

# CTC BOWEL INSUFFLATION BY RADIOGRAPHERS



## MODULE 2: ANATOMY / INDICATIONS / RISK FACTORS

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# OUTLINE

- Module 1: Course requirements  
(Protocols/Logbook/Supervisor)
- **Module 2: Anatomy, indications, risk factors**
- Module 3: Equipment & Preparation
- Module 4: Technique



# LEARNING OUTCOMES

- To review the anatomy of the large bowel
- To understand indications and contraindications for the CT colonography examination
- To be able to question patients appropriately regarding risk factors when undergoing the examination.

# MODULE 2



## Large Bowel Anatomy

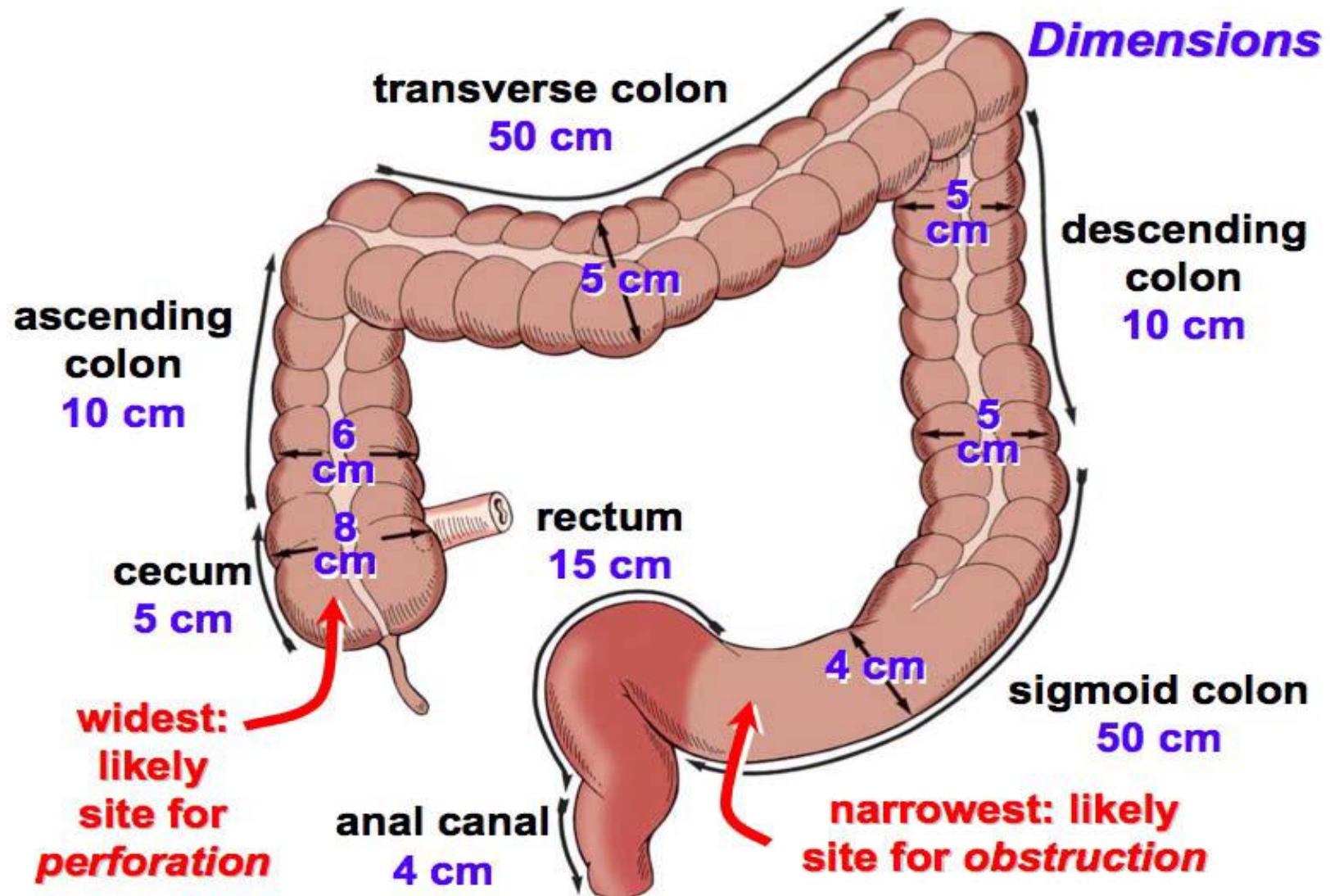
# LARGE BOWEL ANATOMY

- 1.5 m long
- 6 colonic segments
  - (Anal Canal)
  - Rectum
  - Sigmoid colon
  - Descending colon
  - Transverse colon
  - Ascending colon
  - Caecum





