The advances in radiological diagnosis have elucidated the variety of histopathological features of hepatocellular carcinoma (HCC). The teaching points in this presentation are as follows: to review the differentiation, structural and cytological variation of HCCs histopathologically; to learn the vascular changes and functional features of each variation of HCC using CT and MRI; and to explain the radiological and pathological correlations.

**Differentiation of HCCs**

The evaluation of hemodynamic changes can help predict the multistage carcinogenesis of HCCs, including regenerative nodules, dysplastic nodules, and well-, moderately- and poorly differentiated HCCs. The energy source in hypervascular moderately differentiated HCCs is aerobic metabolism, whereas the energy source in some poorly differentiated HCCs that show less arterial blood flow may be glycolysis. Diffusion-weighted imaging may also help predict the differentiation of HCC.

**Structural variation**

Trabecular type: The thickness of the tumor plate, and consequently the size of the sinusoid between tumor plates, can account for the relationship between the washout pattern and the histological grade in trabecular HCCs.  

Pseudoglandular type: A very high signal on a T2-weighted image indicates the pseudoglandular type of HCC.  

Scirrhous type: Prolonged contrast enhancement indicates the scirrhorous type of HCC.

**Cytological variation**

Clear cell (fat, glycogen): Chemical shift imaging can reveal the fat, which can be frequently seen not only in well-differentiated but also in poorly differentiated HCCs. The frequency of intratumoral fat may be related to the degree of arterial blood flow.  

Spindle cell: The SUVmax value can be used to predict the spindle-cell change of HCCs.  

Bile production: The uptake of gadoxetic acid on MRI indicates the bile production of HCCs.  

Cytokeratin 19: A low contrast enhancement ratio for a tumor on gadoxetic acid-enhanced MRI may be related to the expression of biliary marker (for example, cytokeratin 19) and poor prognosis.
Tissue specific contrast agents are increasingly used in the imaging of the liver. They include hepatocyte-specific specific MR contrast agents (e.g., gadoxetic acid) and Kupffer cell-specific ultrasound contrast agents (e.g., perfluorobutane microbubbles), which provide special liver-specific imaging phases - hepatobiliary phase and Kupffer phase, respectively. During the liver-specific imaging phases, the normal hepatic parenchyma is well enhanced while most malignant lesions that contain few normal hepatocytes and Kupffer cells are seen as contrast defects. In addition, the enhancement degree of hepatic parenchyma and tumor may reflect the functional information. In the imaging diagnosis of HCC, hepatobiliary phase imaging as well as Kupffer phase imaging have been reported to be useful in the detection of small tumors, in the evaluation of multi-step hepatocarcinogenesis, and in the assessment of tumor grades. However, the enhancement patterns of HCC or borderline nodules can be different between hepatobiliary phase and Kupffer phase imaging, and therefore, understanding on their differences would lead to appropriate selection of imaging techniques and accurate imaging interpretation. In this lecture, I will review the role of liver-specific imaging techniques including hepatobiliary phase imaging and Kupffer phase imaging, and the molecular changes during the hepatocarcinogenesis and corresponding imaging features. In addition, recent studies regarding the comparison of hepatobiliary phase and Kupffer phase in the diagnosis of HCC will be discussed.
Vascular biology is a relatively new field of biology and has actively expanded our understanding in blood vessels and angiogenesis. Vascular biology can provide with radiologists a new point of view to interpret the imaging findings such as enhancement patterns of liver pathologies, especially hepatic tumors.

In the current talk, I will first deliver an overview on vascular biology which will include but not be limited to angiogenesis/vasculogenesis, major signal transduction pathways, general features of tumor vasculatures, the concept of anti-angiogenic therapy and normalization. Next, I will discuss on how liver vasculatures differ from average blood vessel: the liver holds various blood vessels which can be largely divided into two categories: that is blood vessels with average features (hepatic arteries/arterioles, portal and hepatic veins/venules) versus hepatic sinusoidal capillaries with peculiar features. Their difference in morphology, signal transduction pathways and implications will be briefly discussed along with the concept of “capillarization”. Finally, I will discuss some features of hepatic tumor vasculatures and their theoretical implications.
Hepatocellular carcinoma (HCC) is one of the most common malignancies in the world. This tumor has a tendency to invade intrahepatic blood vessels resulting in intrahepatic and extrahepatic metastases. Although liver resection and transplantation are currently the most important treatments with curative potential in selected patients with HCC, the long-term survival outcomes are still unsatisfactory due to high incidences of tumor recurrence and metastasis. Tumor grading and microscopic vascular invasion (MVI) are accepted worldwide as the two most powerful predictors of prognosis in patients with HCC both after hepatic resection and transplantation, as shown by many series investigating these topics. The survival of patients with poorly differentiated HCC is reportedly worse than that of those with moderately differentiated HCC in surgically resected cases. Macrovascular and MVI in HCC are usually associated with more advanced tumor stage and disease progression. Macrovascular invasion with gross tumor thrombus can be easily diagnosed by radiological imaging. However, because MVI is a histopathological diagnosis, it rarely can be evaluated during the preoperative period despite its well-known importance.

Vascular invasion of HCC is a multi-step biological process involving many factors including the interactions of HCC with the micro-environment and the host status (immune, endocrine, and metabolism). Tumor size > 3.5 cm, AFP > 200 ng/ml and GGT > 53 U/L were reported as three independent predictors for MVI (Zhao H et al.). Another study has reported that the specific macroscopic type of HCC relevant to MVI on histopathological examination could help predict recurrence, and that this is especially true for simple nodular type with extranodular growth and confluent multinodular type tumors. Thus, imaging (CT or MRI) can provide information regarding tumor morphology and vascular pattern predicting tumor grading (i.e., rim enhancement pattern indicating poorly-differentiated HCC). Other imaging features suggesting MVI are irregular circumferential peritumoral enhancement, and non-smooth tumor margin and peritumoral hypointensity in the hepatobiliary phase. Lee S et al. also recently reported that a combination of two or more of the following: arterial peritumoral enhancement, non-smooth tumor margin, and peritumoral hypointensity on hepatobiliary phase, can be used as a preoperative imaging biomarker for predicting microvascular invasion, with specificity > 90%, and is associated with early recurrence after curative resection of single HCC. In addition, diffusion weighted imaging, PET, iso- and hyperintensity in hepatobiliary phase, and fat component can be useful for predicting MVI.

Intrahepatic cholangiocarcinoma (ICC) is typically a hypovascular tumor, based on imaging features, and has very poor survival compared with other digestive diseases. Several prognostic factors for survival in patients with mass-forming ICC such as portal vein invasion, tumor number, lymph node metastasis, and serum CA19-9 level have been known. When classifying ICC into scirrhouss or nonscirrhouss tumors on the basis of the ratio of the scirrhouss areas according to the criteria used by Kajiyama et al., the survival rate in patients with the scirrhouss type of ICC is significantly lower than that in patients with the nonscirrhouss type of ICC. In that sense, by observing degree of delayed enhancement on dynamic CT (4-6 min), we can predict tumor invasiveness of ICC. Asayama et al. reported that the degree of enhancement on delayed-phase CT images correlated with the amount of fibrous stroma, and that patients with a tumor showing a greater area of delayed enhancement showed a lower survival rate. However, given that both poor tumor differentiation and presence of lymph node metastasis have been reported to be related to a poor prognosis, Lacomis et al. demonstrated that better-differentiated tumors were more likely to show delayed contrast material retention than poorly differentiated ones. In gadoxetic acid-enhanced MRI, a significantly higher percentage
relative enhancement on HBP images was seen in moderately differentiated tumors compared with poorly differentiated tumors, and in patients without lymph node metastasis, compared with those with lymph node metastasis. Since poorly differentiated ICC more often shows abundant necrosis, such rule makes sense. In a study by Ariizumi S, the 5-year survival rates of patients with hypervascular ICC that showed high density of the whole tumor and that which showed high density of the tumor with smaller low density in the central area were significantly higher than those of patients with hypovascular ICC. Hypervascular ICCs are commonly seen in patients with chronic viral hepatitis or cirrhosis and are smaller than typical hypovascular ICCs. Thus, until now arterial hypervascularity might be a only imaging feature that useful to predict tumor invasiveness of ICC.

Sarcomatous carcinomas are a very rare variant type of hepatic tumor, defined as a malignant tumor containing an intimate mixture of carcinomatous (either hepatocellular or cholangiocellular) and sarcomatous elements. Thus, sarcomatous changes can occur in both HCC and ICC. The prognosis is known to be poor in patients with S-HCC or S-ICC as a result of the significantly higher frequency of recurrence or metastasis compared with typical HCC or ICC. Based on our recent investigation, hepatic sarcomatous carcinoma generally presents minimal rim-like arterial enhancement or extreme hypovascularity on CT and gadoxetic acid MRI with high frequency of T2 bright area due to extensive necrosis, and vascular invasion.

References

Serrated polyps at CT colonography: relevance, appearance, and avoiding pitfalls

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Serrated polyps represent a family of colonic polyps characterized by infolding and a ‘sawtooth’ appearance of the colonic crypt epithelium on histology. There are three main types including the hyperplastic polyp (constitutes the majority of serrated lesions approaching 80%), the sessile serrated polyp (constitutes about 20%), and the traditional serrated adenoma (less than 1%) (1-3). In the past, the significance of these lesions to the colorectal cancer carcinogenesis pathway was not recognized nor well understood. Over the past decade, our understanding of colorectal cancer development has radically changed. Whereas previously it was thought that all cancers arose via an adenomatous pathway, a separate minor pathway to cancer has been identified through serrated neoplasms. While hyperplastic polyps are benign without future malignant potential, both sessile serrated polyps (SSPs) and traditional serrated adenomas (TSAs) have the potential to transform into cancer. Serrated polyps are now known to account for 20-30% of all sporadic colorectal cancers (4).

The sessile serrated polyp (SSP) is the main lesion of interest. Previously, the existence of this lesion was not recognized, often mistaken for a large hyperplastic polyp. Although infrequently these polyps can harbor dysplasia, they often do not and are distinguished from their similarly-appearing hyperplastic counterpart by architectural distortions at the crypt bases. Unlike hyperplastic polyps, a small percentage of SSPs can progress and transform into cancer. SSPs are subtle lesions and easily missed on screening. They are often the cause of interval developing cancers despite prior screening. SSPs are typically flat in morphology, only minimally raised from the colonic surface. They tend to be large (≥ 10 mm) and located in the right colon.

