Rad Path

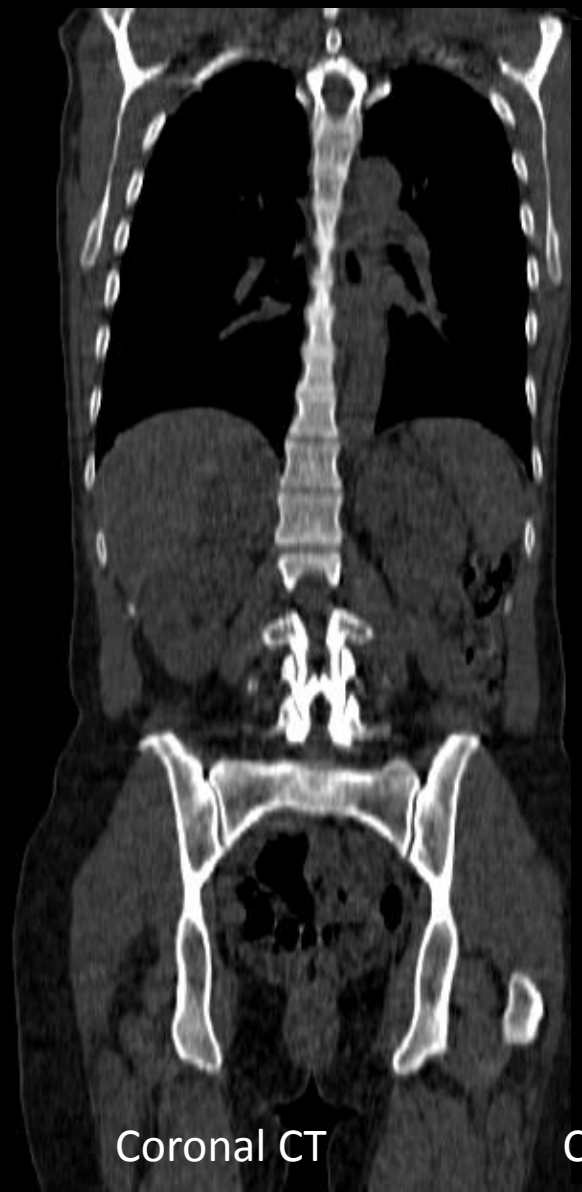
6/23/14

Catie Phillips, PGY -2
Scott Sheehan, PGY-5
Jeffrey Craig, PGY- 1

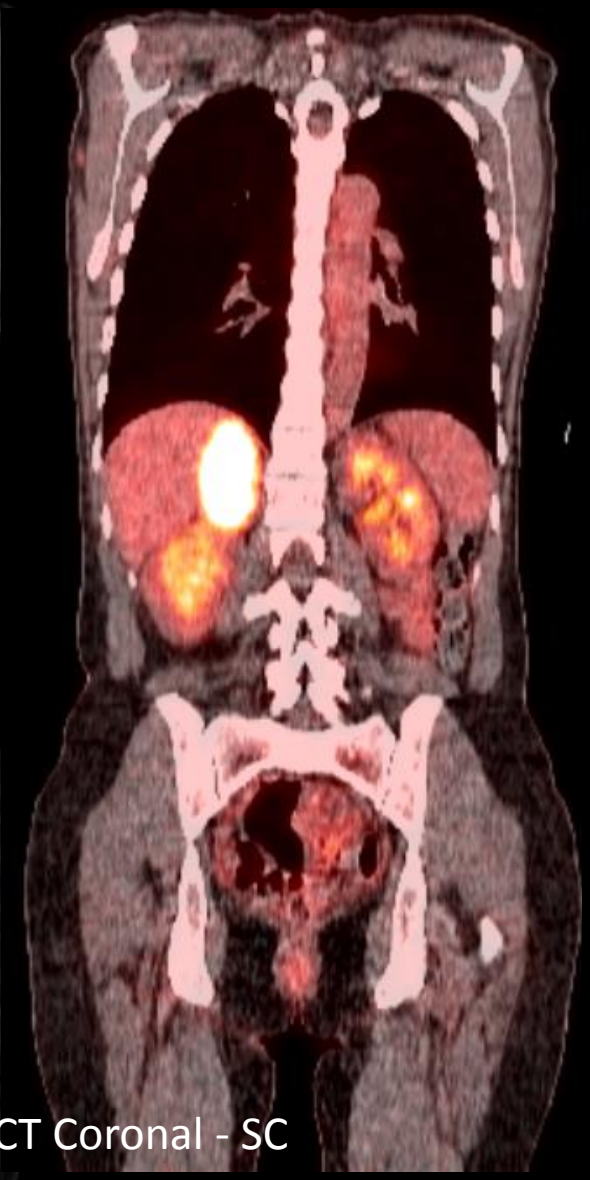
Case 1

- History: 54 year old female with new dx of NHL, here for staging

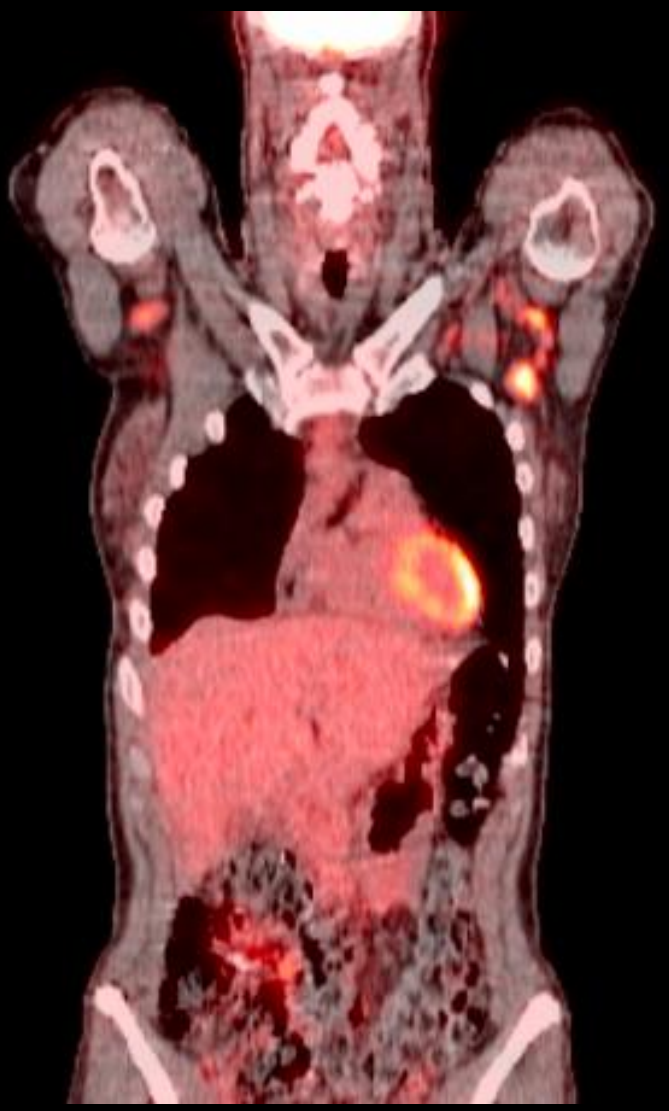
Case 1- PET CT 5/17/2013



Coronal CT



CT Coronal - SC



CT Coronal - SC

ACR appropriateness criteria Incidentally discovered adrenal mass

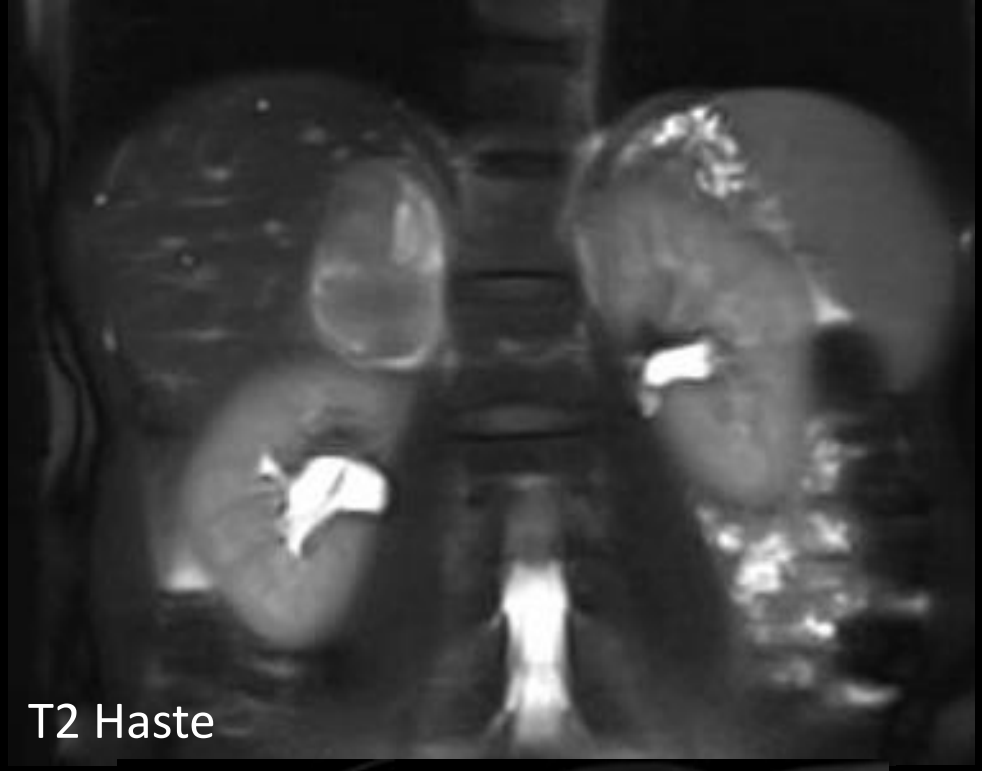
Variant 5: **History of malignancy; mass >4 cm in diameter.**

Radiologic Procedure	Rating	Comments	RRL*
Biopsy adrenal gland	8		Varies
FDG-PET/CT skull base to mid-thigh	8	Alternative to biopsy to diagnose metastasis.	☢☢☢☢
MRI abdomen without and with contrast	1		O
MRI abdomen without contrast	1		O
US adrenal gland	1		O
CT abdomen with contrast	1		☢☢☢
CT abdomen without contrast	1		☢☢☢
MIBG	1		☢☢☢
X-ray abdomen	1		☢☢
CT abdomen without and with contrast	1		☢☢☢☢
Iodocholesterol scan	1		☢☢☢☢

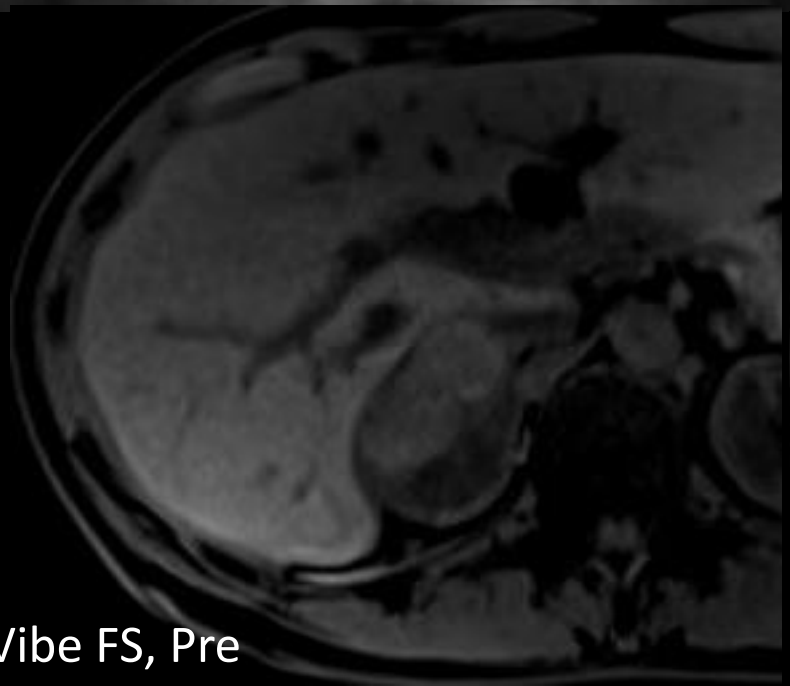
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**

***Relative Radiation Level**

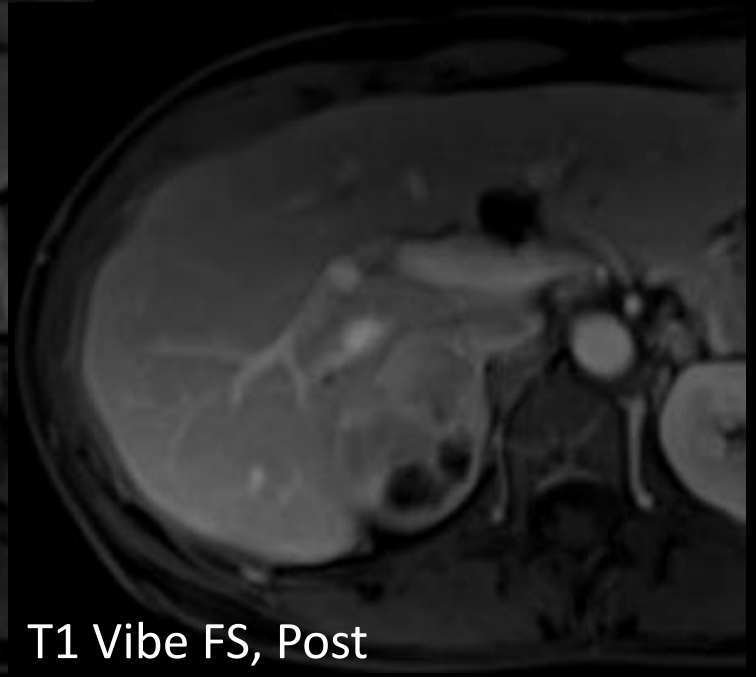
Case 1- MRI 5/22/13



T2 Haste



T1 Vibe FS, Pre



T1 Vibe FS, Post

Case 1 Findings

- PET/CT
  - Heterogeneous, FDG avid >4cm right adrenal mass
- MRI
  - 5.6 x 4.5 x 5.6 cm heterogeneous, largely solid, partially cystic, enhancing mass.
  - No evidence of local invasion
  - No lymphadenopathy in the region

Case 1: Differential

Case 1: Differential

- Adrenal pheochromocytoma
- Adrenal carcinoma
- Metastatic disease
- Lymphoma
- Large adrenal adenoma

Case 1 Pathology

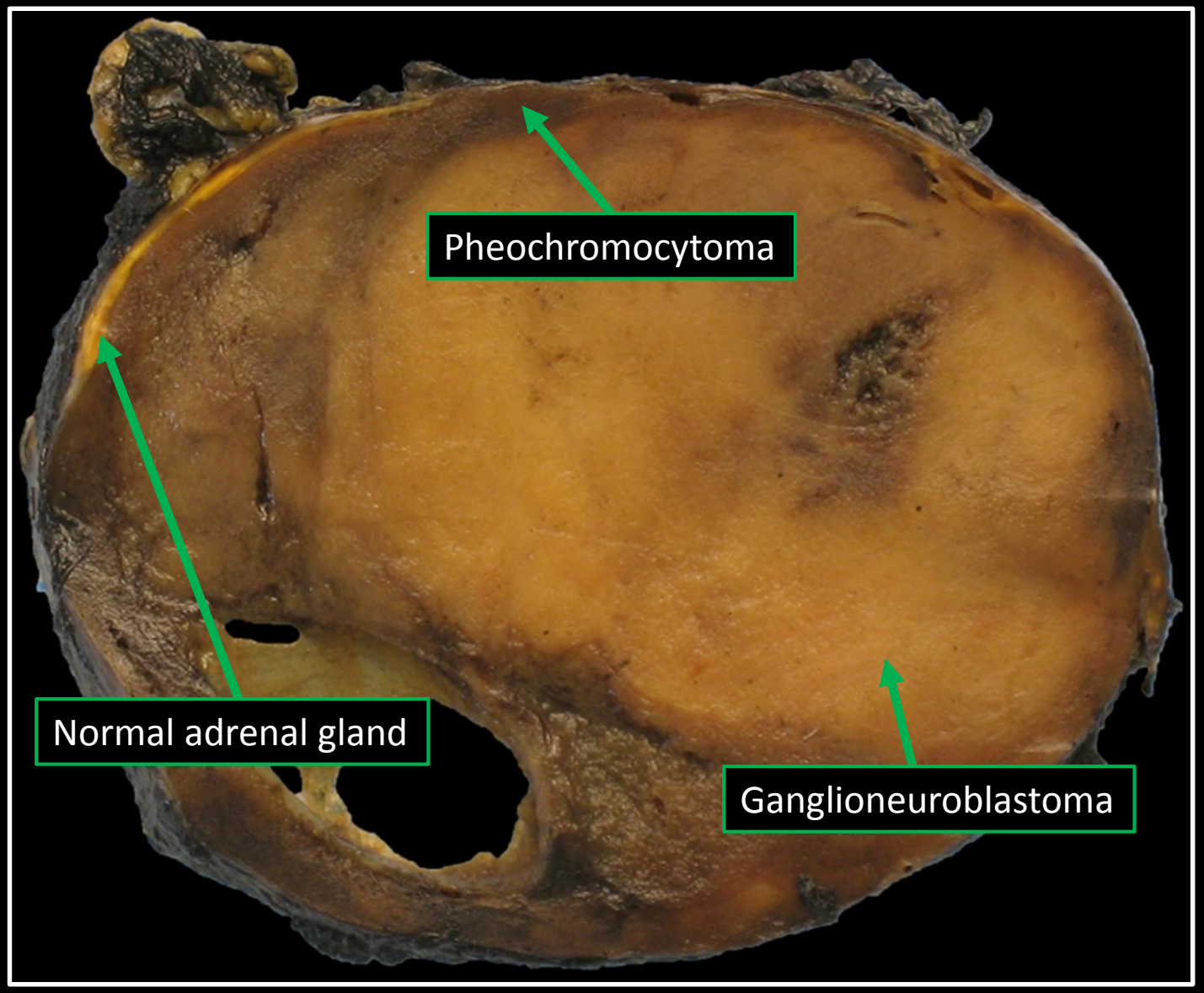
Pheochromocytoma-Ganglioneuroblastoma

- MRN: **28218741**
- Case: **BS-13-G39682**
- Date: **08/20/2013**

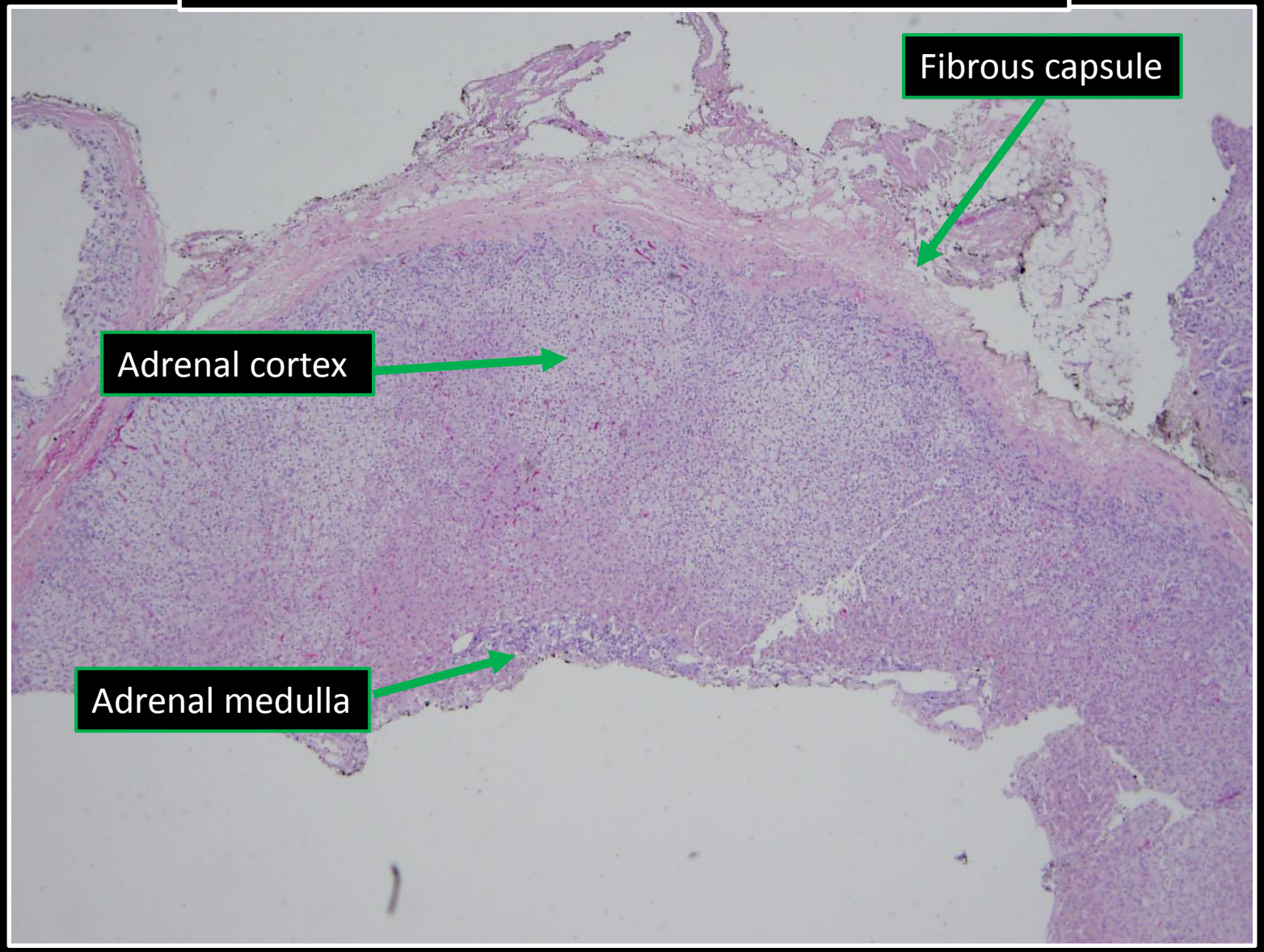
- Specimen: RIGHT ADRENAL MASS (73.6 g)

- Diagnosis: COMPOSITE PHEOCHROMOCYTOMA-GANGLIONEUROBLASTOMA (6.0 cm)