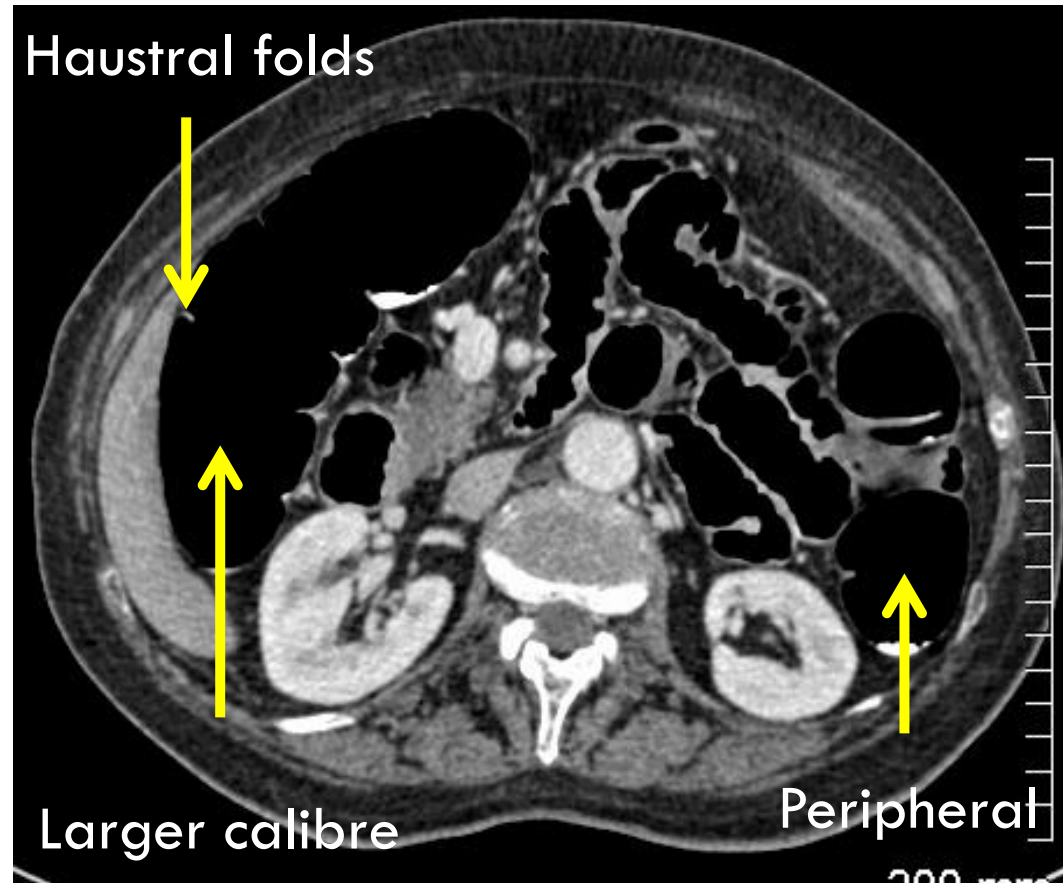
# LARGE BOWEL ANATOMY



# LARGE BOWEL ANATOMY

□ Distinguished by:

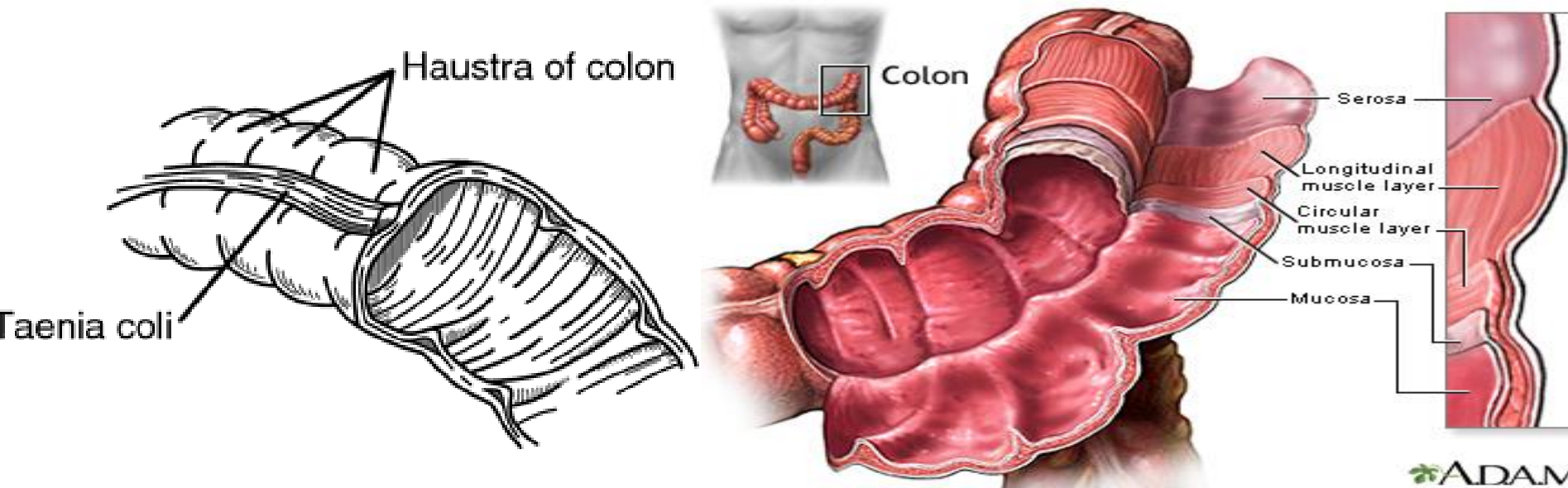
1. larger calibre
2. haustral markings
3. peripheral location





