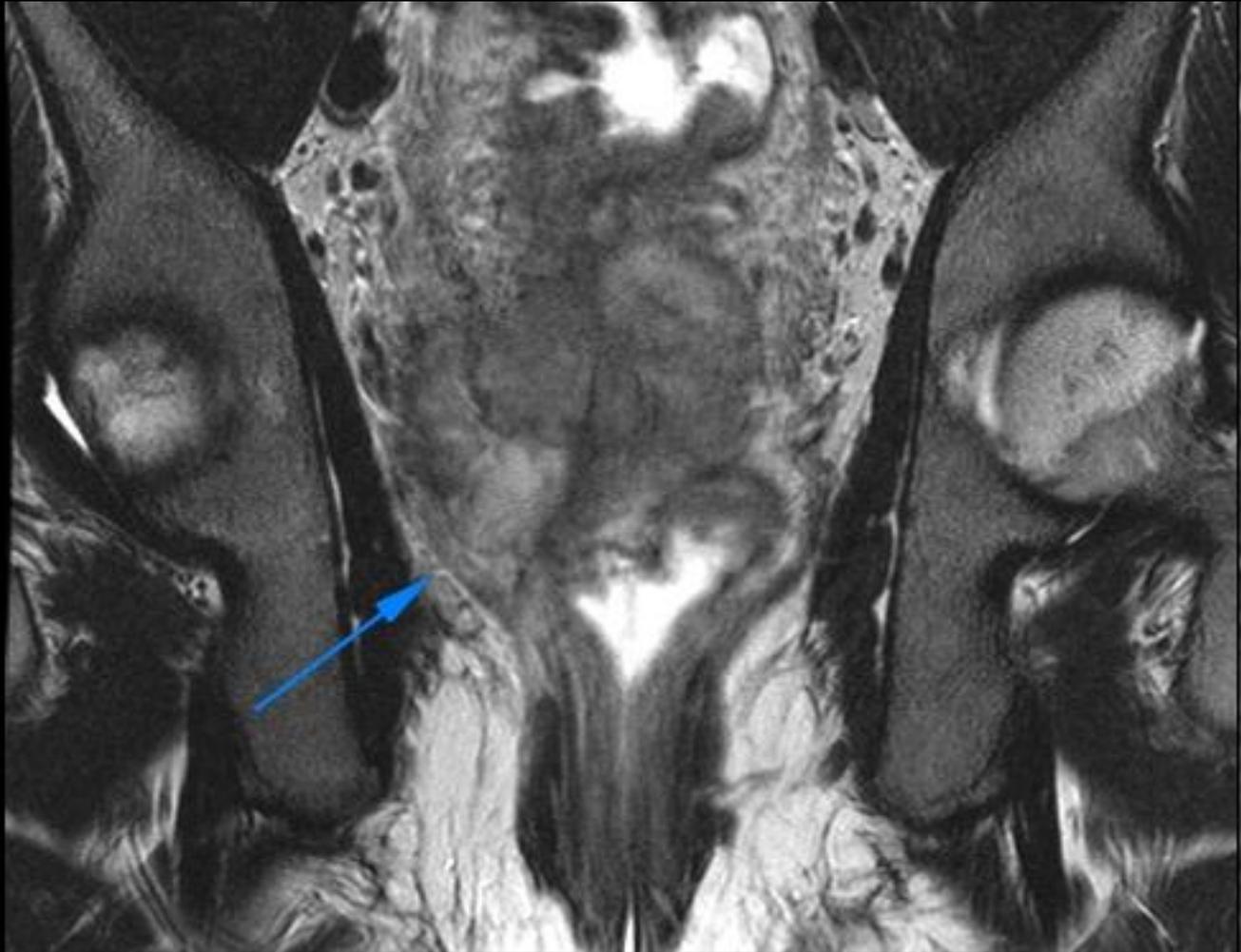


Advancements in GI Radiology



AJ Lewis, MD MBA
Boca Radiology Group

GI Imaging Concepts

- 1) Introduction to GI Radiology**
- 2) Follow-up of Incidental GI findings**
- 3) Advanced techniques in abdominal and pelvic MR**

...refers to the ability of the imaging modality to differentiate two closely-approximated objects.

Low spatial resolution techniques will be unable to differentiate between two objects that are relatively close together.

Spatial Resolution

(The ability to see really small things)

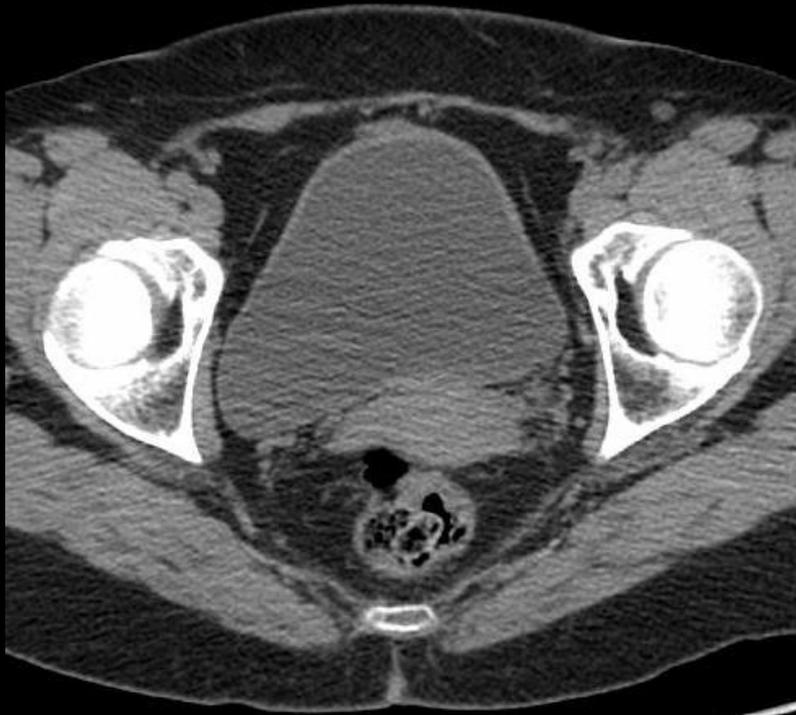
X-ray > CT > US > **MRI**

Modality	Spatial resolution
X-ray	< 1 mm
CT	1-2 mm
US	2-3 mm
MRI	3-4 mm

Contrast Resolution

The ability to distinguish differences in image intensity of adjacent structures of the basis of their grayscale “color.”

CT



MRI



Contrast Resolution

MRI > CT > US > X-ray

Abdominal Imaging Modalities

- Radiography (aka KUB, plainfilm, x-ray)
- Fluoroscopy (Fluoro)
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- Ultrasound (Sonography)

Different methods of looking at the same anatomy
and the same pathology

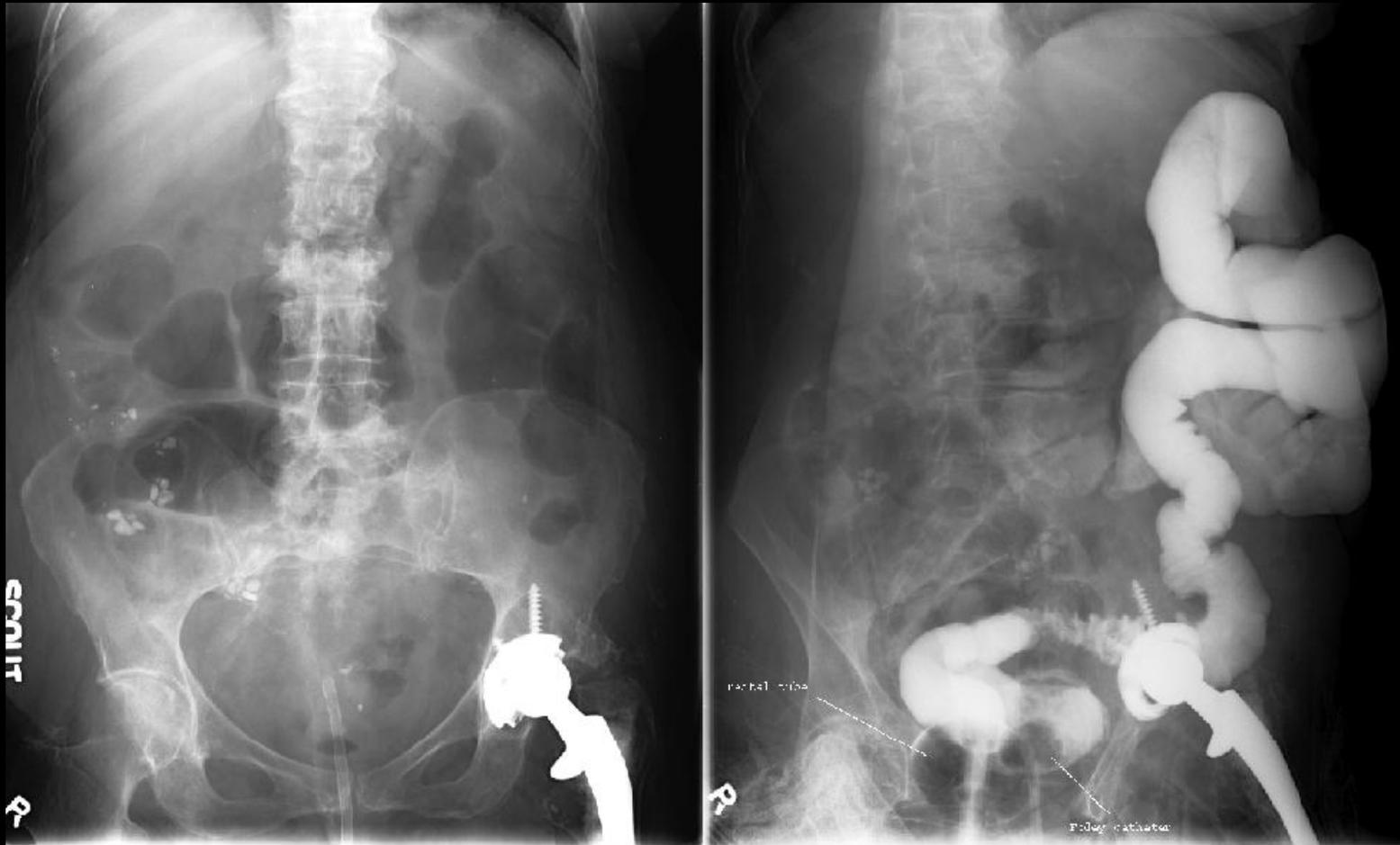
Abdominal Imaging Modalities

- Radiography (aka KUB, plainfilm, x-ray)
- Fluoroscopy (Fluoro)
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- Ultrasound (Sonography)

REMEMBER: MRI > CT > x-ray!!!!

With or without contrast???

Contrast is a substance administered into a patient's blood stream, GI tract, or other space which **increases** that space's conspicuity on imaging.



Computed Tomography (CT)

Should I give contrast (oral and IV)?

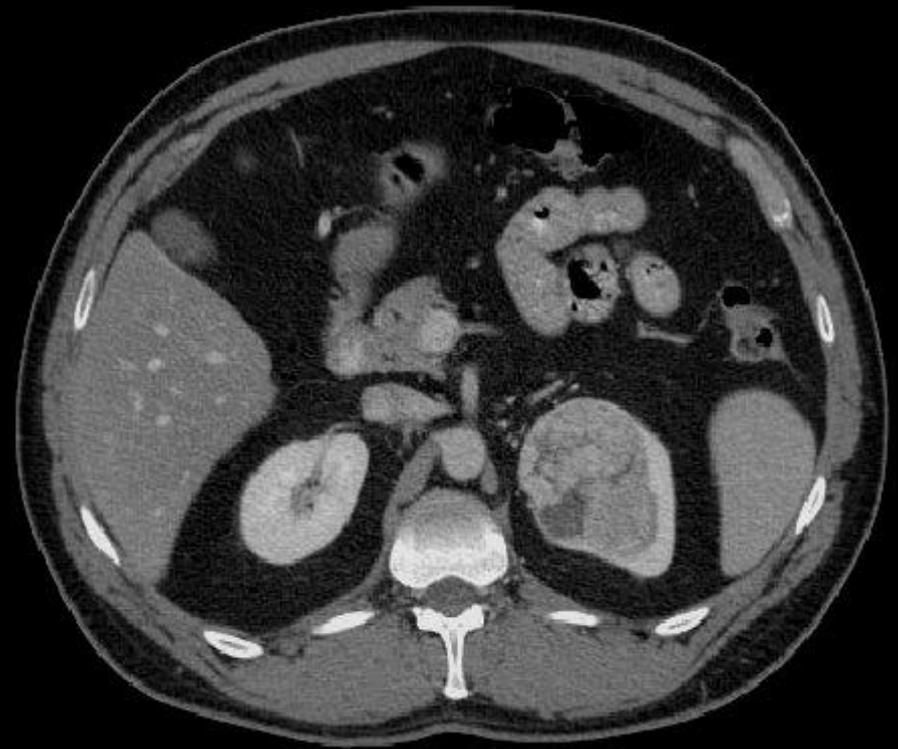
The answer is YES!

Unless.....

- 1) You are looking for renal stones and no other pathology is possible.**
- 2) Patient has renal failure (Creatinine > 1.7)**
- 3) Patient has had prior anaphylactic reaction to CT contrast**

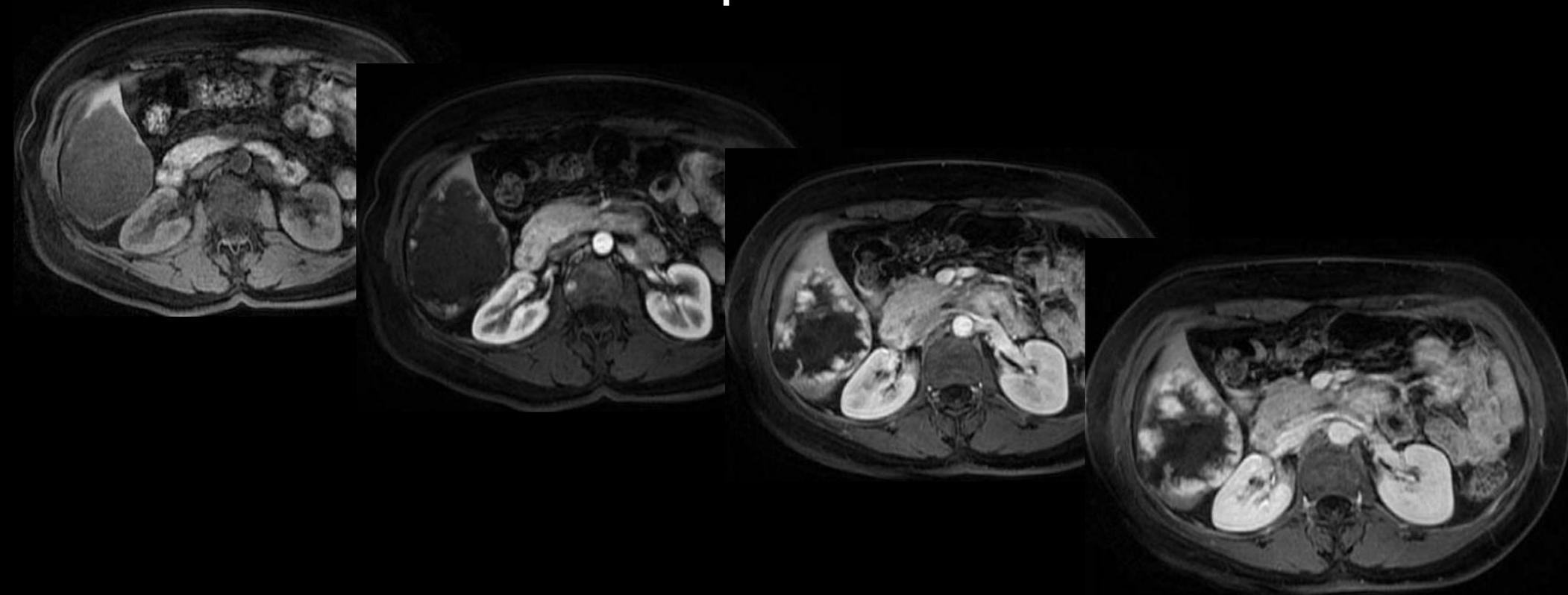
With or without contrast???

Contrast material **improves contrast resolution** and, therefore, **sensitivity and specificity for disease**.



With or without contrast???

