Imaging of GI malignancies for diagnosis & contouring

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Inroduction

- Examination and visualization of anatomy and pathology of GI tract is mandatory for diagnosis.
- Traditional imaging techniques played a leading role.
- Introduction & advances in non-invasive imaging techniques.

Revolutionized GI tract imaging.

Advances in imaging

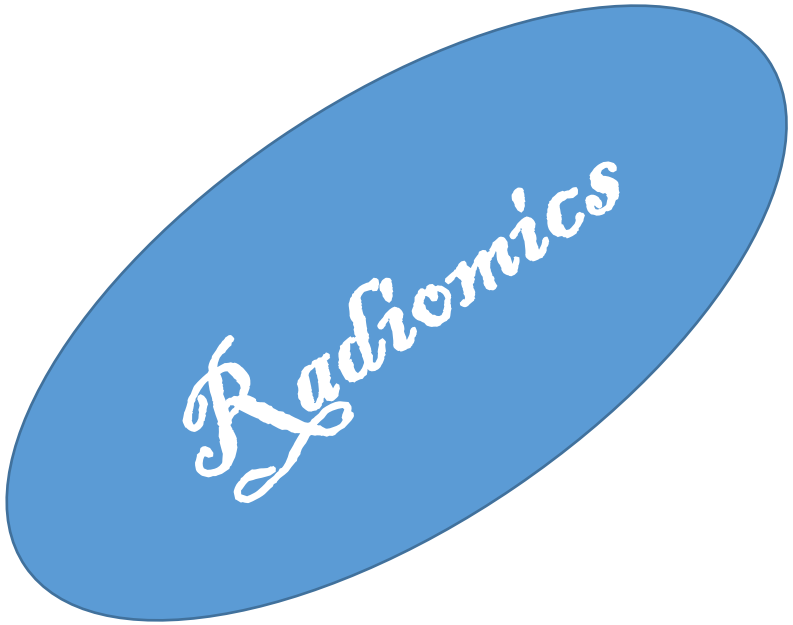
- Imaging data
- 3D acquisition
- Tools for filtering
- Enhancement
- Segmentation
- Tissue classification

Advances in imaging

- Co registration techniques.

- Multimodal data acquisition techniques.

- Improved classification of tissue pathology



- Distinct profile of favourable & unfavourable features.

  Technique used is dependent on

  Availability

  Accuracy

  Usefulness

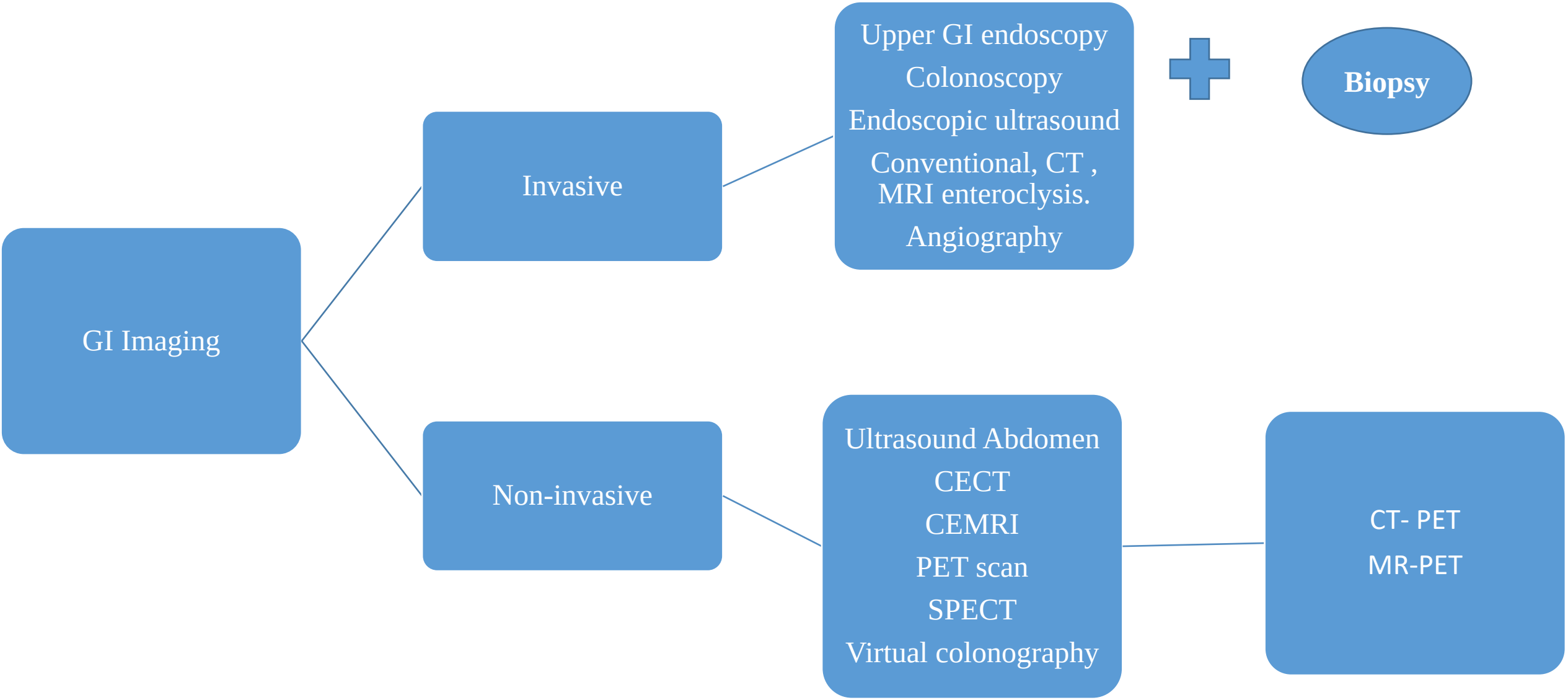
  Safety

  Costs

Diagnostic performance

- Specific method & equipment used.
- Part of GI investigated.
- Patient constitution and preparation.
- Pathology being studied.
- ‘ Gold standard’ compared with.

Diagnostic imaging for GI Malignancies.

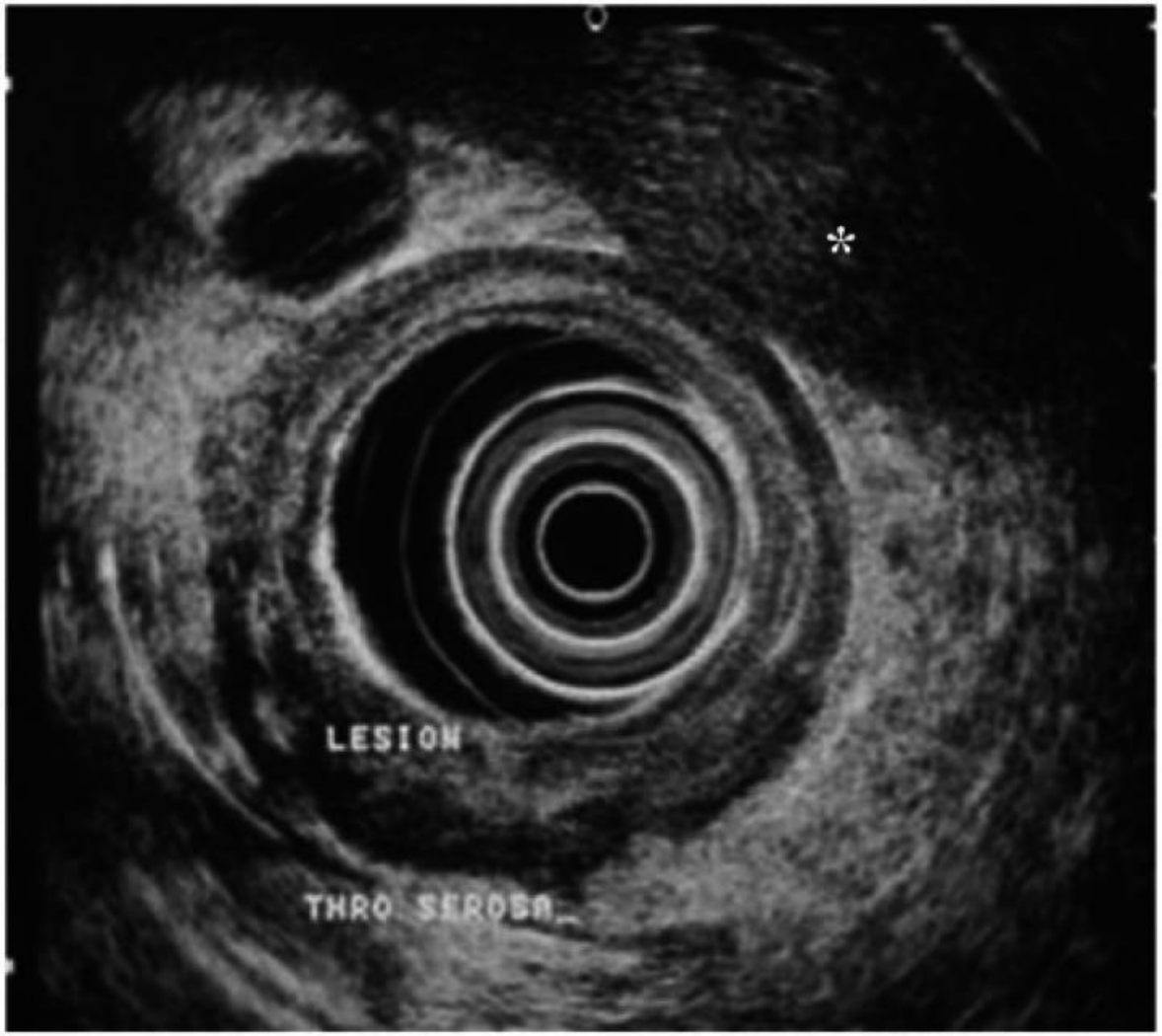


Primary GI malignancies

- Adenocarcinoma
- Lymphoma
- Carcinoid
- Mesenchymal tumours
- Squamous cell carcinoma

Transluminal ultrasound

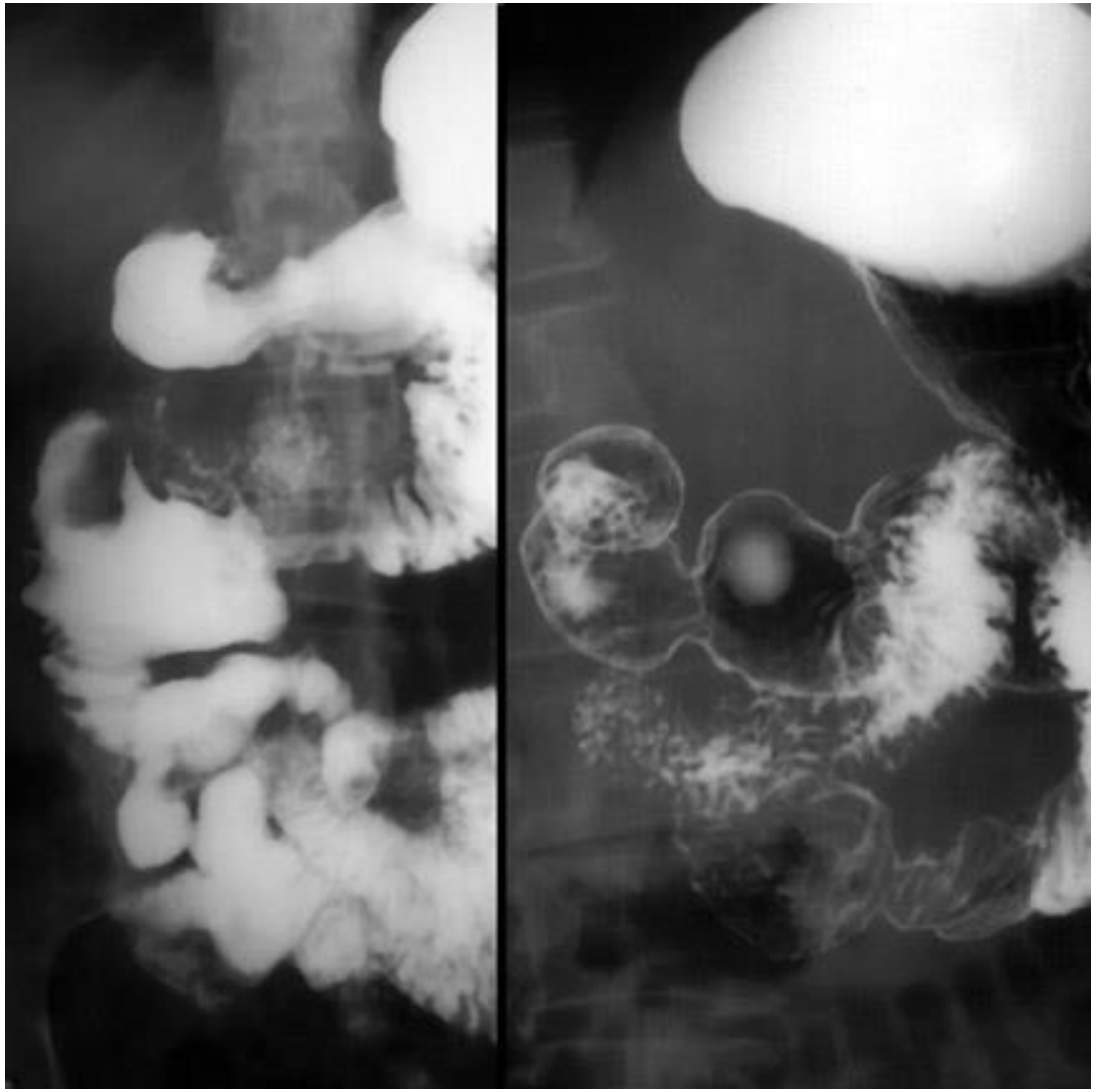
- Safe procedure with no radiation exposure.
- Excellent soft tissue imaging capabilities.
- Allows visualization of intestinal wall fluid, filled intestinal segments & surrounding environment.
- Helps in detecting
  - wall thickening
  - disturbed wall morphology
  - surrounding oedema
  - lymphadenopathy

