeding : II	274
29.	Surgical Anatomy of Rectum : I	291
30.	Surgical Anatomy of Rectum : II	301
31.	HNPCC : I	311
32.	HNPCC : II	321
33.	Hamartomatous Polyposis Syndromes	335
34.	Surgical Anatomy of Anal Canal	347
35.	Peutz Jeghers Syndrome	363
36.	PTEN Hamartoma Tumor Syndrome	371
37.	Polymerase Proofreading Associated Polyposis	381
38.	Other Polyposis Syndromes	387
39.	Familial Adenomatosis Polyposis : I	396
40.	Familial Adenomatosis Polyposis : II	408
41.	CA Colon : I	416
42.	CA Colon : II	425
43.	CA Colon : III	429
44.	Preoperative Evaluation in CA Rectum : I	440
45.	Preoperative Evaluation in CA Rectum : II	448
46.	MRI in CA Rectum : I	464
47.	MRI in CA Rectum : II	476
48.	Pathological Specimen - CA Rectum	488
49.	Decision Making in CA Rectum : I	500
50.	Decision Making in CA Rectum : II	506

51. Anal Canal Neoplasms 514
52. Appendicular Neoplasms 522
53. Colorectal and Small Bowel NETs 528
54. Presacral Tumors 539

Volume - 2

Benign Colon and Rectum

55. Colonic Volvulus 551
56. Colonic Intussusception 564
57. IBD : Ulcerative Colitis I 568
58. IBD : Ulcerative Colitis II 577
59. IBD : Crohn's Disease I 585
60. IBD : Crohn's Disease II 592
61. Colonic Ischemia 599
62. Rectal Prolapse 605
63. RVF & RUF 611
64. Pelvic Floor Dysfunction 619
65. Fecal Incontinence 629
66. Constipation 636

Small Bowel

67. Internal Hernia 649
68. Small Bowel Adenocarcinoma 656
69. Small Bowel Diverticula 668
70. Mesenteric Ischemia 673

Liver Surgery

71. Anatomy of Liver 681
72. Benign Space Occupying Lesions of Liver 691

73. Cystic Space Occupying Lesions of Liver 697
74. Hepatocellular Carcinoma 707
75. Liver Transplantation 715
76. Immunosuppression 724

Biliary Surgery

77. Basics of Biliary System 733
78. Gallstones 742
79. Recurrent Pyogenic Cholangitis 754
80. Primary Sclerosing Cholangitis 762
81. Carcinoma Gall Bladder 768
82. CBD Stones : I 773
83. CBD Stones : II 780
84. Perihilar Cholangiocarcinoma 788
85. Biliary Stricture 796

Pancreas

86. Anatomy and Embryology of Pancreas 804
87. Pancreas Transplantation 813
88. Acute Pancreatitis 820
89. Chronic Pancreatitis 832
90. Cystic Neoplasm of Pancreas 845
91. Pancreatic Neuroendocrine Tumors 856
92. Carcinoma Pancreas 871
93. Pancreas Imaging 884

ANATOMY & PHYSIOLOGY OF OESOPHAGUS

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Swallowing :

3 phases :

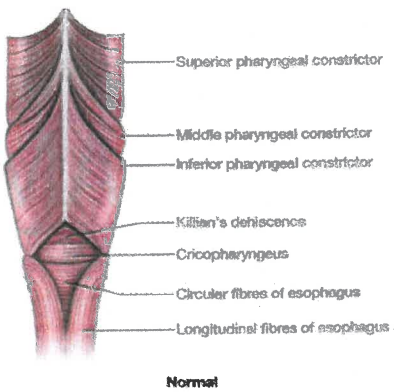
- Oral : Voluntary, initiated when food enters mouth and continues till it reaches soft palate.
- Pharyngeal : Involuntary, involves passage of food bolus from soft palate through pharynx, propelled by pharyngeal muscles.
- Oesophageal : Involuntary, begins when upper oesophageal sphincter (UES) opens.