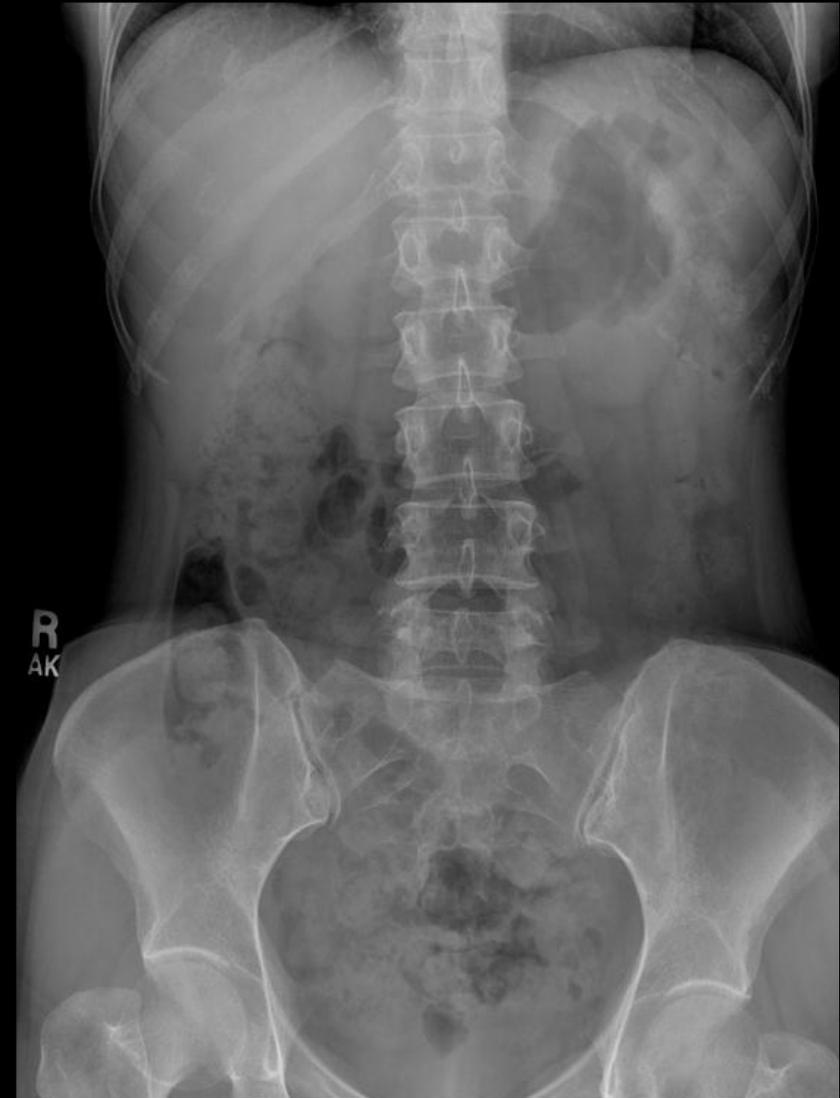
Contrast administration **provides information on physiology and vascularity** of the organ or lesion in question.



Radiography (plain old x-ray)

Things you can see:

- Bones and other calcified or metallic objects
 - Gas in or outside of bowel
 - Faint outline of some solid viscera
-
- Great spatial resolution
 - **Baaaaad** contrast resolution



KUB abdomen film

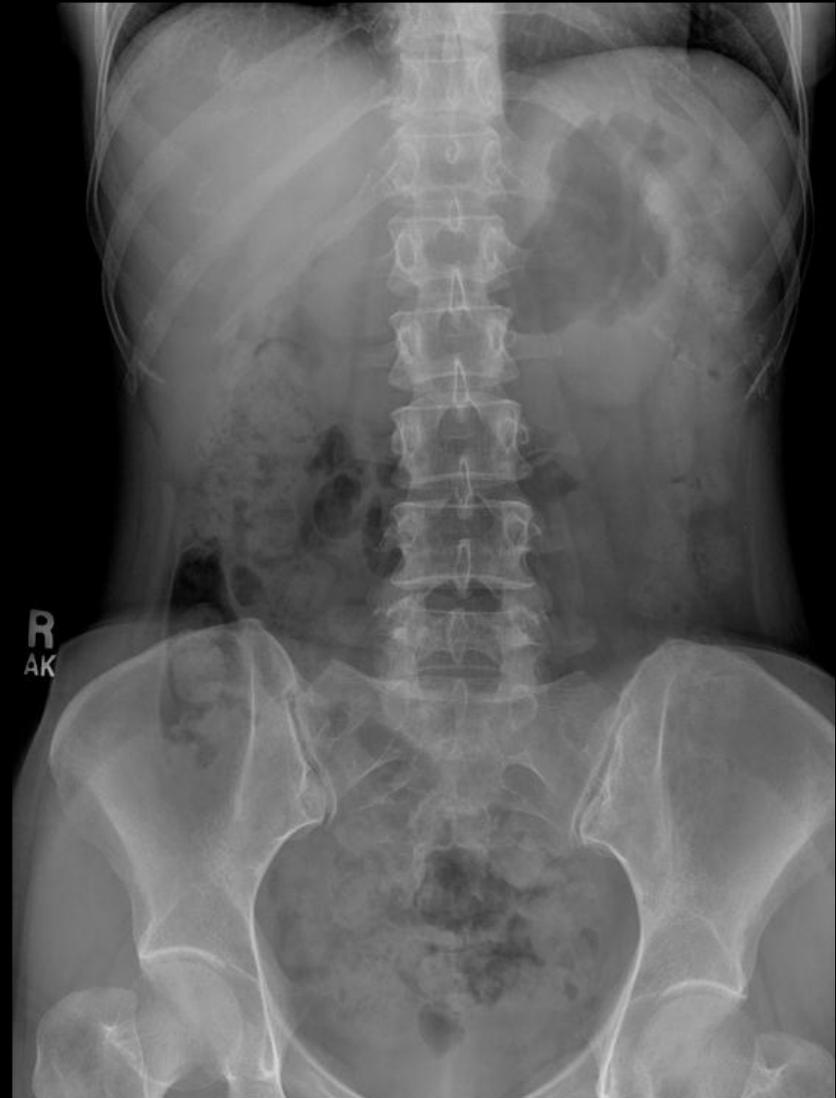
Radiography (plain old x-ray)

Good at:

- Screening for pneumoperitoneum
- Screening for bowel obstruction or ileus
- Evaluating tube / radio-opaque foreign body location

Crappy at:

- Everything else (eg. appendicitis, cholelithiasis, gastroenteritis, cancer, etc.)

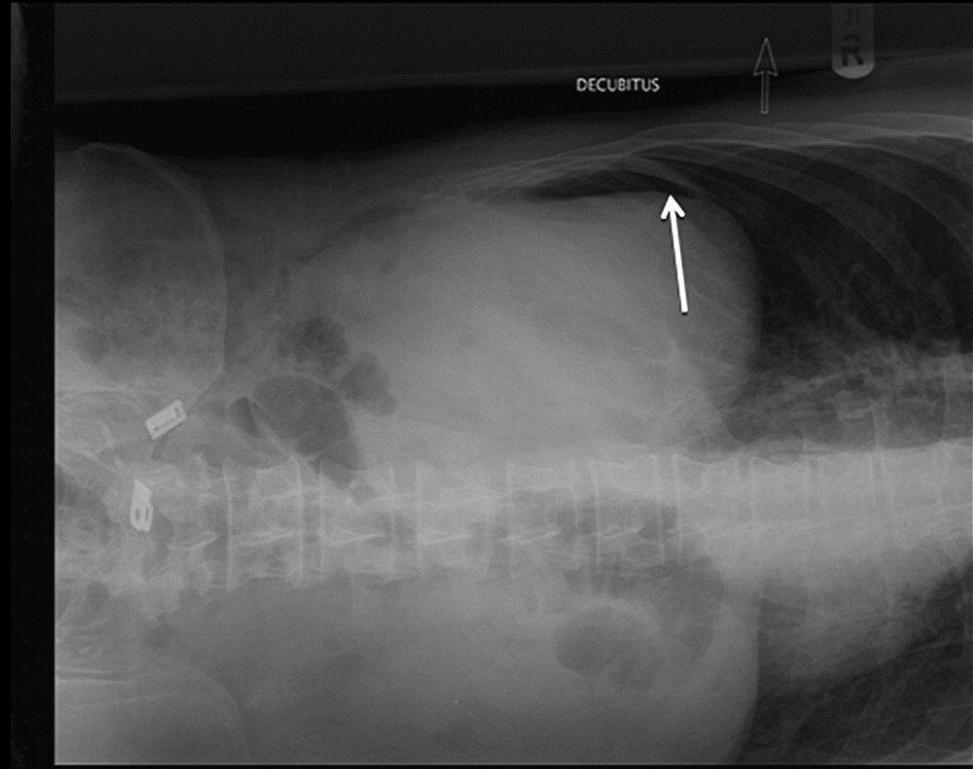


KUB abdomen film

Radiograph variations

- Positional

- Decubitus →
- Supine
- Upright



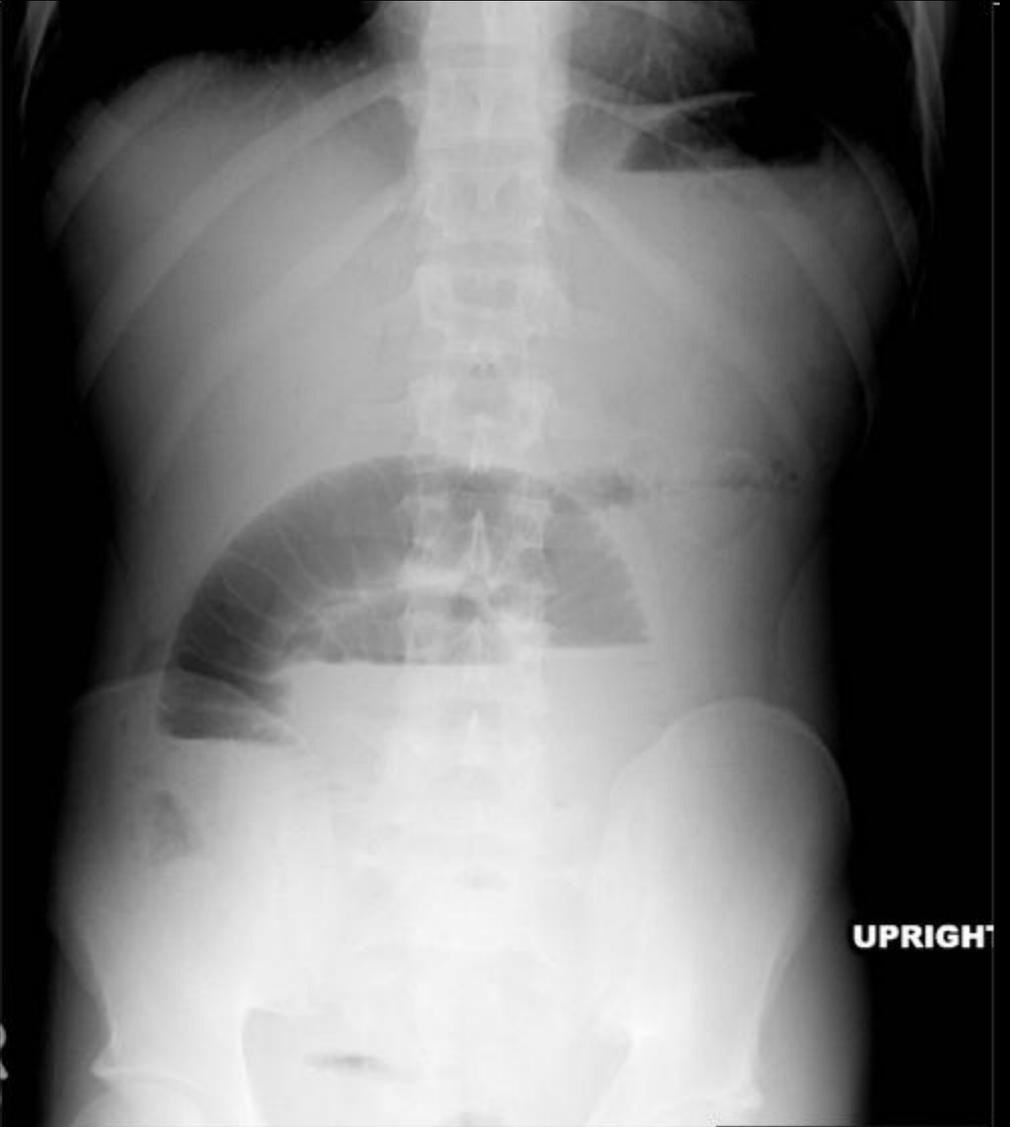
- After contrast administration

- Intravenous pyelogram (IVP)
- For tube placement verification

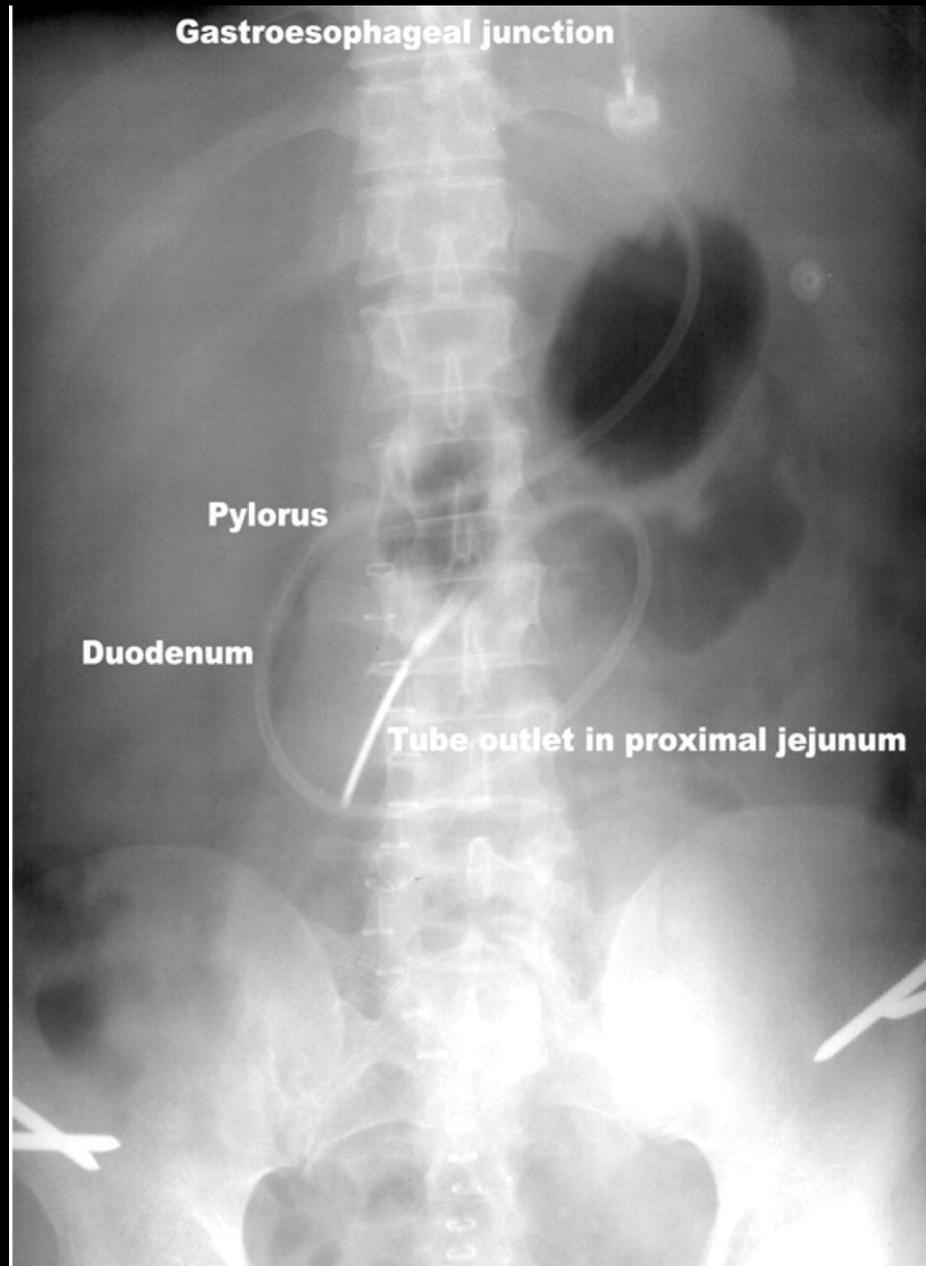
Radiography



Radiography



Radiography



Fluoroscopy

Like x-rays, but **LIVE ON TV !!!!!**

Contrast is administered to demonstrate the lumen (inside) of the space we're interested in.

Provides anatomic and functional information.