# LARGE BOWEL ANATOMY

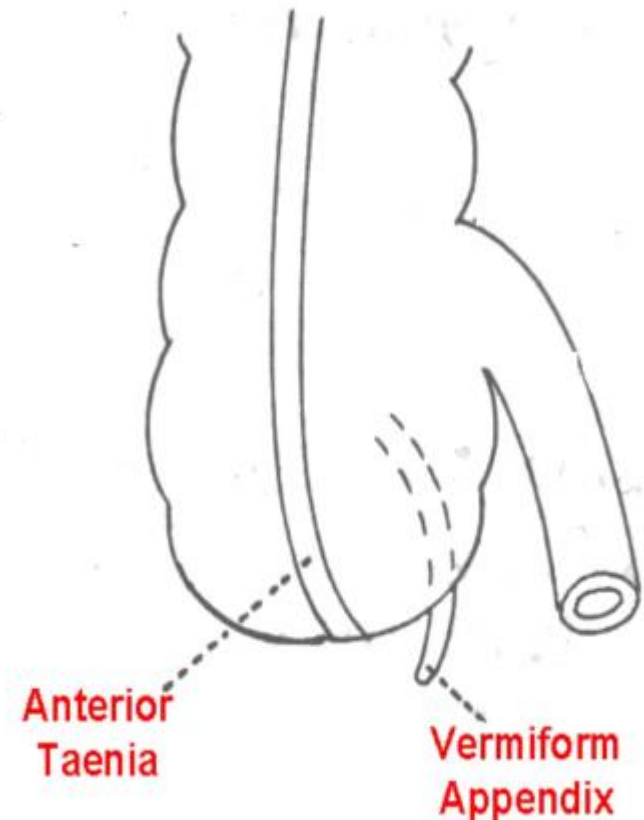
- **Haustra**
  - give colon its segmented appearance
  - Do not reach around entire circumference of colon
- **Bowel wall layers:**
  - Mucosa, submucosa, muscularis, serosa





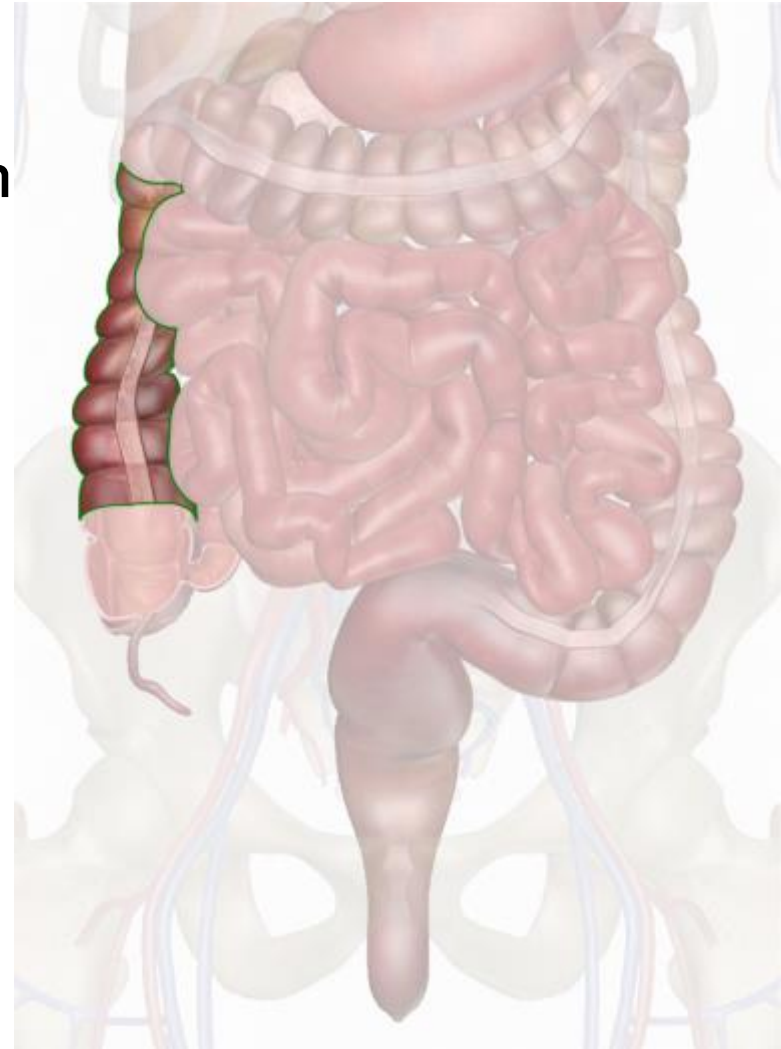
# CAECUM

- 1<sup>st</sup> part of colon – RIF
- Blind ending pouch (8x8cm)
- Continuous with ascending colon above
- Vermiform appendix – from posteromedial wall