Upper esophageal sphincter (UES)

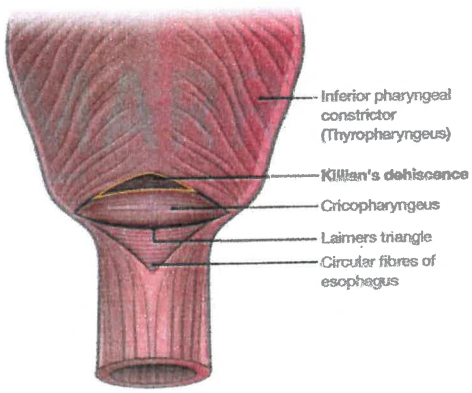
00:02:27

Anatomy :

- Composed of cricoid cartilage, hyoid bone, cricopharyngeal and inferior pharyngeal constrictor muscles.
- Cricoid cartilage at the ventral border and cricopharyngeal muscle toward its lateral and posterior borders.
- Pressure profile asymmetric.
- Nerve supply : Vagus (main supply), also by CN - IX and XII.
- Moves up by 1 cm (Pharyngeal phase) and relaxes for 1 second.
- Cricopharyngeus muscle :
  - Continuous band of striated muscle originating from the cricoid cartilage, without a posterior raphe.
  - Blends superiorly with the inferior pharyngeal constrictor muscle and inferiorly with the circular muscles of the oesophagus.



Posterior view of pharynx : Zenkers diverticulum



Killian's dehiscence

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Assessment of UES :

Indication : Cervical dysphagia.

Anatomic assessment :

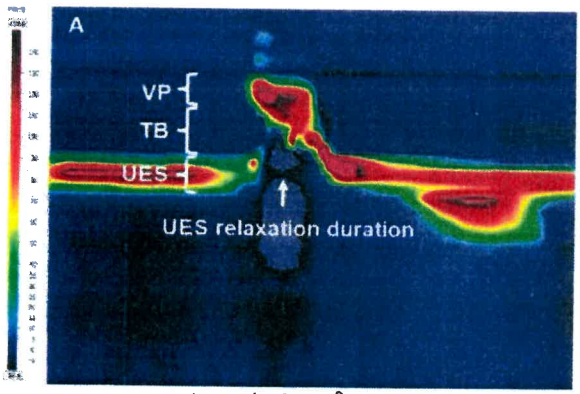
To identify structural deformities/blockages : Eg. Pharyngeal diverticulum, tumors.

- Barium swallow.
- Upper GI endoscopy.

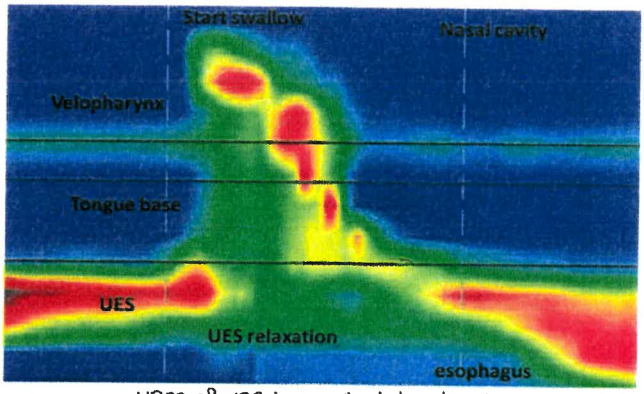
Functional assessment :

Eg., neurological (CVA, Poliomyelitis, Parkinson disease, multiple sclerosis)/ muscular disorders (Polymyositis, myasthenia gravis).

- High speed photography.
- Video manometry.
- High Resolution manometry (HRM).



Normal HRM of UES



HRM of UES in cervical dysphagia

Cervical esophagus 00:10:21

Anatomy :

- 5 cm in length, extends from cricoid cartilage at C6 vertebra to suprasternal notch anteriorly and T1-T2 interspace posteriorly.
- Blood supply : Right and left superior and inferior thyroid arteries, drains into inferior thyroid vein.
- middle thyroid vein is divided for exposure of cervical oesophagus.
- Innervation : Recurrent laryngeal nerves.
- Iatrogenic perforation : Above cricopharyngeal muscle → Posterior pharyngeal perforation.

3 fascia around oesophagus :