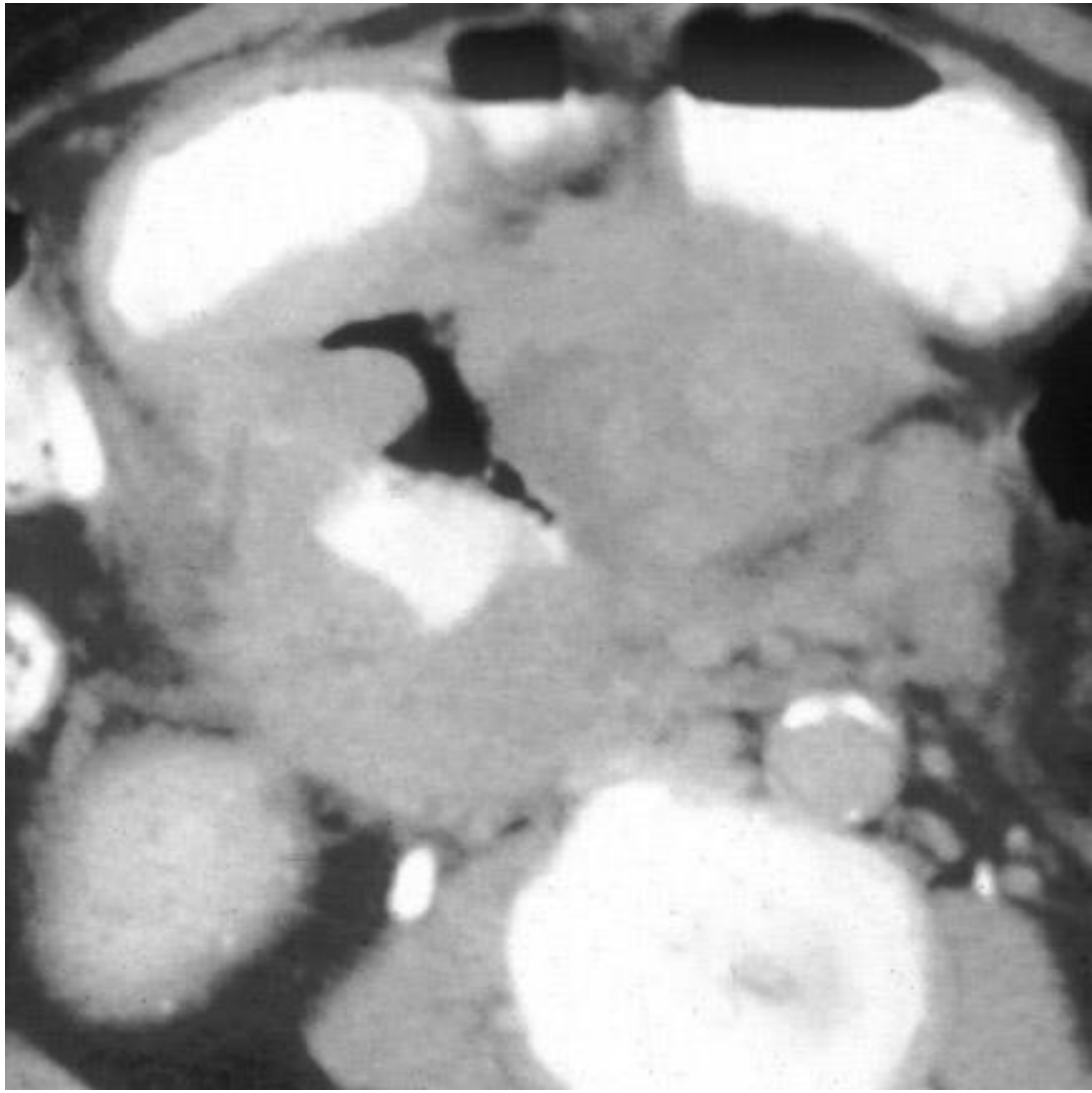


Computed Tomography

- MDCT
- Fast acquisition of thin slices
- Multi-planar reconstructions.
- Valuable in the study of intestinal loops.
- NCCT abdomen is replacing plain radiography
- CECT is valuable in diagnosing inflammatory and neoplastic intestinal lesions

2D versus 3D imaging





CT imaging features: benign versus malignant

Bowel wall thickening

Normal bowel wall thickening is ≤ 3mm.

Frequent cause of pseudo thickening – Incomplete distention

Adequate luminal dilatation with wall thickening connotes pathology.

CT features that help in diagnosis

1. Bowel wall attenuation & enhancement.
2. Degree of wall thickening.
3. Length of involvement.
4. Morphology.

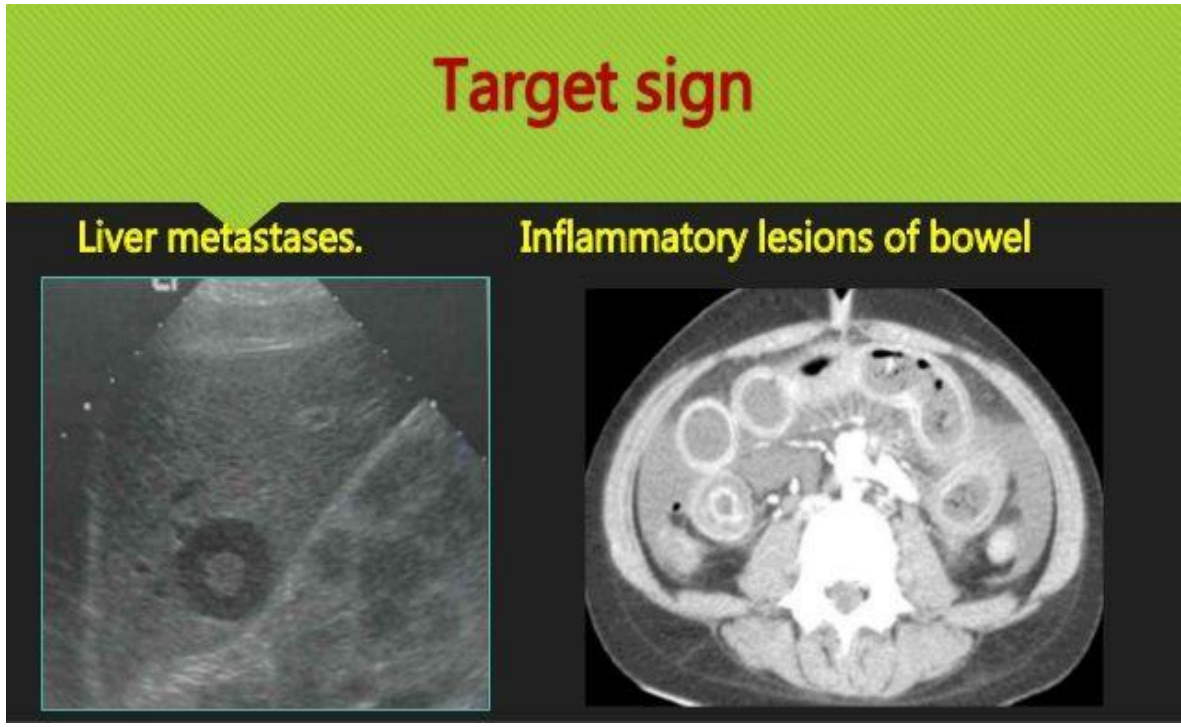
Bowel wall attenuation & enhancement

- Bowel wall stratification- target or double halo sign.

- Smooth alternating low and high attenuation layers conforming to the circumferential strata of bowel wall- benign.

- Exception- Scirrhous adenocarcinoma.

- Heterogenous wall attenuation not conforming to bowel wall- malignant



Degree of bowel wall thickness

- Bowel wall thickness < 1cm – Benign
- Bowel wall thickness > 2 cm – Malignant

Thickened bowel wall can be seen in benign conditions also

Ulcerative colitis

Crohn’s disease

Mycobacterial infection

Cytomegalo virus infection

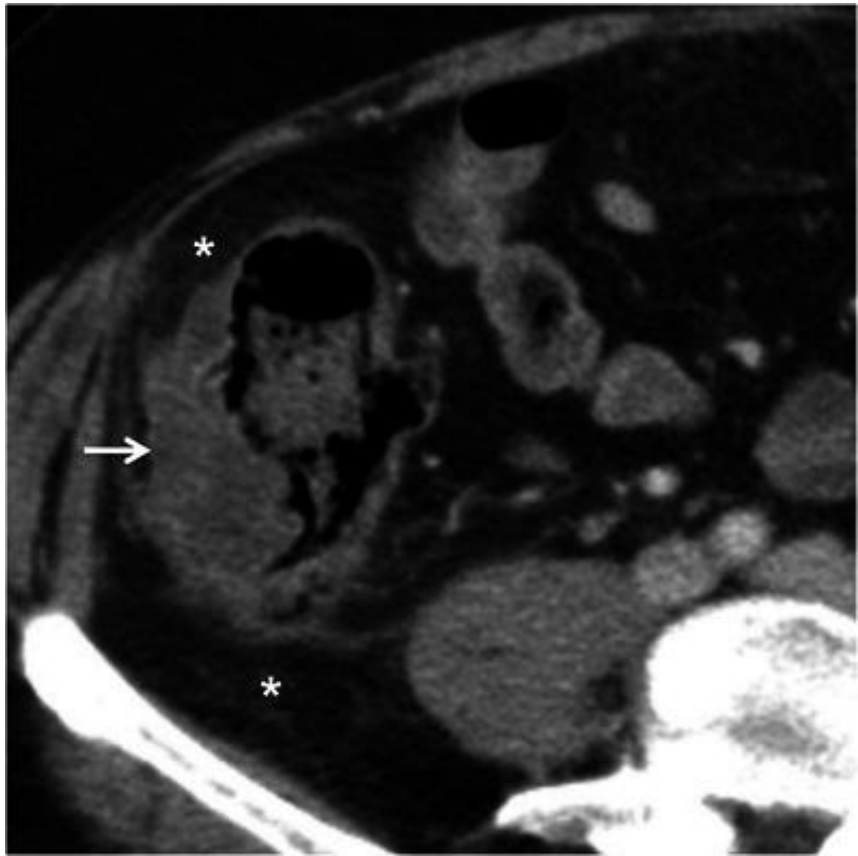
Length of involvement

- Pathology affecting > 20 cm of bowel – benign
- Wall thickening involving < 5 cm – malignant
- 5-20 cm- non specific

- Segmental involvement →
  - Non Hodgkin's lymphoma
  - Granulomatous diseases
  - Bowel haemorrhage

Bowel wall morphology

- Homogenous, symmetric, smooth & tapered wall thickening - Benign
- Irregular, asymmetric, eccentric & abrupt wall thickening – Malignant.



Cavitary masses

- Uncommon but important morphological pattern.