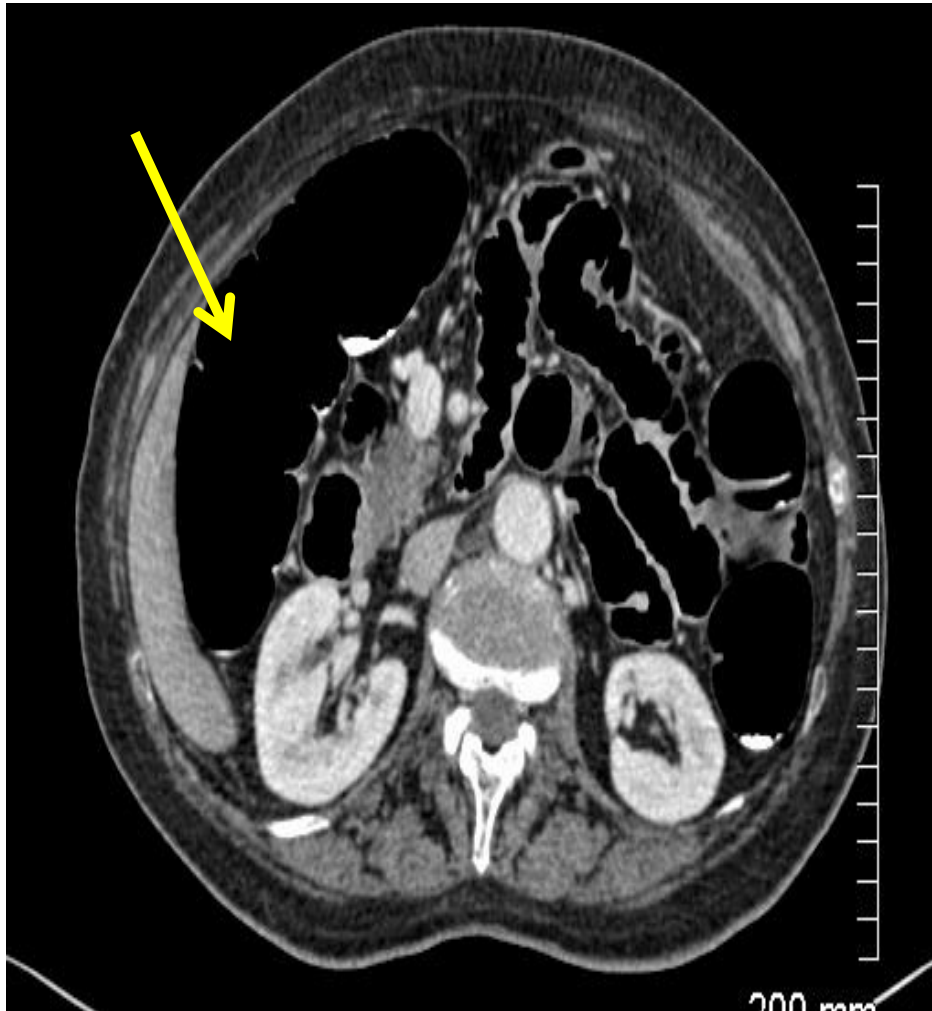


# ASCENDING COLON

- Smaller in calibre than caecum
- Bends abruptly ( $90^\circ$ ) under liver at hepatic flexure



# HEPATIC FLEXURE



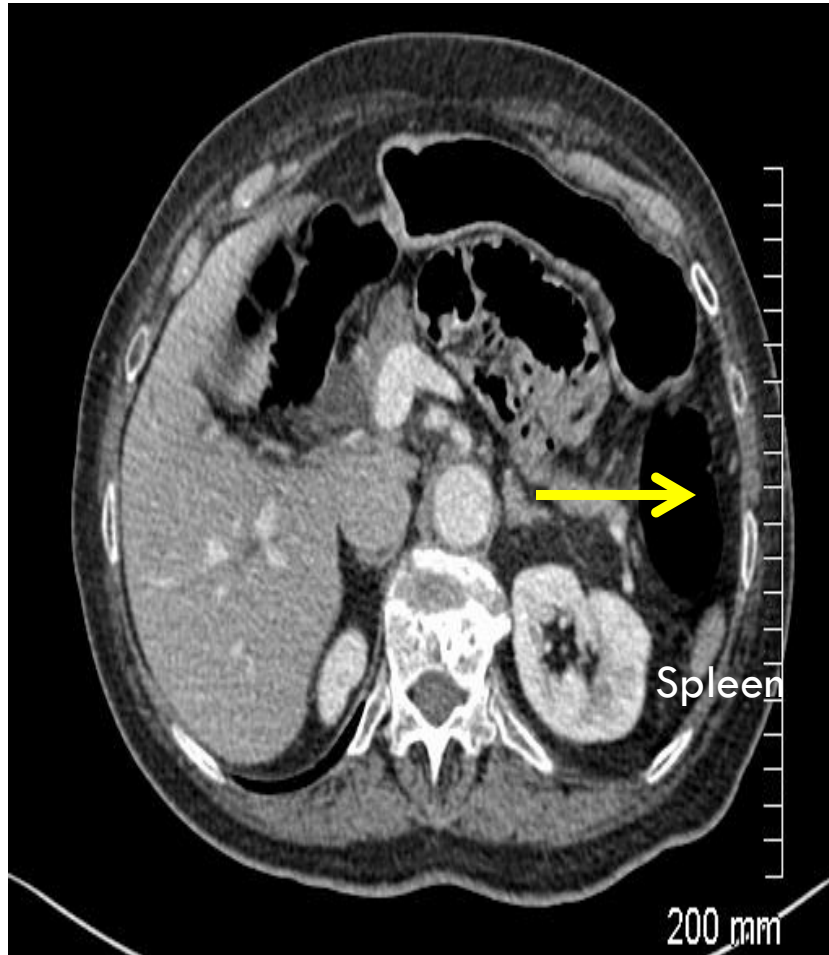
- Sharp bend between ascending & transverse colon
- Located in RUQ – below liver

# TRANSVERSE COLON

- Intraperitoneal
- Hepatic to splenic flexure
- Longest part of colon
- May dip into pelvis