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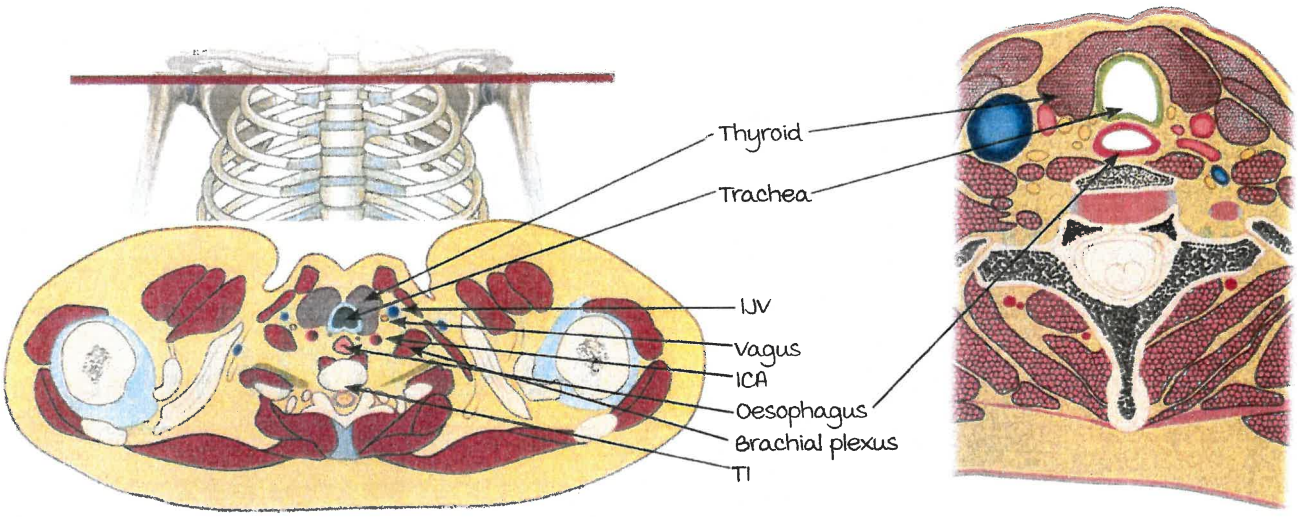
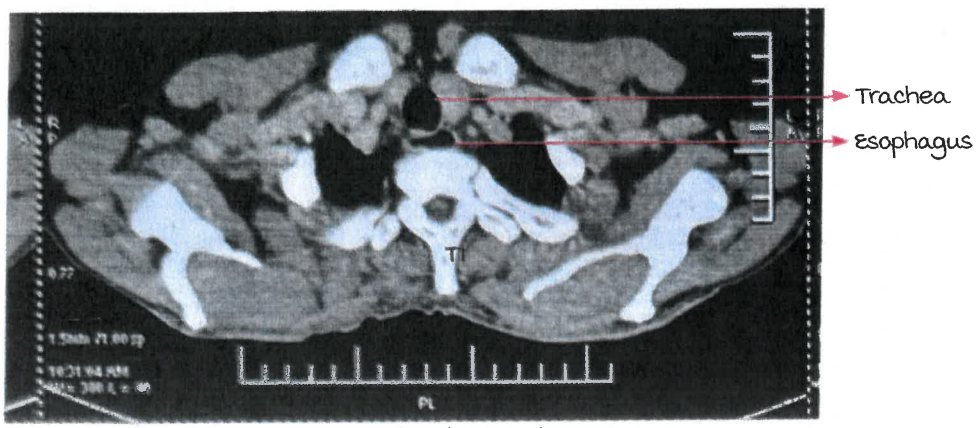
- Anterior : Pretracheal fascia.
- Posterior : Prevertebral fascia.
- Lateral : Carotid sheaths.

2 compartments :

- Paraesophageal space :
  - Anterior to oesophagus.
  - Formed by pretracheal fascia and carotid fascia on either side.
  - Extends to the pericardium.
  - Infections from tonsillar/dental abscesses spread quickly into the mediastinum.
- Retroesophageal space :
  - Posterior to oesophagus.
  - Formed by prevertebral fascia and carotid fascia on either side.
  - Extends to diaphragm, connecting compartments in the neck and chest.



Cervical oesophagus at TI



CT : Cervical esophagus at TI

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Thoracic esophagus

00:17:13

Anatomy :

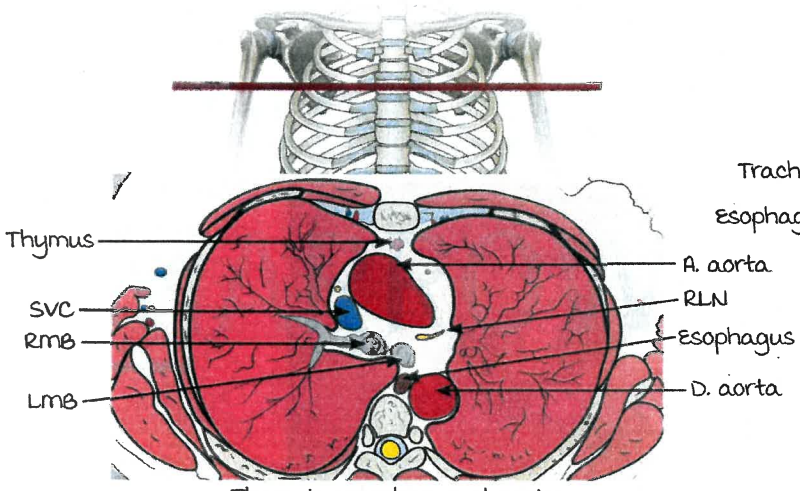
- 20 cm long, extends from thoracic inlet to diaphragmatic hiatus.
- Blood supply : Bronchial arteries, branches from descending aorta (6th to 9th vertebra).
- Venous drainage : Azygos, hemiazygos & bronchial veins.