Although difficult for image-based screening, serrated lesions can be detected at CT colonography. The key is related to a phenomenon of lesional contrast coating of the polyp by the tagging agents (5). This allows easy detection as well as confirmatory evidence that a flat sessile serrated polyp is present. It is theorized that the contrast agents in the bowel preparation can mix with the overlying mucin elaborated by these lesions. This creates adherent coat on the serrated lesion whereas the contrast does not adherent to the normal adjacent colonic mucosa.

Besides the sessile serrated polyp, the traditional serrated adenoma (TSA) holds future malignant potential. These lesions present less of a screening issue as they are rare in prevalence and tend to be easily detected with more bulky polypoid morphologies (i.e., sessile or pedunculated).

This lecture will review the characteristics of serrated lesions and the experience at a large-scale University-based CT colonography colorectal cancer screening program. Strategies to optimize serrated neoplasm detection will be reviewed and pitfalls to avoid will be highlighted. Armed with this information, radiologists should feel confident in their abilities to detect this subtle but important lesion.

References

Learning objectives

After the lecture, the audience should be able to explain or answer the followings.

1. Why is it important to evaluate the entire colorectum in a patient with colorectal cancer?
2. What is currently the best examination to assess the proximal colon in patients with occlusive colorectal cancer?
3. What is the most recommended local staging modality for rectal cancer?
4. How should CT and MRI be used for the evaluation of colorectal hepatic metastasis?
5. How should post-CRT rectal MRI be interpreted?
6. Is restaging imaging necessary before surgery after neoadjuvant CRT in a patient with locally advanced rectal cancer?
Abdomen 137

SF 05 AB-03  What's new in the imaging diagnosis and management of colorectal cancer
14:40 - 15:00 203

Chairperson(s): David Kim  University of Wisconsin Medical School, USA
Seong Ho Park  University of Ulsan College of Medicine, Asan Medical Center, Korea

“Post-surgical follow-up” use and interpretation of imaging during postsurgical follow-up

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Post-surgical surveillance is a routine exam for every patient regardless of the suspicion of cancer recurrence. The purpose of post-surgical surveillance is to detect recurrent disease as early as possible. Surveillance after curative treatment of colorectal cancer commonly includes periodic history taking, physical examinations, laboratory tests, diagnostic imaging studies, and endoscopic procedures. According to a recent systematic review, more patients who underwent post-surgical surveillance were treated with curative surgery when the recurrence was detected, and more asymptomatic recurrences were found at follow-up. However, there was no overall survival benefit for intensifying the follow-up of patients after curative surgery for colorectal cancer.

The majority of recurrences occur within first two to three years after primary resection of colorectal cancer. Distant metastasis occupies more than 50% of all recurrence, which mostly commonly involves the liver and lung. On the other hand, local or perianastomotic recurrence and metachronous colon cancer only account for a small proportion of the overall recurrence.

The liver is the most common organ of distant metastasis in colorectal cancer patients. Although CT is routinely performed for post-surgical evaluation including liver, MRI has become a problem-solving tool in the evaluation of liver. MRI helps to characterize small hepatic lesions, and to detect hepatic metastasis in the fatty liver background. Typical liver metastasis appears as a relatively hypovascular nodule with irregular or ill-defined borders and shows peripheral rim enhancement on CT or MR dynamic images. Sometimes, other focal lesions such as focal sinusoidal obstruction syndrome or eosinophilic infiltration can mimic hepatic metastases, especially when the lesion was newly developed on follow-up imaging.

Thanks to advances in chemotherapy, we can see a favorable response of colorectal liver metastasis, or even observe disappearance of liver metastasis on imaging. There have been several recent published studies on clinical significance and outcome of disappearing (or vanishing) hepatic metastasis. Although there may be some controversy about this issue, gadoxetic acid-enhanced liver MRI with diffusion-weighted imaging is a promising tool for predict clinical complete response.

Finally, complications and toxicities associated with chemotherapy of colorectal cancer can be detected on post-surgical imaging. Oxaliplatin-based regimens are known to induce sinusoidal obstruction syndrome. 5-FU-chemotherapy is known to cause hepatic steatosis. Bevacizumab, one of anti-VEGF-molecular targeted agents, is associated with gastrointestinal perforation and vascular complications such as thromboembolic and hemorrhagic events.

In this lecture, we will discuss the epidemiological aspect of post-surgical surveillance, imaging features and mimickers of colorectal cancer metastasis/recurrence, imaging interpretation of vanishing hepatic metastasis after chemotherapy, and chemotherapy-related complications and its imaging findings.
Total mesorectal excision (TME) has been a standard surgical strategy for rectal cancer, leading to significant improvements in local recurrence rates and survival. It is still gold standard surgical principle for rectal cancer. But, improvement of diagnosis, staging and treatment modalities of rectal cancer induce diversity of surgical treatment. These induce two sided changes such as minimally invasive and maximally invasive approaches.

Preoperative chemoradiotherapy was initiated as an attempt to improve oncologic outcome, and provided a chance to introduce changes in the surgical treatment environment. Many studies have reported a decrease in local recurrence in patients treated with preoperative chemoradiotherapy, and it has been established as a standard treatment for locally advanced rectal cancer, alongside TME. However, there is a wide range of tumor regression after preoperative chemoradiotherapy, and oncologic outcome differs by degree of regression, which led to the pursuit of diversity in surgical treatment. In addition, the widespread introduction of screening programs has led to a significant increase in the early detection of rectal cancers.

For early rectal cancer and good responder to preoperative chemoradiotherapy, several studies have challenged the role of full-thickness en bloc local excision through a trans-anal approach either direct vision, laparoscopic or endoscopic assistance. It is based on an interest in quality of life and realization of the need for individualized treatment according to risk of recurrence. The role of local excision for the treatment of rectal cancer, however, is controversial because of the lack of adequate lymphadenectomy. The local excision was usually considered for clinical early T1 rectal cancer, because the risk of lymph node metastases would increase according to depth of invasion; 0-3% for T1 sm1, 15% for T1 sm2-3 and about 25% for T2 rectal cancers. Therefore, the preoperative staging by MRI is key for the proper selection of rectal patients for a local excision procedure. Endorectal ultrasound might be used as a complementary method to MRI.

Introduction of preoperative chemoradiotherapy made increase the possibility of proper TME for locally advanced rectal cancer patients. However, some patients still showed extensive disease which is not respond to preoperative chemoradiotherapy. It extended beyond TME plane. In addition, the surgical approach for low rectal cancer is a current debate. The rectum and mesorectum were dissected off the levator muscles with conventional abdominoperineal resection (APR) concept. Therefore, the specimen often has a waist at the lower border of the mesorectum, at the level of the puborectalis muscle. If the tumor is located at this level there is a high risk of a perforation at waist point and involved margins and local recurrence rates after this surgery were high. Therefore, extra-levator APR concept was introduced. The main concept of extra-levator APR is to excise the levator muscles en bloc with the specimen that is the external sphincter and levator muscles are excised en bloc with the rectum and mesorectum to create a surgical specimen without a waist.

For tumors beyond the TME plane, in order to attain a R0 resection, the extent and radicality of surgical resection increases and pelvic multivisceral exenteration would be required. It involves en bloc resection of the rectum, bladder and internal genital organs. In exenterative surgery, three different planes of dissection are used: the mesorectal fascia, the ureteric plane and the bony plane lateral to the internal iliac vessels, along the obturator internus and piriformis muscles in the lateral pelvic compartments. The choice of plane is dependent on the local extent of tumor invasion within the different intra-pelvic compartments. It has to be determined by multidisciplinary team approach according to the assessment of involved organ to obtain clear margin based on the preoperative imaging modalities.

TME does not include surgery to the lateral pelvic...
wall compartment, but patients who had lateral pelvic lymphadenopathy on MRI at diagnosis have reported to have a poorer 5 year survival compared with those without pelvic lymphadenopathy. Although concerns persist that routine sidewall clearance adds sexual and urinary functional derangement, without survival benefit in most patients, lateral pelvic lymphadenectomy has been insisted continuously. Lateral pelvic lymphadenectomy is not routinely included in the rectal cancer surgical strategy because the oncological benefit was not consistently proved. However, indication and benefit of lateral pelvic lymphadenectomy have to be studied further.
SS 05 AB-01 09:40
Tumor heterogeneity of pancreas adenocarcinoma assessed by CT texture analysis: association with survival outcomes
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PURPOSE: To determine whether tumor heterogeneity assessed by the CT imaging texture analysis is related to survival outcomes in patients with pancreas head cancer who underwent curative resection.

MATERIALS AND METHODS: A total of 88 patients with pancreas head cancer who underwent preoperative CT and curative resection were included between January 2006 and December 2014. The clinical, pathologic data were achieved from hospital database and texture features (average, standard deviation, kurtosis, skewness, contrast, correlation, entropy) were obtained from preoperative CT images by in-house software for texture analysis with various filter values (fine = 1, medium = 2 or 2.5, coarse = 2.5). After dichotomizing patients into recurred and non-recurred groups, clinical, pathological and texture features from different filters were compared. Univariate Kaplan-Meier method and multivariate Cox regression analysis were used based on the optimal cut-off values from ROC analysis for the prediction of recurrent-free survival (RFS).

RESULTS: The presence of nodal metastasis and texture features including average, contrast, correlation, and standard deviation showed the significant difference between recurred (n = 70, 79.5%) and non-recurred group (n = 18, 20.5%) without or fine (1), medium (1.5, 2) filtration values. After dichotomizing patients into recurred and non-recurred groups, clinical, pathological and texture features from different filters were compared. Univariate Kaplan-Meier method and multivariate Cox regression analysis were used based on the optimal cut-off values from ROC analysis for the prediction of recurrent-free survival (RFS).

CONCLUSION: CT texture features showing lower average and standard deviation are associated with poorer patient outcome after curative resection in patients with pancreas head cancer.

SS 05 AB-03 09:50
Spleen stiffness measurement using shear wave elastography: the feasibility and affecting factors
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PURPOSE: To investigate the success rate of spleen stiffness (SS) measurement and SS value according to influencing factors, using shear wave elastography (SWE).

