


The Society for Pediatric Radiology
58th Annual Meeting & Postgraduate Course

SPR 2015 POSTGRADUATE COURSE
Oncologic Imaging 2

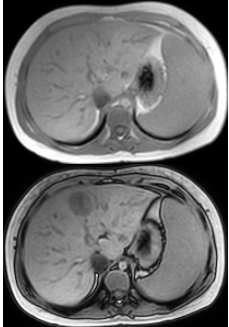
Provided for further study


Visualize the Future 

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What is the best description of the MRI technique shown?

A. Diffusion-weighted imaging
B. **Chemical shift imaging**
C. Hepatocyte specific contrast agent imaging
D. Susceptibility-weighted imaging




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What is the best description of the MRI technique shown?


- Option A is **NOT** correct. The MR images displayed are *not* diffusion-weighted.
- Option B is **CORRECT**. The MR images shown above are T1-weighted gradient recalled echo images that are in-phase (A) and out-of-phase (B), respectively. The lesion within the anterior liver loses signal on the out-of-phase image, suggesting the presence of lipid. Lipid-containing liver lesions are usually hepatocellular neoplasms, either adenomas or carcinomas.
- Option C is **NOT** correct. The images above show no evidence on hepatocyte specific contrast agent imaging. There is no liver parenchymal enhancement, and no excreted contrast material is present in the biliary system.
- Option D is **NOT** correct. There are no clinical applications for susceptibility-weighted imaging of the pediatric abdomen at this time. This MR technique is most commonly used to evaluate the

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What is the best description of the MRI technique shown?

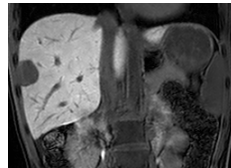
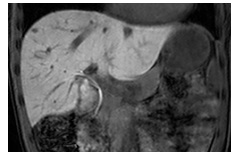
- Brateman L. Chemical shift imaging: a review. *AJR Am J Roentgenol.* 1986 May;146(5):971-80.
- Laumonier H, Bioulac-Sage P, Laurent C, Zucman-Rossi J, Balabaud C, Trillaud H. Hepatocellular adenomas: magnetic resonance imaging features as a function of molecular pathological classification. *Hepatology.* 2008 Sep;48(3):808-18.

Visualize the Future 



What contrast agent was used for the MRI exam in this teenage girl with hepatocellular adenoma?

- A. Dotarem (gadoterate meglumine)
- B. Eovist (gadoxetate disodium)**
- C. Ablavar (gadofosveset trisodium)
- D. Prohance (gadoteridol)
- E. Gadavist (gadobutrol)



Visualize the Future



What contrast agent was used for the MRI exam in this teenage girl with hepatocellular adenoma?

- Options A, C, D, and E are **NOT** correct. None of these contrast agents demonstrate hepatocyte uptake or biliary excretion. These contrast agents are exclusively excreted by the kidneys.
- Option B is **CORRECT**. The images provided show excreted contrast material in the biliary system typical of hepatocyte specific contrast agent excretion. A hypointense lesion in the right hepatic lobe is consistent with the biopsy result of hepatocellular adenoma.

Visualize the Future



What contrast agent was used for the MRI exam in this teenage girl with hepatocellular adenoma?

- 1. Meyers AB, Towbin AJ, Serai S, Geller JI, Podberesky DJ. Characterization of pediatric liver lesions with gadoxetate disodium. *Pediatr Radiol.* 2011 Sep;41(9):1183-97.

Visualize the Future



Which of the following is the **CORRECT** diagnosis in this 10-month-old with palpable abdominal mass?

- A. Lymphoma
- B. Nephrogenic rests
- C. Bilateral Wilms tumor
- D. Diffuse hyperplastic perilobar nephroblastomatosis (DHPLN)**



Visualize the Future





Which of the following is the **CORRECT** diagnosis in this 10-month-old with palpable abdominal mass?