Relations and course :

- Shifts to right at the level of T7 vertebra ⟶ Right thoracotomy or thoracoscopy for surgical approach at mid thorax.
- Upper thorax :
  - Anterior : Trachea.
  - Right side : Azygos.
  - Left side : Left subclavian artery and aortic arch.
- Descending aorta : Turns posteriorly and continues left of oesophagus until T8, where the oesophagus moves anterior to aorta.
- Left lateral distal oesophagus :
  - Covered only with mediastinal pleura → Results in a weak area.
  - M/c site for spontaneous Boerhaave perforation.

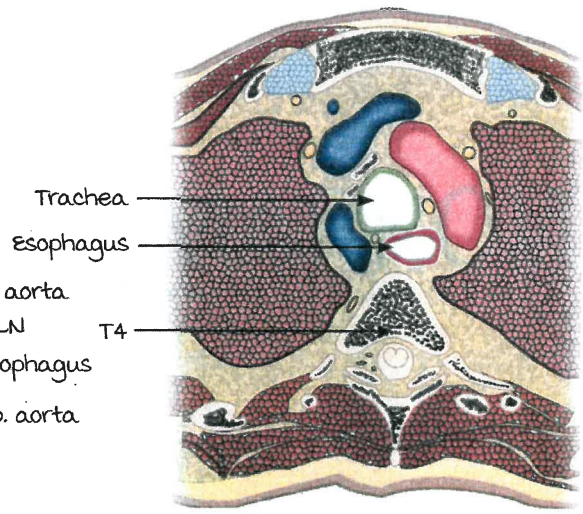
Note :

Bleeding during oesophageal dissection during trans-hiatal esophagectomy is best controlled by : Packing the mediastinum.



Thoracic oesophagus at carina

RLN : Recurrent laryngeal nerve, RMB : Right main bronchus, LMB : left main bronchus, A. aorta : Ascending aorta, D. aorta : Descending aorta