MATERIALS AND METHODS: Three hundred and ten consecutive patients were measured spleen and liver stiffness at the same time by 2D-SWE and spleen size, BMI, and baseline disease were also evaluated. The factors affecting the measurement rate of SS were investigated. The success rate of SS measurement calculated according to the affecting factors. Patients were grouped by spleen size, BMI, and LS. The differences of SS values were evaluated among the groups.

RESULTS: Of 310 patients, SS was successfully measured in 52.9%. In the patients with splenomegaly, the SS measurement was significantly better (80.0% vs. 41.6%) than in the non-splenomegaly group, and the success rate of SS measurement was significantly lower in the obese group (40.6% vs. 61.5%). In the liver cirrhosis group, the success rate of SS measurement was higher than no or mild fibrosis group and significant fibrosis group (78.0% vs. 45.7%, 50.0%). The SS value was significantly higher in the splenomegaly group than in the non-splenomegaly group (35.1 ± 14.4 kPa vs. 23.7 ± 8.7 kPa, p < 0.0001) and increased as the LS value increased (20.6 ± 5.8 kPa vs. 31.9 ± 13.4 kPa vs. 40.0 ± 10.4 kPa, p < 0.001). The size index of spleen, liver stiffness, BMI and subcutaneous fat thickness of abdominal wall were helpful parameters estimating the successful measurement of SS and the AUC value were 0.760, 0.626, 0.608 and 0.700, respectively.

CONCLUSION: Compared with LS measurement, the measurement of SS has low success rate and is technically difficult because it is affected by various factors. Considering these factors will make SS measurement more efficient and SS value useful for management of liver fibrosis and portal HTN.
Evaluation of microvascular flow in the gallbladder bed of liver using cSMI: is it helpful for improvement of diagnostic performance compared with conventional US in diagnosing acute cholecystitis?

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**PURPOSE:** To evaluate diagnostic ability of superb microvascular imaging (SMI) compared to conventional ultrasonography (US) including color Doppler imaging for diagnosing acute cholecystitis.

**MATERIALS AND METHODS:** We prospectively investigated 45 patients who visited our hospital due to right upper quadrant pain and underwent conventional US with additional color-coded SMI (cSMI). US was performed by one radiologist and pixel count of cSMI of gallbladder bed in the region of interest (ROI) was measured. US exams were retrospectively and independently reviewed by two radiologists, and possibility of acute cholecystitis was evaluated by using our overall likelihood score system which includes wall thickening, presence of stones, pericholecystic fluid, gallbladder distension and sonographic murphy sign. We used both pathologic results of each patient who underwent surgical intervention and follow-up results on electric medical record in patients who did not undergo surgery as standard of reference. We calculated additional diagnostic value of cSMI to conventional US compared to conventional US alone. We also used receiver operating characteristic (ROC) curve to obtain optimal cutoff pixel count of cSMI.

**RESULTS:** Of 45 patients, 31 patients underwent surgical intervention, among which 10 patients were pathologically diagnosed with acute cholecystitis. US examinations including cSMI led to detect suspected acute cholecystitis in 13 patients and among them 8 patients were pathologically confirmed. On the other hand, 17 patients were suspected to have acute cholecystitis on conventional US, among which 7 patients were pathologically confirmed (sensitivity, 80.0% vs. 70.0%, respectively; specificity, 85.7% vs. 71.4%, respectively). There were statistically significant differences between acute cholecystitis and not acute cholecystitis groups in the respective of cSMI pixels (p < 0.032). The ROC analysis revealed that the optimal cut-off value, also referred to prediction of acute cholecystitis on cSMI, was 100.3.

**CONCLUSION:** Additional using of cSMI technique to conventional US shows good feasibility with respect to diagnosis of acute cholecystitis compared with conventional US alone.

Prediction of pancreatic fistula and postoperative complications after pancreateico-duodenectomy based on preoperative imaging and clinical features

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**PURPOSE:** Preoperative prediction of post-operative pancreatic fistula (POPF) or severe complications after pancreateico-duodenectomy is important for better patient’s outcome. The preexisting prediction models have used only clinical risk factors. However, imaging also can add important information to predict pancreatic fistula. Therefore, we aim to develop a prediction model to predict POPF based on preoperative imaging features and clinical features.

**MATERIALS AND METHODS:** From the prospectively built surgical registry of our institution, we included adult patients treated with pancreateico-duodenectomy for peripancreatic malignancies whose preoperative CT/MRIs were taken within 1 month before surgery. We retrieved various clinical/surgical factors from the registry. Based on preoperative CT/MRIs, we evaluated presence of the main pancreatic duct (MPD) dilatation, pancreatic fatty degeneration, and visceral obesity/sarcopenia based on the areas of visceral fat and skeletal muscle measured at the L3 vertebrae level. The POPF were scored according to the ISGPF definition. The severe complications were defined according to Clavien-Dindo classification III and IV. Univariate and multivariate logistic regression analyses were performed.

**RESULTS:** A total of 284 patients (163 male, 121 female) met inclusion criteria. The POPF rate was 18.3% (52/284) and severe complication rate was 12.0% (34/284). In both univariate and multivariate analyses, the visceral obesity was the only independent predictor for POPF (OR 2.4, p = 0.025, multivariate analysis) and the vascular resection during pancreaticoduodenectomy was the only independent predictor for severe complications (OR 4.4, p = 0.014, multivariate analysis). The other covariates including MPD dilatation, pancreatic fatty degeneration, sarcopenia, BMI, ASA grade were not predictive.

**CONCLUSION:** Among the preoperative imaging parameters, only the visceral obesity is predictive for POPF. Vascular resection during pancreateico-duodenectomy is strongly predictive of severe postoperative complications.
**Abdomen**

**SS 05 AB-06  10:20-10:50**

Current trends in the diagnosis and management of the pancreatic cystic neoplasm: Italian perspectives

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**Abdomen**

16:00 - 18:00  **Grand Ballroom 101**

**Liver**

Chairperson(s)

Byung Ihn Choi  *Chung-Ang University Medical Center, Korea*

Yong Yeon Jeong  *Chonnam National University Hwasun Hospital, Korea*

**SS 10 AB-01  16:00**

The diagnostic accuracy of gadoxetate-enhanced MRI can be improved depending on how we evaluate washout and capsule appearances in the diagnosis of hepatocellular carcinoma using LI-RADS

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**PURPOSE:** To examine the impact of using both early and late portal phases for evaluating washout appearance and regarding smooth hypointense rim in hepatobiliary phase (HBP) as capsule appearance on the diagnostic accuracy of Liver Imaging Reporting and Data System (LI-RADS) diagnostic algorithm (v. 2014) for hepatocellular carcinoma (HCC) with gadoxetate-enhanced magnetic resonance imaging (MRI).

**MATERIALS AND METHODS:** Our study subjects were 381 hepatic observations (190 HCCs, 10 non-HCC malignancies, and 181 benign lesions) in 226 patients with chronic liver disease who underwent gadoxetate-enhanced MRI for suspected hepatic malignancy between January 2013 and December 2015 at a tertiary hospital. Two board-certified radiologists evaluated the MRI data of these patients, and determined the presence or absence of washout appearance in early portal (approximately 60 seconds after contrast injection) and late portal (approximately 100 seconds) phases, conventional capsule appearance, smooth hypointense rim in the HBP, and other imaging features such as arterial phase hyperenhancement and threshold growth. They also categorized each hepatic observation according to the LI-RADS. Diagnostic performance was compared using generalized estimating equation, with LR-5 or -5V considered positive for HCC.

**RESULTS:** Compared to when only early portal phase was used for evaluating washout appearance and HBP hypointense rim was ignored, additional use of late portal phase and regarding HBP hypointense rim as capsule appearance significantly increased the sensitivity (Reviewer 1, 51.1% vs. 64.2%, p < 0.001; Reviewer 2, 55.8% vs. 70.5%, p < 0.001) and accuracy (Reviewer 1, 73.0% vs. 79.3%, p < 0.001; Reviewer 2, 75.6% vs. 82.4%, p < 0.001) for HCC diagnosis. The specificity did not significantly change (Reviewer 1, 94.8% vs. 94.2%, p = 0.316; Reviewer 2, 95.3% vs. 94.2%, p = 0.155).

**CONCLUSION:** The sensitivity and accuracy of gadoxetate-enhanced MRI in the diagnosis of HCC using the LI-RADS could be improved without compromising the specificity, by evaluating washout appearance in both early and late portal phases and regarding smooth hypointense rim in the HBP as capsule appearance.

**SS 10 AB-02  16:10**

A prospective and long-term follow-up study of non-hypervascular hypointense nodules on the hepatobiliary phase of gadoxetic acid-enhanced MRI

Taeyoung Lee, So Yeon Kim, Jae Ho Byun, So Jung Lee, Hyung Jin Won, Seong Ho Park

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**PURPOSE:** To investigate the incidence of non-hypervascular hypointense nodules on the hepatobiliary phase (HBP) of gadoxetic acid-enhanced MRI and to identify the incidence of arterial hypervascular transformation and associated features in a prospective cohort with a long-term follow-up.

**MATERIALS AND METHODS:** A prospective surveillance study included 407 cirrhosis patients at high risk for HCC who underwent one to three, biannual screening examinations with gadoxetic acid-enhanced MRI between November 2011 and August 2014. Among them, 40 patients were identified to have 63 hypovascular hypointense nodules on HBP of gadoxetic acid-enhanced MRI. Follow-up contrast-enhanced MRI and CT were reviewed to identify hypervascular transformation (median follow-up period, 45 months). Univariate and multivariable Cox proportional hazards model with robust standard errors for clustered data were used to investigate the association between arterial hypervascular transformation and clinical and imaging
Abdomen

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features with respect to nodule size, signal intensity on T1-, T2-, diffusion-weighted, portal and delayed phase images, and intratumoral fat.

**RESULTS:** The incidence of non-hypervascular hypointense nodules on HBP in the prospective cohort was 9.8% (40/407). On follow-up images, the 1-, 3-, and 5-year cumulative incidences of hypervascular transformation were 6.4, 12.8, and 24.3%, respectively. Univariate analyses revealed the size ≥ 1 cm and hypointensity on T1-weighted images as significant risk factors for hypervascular transformation. According to the multivariable analysis, the size ≥ 1 cm was independently associated with hypervascularization with a hazard ratio HR of 12.6 (p = 0.02). The 5-year cumulative incidence of nodules ≥ 1 cm in size (52.5%) was more than 10 folds compared to that of nodules smaller than 1 cm (4.4%).

