PI-RADS v2: pros and cons

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This lecture will cover PI-RADS version 2, specifically some of the pros and cons of its use in clinical practice. Case examples will be presented to articulate some of the key benefits and possible limitations of this important scoring system for multiparametric prostate MRI.
Advances of CAD studies in prostate MRI

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Multiparametric MRI (mpMRI) has been considered as the method of choice for prostate cancer detection, staging, guidance for biopsy and treatment follow-up. However, effectiveness of mpMRI is usually affected by personal experience and expertise. Computer-aided diagnosis (CAD) system shows promise for improved prostate cancer diagnosis. This lecture aims to review the technique advance and effectiveness comparison of the state-of-the-art CADs for prostate cancer on mpMRI.
MC 02 GU-03 08:40
PI-RADS version 2: quantitative analysis helps reliable interpretation of diffusion-weighted imaging for prostate cancer
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PURPOSE: To analyze whether quantitative analysis of apparent diffusion coefficient (ADC) helps reliable interpretation of diffusion-weighted imaging (DWI) for prostate cancer (PCa).

MATERIALS AND METHODS: Consecutive 76 patients with PCa who underwent 3T DWI and surgery were included. Based on the location of an index tumor from surgical specimens, two readers performed DWI scoring of revised Prostate Imaging Reporting and Data System (PI-RADSv2) independently. Then, ADC ratio of benign prostatic tissue-to-cancer was measured in consensus. The ADC ratio was compared between agreement (e.g., score ≥ 4 for both readers) and disagreement groups (e.g., score ≥ 4 only for one reader). The cutoff and area under the curve (AUC) of ADC ratio were analyzed for DWI score ≥ 4.

RESULTS: The rate of inter-reader disagreement regarding DWI score ≥ 4 or not was 11.8% (9/76). The ADC ratio of benign prostatic tissue-to-cancer was measured in consensus. The ADC ratio was compared between agreement (e.g., score ≥ 4 for both readers) and disagreement groups (e.g., score ≥ 4 only for one reader). The cutoff and area under the curve (AUC) of ADC ratio were analyzed for DWI score ≥ 4.

CONCLUSION: The quantitative analysis of ADC ratio between benign prostatic tissue and PCa may be useful for reliable interpretation of DWI score ≥ 4 in PI-RADSv2.
sets of subtracted images of precontrast stage. Two radiologists assessed the probability of the prostate cancer in 4–1 minSUB images and scored 0–3 points (0, invisible; 1, indistinct; 2, fair; 3, excellent) based on the reference standard of T2WI, DWI/ADC maps and pathologic reports in consensus. One of reviewer drew region interest (ROI) in 4–1 minSUB images on the area regarded as the cancer according to the reference standard. With full data sets of DCE images, the time-concentration curve pattern of ROI, peak time, and slope of wash-in and wash-out was assessed in each patient. The visual assessment scores were compared among the three curve pattern groups (1, fast wash-in and wash-out; 2, wash-in and plateau; 3, continuous wash-in).

RESULTS: Prostate cancer was confirmed by prostatectomy in 10 patients, biopsy in 32, and TURP in 1. ROIs were drawn in 32 who showed the concordant findings to prostate cancer on the reference images. In 4–1 minSub image score assessment, there were 12 lesions with score 0, 5 with score 1, 9 with score 2, and 17 with score 3. In time-concentration curve pattern, group 1, 2, and 3 consisted of 26, 1, and 5 lesions, respectively. In the comparison between group 1 and group 2/3, 4–1 minSub image scores (2.4 vs. 1.0), peak time (1.4 min vs. 3.8 min), and slope of wash-in (28.8 vs. 9.3) and wash-out (−81.4 vs. 0.47) were significantly different (p < 0.05). 4–1 minSub image scores had strong negative correlation with curve pattern (rho = −0.538, p = 0.001).

CONCLUSION: 4–1 minSub images mirrored time-concentration curve patterns of DCE MR imaging in prostate cancer. It was a more simple method to display the DCE characteristics without any additional post-processing. Therefore, 4–1 minSub images can replace the curve pattern analysis.

CLINICAL RELEVANCE/APPLICATION: Subtraction images from 4 min to 1 min of DCE MR imaging can reduce the time consuming process of curve-pattern analysis.

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**MC 02 GU-06 09:10**

**PI-RADS version 2: preoperative role in the detection of normal-sized pelvic lymph node metastasis in prostate cancer**

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**PURPOSE:** To analyze whether Prostate Imaging Reporting and Data System version 2 (PI-RADSv2) can help diagnose normal-sized pelvic lymph node metastasis (PLNM) in prostate cancer (PCa).

**MATERIALS AND METHODS:** This retrospective study was approved by Institutional Review Board at our institution. A consecutive series of 221 patients who underwent magnetic resonance imaging and radical prostatectomy with pelvic lymph node dissection (PLND) for PCa were included. No patients had enlarged (≥ 0.8 cm in short-axis diameter) lymph nodes. Clinical parameters [prostate-specific antigen (PSA), greatest percentage of biopsy core, and percentage of positive cores] and PI-RADSv2 score from two independent readers were recorded. Logistic regression, receiver operating-characteristic curve and weighted kappa were used.