- Differential diagnosis

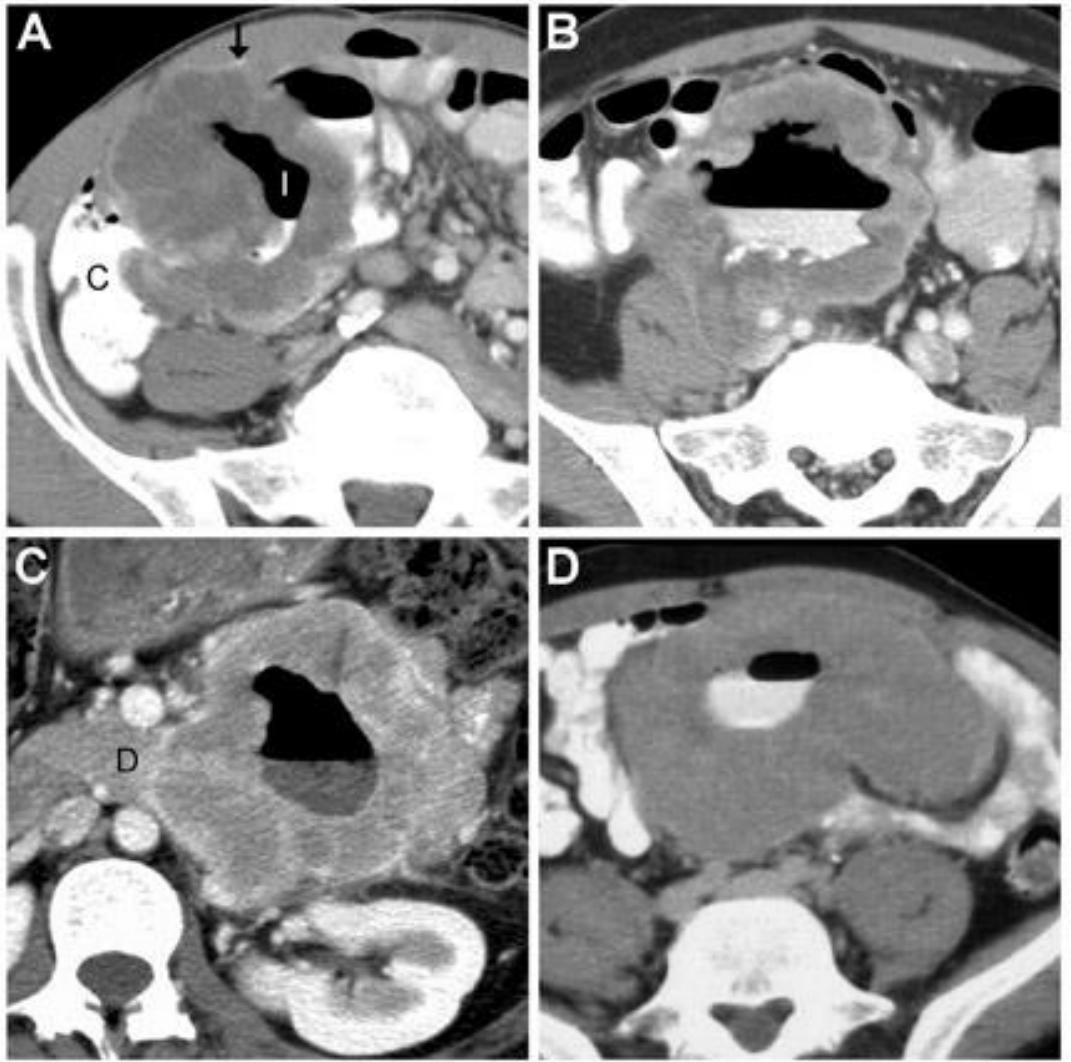
  Adenocarcinoma.

  Non Hodgkin’s lymphoma.

  GIST.

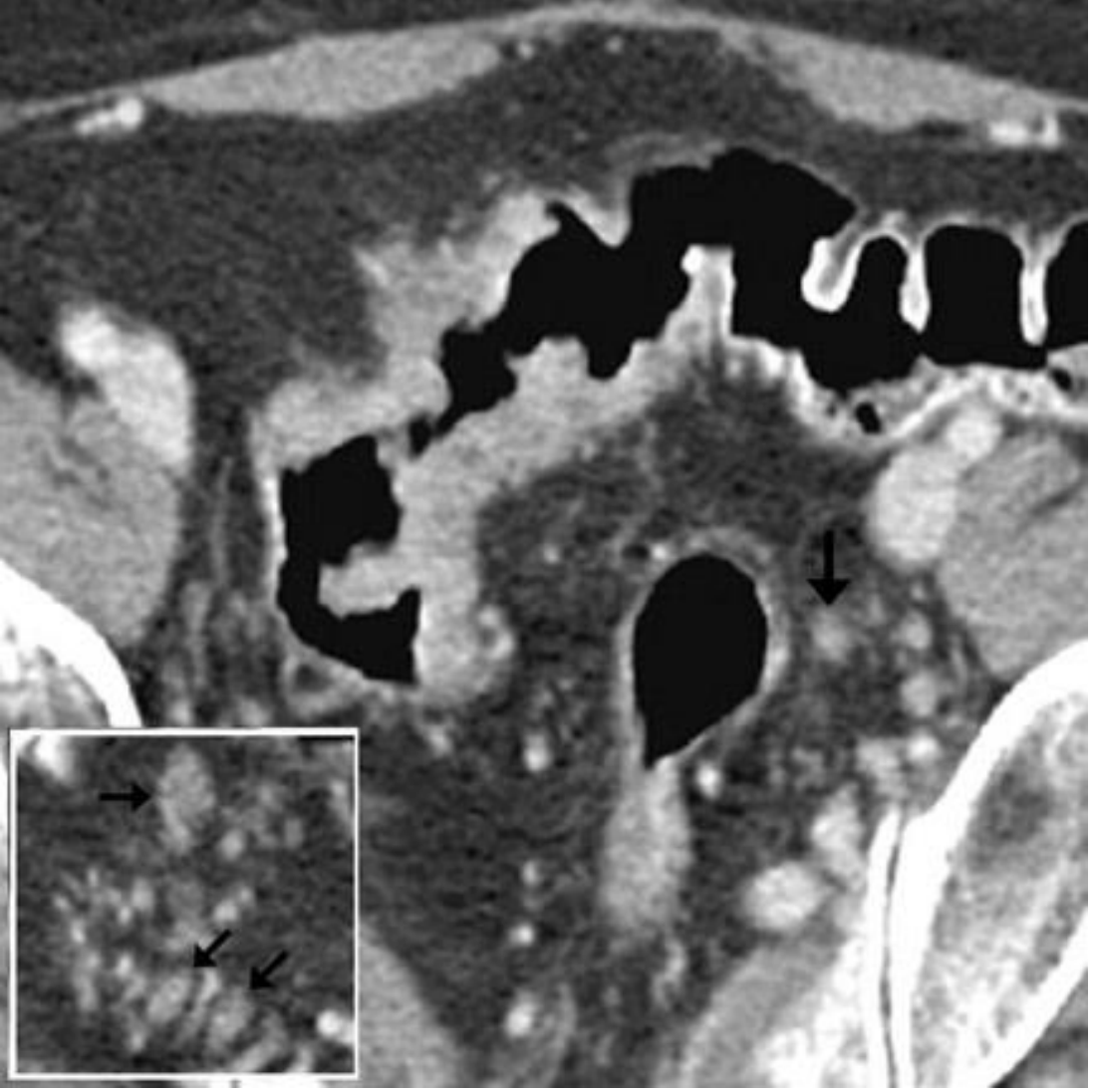
  Metastasis.

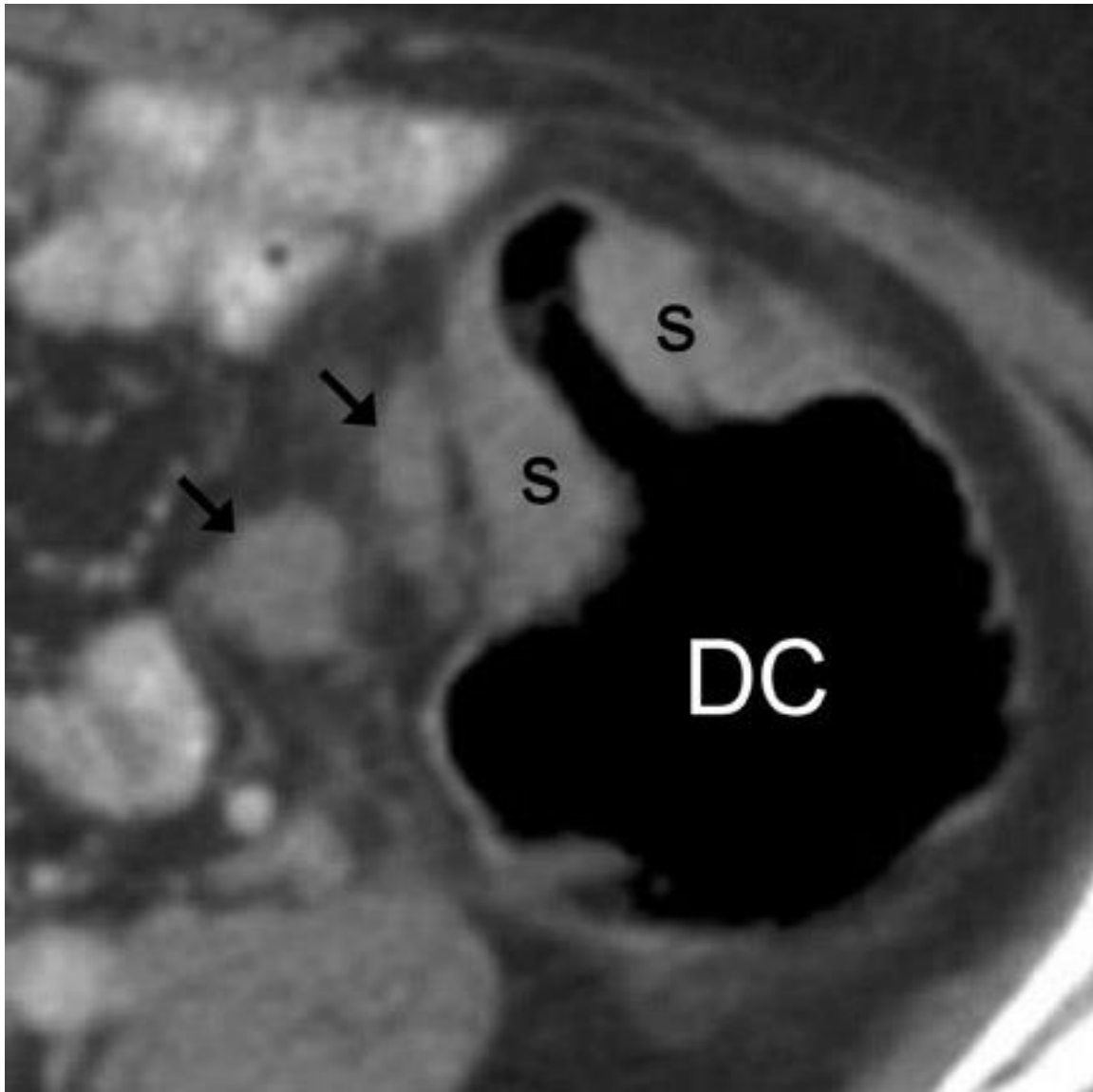
  Diverticulitis with abscess formation.



Adenocarcinoma- Imaging features.