**CONCLUSION:** Our study demonstrates the incidence of non-hypervascular hypointense nodules on HBP and hypervascular transformation in a prospective cohort. Non-hypervascular hypointense nodules ≥ 1 cm in size are strongly associated with hypervascular transformation.

**CLINICAL RELEVANCE:** Non-hypervascular hypointense nodules on HBP ≥ 1 cm in size should be cautiously followed up with their cumulative incidence of hypervascular transformation in mind.

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**SS 10 AB-03 16:20**

**Impacts of adding recent CT arterial phase images on diagnostic performances of gadoxetic acid-enhanced MRI in assessment of HCC**

Seung back Hong, So Yeon Kim, Young-Suk Lim, Seung Soo Lee, Seong Ho Park, Moon-Gyu Lee

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**PURPOSE:** To investigate impacts of adding recent CT arterial phase findings on diagnostic performances of gadoxetic acid-enhanced MRI in the assessment of hepatocellular carcinoma (HCC).

**MATERIALS AND METHODS:** We retrospectively identified 1272 patients (M:F = 1026:246; mean age, 56.6 years) with pathologically confirmed 1490 nodules (1370 HCCs, 60 dysplastic nodules, 39 combined HCC and cholangiocarcinomas, 13 cholangiocarcinomas, 8 nodules with other pathologies) between January 2008 and December 2016 with the following inclusion criteria: patients with chronic hepatitis or liver cirrhosis who had pathologically confirmed focal hepatic lesions; who underwent both multiphase CT and gadoxetic acid-enhanced MRI within 120 days before the pathologic exams; and the size of lesions ≤ 3 cm. We compared the enhancement patterns on arterial phase imaging between the two imaging modalities. The sensitivity and 95% confidence interval (C.I.) for detecting arterial hyperenhancement in patients with HCCs on a per-nodule basis was compared between the MRI only analyses and the CT + MRI analyses using generalized estimated equations based on a binary logistic regression model to account for data clustering and dependency, as some patients had more than one nodules.

**RESULTS:** The mean time interval between MRI and CT was 16.5 days. Among the 1490 nodules, 1361 nodules (91.3%) had the same arterial enhancement patterns both on CT and MRI. In the remaining 129 nodules with the different enhancement patterns between CT and MRI, arterial hyperenhancement was detected only by CT in the majority of cases (86.8%, 112/129, 105 HCCs and seven non-HCC lesions). The sensitivity in detecting arterial hyperenhancement in HCC was significantly improved in the CT + MRI analyses (92.4%; 95% CI, 90.9 to 93.7) compared to the MRI only analyses (84.7%; 95% CI, 82.2 to 87.0) (p < 0.001).

**CONCLUSION:** Adding recent CT arterial phase findings can improve the detection of arterial hyperenhancement of gadoxetic acid-enhanced MRI in the evaluation of HCC.

**CLINICAL RELEVANCE:** Arterial phase findings on recent CT images can serve a substitute for suboptimal arterial phase MR images on gadoxetic acid-enhanced MRI in the assessment of HCC.
Evaluation of transient motion during gadoxetic acid-enhanced multiphasic liver MRI using free-breathing golden-angle radial sparse parallel MRI

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SS 10  AB-04  16:30

PURPOSE: To observe the pattern of transient motion after gadoxetic acid administration including incidence, onset, and duration, and to evaluate the clinical feasibility of free-breathing gadoxetic acid-enhanced liver magnetic resonance imaging (MRI) using golden-angle radial sparse parallel (GRASP) imaging with respiratory gating.

MATERIALS AND METHODS: In this IRB-approved prospective study, 59 patients who provided informed consents were analyzed. Free-breathing dynamic T1-weighted images (T1WI) were obtained using GRASP at 3T after a standard dose of gadoxetic acid (0.025 mmol/kg) administration at a rate of 1 mL/sec, and development of transient motion was monitored, which is defined as a distinctive respiratory frequency alteration of the self-gating MR signals. Early arterial, late arterial and portal venous phases retrospectively reconstructed with and without respiratory gating and with different temporal resolutions (non-gated 13.3-second, gated 13.3-second, gated 6-second T1WI) were evaluated for image quality and motion artifacts. Diagnostic performance in detecting focal liver lesions was compared among the three datasets.

RESULTS: Transient motion (mean duration, 21.5 ± 13.0 seconds) was observed in 40.0% (23/59) of patients, 73.9% (17/23) of which developed within 15 seconds after gadoxetic acid administration. On late arterial phase, motion artifacts were significantly reduced on gated 13.3- and 6-second T1WI (3.64 ± 0.34, 3.61 ± 0.36, respectively), compared with non-gated 13.3-second T1WI (3.12 ± 0.51, p < 0.0001). Overall image quality was highest on gated 13.3-second T1WI (3.76 ± 0.39) followed by gated 6-second and non-gated 13.3-second T1WI (3.39 ± 0.55, 2.57 ± 0.57, p < 0.0001). Only gated 6-second T1WI showed significantly higher detection performance than non-gated 13.3-second T1WI (figure of merit, 0.69 [0.63-0.76]) vs. 0.60 [0.56-0.65], p = 0.004).

CONCLUSION: Transient motion developed in 40% (23/59) of patients shortly after gadoxetic acid administration, and gated free-breathing T1WI using GRASP was able to consistently provide acceptable arterial phase imaging in patients who exhibited transient motion.
kg. The other was performed with dual-energy mode (80 kVp/Sn 140 kVp) and 389 mgI/kg during LAP and PVP. CT number and standard deviation of liver, lesion, pancreas, aorta, portal vein, hepatic vein, paravertebral muscle, and abdominal wall fat were measured on 100 kVp and virtual monochromatic images (VMI) (40-120 keV, 10 keV interval) to calculate signal-to-noise ratio (SNR) and lesion contrast-to-noise ratio (CNR). Two radiologists independently evaluated VMI based on lesion detectability and image quality including artifacts and diagnostic acceptability, compared with the 100 kVp images, using six-point scales.

RESULTS: The SNRs of pancreas, aorta, and veins were similar at 40-50 keV images during LAP and at 40-60 keV images during PVP, compared to those at 100 kVp images (p > 0.05) with exception of the SNRs of aorta and veins, which were significantly higher at 40 keV images during both phases (p < 0.0013) and PVP (p < 0.0109), respectively. The SNR of liver was similar at 60-70 keV images during LAP (p > 0.05) and at 40-60 keV images during PVP (p > 0.05). The CNR of HPELL was significantly higher at 40-50 keV images (p < 0.0002) and was similar at 60 keV images (p > 0.05). The CNR of HPOLL was similar at 40-120 keV images (p > 0.05). Two radiologists voted 50 keV and 50-60 keV images comparable or superior to the 100 kVp images more frequently than the other VMI in patients with HPELL (84.8-89.1%, p < 0.0018) and HPOLL (70.8-83.3%, p < 0.0018), respectively.

CONCLUSION: Using 50-60 keV images, DSCT can reduce total contrast dosage by 30% in abdominal follow-up scans without compromising image quality and detectability of focal liver lesions, compared with the conventional 100 kVp CT.

CLINICAL RELEVANCE: DSCT with reduced contrast dosage by 30% is feasible in abdominal follow-up scans without compromising image quality and detectability of focal liver lesions.
American Joint Committee on Cancer (AJCC) staging. MATERIALS AND METHODS: A total of 361 patients with HCC who underwent curative hepatic resection after preoperative MRI between January 2000 and December 2010 were analyzed. We devised an MRI staging system based on the number of nodules, a size criterion of 2 cm, gross vascular invasion, and two MRI features (rim enhancement and peritumoral parenchymal enhancement in the arterial phase) which were reported to be associated with worse prognosis after curative resection of HCC. In the devised MRI staging, instead of microvascular invasion which is used by the AJCC staging system, the presence or absence of the MRI features was used to differentiate tumor stages 1b and 2; if any of the two MRI features was present in single tumors without gross vascular invasion, they were staged as T2, not T1. Disease-free survival of both staging systems was analyzed using the Kaplan-Meier method with log-rank testing.

RESULTS: Both MRI and AJCC staging systems were excellent for predicting disease-free survival across different tumor stages 1a, 1b, 2, and 3. Of 361 patients, 51 (14.1%), 160 (44.3%), 125 (34.6%), and 25 (6.9%) were staged as T1a, T1b, T2, and T3 by the preoperative MRI staging system, respectively. Disease-free survival was significantly different between T1a and T1b (median, 1925 days vs. 1668 days; p = 0.048), between T1b and T2 (median, 1668 days vs. 799 days; p = 0.002), and between T2 and T3 (median survival, 799 days vs. 141 days; p < 0.001).

CONCLUSION: Preoperative MRI staging system may be comparable to the postoperative AJCC staging system in predicting prognosis following curative resection of HCC.

SS 10 AB-08 17:10 CT texture analysis as a prognostic biomarker in adults with surgically treated mass-forming intrahepatic cholangiocarcinomas (ICCs)
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PURPOSE: To determine whether CT texture analysis (CTTA) has a value in the prediction of progression-free survival (PFS) in patients with mass-forming type intrahepatic cholangiocarcinoma (ICC) undergoing surgical resection.

MATERIALS AND METHODS: Institutional review board approval was obtained for this retrospective analysis, with a waiver of informed consent. The baseline portal-phase CT scans of 28 patients with mass-forming ICCs who underwent surgical treatment were retrospectively analyzed. CTTA was performed using a commercially available texture analysis software (TexRAD, TexRAD Ltd, Cambridge, UK) which employed a filtration-histogram technique by drawing a region of interest (ROI) of the largest tumor cross-sectional area from portal phase images. Mean, standard deviation (SD), entropy, mean of positive pixels (MPP), skewness and kurtosis of the pixel distribution histogram were derived from CT images without filtration and with filter values corresponding to fine (2), medium (3, 4, 5) and coarse (6) textures. Patients were followed up until disease progression. Kaplan-Meier analysis was performed to determine the relationship between CT texture features and disease-free survival (DFS), and a Cox proportional hazard regression model was used for multivariate analysis.