**RESULTS:** Normal-sized PLNM was found in 9.5% (21/221) of patients. The area under the curve of PI-RADSv2 for normal-sized PLNM was 0.788 (95% confidence interval [CI], 0.728–0.840) for reader 1 and 0.786 (95% CI, 0.726–0.839) for reader 2. In multivariate analysis, PI-RADSv2 (reader 1, OR = 18.465, p = 0.009; reader 2, OR = 4.406, p = 0.026) and PSA (reader 1, OR = 1.025, p = 0.008; reader 2, OR = 1.020, p = 0.037) were predictive of normal-sized PLNM. The threshold of PI-RADSv2 was a score of 5, where PI-RADSv2 was associated with high sensitivity (reader 1, 95.2%; reader 2, 90.5%) and negative predictive value (reader 1, 99.2%; reader 2, 98.6%) for normal-sized PLNM. The inter-reader agreement was excellent for PI-RADSv2 of 5 or not (weighted kappa = 0.804).

**CONCLUSION:** Analysis of PI-RADSv2 may be useful for assessing normal-sized PLNM in PCa.
Iodinated and Gadolinium-based contrast agents can induce hypersensitivity reactions, ranging from minor hives to severe anaphylactic shock leading to death. These reactions can have a true allergic (IgE mediated) mechanism or can be due to the chemotoxic effect of the molecule. The differential diagnosis between the two mechanisms is based on a triad:

1. Severity of the reaction: the more severe, the more chances to be allergic
2. Elevated plasma levels of Tryptase, indicating mastocyte activation
3. Positive skin tests for the culprit agent
Renal malignancies

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Highlights

• Both CT and MRI are useful for the work up of renal malignancies
• Many renal malignancies have typical imaging appearances

Outcomes/Objectives

Attendees will learn review the imaging appearances of many renal tumors and learn how to distinguish between them.

Introduction and Purpose

Both CT and MRI have been used for the evaluation of renal malignancies. Routine CT imaging to evaluate renal masses includes an unenhanced series to identify the presence of lipid, calcification and as a baseline for enhancement. Nephrographic phase is used to maximize renal mass detection and measure enhancement, and excretory phase is sued to identify collecting system abnormalities and surrounding anatomy. A renal MRI protocol includes T1 in and opposed phase for the detection of intravoxel lipids, T2 imaging for intrinsic T2 signal of the mass, axial diffusion weighted imaging and dynamic contrast enhanced T1 with fat suppression to identify macroscopic fat and tumor enhancement. Tumors can be characterized based on a number of features including shape, size, location, enhancement pattern, composition, signal intensity and vascular involvement.

Clear cell carcinomas (ccRCC) are the most common type of RCC, comprising 65–80% of all RCC. ccRCC behave more aggressively than other types of RCC and have a higher rate of metastasis at presentation. ccRCC may become large in size, have extensive necrosis and are known to invade venous structures. These tumors are cortically based, enhance avidly on both CT and MR. Up to 60% will demonstrate microscopic (intracellular) lipid detectable on chemical shift MR sequences. Papillary RCC (pRCC), 10–15% or RCC, are smaller tumors tend to present at a lower grade and earlier stage than ccRCC, and are known to metastasize via lymphatics. pRCC are homogenous, relatively hypovascular masses and may not enhance. On unenhanced CT these masses can appear hyperdense. On MRI, pRCC are isointense on T1, hypointense on T2 (due to the dense papillary architecture) and enhance less than the surrounding renal parenchyma. These lesions may contain hemosiderin and thus show signal loss that is more pronounced on the longer TE In phase images.

Chromophobe RCC (chrRCC), 4–11% of RCC, share a common cell line with oncocytomas. chrCC are typically well defined peripherally located tumors with a degree of enhancement between ccRCC and pRCC. They tend to be more homogenous appearing on CT but may be heterogeneous on MR.

Transitional cell carcinoma (TCC) arise from the transitional epithelium and are often multifocal. TCC can appear as an infiltrative reniform mass or urothelial thickening. On unenhanced CT, TCC is routinely higher in attenuation than the surrounding urine and similar or higher than the surrounding kidney. Enhancement of a filling defect is strongly suggestive of a TCC on CT. TCC show moderate early enhancement and appear hypovascular to the adjacent renal parenchyma. On MR these tumors are isointense on T1, and iso- to hypointense on T2. They may show marked restricted diffusion.

Renal lymphoma may be due to hematogenous dissemination or contiguous extension of retroperitoneal disease. The most common appearance is one or more homogenous masses showing low-level enhancement. Infiltrative masses are less common. On MR, renal lymphoma is iso- or hypointense on T1, hyointense on
T2 and show little enhancement.

References


MR imaging techniques and features of ovarian cancer

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MR imaging techniques and features of ovarian cancer

Imaging techniques of ovarian cancer
Conventional MR imaging: T1-weighted, T2-weighted, and fat-suppressed T1-weighted images, these conventional sequences can evaluate predominantly anatomic information from the signal characteristics of the adnexal mass.