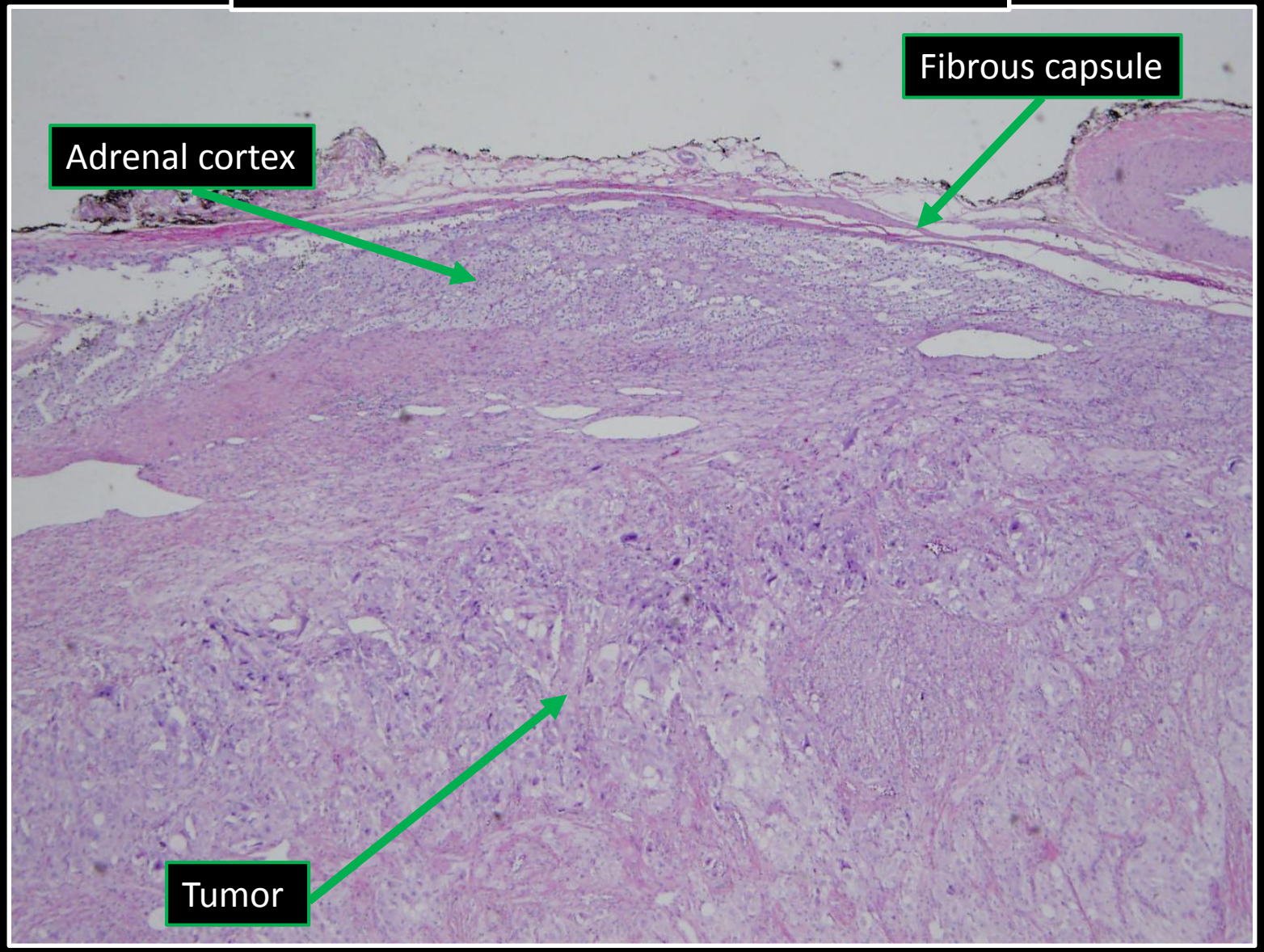
Pheochromocytoma-Ganglioneuroblastoma



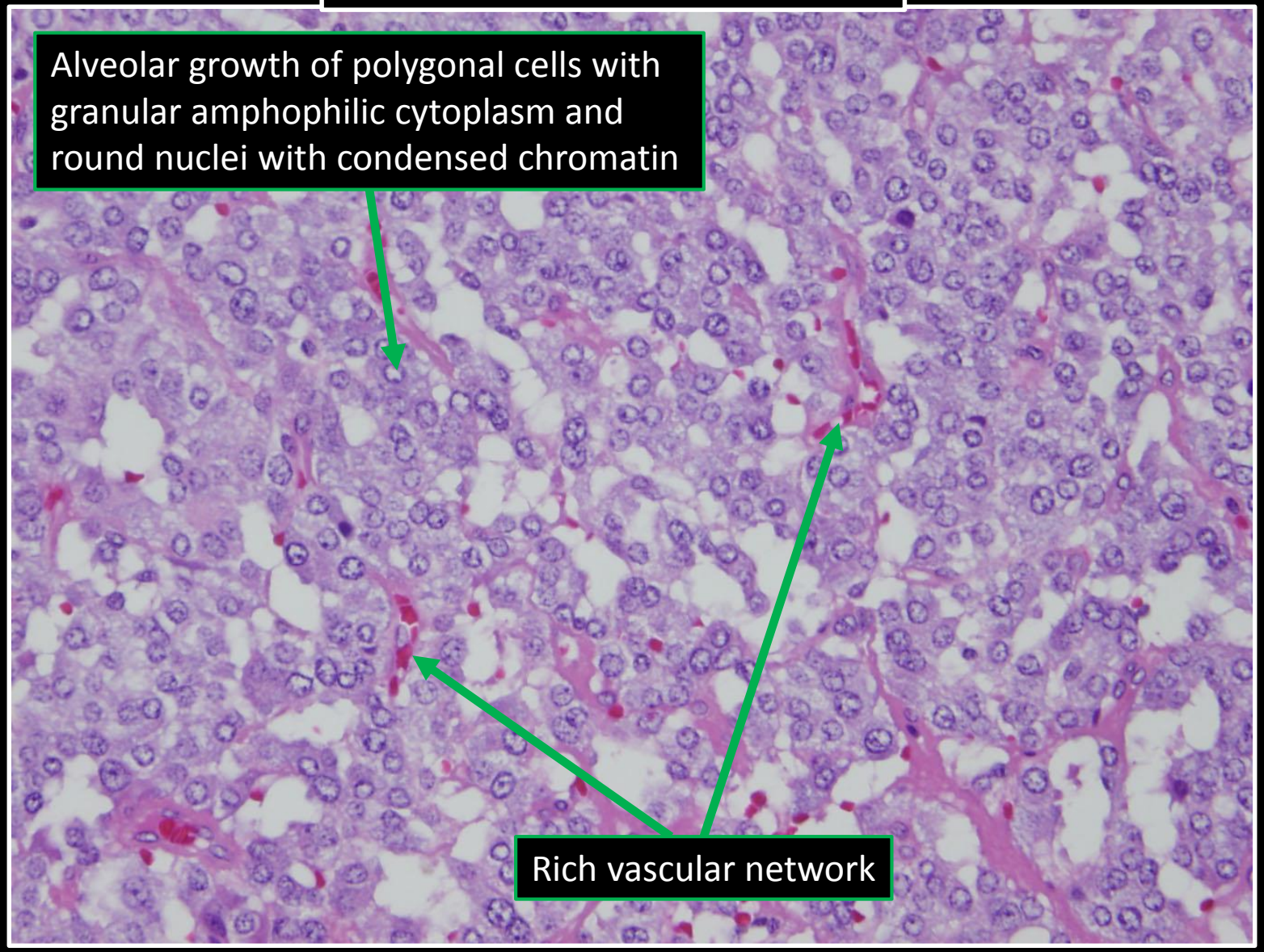
Normal capsule, cortex and medulla (4X)



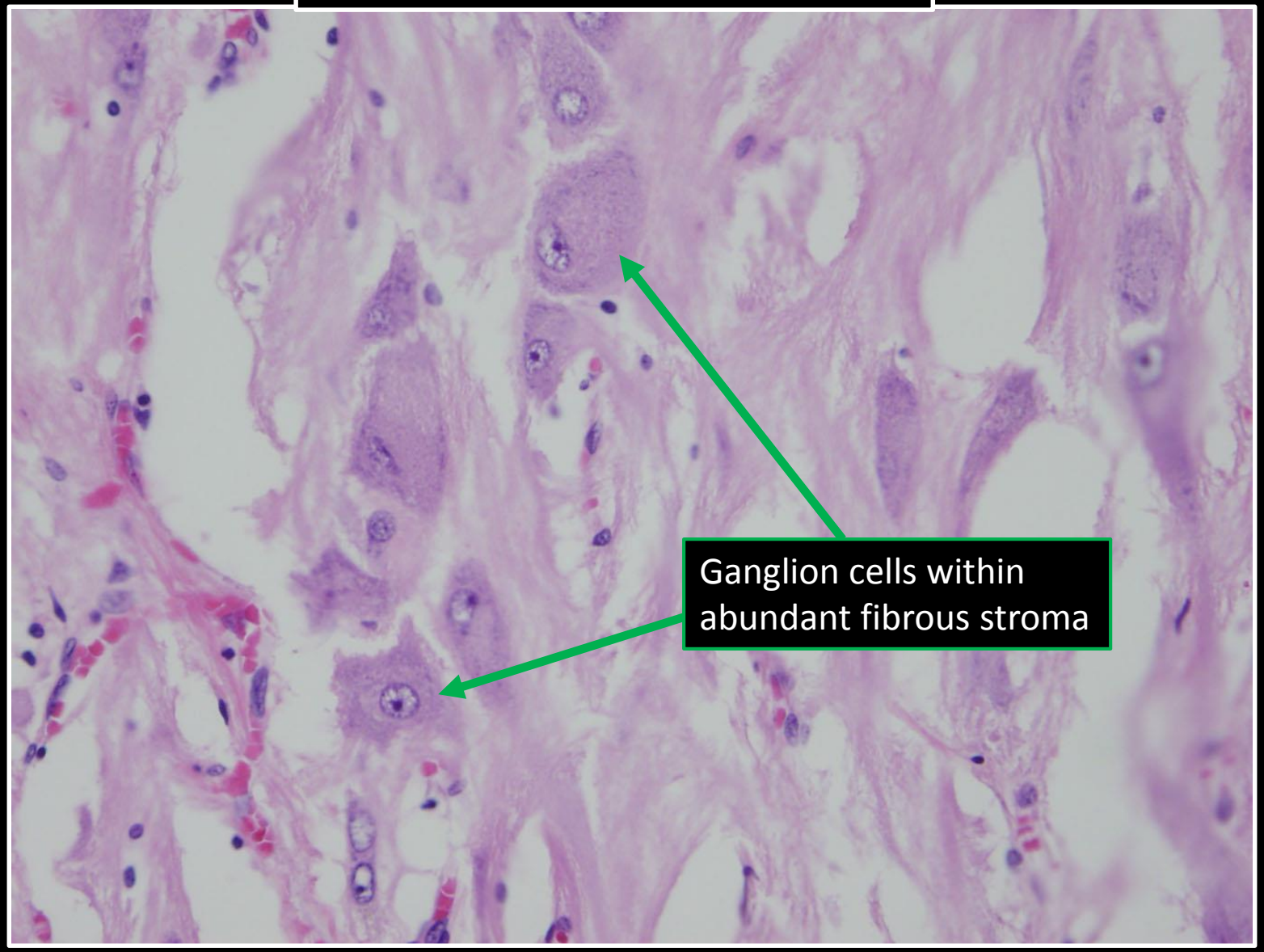
Tumor with capsule and cortex (4X)



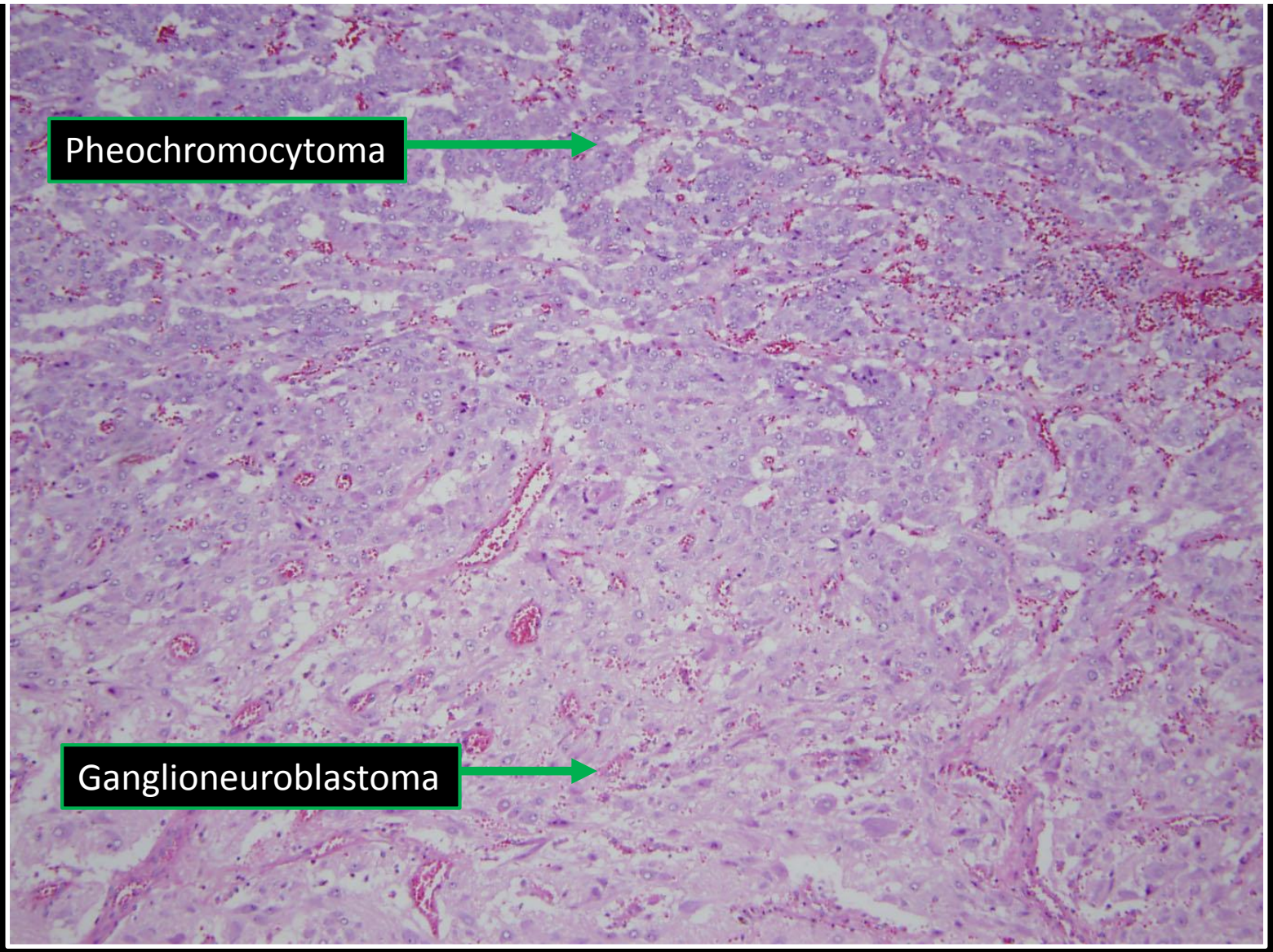
Pheochromocytoma (40X)



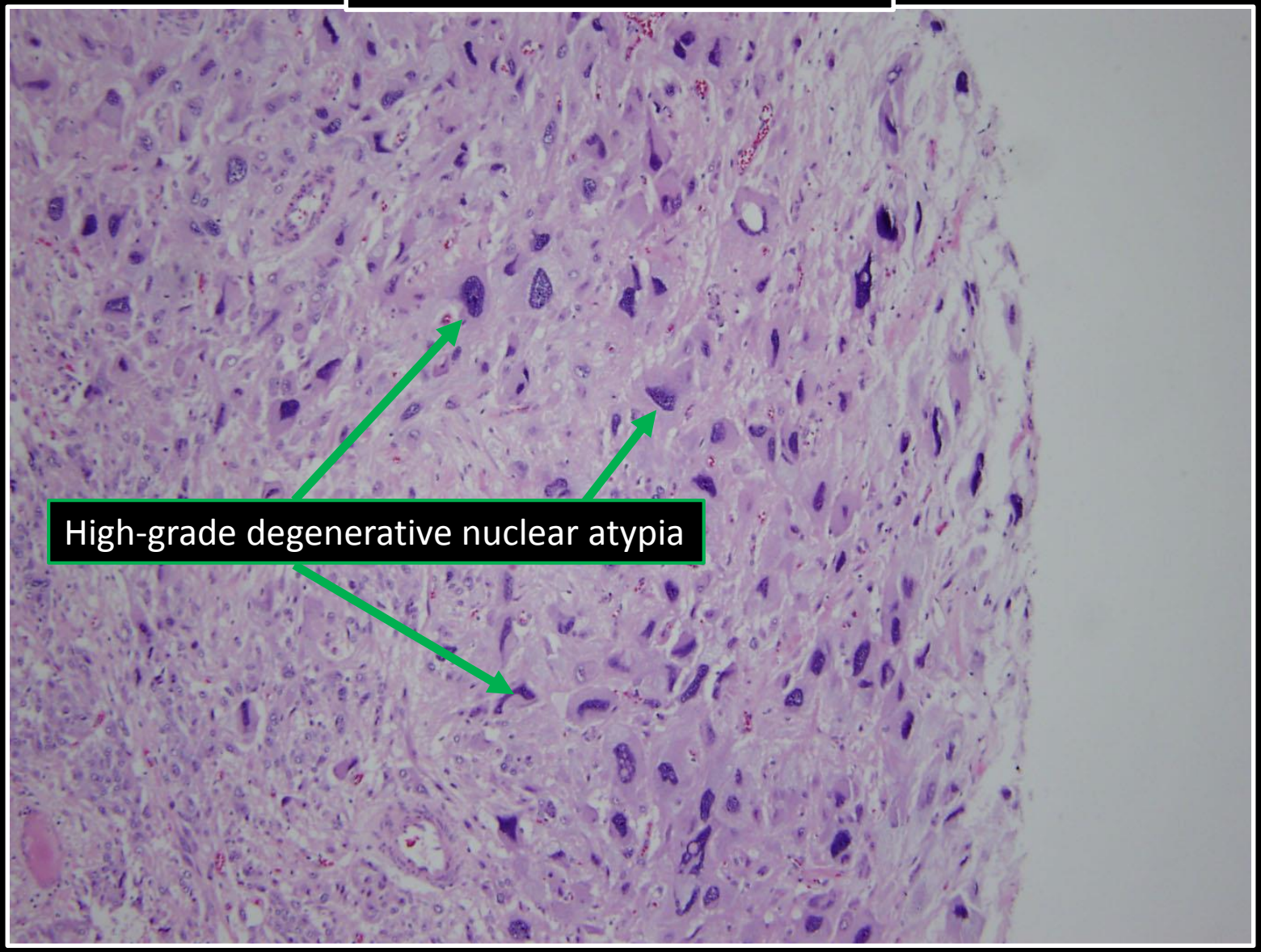
Ganglioneuroblastoma (40X)



Pheochromocytoma-ganglioneuroblastoma interface (10X)



Pleomorphic focus (10X)



Case 1 additional history

- 24 hr urine catecholamines:
  - Normetanephrine 771, (nl 82-500)
  - Metanephrine 1115, (nl 45-290)
  - VMA 24.9, (nl 0=7.5)

Case 1- Pheochromocytoma

The what:

- Tumor arising from chromaffin cells of adrenal medulla or extra-adrenal ectopic tissue

The where:

- ADRENAL MEDULLA (90%)
- Extra-adrenal (10%)
  - Along sympathetic chain, neck →urinary bladder
  - Subdiaphragmatic (90%), Thoracic (10%)
  - Organ of Zuckerlandl + urinary bladder are common sites

The who:

- 10% pediatric
- 10% familial
- 10% Autosomal dominant transmission
  > 3cm? → Likely NONsyndromic case

Case 1- Pheochromocytoma

What in the world does it look like:

- CT:
  - Well defined, round, homogenous mass of muscle density
  - Heterogeneous enhancement→ 2/2 necrosis (↓density) ± bleeding (↑ density)
  - ± Areas of curvilinear mural calcification

- MRI
  - T1
    - Isointense to liver
    - can have heterogeneous signal intensity
  - T1 C+
    - Salt and pepper pattern (tumor vascularity)
    - Salt = enhancing parenchyma, pepper = flow void of vessels
  - T2
    - Markedly hyperintense 2/2 ↑ water content from necrosis
    - Heterogeneous signal intensity → hemorrhage and necrosis with fluid levels

Case 1- Pheochromocytoma

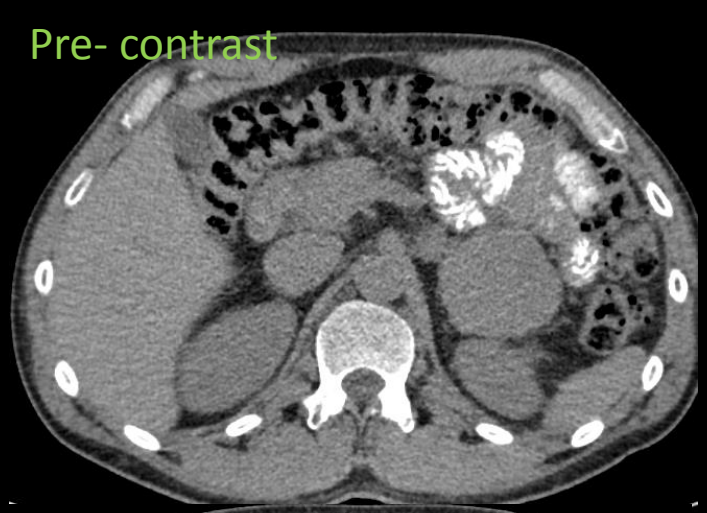
What else do I need to know:

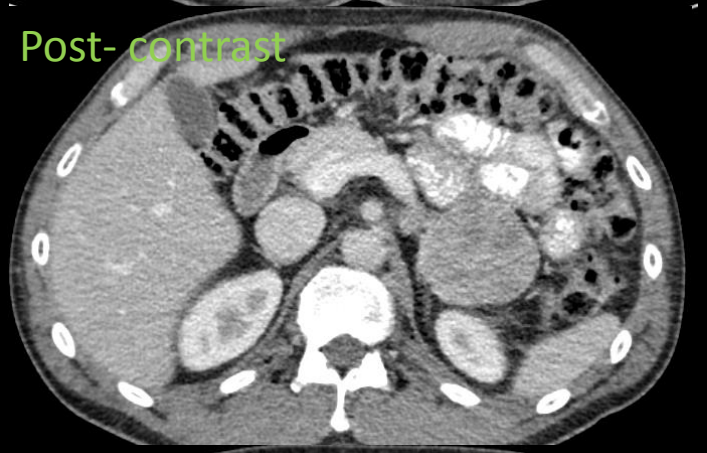
- Rule of 10's
  - 10% extra-adrenal, familial, pediatric, have autosomal dominant transmission
  - 10% bilateral, malignant, and extra-abdominal
  - 10% silent
- 90% patients present with HTN 2/2 release of catecholamines
- Hard to differentiate benign or malignant with imaging alone
  - Distant mets point to malignancy
  - Not sure?
    - I^{131} or I^{123} Study to look for tumor
    - 80-90% sensitive and 90-100% specific
- Clinical history and lab values are needed for diagnosis

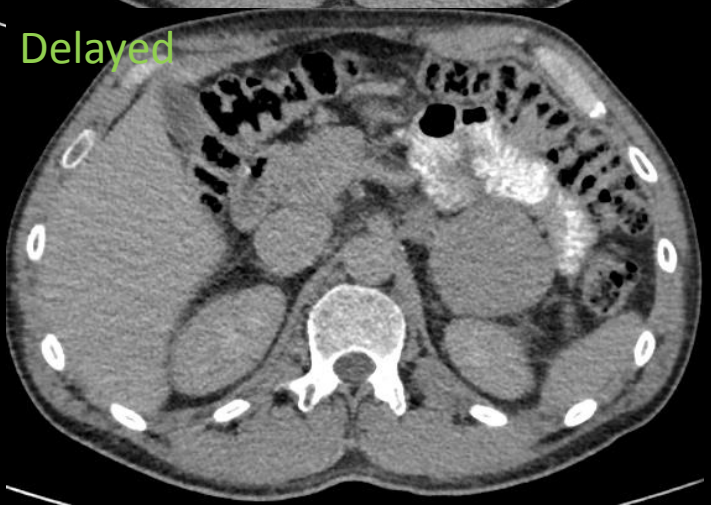
Case 2

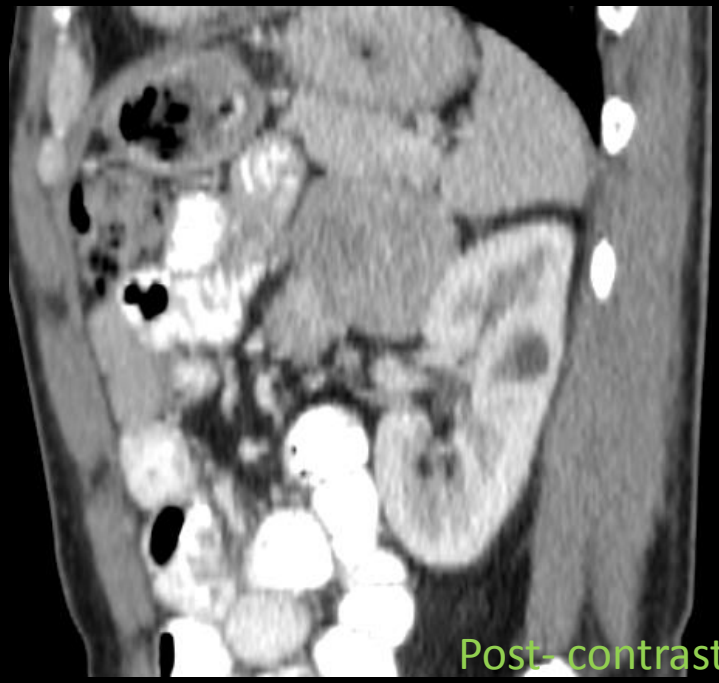
- History: 42 year old male gym owner with 8 months of abdominal bloating, weight gain, increased “facial puffiness,” and intermittent muscle cramps