RESULTS: Univariate analysis identified about half of the CT texture features across the different filters - fine, medium and coarse texture scales were significant univariate markers of DFS (17 significant features of the total 35 texture features, p < 0.05). Among clinical and pathologic parameters, size, multiplicity and vascular invasion (p = 0.025, 0.027 and 0.029, respectively) were also significant univariate markers of DFS. A Cox regression model including significant univariate markers which had good distribution of patients in Kaplan-Meier curves identified that CT texture feature (medium texture scale - mean: HR = 0.049, 95% CI= 0.005-0.467, p = 0.009, coarse texture scale - mean: HR = 240.04, 95% CI = 8.82-6535.75, p = 0.001) and multiplicity (HR = 15.64, 95% CI = 2.09-116.90, p = 0.007) were independent predictors of DFS.

CONCLUSION: Medium- and coarse-filter texture feature is associated with poorer DFS in patients with mass-forming ICC, independent from clinical and pathologic markers.
Diagnosis of hepatocellular carcinoma (HCC) using (MRI with extracellular agent: Liver Imaging Reporting and Data System (LI-RADS) versus simplified LI-RADS (sLI-RADS))

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PURPOSE: To evaluate feasibility of a simplified Liver Imaging Reporting and Data System (LI-RADS) to improve practical convenience while maintaining diagnostic performance for hepatocellular carcinoma (HCC).

MATERIALS AND METHODS: Our study population consisted of 74 patients at risk of developing HCC without history of previous treatment for hepatic malignancy. 94 hepatic observations (HCC [n = 72], other malignancy [n = 1], benign [n = 21]) seen in MRI with extracellular agent were retrospectively reviewed. Either histopathology or long-term (> 18 months) follow-up image was used as standard of reference. Two board-certified radiologists evaluated presence or absence of each major and ancillary features according to LI-RADS lexicon and categorized all hepatic observations into LI-RADS version 2014 and simplified LI-RADS (sLI-RADS). Diagnostic performance of each diagnostic algorithm as sensitivity, specificity, and accuracy were assessed.

RESULTS: For diagnosis of HCC, grade 5 of sLI-RADS revealed higher sensitivity (86.1% vs. 80.6%, p = 0.040) and accuracy (88.3% vs. 84.0%, p = 0.041) than that of LI-RADS v 2014 without significant change of diagnostic specificity (95.5% for both algorithms). When considering both of grade 4 and 5 as positive result of the test for diagnosis of HCC, sensitivity (98.6% vs. 97.2%, p = 0.341) was not improved. However, specificity (72.7% vs. 36.4%, p < 0.001) and accuracy (92.6% vs. 83.0%, p = 0.002) of sLI-RADS was significantly higher than LI-RADS v 2014.

CONCLUSION: Simplified version of LI-RADS with ancillary findings is feasible for practical use in diagnosis of HCC using MRI with extracellular agent.

Liver function estimation using hepatocyte fraction map at gadoxetic acid enhanced liver MRI in patients with chronic liver disease

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PURPOSE: To determine whether hepatocyte fraction shows significant correlation with indocyanine green retention test (ICG R15) which is commonly used for estimating liver function quantitatively in critical situation.

MATERIALS AND METHODS: This prospective ongoing study was approved by our Institutional Review Board, and informed consent was obtained from all patients. From August 2016, a total of 33 patients with chronic liver disease (M:F = 28:5; mean age, 59.8 ± 9.2 years) were enrolled and underwent gadoxetic acid-enhanced liver MRI followed by ICG R15 test. A standard dose of gadoxetic acid (0.025 mmol/kg) was intravenously injected. Fat quantification map was obtained using multi-echo Dixon method before contrast media injection. In addition, T1 map of the liver using Look-Locker sequence was obtained before contrast (preT1 map) media injection and 10 minutes (postT1 map) after contrast media injection using following scan...
parameters: T1-TFE, TR/TE = 7/1.7 msec, FA = 7°, acceleration factor of 2, shot interval = 5 msec. Pre- and post-contrast T1 values (msec), difference of them (ΔT1), hepatocyte fraction and rate of hepatocyte uptake (K) were calculated using dedicated off-line software.

RESULTS: There were 87.9% (29/33) patients with chronic liver disease or Child-Pugh A, and 12.1% (4/33) patients were Child-Pugh class B. There were significant differences of ICG R15 (18.7 ± 14.9% vs. 62.6 ± 17.7%, p < 0.0001), hepatocyte fraction (66.4 ± 8.5%, 52.7 ± 11.6%, p < 0.007), K (21.8 ± 9.5 min-1 vs. 8.8 ± 4.0 min-1, p = 0.01) and postT1 (339.7 ± 82.4 msec vs. 496.3 ± 119.2 msec, p = 0.002) between two groups. However, ΔT1 and preT1 did not show significant difference (p = 0.27, p = 0.31). Hepatocyte fraction and K showed a significant negative correlation with ICG R15 (r = -0.50 [95% CI: -0.72, -0.19], and -0.68 [95% CI: -0.83, -0.45]), as well as Child-Pugh scores (r = -0.47 [-0.7, -0.15], -0.48 [-0.7, -0.16]).

CONCLUSION: Hepatocyte fraction map would provide information on liver function non-invasively.

SS 10 AB-11 17:40
Optimizing the definition of arterial enhancement in CT and gadoxetic acid-enhanced MRI in patients with hepatocellular carcinoma
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PURPOSE: According to the current guidelines, arterial enhancement for diagnosis of hepatocellular carcinoma (HCC) is determined using the arterial phase only. We investigated the optimal definition of arterial enhancement in patients with HCCs using computed tomography (CT) and gadoxetic acid-enhanced magnetic resonance imaging (Gd-MRI).

MATERIALS AND METHODS: A total of 147 consecutive patients with surgically proven HCCs, who had undergone both pre-operative CT and Gd-MRI between December 2011 and October 2013, were included. Identification rates of arterial enhancement on CT and MR images using arterial phase only, dual phase (unenhanced and arterial phases), and also subtraction MR images were assessed qualitatively. In addition, quantitative values including the absolute HCC enhancement ratio on arterial phase and the relative odds ratio of HCC enhancement using dual phase images were analyzed.

RESULTS: In qualitative analysis, the identification rates for arterial enhancement on CT were significantly different between arterial phase and dual phase (77.8% vs. 90.4%; p < 0.001), whereas the rates were similar on Gd-MRI (91.8% vs. 93.9%; p = 0.257). In addition, the MRI identification rate increased to 98.6% using subtraction MR images. In quantitative analysis, Gd-MRI was better than CT in terms of the absolute or relative arterial enhancement ratio of HCCs (p < 0.05).

CONCLUSION: Using CT, arterial enhancement of HCC was more accurately visible in dual phase than in arterial phase images, unlike with Gd-MRI. Further, Gd-MRI, including subtraction MR images, was superior to CT for detection of arterial enhancement of HCCs.

SS 10 AB-12 17:50
Treatment response to TACE in isoechoic HCC on the Kupffer phase image of CEUS using Sonazoid
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PURPOSE: To evaluate the treatment response in isoechoic HCC on the Kupffer phase image of Sonazoid-enhanced US to transcatheter arterial chemoembolization (TACE) as an alternative treatment and to identify the incidence of these isoechoic HCC showing discrepancy with the hepatobiliary phase (HBP) image of gadoxetic acid-enhanced MRI (EOB-MRI).

MATERIALS AND METHODS: Among 125 patients who underwent both EOB-MRI and CEUS using Sonazoid for radiofrequency ablation (RFA) planning were included between April 2014 and October 2016, any of the 22 patients met the following criteria were excluded: 1) Kupffer phase image not obtained (n = 4), 2) poorly visible due to poor sonic window (n = 10), and 3) interval between two exams more than 30 days (n = 8). A total 103 patients with 123 HCCs (84 men and 23 women; mean age, 63.2 years) were included. Sonazoid was used for CEUS after conventional gray-scale US. Two radiologists retrospectively reviewed the Kupffer phase image of CEUS in consensus. On the Kupffer phase image, echogenicity of HCC was evaluated and classified as hypo- and iso-echogenicity. Then we evaluated treatment response of isoechoic HCCs which were not eligible for RFA and treated by TACE.

RESULTS: 123 HCCs were classified as 104 hypo-echoic and 19 isoechoic HCCs according to the echogenicity on the Kupffer phase image of CEUS. Therefore, the incidence of isoechoic HCCs was approximately 15.4% (19/123). Among 19 isoechoic HCCs, 1 HCC was lost to follow up, and the remaining 18 HCCs were treated by surgical resection (n = 1), RFA (n = 2; visible on gray-scale and with assistance of fusion imaging, respectively), or TACE (n = 15). 10 out of 15 (66.7%) HCCs treated by TACE showed compact
Lipiodol uptake follow-up CT scan. The remaining 5 HCCs showed incomplete Lipiodol uptake, but demonstrated partial response or stable disease. There was no case showing progressive disease. **CONCLUSION:** Isoechoic HCCs which were not eligible for RFA showed a relatively good response to TACE without demonstrating progressive disease. The incidence of these isoechoic HCC on the Kupffer phase image of Sonazoid-enhanced US was approximately 15.4%.

**SS 15 AB-02 08:10**
Radiofrequency ablation of VX2 subcapsular hepatic tumor in vivo in rabbit: comparison of no-touch technique with conventional direct tumor puncture technique

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**PURPOSE:** To compare bipolar radiofrequency ablation (RFA) with no touch technique with conventional direct tumor puncture technique in terms of therapeutic efficacy, complication and tumorigenic factor in rabbit VX2 subcapsular hepatic tumor model.

**MATERIALS AND METHODS:** Forty-eight rabbits with VX2 hepatic subcapsular tumor were divided into three groups: Group A (n = 22) with direct tumor puncture RFA (dtpRFA); Group B (n = 23) with no touch RFA (ntRFA); Group C (n = 3) as control. Ultrasonography guided bipolar RFA was performed after 10 days of tumor implantation. Each three groups were subdivided into two sets for pathologic analysis with Hematoxylin & Eosin staining and for CT follow up until one month after RFA. Ki67 immunohistochemical staining was performed to visualize hepatocyte regeneration and serum hepatocyte growth factor (HGF) and vascular endothelial growth factor (VEGF) on day 1, day 2, and day 3 after RFA were measured by ELISA assay.