Contrast-enhanced MR imaging: Fat-suppressed T1WI obtained pre and post administration of contrast material enable exhibit enhancing solid components, which help differentiate benign and malignant lesions in axial.

Dynamic contrast-enhanced MR imaging: The malignant ovarian masses show obvious early enhancement, which less than one minutes of injection, this enhancing pattern is more frequently on multiphase dynamic contrast-enhanced MR images compare with benign lesions.

Diffusion-weighted imaging: DWI may describe changes in signal intensity and provide information on vascularity and perfusion of lesion in different phases.

MR sequence evaluation of ovarian cancer
Axial and sagittal T2WI can depict anatomy and provide the origin information of the lesion.

Intralesional High signal indicates fat, blood, or proteinaceous or mucinous content in axial T1WI sequence.

Intralesional loss of signal intensity, which shows high signal on T1-weighted images, indicates fat content in T1-weighted fat-saturated sequence.

Early enhancing characteristics help differentiate benign and malignant lesions in axial T1-weighted fat-saturated dynamic contrast-enhanced sequence.

Solid portions with hyperintense signal on diffusion-weighted images (b=1000 sec/mm²), and intermediate signal intensity on T2-weighted images are likely malignant.

Imaging features of malignant ovarian tumors
Ovarian tumors are classified as epithelial tumors, germ cell tumors, sex cord-stromal cell tumors, and metastatic tumors on the basis of tumor origin. Malignant subtypes of epithelial tumors include serous cystadenocarcinoma, mucinous cystadenocarcinoma, clear cell carcinoma and endometrioid carcinoma.

Serous cystadenocarcinoma
The typical MR imaging appearance of serous cystadenocarcinoma is as a cystic and solid mass. Axial T1-weighted image shows hypointense/isointense signal, and axial T2-weighted image shows hyperintense/isointense signal. Contrast-enhanced fat-suppressed T1-weighted image shows heterogeneous enhancement. There is no sign of papillary projections of the tumor is the typical appearance of a serous adenocarcinoma.

Mucinous cystadenocarcinoma
Mucinous cystadenocarcinoma are seen usually as a large cystic and solid mass. Axial T1-weighted image shows hypointense/hyperintense signal, and axial T2-weighted image shows hyperintense/hypointense signal, contrast-enhanced fat-suppressed T1-weighted image shows heterogeneous enhancement. There is no sign of papillary projections.

Clear cell carcinoma
The typical MR imaging appearance of clear cell carcinoma is as a cystic ovarian mass with the margin being generally smooth. Solid protrusions are often both round and few in number. Axial T1-weighted image shows complex signal, which can vary from low to very high (often dependent on hemorrhagic component.)
Ovarian Endometrioid carcinoma
Imaging findings are nonspecific and include a large, complex cystic mass with solid components. Endometrial thickening can also be seen on imaging studies, T2WI exhibits relatively low signal intensity of the tumor wall. A shading sign also may be seen, which are hyperintense signal on T1WI, and hypointense signal on T2WI affecting because of variable portions of the cyst. Contrast-enhanced fat-suppressed T1-weighted image shows mild enhancement of the solid components.

Malignant subtypes of germ cell tumors
Malignant germ cell tumors include immature ovarian teratoma and dysgerminoma. They are generally large and nonspecific with a complex imaging, but predominantly solid appearance.

Immature ovarian teratoma
MR imaging of immature teratomas show a predominantly solid lesion with fatty elements, irregular calcifications, and numerous cysts with different sizes. Because cystic components may contain serous, mucinous, fatty sebaceous material or hemorrhage, so the lesion exhibits a wide variety of signal intensities at T2-weighted MR imaging.

Dysgerminoma
Dysgerminomas are characteristically purely solid. Dysgerminomas have low signal intensity relative to muscle on T1WI and are isointense or slightly hyperintense on T2WI. Usually, imaging features of septa are hypo-isointense on T2WI and are difficult to appreciate on T1WI, with obvious enhancement after administration of contrast material.

Malignant subtypes of sex cord-stromal tumors
Subtypes of Sex cord-stromal tumors include granulosa-stromal cell tumors and sertoli-stromal tumors. The granulosa cell tumor of the ovary is the most common malignant sex cord-stromal tumor.

Granulosa cell tumors
The MR imaging features varies widely: such as a solid mass, a multiloculated solid and cystic mass, or a purely cystic lesion. The signal of the lesion shows heterogeneous both on T1-weighted and T2-weighted images, this is caused by intratumoral bleeding, infarct, fibrous degeneration, and irregularly arranged tumor cells.

Metastatic ovarian tumors
In ovarian metastasis, the most common primary tumors include stomach and colon. The MR imaging features include signal of soft tissue with areas of cystic necrosis. T1-weighted image shows isointense to hypointense signal. T2-weighted image shows heterogeneous signal of solid component with hyperintensity of cystic component. Contrast-enhanced fat-suppressed T1-weighted image demonstrates inhomogeneous enhancement of solid components. Krukenberg tumor exhibits some characteristic features, such as bilateral complex lesions with hypointense signal solid components and internal hyperintense signal on T1-weighted and T2-weighted images.
Many treatment options are available to patients with newly diagnosed endometrial, cervical, or ovarian cancer. MR imaging plays an important role in the patient's journey from the initial evaluation of disease extent to treatment selection and follow-up.