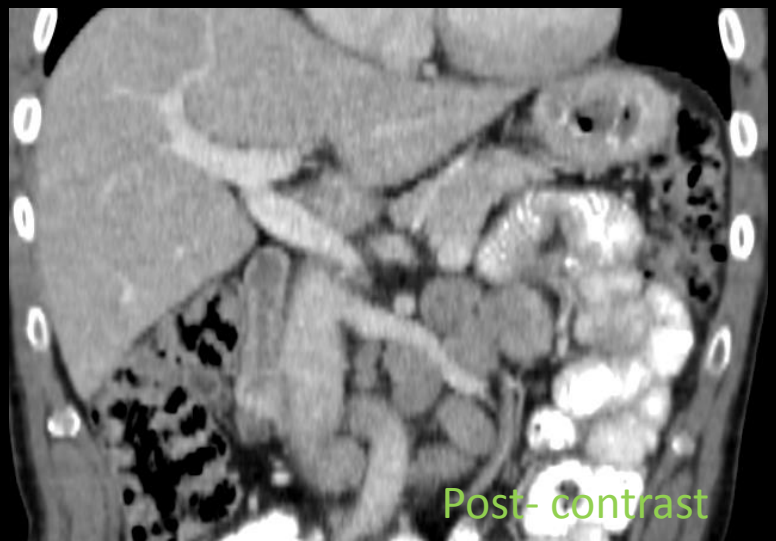
CT 12/7/12


Pre- contrast


Post- contrast

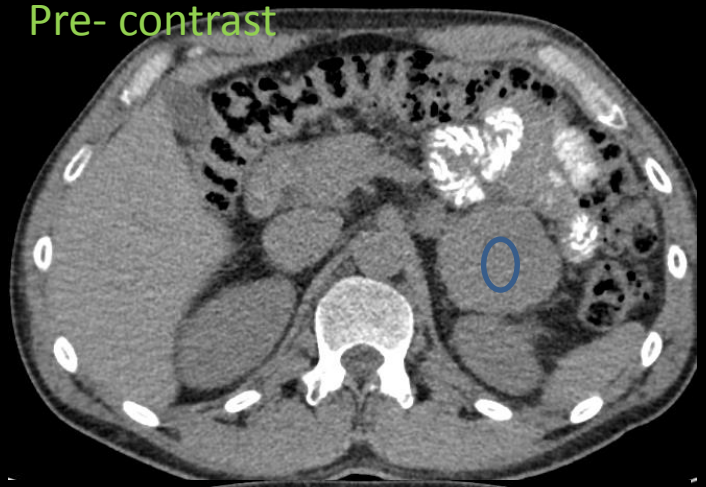

Delayed


Post- contrast


Post- contrast

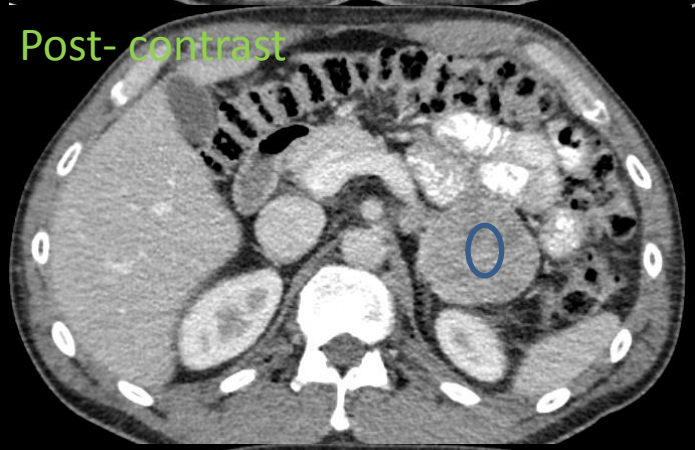
CT 12/7/12

Pre- contrast



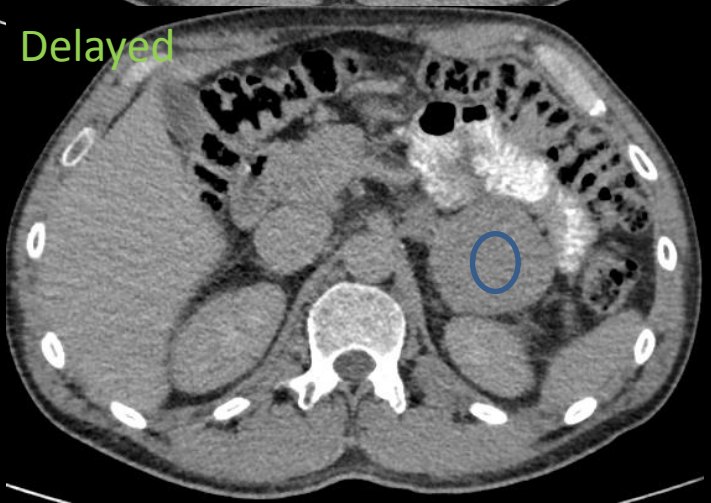
ROI 42

Post- contrast

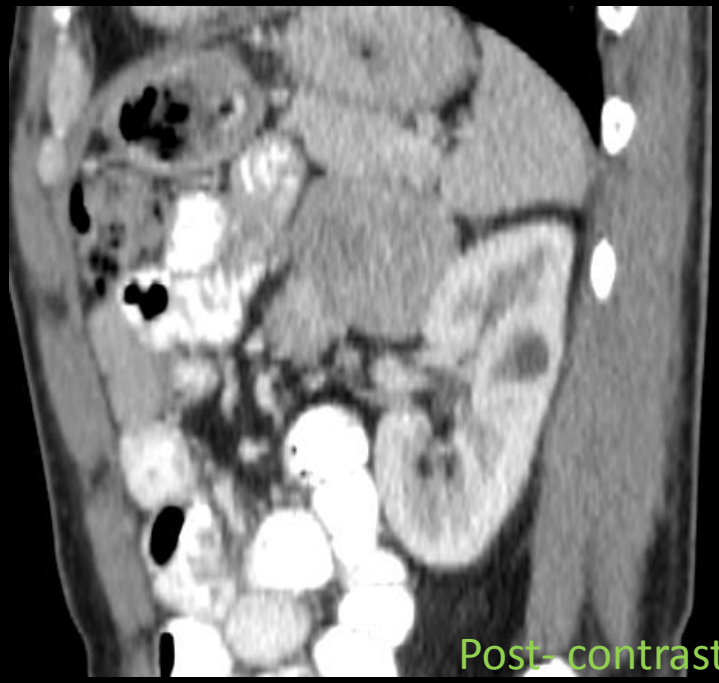


ROI 80

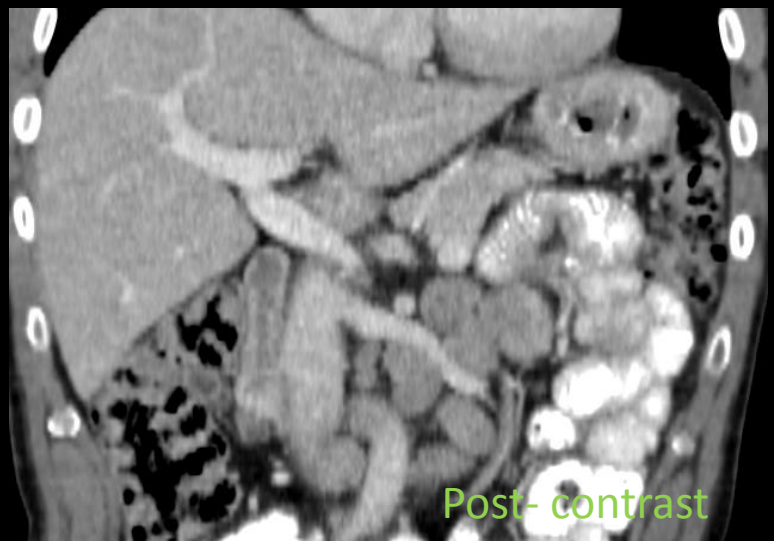
Delayed



ROI 58

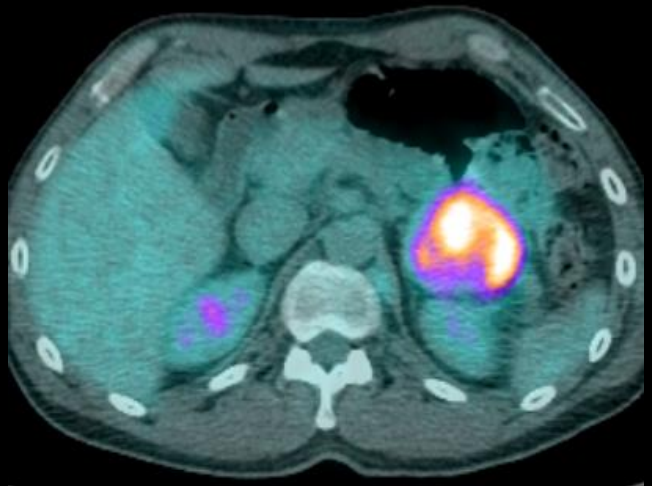


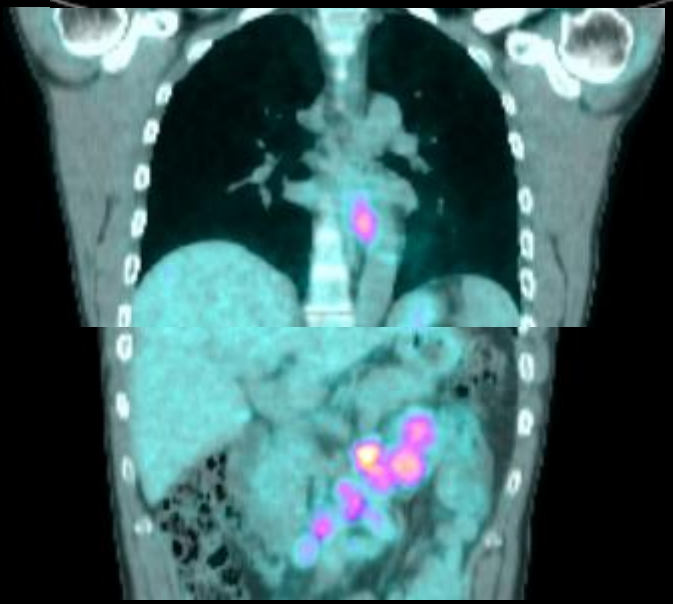
Post- contrast

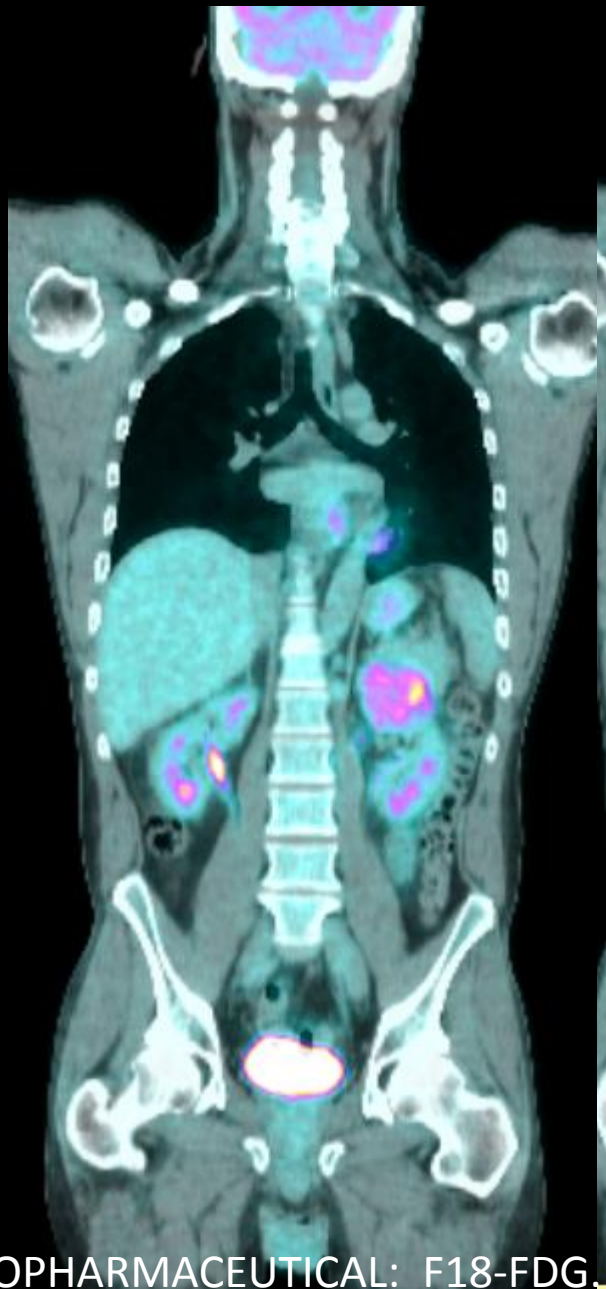


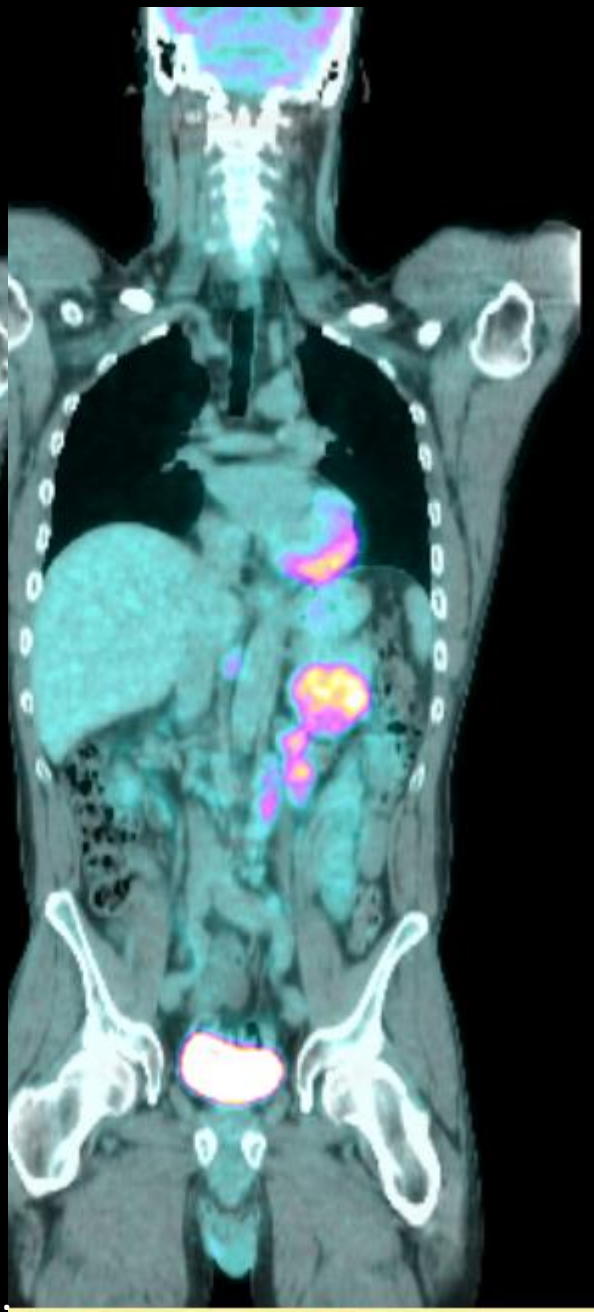
Post- contrast

PET/CT 12/14/12









RADIOPHARMACEUTICAL: F18-FDG.

Case 2 findings

- CT:
  - 5-6 cm irregular enhancing adrenal mass w/ inferior extension near the renal vein w/o obvious invasion into the renal hilum.
  - The mass abuts the superior pole of the kidney as well as the pancreas, and it is not clear if there is invasion into either of these organs.
  - retroperitoneal lymphadenopathy.
  - % washout = 58%

- PET/CT:
  - Intensely FDG avid 5.9 x 5.1 cm left adrenal mass
  - multiple metastatic retroperitoneal FDG avid lymph nodes.
  - 1.1 cm FDG avid left inferior mediastinal lymph node, suspicious for metastasis.

Case 2 Differential

Case 2 Differential

- Adrenal carcinoma
- Pheochromocytoma
- Lymphoma
- Hemorrhage
- Metastatic disease
- Lipid poor adenoma

Pathology case 2

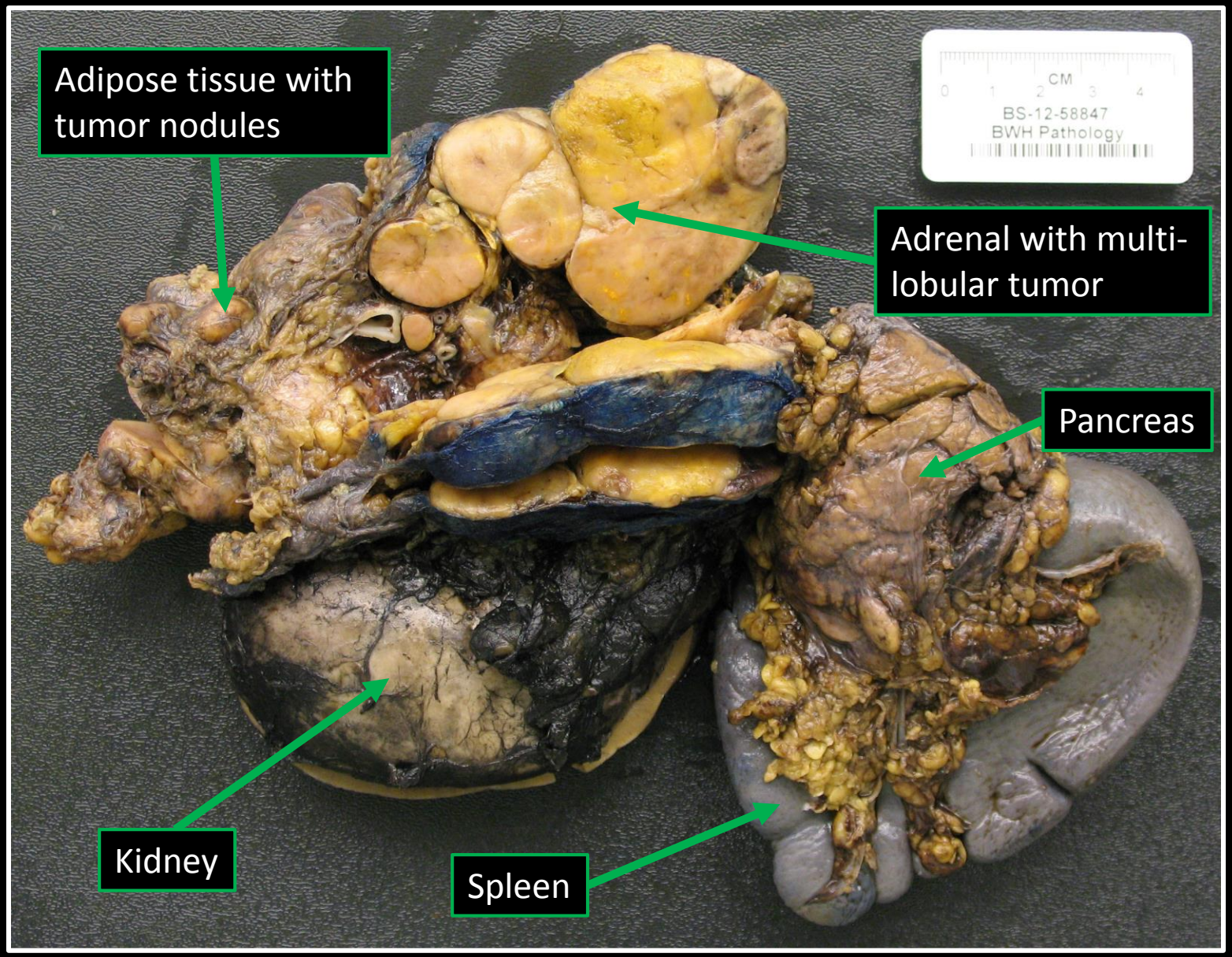
Adrenal Cortical Carcinoma

- MRN: **12709051**
- Case: **BS-12-R58847**
- Date: **12/20/2012**

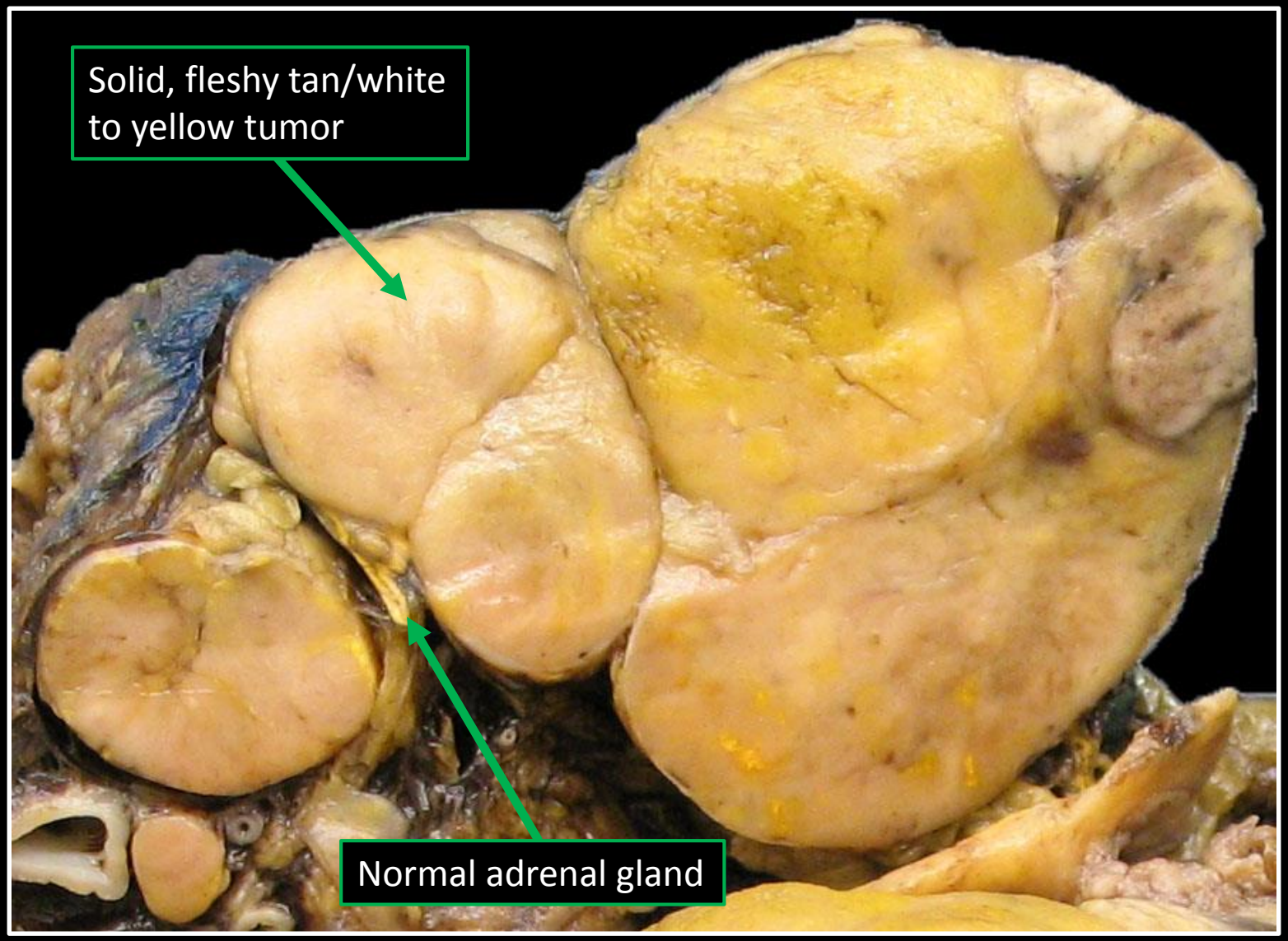
- Specimen: RADICAL LEFT ADRENALECTOMY, EN BLOC RESECTION