Routine fluoroscopic studies

Esophagram



Upper GI



mass, ulcer, reflux

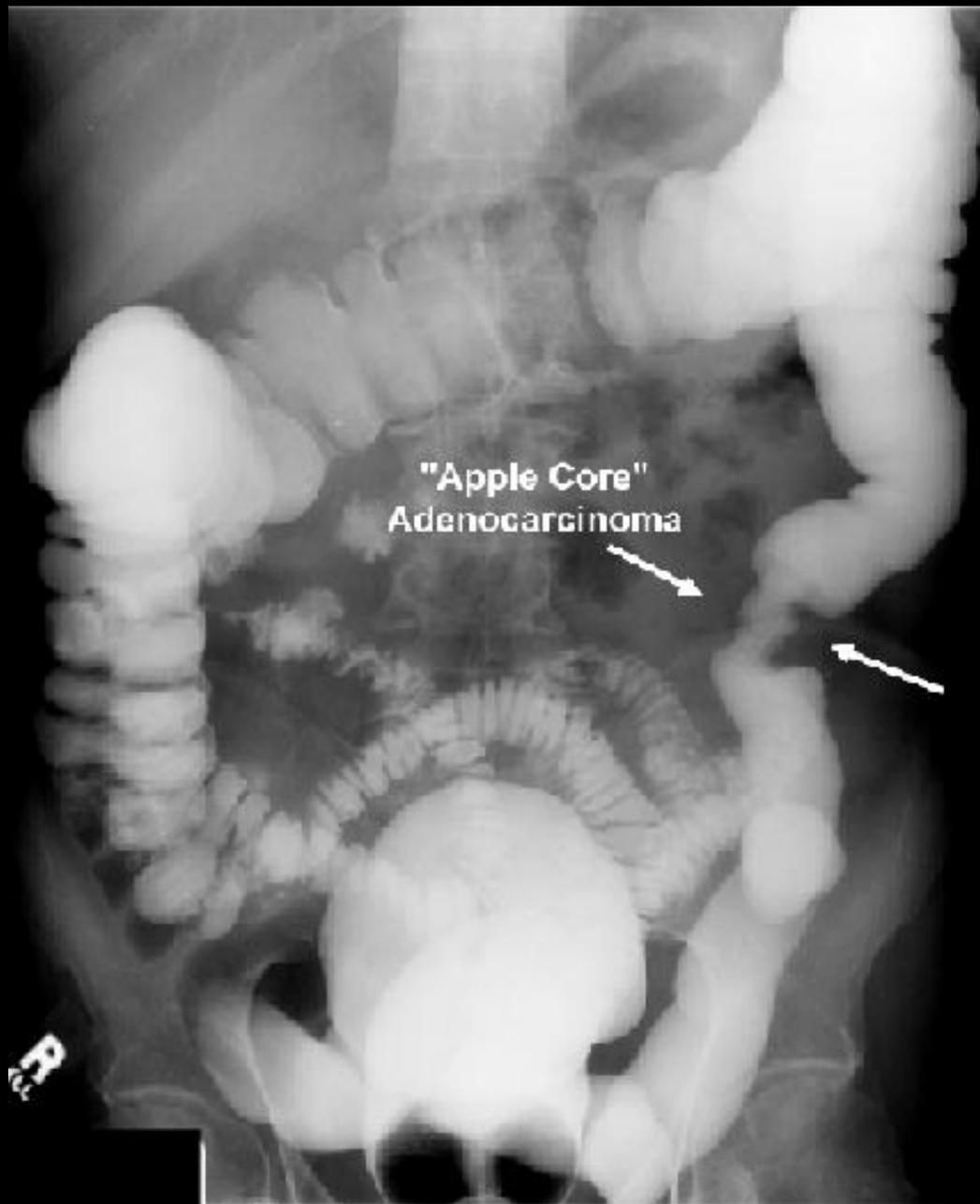
Barium enema



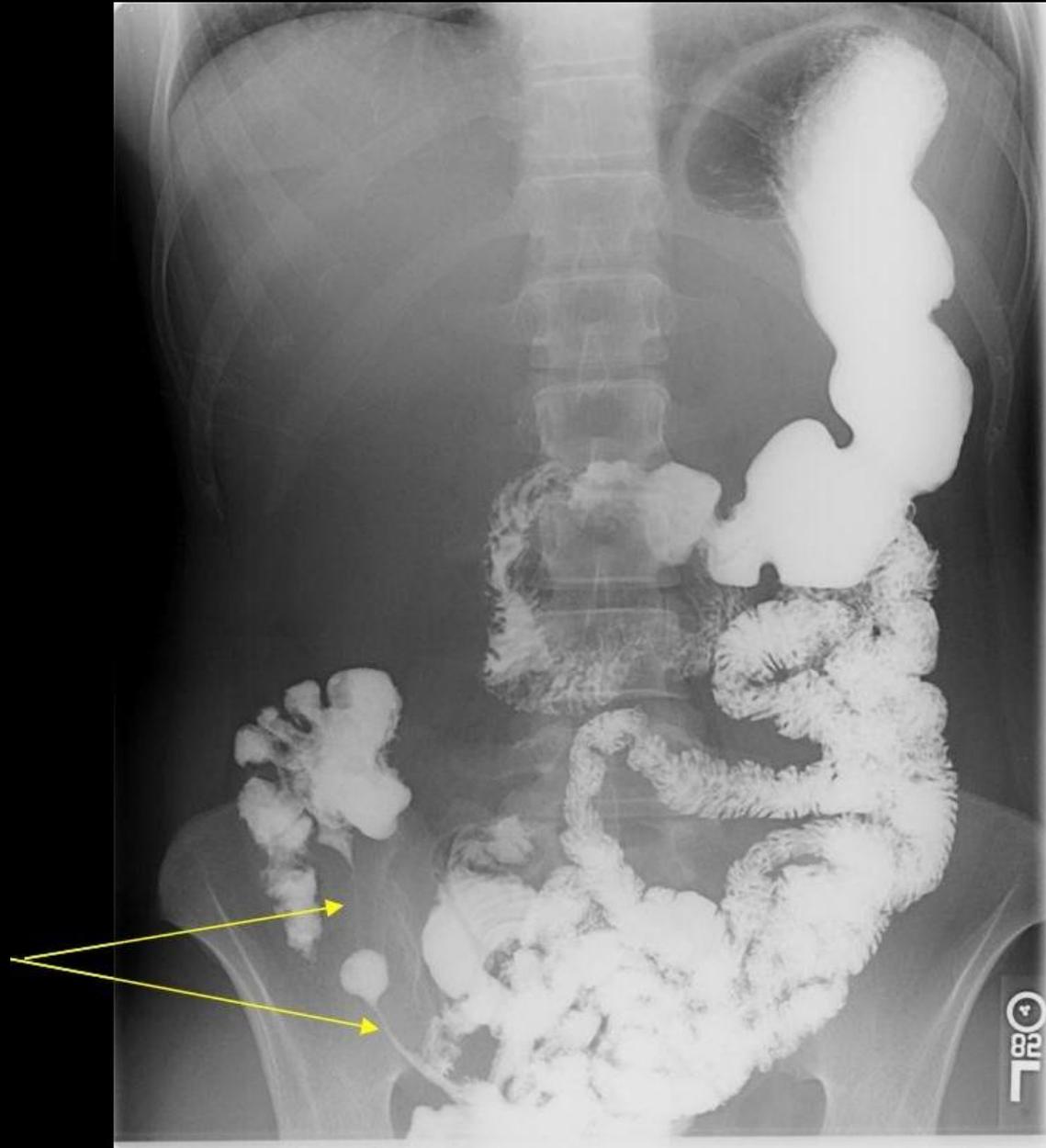
mass, polyp

dysphagia, stricture

Barium Enema



Small Bowel Follow Through



Computed Tomography (CT)

Pros:

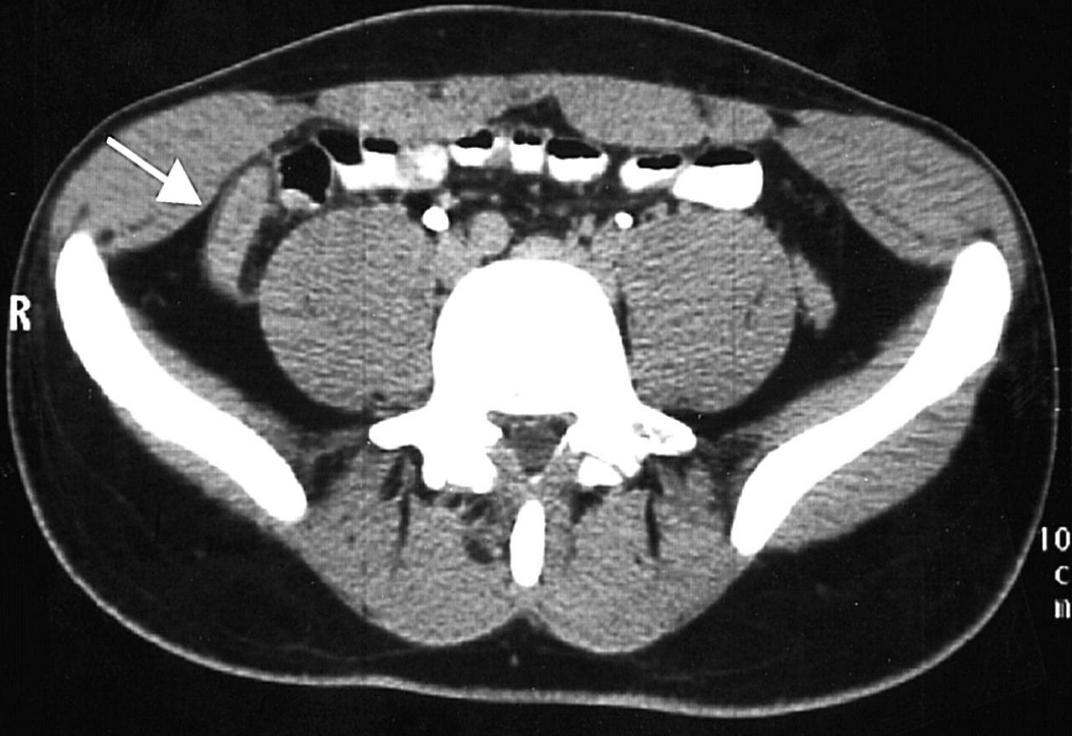
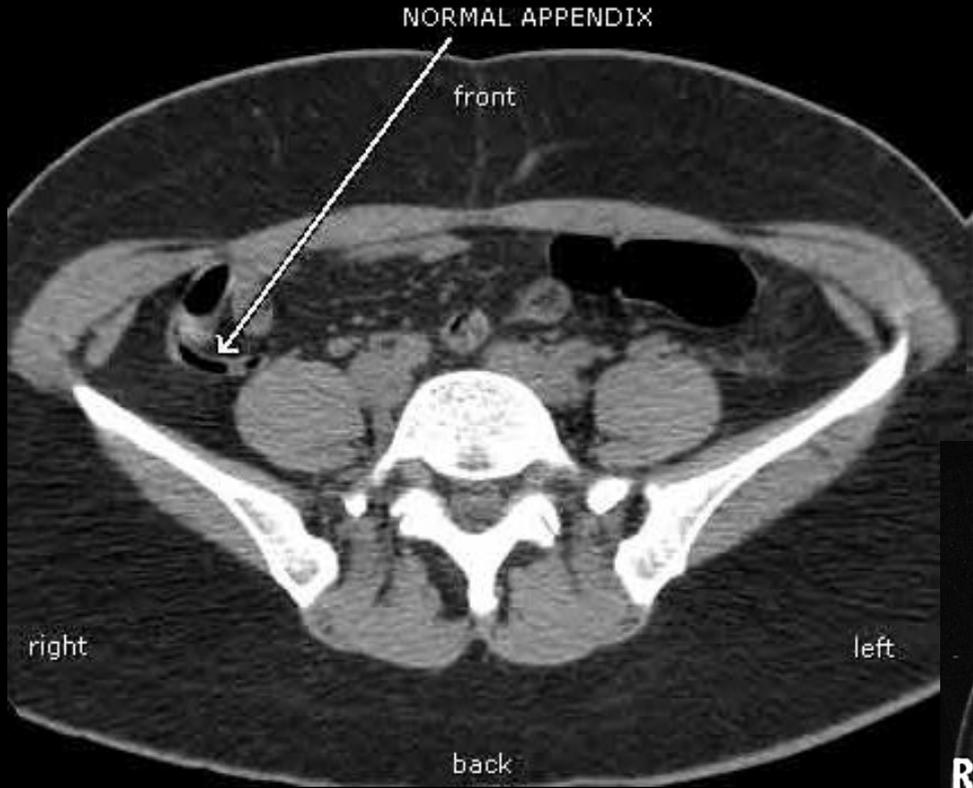
- Very good spatial resolution
- Pretty good contrast resolution without contrast
- Very good contrast resolution with contrast

- Excellent anatomic detail
- Sensitive and specific for almost any abdominal disease which causes anatomic changes (inflammation, masses, obstruction, stones, etc.)
- Quick to acquire

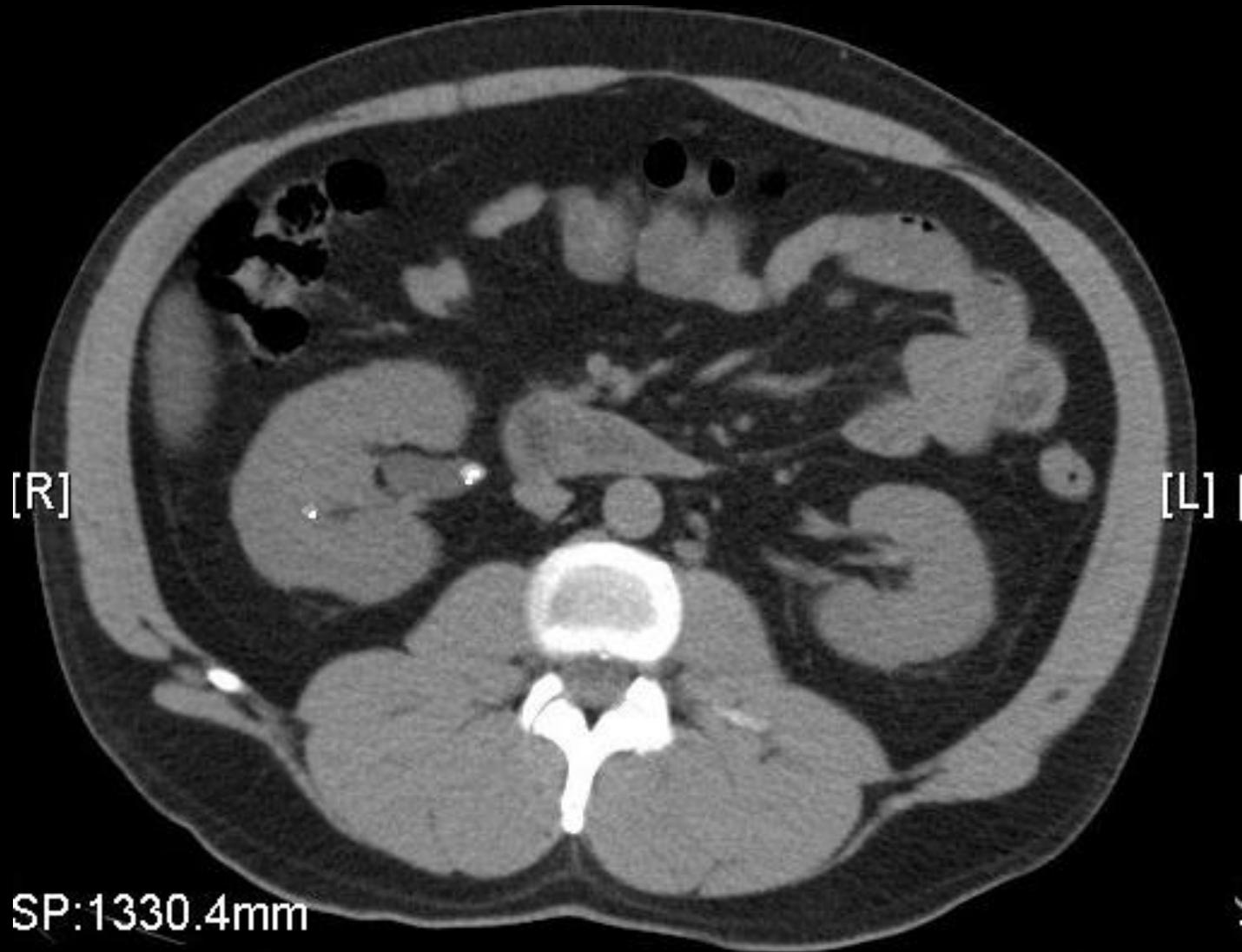
Cons:

- Uses ionizing radiation
- Poor specificity for GYN pathology

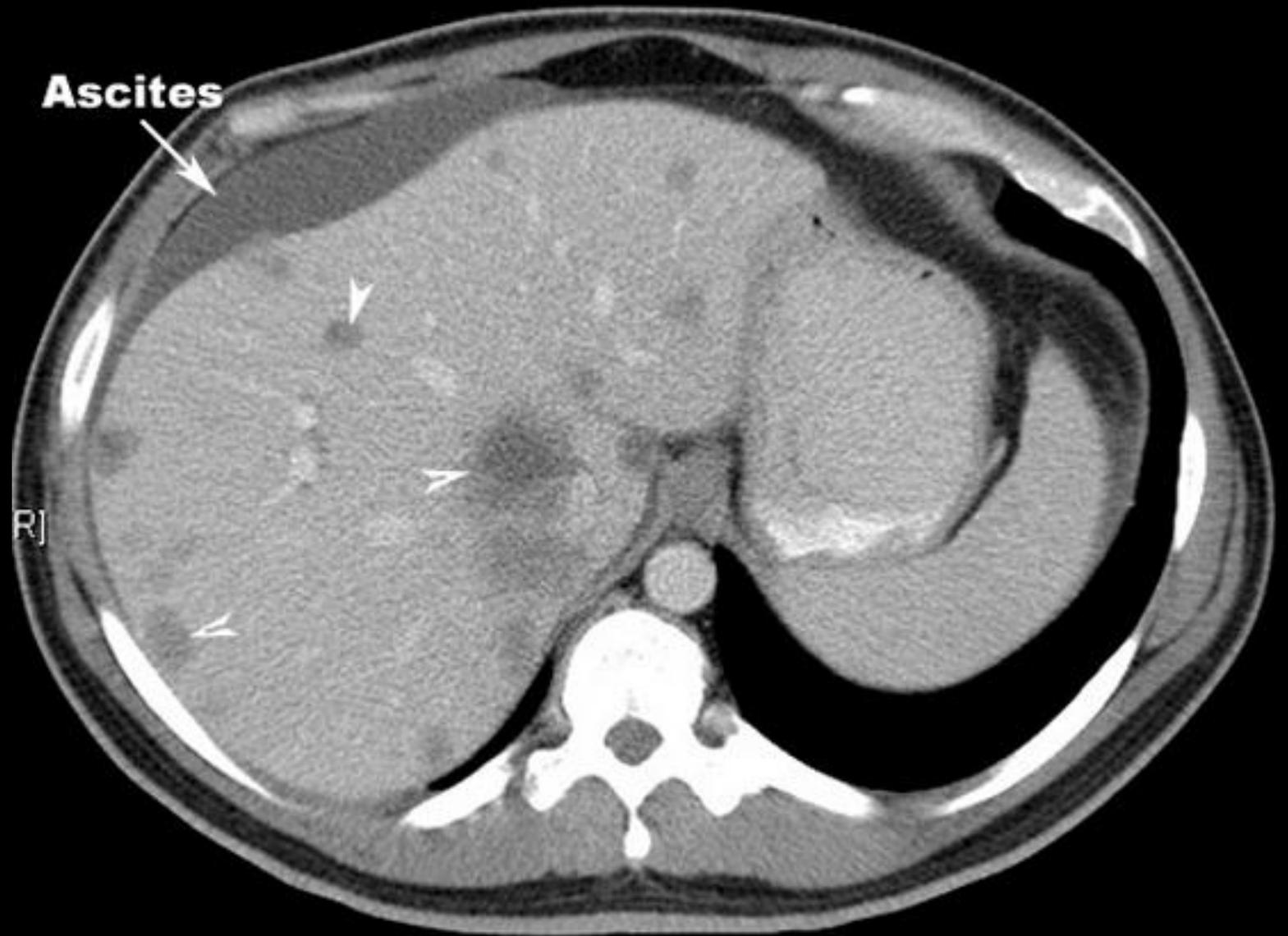
Computed Tomography (CT)



Computed Tomography (CT)



Computed Tomography (CT)



Magnetic Resonance Imaging (MRI)

- Amazing **contrast resolution**
- Pretty good spatial resolution
- **Problem-solving technology**

- Pros

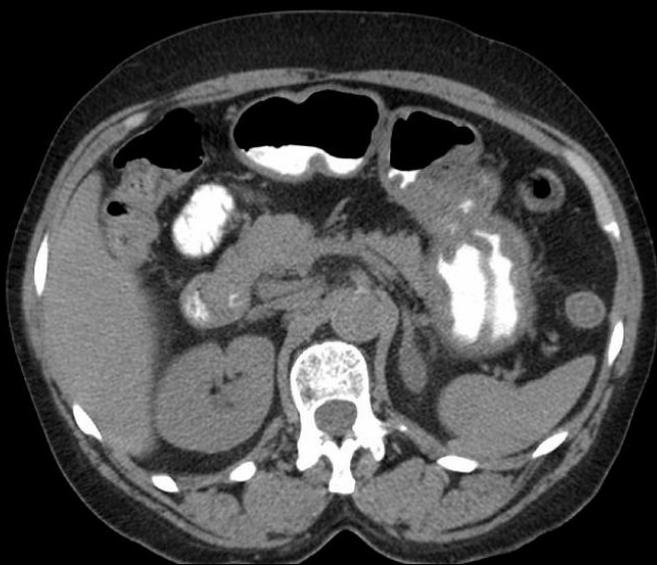
- Excellent tissue characterization
- Very sensitive and specific for soft tissue lesions, especially in solid organs
- Excellent characterization of GYN pathology

- Cons

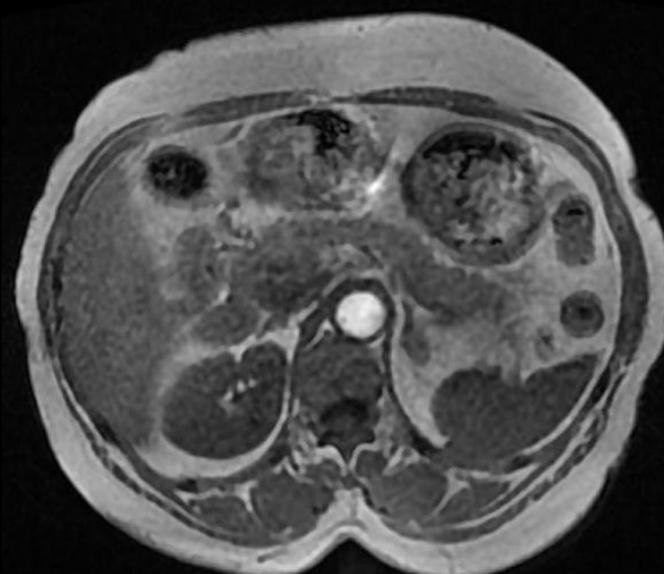
- Expensive
- Long acquisition time
- Quality depends on patient cooperation

Magnetic Resonance Imaging (MRI)

CT without



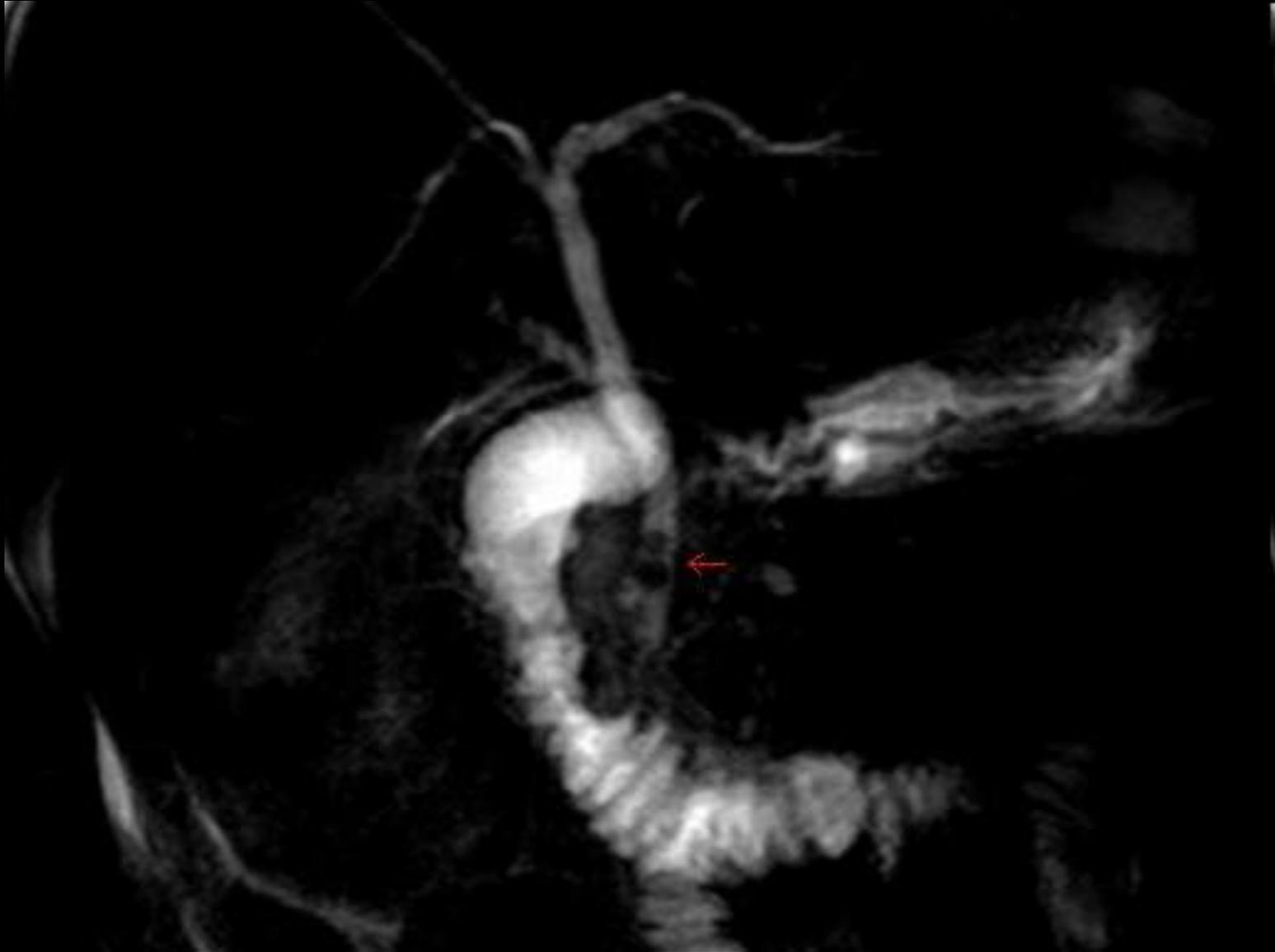
T1WI in-phase



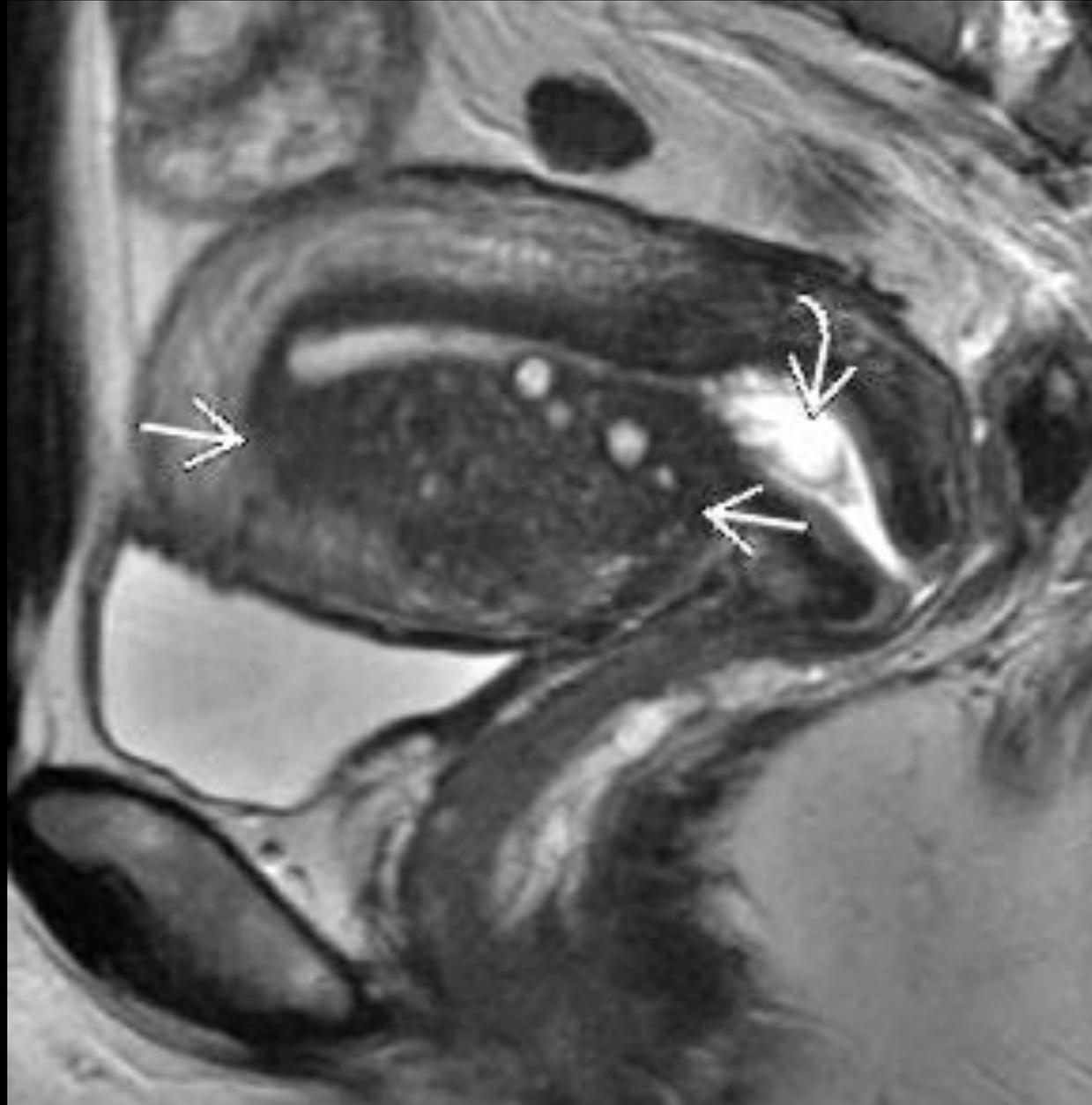
T1WI out-of-phase



Magnetic Resonance Imaging (MRI)



Magnetic Resonance Imaging (MRI)



Magnetic Resonance Imaging (MRI)



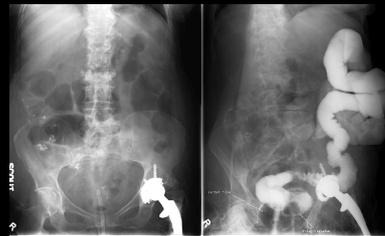
Basic Abdominal and Pelvic Imaging Concepts

Remember the basics:

Resolu_{tion}

Modalities (x-ray, Fluoro, CT, MRI, US)

With or without contrast?



If you don't know what to do,

ask a radiologist !!!

Management of Incidental GI Findings

Cystic Pancreatic Lesions

- pancreatic cysts, pseudocysts, benign neoplasms

Renal Cystic Lesions

Liver lesions

- hemangiomas, FNH, adenomas

Pancreatic cystic lesions

When we say pancreatic cyst, what do we mean?

- Pseudocysts
- Serous neoplasms
 - Serous cystadenoma
 - Serous cystadenocarcinoma (very rare)
- Mucinous Neoplasms
 - Mucinous cystic neoplasm
 - Intraductal papillary mucinous neoplasm
- Cystic variants of solid neoplasm
 - Neuroendocrine tumour
 - Ductal adenocarcinoma
 - Acinar cell tumour
- Others
 - Solid pseudopapillary tumour
 - Lymphoepithelial cyst

Pancreatic cystic lesions

	Pseudocyst	Cystic Tumor
Sex	Males > Females	Females > Males
Acute/chronic pancreatitis	History of acute/chronic pancreatitis or trauma	No antecedent factors
Serum amylase level	Elevated	Normal, except in intraductal papillary mucinous tumor
Cystic fluid	Opalescent/blood/debris	Clear in serous cystadenoma, mucoid in mucinous cystic neoplasm
	High amylase level	Low amylase level
	Tumor markers low	Tumor markers may be high
	Cytology shows inflammation	Cytology often positive
Imaging	Usually shows single cyst	Frequently shows multiple cysts
	No solid components	Solid components
	Calcification may be diffuse	Focal calcification
Communication with pancreatic duct	Communication in majority	No communication
Ductal system	Features of chronic pancreatitis	No chronic pancreatitis
Surgical findings	Thick wall and abnormal pancreatic parenchyma	Epithelial lining, adjacent normal pancreas

Pancreatic cystic lesions

There are many “cysts” which may/do not need intervention

- Pseudocysts
- Serous neoplasms
 - Serous cystadenoma
 - Serous cystadenocarcinoma (very rare)
- Mucinous Neoplasms
 - Mucinous cystic neoplasm
 - Intraductal papillary mucinous neoplasm
- Cystic variants of solid neoplasm
 - Neuroendocrine tumour
 - Ductal adenocarcinoma
 - Acinar cell tumour
- Others
 - Solid pseudopapillary tumour
 - Lymphoepithelial cyst
 - True cysts (including von Hippel Lindau disease)

Plus

The risk of surgery, (disease of the elderly)
Specific pancreatic complications

Pancreatic IPMNs vs True Cysts

IPMN:

Can be side branch or main duct

Characterized by:

Mucin production

Dilation of the pancreatic duct

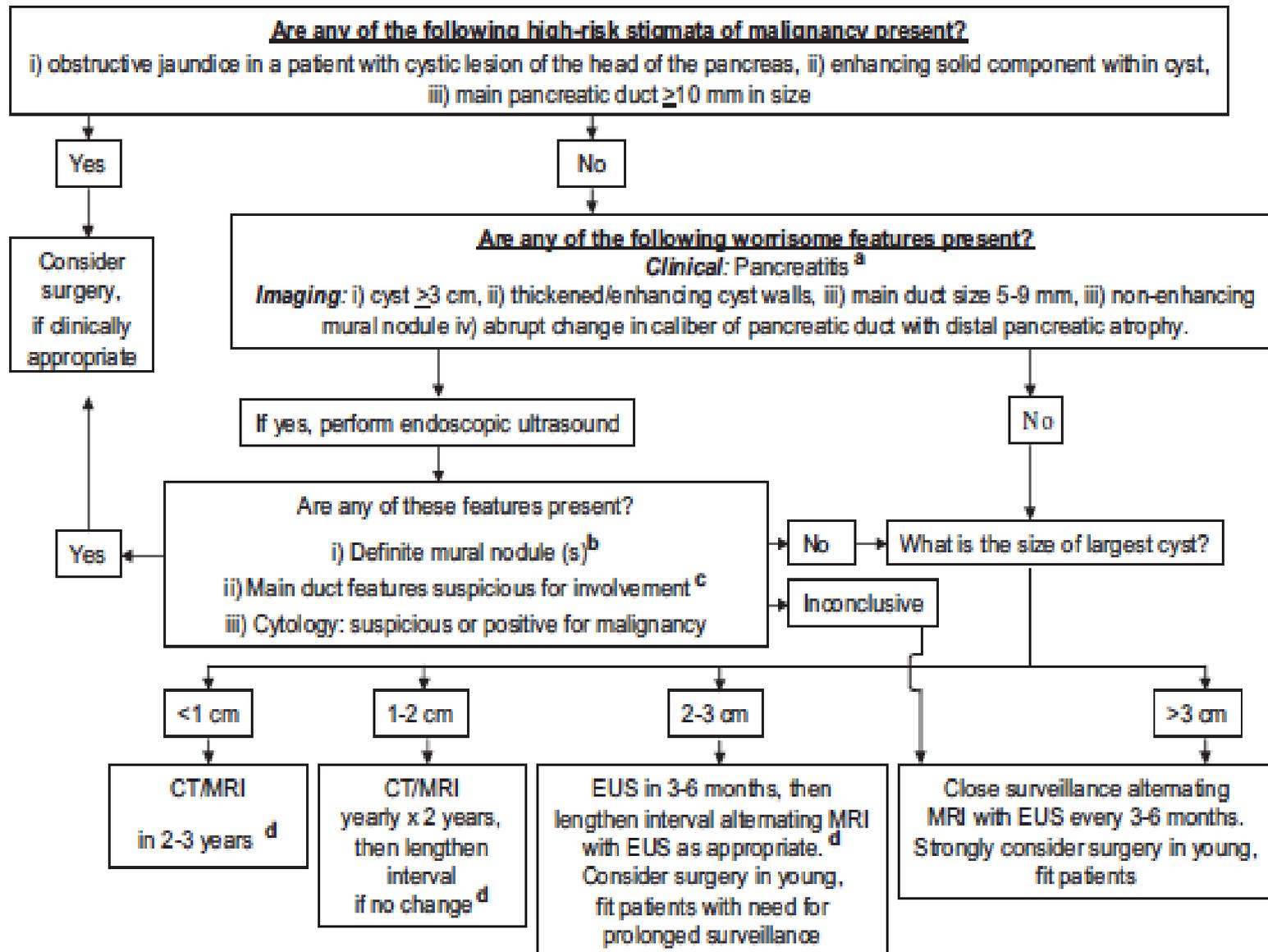
Intraductal papillary growth

True Cysts:

10% of patients with ADPCKD

30% of patients with VHL

Pancreatic cystic lesions



Renal Cysts

Bosniak Classification:

I – simple

II – minimally complex

IIF- minimally complex

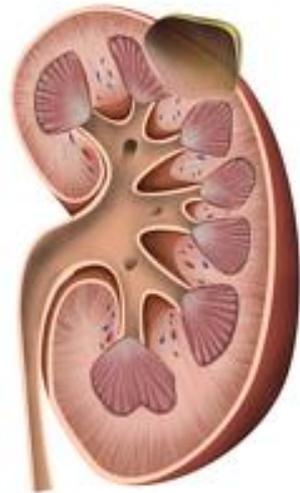
III/IV - neoplasm

Bosniak classification of renal cysts

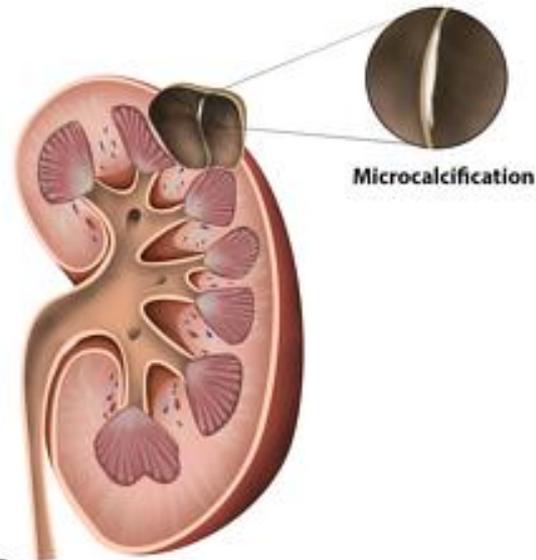
Category	CT features	Significance
Class I	Water density homogenous Noncalcified, smooth margin No enhancing component	Benign
Class II	Thin septae (<1 mm) Thin calcification (<1 mm) Hemorrhagic cyst	Benign
Class IIF		Likely benign Follow-up imaging indicated
Class III	Thick septa Thick calcification Thick wall Multilocular +/- enhancement	≈ 50% malignant
Class IV	Criteria of category III Enhancing solid mass of wall or septa	Definitely malignant

Chapple CR et al. Practical urology: Essential principles & practice.
Springer-Verlag, London, 2011.

Bosniak classification of renal cysts

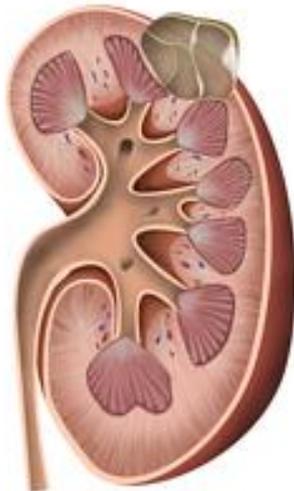


1 ~0% are malignant

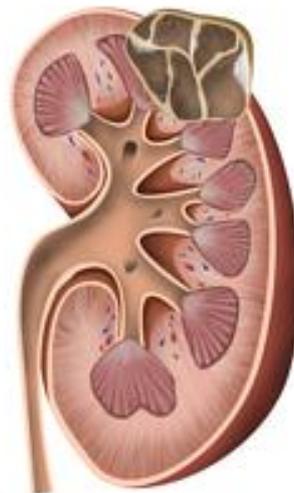


Microcalcification

2 ~0% are malignant



2F ~5% are malignant



3 ~50% are malignant



4 ~100% are malignant

Bosniak I



Bosniak II



Bosniak IIF



Contrast-enhanced CT image shows a partially exophytic cyst with a fine septation inside. Subtle nodularity is observed in the septum, which has perceptible but not measurable contrast-enhancement (arrow).

Bosniak III/IV



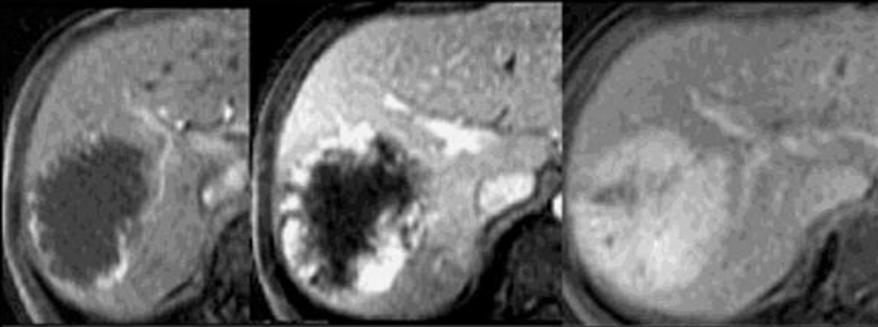
Incidental Liver Lesions

“Hepatic Hypodensities”:

- 1) Hemangiomas
- 2) Adenomas
- 3) Focal Nodular Hyperplasia (FNH)
- 4) Cysts
- 5) Biliary cystadenomas

Hemangiomas

Hemangioma: Gd-MRI
Progressive centripetal enhancement



Hyperechoic on U/S

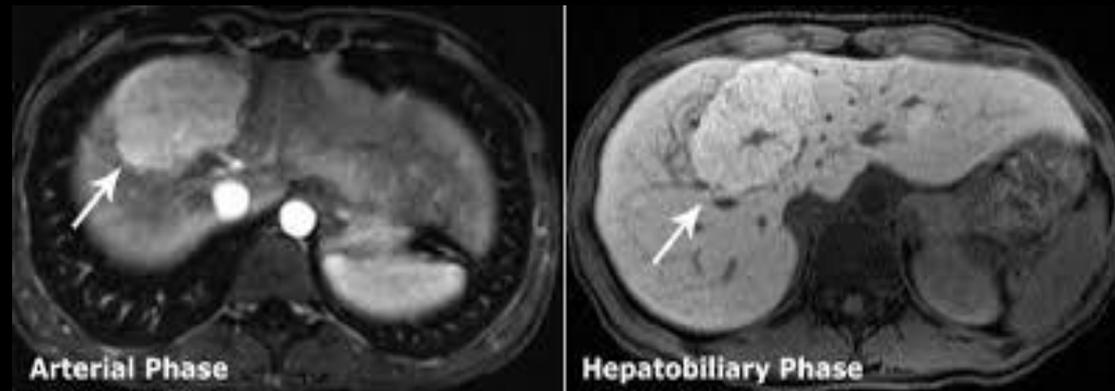
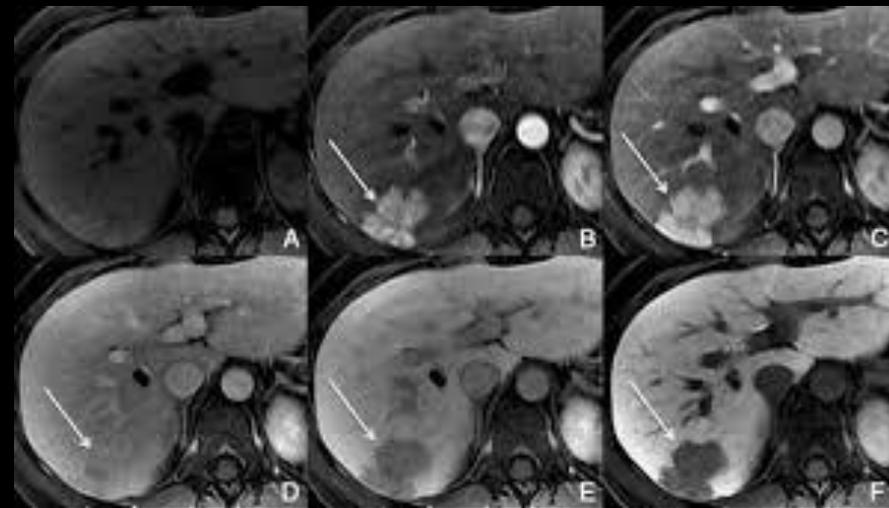


No follow-up necessary

Adenoma vs. FNH

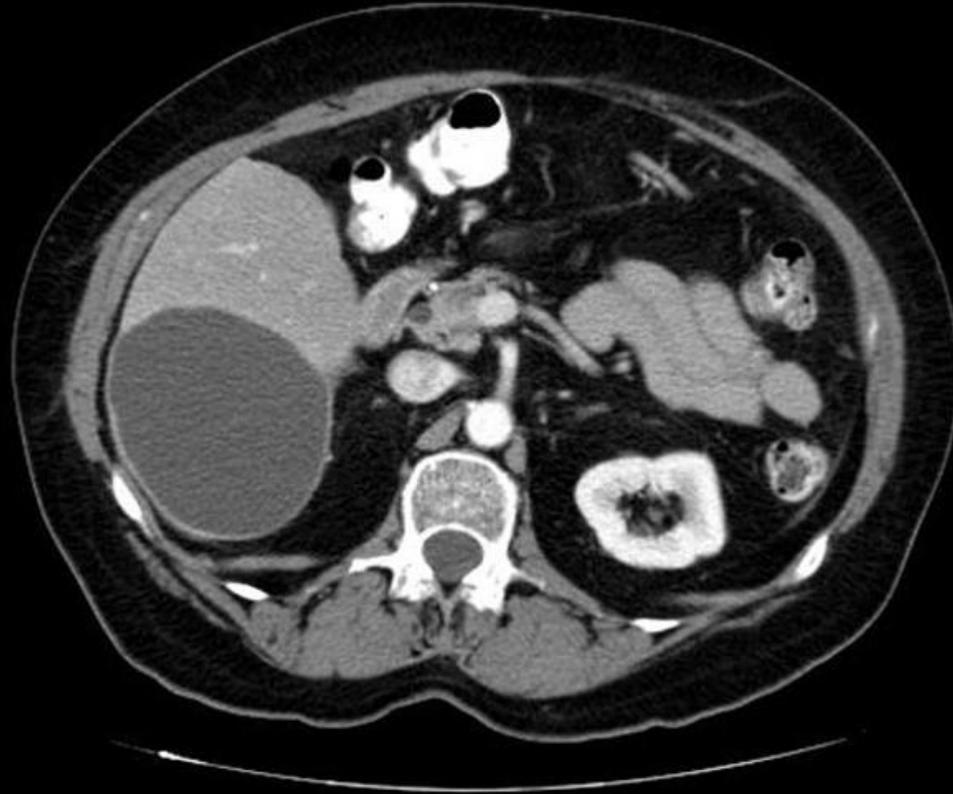
Adenoma

FNH



FNH - No follow-up necessary
Adenoma – follow-up yearly
>4 cm consider surg consult

Biliary Cystadenoma



More common in middle age women

**Benign neoplasm, treated surgically
-risk of cystadenocarcinoma**

Latest Applications for GI MRI

- 1) Rectal MR**
- 2) MR Enterography**
- 3) Pancreatic MR**

Rectal MR

Useful for identification of:

- 1) Tumor extension beyond serosa (T3)**
- 2) Perirectal lymph nodes**
- 3) Relation of tumor to anal canal**

Tx: Determination of tumor is not possible because of incomplete information

Tis: Tumor in situ involves only the mucosa and has not grown beyond the muscularis mucosa

T1: Tumor grows beyond the muscularis mucosa into the submucosa

T2: Tumor grows through the submucosa and extends into the muscularis propria (MP)

American Joint Committee on Cancer

T3a: Tumor < 1 mm beyond MP

T3b: Tumor > 1 – 5mm beyond MP

T3c: Tumor > 5 – 15 mm beyond MP

T3d: Tumor > 15 mm beyond MP

RSNA

T3a: Tumor < 5mm beyond MP

T3b: Tumor 5 – 10 mm beyond MP

T3c: Tumor > 10 mm beyond MP

T4a: Tumor penetrates the visceral peritoneum

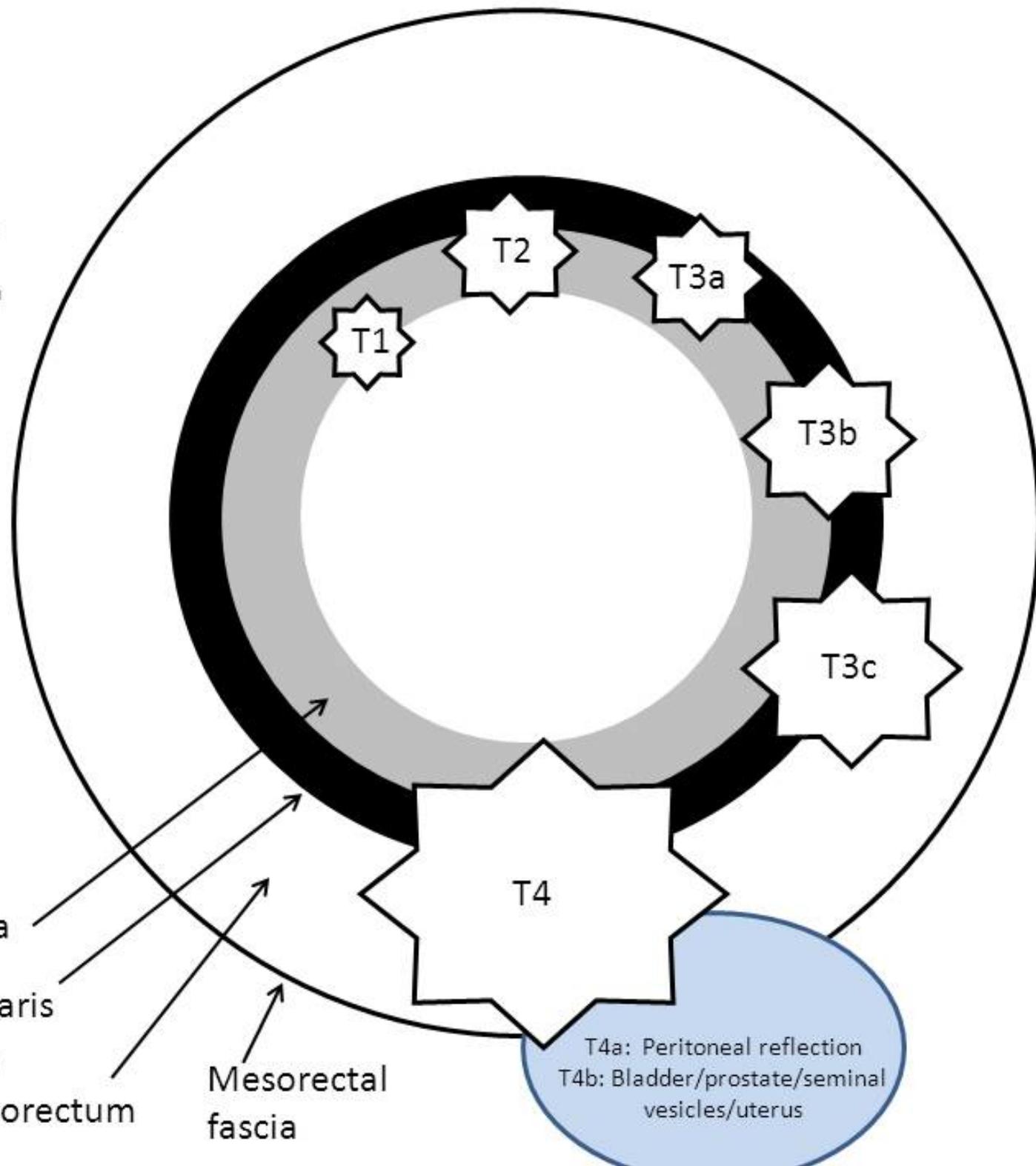
T4b: Tumor directly invades or is adherent to other organs or structures

