Diffusion Weighted MR Imaging of Peritoneal Tumor: Comparison with Conventional MR Imaging, and Surgical and Histopathologic Findings

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Purpose: To evaluate the utility of single shot SE EPI diffusion weighted imaging (DWI) using a b value of 300-500 s/mm^2 for depicting peritoneal tumor. The depiction of peritoneal metastases on cross sectional imaging is complicated by the diffuse spread of tumor and the extensive surface area of the peritoneum which may serve as sites of tumor deposition. Delayed gadolinium-enhanced MR imaging has been shown to be more accurate than helical CT for depicting small volume peritoneal tumors.

The use of diffusion weighted MR imaging of the abdomen and pelvis provides a new contrast mechanism to evaluate patients with abdominal malignancy. We hypothesized that on DW images ascites and bowel contents would be suppressed while peritoneal and serosal tumors would show restricted diffusion and be depicted as areas of high signal intensity. We undertook this study to determine if the information from DW images would improve the accuracy of MR imaging for depicting peritoneal metastases in oncology patients.

Materials and Methods: Twenty-four oncology patients (17 women and 7 men, mean age 58.5 yrs) underwent preoperative abdominal MRI imaging. Primary tumors included ovarian cancer (7), pseudomyxoma peritonei (8), colon cancer (4), esophageal cancer (1), pancreatic cancer (1), breast cancer (1), urachal cancer (1), and a GIST (1). MR imaging of the abdomen and pelvis included breath-hold Single shot spin-echo EPI DWI b value 300-500 s/mm^2, TR 2800-3500, TE 50-58 ms, matrix 256x128 or 192x224, slice thickness 7-8mm, 2-3 nex, gradient overplus to combine the diffusion signal from all three vectors. Time of breath hold was 23-26 seconds for 24 slices with the abdomen and pelvis acquired as two separate breath hold acquisitions. Single shot RARE coronal images and axial T1 gradient-echo; fat suppressed T2-weighted images were obtained through the abdomen and pelvis. Following IV injection of 0.2 mmol/kg gadolinium chelate dynamic fat suppressed gadolinium-enhanced 3D gradient-echo imaging, and delayed fat suppressed 2D gradient-echo MR imaging was performed. Delayed coronal and sagittal 3D gradient-echo images were also obtained. MR exams were performed on a 1.5T Philips Achieva MR scanner or a General Electric Signa HD scanner.

At three separate sessions images were reviewed for peritoneal tumor at 16 anatomic sites including the right subphrenic, left subphrenic, gastric, lesser omentum, lesser sac, right subhepatic, right paracolic, left paracolic, omentum, small bowel mesentery, small bowel, colon, pelvis, uterine serosa, ovaries, and bladder. First the DW images alone were reviewed, followed by the unenhanced and gadolinium-enhanced MRI, and finally the combined DWI and MRI were reviewed together.

All patients underwent subsequent surgical exploration for tumor debulking and staging. A site-by-site comparison of the findings on DWI, MRI, and combined DWI and MRI was made with results of surgical and histopathologic evaluation. Sensitivity, specificity, and accuracy were calculated for the DWI, MRI, and combined DWI and MRI.

Results: One hundred and fifty-three sites of peritoneal tumor were proved by surgical and histopathologic findings. DWI depicted 114 sites of peritoneal tumor with 24 false positive sites (sensitivity 75%, specificity 87%, accuracy 81%), compared to MR images 119 sites with 26 false positive sites (sensitivity 78%, specificity 86%, accuracy 82%), and combined DWI and MRI 141 sites with 14 false positive sites (sensitivity 92%, specificity 92%, accuracy 93%).

Peritoneal tumor demonstrated restricted diffusion with high signal intensity on DWI. Ascitic fluid was low signal intensity on DWI increasing conspicuity of peritoneal tumors. The addition of the DWI to the conventional MR images was particularly effective in depicting additional mesenteric and bowel serosal tumor; showing additional mesenteric tumor in three patients, small bowel serosal tumors in four patients, and serosal colonic tumor in four patients. DWI also showed uterine serosal implants in four additional patients not depicted on conventional MR images. In 18 of 24 (75%) the DWI increased the confidence for image interpretation and in 15 (63%) patients the DWI added new information.

Conclusions: Adding DWI to routine MRI improves the sensitivity and specificity for depicting peritoneal metastases. Breath-hold DWI is now routinely used in all oncology patients referred for abdominal MRI.

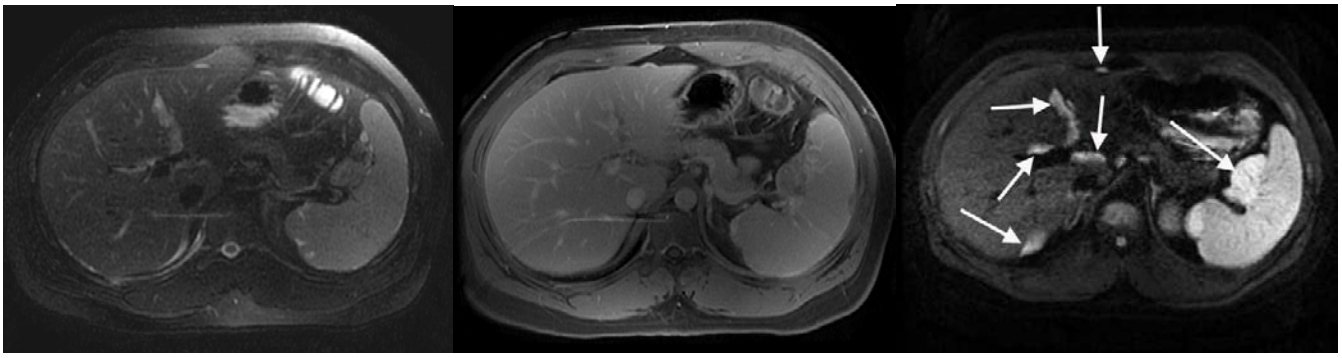

Figure 1: Patient with pseudomyxoma peritonei. T2-weighted image (left) shows small perisplenic metastases. Delayed gadolinium-enhanced SGE image (middle) shows small peritoneal perihepatic and perisplenic metastases. DWI b300 s/mm^2 s/mm^2 (right) shows large metastasis medial to spleen, and smaller portal, portal caval, perihepatic, and right subhepatic tumor. In this case the central periportal and portal caval tumor is better depicted on the DW image.