# SPLENIC FLEXURE



- Where transverse turns into descending colon
- Just inferior to spleen

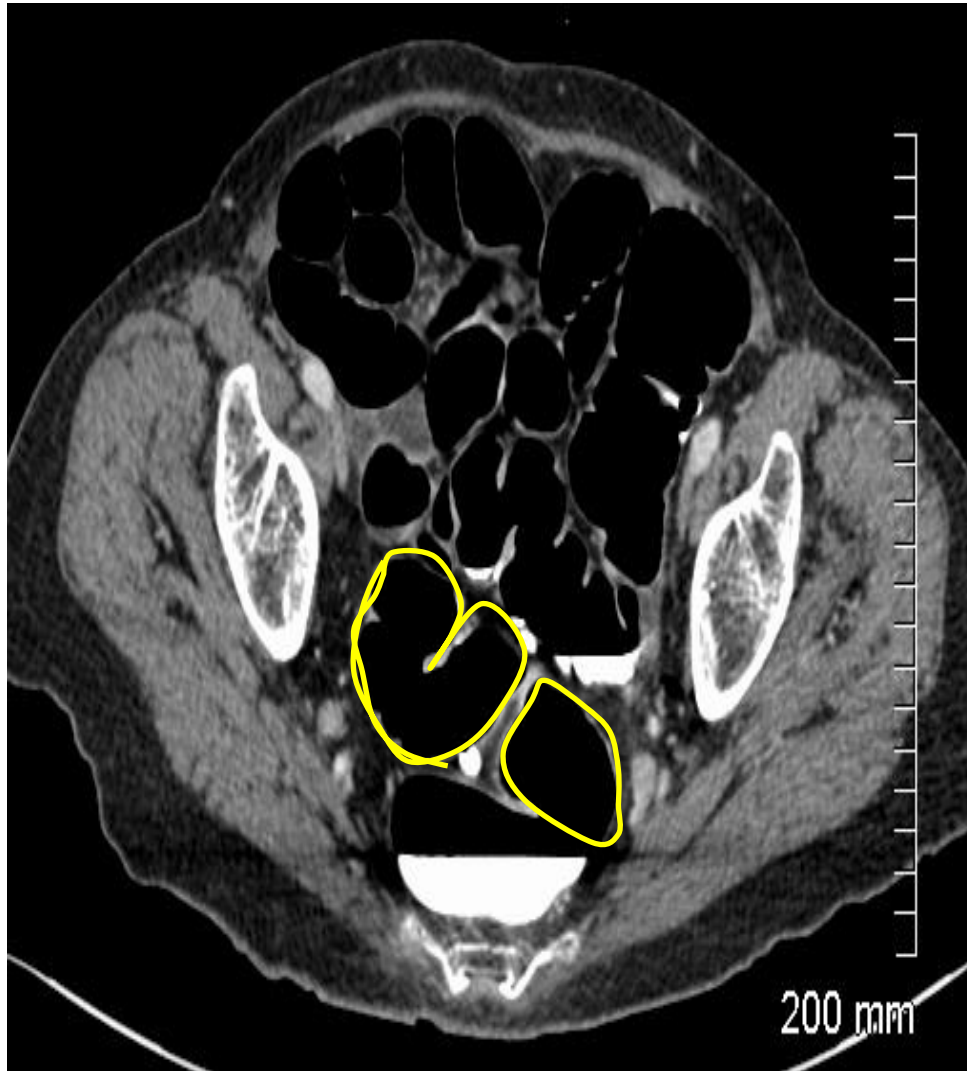
# DESCENDING COLON



- Short (10cm)
- Retroperitoneal
- Lies posteriorly along **left** paracolic gutter