Thoracic oesophagus at T4

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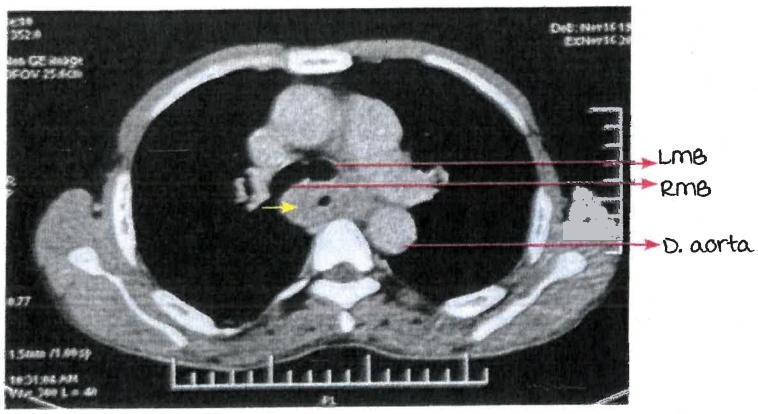
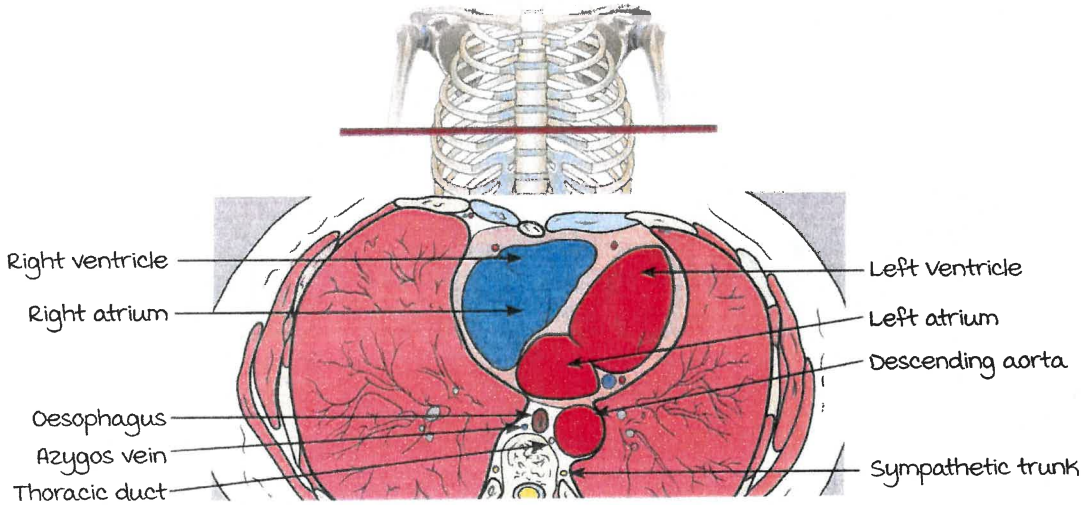
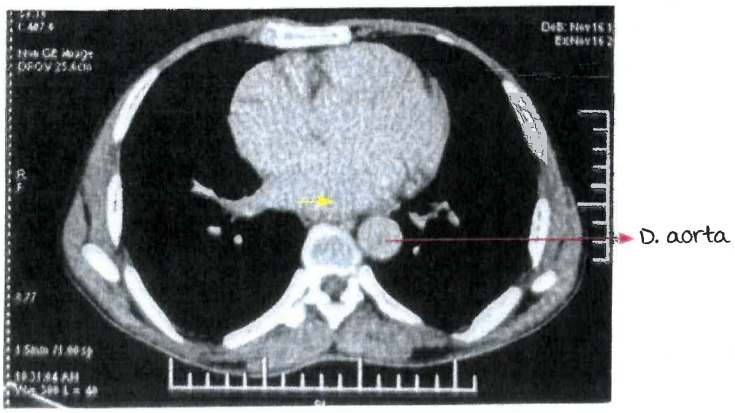


CT : Thoracic oesophagus at T4 (Arrow)
abnormally thick d/t oesophageal carcinoma



Thoracic oesophagus at midthorax



CT : Thoracic oesophagus at midthorax (Arrow)

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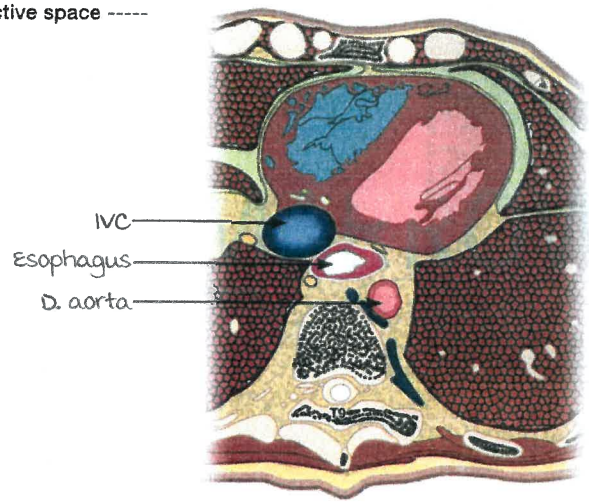
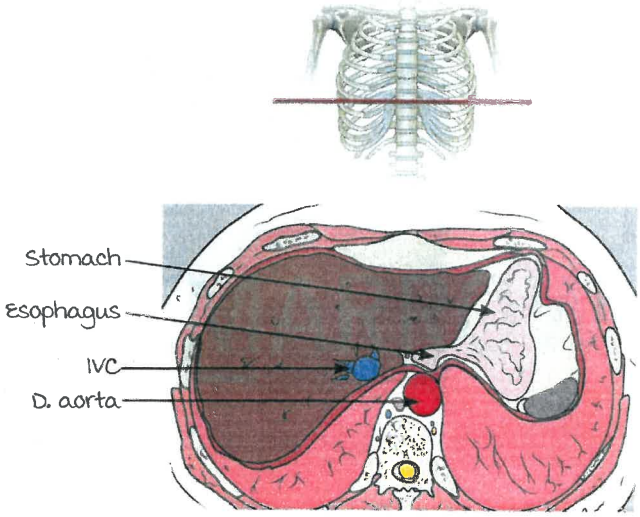


Thoracic oesophagus at T9



OG junction

Lower esophageal sphincter 00:29:03

Anatomy :

- Best studied by Liebermann-Meffert.
- Mechanical description : Demeester school.
- Dynamic concept : Gastroenterologists Dent and Dodds, involving transient Lower Esophageal Sphincter Relaxations (tLESR).