- Irregular asymmetric wall thickening.
- Luminal narrowing with tendency for obstruction.
- Short segment involvement
- Abrupt transition from unaffected bowel wall to mass- Shouldering
- Locoregional lymph node involvement.
- Lobulated polypoidal mass
- Superficial nodular mass
- Deep ulcerative mass
- Rigid fixed appearance- Linitis plastic.
- Calcification – mucinous adenocarcinoma

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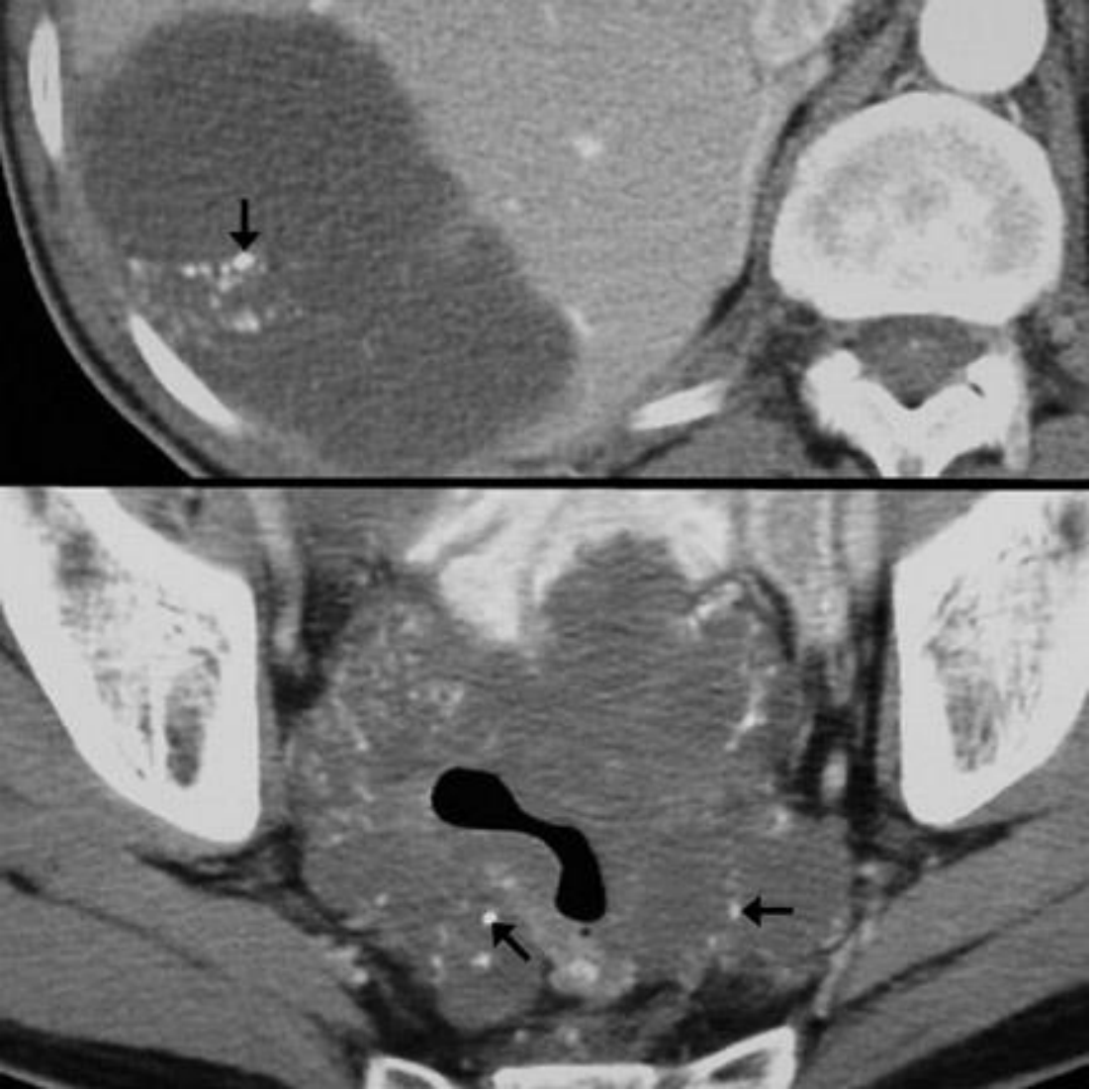
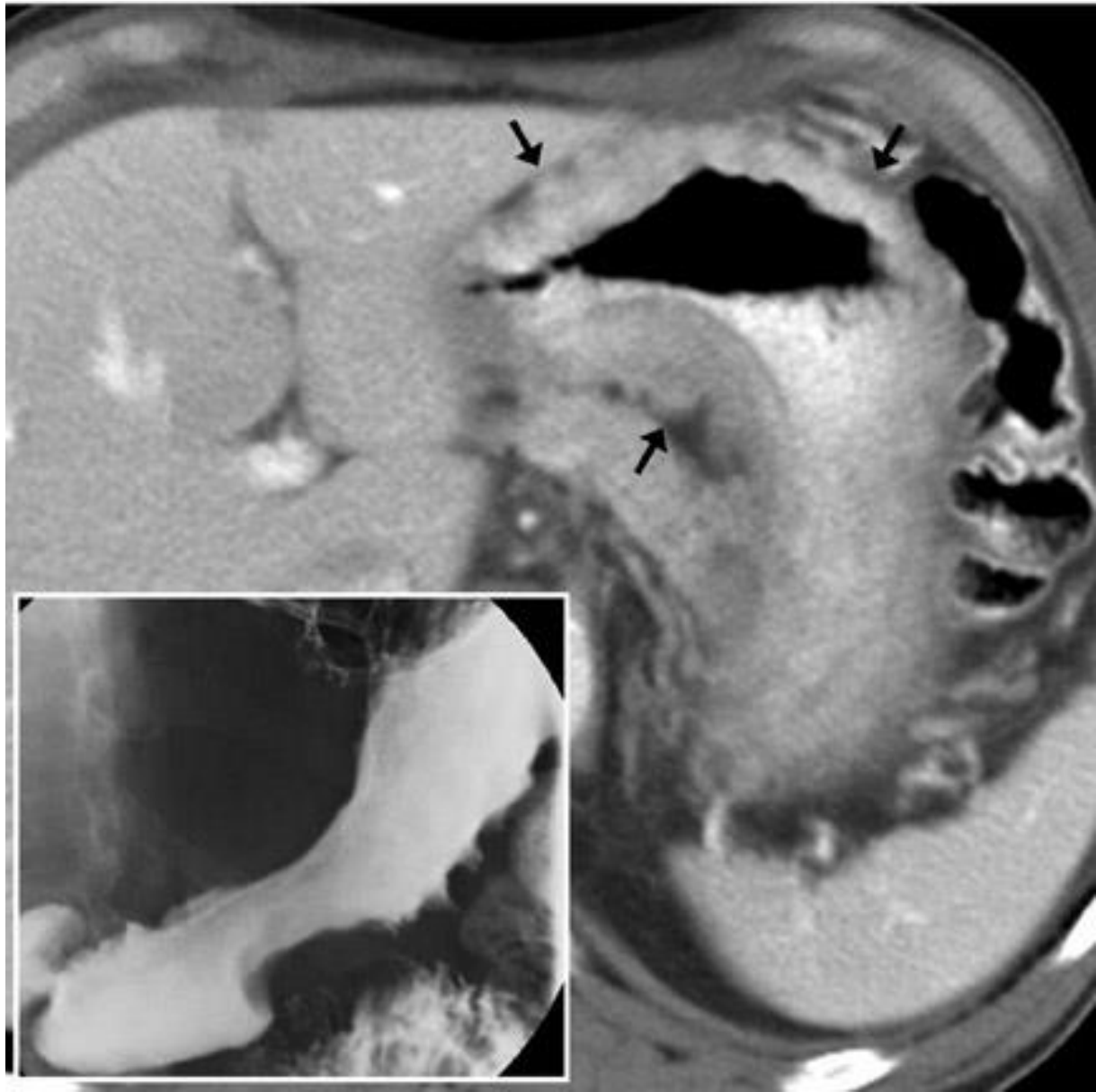