- Diagnosis: ADRENAL CORTICAL CARCINOMA (8.5 cm) – pT3N1

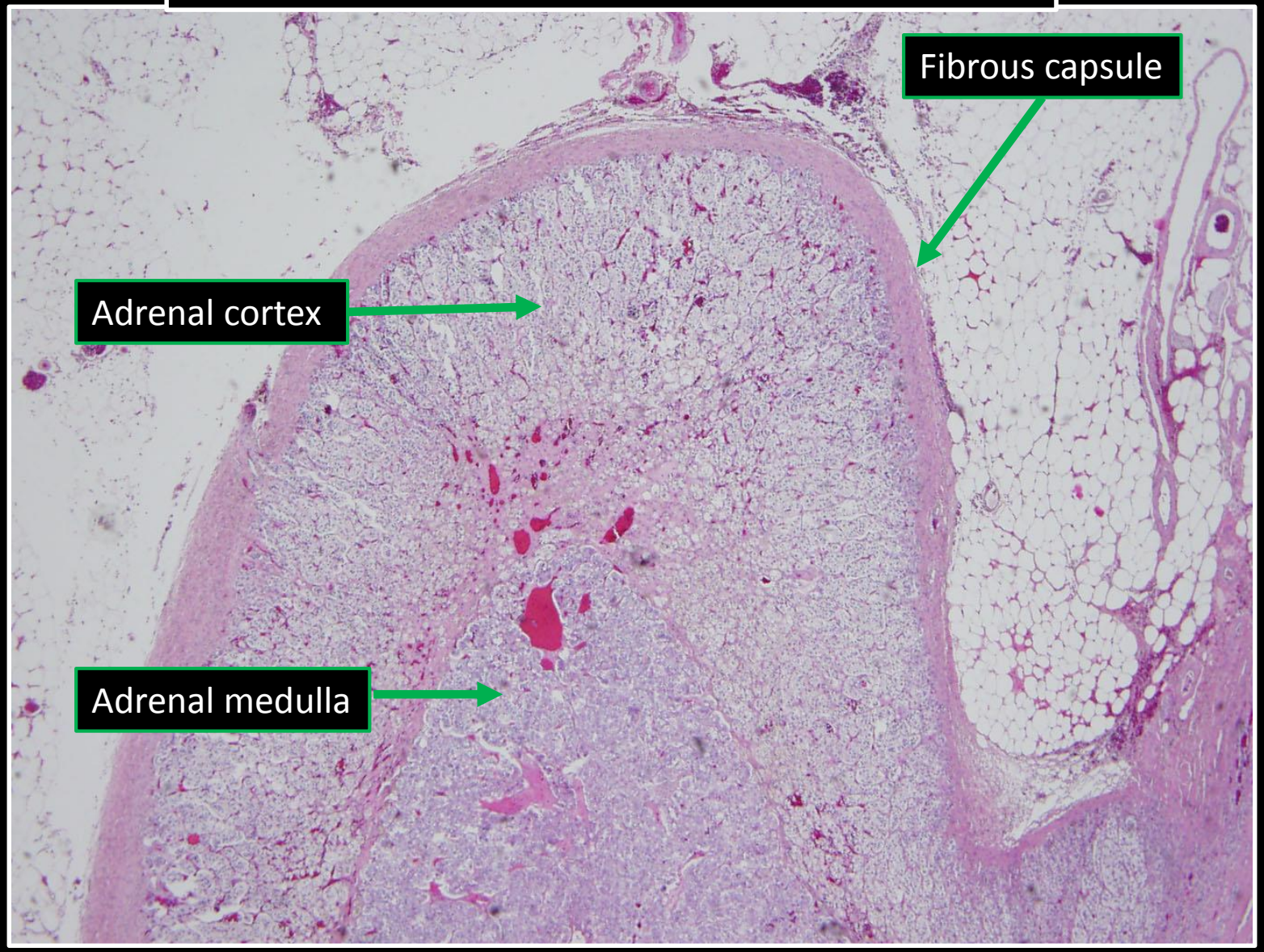
En bloc resection



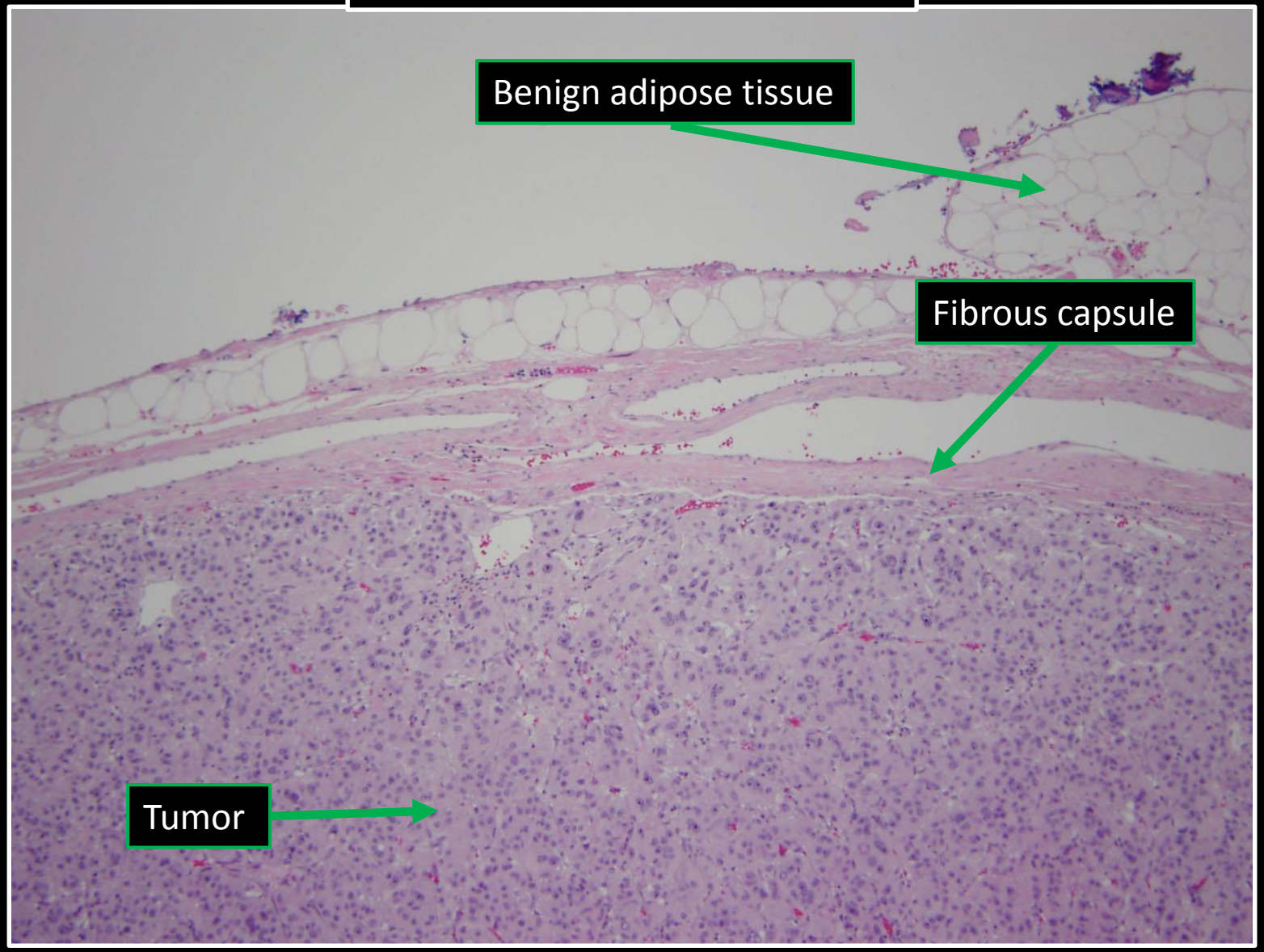
Adrenal cortical carcinoma



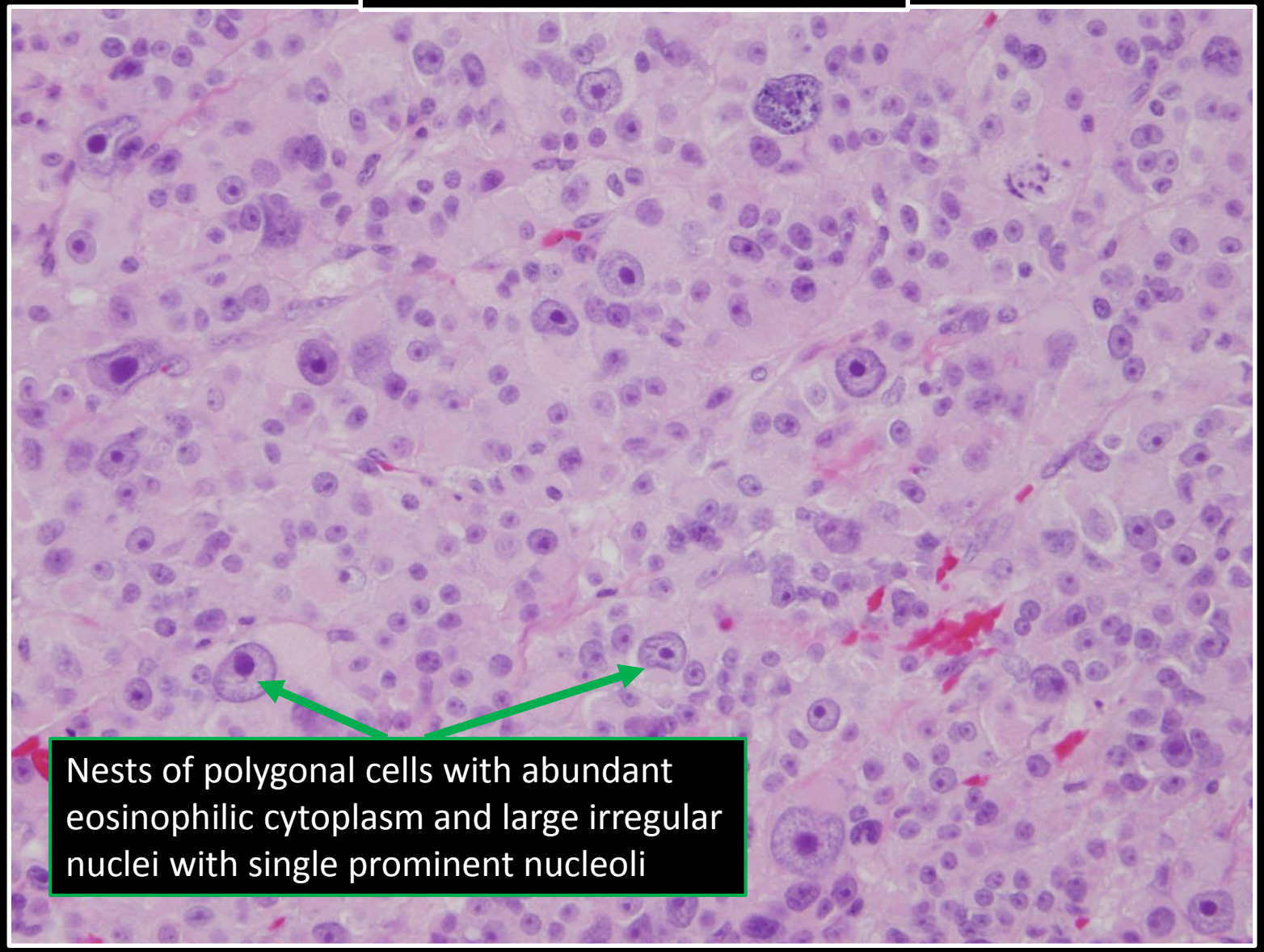
Normal capsule, cortex and medulla (4X)



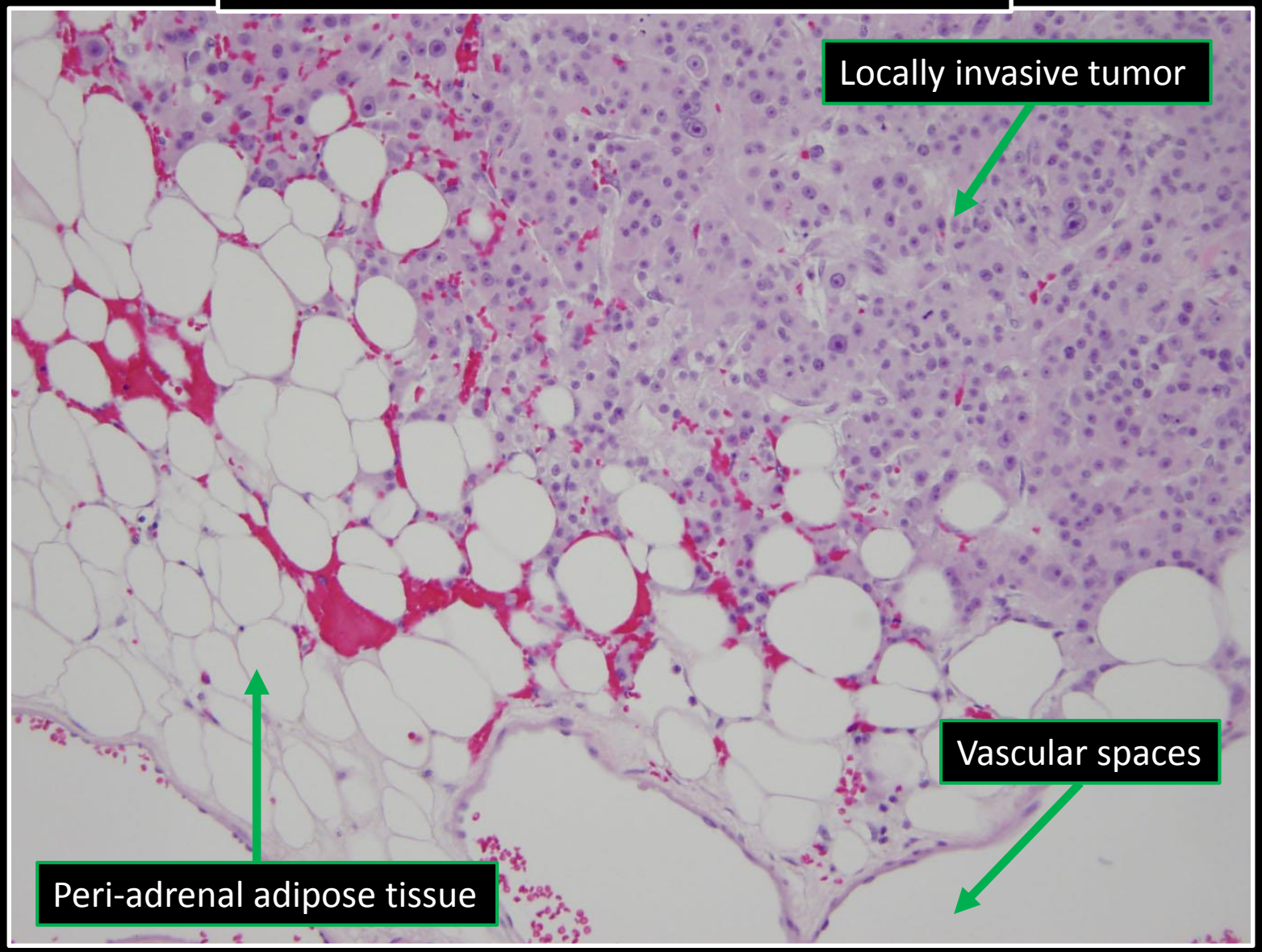
Tumor with capsule (10X)



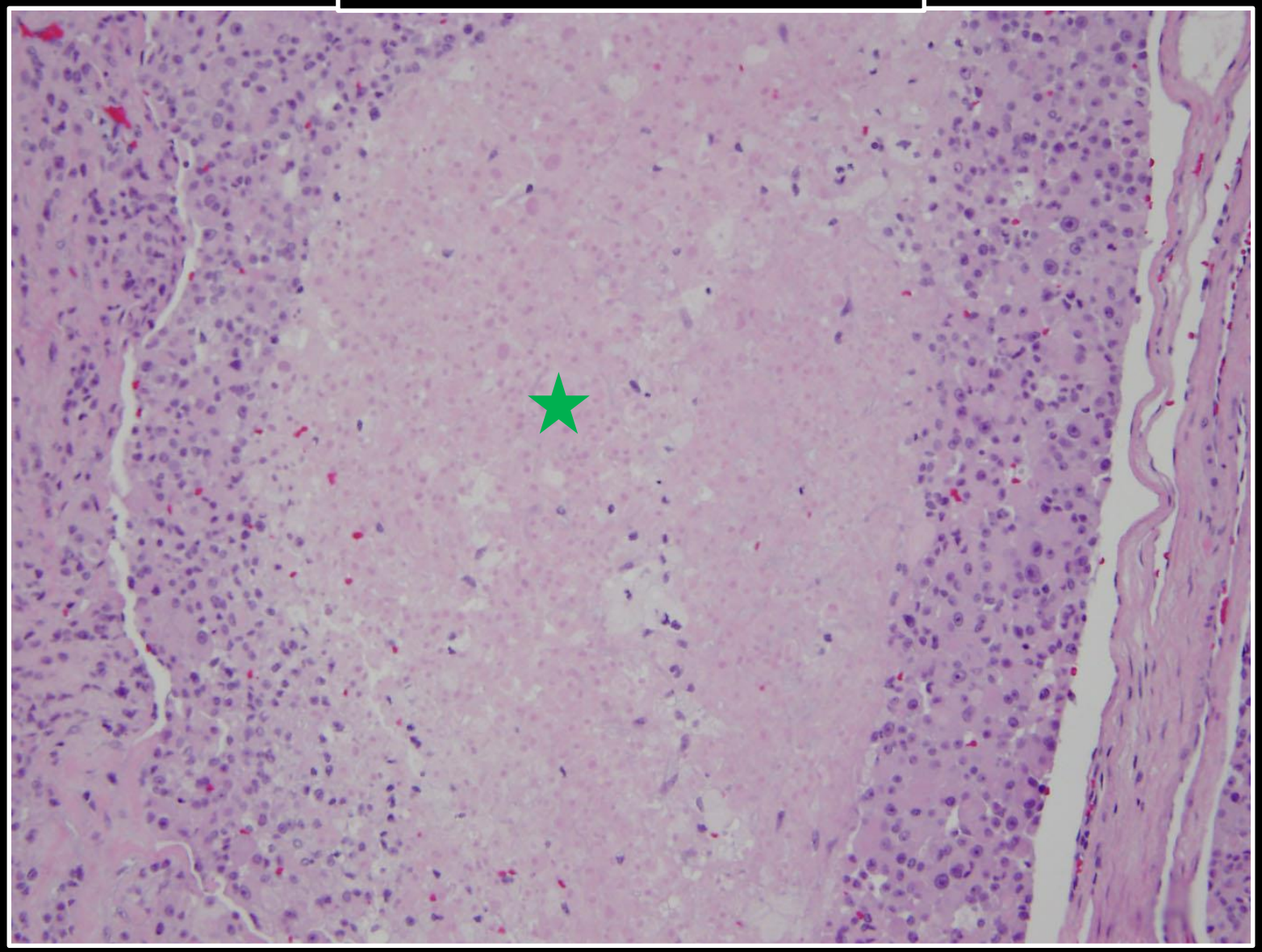
Pleomorphic focus (40X)



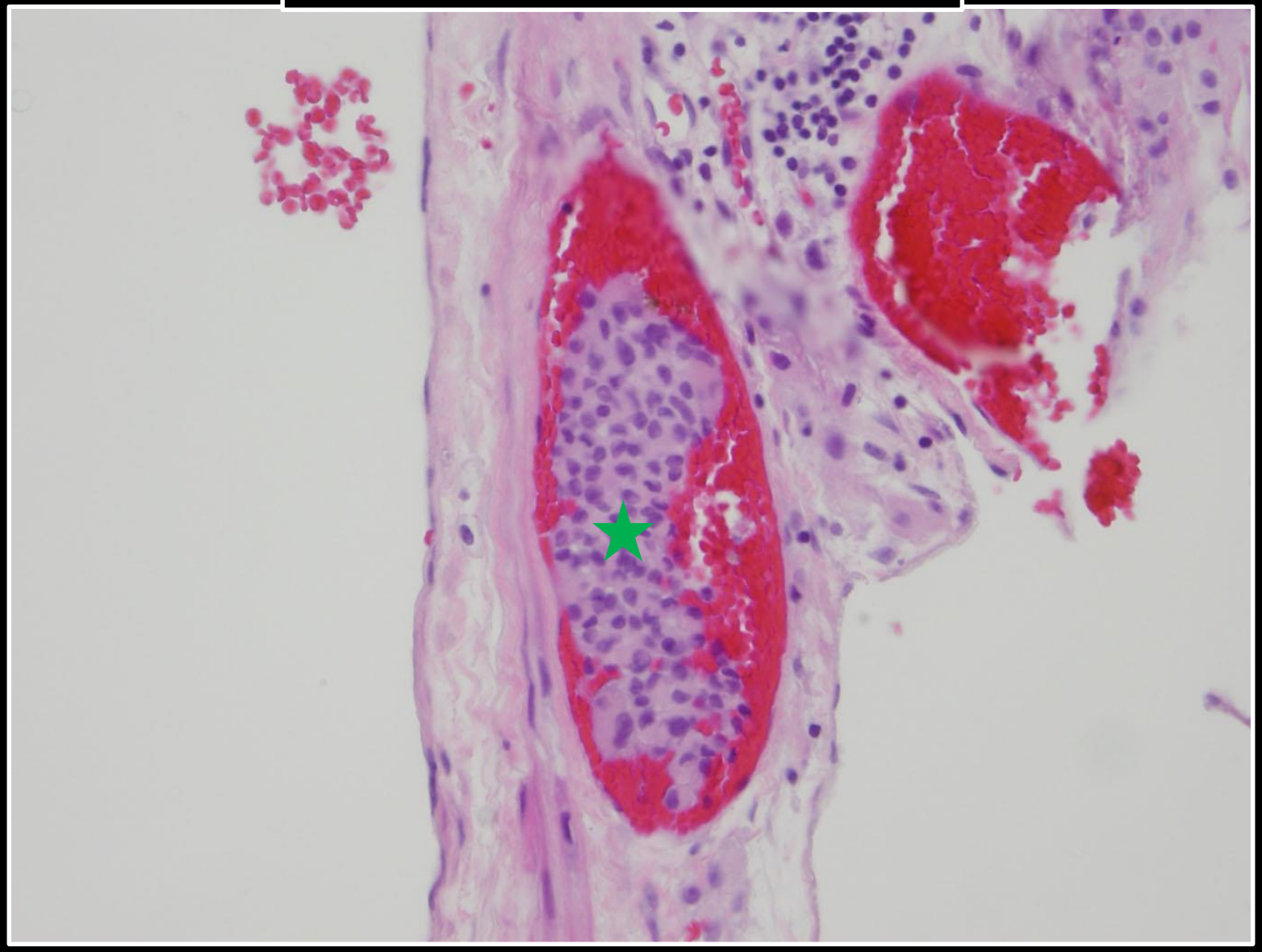
Tumor invading adipose tissue (20X)



Coagulative necrosis (20X)



Lymphovascular invasion (40X)



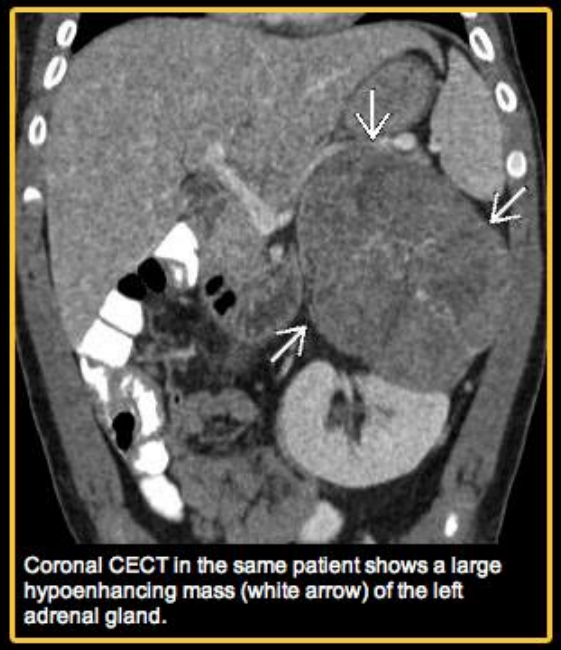
Case 2 – Adrenal cortical carcinoma

The what:

- Malignancy of the adrenal cortex
- Very rare, prevalence of $1/10^6$

The where:

- More common on the right
- 15% bilateral
- Mets: Lung, liver, skin, lymph nodes



Coronal CECT in the same patient shows a large hypoenhancing mass (white arrow) of the left adrenal gland.