**RESULTS:** Group A and B induced similar degree of complete necrosis regarding primary tumor, whereas group B showed larger peritumoral complete necrosis than group A (viable satellite nodules within 0.5 cm from tumor; A 50% (4/8) vs. B (0/9), p = 0.029). CT follow-up revealed 42.8% (6/14) and 35.7% (5/14) of local recurrence in group A and B, respectively (p = 1.0). Peritoneal seeding was significantly more common in group A than B (71.4% (10/14) vs. 21.4% (3/14), p = 0.021). The number of Ki67 positive hepatocyte (cells per x 40 frame, 7.5 (± 3.0) vs. 8.1 (± 4.1), p = 1.0) and elevation of HGF and VEGF did not differ between after treatment were occurred in 22 of 61 patients (36.1%), vascular thrombosis (4.9%, 3/61) were rarely occurred. In addition, biloma formation and hepatic infarction (0%, 0/61) were not happened. Most of patients had a patent vessel adjacent tumor at immediately after cryoablation and follow-up CT scan (95.1%, and 96.7%, respectively). **CONCLUSION:** Cryoablation is an effective treatment tool for the treatment of perivascular HCC in terms of local tumor control and vascular injury.
group A and B. **CONCLUSION:** NtRFA induces larger peritumoral complete necrosis and less peritoneal seeding compared to dtpRFA which may contribute for better treatment result in subcapsular hepatic tumor. No difference between elevation of tumorigenic factor between dtpRFA and ntRFA. **CLINICAL RELEVANCE:** For subcapsular hepatic tumor, RFA with no touch technique may provide better outcome than with conventional direct tumor puncture technique considering larger peritumoral complete necrosis and less peritoneal seeding.

**PURPOSE:** To evaluate diagnostic performance of computed tomographic angiography (CTA) and contrast-enhanced US (CEUS) to diagnose significant hepatic artery obstruction (HAO) in liver transplantation (LT) recipients suspected of HAO by Doppler US. **MATERIALS AND METHODS:** The Institutional Review Board approved this study, with a waiver of informed consent. Among 1246 adult LTs with 1320 grafts performed in a single institution from January 2014 to February 2017, 132 grafts in 130 recipients were suspected of HAO by Doppler US. Of these, reference diagnosis of HAO was made by surgery, hepatic arteriography, or by cross-sectional CT abnormality. We selected 111 grafts with CTA (n = 91), CEUS (n = 68), or both (n = 48) obtained within 24 hours of diagnosis for our study. CTA and CEUS were retrospectively reviewed and their diagnostic performances were assessed. Accuracies of CTA and CEUS were compared using McNemar test in grafts evaluated with both modalities. **RESULTS:** Incidence of significant HAO was 1.7% (23/1320). Most significant HAOs were found within 2 weeks after LT (mean, 8.7 days; range 1-66). Sensitivity, specificity, positive predictive value, and negative predictive value of CTA were 92.9% (26/28), 91.0% (59/63), 86.7% (26/30), 96.7% (59/61), and 93.4% (85/91), respectively. Those of CEUS were 94.7% (18/19), 93.9% (46/49), 85.7% (18/21), and 97.9% (46/47), respectively. Accuracies of two modalities were not significantly different (p = 0.68). CTA found one HAO that were missed by CEUS, and CEUS found two HAOs that were missed by CTA, vice versa. **CONCLUSION:** Both CEUS and CTA are helpful and complementary tool for diagnosis of significant HAO in recipients with suspected HAO with Doppler US. CEUS was more accurate than CTA, with no statistical significance.
SS 15 AB-04 08:30
Evaluation of prognostic factors of early recurrence with local tumor progression of hepatocellular carcinoma following radiofrequency ablation
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PURPOSE: The purpose of this study is to review the prognostic factors of early recurrence with local tumor progression of small hepatocellular carcinoma (HCC) after ultrasound guided radiofrequency ablation (RFA).

MATERIALS AND METHODS: From January 2012 to May 2016, 324 patients with HCC in our hospital were treated with ultrasound guided RFA. Patients who had pre-RFA magnetic resonance imaging (MRI) were enrolled (n = 253). Among them, 91 patients were diagnosed as early recurrence with newly appeared tumors in other location (n = 53), and local tumor progression (n = 38) by CT or MR imaging and. Then, among the 38 patients with local tumor progression, 21 patients who underwent incomplete ablation were excluded. Finally, 17 patients (22 RFA sites) who showed early recurrence with local tumor progression were included in this study and 20 patients (20 RFA sites) were collected as the control group. Tumor size, location, and variable MR image findings such as enhancement pattern, tumor margin, signal intensity on T2-weighted image, diffusion restriction, Gadolinium-EOB-DTPA uptake pattern on hepatobiliary phase and presence of portal vein thrombosis or main vessel abutment, coefficient of variation (CV) of hepatic parenchyma were analyzed by MR imaging. Also, the use of artificial ascites and the quantitative value of alpha-fetoprotein (aFP) were evaluated.

RESULTS: The mean size of HCCs in recurrence group is 2.1 cm and that of the control group is 1.5 cm (p = 0.01) and the location of tumor in the recurrence group shows predominance in subcapsular area (p = 0.02). Even though enhancement pattern, tumor margin, gadolinium-EOB-DTPA uptake, diffusion restriction, CV mapping are not show correlation with the early tumor recurrence, but high signal intensity of tumor on T2-weighted images is associated with the early tumor recurrence (p = 0.014). The use of artificial ascites during RFA and the presence of portal vein thrombosis or main vessel abutment, coefficient of variation (CV) of hepatic parenchyma were analyzed by MR imaging. Also, the use of artificial ascites and the quantitative value of alpha-fetoprotein (aFP) were evaluated.

CONCLUSION: Tumor size, location, T2 signal intensity on MR imaging, the use of artificial ascites are correlated with early recurrence with local tumor progression of HCCs. Also, high aFP level and presence of portal vein thrombosis can be used as prognostic factors of early tumor recurrence after RFA.

SS 15 AB-05 08:40
Prediction of intrahepatic distance recurrence after radiofrequency ablation of hepatocellular carcinoma: role of CT findings indicating portal hypertension
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PURPOSE: To determine whether the degree of portal hypertension (PH) assessed by CT findings could also predict intrahepatic distance recurrence (IDR) in patients with hepatocellular carcinoma (HCC) who received radiofrequency ablation (RFA).

MATERIALS AND METHODS: From August 2012 and April 2016, 78 patients who received RFA as initial treatment of HCC with available LS values prior to RFA were included, and the presence of IDR was reviewed. Two radiologists evaluate CT features: tumor size, multiplicity of tumors, and the signs of PH such as the diameter of main portal vein, splenic volume, the presence of gastroesophageal varices at risk of recurrence (GEV-R), and the amount of ascites. GEV-R was defined as the presence of esophageal varix and/or large gastric varix (≥ 10 mm) on CT. A LSM value and the fibrosis indices such as APRI and FIB-4 scores were also investigated. We assessed recurrence-free survival rate using Kaplan-Meier curves, and analyzed multivariate Cox proportion hazards regression analyses. For validation of model, we also performed the validation study with the patients who underwent RFA without the result of LSM during the same period (n = 89).

RESULTS: During a median follow-up of 407 days, IDR was identified in 38.5% of the subject (30/78). On univariate analysis, tumor size, LSM, APRI score, and GEV-R were significantly associated with IDR. Subsequent multivariate analysis including all variables identified that tumor size and LSM were significant independent predictors of IDR. However, among the CT features only, GEV-R was significant independent predictor of IDR (HR = 3.907; p = 0.002) as well as tumor multiplicity (HR = 2.790; p = 0.030). On validation study, tumor multiplicity (HR = 2.86; p = 0.083) was the only significant independent predictors of IDR after RFA. GEV-R shows increased tendency of recurrence (HR = 1.68; p = 0.083).

CONCLUSION: GEV-R on CT could be a non-invasive predictor of recurrence after RFA as well as LSM.
SS 15 AB-06  08:50

Gallbladder distention with residual gastric contents after fasting: A finding that suggests acute cholecystitis

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PURPOSE: Computed tomography (CT) findings in acute cholecystitis have been described in multiple previous reports. However, establishing a definitive diagnosis by CT is often challenging, especially for non-contrast-enhanced CT. The purpose of this study was to evaluate whether gallbladder (GB) distension, together with residual gastric contents after fasting, could be a useful diagnostic sign for acute cholecystitis.

MATERIALS AND METHODS: We retrospectively reviewed CT images from 45 consecutive patients diagnosed with acute cholecystitis between November 2015 and October 2016. Patients selected for inclusion were those who demonstrated large amount of residual gastric contents (cutoff value: larger than 16 cm² on single axial scan) after at least 6 hours of fasting. Eleven patients met criteria for inclusion (mean age, 69 ± 16 years [± standard deviation]; M:F = 5:6). Maximal short-axis GB diameters were measured. Comparison CT measurements were obtained from a control group of patients with non-hepatobiliary emergency room diagnoses whose CT images showed residual gastric contents (n = 49; mean age, 46 ± 18 years; M:F = 22:27). Student’s t test was used to compare GB measurements between groups, and receiver operating characteristic (ROC) curve analysis was used to select a cut-off value for diagnostic use.

RESULTS: The mean GB short-axis diameter was significantly greater in acute cholecystitis patients than in controls (56 ± 11 mm vs. 22 ± 7 mm, respectively; p < 0.001). The area under the curve was 1.0, and the cut-off value was 39.5 mm, with sensitivity 100% and specificity 100%.

CONCLUSION: GB distension with residual gastric contents on CT images after fasting may suggest acute cholecystitis.

CLINICAL RELEVANCE: We often visualize residual food in the stomach on CT images, even after more than 6 hours of fasting. This can be because indigestion is one symptom of acute cholecystitis, and in the emergency room, patients usually wait only the minimum fasting time before scanning. Finding GB distension together with residual gastric contents on CT may be a sensitive and specific sign because having residual food in the stomach stimulates GB contraction. This sign may be helpful for diagnosing cases of acute cholecystitis, even when using non-contrast-enhanced CT.

SS 15 AB-07  09:00

Hepatocellular carcinoma: texture analysis of preoperative CT images as a potential marker of disease free survival

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MATERIALS AND METHODS: Institutional Review Board approved this retrospective study, with a waiver of informed consent. From January 2009 to January 2015, 81 patients with single HCC underwent preoperative contrast-enhanced CT with same protocol and vender. Texture features of the largest tumor cross-sectional area from arterial and portal phase liver CT images were assessed by using TexRAD software which employed a filtration-histogram technique. Mean value of positive pixels (MPP), entropy, kurtosis, skewness, and standard deviation (SD) of the pixel distribution histogram were derived from the images without filtration and with filter values corresponding to fine, medium, and coarse texture scale. The texture features were compared between groups with different histologic grade using Student’s t-test and Mann-Whitney test. Kaplan-Meier analysis was performed to determine the relationship between CTTA and DFS. The Cox proportional hazards model was used to assess the independence of texture parameters from other known clinical and imaging parameters.