Lobulated polypoid mass

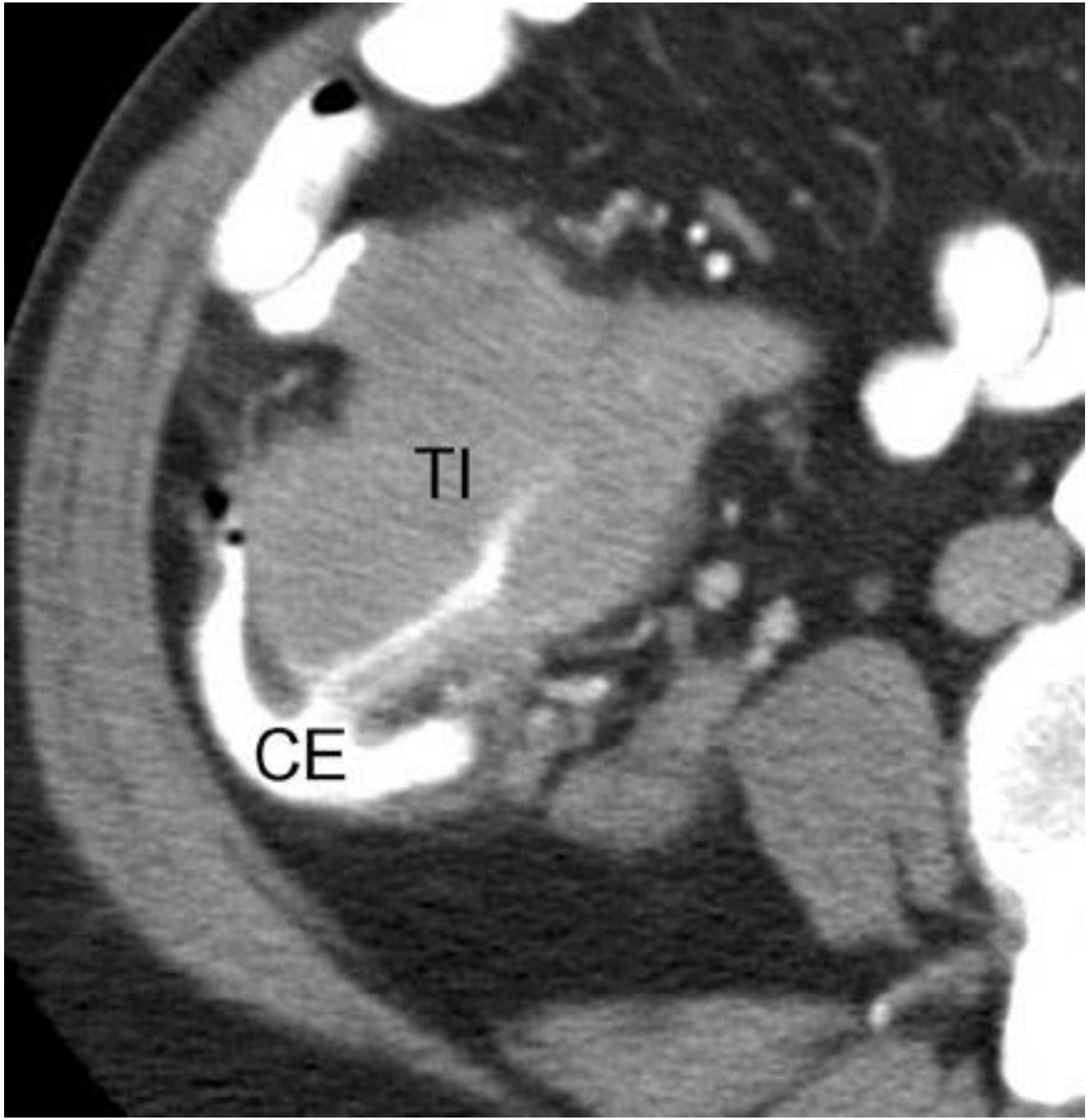
Krukenberg tumour

Lymphoma- Imaging features

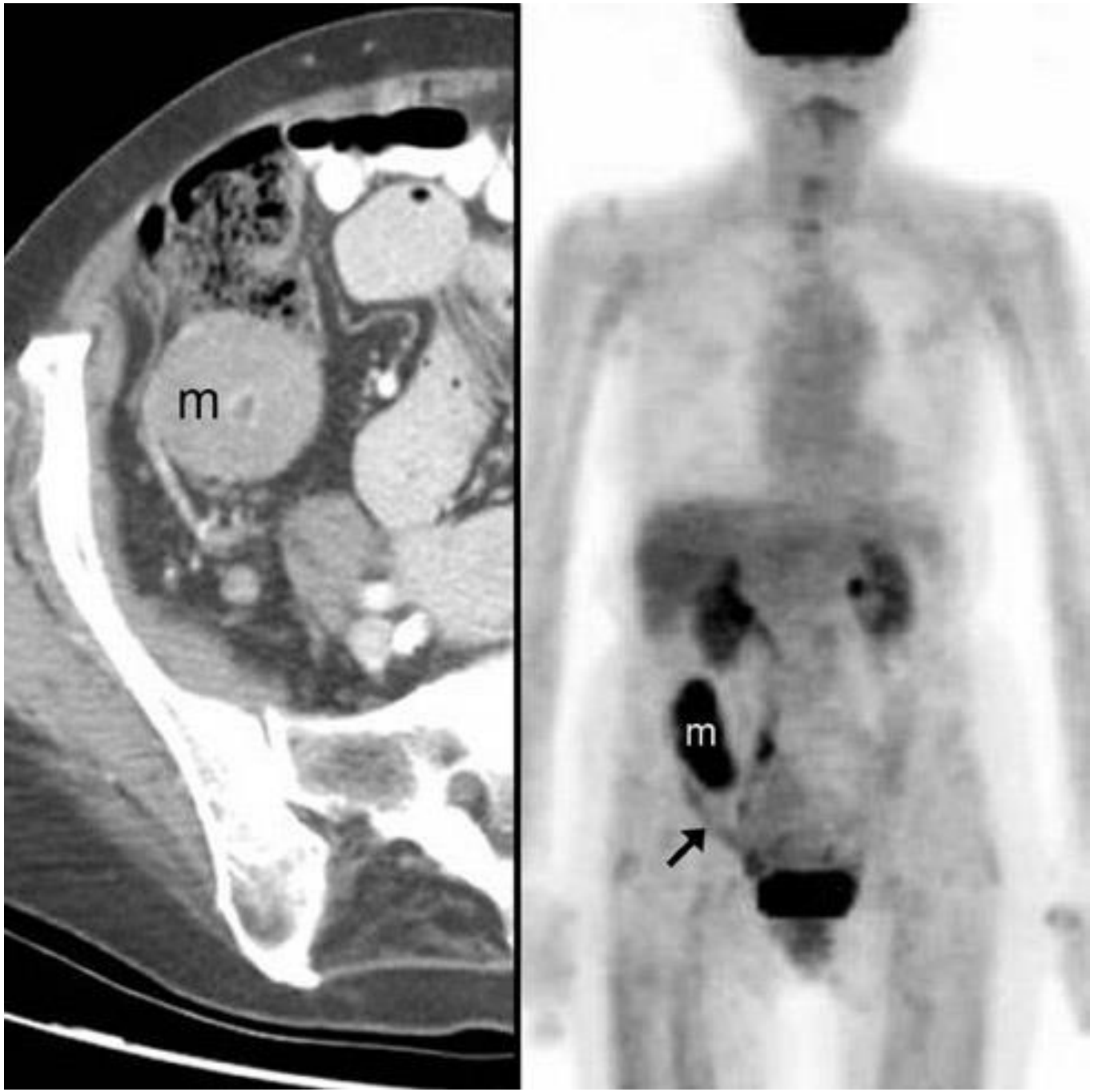
- Circumferential homogenous smooth bowel wall thickening without obstruction.
- Mid to long segment bowel involvement
- ‘mesenteric sandwich’
- Aneurysmal dilatation of involved bowel
- Splenomegaly

Lymphoma stomach

Circumferential homogenous smooth bowel wall thickening



Lymphoma Ileum



Smooth bowel wall thickening - colon

Carcinoid – Imaging features

- Submucosal tumour of neuroendocrine origin.
- Commonest site- Appendix (35%) Distal Ileum (16%)
- Highly malignant & metastatic.
- Primary mass usually undetectable.
- Bull’s eye lesion- sub mucosal mass
  with central ulceration.

Carcinoid- Imaging features

Metastatic node in regional mesentery

Heamatogenous Liver metastasis. ‘Hypervascular’

Mesenchymal tumours

- GIST
- Leiomyoma
- Leiomyosarcoma
- Gastrointestinal lipomas
- Liposarcoma
- Nerve sheath tumours

GIST

- Most common mesenchymal tumour of GI tract

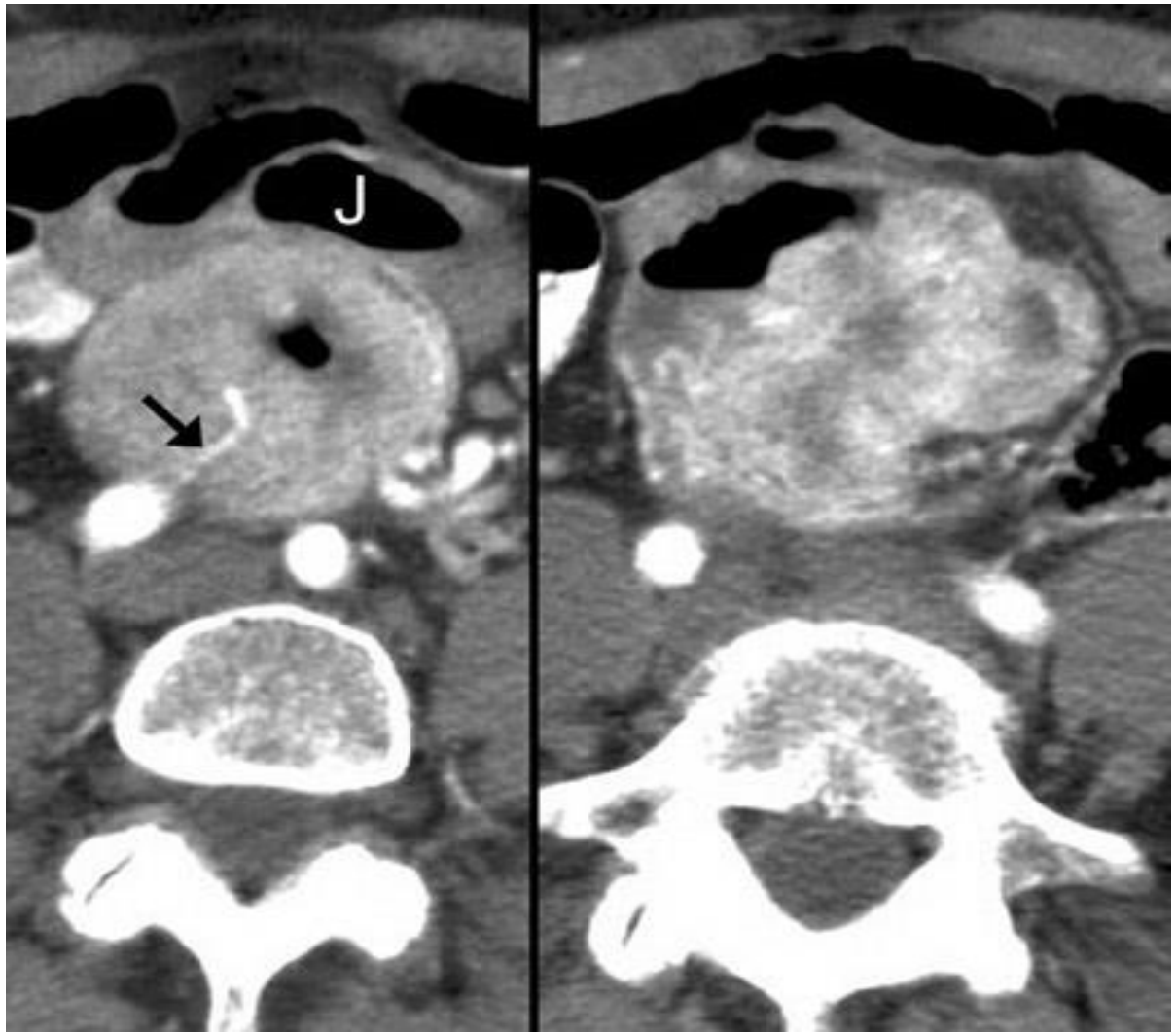
  Stomach- 70%

  Small bowel- 20-30%

  Anus/rectum- 7%

- EGIST- infrequent

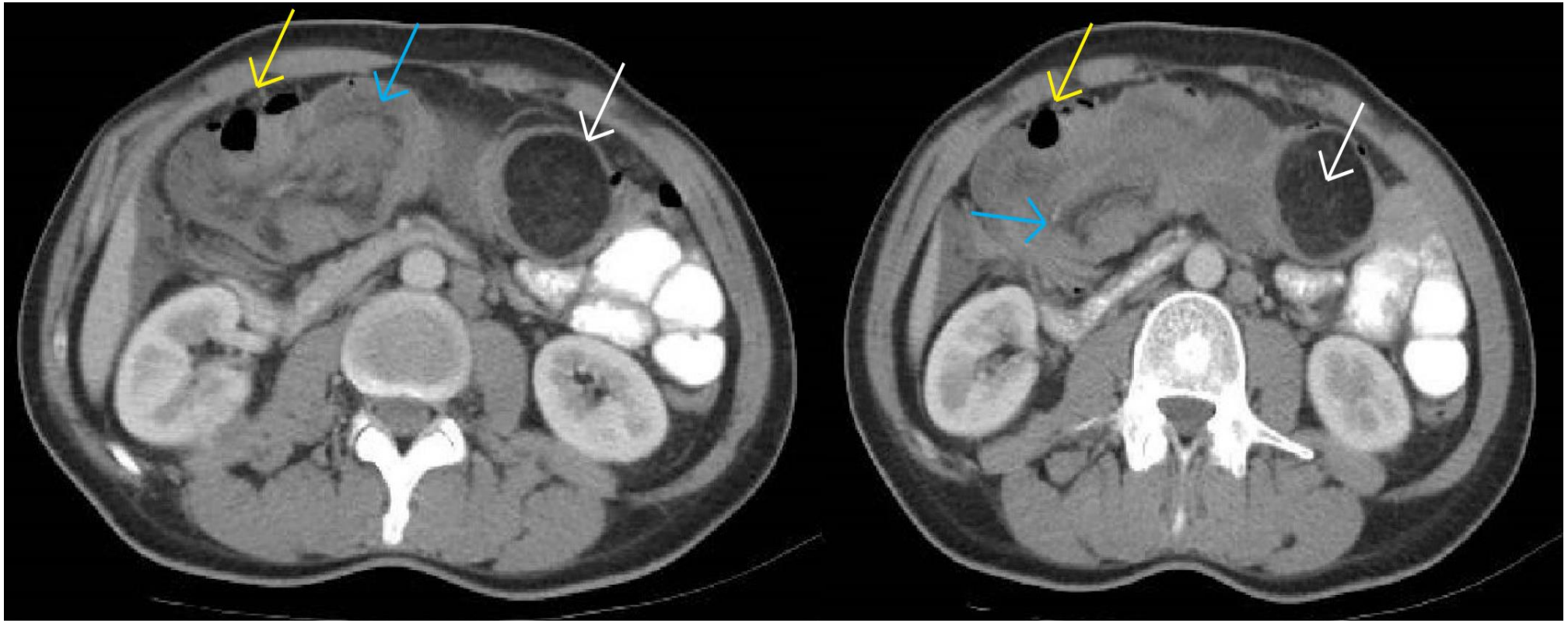
Gastrointestinal stromal tumours (GIST)



Bulky heterogeneously hyper enhancing mural masses

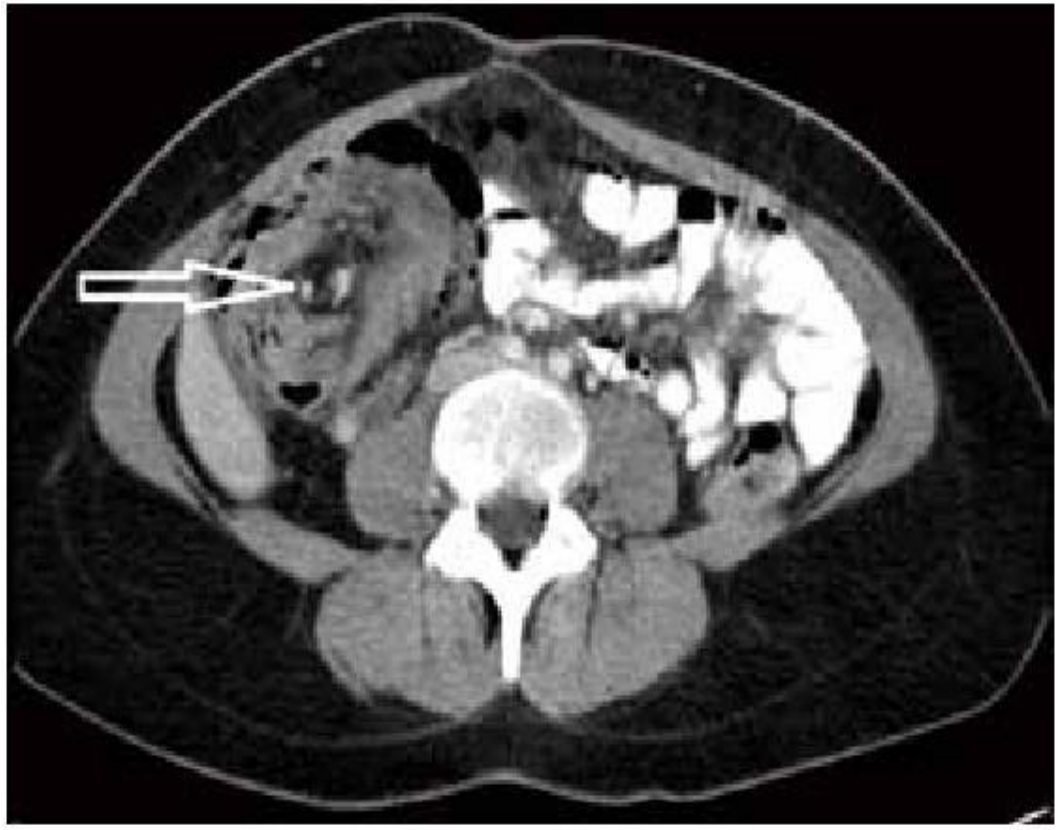
Gastrointestinal lipoma

- Most often involve Ileum & Colon
- Well defined fat attenuating mass is diagnostic