In patients with endometrial carcinoma, MR imaging can provide added value as a local staging tool by allowing accurate assessment of the depth of myometrial invasion and cervical stromal invasion, which in turn correlate with likelihood of lymph node metastases and overall patient survival; hence, in combination with tumor histology and grade, MR imaging aids the patient's preoperative risk stratification and ultimately guides presurgical treatment planning.

Whenever possible, tumor grade and histology should be considered before reporting an MR imaging case of endometrial carcinoma: Grade 3 endometrioid adenocarcinomas and serous papillary and clear cell carcinomas demonstrate more aggressive biologic behavior and, therefore, have a 50% pretest probability of advanced disease and/or peritoneal spread at the time of presentation.

In patients with cervical cancer, MR is the best single imaging method for determining tumor location and size, involvement of parametria, pelvic side wall, adjacent organs, or nodal enlargement, and the high negative predictive value of MR imaging in excluding parametrial invasion is important for selecting patients for radical surgery.

In young women with small invasive cervical cancer who wish to preserve fertility, in whom a more conservative surgical procedure can be performed, MR imaging is the best method for determining eligibility in terms of tumor size, cervical length, and distance of tumor from the internal cervical os.

In patients with ovarian cancer, the extent and location of peritoneal spread dictates the choice between cytoreductive primary surgery versus neoadjuvant chemotherapy; therefore, accurate mapping of the disease with imaging plays a crucial role in treatment selection and directly influences patient outcome.

Advances in MR imaging techniques, along with the growing role of the radiologist as part of a multidisciplinary treatment-planning team, have become central in tailoring treatment options and frequently lead to modifications in the therapeutic approach in patients with gynecologic malignancies.

References
Update in urologic & gynecologic imaging

Chairperson(s)
Eun Ju Lee  Ajou University Hospital, Korea
Hae Jeong Jeon  Konkuk University Medical Center, Korea

MC 02 GU-11  10:40
Measurement of renal perfusion using arterial spin labeling magnetic resonance imaging in healthy volunteers: feasibility, reproducibility and variation
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¹Dong-A University Hospital, ²Asan Medical Center, Korea.
jedidw@naver.com

PURPOSE: This study evaluated the feasibility, reproducibility and variation of renal perfusion and arterial transit time (ATT) using pseudo-continuous arterial spin labelling magnetic resonance imaging (PCASL MRI) in healthy volunteers.

MATERIALS AND METHODS: PCASL MRI was performed in 28 healthy volunteers on two different occasions using a 3 T MRI scanner with 2D spin echo EPI sequence with background suppression. Serum creatinine and estimated glomerular filtration rate (eGFR) were measured prior to MRI scanning. Four different post-labeling-delay points (0.5, 1.0, 1.5, 2.0 sec) were used for calculating ATT and ATT corrected renal blood flow (ATT-cRBF). ATT and ATT-cRBF were calculated and evaluated for each kidney and subject. The intra-class correlation (ICC) and Bland-Altman plot were used to assess reproducibility of PCASL MRI technique.

RESULTS: 26 subjects yielded 52 kidneys, with a mean age of 38.6 ± 9.8 years, eGFR of 89.1 ± 21.2 ml/min/1.73 m². Two subjects failed in ASL MRI examination. Mean cortical and medullary ATT-cRBF for subject were 215 ± 65 and 81 ± 21 ml/min/100g, respectively. Mean cortical and medullary ATT for subject were 1141 ± 262 and 1123 ± 245 ms, respectively. The ICC for cortical ATT-cRBF was 0.92 and the within subject coefficient of variance was 14.4%. The ICC for medullary RBF, cortical and medullary ATT were poor. Bland-Altman plot for cortical RBF showed good agreement between two measurements.

CONCLUSION: PCASL MRI is a repeatable method of measuring renal cortical perfusion in healthy subjects. In contrast, ATT for renal cortex and medulla had poor reproducibility and large variation.

MC 02 GU-12  10:50
Monoeexponential, biexponential, and stretched exponential DWI models: viable quantitative biomarkers for differentiating renal clear cell carcinoma and minimal fat angiomyolipoma
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PURPOSE: To qualitatively compare and evaluate the potential of various diffusion parameters obtained from monoeexponential, biexponential, and stretched exponential diffusion-weighted imaging models in differentiating between minimal fat angiomyolipoma (MFAML) and clear cell renal cell carcinoma (ccRCC).

MATERIALS AND METHODS: The Institutional Review Board approved this retrospective study and waived the informed consent requirement. Multi-b values DWI (0-1700 sec/mm²) imaging were performed in 131 patients with either pathologic analysis-confirmed MFAML (n = 27) or ccRCC (n = 104) by using 3-T MRI. An isotropic apparent diffusion coefficient (ADC) was calculated from diffusion weighted images by using a monoeexponential model. A pseudo-ADC (ADCfast), true ADC (ADCslow), and perfusion fraction (f) were calculated from diffusion weighted images by using a biexponential model. A water molecular diffusion heterogeneity index (α) and distributed diffusion coefficient (DDC) were calculated from diffusion-weighted images by using a stretched exponential model. All parameters were compared between MFAML and ccRCC by using the Student’s t test. Receiver operating characteristic and intraclass correlation coefficient analysis were used for statistical evaluations.