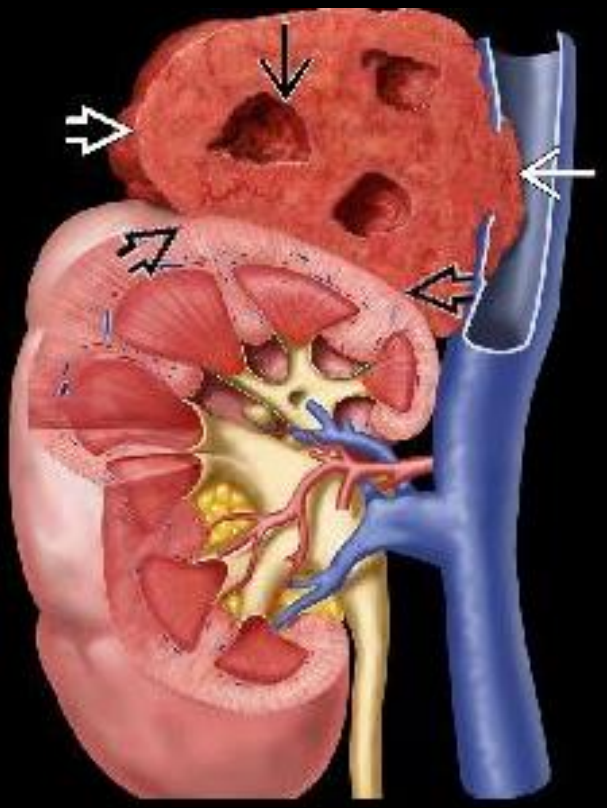
The who:

- Bimodal age distribution
  - Adults 30-40
  - Kids <10yrs
- Most common in kids <6yrs of age
- Female predominance
- Prognosis better kids>>>adults

https://my.statdx.com/STATdxMain.jsp?rc=false#dxContent;adrenocortical_carcinoma_dx

Case 2 – Adrenal cortical carcinoma

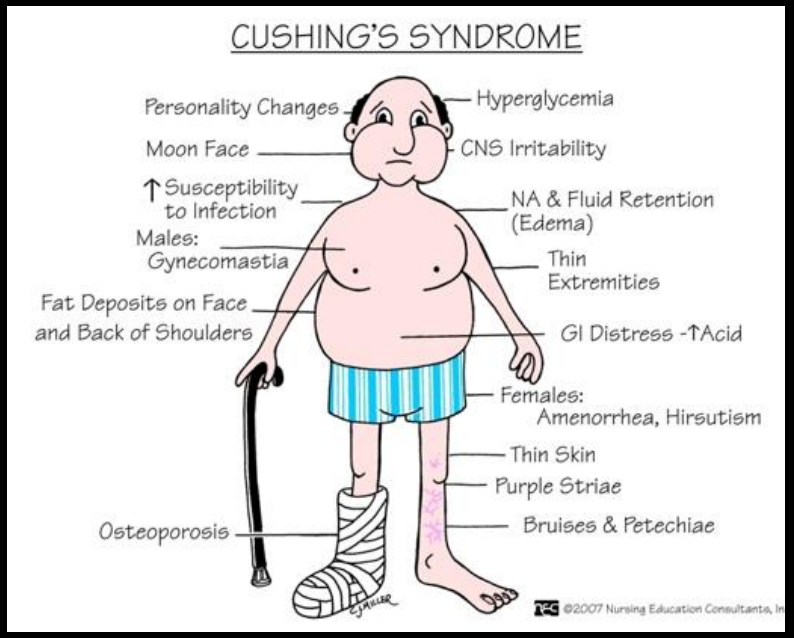
- The what in the world does it look like:
  - CT
    - Average size at dx 7-10cm
    - Well defined soft tissue mass with thin, enhancing rim
    - Displaces kidney inferiorly
    - Central stellate areas of low attenuation
    - Calcification seen in ~70% of masses
    - Central necrosis and hemorrhage are typical
  - MRI
    - T1
      - Heterogeneous mass
      - Isointense to muscle
    - T2
      - Iso→hyperintense compares to subcutaneous fat
      - Central stellate area is hyperintense to fat
    - T1 +C
      - Heterogenous enhancement
      - Can have central stellate area that does not enhance



Case 2 – Adrenal cortical carcinoma

What else do I need to know:

- Tumors are hormonally active:
  - Virilization (kids)
    - Excess androgens
  - Cushing syndrome (adults)
    - Excess cortisol
    - Up to 75% of cases
- Treatment
  - Surgical excision (preferred)
  - Chemo if resection not possible
- Weight of tumor
  - Most important predictor of clinical outcome
- Up to 80% have mutation of p53 tumor suppressor gene
- Associated with Li-Fraumeni syndrome, Beckwith-Wiedemann syndrome and hemihypertrophy



http://www.neurobodyfit.com/learn-about-cushings-syndrome/

Case 3

- History: 69 year old female with 3 months of progressive fatigue, low back, and flank pain.

ACR appropriateness criteria

Variant 2: **Patient with one or more of the following: low-velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70 years.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
X-ray lumbar spine	6		☢☢☢
Tc-99m bone scan with SPECT spine	4	SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
MRI lumbar spine without and with contrast	3		O
CT lumbar spine with contrast	3		☢☢☢
CT lumbar spine without and with contrast	1		☢☢☢☢
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray myelography lumbar spine	1		☢☢☢
X-ray discography lumbar spine	1		☢☢
X-ray discography and post-discography CT lumbar spine	1		☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

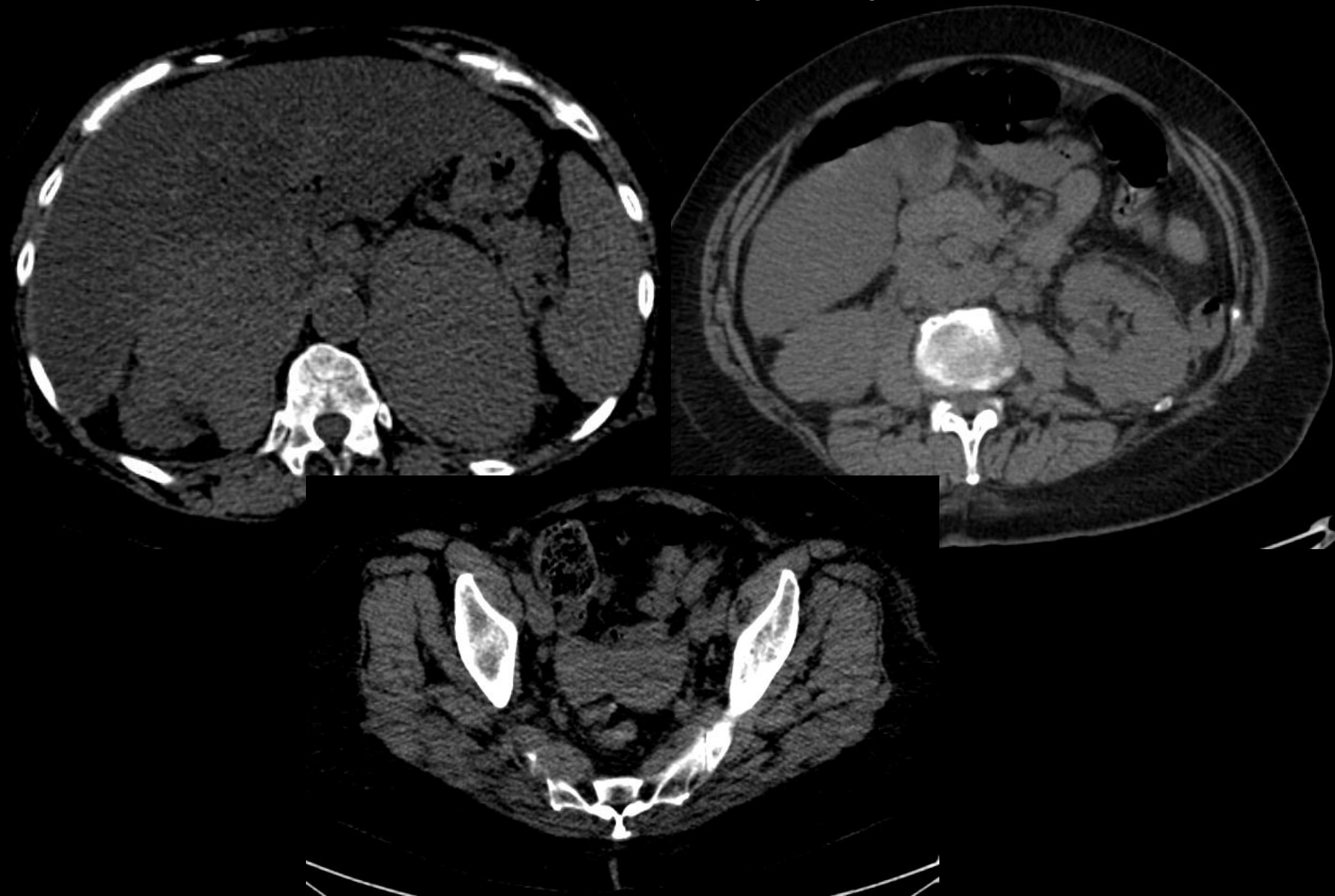
Variant 2: **Recurrent symptoms of stone disease.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis without contrast	7	Reduced-dose techniques preferred.	☢☢☢☢
US kidneys and bladder retroperitoneal with Doppler and KUB	7		☢☢
CT abdomen and pelvis without and with contrast	6	If CT without contrast does not explain pain or if without has abnormality that should be further assessed with contrast (eg, stone versus phleboliths).	☢☢☢☢
X-ray abdomen and pelvis (KUB)	6	Good for baseline and post-treatment follow-up.	☢☢
MRI abdomen and pelvis without contrast (MR urography)	4		O
MRI abdomen and pelvis without and with contrast (MR urography)	4	See statement regarding contrast in text under "Anticipated Exceptions."	O
CT abdomen and pelvis with contrast	2		☢☢☢☢
X-ray intravenous urography	2		☢☢☢

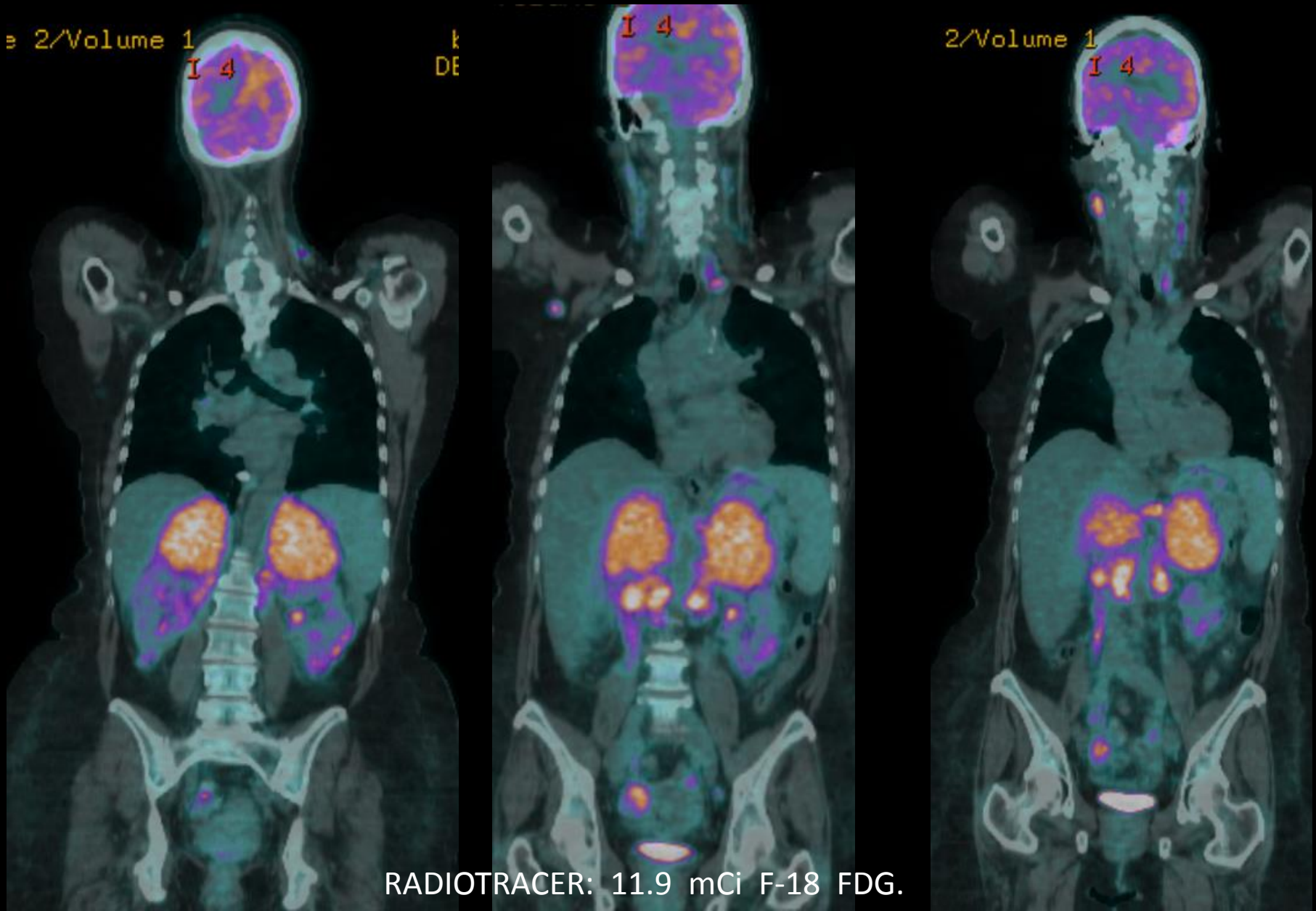
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Case 3- CT 3/15/11

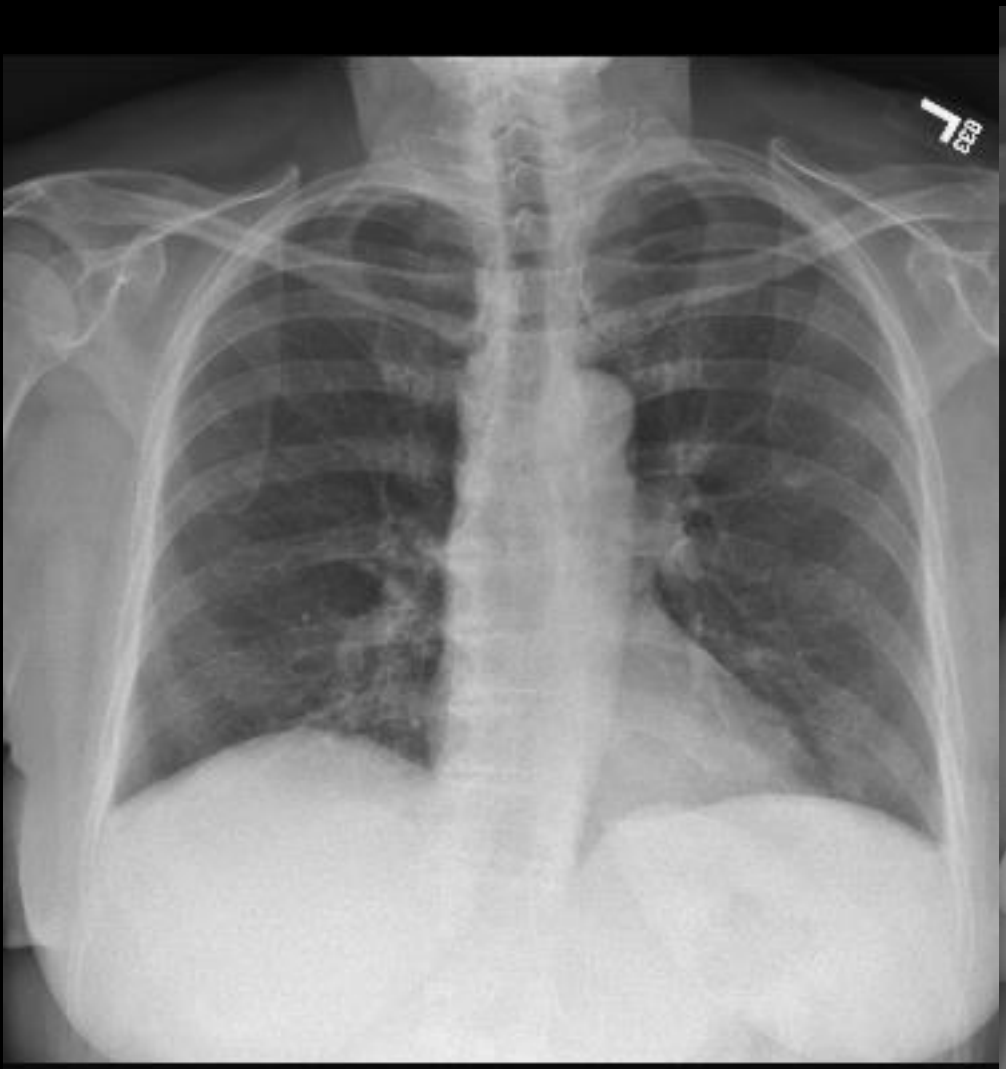


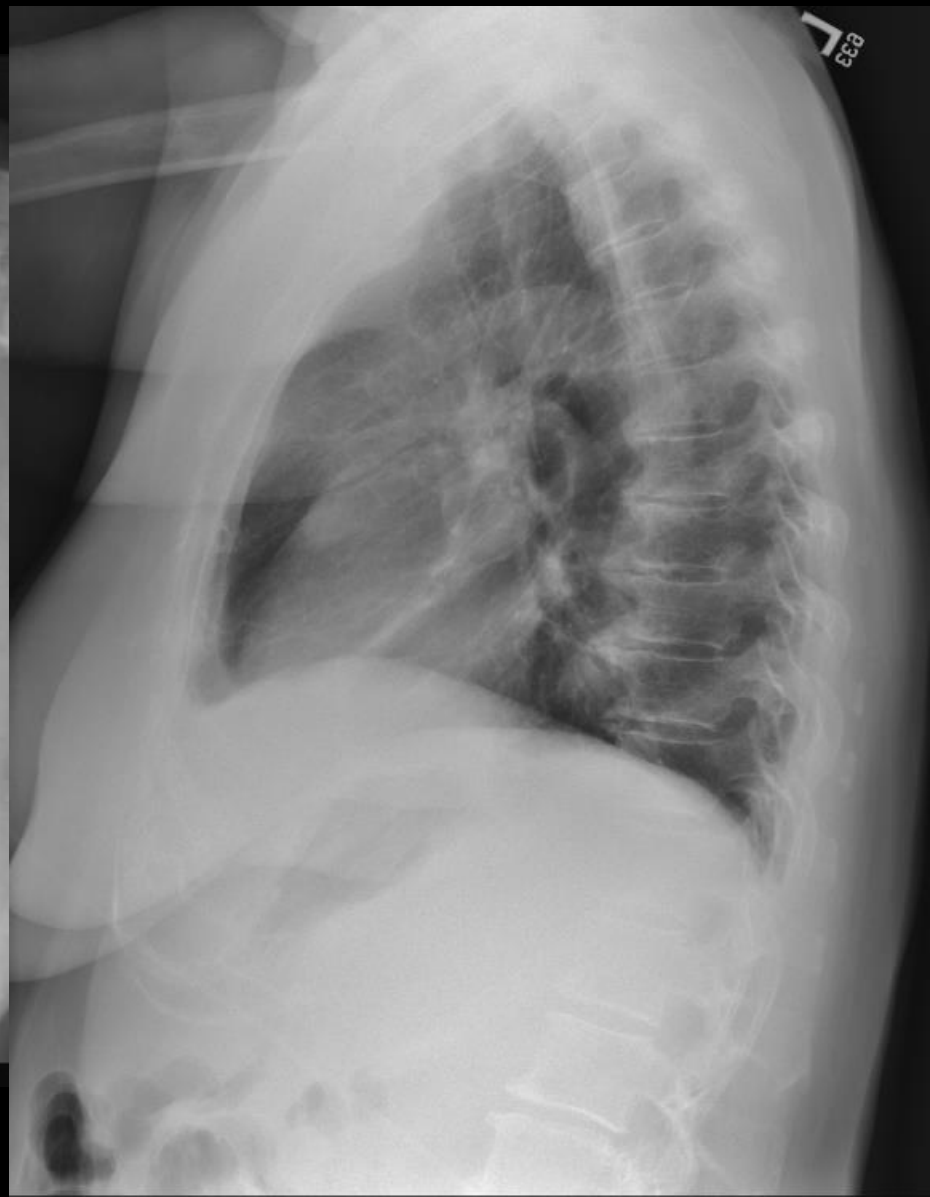
Case 3- PET/CT 3/15/11



RADIOTRACER: 11.9 mCi F-18 FDG.

CXR 3/14/11





Case 3 Findings

- CT
  - Bilateral adrenal masses with associated bulky RP adenopathy.
- PET/CT
  - Extensive FDG avid disease involving multiple lymph node stations above and below the diaphragm
  - Intense FDG avid bilateral perirenal, pericholecystic, and right ovarian soft tissue.