3 manometrically assessed components :

- Overall length of the high pressure zone.
- Sphincter pressure.
- Sphincter position : Expressed by intraabdominal length of high pressure zone.

Note :

- Phrenoesophageal membrane : Not circular ligament, has a triangular opening.
- Vagal branches regulate the neurological function of LES.
- Main body of the crura develop their muscle structure from a caudal posterior position.
- Integrated Relaxation Pressure (IRP) :
  - Best metric to differentiate between normal and impaired EGJ relaxation.
  - Factors influencing IRP : Intrabolus pressure, LES relaxation & crural diaphragm.

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EGJ subtypes :

- Type I : LES and CD are completely overlapped.
- Type II : Pressure peaks between LES and CD are separated, with the separation ≤ 2 cm.
- Type III : Separation between LES and CD > 2 cm.
  - IIIa : Pressure inversion point remains at level of CD.
  - IIIb : Pressure inversion point is localized at level of LES.

Esophageal peristalsis :

Primary peristalsis :

- Wave initiated by swallowing.
- Travels at a speed of 3-4 cm/s.
- Reaches amplitudes of 60-140 mmHg in the distal oesophagus.

Secondary peristalsis :

- Local stimulation by distension at any point in the body of oesophagus → Peristaltic wave from the point of stimulus.
- Aids oesophageal emptying when the primary wave has failed to clear the lumen of ingested food, or when gastric contents reflux from the stomach.

Tertiary peristalsis :

- Abnormal.
- Frequently seen in elderly people who have no symptoms of oesophageal disease.

Vagus Nerves :

- Provide parasympathetic innervation.
- Innervate myenteric (Auerbach) and meissner plexus.
- Achalasia results from degeneration of Auerbach plexus.
- Anterior fibres from left vagus coalesce into anterior vagus.
- Posterior fibres from right vagus form posterior vagal trunk.
- Both vagal trunks can contain left or right vagal nerves.

Trachea :

- Oesophagus is closely related to the membranous trachea.
- During dissection of cervical oesophagus, injury to trachea could happen.
- Carina is located at 25 cm from the incisors
- Oesophageal tumors proximal to carina can cause tracheal invasion.
- Tumors below carina, close to left mainstem bronchus can result in a bronchoesophageal fistula.

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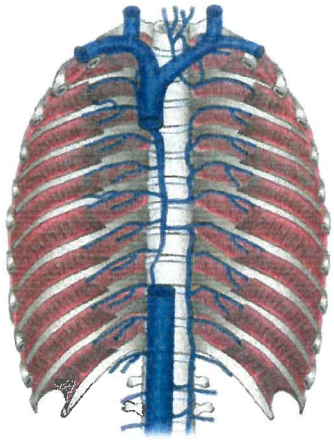
Azygos Vein :

- Origin : Lumbar azygos vein/ inferior vena cava.
- Tributaries : Hemiazygos & accessory hemiazygos vein.
- Drains to : Superior vena cava just before it pierces pericardium.
- Course : Ascends in posterior mediastinum, right posterolateral aspect of descending thoracic aorta, anterior to T4–T12 vertebrae.
- At T4 arches above right pulmonary hilum, drains into SVC.



Azygous venous system

Recurrent Laryngeal Nerve :

- Originate from the vagus nerves
- Right nerve recurs posteriorly around right subclavian artery
- Left nerve recurs around the aortic arch.
- Both recurrent nerves ascend in tracheoesophageal groove.
- Left nerve comes closer to oesophagus, as cervical oesophagus deviates to left.
- Non-recurrent nerve : Occurs rarely on the right.
- Also innervate the cricopharyngeal muscle and cervical oesophagus.
- Unilateral Injury → Hoarseness, with impaired swallowing and aspiration.
- Injury to both recurrent nerves → Bilateral vocal cord paralysis, airway obstruction and need for tracheostomy.

