

segmented the liver on unenhanced T1-weighted magnetic resonance images using the new prototype software and an established semi-automatic liver tumor segmentation software, which was considered the gold-standard. The segmented volumes and processing times were recorded. Statistical significance was assessed with paired *t*-tests and Wilcoxon rank-sum tests.

**Results:** Using the established software, median liver volume was 1692 cc (range 1014 - 3197 cc). The prototype's first pass reported median liver volume of 1686 cc (range 1084 - 2361.1 cc), resulting in a median segmentation error of 63 cc or 4.9% ( $p=0.150$ ). Specifically, the segmentation error was  $<10\%$  in 19 patients (76%), 10-20% in 3 patients (12%), 20-30% in 2 patients (8%) and  $>30\%$  in 1 patient (4%). After the second pass, the median liver volume was 1689 cc (range 1025 - 3180 cc), corresponding to a median segmentation error of 13 cc or 0.8% ( $p=0.174$ ). The mean processing time of the prototype's first and second pass was  $9.2 \pm 0.9$  and  $70 \pm 46$  seconds, respectively. Overall, the prototype was significantly faster than the established software ( $79 \pm 46$  vs.  $145 \pm 47$  seconds;  $p<0.001$ ).

**Conclusion:** In the majority of patients (76%), the automatic calculation of the liver volume was done within 10 seconds with a segmentation error  $<10\%$ . After user modifications, the segmentation error dropped to  $<1\%$  while still having a 46% reduction in total segmentation time compared to the established software. The prototype is an accurate and work-flow efficient segmentation solution for diseased livers.

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Abstract No. 230

### Map the fat: near field temperature monitoring during MRgFUS treatment of uterine fibroids

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**Purpose:** MR guided focused ultrasound (MRgFUS) is a novel treatment for symptomatic uterine fibroids. Near field tissue heating during the procedure may result in skin burns and potentially cause tissue necrosis. The purpose of this study was to prospectively evaluate near field skin and adipose tissue heating during MRgFUS treatment of symptomatic uterine fibroids.

**Materials and Methods:** Seven women were enrolled in the study and treated on a 3T MRgFUS system (GE Healthcare, Waukesha, WI and InSightec, Haifa, Israel) between July 2013 and June 2014. Fat temperature mapping was performed during the MRgFUS treatments with sonication energy up to 5700 J and duration of 20 seconds per sonication (70-98 sonications total). T2 maps of the abdominal fat were acquired between sonications.

**Results:** In all patients, there was a measurable change in T2 of the adipose tissue in the path of the sonication beam. The areas of the increased temperature after a number of sonications matched the intersection of the ultrasound beam with the slice being treated. A temperature increase of up to  $15^{\circ}\text{C}$  was noted in the adipose tissue, with sustained heating to temperatures of  $50\text{-}52^{\circ}\text{C}$  throughout the treatment.

**Conclusion:** During MRgFUS treatment for uterine fibroids, near field heating of the skin and adipose tissue reaches high

temperatures. The cumulative high thermal dose may result in skin burns and necrosis of adipose tissues. Our results demonstrate the feasibility and importance of monitoring near field heating in adipose tissues using T2 mapping.

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Abstract No. 231

### Screening of renal artery pseudoaneurysms by early postoperative contrast-enhanced computed tomography in patients without renal impairment after partial nephrectomy and prophylactic embolization

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**Purpose:** To retrospectively evaluate whether prophylactic embolization of renal artery pseudoaneurysms after partial nephrectomy in patients without renal impairment can prevent delayed hemorrhage.

**Materials and Methods:** Between January 2012 and May 2014, early postoperative contrast-enhanced computed tomography (CT) at 3-5 days after partial nephrectomy was performed in 312 patients (group A). If renal artery pseudoaneurysms were detected on CT, prophylactic embolization was performed. Frequency of delayed hemorrhage that occurred more than 3 days after surgery in group A was compared with that of 212 patients (group B) who underwent partial nephrectomy between January 2010 and December 2011 without early postoperative CT. Changes in estimated glomerular filtration rate (eGFR) at discharge were compared between the groups.

**Results:** Prophylactic embolization of renal artery pseudoaneurysms was performed in 26 patients (8%) in group A. Frequency of delayed hemorrhage in group A (0.6%) was significantly lower than that in group B (4.7%,  $p = 0.002$ ). No major complications attributable to prophylactic embolization were observed. The decrease in eGFR in group A ( $-2 \pm 13\%$ ) was not worse than that in group B ( $-4 \pm 14\%$ ,  $p = 0.108$ ).

**Conclusion:** Prophylactic embolization of renal artery pseudoaneurysms in patients without renal impairment can prevent delayed hemorrhage after partial nephrectomy, without major complications.

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Abstract No. 232

### Open trajectory cone-beam CT acquisition improves liver visualization during IR procedures

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**Purpose:** Cone-beam CT (CBCT) facilitates intra-procedural visualization and assessment of liver cancer during intra-arterial therapies (IAT). However, high BMI patients present a challenge to the image acquisition in terms of capturing the

liver region of interest while still allowing for the C-arm to rotate around the patient. The geometric motion of the C-arm at our institution (Allura FD20, Philips Healthcare, Best, The Netherlands) was modified to rotate from 55 to -185 degrees (open trajectory) instead of 120 to -120 degrees (closed trajectory). All other imaging parameters were the same. This opened up room for asymmetrical positioning of the patient, allowing for centering the field of view (FOV) on the liver rather than on the spine. The purpose of this study was to compare the liver coverage between closed and open trajectory CBCT.