Case 3 Differential

Case 3 Differential

- Lymphoma
- Metastatic disease
- Diffuse infectious process, TB or histoplasmosis

Case 3 Pathology

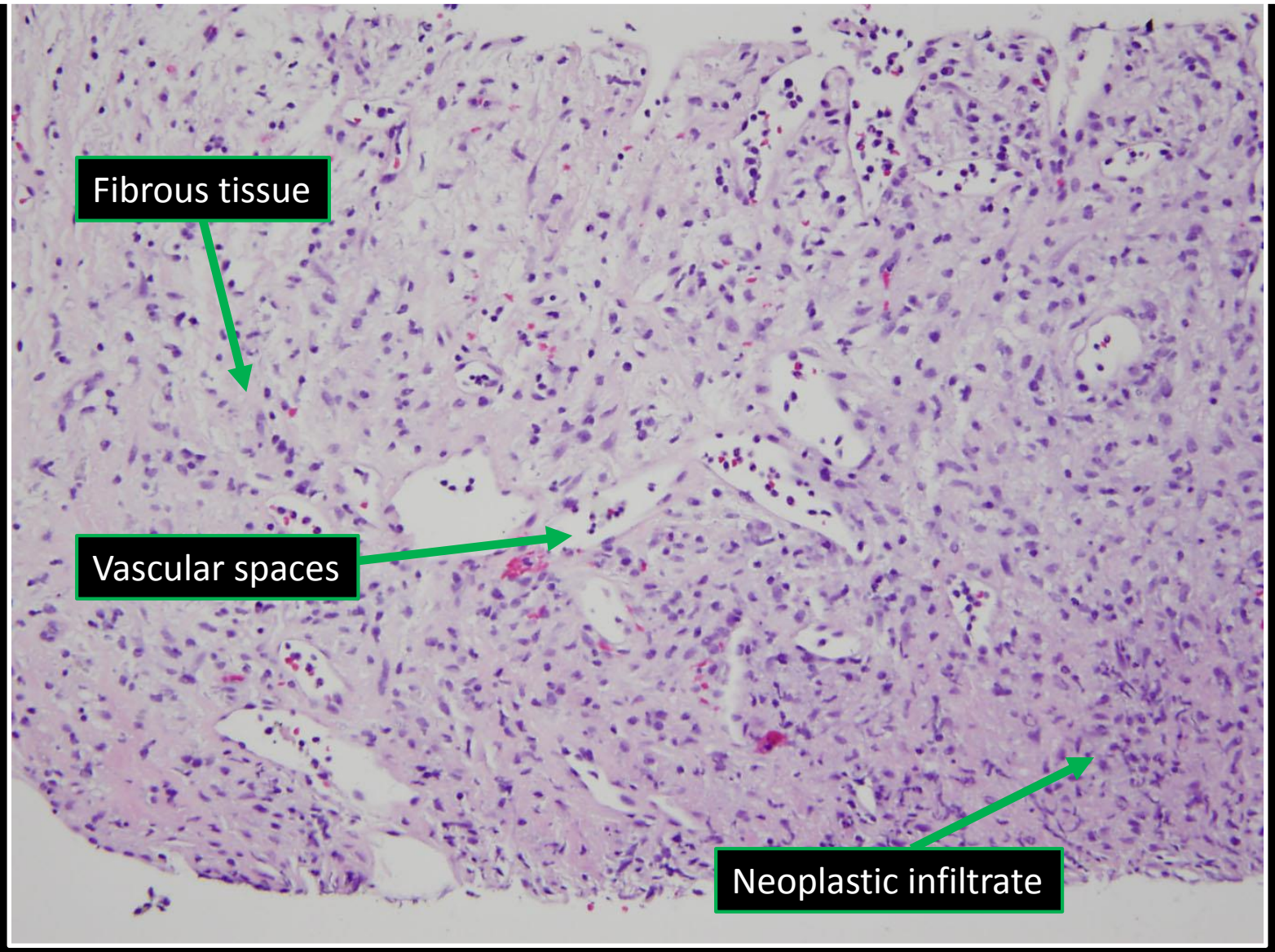
Diffuse large B-cell lymphoma involving the adrenal

- MRN: **25675414**
- Case: **BS-12-A08642**
- Date: **02/22/2012**

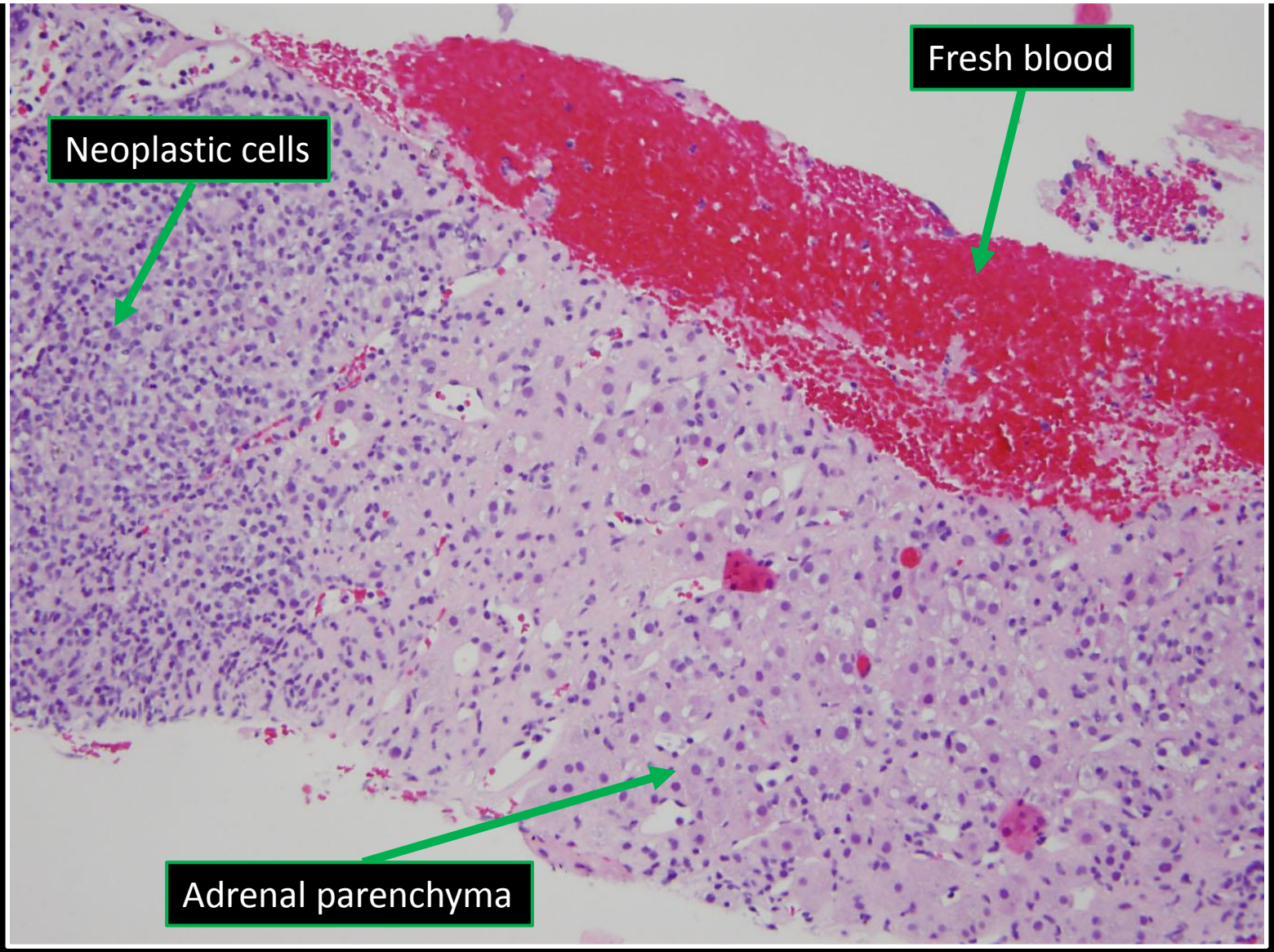
- Specimen: ADRENAL GLAND, CORE BIOPSY

- Diagnosis: Diffuse Large B-Cell lymphoma

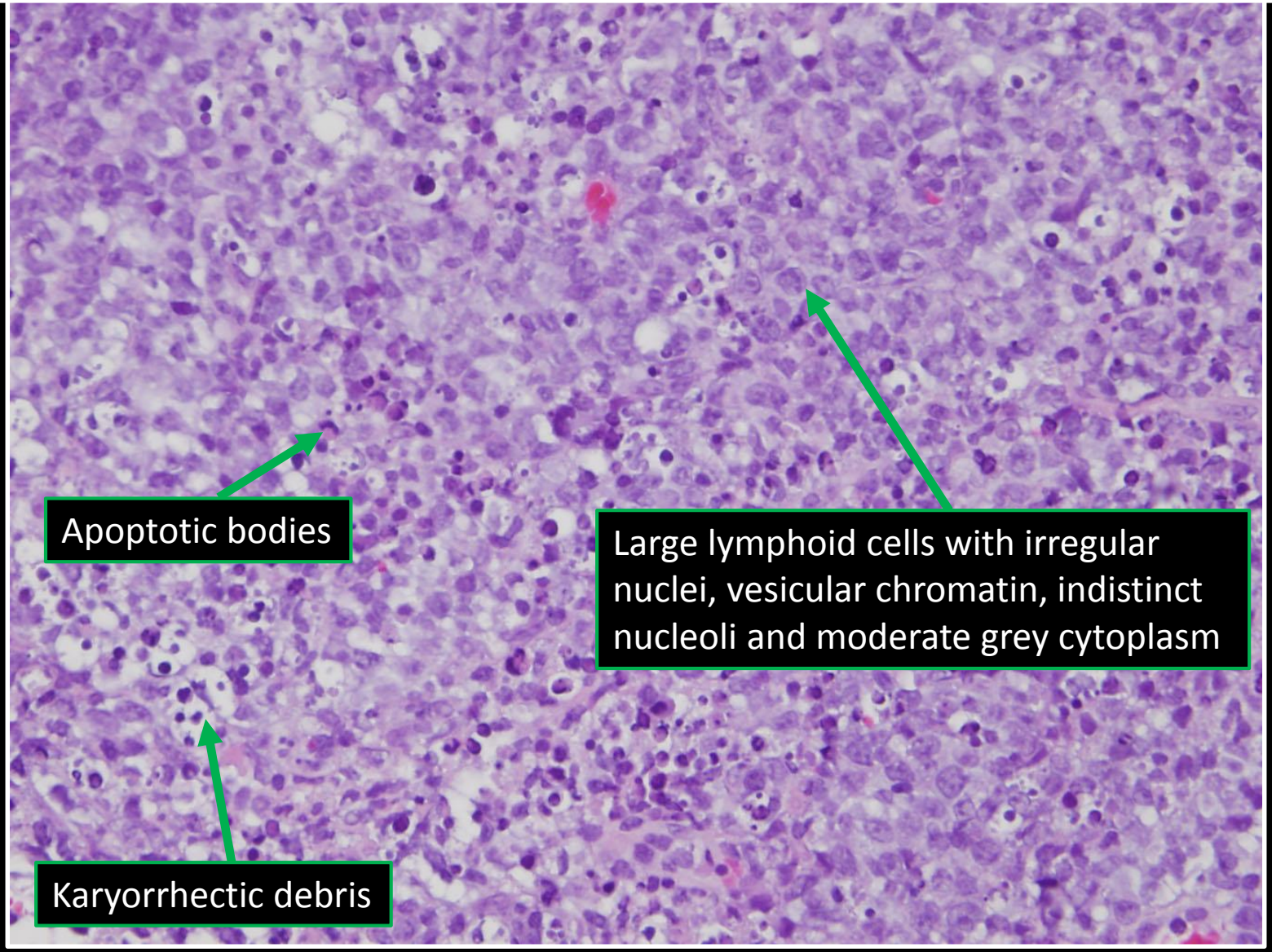
Core biopsy – adrenal gland: Fibrovascular tissue with tumor (20X)



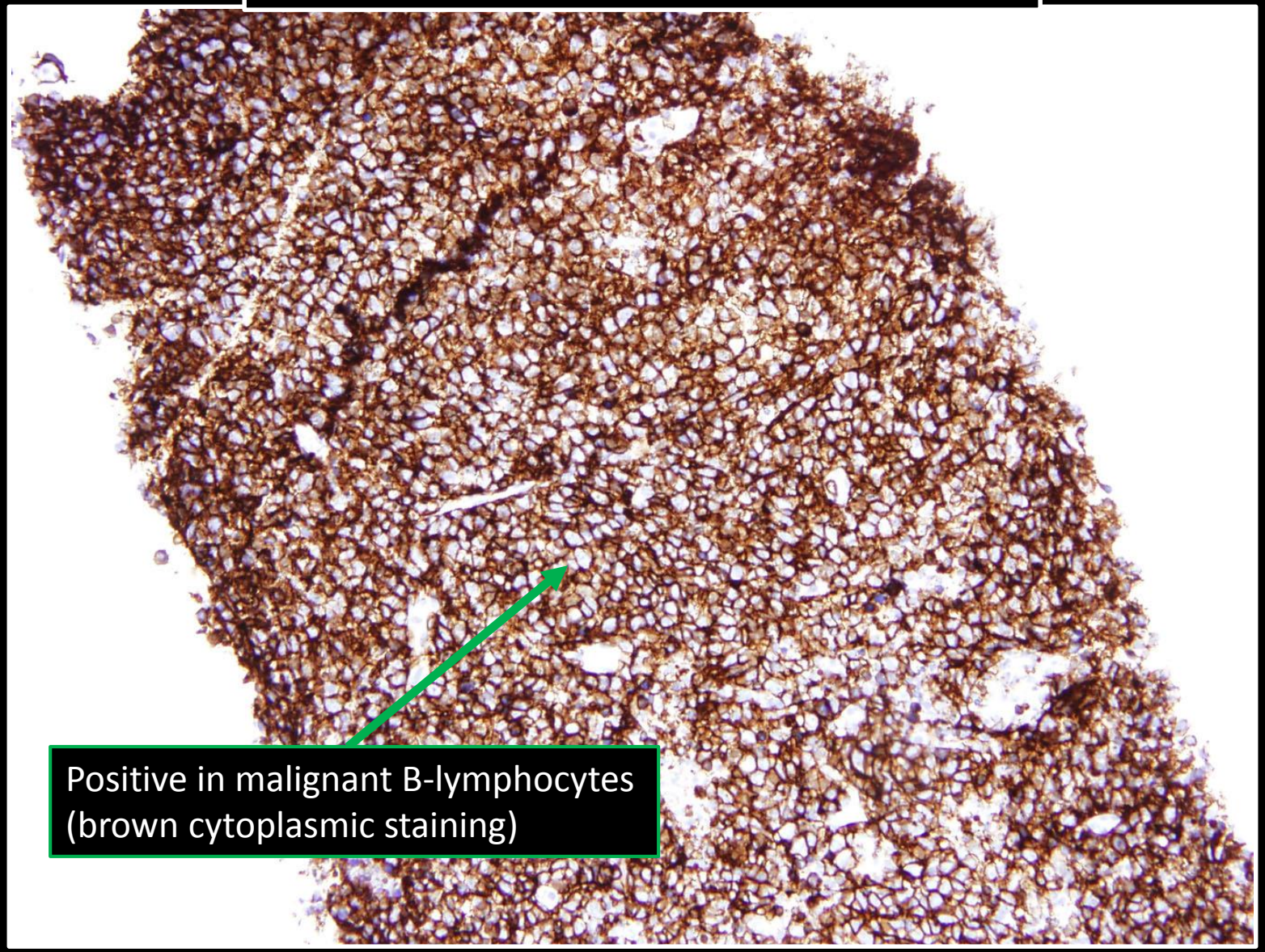
Core biopsy – adrenal gland: Adrenal parenchyma with tumor (20X)



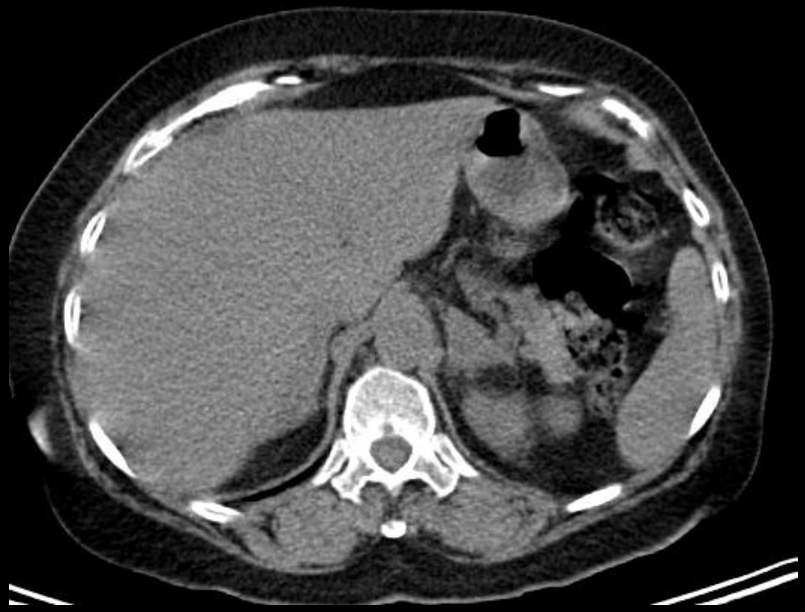
Core biopsy – adrenal gland: Diffuse large B-cell lymphoma (40X)

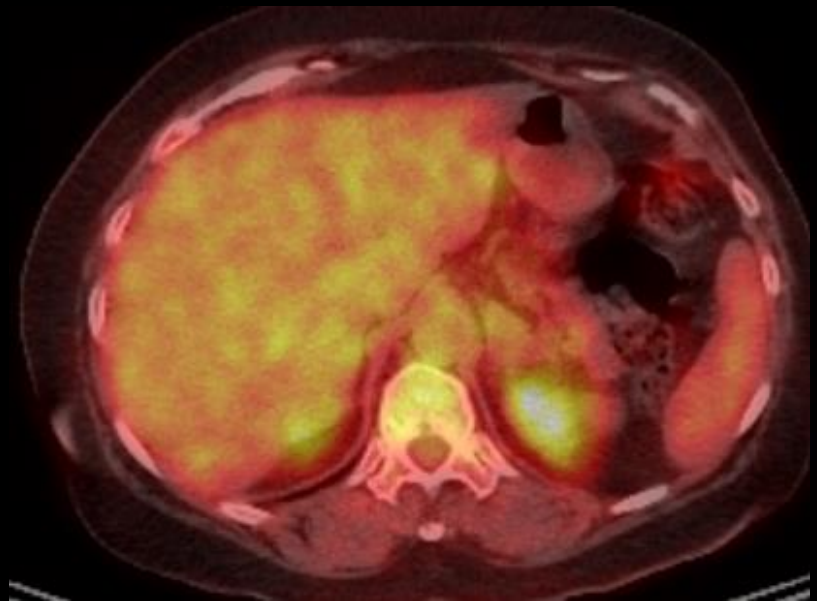


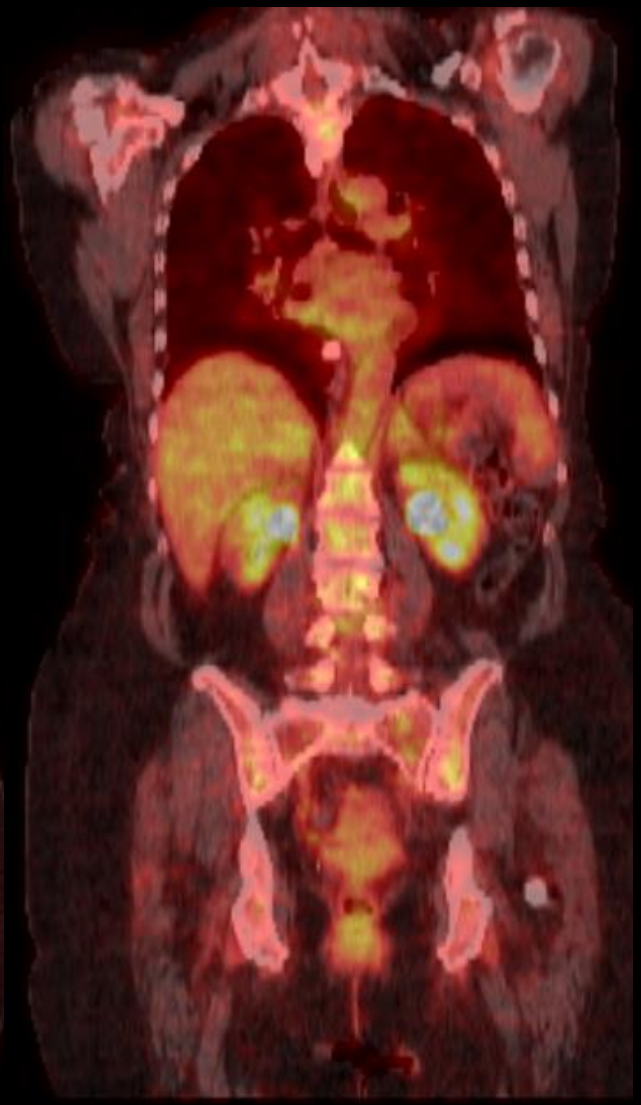
Immunohistochemistry: CD20 (20X)



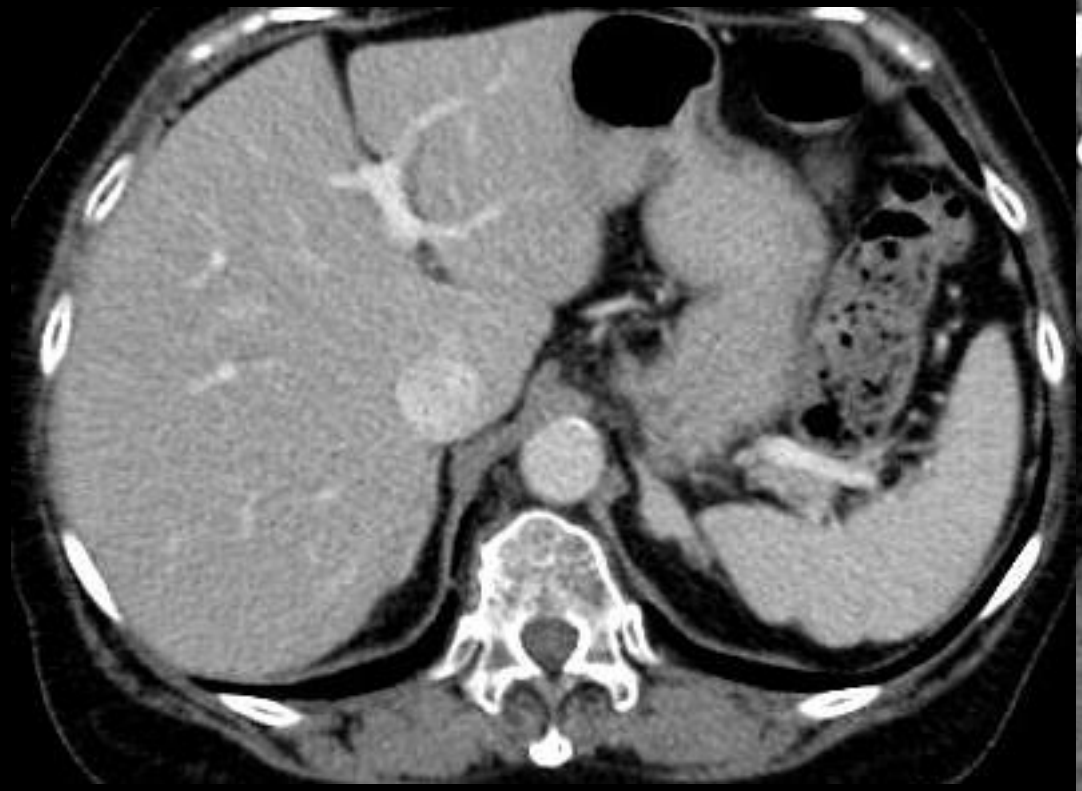
Post treatment PET/CT 5/23/11

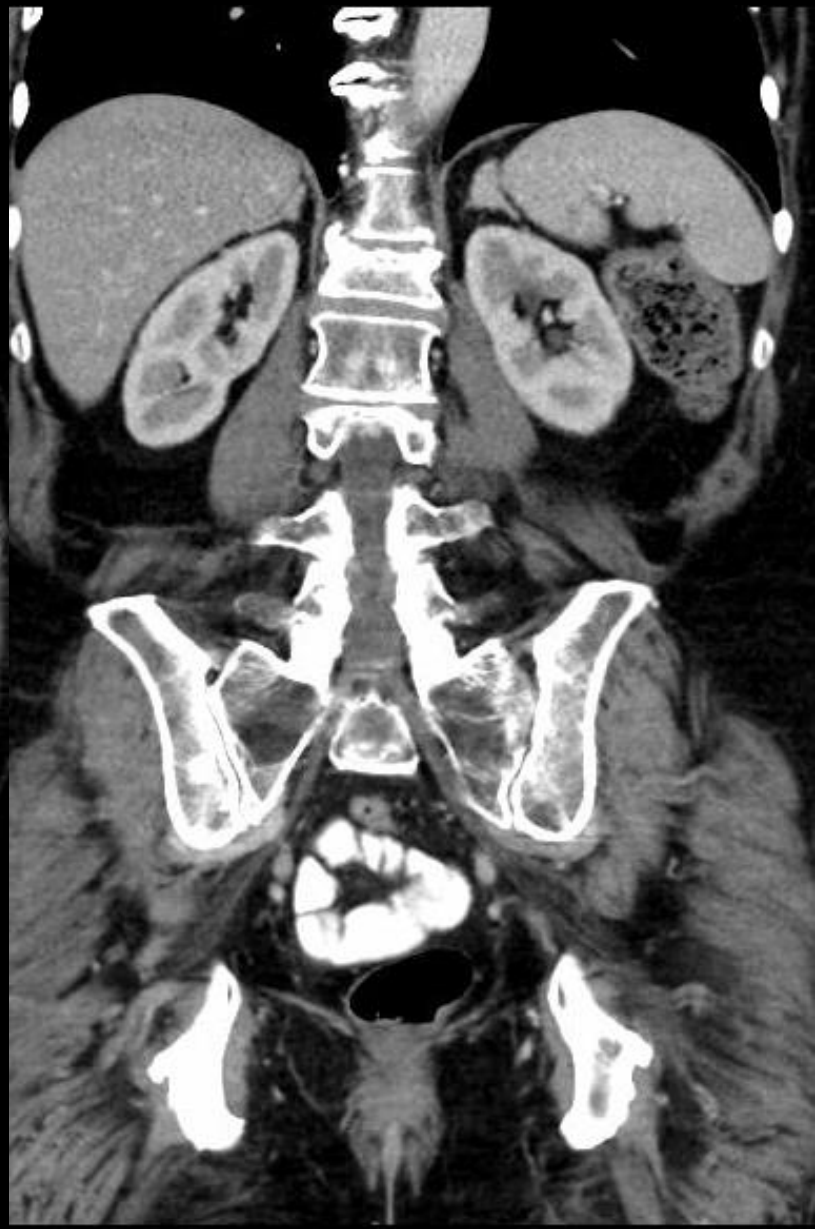






Case 3- CT 11/21/12





Case 3: Diffuse large B-cell lymphoma

The what:

- Malignant sold neoplasm made of lymphoid tissue derived from B cells
- Fast growing, aggressive form of NHL

The where:

- Mediastinal, hilar, or in this case adrenal and ovarian
- 25% of lymphoma cases involve adrenals
  - 50% are bilateral
- Adrenal gland is an extremely rare site of *primary* extranodal NHL, accounting for <1% of all NHL and only 3% of primary extranodal lymphomas

The who:

- Patients in 7th decade, average age at diagnosis is 64
- M>F
- Linked to altered immunity (HIV, EBV, environmental exposures to pesticides)

Case 3: Diffuse large B-cell lymphoma

What in the world does it look like:

- CT
  - Bulky lymphadenopathy → 75% intrathoracic
  - Hypodense lymphadenopathy indicated necrosis or cystic change
  - Calcification rare before treatment

- MRI
  - T1
    - Homogenous lymphadenopathy
  - T2 & T1 + C
    - Homogeneous or heterogeneous due to necrosis
    - Homogenous signal = better survival in patients with high grade NHL

- PET/CT
  - Focal radiotracer uptake in active lymph nodes/extranodal disease sites

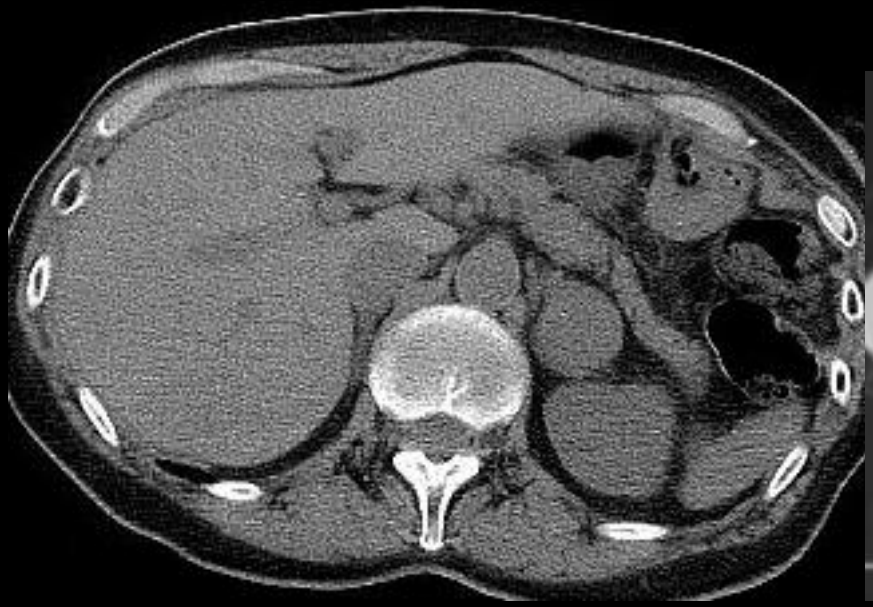
Case 3: Diffuse large B-cell lymphoma

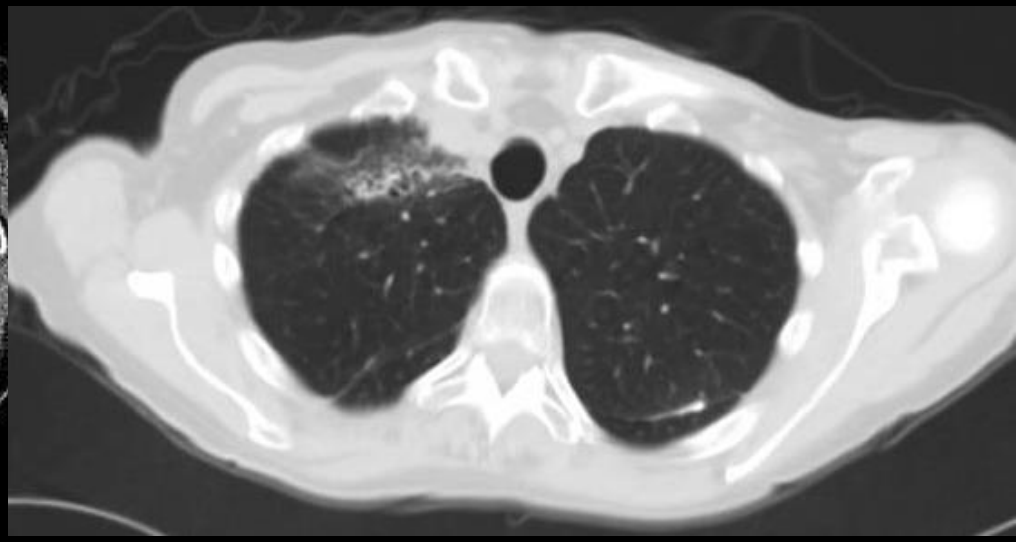
- The what else do I need to know:
  - Best imaging tool:
    - FDG PET/CT is modality of choice for staging
  - Ga-67 scintigraphy
    - High grade NHL shows intense uptake
      - Positive scan midway through chemo course = alternative therapy
  - Treatment:
    - Chemotherapy (R-CHOP) and radiotherapy (if curable)
  - Consider NHL in classic differential for diagnosis of an anterior mediastinal mass

Case 4

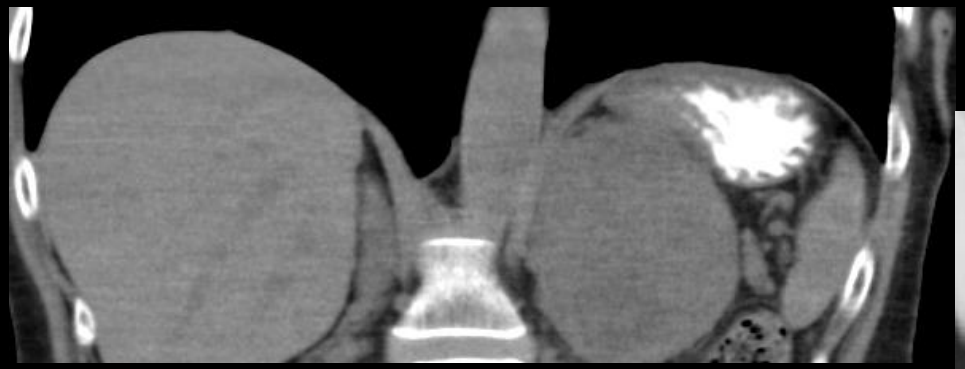
- History: 71 year old asymptomatic female with hx of NSCLC (limited stage, dx 2006) and SCLC (dx 2008), s/p resection, chemotherapy, and XRT, here for restaging

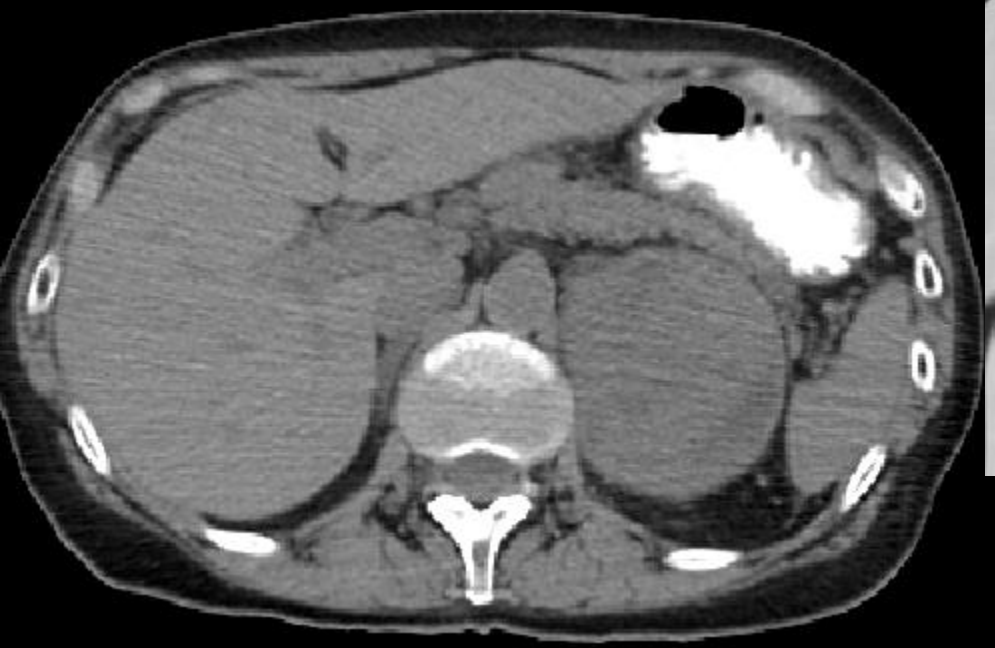
Noncontrast CT chest 6/21/08

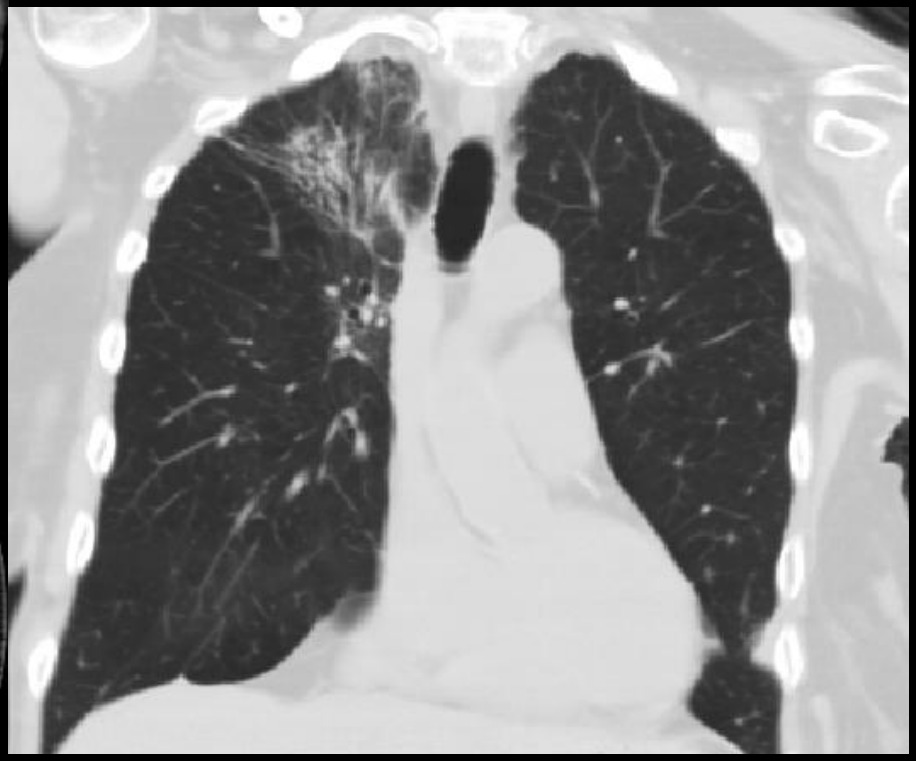




Noncontrast CT chest 9/25/08







ACR appropriateness criteria Incidentally discovered adrenal mass

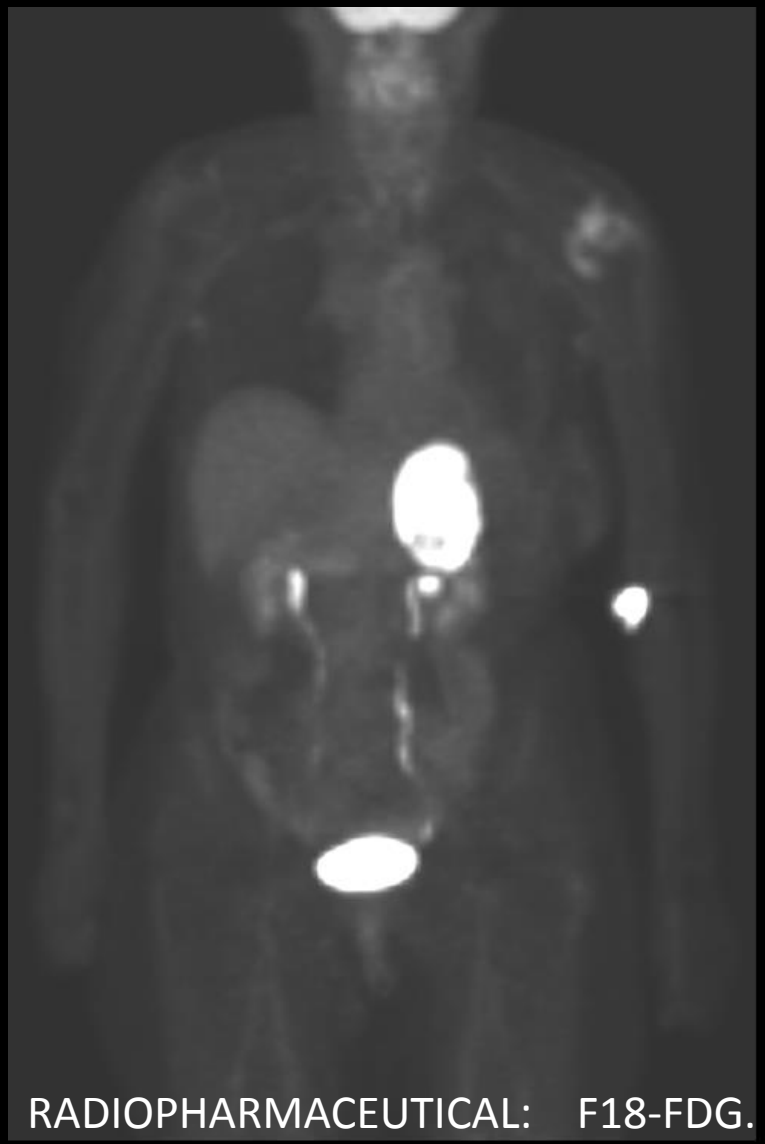
Variant 5: **History of malignancy; mass >4 cm in diameter.**

Radiologic Procedure	Rating	Comments	RRL*
Biopsy adrenal gland	8		Varies
FDG-PET/CT skull base to mid-thigh	8	Alternative to biopsy to diagnose metastasis.	☢☢☢☢
MRI abdomen without and with contrast	1		O
MRI abdomen without contrast	1		O
US adrenal gland	1		O
CT abdomen with contrast	1		☢☢☢
CT abdomen without contrast	1		☢☢☢
MIBG	1		☢☢☢
X-ray abdomen	1		☢☢
CT abdomen without and with contrast	1		☢☢☢☢
Iodocholesterol scan	1		☢☢☢☢

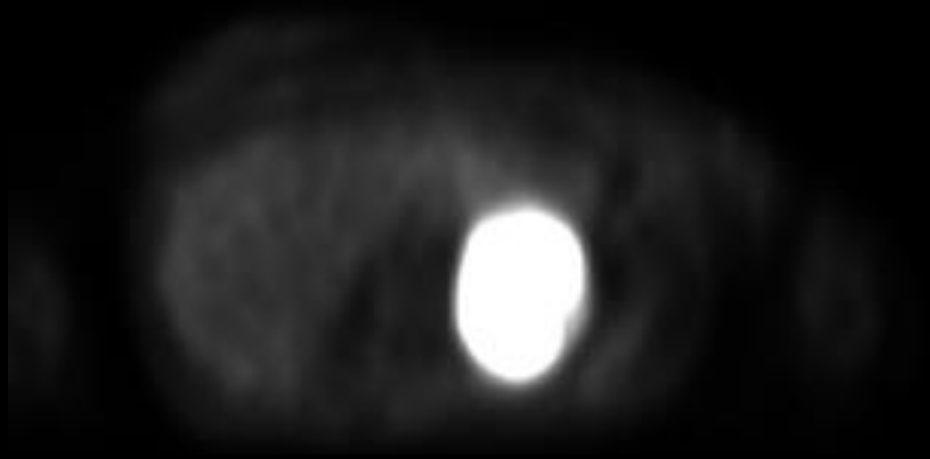
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**

***Relative Radiation Level**

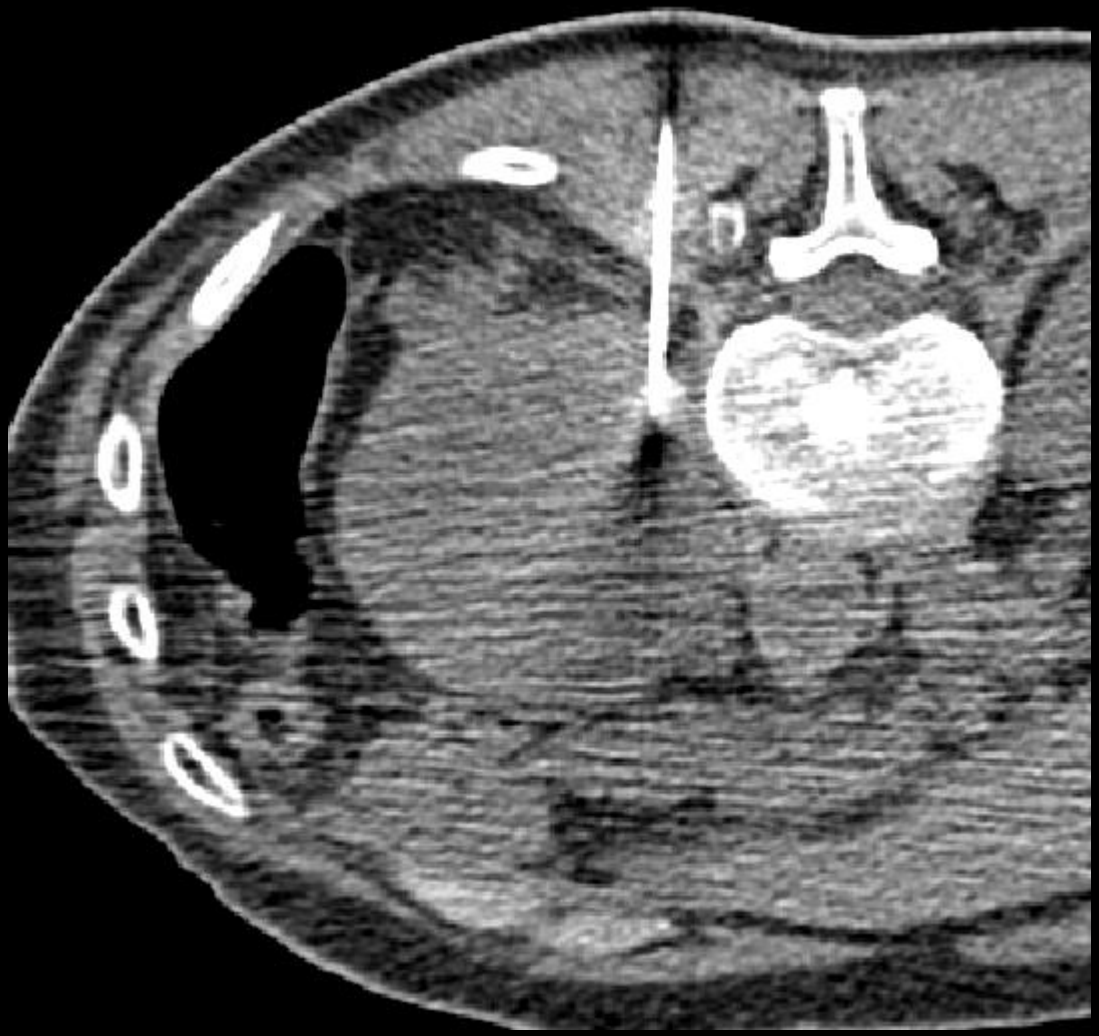
PET/CT 9/29/2008



RADIOPHARMACEUTICAL: F18-FDG.



CSIR 10/1/08



Case 4 findings:

- CT
  - Round, well circumscribed 7.4 x 6.8cm left adrenal mass
  - No significant RP lymphadenopathy
- PET/CT
  - large intensely FDG avid left adrenal lesion measuring 8.8 x 7.6 cm w/ SUV max of 31.3.
- CSIR bx
  - Successful…pathology..