RESULTS: ADC, ADCslow, α values were significantly lower in the MFAML group than in the ccRCC group (p < 0.001). ADCfast, f, DDC values were slightly higher in the MFAML group than in the ccRCC group, however, the difference was not significant (p > 0.05). The AUC values for both α (0.953) and ADCslow (0.964) were significantly greater than those for ADC (0860), ADCfast (0.605), f (0.596), and DDC (0.477) in the differentiation of MFAML from ccRCC.

CONCLUSION: Multi-b values DWI are feasible and useful in the noninvasive tissue characterization of renal tumors. Water molecular diffusion heterogeneity index (α) and ADCslow may provide additional information and could lead to improved differentiation with better sensitivity and specificity between MFAML and ccRCC compared with conventional diffusion parameters.
Fig. 1. Images obtained in a 49-year-old man with clear cell renal cell carcinoma (Fuhrman II). A. T1-weighted and B, T2-weighted MR images show that the tumor is hypointense. C. The ADC map and D, the ADCslow map show decreased ADC values. E. The ADCfast and F, f map show slightly increased values. G. The DDC map show no increased values. H. The α map show slightly increased values.

Fig. 2. Images obtained in a 42-year-old man with minimal fat angiomyolipoma. A. T1-weighted and B, T2-weighted MR images show that the tumor is hypointense. C. The ADC map and D, the ADCslow map show decreased ADC values. E. The ADCfast and F, f map show slightly increased values. G. The DDC map show slightly decreased values. H. The α map show decreased values.

Table 1. Differences in the imaging Parameters in Patients with ccRCC and those with MFAML.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ccRCC Mean±SD</th>
<th>MFAML Mean±SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC(×10^-3 mm^2/s)</td>
<td>1.32±0.21</td>
<td>1.02±0.19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ADCslow(×10^-3 mm^2/s)</td>
<td>0.98±0.21</td>
<td>0.56±0.09</td>
<td>&lt;0.001</td>
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<tr>
<td>ADCfast(×10^-3 mm^2/s)</td>
<td>43.16±40.94</td>
<td>56.90±65.95</td>
<td>.136</td>
</tr>
<tr>
<td>f</td>
<td>0.37±0.08</td>
<td>0.40±0.10</td>
<td>.090</td>
</tr>
<tr>
<td>DDC(×10^-3 mm^2/s)</td>
<td>2.13±1.07</td>
<td>2.30±1.40</td>
<td>.424</td>
</tr>
<tr>
<td>α</td>
<td>0.67±0.11</td>
<td>0.43±0.09</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 2. Diagnostic Performance of Diffusion Parameters ADC, ADCslow, ADCfast, f, DDC, α for Differentiation of MFAML from ccRCC.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AUC value</th>
<th>cutoff value</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Youden index</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC</td>
<td>0.860(0.735, 0.925)</td>
<td>1.16</td>
<td>79.0</td>
<td>81.6</td>
<td>0.606</td>
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<td>ADCslow</td>
<td>0.964(0.934, 0.994)</td>
<td>0.68</td>
<td>95.2</td>
<td>94.7</td>
<td>0.899</td>
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<tr>
<td>ADCfast</td>
<td>0.605(0.501, 0.708)</td>
<td>24.5</td>
<td>78.9</td>
<td>48.6</td>
<td>0.275</td>
</tr>
</tbody>
</table>

MC 02 GU-13 11:00
Long-term prognosis of invisible endometrial cancer on MR imaging
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PURPOSE: To retrospectively evaluate the long-term outcomes of patients with invisible endometrial cancer on magnetic resonance imaging (MRI).

MATERIALS AND METHODS: Between February 1995 and December 2011, we reviewed the medical records of 433 patients with endometrial cancer, which was staged IA on MRI. Of these patients, 89 had MRI-invisible cancer and 344 had MRI-visible cancer. Both cancers were treated with simple hysterectomy with or without lymph node dissection according to the surgeon’s decision. Both cancers were compared regarding pathologic findings, recurrence rates, and survival rates.

RESULTS: The median sizes of MRI-invisible and MRI-visible cancers were 4 mm (0 to 40 mm) and 20 mm (0 to 89 mm), respectively (p < 0.001). Myometrial invasion of these groups were detected in 20.2% (18/89) and 56.7% (195/344), respectively (p < 0.001). Lymphadenectomy and follow-up imaging revealed no lymph node metastasis in patients with MRI-invisible cancers, while those revealed in 4.7% (16/344) of patients with MRI-visible cancers (p = 0.052). The recurrence rates of MRI-invisible and MRI-visible cancers were 1.1% (1/89) and 7.8% (27/344), respectively (p = 0.026). The recurrence-free survival rates of these groups were 98.9% (88/89) and 91.6% (315/344), respectively (p = 0.022).