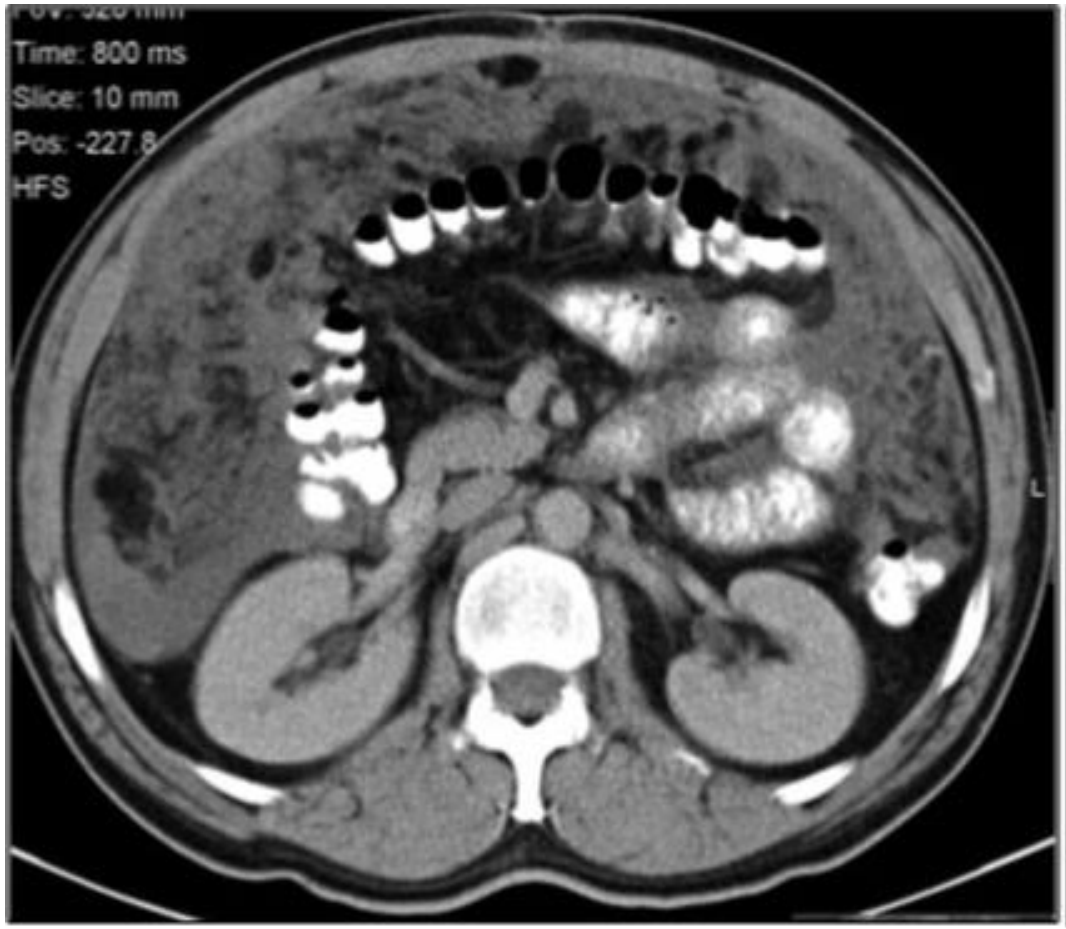


Miscellaneous primary tumour

- Appendiceal mucoceles
- Mucinous cystadenoma
- Mucinous cystadenocarcinoma



Pseudomyxoma peritonei



Metastasis to GI Tract

- Heamatogenous

  Lung, Breast, Kaposi's sarcoma, Melanoma

  Anti mesenteric border.
- Peritoneal seeding

  Ovary & GI primaries.

  Mesenteric border

Rounded bowel masses with luminal protrusion

- Cavitating metastasis- Melanoma.

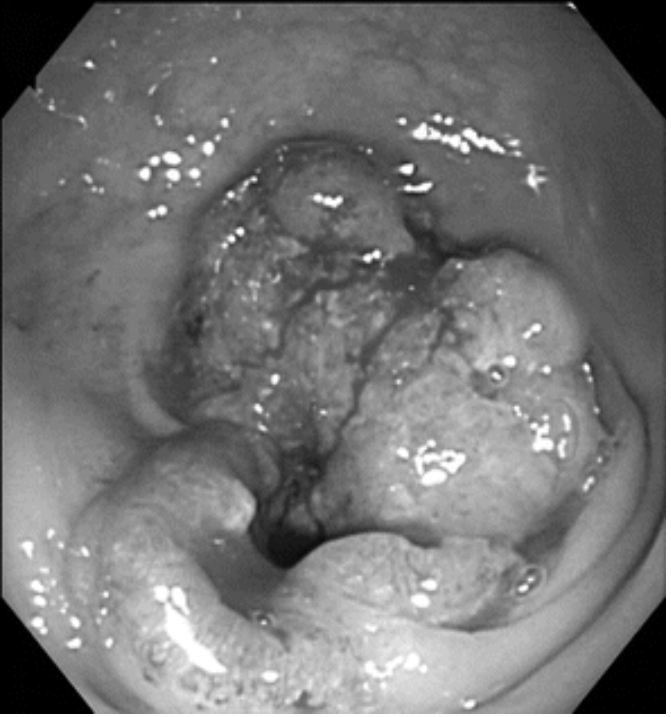
- Complications – Intersusception, Obstruction, Perforation

Bull's eye lesions

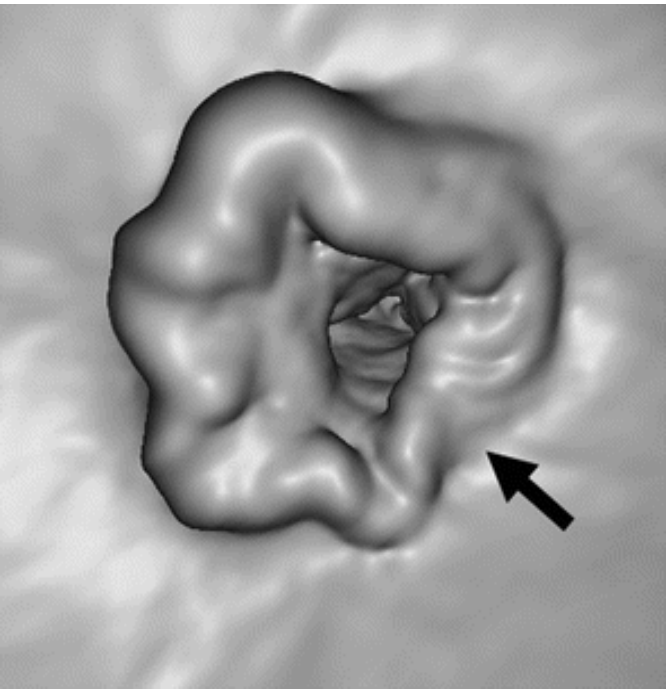
- Metastases from melanoma or lymphoma
- Kaposi sarcoma

MDCT Colonography

- Non- invasive screening examination
- Large intestine studies.
- Large intestine is distended after colonic preparation.
- Prone & supine position.
- Reviewed with multi planar views & virtual endoscopy
- Allows detection of polyps > 6 mm
- Allows detection of extra-colonic pathology is possible



1 Colonoscopic picture of large bleeding mass obstructing rectum



2 Virtual colonoscopic image after enhancement.

3 Ray-sum image

4 Polypoidal occlusive carcinoma rectum

Magnetic Resonance Imaging

- No long term & short term hazards
- Excellent soft tissue imaging capabilities for GI tract.
- Limitations

  Long acquisition times.

  High risk of motion artefacts.
- Recent technological advances

  Parallel imaging faster and higher quality image acquisition.

MR Colonography

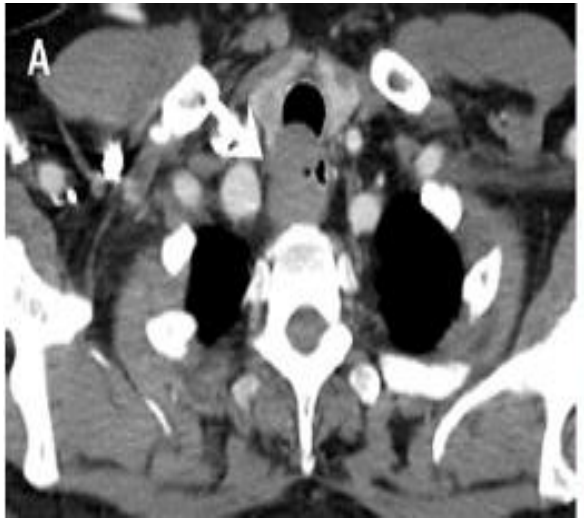
70% more abnormalities detected than CE

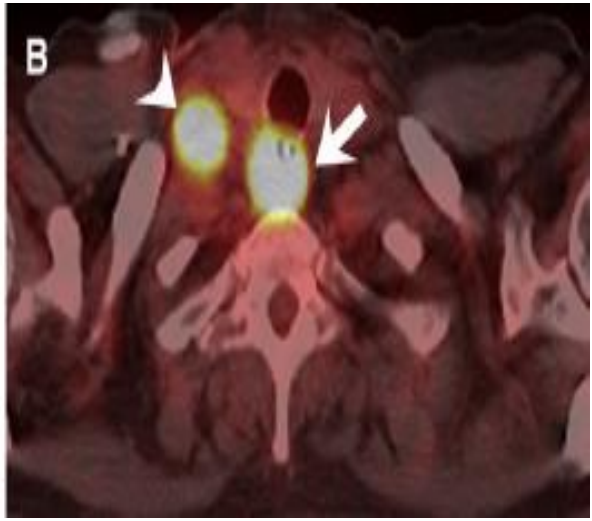
Sensitivity of MRE

- Superficial ulcers- 40%
- Fold distortion- 30%
- Fold thickening- 62.5 %
- Deep ulcers- 89.5%
- Cobble stoning pattern- 92.3%
- Stenosis & prestenotic dilatation- 100%

Imaging & Oesophageal carcinoma

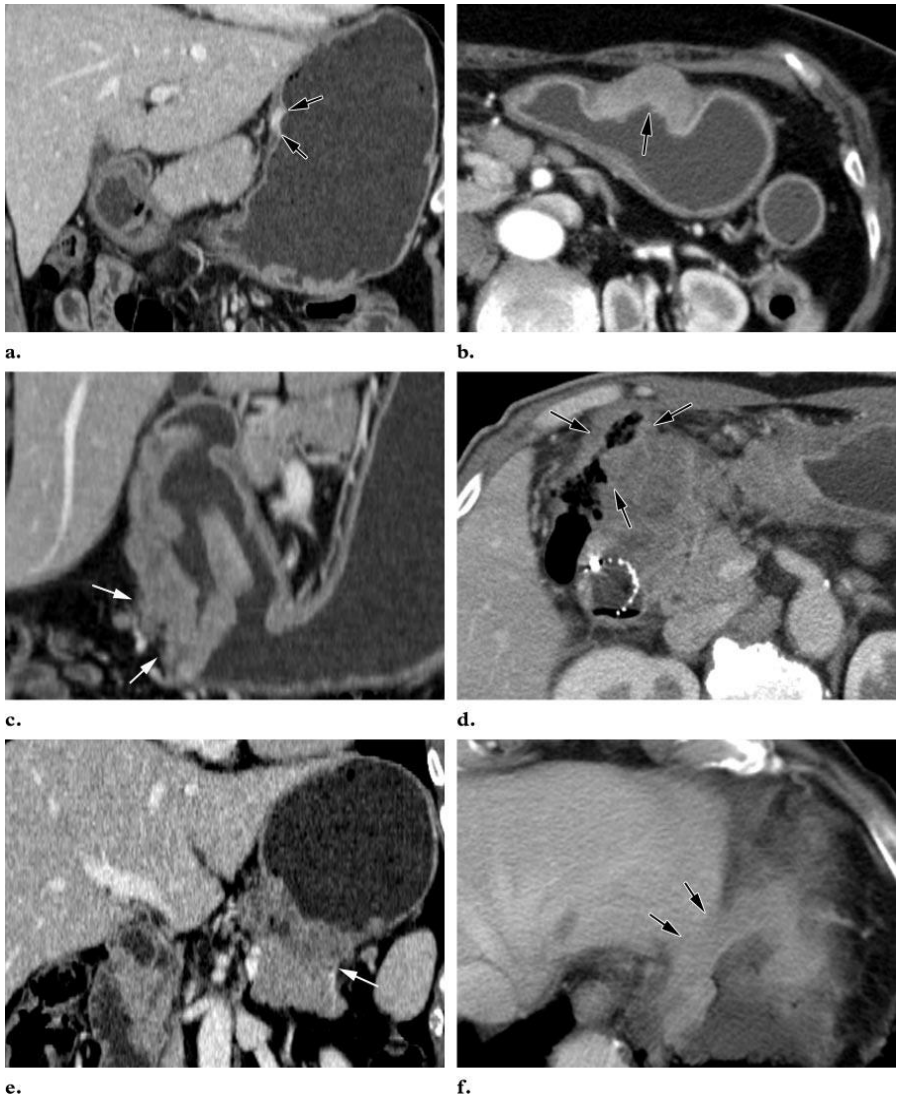
- Endoscopic Ultra Sonography
- CE Computed Tomography
- Integrated PET-CT