# SIGMOID COLON



- Pelvic brim to third part of sacrum
- 45cm
- Characteristic S shape

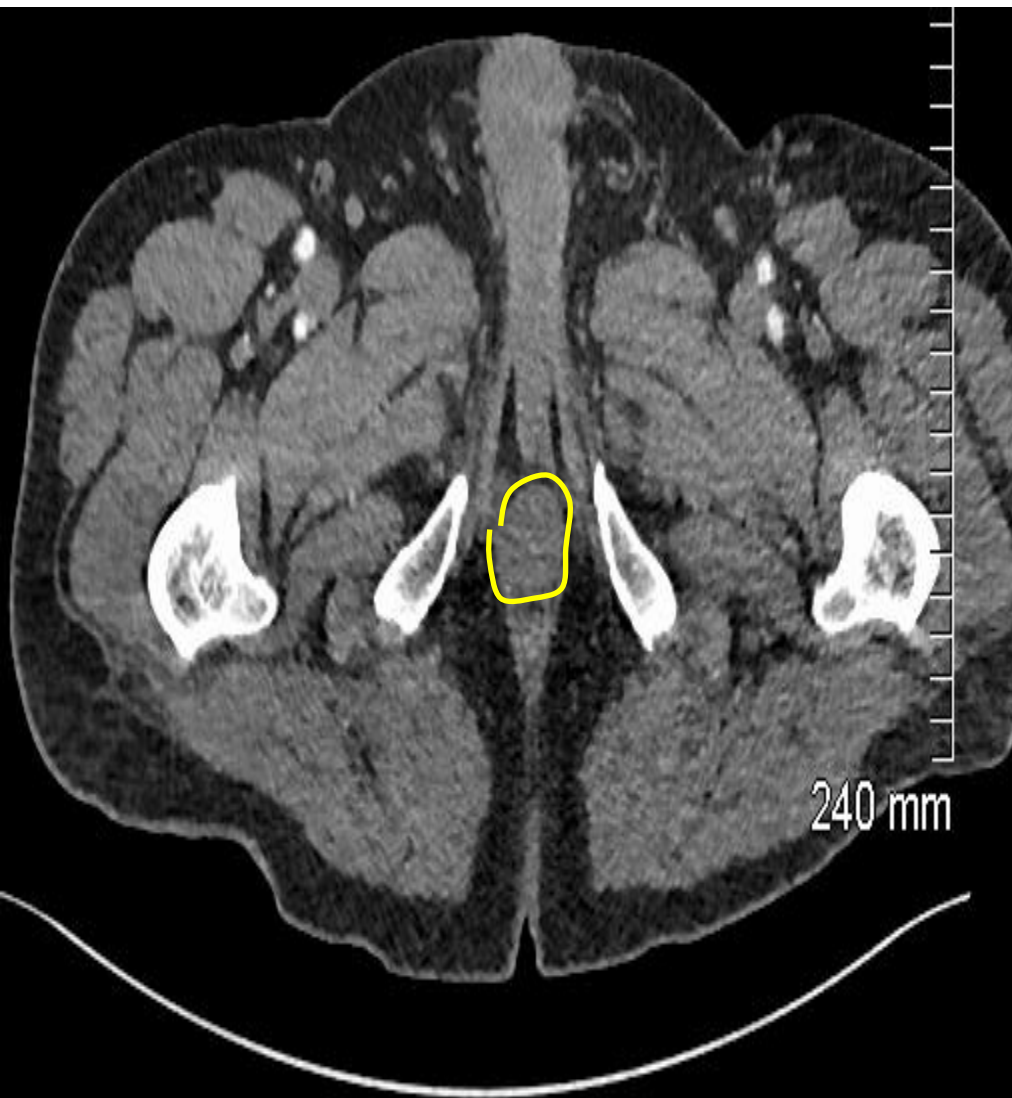


# RECTUM



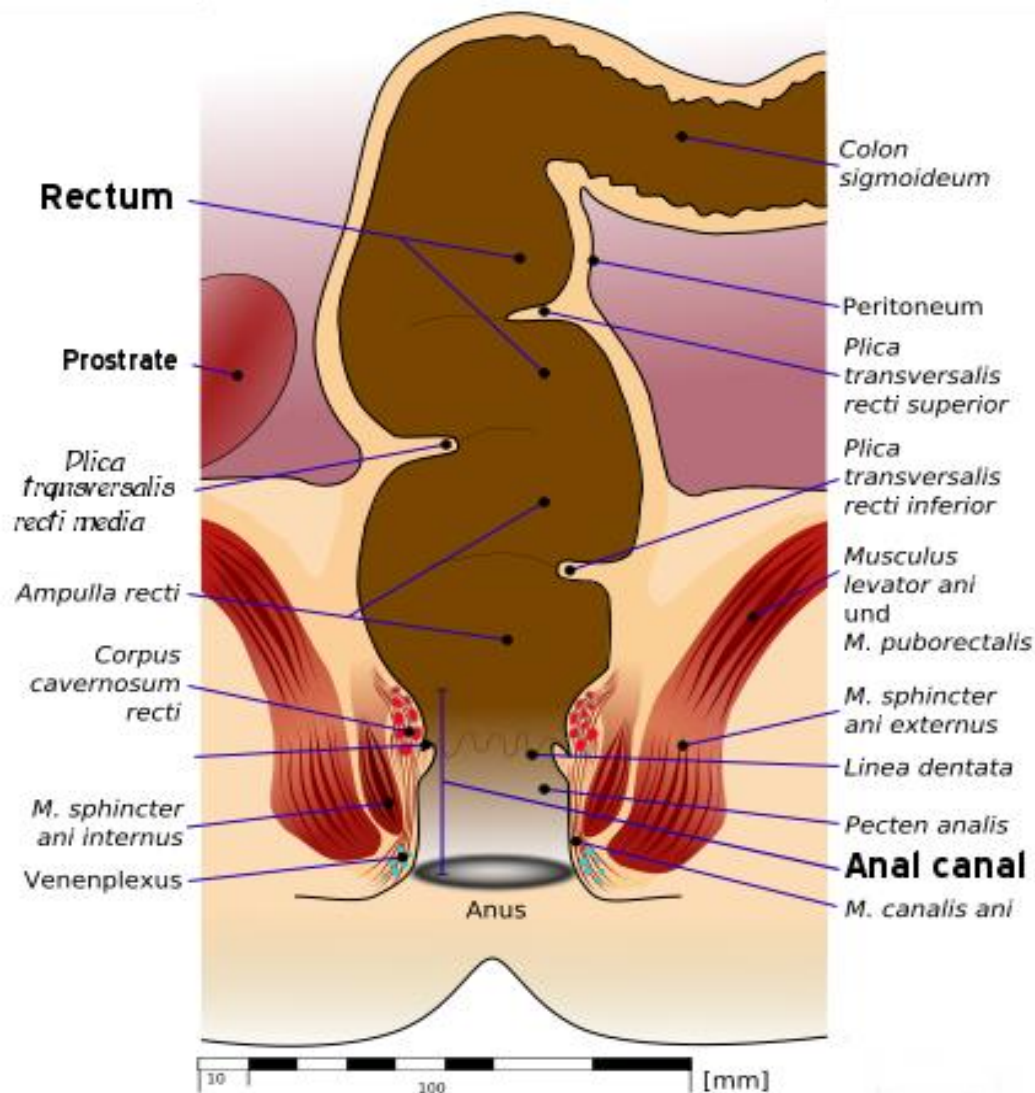
- Final straight portion
- 12cm long
- S3 – pelvic floor muscles
- Same calibre as sigmoid but dilates near termination (rectal ampulla)