Submucosa

Muscularis propria

Mesorectum

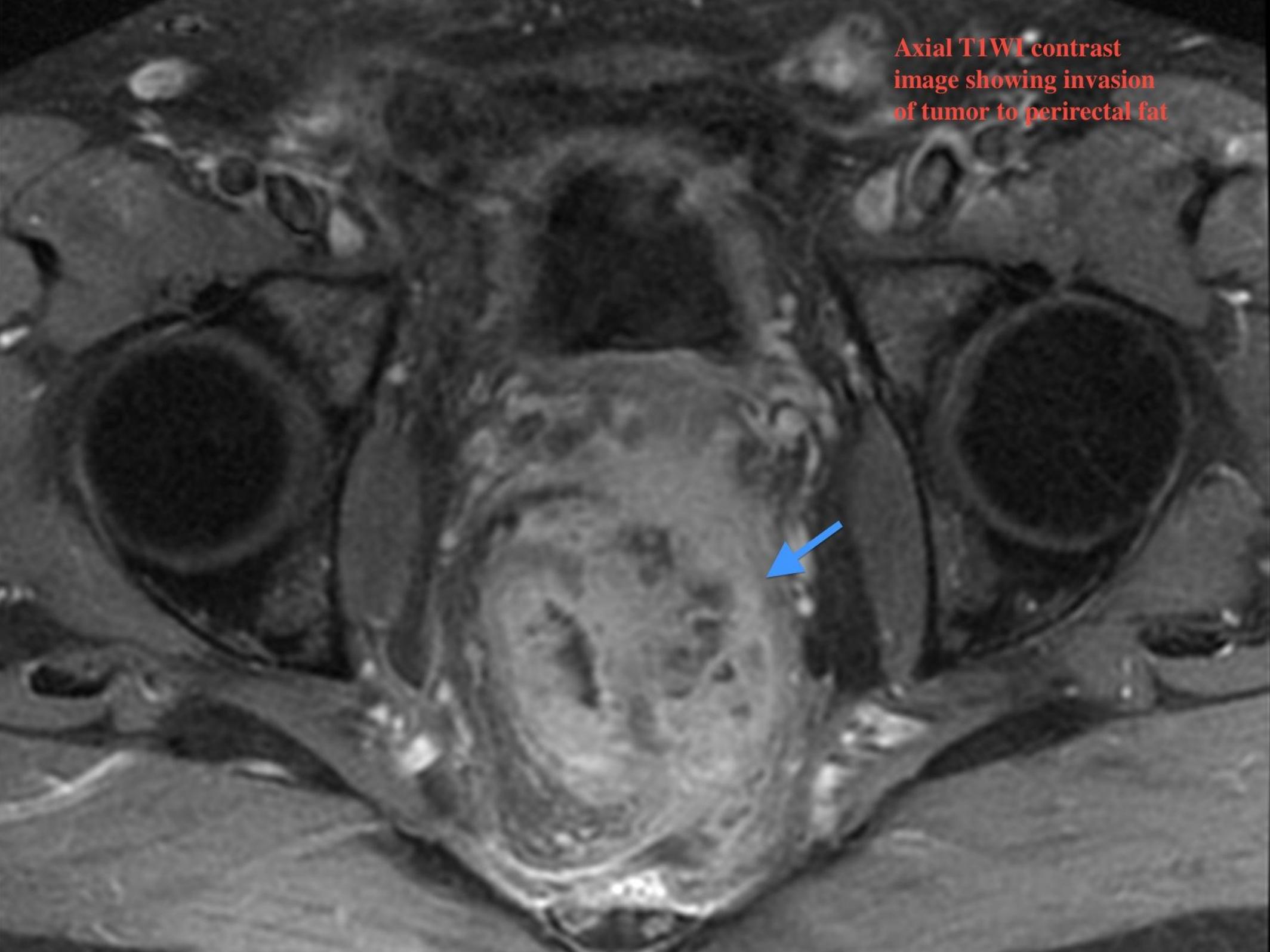
Mesorectal fascia



T4a: Peritoneal reflection
T4b: Bladder/prostate/seminal vesicles/uterus

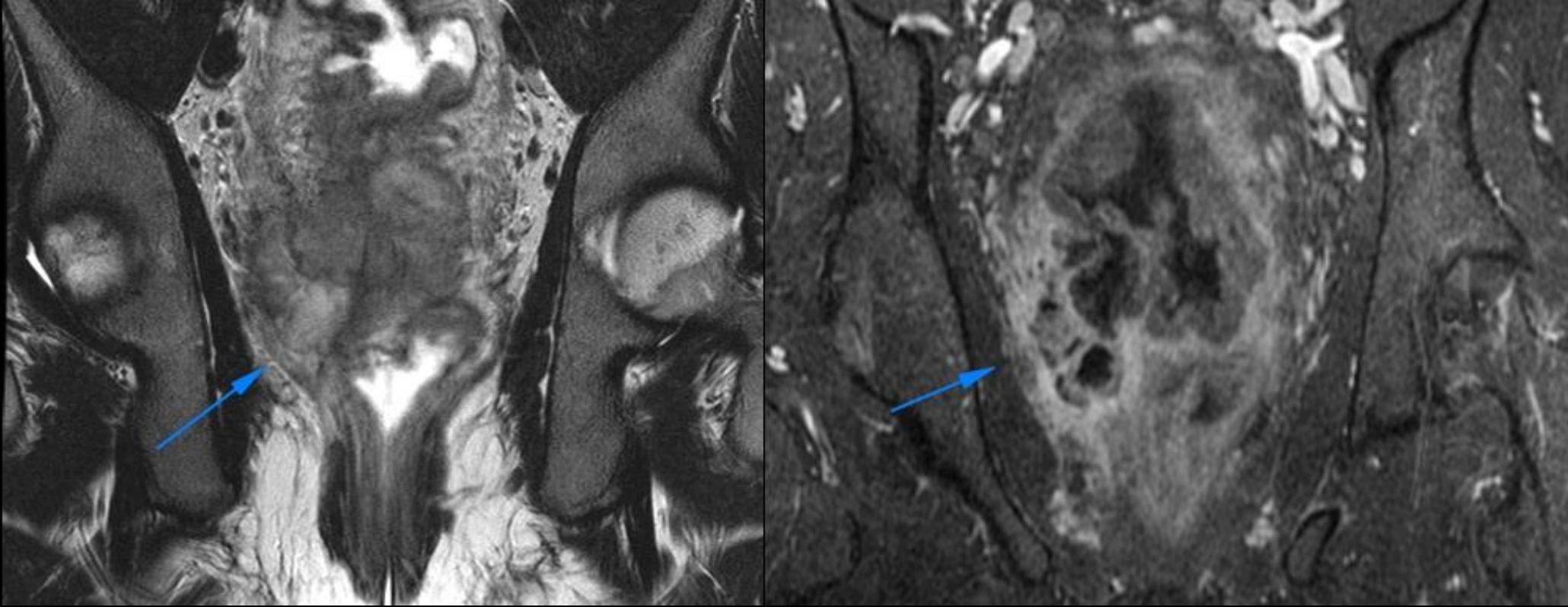
Rectal MR





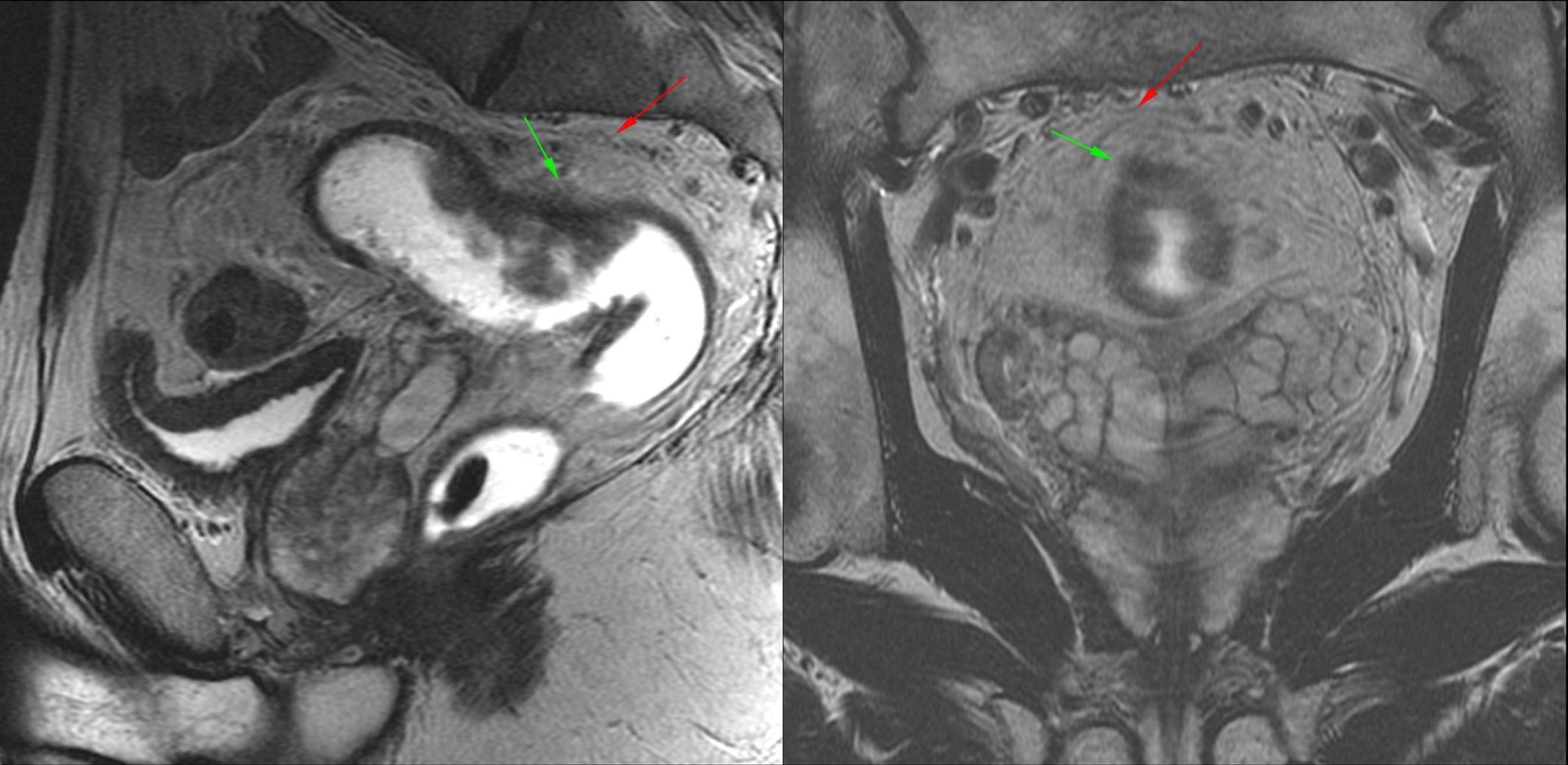
Axial T1WI contrast image showing invasion of tumor to perirectal fat

Rectal MR



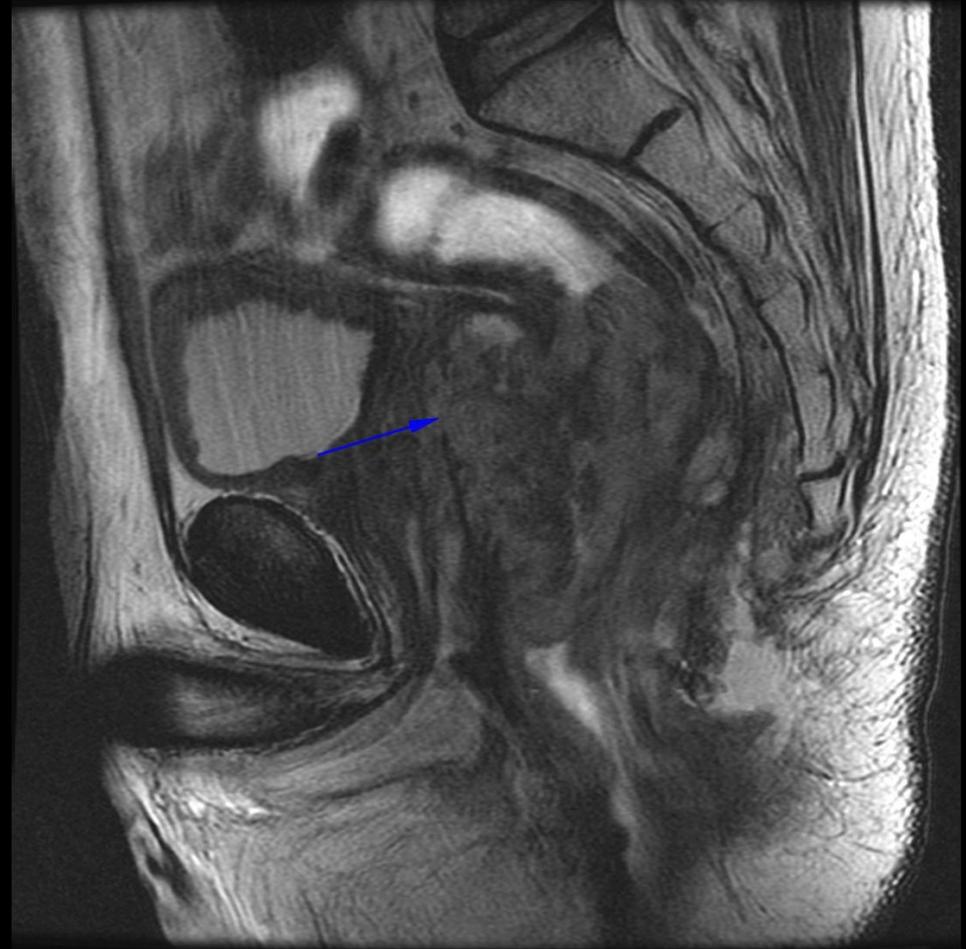
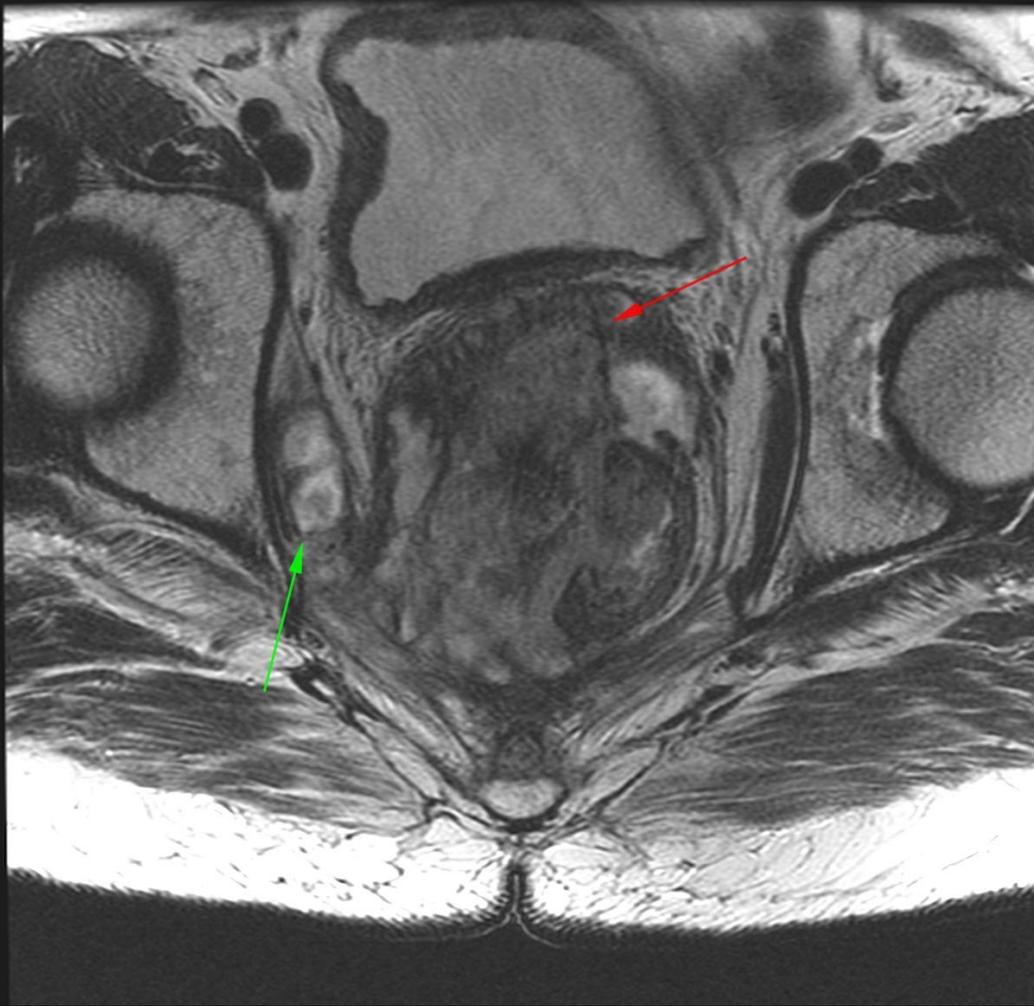
Extension of tumor into the Mesorectal Fascia