**Materials and Methods:** 15 patients (mean age  $65 \pm 5$  years, mean BMI  $27.9 \pm 5.6$ ) who underwent two sessions of IAT had CBCT acquisitions with both the closed (during 1<sup>st</sup> IAT session) and open (during 2<sup>nd</sup> IAT session) trajectories. The liver volumes were measured using a 3D segmentation software on intra-procedural CBCT and the pre-IAT MRI. In addition, the number of missed or partially depicted lesions on both trajectories were assessed. MRI was used as the standard because of its larger FOV that captures the entire liver. Statistical significance was assessed with a paired t-test.

**Results:** The mean liver volume according to both MRs showed no significant difference ( $1973 \pm 633$  vs.  $1929 \pm 628$  cc,  $p=0.642$ ). On closed trajectory CBCT, a mean liver volume of  $1695 \pm 542$  cc was measured, whereas the mean liver volume using open trajectory was  $1857 \pm 571$  cc. The liver coverage of open trajectory CBCT was significantly higher compared to closed trajectory CBCT (96% v. 86% of the liver volume as measured on MR,  $p=0.002$ ). In 8 out of 15 patients (53.3%), intrahepatic lesions were either missed or only partially depicted due to the lower coverage of closed trajectory CBCT. All lesions (100%) were completely depicted using the open trajectory CBCT.

**Conclusion:** The open trajectory CBCT acquisition allows for more complete depiction of the liver.

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Abstract No. 233

### Utility of MRV in screening stroke patients for May-Thurner syndrome

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**Purpose:** Cryptogenic stroke accounts for up to 40% of ischemic strokes. As part of the workup for cryptogenic stroke, patients may get a pelvic MRI to assess for May-Thurner syndrome. The aim of this study was to investigate the incidence of May-Thurner syndrome (MTS) in patients with cryptogenic stroke.

**Materials and Methods:** In this IRB approved study a search of our electronic report database for terminology consistent with MTS and stroke. Over a 12-year period from 2001-2013, 214 patients with cryptogenic stroke had an MRV study of the pelvis to evaluate for MTS as the potential etiology of the patient's stroke. As a control, 50 consecutive patients who obtained CT angiograms were randomly selected to assess for presence of MTS. Patient demographics, medical history, MRV findings and the presence of signs of MTS, thrombosis and classic May-Thurner anatomy were recorded. The degree of iliac vein

compression was calculated as the AP diameter of the iliac vein at the site of crossing of the overlying iliac artery divided by the AP diameter of the uncompressed caudal iliac vein segment. Fisher's Exact test was used to compare the presence of MTS in the stroke and control groups. Student t-test was used to compare the difference in the degree of compression of the left iliac vein in the stroke and control group.

**Results:** There were 111 men and 103 women (mean age 52, range: 17-95) with cryptogenic stroke. In the stroke group, 177 patients (82%) had a history of PFO and 67 patients (31%) had MTS; compression of the left common iliac vein by the overlying right common iliac artery exceeded 50%. There were 33 men and 17 women (mean age 56, range 23-91) in the control group and only 4 patients (8%) had MTS. Incidence of MTS in the stroke group was significantly greater than the control group ( $p=0.0006$ ). Also, there was significantly more compression of the left common iliac vein in the stroke group (32% compression; range 0-100%) compared to the (13% compression, range 0-68%) ( $p<0.00001$ ).

**Conclusion:** There has been a recent surge in interest in obtaining MRV to evaluate cryptogenic stroke patients. Our results indicate that MRV of the pelvis may be appropriate in this context.

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Abstract No. 234

### Pre-procedural MRA for treatment planning prior to prostate artery embolization

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**Purpose:** The purpose of our study was to assess the utility of pre-procedural MRA in identifying the arterial vascular supply to the prostate to facilitate planning for prostate embolization.

**Materials and Methods:** This retrospective study includes 7 patients who underwent MRA of both iliac arteries followed by prostate embolization in a single institution over the course of 1 year. The prostatic arteries were identified on multiplanar and curved planar reformats. A centerline drawn through the prostatic artery on a curved planar reformat was then superimposed upon a rotational maximum intensity projection of the internal iliac artery to depict the origin and trajectory of the prostatic artery. Results of the MRA were compared with angiographic findings to assess the accuracy of MRA in detecting the origin of the prostatic artery.

**Results:** MRA successfully identified 11 of 14 prostatic arteries. The left prostatic artery and its origin were not identified in 3 patients. Seven right and 7 left prostatic arteries were identified during the angiogram. Of the prostatic arteries visualized on the MRA, there was 100% concordance with the angiogram in identifying the origin of the vessel.

**Conclusion:** Our findings suggest that a pre-procedural MRA may be beneficial in identifying the prostatic artery and its origin to facilitate prostate artery embolization. Of the vessels identified by MRA, there was high accuracy in assessing the vessel origin. Furthermore, rotational capability of the MRA can further assist in identifying the best angulations to use during angiography to identify the origin of the prostatic artery. Further studies are needed to validate the utility of MRA prior to PAE.