RESULTS: SD and MPP quantified from fine to coarse texture on arterial phase CT images showed significant associations with the histologic grade (p < 0.05). Univariate analysis identified most CT texture features across the different filters - fine, medium and coarse texture scales were significant univariate markers of DFS. Also a number of known clinical and imaging parameters such as tumor size, the average intensity of tumor, vascular invasion, satellite nodule, necrosis, histologic grade, the level of AFP and PIVKA were significant univariate markers of DFS. A Cox regression model including all significant univariate markers identified that CTTA on arterial phase CT images (fine texture scale - skewness: p = 0.001, coarse texture scale - mean: p = 0.037), satellite nodule (p = 0.003) and tumor size (p = 0.004) were independent predictors of DFS.

CONCLUSION: CTTA could act as a prognostic biomarker in HCCs and play a key complementary role as an adjunct with other known clinical and imaging markers in better risk stratification of these patients.
SS 15 AB-08  09:10
Prognosis after transarterial chemoembolization using DC-beads hepatocellular carcinoma: tumor response evaluation using volumetric assessment
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PURPOSE: To evaluate whether three-dimensional (3D) volumetric assessment may predict patients’ overall survival in patients with hepatocellular carcinoma (HCC) initially treated by transarterial chemoembolization (TACE) using DC-beads.

MATERIALS AND METHODS: This retrospective analysis included 24 patients (M:F = 19:5; mean age, 60.6; ranged, 32-81 years) with HCC who underwent their initial TACE using DC beads. Follow-up computed tomography (CT) was performed in 6 weeks after TACE. Tumor response was evaluated on arterial phase using conventional criteria (European Association for the Study of the Liver guidelines [EASL] and modified Response Evaluation Criteria in Solid Tumors [mRECIST]), and volumetric criteria using a dedicated software (volumetric [v] RECIST for overall tumor volume and quantitative [q] EASL for enhancing lesion volume). Accordingly, patients were classified as responders and non-responders. Kaplan-Meier analysis with log-rank test was used to calculate overall survival between two groups.

RESULTS: Patients were classified into responder and nonresponder according to mRECIST (18:6), EASL (18:6), and qEASL (18:6). None of the patients were classified as responder according to vRECIST criteria. Neither mRECIST nor EASL predicted patients’ overall survival (p = 0.45 and p = 0.66, respectively). Responders on qEASL showed a significantly longer median overall survival than nonresponders (48.9 months vs. 29.4 months, p = 0.014; hazard ratio 0.16).

CONCLUSION: Early volumetric assessment for tumor enhancement may predict overall survival in patients with HCC initially treated with DC beads.
Use of restaging abdominopelvic CT after neoadjuvant chemoradiation therapy in patients with nonmetastatic locally advanced rectal cancer
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PURPOSE: Neoadjuvant chemoradiation therapy (CRT) is current standard for locally advanced rectal cancer without distant metastasis, but it delays surgery for several months. We investigated if restaging abdominopelvic CT after neoadjuvant CRT is beneficial given the time lag from the initial diagnosis.

MATERIALS AND METHODS: 472 patients (M:F, 308:164; 62.2 ± 11.8 years) who had newly diagnosed with rectal cancer (T3 or N+ as assessed with MRI), no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/CT, and no previous (during past 5 years) or concomitant cancers, and underwent long-course CRT were included. Patients were reevaluated 4-6 weeks after CRT with rectal MRI and restaging abdominopelvic CT (n = 231) or with rectal MRI alone (n = 218). 23 patients dropped out. Diagnostic yield of the restaging CT for abdominopelvic metastasis was determined. The rate of overlooked metastasis, defined as lesions that were unexpectedly found during rectal cancer surgery or developed early (within 6 months) after the surgery or CRT (for 8 patients followed without surgery), and the outcome of the overlooked lesions were compared between the two patient groups. Abdominopelvic progression-free survival (PFS) was compared between the two groups.

RESULTS: Diagnostic yield of restaging CT was 2.2% (5/231), all of which were resected with curative intent. Restaging CT created false positives in three patients, causing unnecessary hepatic resection (n = 1), RFA (n = 1), and follow-up liver MRI (n = 1). Restaging CT group had seven patients (3%) with overlooked abdominopelvic metastasis; four patients found during the surgery, three of whom could be operated with curative intent, and three patients as early postsurgical metastasis, one of whom was amenable to curative-intent treatment. The no CT group had seven patients (3.2%) with overlooked metastasis; all as early postsurgical metastasis, three of whom were amenable to curative-intent treatment. These rates did not significantly differ (p = 1). Abdominopelvic PFS did not significantly differ between the two groups (p = 0.426).

CONCLUSION: Restaging abdominopelvic CT after CRT for locally advanced rectal cancer does not have a clear benefit due to its low yield, insufficient exclusion of metastasis, and unignorable risk of false-positives.

Magnetic resonance tumor regression grade to assess response after neoadjuvant chemoradiation therapy for locally advanced rectal cancer: pathologic characteristics of the response assessment system
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PURPOSE: Chemoradiation therapy (CRT) before surgery has become the standard for locally advanced rectal cancer. Imaging methods to assess CRT response have been proposed, of which magnetic resonance tumor regression grade (mTRG) is most prominent although its pathologic characteristics are not well known yet. This study is to determine the pathologic nature of mTRG and suggest how to use mTRG for patient management.

MATERIALS AND METHODS: 472 consecutive patients (M:F, 308:164; 62.2 ± 11.8 years) who had newly diagnosed rectal cancer of T3 or N+ stage as assessed with MRI, no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/ICT, and no previous (during past 5 years) or concomitant cancers, underwent long-course CRT. We finally analyzed 439 patients after excluding dropouts during CRT (n = 19), no post-CRT MRI (n = 4), no surgical resection (n = 9), and loss of pathology data (n = 1). Post-CRT MRI was obtained 4-6 weeks after the finish of CRT. Three experienced abdominal radiologists evaluated CRT response using mTRG (1 to 5). Pathologic tumor regression was graded using surgical specimen according to complete (1), near complete (2), moderate (3), minimal (4), and no regression (5). We performed a correlative analysis between mTRG and pathologic TRG and pT stage.

RESULTS: The study cohort consisted of pathologic TRG1 (n = 88), 2 (n = 113), 3 (n = 175), 4 (n = 62), and 5 (n = 1). mTRG grades distributed similarly, showing 15% mTRG1 (n = 66), 25.5% mTRG2 (n = 112), 37.1% mTRG3 (n = 163), 21.4% mTRG4 (n = 94), and 0.9% mTRG5 (n = 4). mTRG1 showed complete and near complete regression in 60.6% and 27.3%, respectively. These were 22.3% and 52.7%, respectively, for mTRG2. mTRG3 and 4 had only 26.4% and 14.9%, respectively, rates of combined complete and near complete regression. Pathologic T stages of mTRG1 were pT0 (i.e., complete regression) in 60.6%, pT2 or lower in 89.4%, and pT3/4 without achieving near complete regression in only 3%. When mTRG1 and 2 are combined, these values were 36.5%, 77.5%, and 7.9%.
CONCLUSION: mrTRG1, possibly combined mrTRG 1 and 2, seems to be reasonable criteria to recommend a local excision instead of a radical surgery while it seems unclear if mrTRG could be a robust tool to find candidates for nonsurgical observation.

SS 19 AB-04  10:20
How to accurately measure the location of rectal cancer on preoperative MR imaging: a prospective study with anal verge marker
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PURPOSE: To find a feasible way to determine the location of anal verge as an anatomical landmark and the exact distance from it to the tumor on rectal MR imaging.

MATERIALS AND METHODS: Total 50 consecutive patients scheduled for MRI for the evaluation of rectal cancer from February to October 2016 were enrolled in this prospective study. Under informed consent, two skin markers were attached to the verified anal verge (6 & 12 o’clock direction) just before MR scan. Makers were spherical, 6 mm sized, made of gel and paraffin film, and appeared hyperintense on T2 weighted image (T2WI). On sagittal T2WI, the distance between the lowest margin of cancer and the upper tangent of two markers was independently measured by two radiologists in 6 different ways, and the measurements were compared with those of the rigid sigmoidoscope as gold standard. Intraclass correlation coefficient (ICC) was used for the correlation verification. Precise localization of anal verge was also analyzed based on anal verge marker and surrounding anatomical structures on rectal MRI.

RESULTS: Among 6 different measuring methods, “Direct center method” showed the highest correlation with gold standard (ICC = 0.81) and good interobserver correlation (ICC = 0.98), statistically. “Direct center method” measures the straight distance between A and B on mid-sagittal T2WI (A; center of the line segment abutting the lowest margin of tumor and perpendicular to the longitudinal axis of rectum, B; upper tangent of the anal verge markers). The location of anal verge identified by marker was within a range of -1.4~1.5 cm (mean, -0.24 cm, SD 0.65 cm) from the lowest margin of the external sphincter (negative value means that anal verge is above the lowest margin of the external sphincter).

CONCLUSION: The “direct center method” is accurate and relatively easy way to measure tumor location on preoperative rectal MRI. The anal verge is located between 1.4 cm above and 1.5 cm below the lowest margin of the external sphincter, and more frequently it is in the upper portion of the lowest margin of the external sphincter. Among the many unproven methods for tumor localization, “direct center method” based on the exact location of anal verge is the best feasible method for preoperative cancer localization on rectal MRI.

SS 19 AB-05  10:30
Systematic review and meta-analysis of CT features for differentiating complicated and uncomplicated appendicitis
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PURPOSE: The role of CT in differentiating complicated appendicitis has become more important, as evidence for conservative management of uncomplicated appendicitis accumulates. This systematic review and meta-analysis aimed to identify CT features for differentiating complicated appendicitis, and to summarize their diagnostic accuracy.

MATERIALS AND METHODS: 23 studies on CT diagnosis of complicated appendicitis (perforated or
gangrenous appendicitis) were selected via systematic review. Pooled sensitivity, specificity, odds ratio (OR), positive and negative likelihood ratios, and their 95% confidence intervals (CI) were calculated using bivariate random effects model. CT features with pooled diagnostic OR with 95% CI not including 1 were considered informative.