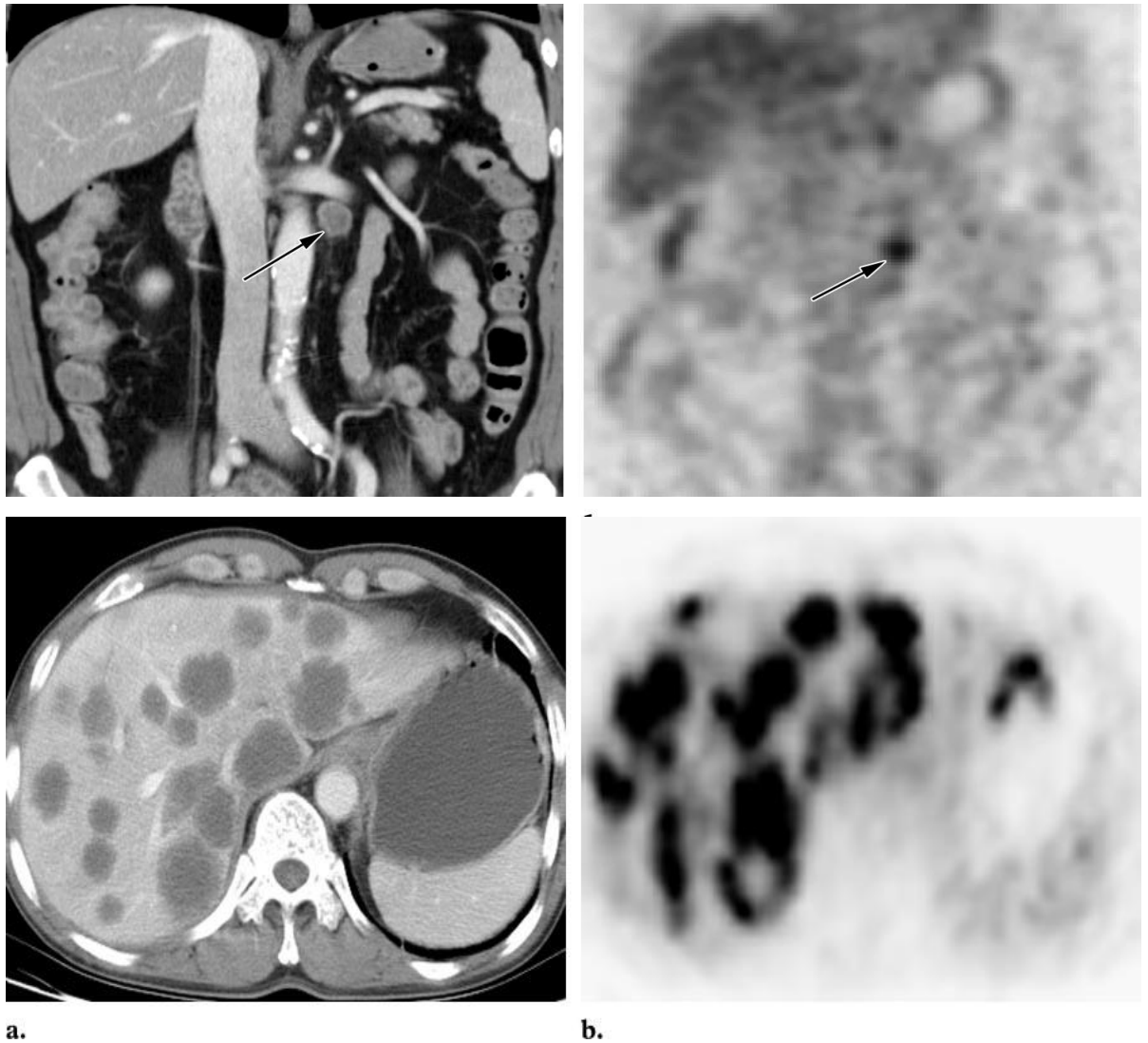




Imaging & Gastric carcinoma

Endoscopic ultrasound
CE compted tomography





MRI & Small intestine

- Provides cross sectional imaging without radiation hazards.
- Visualization of entire bowel- high specificity & sensitivity.
- Detection of other relevant abdominal pathology.
- Luminal- Stenosis, cobble stoning & fissures
- Mural- Wall thickening & wall enhancement
- Exocentric pathologies- Mesenteric inflammation, fibrofatty proliferation, Lymphadenopathy, hypervascularity, abcesses & fistulas.

Diffuse large B- cell lymphoma of Ileum

MRI & Pelvis

- Gold standard in oncologic pelvic examination.
- Provides morphological & functional data.

- Offers accurate evaluation of cancer stage.

Degree of tumor infiltration.
Involvement of internal & external sphincter
Inter sphincteric plane
Lymph node status

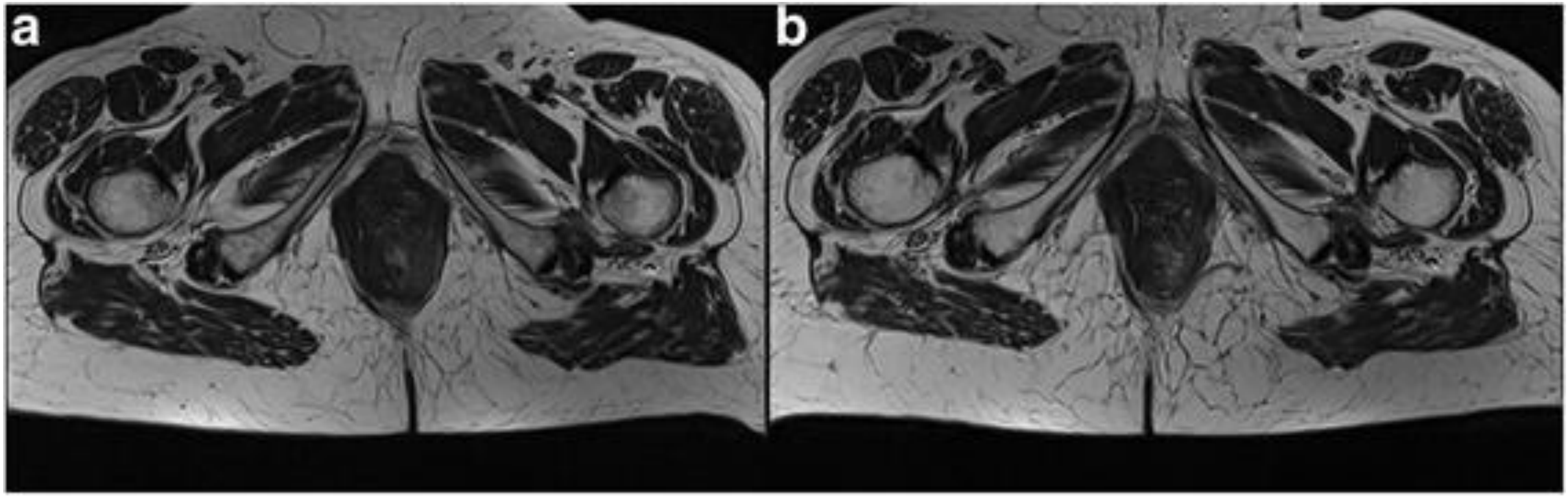
Granata et al. Infectious Agents and Cancer (2016) 11:52

MRI & Rectum

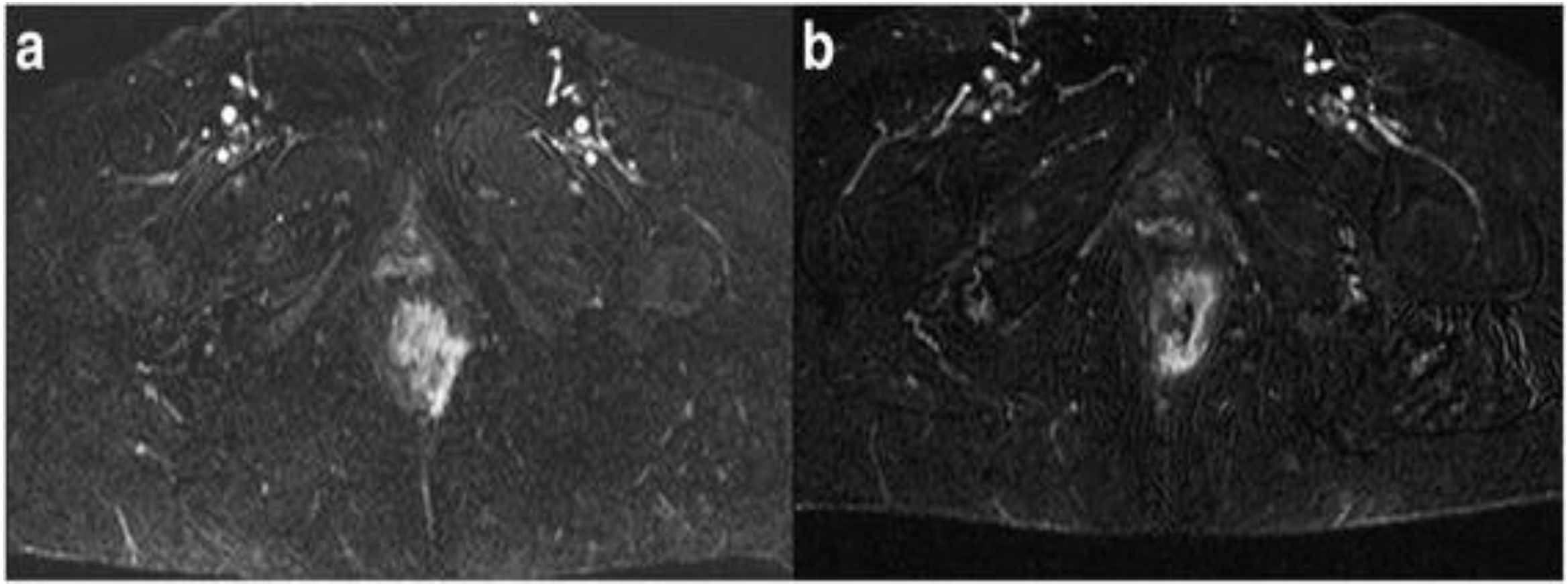
- Gold standard for staging
- Pelvic MRI with endorectal coils
- Excellent soft tissue imaging.
- Gives exact visualisation of infiltration of rectal wall & perirectal fat.