- Option A is **NOT** correct: Though lymphoma can present with bilateral renal masses, these patients are typically older, have evidence of lymphadenopathy, and multiple renal masses. The young age of this patient, lack of retroperitoneal lymphadenopathy, and rind-like thickening of the renal cortex argues against the diagnosis of lymphoma
- Option B is **NOT** correct: Nephrogenic rests are foci of persistent embryonic metanephric tissue that persist beyond 36 weeks gestation. Nephrogenic rests can be single or multiple. These are precursor lesions for Wilms tumor and imaging differentiation between nephrogenic rests and Wilms tumor is challenging.
- Option C is **NOT** correct: Bilateral Wilms tumor is not correct. Even though the kidney is enlarged, the rind like expansion of the cortex with uniform attenuation supports the diagnosis of DHPLN rather than Wilms tumor. This imaging differentiation is important to avoid unnecessary surgical intervention (surgery or biopsy)
- Option D is **CORRECT**. DHPLN is characterized by massive enlargement of one or both kidneys with a rind-like expansion of the renal cortex by nephroblastic tissue and preservation of renal shape. These patients are at high risk of developing Wilms tumor and require more aggressive clinical management than children with multifocal nodular nephrogenic rests.

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Which of the following is the **CORRECT** diagnosis in this 10-month-old with palpable abdominal mass?

- Perlman EJ, Faria P, Soares A, Hoffer F, Sredni S, Ritchey M, Shamberger RC, Green D, Beckwith JB; National Wilms Tumor Study Group. Hyperplastic perilobar nephroblastomatosis: long-term survival of 52 patients. *Pediatr Blood Cancer*. 2006 Feb;46(2):203-21.

Visualize the Future



In the image shown below, which of the following imaging findings warrants chemotherapy prior to nephrectomy?

- Ascites indicative of tumor rupture
- Retroperitoneal lymphadenopathy
- Right atrial tumor thrombus**
- Large bulk of the renal tumor



Visualize the Future



In the image shown below, which of the following imaging findings warrants chemotherapy prior to nephrectomy?

- Option A is **NOT** correct. Though presence of ascites beyond cul-de-sac is an imaging indicator of pre-operative tumor rupture, the definitive diagnosis of tumor rupture implying stage III disease and hence need for abdominal radiation has to be made at the time of laparotomy. Tumor rupture is not an indication for secondary nephrectomy in the current COG trials.
- Option B is **NOT** correct. Though imaging has high specificity for detection of lymph node metastasis in Wilms tumor, the sensitivity is low. Definitive diagnosis of lymph node metastasis has to be made at pathological evaluation of surgically sampled lymph nodes. Bulky retroperitoneal lymphadenopathy is not a contraindication to primary nephrectomy in the current COG trials.
- Option C is **CORRECT**. Tumor thrombus extending above the hepatic veins is one of the few indications for pre-operative chemotherapy prior to nephrectomy in the current COG studies. This is due to high intra-operative morbidity caused by cavoatrial thrombus.
- Option D is **NOT** correct. Tumor size alone is not an indication for secondary nephrectomy. Surgical evaluation at initial presentation provides accurate information regarding staging and presence of anaplasia and is the preferred therapy approach in the current COG trials.

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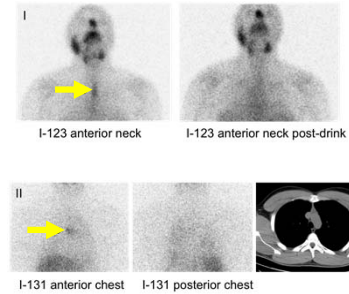
In the image shown below, which of the following imaging findings warrants chemotherapy prior to nephrectomy?

- Kaste SC, Dome JS, Babyn PS, Graf NM, Grundy P, Godzinski J, Levitt GA, Jenkinson H. Wilms tumour: prognostic factors, staging, therapy and late effects. *Pediatr Radiol.* 2008 Jan;38(1):2-17. Epub 2007 Nov 17.