Thoracic Duct :

- Begins in the abdomen as the cisterna chyli at T12.
- Passes through aortic hiatus along with azygos vein.
- Lies on anterior surface of vertebra, posterior to oesophagus between the azygos on right and descending aorta on left.
- Right and posterior to the oesophagus up to T7, crosses midline to left side at T5.
- Ascends 2–3 cm above clavicle and descends to empty into junction of left subclavian and internal jugular veins.
- Mass ligation in chylothorax : Tissue between azygos vein and aorta is ligated just above diaphragm.

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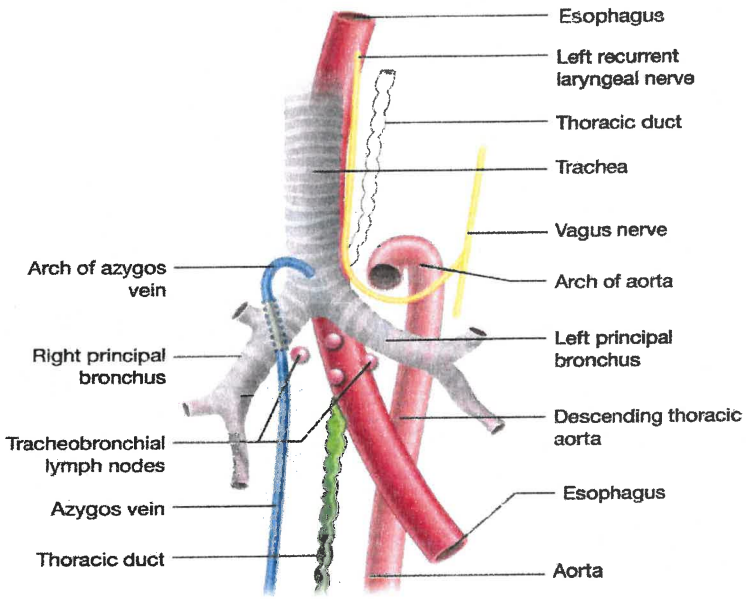
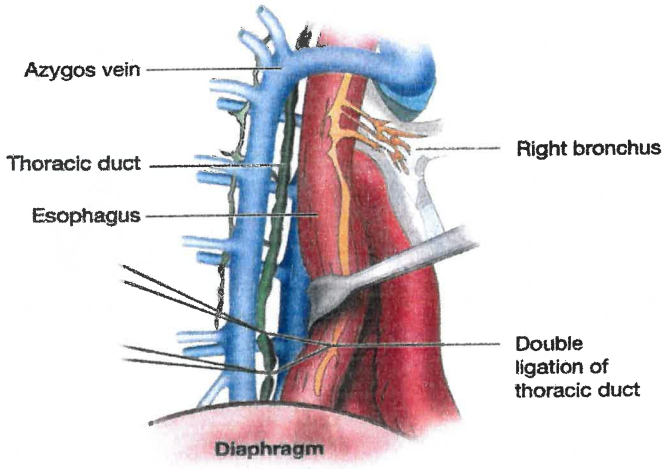


Course of oesophagus



mass ligation

----- Active space -----

BENIGN OESOPHAGEAL LESIONS

Esophageal duplication cyst

00:00:15

Overview :

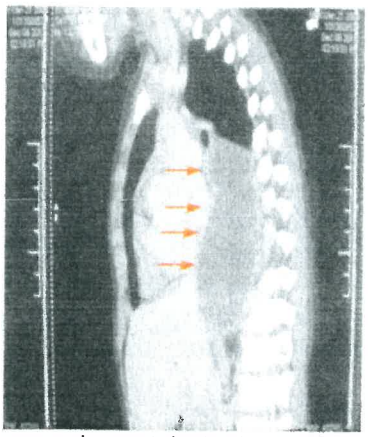
- 2nd m/c benign posterior mediastinal lesion in children (m/c : Bronchogenic cyst).

Types :

- Cystic form (80%) : No luminal communication.
- Tubular form (20%) : Communicates with esophageal lumen.
- May contain heterotopic gastric or pancreatic mucosa.

Palmer's criteria :

- Lesion should be within or attached to esophageal wall.
- 2 layers of smooth muscle (Inner circular and outer longitudinal).
- Cyst wall lining should contain ciliated epithelium or embryologic tissue.



Esophageal duplication cyst

Investigations :

- CT : Smooth, well-defined hypodense lesion in posterior mediastinum close to esophagus.
- Endoscopy : Submucosal lesion.

Treatment :

Resection (Recommended over EUS/FNA); risk of ulceration, malignant transformation).