CONCLUSION: MRI-invisible endometrial cancer can be treated with less invasive surgery because of its lower tumor burden and better prognosis. This cancer may not require lymphadenectomy because of no metastasis or recurrence in lymph nodes.
Preoperative prediction for evaluation of suboptimal resection in advanced ovarian cancer based on clinical and CT parameters

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PURPOSE: We determine the prediction of suboptimal resection (SOR) in patients with advanced ovarian cancer based on clinical and CT parameters.

MATERIALS AND METHODS: Between 2007 and 2015, 327 consecutive patients with FIGO stage III–IV ovarian cancer and preoperative CT were enrolled. Patients who were diagnosed during 2007–2012 were assigned to a derivation dataset (n = 220) and the others were assigned to a validation dataset (n = 107). Clinical parameters were reviewed, and two radiologists assessed the presence or absence of disease at tabulated parameters on CT images. Logistic regression analyses based on the area under the receiver-operating characteristic curve (AUROC) were performed to identify variables predicting suboptimal resection (SOR), and generated simple score using Cox proportional hazards model.

RESULTS: Logistic regression identified that ECOG-PS 2, peritoneal involvement, bowel mesentery involvement, diaphragmatic involvement, suprarenal lymph node and pleural effusion were independent variables of SOR. With the exception of the residual disease (p = 0.001), there was no statistical difference in both datasets in keeping with improved optimal resection rates from 45.0% (99/220) in the derivation dataset to 64.4% (69/107) in the validation dataset. Overall AUROC for score predicting SOR was 0.761 with sensitivity, specificity, and positive and negative predictive values of 70.6%, 73.2%, 68.7%, 91.9%. In the derivation dataset, AUROC was 0.792, with a sensitivity of 71.4% and specificity of 74.3%, and AUROC of 0.758 with a sensitivity of 69.2% and specificity of 72.8% in the validation dataset.

CONCLUSION: CT may be a useful adjunct for preoperative prediction of SOR in patients with advanced ovarian cancer.

Assessment of clinical and radiologic differences between small and large adrenal pheochromocytomas

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PURPOSE: To evaluate differences in clinical and radiologic features of small and large pheochromocytomas.

MATERIALS AND METHODS: This study included 39 patients with surgically confirmed adrenal pheochromocytoma. Computed tomography (CT) examinations were performed using an adrenal protocol. Ten patients with adrenal pheochromocytoma of less than 3 cm constituted group A. The remaining 29 patients with adrenal pheochromocytomas of more than 3 cm constituted group B. Several clinical and radiologic features, including incidentaloma, hyperadrenergic symptoms, biochemical test results, radioisotope (RI) uptake, adrenal mass attenuation, and washout value, were statistically analyzed and compared between the groups.

RESULTS: No significant differences were found in clinical features between groups A and B. Group A had more relatively homogeneous masses than group B (6 [60%] in group A vs. 9 [31%] in group B; p = 0.141). The number of radioisotope-positive pheochromocytomas did not differ significantly between the groups.

CONCLUSION: Pheochromocytomas tend to have different CT imaging features mimicking other tumors according to the size of the tumors. Clinical features and RI study that are not different between small and large pheochromocytomas should be considered to diagnosis adrenal tumor accurately.
SS 05 GU-03 09:50
Correlation of CT imaging features and tumor size with Fuhrman grade of clear cell renal cell carcinoma
Saelin Oh, Deuk Jae Sung, Ki Choon Sim, Na Yeon Han, Beom Jin Park, Min Ju Kim, Sung Bum Cho
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BACKGROUND: Identification of clinical features to determine the aggressive potential of tumors is highly warranted to stratify patients for adequate treatment. CT imaging features of clear cell renal cell carcinoma (ccRCC) may contribute to personalized risk assessment.

PURPOSE: To assess the correlation between CT imaging features and Fuhrman grade of ccRCC, and to identify the predictors of high Fuhrman grade in conjunction with tumor size.

MATERIALS AND METHODS: CT scans of 169 patients with 173 pathologically proven ccRCCs were retrospectively reviewed in consensus by two radiologists for the presence of intratumoral necrosis and intratumoral cyst, and tumor size. Histologic grade was classified as either low (Fuhrman grade I or II) or high (Fuhrman grade III or IV). Statistical significance was evaluated by using univariate, multivariate regression, receiver-operating characteristic (ROC) curve, and Spearman correlation analyses.

RESULTS: On CT, 20 of the 173 tumors had intratumoral cysts, 60 had intratumoral necrosis, and 93 showed entirely solid tumor. The odds of high grade were higher with intratumoral necrosis and entirely solid tumor than with intratumoral cyst (p < 0.03). Intratumoral necrosis showed a significantly high odds ratio of 25.73 for high Fuhrman grade. The ROC curve showed a threshold tumor size of 36 mm to predict high Fuhrman grade for overall tumors (area under the ROC curve, 0.70). In ccRCCs with intratumoral necrosis or cyst, tumor size did not significantly correlate with Fuhrman grade.

CONCLUSION: Intratumoral necrosis on CT was a strong and independent predictor of biologically aggressive ccRCCs, irrespective of tumor size.