In the above figures, the arrows **most likely** depict

- A. Pathologic activity in figure I, physiologic in figure II
- B. Physiologic activity in both figures I and II**
- C. Physiologic activity in figure I, pathologic in II
- D. Pathologic activity in both figures I and II
- E. Insufficient information to draw any conclusion



In the above figures, the arrows **most likely** depict

- Options A, C, D, and E are **NOT** correct. There are no findings that suggest that this uptake is pathologic.
- Option B is **CORRECT**.
 - In figure I, activity in the mid-chest that clears after drinking water represents swallowed salivary secretions within the esophagus.
 - In figure 2, the activity seen in the anterior mid-chest correlates with normal thymus gland on CT and represents physiologic thymic uptake. The mechanism is not entirely clear, but is likely related to uptake of iodine via thymic sodium-iodide symporter with iodine concentration in Hassall's bodies. Thymic uptake tends to become more evident on delayed imaging, with a therapeutic dose, in younger patients, and with less residual or metastatic thyroid tissues.



In the above figures, the arrows **most likely** depict

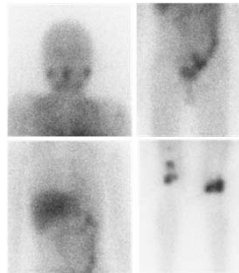
- Oh JR, Ahn BC. *Am J Nucl Med Mol Imaging.* False-positive uptake on radioiodine whole-body scintigraphy: physiologic and pathologic variants unrelated to thyroid cancer. 2012;2(3):362-85.
- Shapiro B, Rufini V, Jarwan A, Geatti O, Kearfott KJ, Fig LM, Kirkwood ID, Gross MD. Artifacts, anatomical and physiological variants, and unrelated diseases that might cause false-positive whole-body 131-I scans in patients with thyroid cancer. *Semin Nucl Med.* 2000 Apr;30(2):115-32.





What is the **major** mechanism of uptake of I-131 MIBG in neuroblastoma cells?

- A. **Specific active transport via norepinephrine transporter**
- B. Non-specific passive transport
- C. Retinoic acid receptor
- D. ALK tyrosine kinase receptor
- E. GD2 receptor



Post I-131 MIBG therapy scan



Visualize the Future



What is the **major** mechanism of uptake of I-131 MIBG in neuroblastoma cells?

- Option A is **CORRECT**. The majority of MIBG uptake in neuroblastoma cells is through active transport (Uptake-1) via norepinephrine transporter (NET), which is approximately 50 times more efficient than passive transport. 90% of neuroblastomas express NET.
- Option B is **NOT** correct. Norepinephrine is also taken into cells by passive, non-specific diffusion (Uptake-2) that is energy-independent, unsaturable, and results in low-level norepinephrine accumulation.
- Option C is **NOT** correct. Retinoic acid receptors mediate the differentiation and growth arrest effects of retinoic acid on neuroblastoma cells.
- Option D is **NOT** correct. Surface glycolipid molecule disialoganglioside (GD2) is the target receptor of GD-2 directed antibodies, which are investigational immunotherapy agents against neuroblastoma.
- Option E is **NOT** correct. ALK tyrosine kinase receptor is the target for investigational ALK inhibitors.



Visualize the Future



What is the **major** mechanism of uptake of I-131 MIBG in neuroblastoma cells?

- Dubois SG, Geier E, Batra V, Yee SW, Neuhaus J, Segal M et al. Evaluation of Norepinephrine Transporter Expression and Metaiodobenzylguanidine Avidity in Neuroblastoma: A Report from the Children's Oncology Group. Int J Mol Imaging. 2012;2012:250834.
- Streby KA1, Shah N, Ranalli MA, Kunkler A, Cripe TP. Nothing but NET: a review of norepinephrine transporter expression and efficacy of 131I-MIBG therapy. Pediatr Blood Cancer. 2015 Jan;62(1):5-11.
- Matthey KK1, George RE, Yu AL. Promising therapeutic targets in neuroblastoma. Clin Cancer Res. 2012 May 15;18(10):2740-53.



Visualize the Future



Contrast enhanced ultrasound is a valuable biomarker of tumor _____.

- A. Hypoxia
- B. Cell proliferation
- C. Apoptosis
- D. Metastasis
- E. **Angiogenesis**



Visualize the Future



Contrast enhanced ultrasound is a valuable biomarker of tumor _____.