Esophageal leiomyoma

00:01:50

Overview :

- m/c benign esophageal or GE junction tumour.
- m/c location : Distal two-thirds of the esophagus.
- M : F = 2 : 1.
- Originate in intramural layers of the esophagus.
- 50% Asymptomatic.

Indications for resection :

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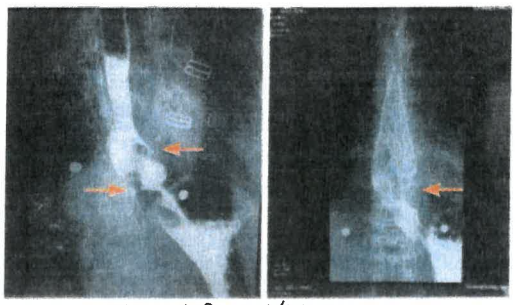
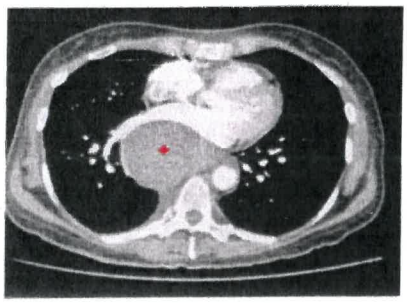
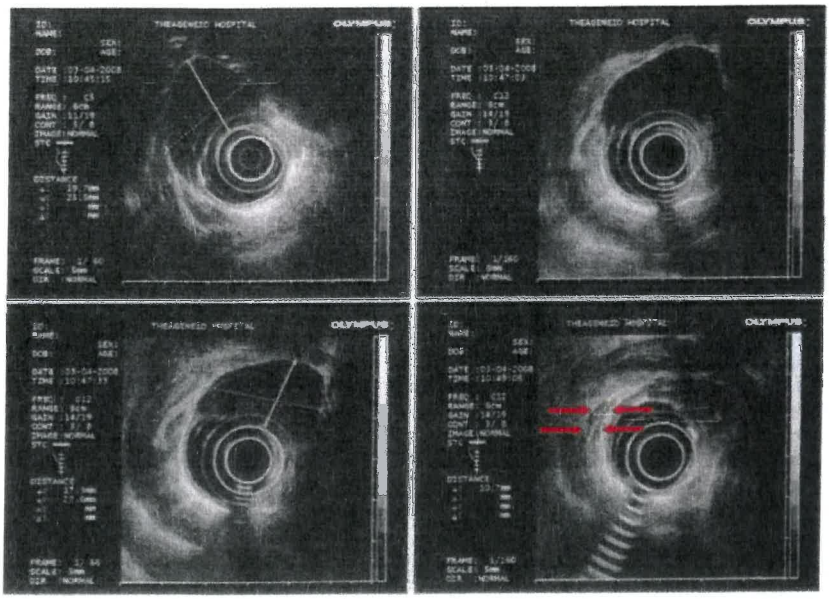
- Symptomatic lesions.
- Inability to rule out malignancy or distinguish from GIST.
- Atypical imaging findings.
- Overlying mucosal erosion or dysplastic changes.
- Regional lymphadenopathy, large tumors.
- Tumour growth during surveillance.



Filling defect d/t leiomyoma



Leiomyoma



Endoscopy in leiomyoma

Esophageal GIST 00:03:03

Overview :

- Less common than leiomyoma.
- M : F = 2 : 1.
- Highest malignant potential.

----- Active space -----

Management :

- Indications for surgical resection :
  1. Size >2 cm.
  2. Size < 2 cm + high-risk.
  3. Symptomatic or increasing size.
- Lymphadenectomy : Not required unless there are pathologically positive nodes.
- Re-resection of microscopically positive resection margins : Generally not indicated.

Schwannoma 00:03:50

Features :

Least common among esophageal mesenchymal submucosal tumors.

- Present between 4^{th}–6^{th} decade of life.
- No gender predominance.

Origin : Interstitial cells of Cajal.

Location : Stomach (60%), esophagus (5%).

Histology : Moderately cellular with spindle cells.

IHC :

- Positive : S-100, GFAP.
- Negative : c-KIT, CD34, SMA.

m/c presenting symptom : Dysphagia.

Management

- PET scan : FDG avid (Similar to leiomyoma, GIST).
- Treatment :
  - Surgery (mainstay).
  - Chemotherapy and radiation are ineffective.

Fibrovascular polyps 00:04:53

Overview :

- Rare but m/c intraluminal tumour of the esophagus.
- Originates as submucosal thickening near cricopharyngeus muscle → Elongates into polypoid shape due to esophageal peristalsis.