SS 05 GU-04 10:00
“Bubble over sign” on CT helps differentiate fat-poor angiomyolipoma from renal cell carcinoma: retrospective analysis of consecutive 602 subjects
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PURPOSE: To assess whether morphologic analysis using computed tomography (CT) can help differentiate fat-poor angiomyolipoma (AML) from renal cell carcinoma (RCC).

MATERIALS AND METHODS: Consecutive 602 patients with a histologically confirmed fat-poor AML (n = 49) or renal cell carcinoma (n = 553) were found between January 2006 and May 2015. Lesion size was less than 4cm on contrast-enhanced CT. For morphologic analysis, the bubble over sign and angular interface were evaluated. The bubble over sign was defined when the length of contact between bulging out portion of a mass and adjacent renal capsule is 3 mm or greater. The angular interface was defined when the angle of parenchymal portion of a mass is 90° or less. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were assessed. Logistic regression was conducted to determine which variable is predictive of fat-poor AML.

RESULTS: For the diagnosis of fat-poor AML, sensitivity, specificity, PPV, NPV, accuracy, and AUC were 61.2% (30/49), 97.1% (537/553), 65.2% (30/46), 96.5% (537/556), and 94.2% (567/602) with bubble over sign, while they were 55.1% (27/49), 81.9% (453/553), 21.3% (27/127), 95.3% (453/475), and 79.7% (480/602) with angular interface, respectively. Both CT variables were predictive of fat-poor AML (bubble over sign, odds ratio = 39.632, p < 0.001; angular interface, odds ratio = 2.703, p = 0.010).

CONCLUSION: Angular interface on CT may be seen in some RCCs (18.1% in our study), resulting in low PPV for fat-poor AML. The morphologic analysis of bulging out portion may help the differentiation.
To investigate the application value in renal malignant tumors and minimal fat angiomyolipoma using stretched exponential model

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PURPOSE: To investigate and determine the utility of stretched exponential diffusion model in characterization of the water diffusion heterogeneity in renal malignant tumors and minimal fat angiomyolipoma (MFAML).

MATERIALS AND METHODS: 96 patients with renal tumors, a total of 103 lesions (79 malignant renal tumors, 24 MFAML) underwent 3.0T MRI scan using 12 b values (b = 0–1700 s / mm²). Respective stretched exponential parameters (DDC, distributed diffusion coefficient; and alpha (α), water heterogeneity) were calculated. The DDC (both in 10⁻³ mm²/s) and a (range, 0–1) values were compared between renal malignant tumors and minimal fat angiomyolipoma using independent sample t-test and for determination of the predictive powers of DDC and α using ROC curve analyses.

RESULTS: The mean ± standard deviation values were DDC = 1.52 ± 0.57 (×10⁻³ mm²/s) for renal malignant tumor versus 3.12 ± 1.59 (×10⁻³ mm²/s) for MFAML; α = 0.72 ± 0.08 for renal malignant tumor versus 0.38 ± 0.08 for MFAML. α was significantly lower in the MFAML group while DDC values were on the opposite. DDC and α were both reliable independent predictors, with α (0.994, area under curve) being more powerful. Optimal cut-off values were (sensitivity, specificity) DDC = 0.692 × 10⁻³ mm²/s (62.5%, 94.9%), α = 0.55 (98.7%, 95.8%).

CONCLUSION: The stretched exponential model DWI can provide more parameters in characterization of renal tumors and the heterogeneity index α is robust and can potentially help in distinguishing MFAML from renal malignant tumors.

Small solid renal mass (< 4 cm) without gross fat: CT criteria for achieving high positive predictive value for renal cell carcinoma

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PURPOSE: To establish computed tomography (CT) criteria for achieving high positive predictive value (PPV) for renal cell carcinoma (RCC) in patients with a small solid renal mass less than 4cm (SSRM) without gross fat.

MATERIALS AND METHODS: Consecutive 108 patients (age, 53.2 ± 12.0 years) with SSRM without gross fat (size, 2.5 ± 0.8 cm) and three-phase CT, which consisted of unenhanced, corticomedullary (CMP), and nephrographic phases (NP), were evaluated. SSRMs were pathologically proven as 95 RCCs and 13 non-RCCs (surgery, n = 107; biopsy, n = 1). The ‘persistent-low sign’ was defined when a focal area of low density is seen at the same location within the lesion on both CMP and NP. The lesion attenuation (lower; iso; and higher compared with that of renal parenchyma on unenhanced image), shape (round; lobulated; and infiltrative), and calcification were also analyzed by two independent readers. The PPV and inter-reader agreement using weighted kappa were assessed.

RESULTS: The PPV of CT criteria (a, positive calcification OR b, persistent-low sign, lower-to-iso attenuation on unenhanced image, and round shape) was 97.8% (45/46) with reader 1 and 100% (41/41) with reader 2 for the diagnosis of RCC. The weighted kappa regarding inter-reader agreement was 1.000 for calcification, 0.951 for low-to-iso attenuation, 0.915 for round shape, 0.797 for persistent-low sign, and 0.827 for CT criteria.