- Option A is **NOT** correct. CEUS cannot measure tumor oxygen levels. Tumor hypoxia may be measured by BOLD MRI or PET imaging.
- Option B is **NOT** correct. CEUS does not detect cell proliferation. Tumor cell proliferation may be measured by diffusion weighted MRI or PET imaging.
- Option C is **NOT** correct. Apoptosis may be measured by diffusion weighted MRI or nuclear imaging, but not by CEUS.
- Option D is **NOT** correct. CEUS is not a good method of detecting tumor metastasis because it cannot be used as a screening tool. Tumor metastasis is assessed by whole body and cross-sectional imaging techniques.
- Option E is **CORRECT**. Because ultrasound contrast agents behave like red blood cells in the human circulation they are good surrogate markers of tumor blood flow and angiogenesis.

Visualize the Future



Contrast enhanced ultrasound is a valuable biomarker of tumor _____.

- Padhani AR, et al. Multiparametric imaging of tumor response to therapy. Radiol. 2010;256:348-364.
- Gwyther SJ, et al. How to assess anti-tumor efficacy by imaging techniques. Eur J Cancer. 2008;44:39-45
- Fass L. Imaging and cancer. Mol Oncol. 2008;2:115-152
- Marcus CD, et al. Imaging techniques to evaluate the response to treatment in oncology: Current standards and perspectives. Critical Reviews Oncol/Hematol. 2009;72:217-238.

Visualize the Future



Ultrasound contrast agents are good surrogate markers of tumor blood flow because:

- They diffuse across the vascular membrane.
- They adhere to the vascular endothelium.
- The microspheres approximate the size of a red blood cell and flow freely throughout the circulation.**
- They only flow into tumors.
- They are metabolized by tumor cells.

Visualize the Future



Ultrasound contrast agents are good surrogate markers of tumor blood flow because:

- Option A is **NOT** correct. Unlike CT and MR contrast agents which are composed of very small particles that diffuse freely across the vascular membrane, ultrasound contrast agents are composed of larger microspheres that cannot diffuse and, therefore, remain within the vascular space.
- Option B is **NOT** correct. The clinically available ultrasound contrast agents are not targeted agents and do not adhere to cells.
- Option C is **CORRECT**. Ultrasound contrast agents range in size from 2 to 4.5 microns which is about the size of a red blood cell. Ultrasound contrast agents will follow the same circulatory route as normal blood cells.
- Option D is **NOT** correct. Ultrasound contrast agents flow freely throughout the body, following the normal circulatory route of red blood cells.
- Option E is **NOT** correct. The outer shell of ultrasound contrast agents, whether a phospholipid or protein, is metabolized by normal metabolic routes, but not metabolized by tumor cells. The inner gas is then exhaled by the lungs.

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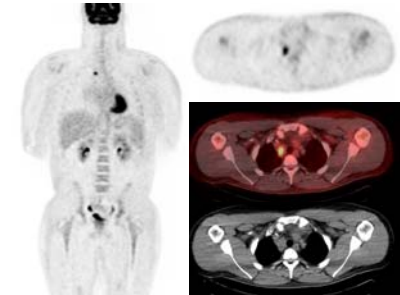
Ultrasound contrast agents are good surrogate markers of tumor blood flow because:

- Wilson SR, et al. Microbubble-enhanced US in body imaging: what role? Radiology. 2010;257:24-39.
- Burns PN, et al. Microbubble contrast for radiological imaging: 1. Principles. Ultrasound Q. 2006;22:5-13.
- McCarville MB, et al. Angiogenesis inhibitors in a murine neuroblastoma model: quantitative assessment of intratumoral blood flow with contrast-enhanced gray-scale US. Radiology. 2006;240:73-81
- Lamuraglia M, et al. Clinical relevance of contrast-enhanced ultrasound in monitoring anti-angiogenic therapy of cancer: current status and perspectives. Crit Rev Oncol Hematol. 2010;73:202-12.



An 18-year-old with Hodgkin lymphoma undergoes an FDG PET scan after initial chemotherapy. What Deauville score should be given?