# ANAL CANAL



- Terminal portion
- 3-5cm
- Surrounded by muscles
- Lumen closed

# ANAL CANAL



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# QUESTION SLIDE

The longest part of the colon is the

- a) Ascending
- b) Descending
- c) Transverse
- d) Sigmoid



# QUESTION SLIDE

The narrowest part of the colon and the most likely site for obstruction is the

- a) Ascending
- b) Descending
- c) Transverse
- d) Sigmoid



# INDICATIONS & CONSIDERATIONS



# INDICATIONS

- incomplete or failed colonoscopy (CS),
- the evaluation of elderly, frail, and symptomatic patients,
- the investigation of diverticular disease
- CRC screening and surveillance
  - despite the lack of robust evidence, if colonoscopy is unfeasible CTC may be recommended





# INCOMPLETE / FAILED CS

- Not uncommon (10-15%)
  - ▣ Caecal intubation rate extremely variable
  - ▣ More common in elderly and in women
  - ▣ 10% of colonoscopies considered challenging even for experts
  
- Causes: poor bowel prep, obstructing masses, neoplastic/inflammatory strictures, redundant colon, patient discomfort, colonic spasm, severe diverticulosis, adhesences from previous surgery



# INCOMPLETE / FAILED CS

- If incomplete CS, examination of entire colon recommended to avoid missing advanced lesion
- CTC superior to Barium Enema
- CTC benefits
  - ▣ can look for extracolonic findings
  - ▣ can assist in staging of neoplasms
  - ▣ can define causative factors for incomplete CS – colonic looping, acute flexures etc



# ELDERLY AND FRAIL

- Colonoscopy may be unfeasible because of patients condition (e.g. age, poor bowel preparation, or associated co-morbidities)
- CS also has increased risk of perforation and bleeding in elderly and those undergoing anti-coagulant therapy
- CTC is technically feasible, well tolerated and safe
- Only positive findings will be referred for more invasive and risky examinations



# DIVERTICULAR DISEASE

- Most common colonic disorder in western world (>60% at 80 years)
- Clinical diagnosis challenging – imaging needed
- Choice of CS or CTC depends on patient age, risk factors, clinical status, preference, local expertise
- CTC preferred in elderly



# SYMPTOMATIC PATIENTS

- Many patient symptoms suggestive of CRC are highly non-specific (abd pain, rectal bleeding, weight loss)
- Many patients referred for CS – may have normal results
- CTC can be used to triage patients, with positive findings sent for CS
- Current advise:
  - Refer for CS: symptoms of bleeding + diarrhea
  - Refer for CTC: symptoms of pain or weight loss

# OTHER



- Some other indications being explored
- CTC for tumour localisation prior to laparoscopic surgery (due to inaccuracy of CS in determining localisation and extent of lesion)
- Investigation of patients with colonic stoma
- Assessment of colonic involvement in patients with pelvic endometriosis



# CRC SCREENING

- Fecal occult blood tests mostly used
- Role of CTC: replace Barium enema for incomplete CS or those refusing CS
- Dutch studies showed increased compliance (34% vs 22%) when CTC compared to CS





# CRC SURVEILLANCE

- Patients with previous CRC surgery need colonic + extracolonic surveillance
- >50% of recurrent tumours present as extracolonic metastatic disease (e.g. in liver) and lack an intraluminal component
- Currently: combination of clinical assessment, CEA testing, CS and contrast CT
- CTC + IV useful for patients unable / unwilling to have CS



# RCR GUIDELINES (iRefer, 2014)

Clinical problem	Recommendation	Comment
Intestinal blood loss	Indicated	IV CT or CTC useful to look for lesions that may be bleeding
Change in bowel habit	Indicated	Colonoscopy is first line in younger patients but CTC is radiological investigation of choice for detecting colorectal cancer and large polyps, with similar accuracy to CS
Inflammatory bowel disease (long term follow up)	Indicated only in specific circumstances	CTC is an alternative to barium enema for differentiating benign from malignant strictures when CS unfeasible
Asymptomatic 50-75 yo with positive faecal occult blood test on screening	Indicated only in specific circumstances	CS investigation of choice and enables biopsy, where incomplete or contraindicated, CTC is accurate and well accepted by patients



# QUESTION SLIDE

According the iRefer guidelines, CTC is indicated in which of the following circumstances

- a) Change in bowel habit for younger persons
- b) Asymptomatic 60 year old with positive fecal occult blood test
- c) Intestinal blood loss



# CONTRAINDICATIONS

- Acute abdominal conditions, (diverticulitis or the acute phase of IBDs), due to high risk of complications (i.e., perforations).
- Precautions should be taken when performing CTC after endoscopic resection (? two week delay – although evidence lacking)
- Endoscopic biopsy not considered a contraindication and same day CTC can be performed



# PATIENT RISK FACTORS

- Most serious complication of CTC = perforation
- Range in literature 0.05-0.06% (1 in 2000) (Sosna et al, 2006)
  - ▣ Vs optical colonoscopy rate of 0.1-0.2% (Basset et al, 2008)
- Vital to identify potential risk factors
  - ▣ Symptoms of partially obstructing colonic lesion
  - ▣ Known hernia
  - ▣ Recent colonic polypectomy / biopsy
  - ▣ Known underlying colon disease
  - ▣ Elderly / frail
  - ▣ Difficulty inserting rectal tube



# COLONIC PERFORATION

## Examination specific risk factors

- Rectal intubation
- Over insufflation
- Previous micro-perforation (incomplete / difficult colonoscopy)
  