RESULTS: 184 overlapping descriptors for various CT findings were subsumed under 14 features. Of those 14 features, 10 features were informative for complicated appendicitis. There was general tendency for these features to show relatively high specificity, but low sensitivity. “Extraluminal appendicolith”, “abscess”, “appendiceal wall enhancement defect”, “extraluminal air”, “ileus”, “periappendiceal fluid collection”, “ascites”, “intraluminal air” and “intraluminal appendicolith” showed pooled specificity above 70% (ranging 74% to 100%), but sensitivity limited in range from 14% to 59%. “Periappendiceal fat stranding” was the only feature that showed high sensitivity (94%; 95% CI, 86%-98%) but low specificity (40%; 23%-60%).

CONCLUSION: The study identified 10 informative CT features, 9 of which showed high specificity, but low sensitivity. For avoidance of potential complication following false negative diagnosis in using conservative management for uncomplicated appendicitis, presence of any of the 9 features could be regarded as a predictor for complicated appendicitis not amenable to conservative management.

SS 19 AB-06 10:40
Correlation between perfusion CT and dual-energy CT in colorectal cancer
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PURPOSE: To determine the correlation of iodine density derived from dual-energy CT (DECT) and perfusion CT parameters in patients with pathologically-proven colorectal cancer (CRC) with its intra- and inter-observer agreements.

MATERIALS AND METHODS: Institutional Review Board, Ethics Committee Approval and written informed consent were obtained. Forty-six patients with CRC who underwent same day DECT and perfusion CT were prospectively enrolled. Three radiologists independently analyzed iodine density of the lesion and iodine ratios (iodine attenuation of the lesion divided by iodine attenuation of the aorta (A) or IVC (V)) from DECT and blood flow (BF), blood volume (BV), time to peak (TTP), permeability (PMB), and mean transit time (MTT) from perfusion CT. Pearson R and linear correlation tests were used to correlate between DECT and perfusion CT. Intra- and inter-observer agreements were analyzed using kappa statistics and intraclass correlation coefficient (ICC); in addition, radiation dose was also compared using a paired t-test.

RESULTS: DECT was successful in all 46 patients; however, only 30 patients were enrolled for further analysis because 16 patients failed to obtain adequate perfusion CT parameters due to bowel movement. Significant correlations were found between iodine parameters from DECT and perfusion CT parameters: iodine density and BF (r = 0.412, p = 0.024), iodine density and BV (r = 0.461, p = 0.01), iodine ratio (A) and BF (r = 0.3714, p = 0.043), iodine ratio (A) and BV (r = 0.418, p = 0.022), and iodine ratio (V) and PMB (r = 0.476, p = 0.008). DECT represented better intra-observer and inter-observer agreement (k = 0.99, ICC = 0.97 in iodine density; k = 0.98, ICC = 0.93 in iodine ratio (A); and k = 0.89, ICC = 0.93 in iodine ratio (V), respectively) than those of perfusion CT (k = 0.92, ICC = 0.91 in BF; k = 0.85, ICC = 0.86 in BV; k=0.95, ICC=0.76 in PMB, respectively). The volume of CT dose index and dose-length product in DECT (10.26 ± 1.73 mGy and 506.7 ± 115.6 mGy*cm) were significantly lower than those of perfusion CT (75.76 mGy and 911 mGy*cm).

CONCLUSION: Iodine parameters from DECT are significantly correlated with perfusion CT parameters with better intra- and inter-observer agreements and lower radiation exposure.
SS 19 AB-07 10:50
Interobserver reproducibility in assessing the response after neoadjuvant chemoradiation therapy for locally advanced rectal cancer using magnetic resonance tumor regression grade (mrTRG)
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PURPOSE: Methods to assess the response after neoadjuvant chemoradiation therapy (CRT) for locally advanced rectal cancer on post-CRT MRI have been proposed, of which magnetic resonance tumor regression grade (mrTRG) is seemingly most recognized. However, interobserver reproducibility of mrTRG has hardly been evaluated outside those who developed the mrTRG system. This study is to assess the interreader reproducibility of mrTRG externally.

MATERIALS AND METHODS: 50 pairs of pre- and post-CRT (obtained 4-6 weeks after the finish of CRT) rectal MRI sets obtained in 50 patients (M:F = 36:14; 65.5 ± 12.4 years), who were randomly chosen from a consecutive cohort of 439 patients who underwent long-course CRT for a newly diagnosed locally advanced rectal cancer (T3 or N+ stage as seen on pre-CRT MRI, no distant metastasis, and no other previous or concomitant cancers), were included. Before the study, three abdominal radiologists experienced with rectal MRI went through an educational session consisting of a review of 50 training cases collected outside the study cohort and reading of relevant articles. The three readers assessed the CRT response for this study using mrTRG (1 to 5) independently blinded to any other information than the history of CRT. We analyzed interreader reproducibility regarding the description of individual mrTRG (1 to 5) as well as regarding the binary interpretation of mrTRG1 and 2 (i.e., good response) versus 3-5, using weighted kappa with linear weights and the conventional kappa, respectively. For mrTRG1 and 2 versus 3-5, the proportional agreement was also obtained.

RESULTS: According to the consensus interpretation among the three readers, the mrTRG distribution in the study patients was 14% mrTRG1 (n = 7), 26% mrTRG2 (n = 13), 32% mrTRG3 (n = 16), 28% mrTRG4 (n = 14), and 0% mrTRG5. The weighted kappa for describing the individual mrTRG (1 to 5) was 0.62 overall and 0.60 to 0.62 for individual reader pairs. The kappa for mrTRG1 and 2 versus 3-5 was 0.65 overall and 0.57 to 0.72 for individual reader pairs. The proportional agreement in interpreting mrTRG1 and 2 versus 3-5 was 83% overall and 80-86% for individual reader pairs.

CONCLUSION: mrTRG showed a substantial inter-observer reproducibility, which further supports its implementation for use in clinical practice and trials.

SS 19 AB-08 11:00
Assessment of the neoadjuvant chemoradiation outcomes in patients with clinical T1/T2 rectal cancer using the MRI tumor regression grade
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PURPOSE: To analyze magnetic resonance imaging (MRI) tumor regression grade (mrTRG) for predicting the outcomes after the neoadjuvant chemoradiation in patients with clinical T1/T2 rectal cancer.

MATERIALS AND METHODS: Between 2012 and 2016, we retrospectively registered 39 patients with clinical T1/T2 rectal cancer who had undertaken either the total mesorectal excision or local excision after the neoadjuvant chemoradiation. Initial rectal MRI was visually analyzed to determine the mural involvement of the primary tumor (partial or transmural involvement) and both initial and post-treatment rectal MRI were reviewed for mrTRG. Surgical pathologic assessment including Mandard grade was used to evaluate the tumor regression after the neoadjuvant chemoradiation and Mandard grade 1 was considered as pathological complete response (pCR). Associations of mrTRG and the mural involvement of the primary tumor with Mandard grade and pathologic T stage (pT) were analyzed.

RESULTS: Out of 39 patients, twenty patients had mrTRG 1 and nineteen patients had mrTRG 2-4 (mrTRG2 = 11, mrTRG3 = 6, mrTRG4 = 2). Sixty-five percent (13/20) of mrTRG 1 patients showed pCR, and this positive predictive value of mrTRG 1 was higher than observed pCR rate (18/39, 46.2%). The odds of accomplishing pCR were 5.2 times higher for mrTRG 1 than they were for mrTRG 2-4 (95% confidence interval [CI]: 1.3-20.5, p = 0.019). Univariate analysis of the mural involvement of primary tumor indicated that the difference in probability of pCR did not reach the significance (OR = 1.1, 95% CI = 0.3-3.9, p = 0.882). Ninety percent (18/20) of mrTRG 1 patients had early stage cancer (pT0, pTis and pT1) after the preoperative chemoradiation. Univariate analysis demonstrated that mrTRG1 group was significantly more likely to have early stage cancer than was mrTRG2-4 group (OR = 8.1, 95% CI = 1.5-45.1, p = 0.017), while the odds ratio of partial involvement of the primary tumor was not statistically significant (OR = 3.6, 95% CI = 0.8-16.3, p = 0.103).

CONCLUSION: mrTRG 1 can be used as a supportive factor to predict the complete response after the
neoadjuvant chemoradiation in patients with clinical T1/T2 rectal cancer. Moreover, mrTRG seem to deduce pathologic early stage rectal cancer which can be the candidate for local excision rather than total mesorectal excision.

SS 19  AB-09  11:10
Comparison of standard staging protocol and WB-MRI for initial staging of rectal cancer
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PURPOSE: To evaluate the clinical feasibility of whole-body magnetic resonance imaging (WB-MRI) including contrast-enhanced T1-weighted imaging (T1WI) and diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) in rectal cancer initial staging.

MATERIALS AND METHODS: This retrospective study was approved by our IRB and the requirement for informed consent was waived. A total of 133 patients (M:F = 87:46; mean age, 62.4 years) who underwent standard protocol (chest, abdomen computed tomography and rectal MRI), WB-MRI (WB-T1WI and DWIBS) at 3T for initial staging were included. One attending radiologist reviewed standard protocol and two attending radiologists reviewed WB-MRI in consensus. Finally, “true” M staging was obtained using either biopsy or follow-up imaging. Agreement of M-staging for rectal cancer was obtained between standard protocol and WB-MRI, between true M-stage and standard-protocol and WB-MRI.

RESULTS: The agreement for M-staging between standard protocol and WB-MRI was 83.5% (111/133). M-staging of WB-MRI agreed to that of standard protocol in 96.0% (97/101) for M0, and 43.7% (14/32) for M1. M-staging agreement between standard protocol and “true” M-stage was 86.5% (115/133); standard protocol agreed to “true” M-staging in 86.8% (99/114) for M0 and in 88.9% (16/18) for M1. WB-MRI showed 94.0% (125/133) of agreement to “true” M-staging: the agreement rates between the two were 97.4% (111/114) for M0 and 77.8% (14/18) for M1. One patient who was reported as having lung metastasis on both protocols was confirmed with primary lung cancer on biopsy.

CONCLUSION: WB-MRI showed high agreement with standard protocol for initial rectal cancer staging and “true” M-staging.