- A. Deauville 1
- B. Deauville 2
- C. Deauville 3
- D. Deauville 4
- E. **Deauville 5**



An 18-year-old with Hodgkin lymphoma undergoes an FDG PET scan after initial chemotherapy. What Deauville score should be given?

Option E is **CORRECT**. On this scan, a focus of uptake is seen in the mediastinum with intensity markedly increased compared to liver, which would give a score of Deauville 5.

- Deauville 1 = no residual uptake above the background.
- Deauville 2 = residual uptake less than or equal to the mediastinum.
- Deauville 3 = residual uptake greater than mediastinum, but not greater than liver.
- Deauville 4 = residual uptake moderately increased compared with liver.
- Deauville 5 = residual uptake markedly increased compared with liver or new sites of disease.



An 18-year-old with Hodgkin lymphoma undergoes an FDG PET scan after initial chemotherapy. What Deauville score should be given?

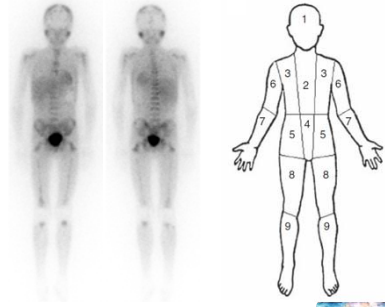
- Biggi A, et al. International Validation Study for Interim PET in ABVD-Treated, Advanced-Stage Hodgkin Lymphoma: Interpretation Criteria and Concordance Rate Among Reviewers. J Nucl Med. 2013;54:683-690.





A 13-year-old boy with neuroblastoma undergoes an I-123-MIBG scan after initial chemotherapy. What Curie score should be given?

- A. 30
- B. 21**
- C. 7
- D. 3
- E. 0



Visualize the Future



A 13-year-old boy with neuroblastoma undergoes an I-123-MIBG scan after initial chemotherapy. What Curie score should be given?

Option B is **CORRECT**.

- A score of 30 would require the presence of soft tissue disease and diffuse involvement of the entire skeleton. On the scan, no soft tissue disease is seen and a few areas of the skeleton are spared (most notably the forearms and distal legs).
- Scores of 7 and 3 would indicate less extensive skeletal involvement than seen on the scan.
- A score of 0 indicates a normal scan. The presence of skeletal uptake is NOT normal on an MIBG scan.

Visualize the Future



A 13-year-old boy with neuroblastoma undergoes an I-123-MIBG scan after initial chemotherapy. What Curie score should be given?

- Matthay KK, et al. Criteria for evaluation of disease extent by ¹²³I-metaiodobenzylguanidine scans in neuroblastoma: a report for the International Neuroblastoma Risk Group (INRG) Task Force. Br J Cancer. 2010;102:1319-26.

Visualize the Future



Based on RECIST 1.1 criteria, which of the following lesions would be an appropriate target lesion on CT?

- A. Low attenuation liver lesion measuring 0.8 cm in maximum diameter
- B. Lymph node in the right hilum measuring 1.3 cm in short axis diameter
- C. Subcarinal mass measuring 2.5 cm in maximum diameter**
- D. Lucent bone lesion, without a soft tissue component, measuring 1.9 cm in maximum diameter
- E. A right renal simple cyst measuring 3.2 cm in diameter

Visualize the Future





Based on RECIST 1.1 criteria, which of the following lesions would be an appropriate target lesion on CT?

- Option A is **NOT** correct. A target lesion must measure over 1 cm in diameter
- Option B is **NOT** correct. In order to be target lesions, lymph nodes, must measure over 1.5 cm in short axis diameter.
- Option C is **CORRECT**. A target lesion must be over 1 cm in diameter
- Option D is **NOT** correct. In order to be a target lesion, a bone lesion must have an identifiable soft tissue component
- Option E is **NOT** correct. Simple cysts cannot be included as target lesions because they are not a part of the malignant process.



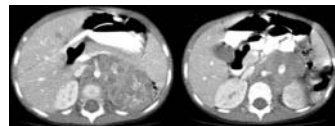
Based on RECIST 1.1 criteria, which of the following lesions would be an appropriate target lesion on CT?