MRI Anal Canal tumours

TSE T2W in axial plane



Post contrast sequences

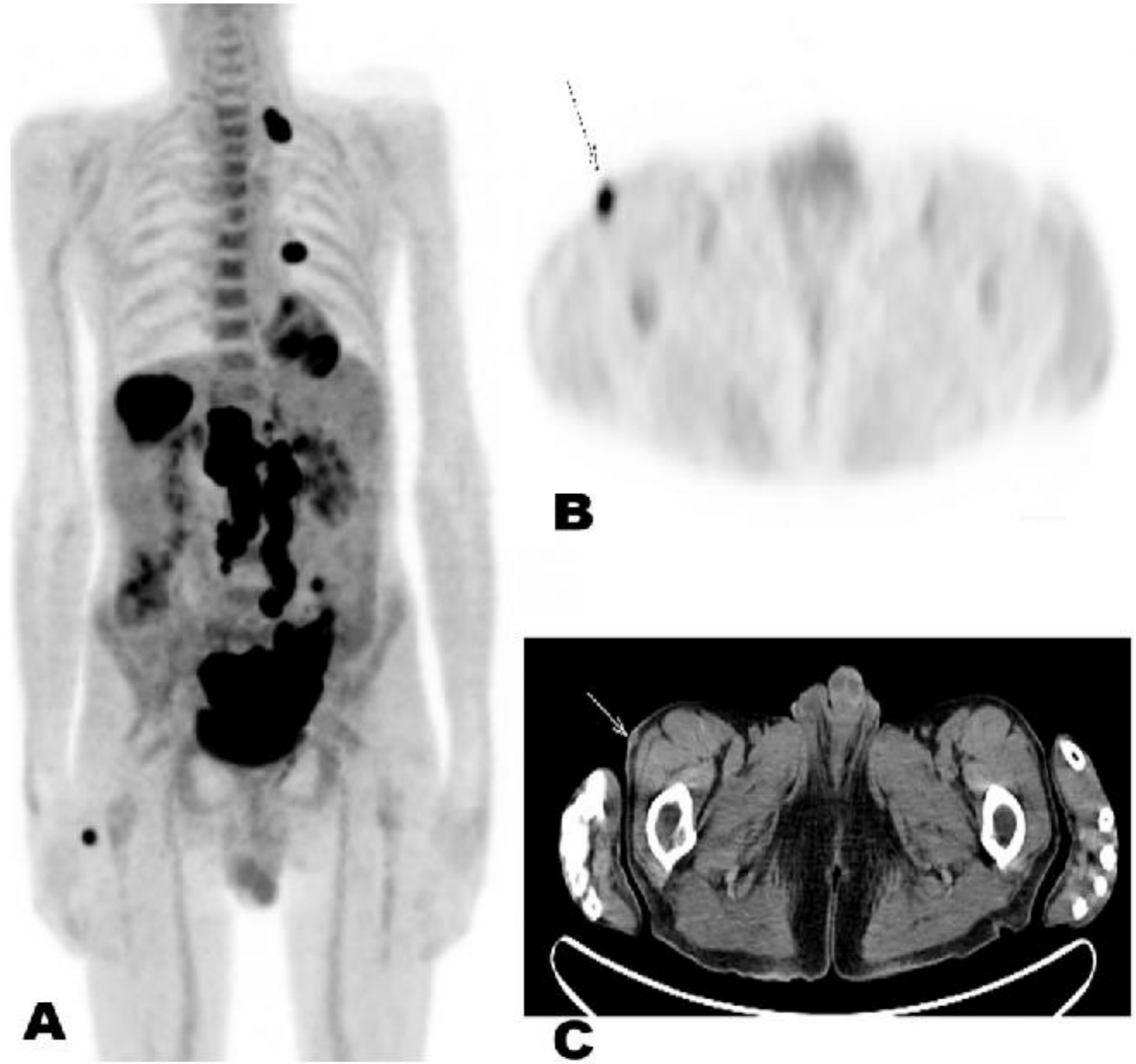


Anal canal imaging- 3D EAUS & CEMRI

Technique	3D EAUS	MRI
Advantages	Easier; quicker; low cost and better tolerated by patients	MRI is the gold standard in oncological pelvic examination, providing morphological and functional data
Disadvantages	The accuracy of US varies according to the operator skill; small field of view	Expensive, poorly tolerated by the patient, long time for the examination
T stage	More accurate for T1 than MRI and to asses relationship between lesion and sphincteric plan	MRI is a valuable diagnostic tool in anal cancer staging, although the major limitation is an incorrect detection of T1 patients
N stage	Only N1, so EAUS should be supplemented by MRI since US has a limited field of view.	Effective assessment of lymph nodes status thanks to morphological and functional data by DWI.
Post Treatment Assessment	EAUS did not provide any advantage over DRE in identifying local recurrence, and should not be recommended for routine surveillance	MR imaging plays an important role in therapeutic assessment, properly stratify patients into responders or non responders to neoadjuvant treatment, surveillance after surgery, and evaluation of suspected disease fall-out

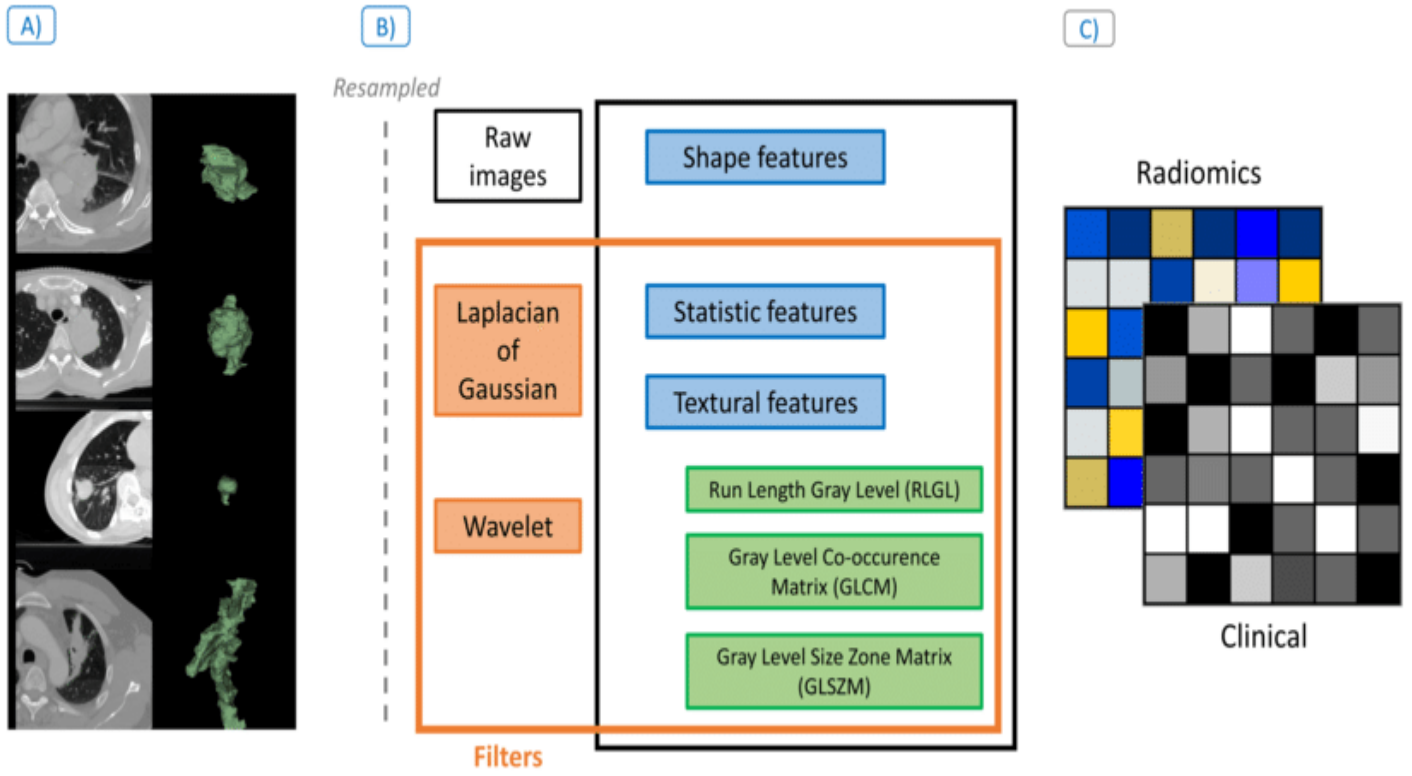
Positron Emission Tomography (FDG- PET)

- High accuracy in the diagnosis and follow up oesophageal, gastric, colorectal and stromal cancers.
- Excellent for evaluation beyond local lymphadenopathy and metastatic disease.



Radiomics: Images are more than Pictures. They are data

- The conversion of digital medical images into mineable high dimension data
- Motivated by the concept that biomedical images contain information that reflects underlying pathophysiology and that these relationships can be revealed via quantitative image analysis.



Take Home Message

- Imaging plays a key role in diagnosis & staging of GI tumours.
- Corner stone for appropriate patient selection in oesophageal cancer- EUS,CECT & PET/CT.
- Advanced CECT techniques with optimal contrast & multiplanar reformation & PET/CT for gastric cancer.
- MRI – Gold standard for small intestine, rectal & anal cancer cancers.
- Imaging supplemented by clinical history, Good clinical examination will lead to accurate diagnosis & staging and hence to accurate contouring.

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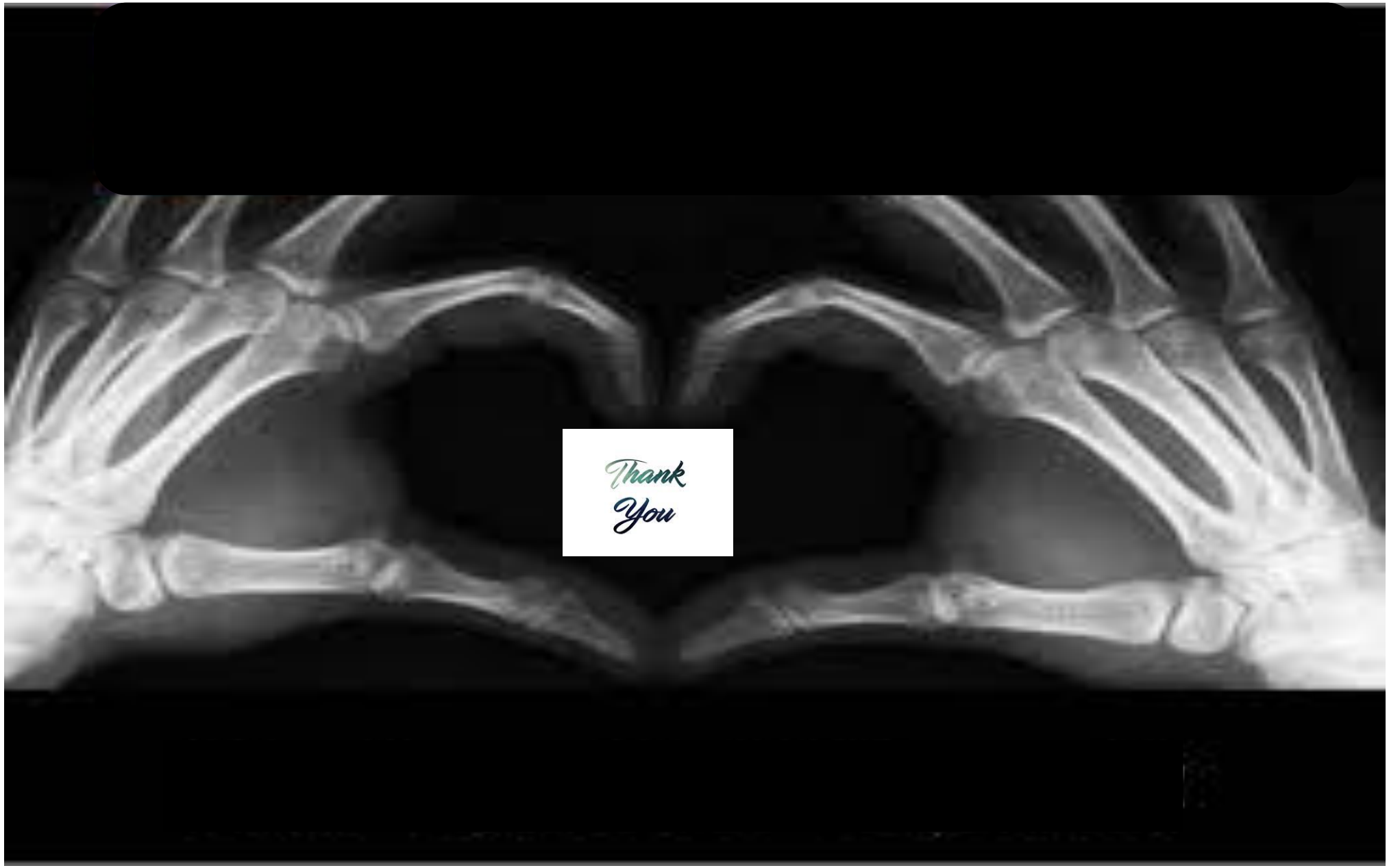
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