Rectal MR



Subtle Extension of tumor into the Mesorectal Fascia

Rectal MR



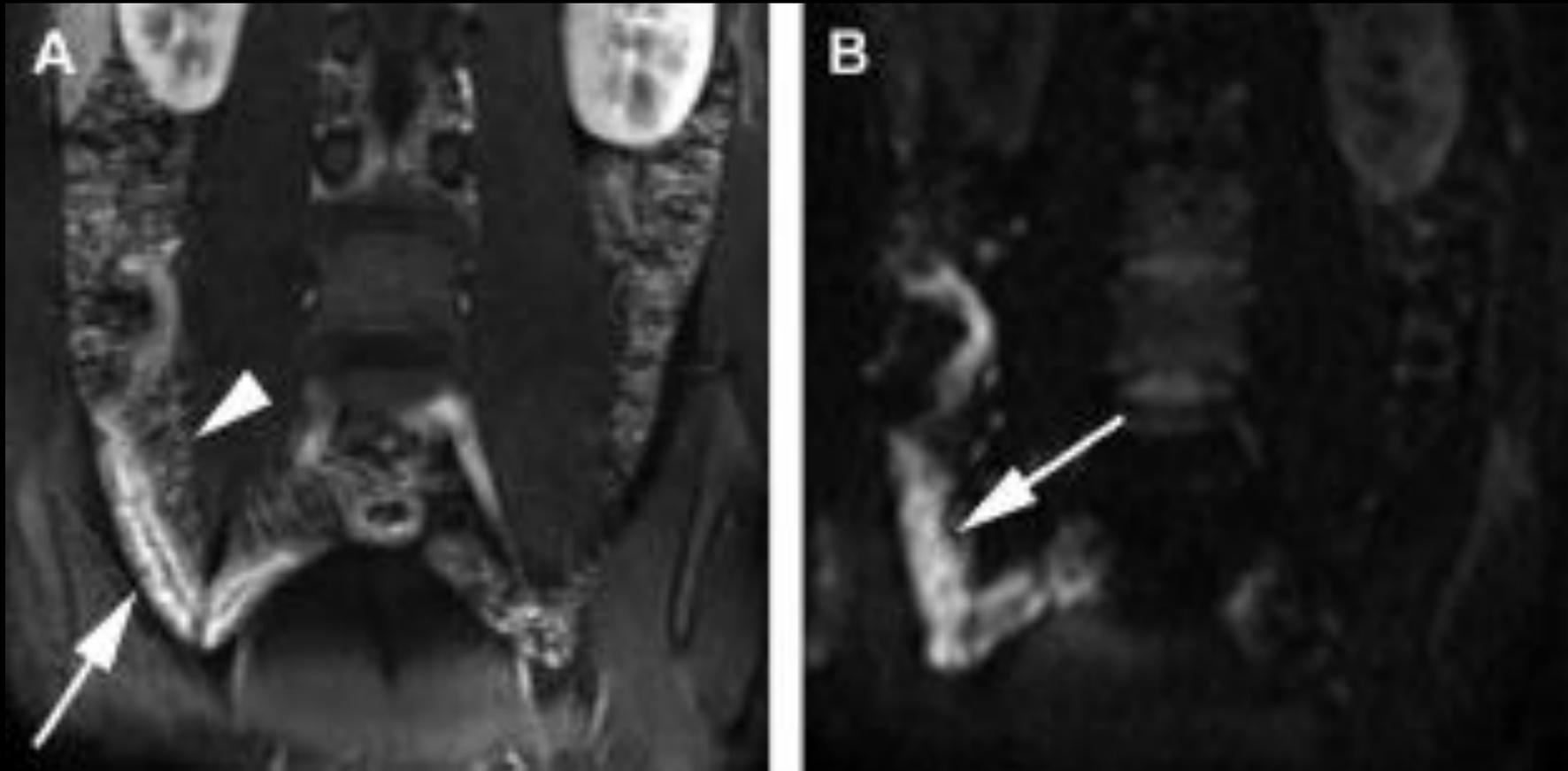
Invasion of the vaginal canal anteriorly by rectal tumor

MR Enterography

Useful for identification of:

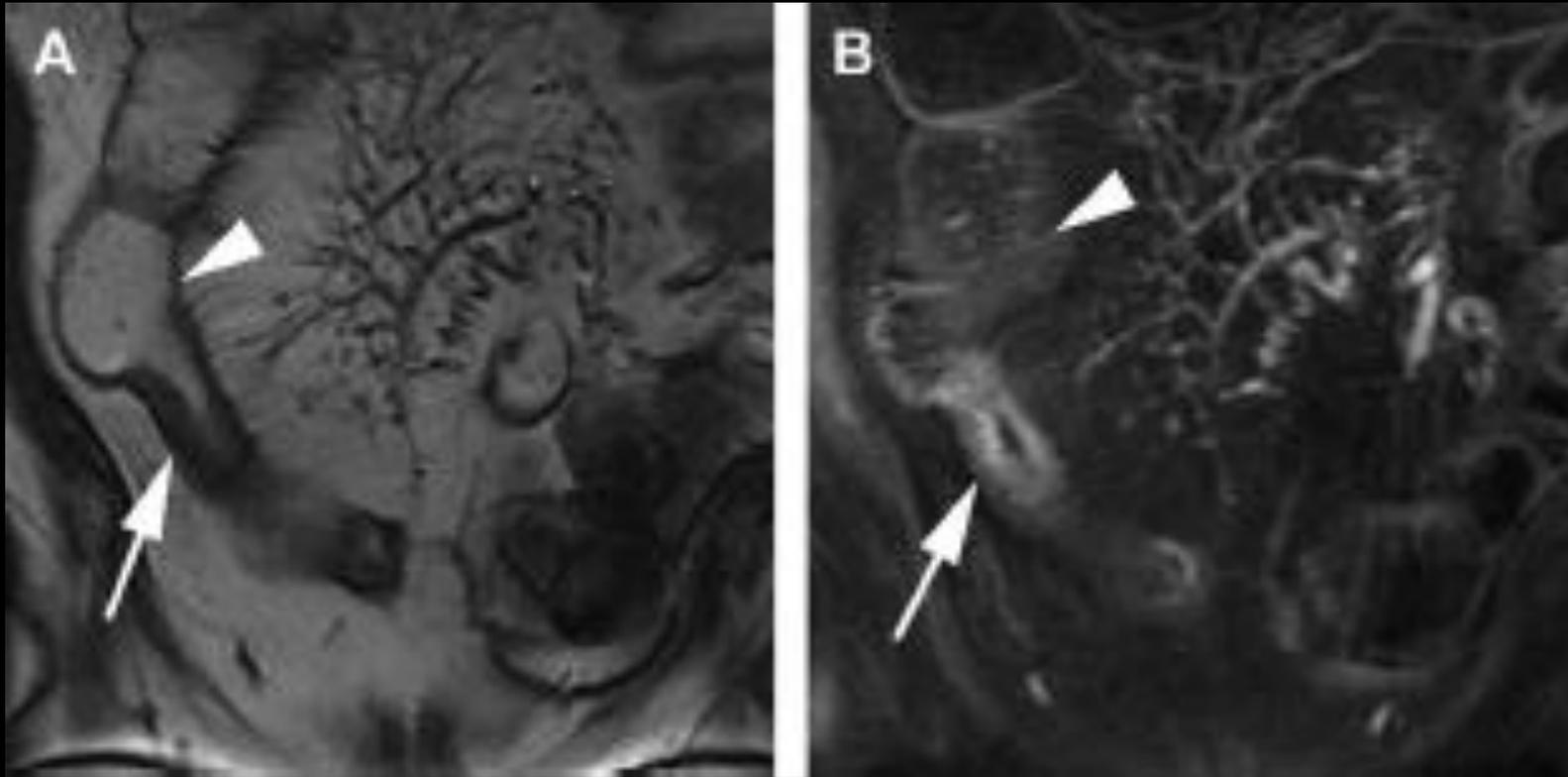
- 1) Complications of Crohn's disease (predominantly fistulas and strictures)**
- 2) Surveillance of Crohn's Disease or UC**
- 3) Evaluation of small bowel lesions (polyps, tumors not accessible by endoscopy)**
- 4) Unexplained abdominal pain**

MR Enterography



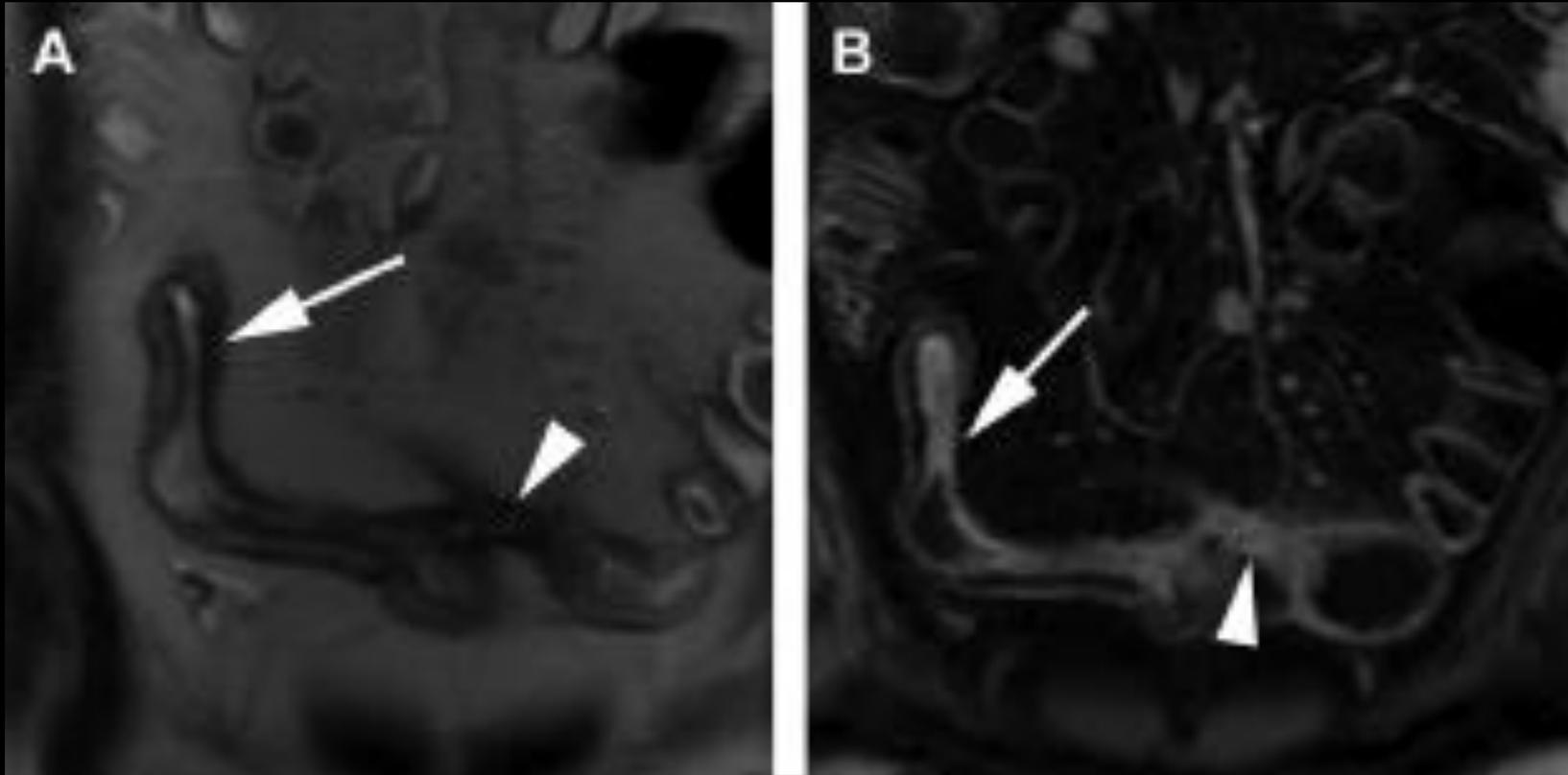
(A) Fat-suppressed T1-weighted image demonstrates mucosal hyperenhancement of the terminal ileum (arrow) and engorged vasa recta in the mesentery “comb sign” (arrowhead). (B) Coronal DWI (b500) demonstrates signal hyperintensity in the bowel wall (arrow).

MR Enterography



A 60-year-old man with active transmural inflammation with stricturing. (A) Coronal true FISP demonstrates a fixed, thick-walled loop of ileum (arrow) with upstream dilation (arrowhead). Note the engorged vasa recta “comb sign.” (B) Coronal contrast-enhanced, fat-suppressed T1-weighted image demonstrates hyperenhancement of this thick-walled loop of ileum (arrow), suggesting a component of active inflammation. Upstream dilatation persists (arrowhead).

MR Enterography



A 34-year-old woman with penetrating Crohn disease. (A) Coronal single-shot fast spin-echo image demonstrates a long segment of terminal ileal wall thickening (arrow) and a fistulous tract between 2 fixed loops of small bowel (arrowhead). (B) Coronal contrast-enhanced, fat-suppressed T1-weighted image demonstrates a long segment of mucosal hyperenhancement (arrow) with an enhancing fistula (arrowhead) to an adjacent segment of mildly dilated small bowel.