CONCLUSION: The interpretation of three-phase CT may allow excellent PPV for diagnosis of RCC. The CT criteria of this study may help reduce therapeutic process, as omitting unnecessary biopsy in patients with SSRM without gross fat.
SS 05 GU-07 10:30
CT-guided radiofrequency ablation of T1a renal cell carcinoma in Korea: mid-term outcomes
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PURPOSE: To evaluate the mid-term outcomes of percutaneous radiofrequency ablation (RFA) treatment in patients with small (< 4 cm) renal cell carcinoma (RCC) in Korea.

MATERIALS AND METHODS: Between 2010 and 2015, 51 patients (M:F = 40:11; median age, 57 years) with biopsy-proven 51 RCC were treated using CT-guided RFA. All patients were clinically staged T1aN0M0 prior to RFA. The median tumor size and follow-up period were 2.1 cm (range, 1.0–3.9 cm) and 26 months (4–60 months), respectively. Local tumor progression, distant metastasis, primary and secondary effectiveness rates, and major complication rates were recorded. Estimated glomerular filtration rates (GFRs) between pre-RFA and last follow-up were compared using paired t-tests. The 2-year recurrence-free survival rate was calculated using Kaplan-Meier survival analysis.

RESULTS: Of the 51 patients, two (3.9%) experienced local tumor progression, and one (2.0%) had lymph node metastasis after the first RFA session. Primary and secondary effectiveness rates were 96.1% (49/51) and 100% (1/1), respectively. Only one patient experienced a major complication (uretero-pelvic stricture) after the second RFA session for treating a local tumor progression, and the major complication rate was 1.9% (1/52). The median pre-RFA and last follow-up GFRs were 87.1 mL/min/1.73 m² (14.2–142.7 mL/min/1.73 m²) and 72.0 mL/min/1.73 m² (7.2–112.6 mL/min/1.73 m²), respectively (p < 0.0001). The 2-year recurrence-free survival rate was 96.0%.

CONCLUSION: CT-guided RFA is a safe and effective treatment in Korean patients with T1a RCC because of excellent mid-term outcomes.

SS 05 GU-08 10:40
Noncontrast MR imaging for bladder cancer: fused high-b-value diffusion-weighted imaging and T2-weighted imaging helps evaluate depth of invasion
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PURPOSE: To investigate utility of noncontrast magnetic resonance (MR) imaging including fused high-b-value diffusion-weighted imaging (DWI) and T2-weighted imaging (T2WI) to evaluate the depth of invasion in bladder cancer.

MATERIALS AND METHODS: Consecutive 62 patients with surgically confirmed urothelial carcinoma in the urinary bladder were included. The patients underwent preoperative 3T magnetic resonance imaging (MRI). An experienced genitourinary radiologist analyzed the depth of invasion (e.g., T-stage, < 2 vs. ≥ 2) by using T2WI, DWI, both T2WI and DWI, and fused DWI and T2WI (fusion MR), respectively. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were investigated. The area under the curve (AUC) was analyzed for the identification of T-stage of 2 or greater.

RESULTS: The rate of patients with surgically confirmed T-stage of 2 or greater were 41.9% (26/62). The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were 50.0%, 55.6%, 44.8%, 60.6%, and 53.2% with T2WI, 57.7%, 77.8%, 65.2%, 71.8%, and 69.4% with DWI, 65.4%, 80.6%, 76.3%, 80.6%, and 74.2% with both T2WI and DWI, and 80.8%, 77.8%, 72.4%, 84.8%, and 79.0% with fusion MR, respectively. The AUC was 0.528 with T2WI, 0.677 with DWI, 0.730 with both T2WI and DWI, and 0.790 with fusion MR for the identification of T-stage of 2 or greater.

CONCLUSION: Fused high-b-value DWI and T2WI may be a promising noncontrast MR technique to assess the depth of invasion in bladder cancer.
PURPOSE: To evaluate the determinant pretreatment CT findings that can predict surgical intervention for patients suffering from corpus luteal cyst rupture with hemoperitoneum.

MATERIALS AND METHODS: From January 2009 to December 2014, a total of 106 female patients who visited the emergency room of our institute for acute abdominal pain and were subsequently diagnosed with ruptured corpus luteal cyst with hemoperitoneum were included in our retrospective study. The analysis of CT findings included cyst size, cyst shape, sentinel clot sign, ring of fire sign, depth of hemoperitoneum, active bleeding in the portal phase and attenuation of hemoperitoneum. The comparison of CT findings between the surgery and conservative management groups was performed with the Mann-Whitney U test or Chi-square test, and logistic regression analysis was used to determine significant CT findings in predicting surgical intervention for a ruptured cyst.

RESULTS: The presence of active bleeding and the hemoperitoneum depth were significantly different between the surgery and conservative management groups on comparative analysis, and they were proven to be significant CT findings for predicting surgery, with adjusted ORs of 3.773 and 1.318, respectively (p < 0.01).

CONCLUSION: The presence of active bleeding and the hemoperitoneum on a pretreatment CT scan can be predictive warning signs of surgery for a patient with a ruptured corpus luteal cyst with hemoperitoneum.