- Eisenhauer EA, et al. New response evaluation criteria in solid tumors: Revised RECIST guideline (version 1.1). Eur J Cancer 2009;45: 228-247.



A 3-year-old girl is newly diagnosed with neuroblastoma. CT shows a large retroperitoneal mass encasing the aorta, the celiac axis, the root of the superior mesenteric artery, and the left renal artery. No distant metastatic disease is detected. Based on the International Neuroblastoma Risk Group staging system, what stage would this patient be assigned?

- A. L1
- B. L2
- C. M
- D. MS



A 3-year-old girl is newly diagnosed with neuroblastoma. CT shows a large retroperitoneal mass encasing the aorta, the celiac axis, the root of the superior mesenteric artery, and the left renal artery. No distant metastatic disease is detected. Based on the International Neuroblastoma Risk Group staging system, what stage would this patient be assigned?

- Option A is **NOT** correct. Encasement of the SMA and other vessels is an "Imaged Defined Risk Factor" which upstages the patient beyond L1 disease
- Option B is **CORRECT**. The disease is localized, and the vascular encasement is an IDRf which defines this as L2 disease
- Option C is **NOT** correct. Distant metastases are present in stage M disease
- Option D is **NOT** correct. Stage MS patients must be under 18 months of age and have metastatic disease limited to bone marrow, skin and liver





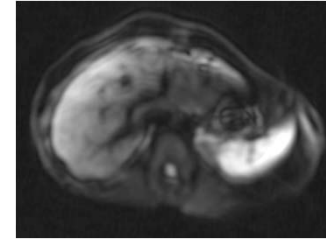
A 3-year-old girl is newly diagnosed with neuroblastoma. CT shows a large retroperitoneal mass encasing the aorta, the celiac axis, the root of the superior mesenteric artery, and the left renal artery. No distant metastatic disease is detected. Based on the International Neuroblastoma Risk Group staging system, what stage would this patient be assigned?

- Brisse HJ, et al. Guidelines for imaging and staging of neuroblastic tumors: Consensus report from the International Neuroblastoma Risk Group project. Radiology 2011;261:243-257.



What is the greatest source of artifact on this diffusion weighted image?

- A. Chemical shift
- B. Distortion**
- C. Fat suppression failure
- D. Aliasing
- E. Pin cushion



What is the greatest source of artifact on this diffusion weighted image?

- Option A is **NOT** correct. Chemical shift artifact is a spatial uniform shift.
- Option B is **CORRECT**. Distortion is a spatially varying shift. Note in the image the left side of the patient, particularly the left anterior abdominal wall is the most shifted.
- Option C is **NOT** correct. Fat suppression is actually quite good in this image.
- Option E is **NOT** correct. Aliasing is a wrap-around artifact from a field of view that is too small for the imaged anatomy. In this image, air is imaged all the way around the patient.
- Option E is **NOT** correct. Pin cushion is a geometric distortion that occurs in large field of view imaging and manifests most in the corners of the image.



What is the greatest source of artifact on this diffusion weighted image?

- Le Bihan D, et al. Artifacts and pitfalls in diffusion MRI. J Magn Reson Imaging. 2006;24:478-488.





Which of the following is directly measured in perfusion MRI:

- A. Pharmacokinetic parameters
- B. Contrast agent concentration
- C. MRI signal intensity**
- D. Tumor relaxation rates
- E. Blood flow



Which of the following is directly measured in perfusion MRI:

- Option A is **NOT** correct. Pharmacokinetic parameters are derived indirectly and are based on a number of assumptions, including a pharmacokinetic model.
- Option B is **NOT** correct. Contrast agent concentration is indirectly assessed through the MR signal and is based on an assumption of low contrast agent concentration
- Option C is **CORRECT**. MRI signal intensity is directly measured.
- Option D is **NOT** correct. Relaxation rates are not directly measured but inferred from changes to the MRI signal intensity.
- Option E is **NOT** correct. Blood flow is not directly measured, though a blood pool volume can be indirectly assessed.