- Use of rectal catheters and automated insufflation may reduce incidence of adverse events (Yee et al Radiology 2002, 255(P):305)

Table 1. Multicenter surveys

Author	Gas delivery air or CO <sub>2</sub>	Operator	Symptoms of perforation	Risk factors	Management	Perforation rate (%)
Burling et al. Radiology 2006	Air ( <i>n</i> = 6) CO <sub>2</sub> ( <i>n</i> = 2)	Radiologist ( <i>n</i> = 3) Technician ( <i>n</i> = 3) Resident ( <i>n</i> = 1)	4 symptomatic ( <i>n</i> = 4) 4 asymptomatic ( <i>n</i> = 4)	Active ulcerative colitis ( <i>n</i> = 1) Obstructing sigmoid cancer ( <i>n</i> = 1)	7 Conservative 1 Surgical	0.05
Sosna et al. Radiology 2006	Air ( <i>n</i> = 7)	Radiologists Residents Registered physicians	Unknown	Inguinal hernias ( <i>n</i> = 4) Previous biopsy ( <i>n</i> = 1) Obstructive cancer ( <i>n</i> = 1) Severe diverticulosis ( <i>n</i> = 3)	3 Conservative 4 Surgical	0.059
Pickhardt et al. Radiology 2006	Air ( <i>n</i> = 2)	Unknown	Symptomatic ( <i>n</i> = 1) Asymptomatic ( <i>n</i> = 1)	Annular carcinoma of the sigmoid colon ( <i>n</i> = 1)	All conservative	0.009

Table 2. Single case reports

Author	Gas delivery air or CO <sub>2</sub>	Operator	Symptoms of perforation	Risk factors	Management	Perforation rate
Bassett et al. Abdominal Imaging 2008	CO <sub>2</sub>	Technician	Asymptomatic	Diverticulosis	Conservative	0.02%
Belo-Oliveira et al. Dis Colon Rectum 2007	Air	Nurse	Asymptomatic	Inguinal hernia	Surgical	Unknown
Wong et al. World J Gastroenterol 2007	Air	Unknown	Abdominal pain	Crohn's disease with terminal ileitis and sigmoid stricture	Surgical	Unknown
Young et al. AJR 2006	CO <sub>2</sub>	Nurse	Vague lower abdominal pain	None	Conservative	0.02%
Triester et al. Am J Gastroenterol 2006	CO <sub>2</sub>	Unknown	Asymptomatic	Active stenosing ileocolonic Crohn's disease	Surgical	Unknown
Coady-Fariborzian et al. Dis Colon Rectum 2004	Air	Unknown	Abdominal pain	Ulcerative colitis	Surgical	Unknown
Kamar et al. Dis Colon Rectum 2004	Air	Unknown	Asymptomatic	Biopsy stenosing cancer of the recto-sigmoid junction	Surgical	Unknown



# COLONIC PERFORATION

- Many patients may be asymptomatic
- Therefore all 2D scan images should be checked for perforation, prior to patient leaving scanning suite.
- If detected:
  - Immediate decompression of colon
  - Immediate surgical consultation





# INGUINAL HERNIAS

- Specific attention needed to left groin in patients with known pre-existing left inguinal hernia during insufflation (Sosna, Belo-Oliveria)
- Discontinue insufflation if hernia sac increases in size
- Palpation necessary to evaluate distension & ask patient to report any symptoms

Sosna J, Sella T, Bar-Ziv J, Libson E. Perforation of the colon and rectum a newly recognized complication of CT colonography. *Semin Ultrasound CT Mri* 2006;27:161–165.

Belo-Oliveira P, Curvo-Semedo L, Rodrigues H, et al. Sigmoid colon perforation at CT Colonography secondary to a possible obstructive mechanism: report of a case. *Dis Colon Rectum* 2007;50:1478–1480. [PubMed: 17665253]



# DIVERTICULA

- Saclike protrusions in colonic wall
- Develop as a result of herniation of the mucosa and submucosa through points of 'weakness'
- More common in sigmoid (5-10% entire colon involved)
- Represent closed chambers of colonic lumen with low resistance to stretching – **risk of perforation**
- Incidence of approx 30% in patients over 50 yrs ()
- Most people with uncomplicated diverticulosis are asymptomatic – therefore impossible to estimate risk of perforation before CTC (except in patients with prior colon imaging)
- Careful bowel distension must be adopted



# CAREFUL !

- Insufflation may cause vaso-vagal reactions linked to stimulation of the vagus nerve, which follow the stretching of the vagi fibers
- Large volumes of gas may increase the risk of vaso-vagal reactions (hypotension, bradycardia, nausea, vomiting and even to syncope)
- All should be immediately treated by a radiologist



# QUESTION SLIDE

Which of the following are risk factors for colonic perforation during CTC (tick all that apply)

- a) Elderly / frail
- b) Inguinal hernia
- c) Recent colonic polypectomy / biopsy
- d) Symptoms of partially obstructing colonic lesion
- e) Known underlying colon disease
- f) Difficulty inserting rectal tube
- g) Incomplete difficult colonoscopy
- h) Diverticular disease



# SUMMARY

- Revise anatomy to facilitate optimal technique
- Must understand indications and contraindications for CTC to ensure justification and avoiding unnecessary invasive examinations
- Become familiar with bowel insufflation equipment locally and read manufacturers instructions



# REFERENCES

- ESGAR (2015). Consensus statement on CT colongraphy