MR Enterography



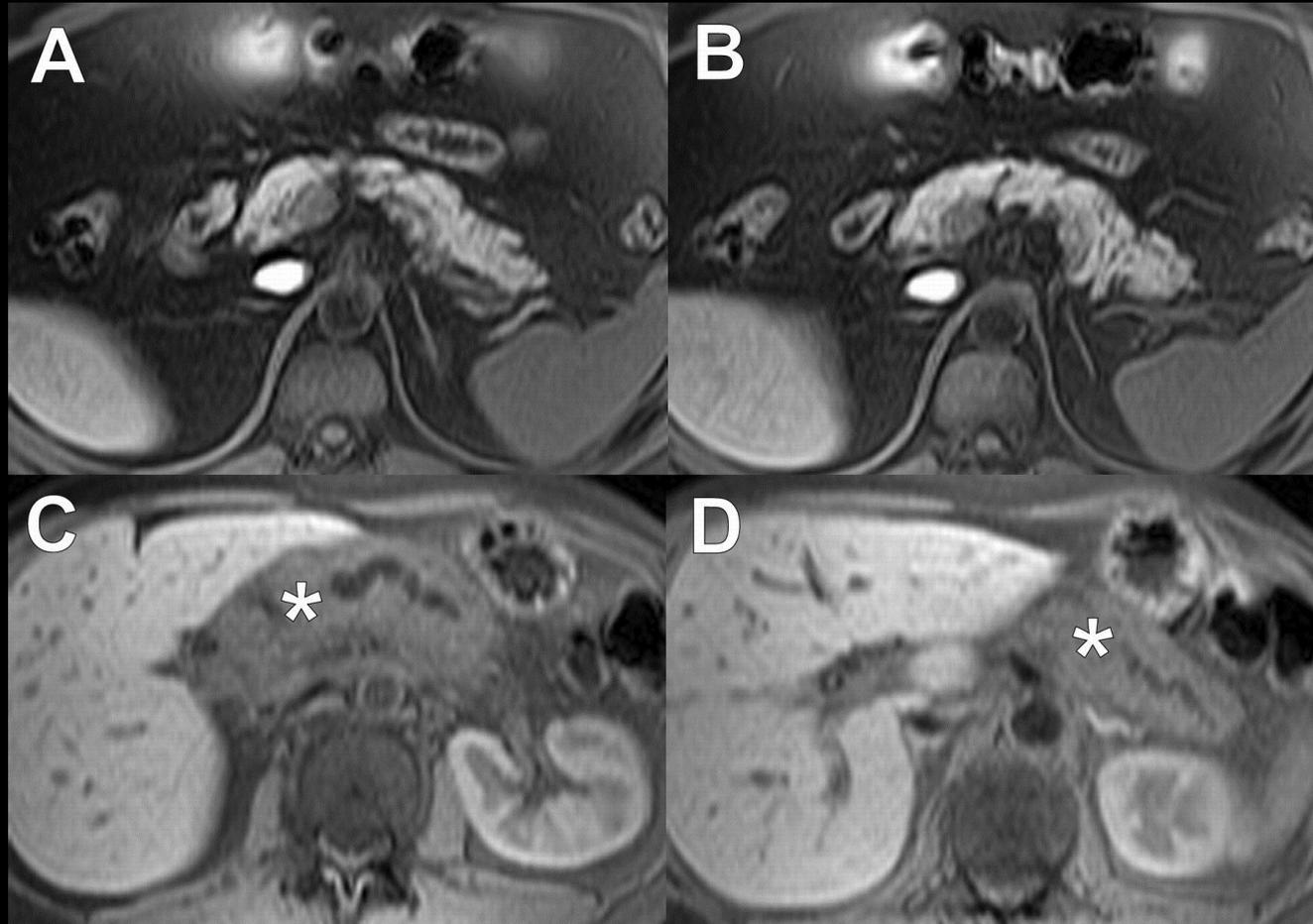
- (A) Coronal contrast-enhanced, fat-suppressed T1-weighted image demonstrates complex enteroenteric fistulas (arrow) and active inflammatory disease.**
- (B) Coronal fast imaging with SSFP demonstrates a hypointense, thick-walled segment of bowel (arrow) with marked upstream dilation (arrowhead). This stricture was treated surgically**

Pancreatic MRI

Useful for identification of:

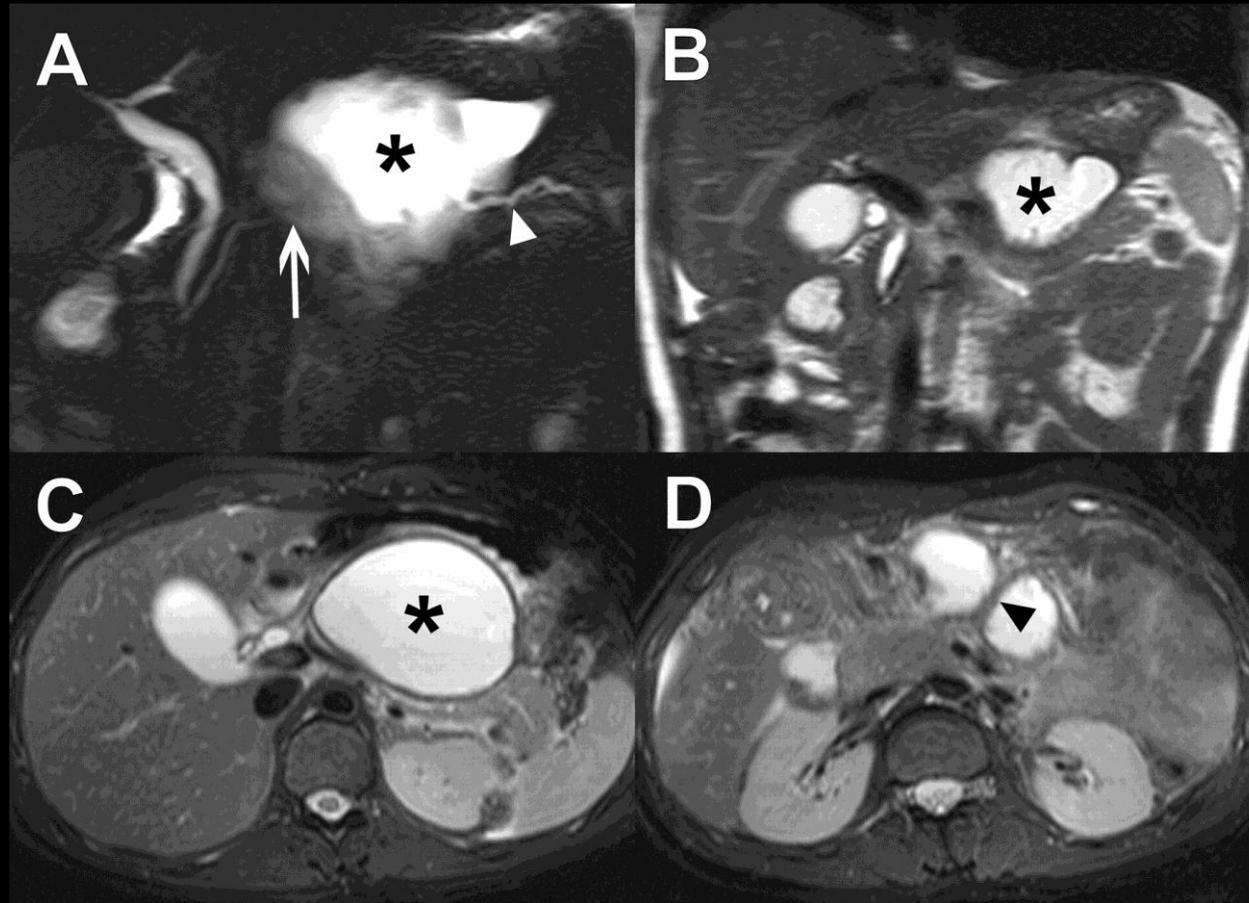
- 1) Complications of pancreatitis (pseudocysts, ductal disruption, necrotizing pancreatitis)**
- 2) Characterization of pancreatic cystic lesions**
- 3) Evaluation of pancreatic malignancy (equivalent to Pancreatic Protocol CT)**

Pancreatic MRI



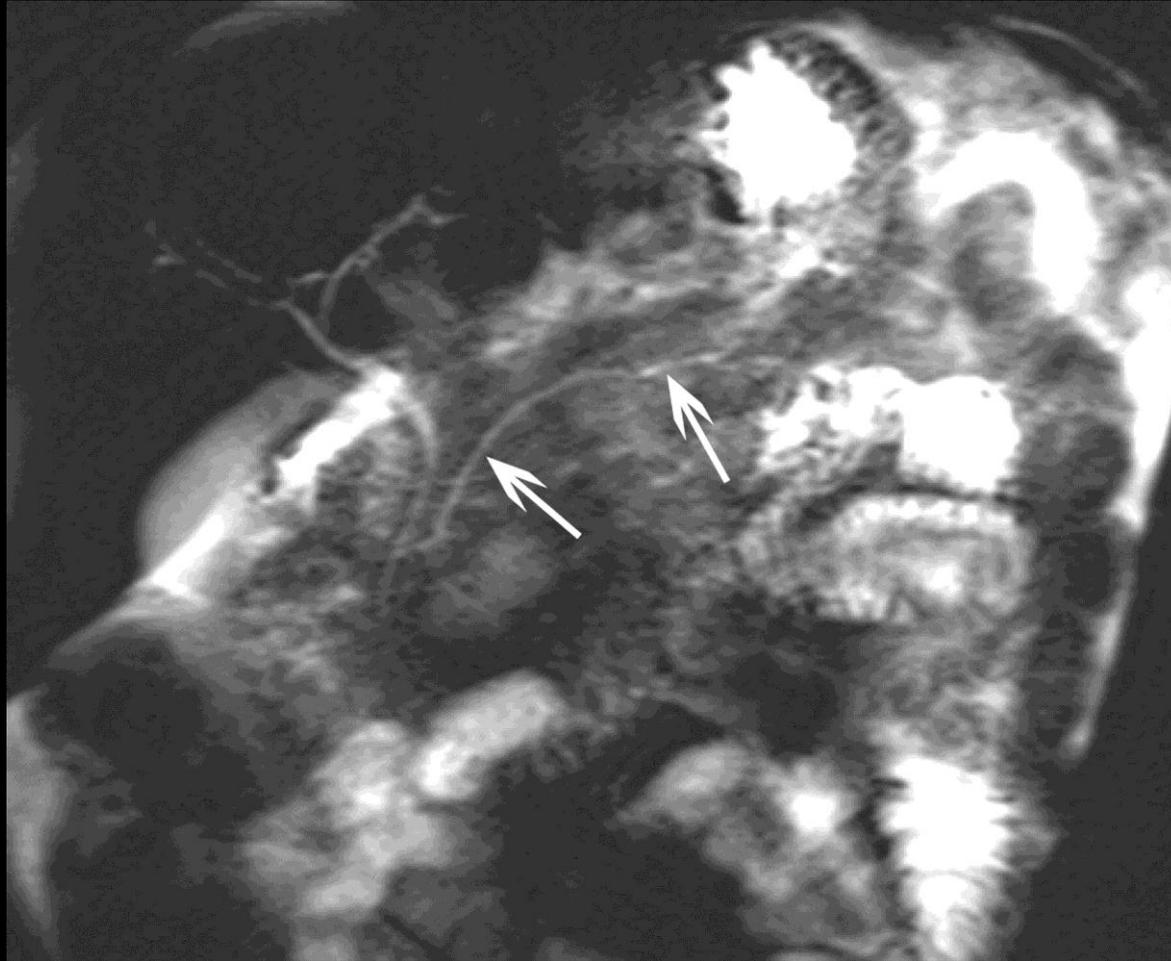
Normal pancreas (A, B) and chronic pancreatitis (C, D) demonstrated with an axial T1-weighted sequence. In chronic pancreatitis, the signal is dramatically reduced (*) because of the diffuse fibrosis in the gland.

Pancreatic MRI



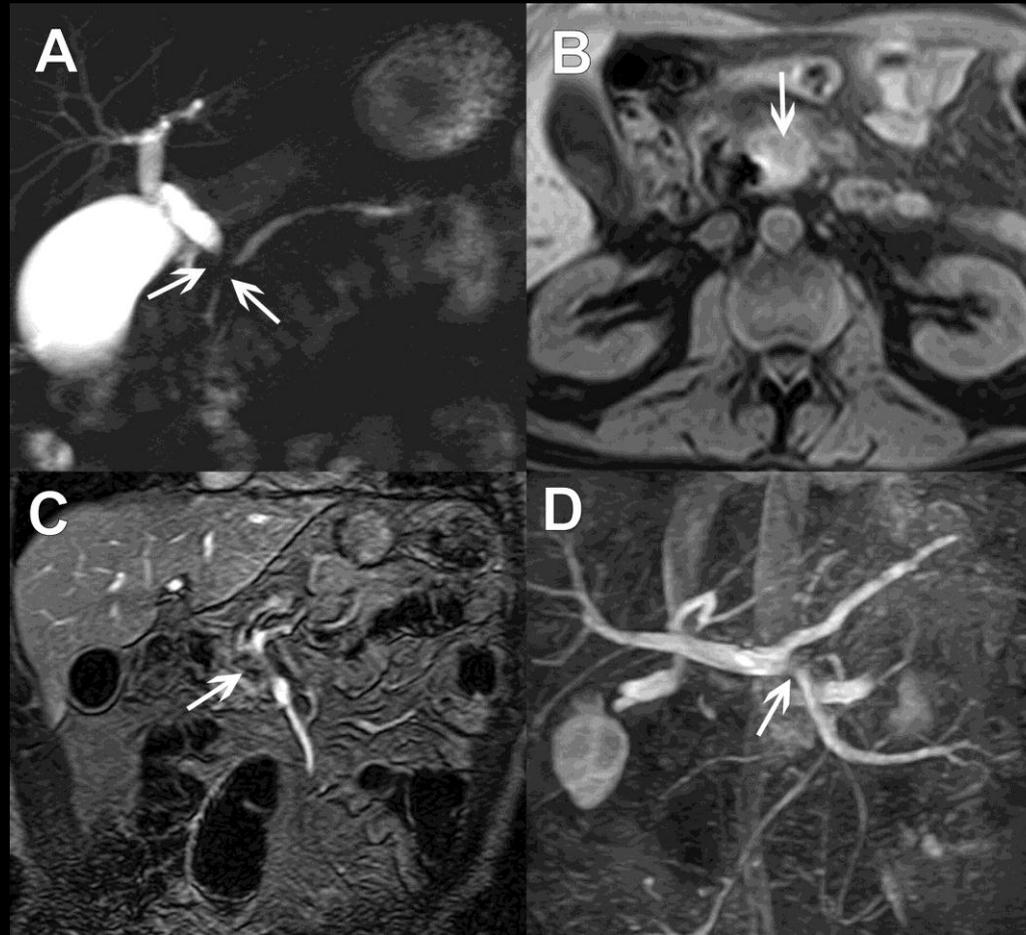
Acute pancreatitis, pancreatic duct disruption, and pseudocyst demonstrated with MRCP (A) and with coronal (B) and axial (C, D) T2-weighted sequences with fat suppression. In A, a pancreatic duct defect (arrow) is seen in conjunction with a heterogeneous pseudocyst (*) and upstream dilatation of the pancreatic duct (arrowhead). The pseudocyst wall and internal septations (arrowhead in D) are better depicted in B—D.

Pancreatic MRI



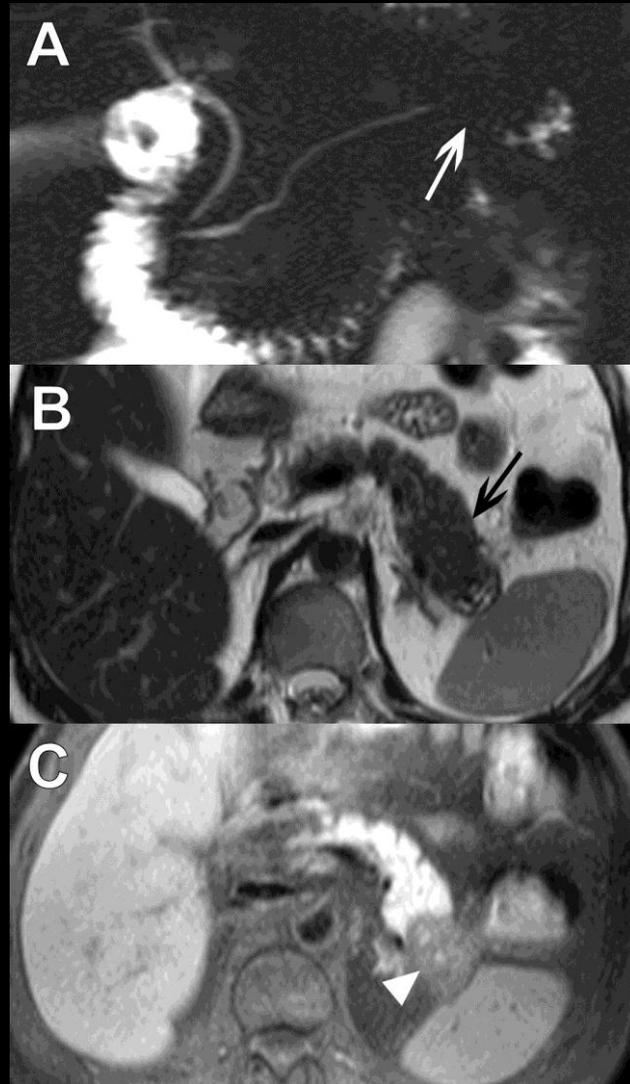
Patient with acute necrotizing pancreatitis, peripancreatic inflammation, and ascites. Suboptimal visualization of the common bile duct and pancreatic duct (arrows) due to increased signal intensity of the background tissue is observed on this MRCP image.

Pancreatic MRI



Pancreatic cancer with venous invasion. Staging with “all-in-one” MR imaging. (A) MRCP shows a double-duct stricture in the head of the pancreas (arrows). (B) Unenhanced axial fat-suppressed T1-weighted image demonstrates hypointense pancreatic tumor (arrow). (C, D) Coronal gadolinium-enhanced dynamic 3D GRE T1-weighted image (C) and corresponding MIP (D) nicely demonstrate superior mesenteric vein invasion (arrows).

Pancreatic MRI



Neuroendocrine tumor involving the tail of the pancreas shown on (A) MRCP, (B) axial TSE T2-weighted, and (C) fat-suppressed TSE T1-weighted images obtained at the level of the tumor. In A, a stricture with upstream dilatation of the pancreatic duct is displayed (arrow). In B, no difference in signal intensity is detected between the tumor (arrow) and the adjacent pancreas. In C, the tumor is clearly delineated (arrowhead).

Recap

1) GI Radiology can be confusing, if you aren't sure what to order call:

x7340

2) Most incidental pancreatic cysts can be followed with MRI every 1-2 years

3) MR for problem solving in rectal cancer, IBD/unexplained abdominal pain and diseases of the pancreas.

Thank You!!

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Cell 843-576-9792

x3640

WOLD FAMILY CENTER FOR EMERGENCY MEDICINE