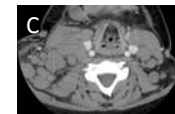
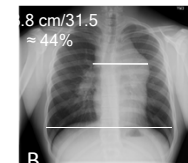
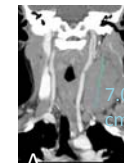
Which of the following is directly measured in perfusion MRI:

- Li SP, et al. Tumor response assessments with diffusion and perfusion MRI; J Magn Reson Imaging. 2012;35:745- 763.



With regard to the assessing disease bulk in Hodgkin Lymphoma, which of the following measurements **DOES NOT** qualify as bulky disease?

- A. Cranio/caudal measurement of cervical adenopathy = 7.0 cm
- B. Transthoracic ratio of greater than 1/3, measured on PA Upright Chest
- C. Conglomerate of small cervical lymph nodes**
- D. Mediastinal mass of 10 cm in transverse dimension





With regard to the assessing disease bulk in Hodgkin Lymphoma, which of the following measurements DOES NOT qualify as bulky disease?

- Options A, B, and D are **NOT** correct. All of these measurements fulfill criteria used by the Children's Oncology Group to establish bulk disease and are based on the Cotwold Modification of the Ann Arbor criteria. Note that the recent adult criteria established by the International Working Group use a CT measurement of 10 cm. The COG has modified this, and uses a measurement of > 6 cm account for the smaller volumes of bulky disease found in children, and allow craniocaudal measurements to be used.
- Option C is **CORRECT**. Small lymph node conglomerates do not meet the criteria for bulk disease.



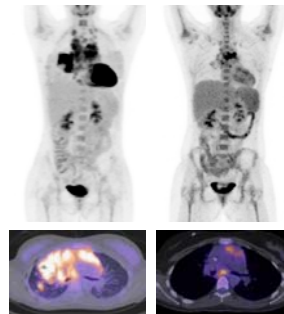
With regard to the assessing disease bulk in Hodgkin Lymphoma, which of the following measurements DOES NOT qualify as bulky disease?

- Lister TA, et al. Report of a committee convened to discuss the evaluation and staging of patients with Hodgkin's disease: Cotswolds meeting. J Clin Oncol. 1989;7:1630-1636.
- Cheson BD, et al. Recommendations for initial evaluation, staging, and response assessment of Hodgkin and non-Hodgkin lymphoma: the Lugano classification. J Clin Oncol. 2014;32:3059-3068.
- Cheson BD, et al. Revised response criteria for malignant lymphoma. J Clin Oncol. 2007;25:579-586.



Using the Deauville 5-point scale of response assessment in Hodgkin lymphoma, which of the options below best describes this patient's response:

- Deauville 2: \leq mediastinal blood pool
- Deauville 3: $>$ mediastinal blood pool but \leq liver
- Deauville 4: Moderate increase compared to liver**
- Deauville 5: $>$ 75% shrinkage of the mediastinal mass



Using the Deauville 5-point scale of response assessment in Hodgkin lymphoma, which of the options below best describes this patient's response?

- Answer C is **CORRECT**. Based on the criteria proposed at the 2009 Interim-PET workshop in Deauville, France a 5-point visual scale was proposed that incorporates the use of internal reference standards to aid in the semi-quantitative visual assessment of interim PET results. Using these criteria, only answer C is correct. The residual uptake shown is clearly greater than both mediastinal blood pool and liver, negating A and B. The image shown could be interpreted as either mild/moderate uptake over liver (Deauville 4) or significant uptake relative to liver (Deauville 5). However, in answer D the Deauville 5 choice refers to an anatomic measurement and % shrinkage, which is incorrect. The Deauville criteria refer only to post-therapy FDG-PET assessment.





Using the Deauville 5-point scale of response assessment in Hodgkin lymphoma, which of the options below best describes this patient's response?

- Cheson BD, et al. Recommendations for initial evaluation, staging, and response assessment of Hodgkin and non-Hodgkin lymphoma: the Lugano classification. *J Clin Oncol.* 2014;32:3059-3068.
- Meignan M, et al. Report on the third international workshop on interim positron emission tomography in lymphoma held in Menton, France, 26-27 September 2011 and Menton 2011 consensus. *Leuk Lymphoma.* 2012;53:1876-1881.