Case 4 Differentials

Case 4 Differentials

- Metastatic disease
- Pheochromocytoma
- Lymphoma
- Large adenoma
- Adrenal carcinoma
- Adrenal hemorrhage

Case 4 Pathology

Metastatic carcinoma to the adrenal

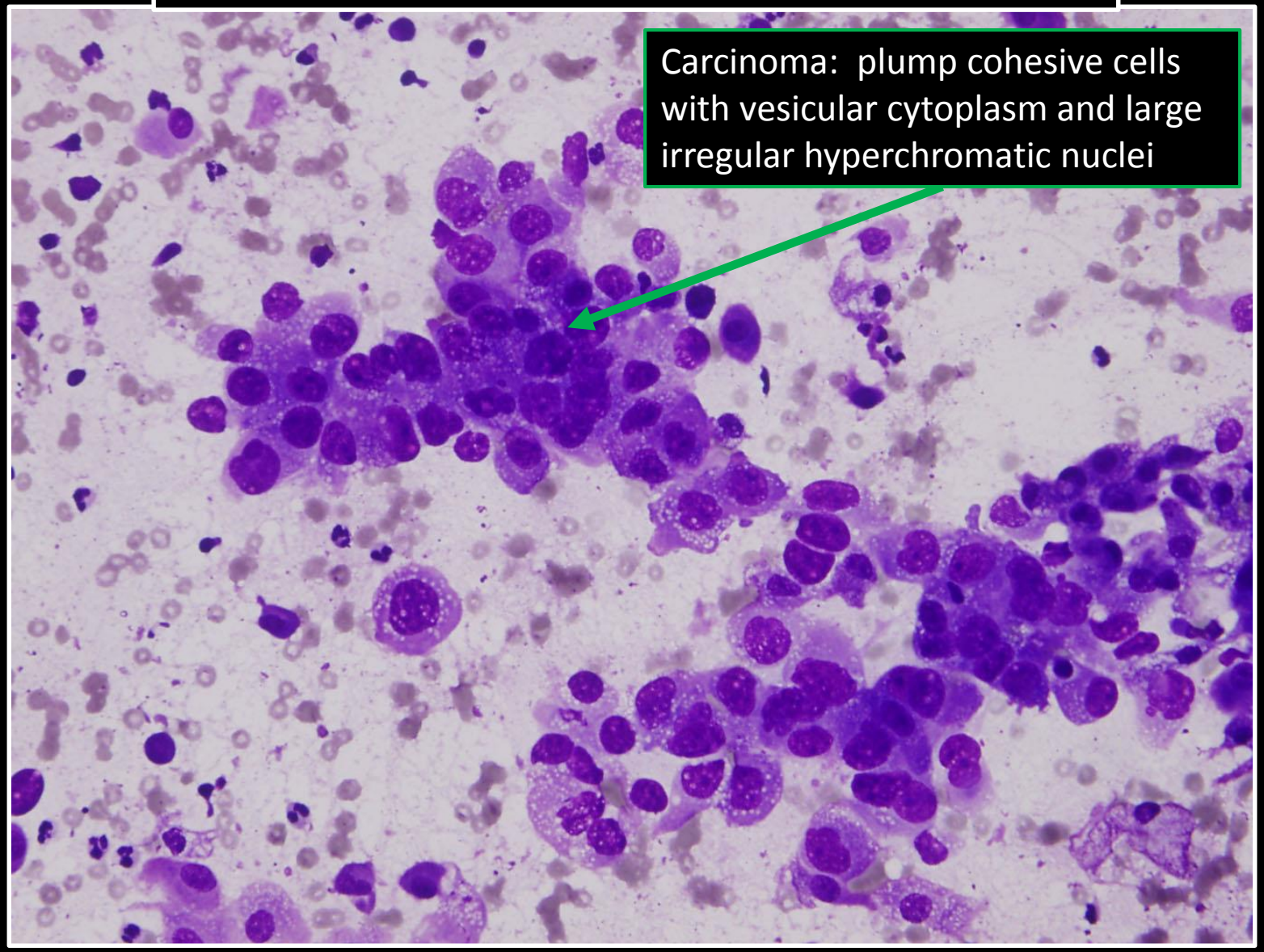
- MRN: **16498917**

- Case: **BC-08-G42546**
- Date: **10/01/2008**
- Specimen: LEFT ADRENAL MASS, FINE NEEDLE ASPIRATION with CELL BLOCK

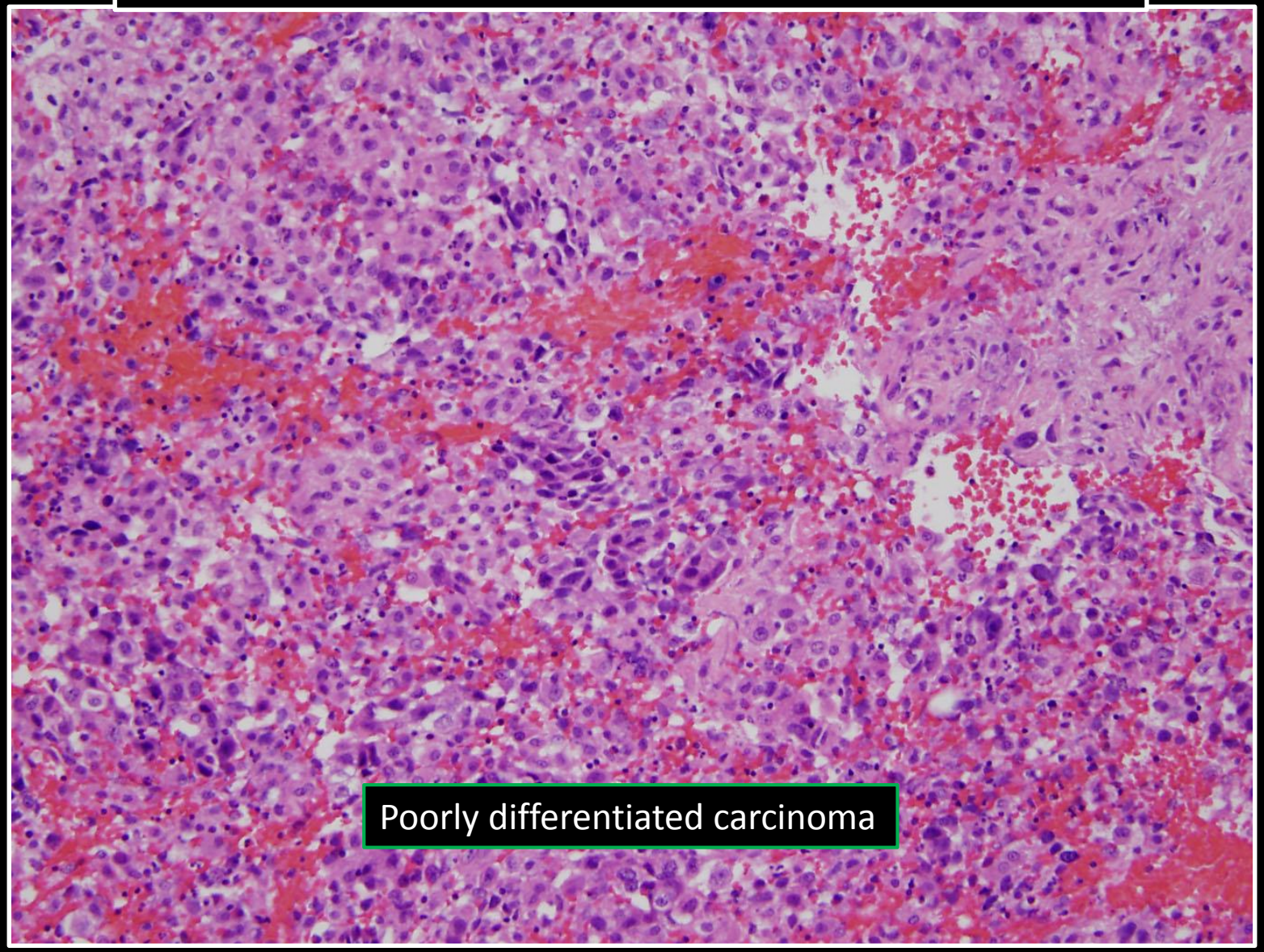
- Case: **BS-08-R50449**
- Date: **11/13/2008**
- Specimen: LEFT ADRENAL TUMOR, RESECTION

- Diagnosis: METASTATIC POORLY DIFFERENTIATED CARCINOMA, most consistent with SQUAMOUS CELL CARCINOMA

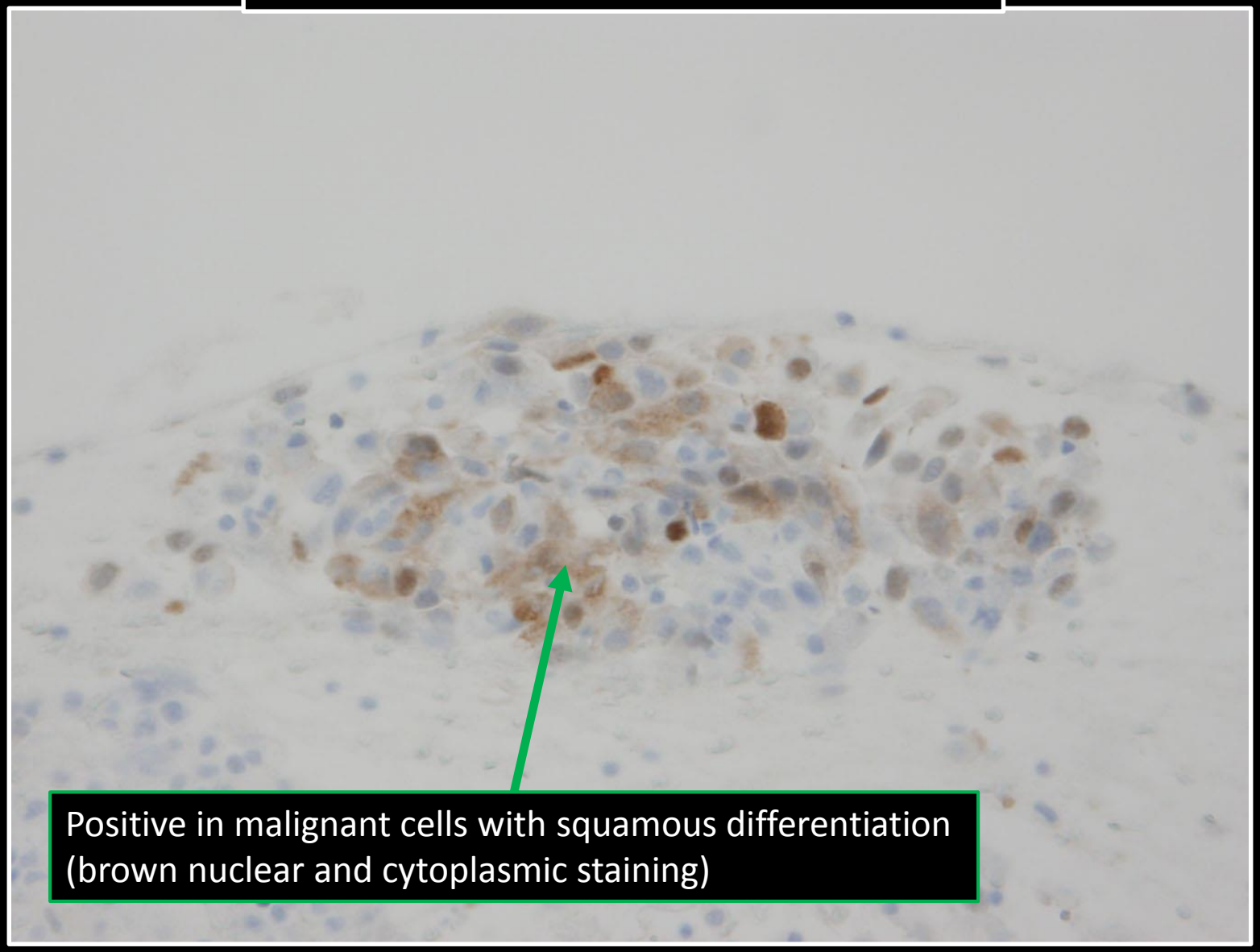
Fine needle aspirate – adrenal: Smear (40X)



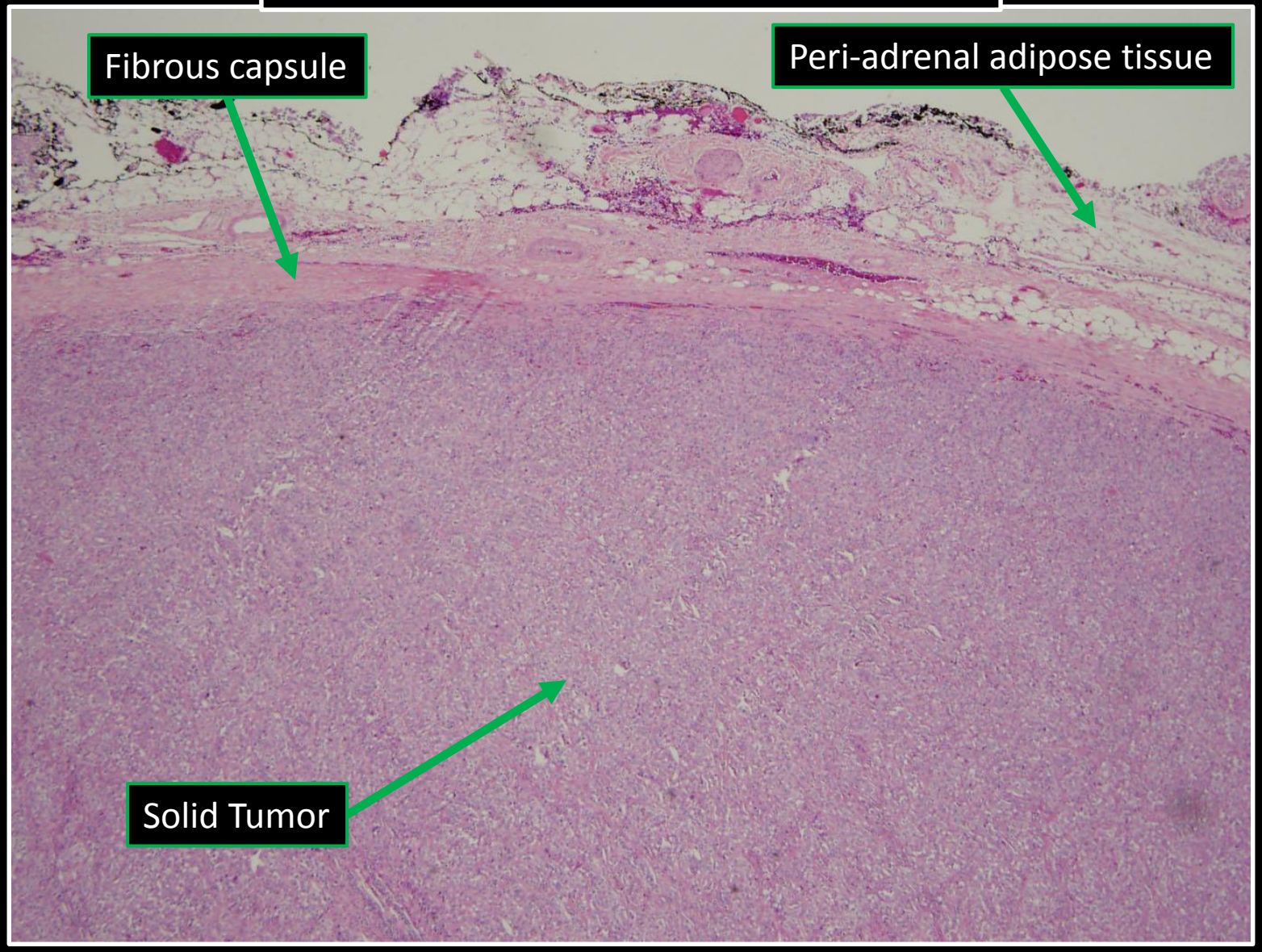
Fine needle aspirate – adrenal: Cell block (20X)



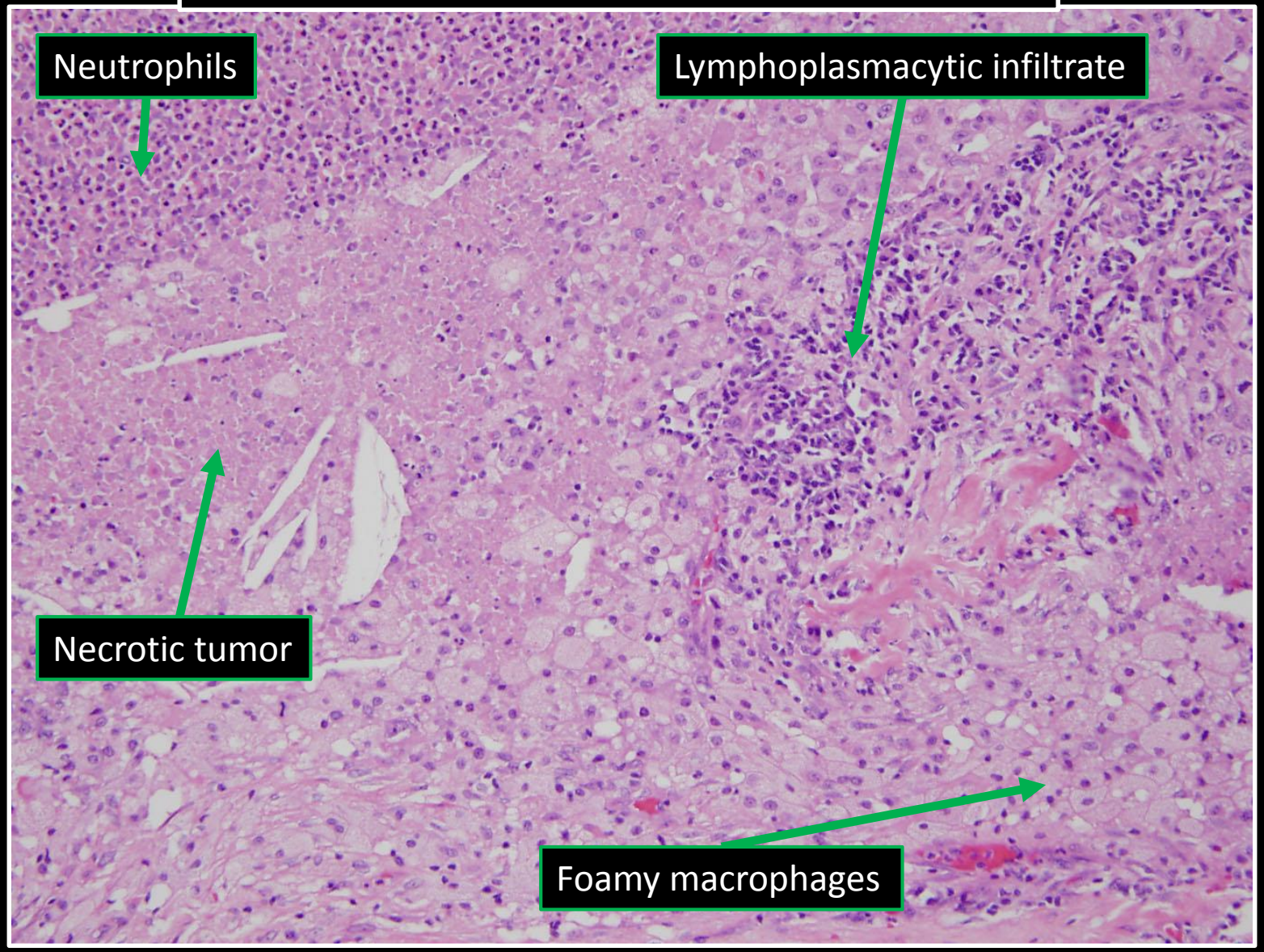
Immunohistochemistry: P63 (40X)



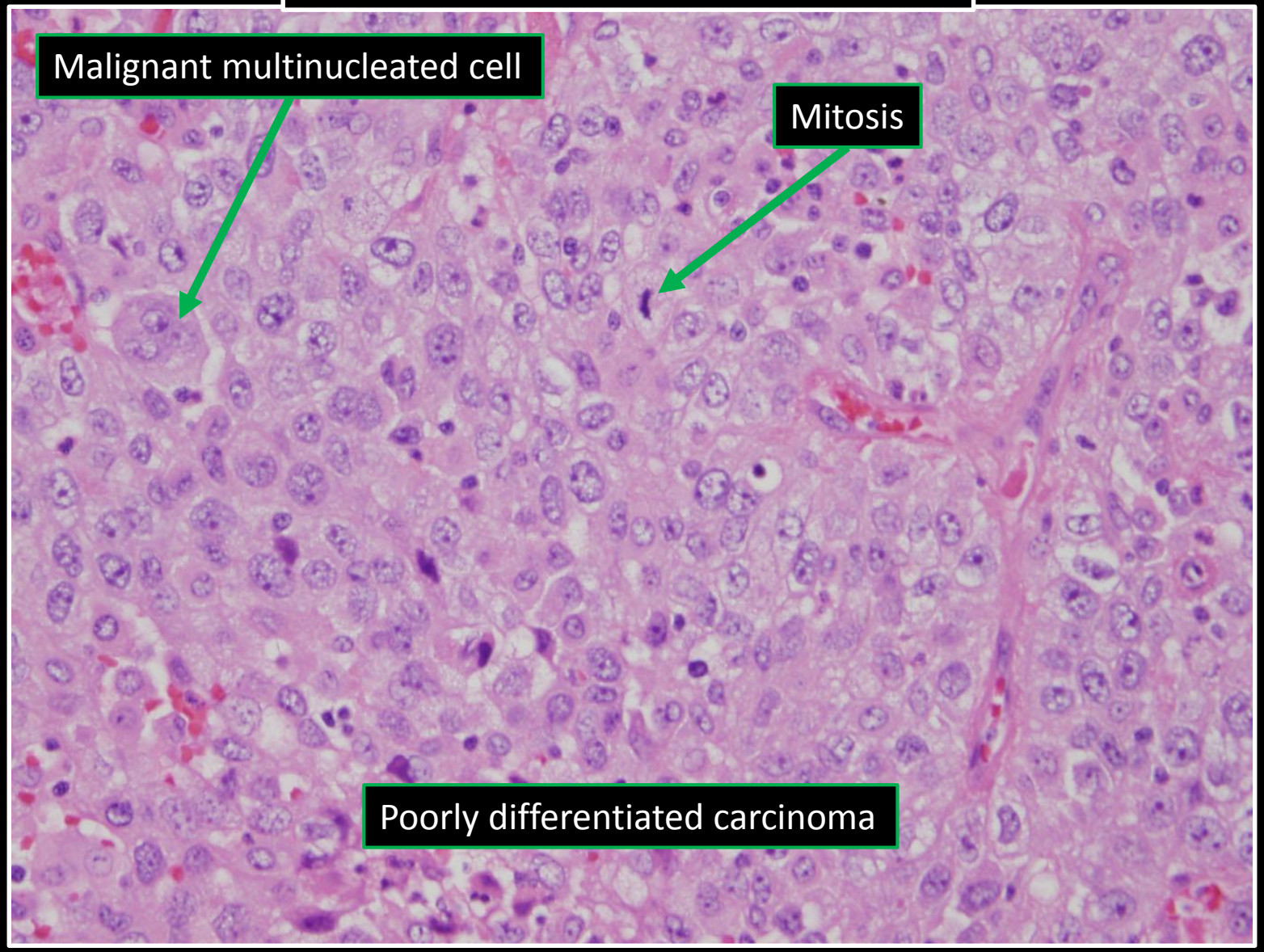
Resection: Metastatic tumor (4X)



Necrotic tumor with inflammation (10X)



Squamous cell carcinoma (40X)



Case 4: Adrenal metastases

The what:

- Primary other organ malignances sending trouble-maker cells to the adrenal glands

The where:

- 4th most common site of mets after lung, liver, and bone
- Discrete intraparenchymal masses or direct extension from tumors in adjacent organs

The who:

- Melanoma: 50% met to adrenals
- Lung and breast: 30-40% with adrenal mets
- Renal and GI cancers: 10-20% met to adrenals
- Lymphoma: 25% involve adrenals
- Indicates stage IV of distant metastatic disease

Case 4: Adrenal metastases

What in the world does it look like:

- CT
  - Small mets
    - Well defined, round, or oval in shape with preserved adrenal contour
    - Homogenous soft tissue density
    - Unilateral or bilateral
    - Necrosis, hemorrhage, and calcifications are rare
  - Large mets
    - Heterogeneous density 2/2 necrosis and hemorrhage
    - Distort normal adrenal contour, lobulated margins
    - Prolonged washout on CECT
      - » washout value <60% after 10-15 mins = met or other nonadenoma

Case 4: Adrenal metastases

What in the world does it look like:

- MRI
  - Without necrosis and hemorrhage
    - T1
      - » homogeneous and hypointense
    - T2
      - » Hyperintense (fluid content)
    - No signal loss on opposed phase GRE (unlike lipid-rich adenoma)
  - With necrosis and hemorrhage
    - T1 and T2
      - » Heterogeneous
  - Exception → Melanoma
    - T1
      - » Hyperintense (melanin and hemorrhage)
    - T2
      - » Typically hypointense, but occasionally remains hyperintense, mimicking pheos

Case 4– Adrenal Mets

What else do I need to know:

- Almost always clinically silent- so remember to look!
- Extensive masses → Addison's disease
  - When >90% tissue damaged
  - ↓cortisol, aldosterone, androgens, Na+ & Cl-
  - ↑K+ and ACTH
- Adrenal collision tumor = met + adenoma
- Adrenal gland:
  - Located bw T11-L2
  - Length may be up to 4cm
  - Width: <1cm (right thinner than left)

http://www.neurobodyfit.com/learn-about-cushings-syndrome/

Works consulted

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- Stat dx
- http://www.neurobodyfit.com/learn-about-cushings-syndrome/

Thank you

- Angela Giardino
- Jeffrey Craig
- John Phillips

The end