

Preoperative Evaluation of Peritoneal Carcinomatosis using Multiphase Dynamic Contrast Enhanced MR-Imaging in Correlation with Complete Surgical Exploration and Histopathology

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Background: Peritoneal carcinomatosis (PC) appears in a variety of different tumor entities and comes along with limited patient prognosis. However, new approaches in the treatment of PC are developed so that accurate pre therapeutic assessment of the presence and extent of PC to determine therapeutic strategies is mandatory (1, 2). Total peritonectomy and multivisceral resection with additional hyperthermic intraperitoneal chemotherapy (HIPEC) is a new approach with curative intention in patients with PC. Regarding extent and accompanying morbidity and mortality of this concept, accurate patient selection to achieve optimal results is preliminary (3). Above all, contraindications such as visceral involvement resulting in irresectability have to be ruled out (3).

MRI provides high diagnostic accuracy ranging at 90% for PC but limited sensitivity for small lesions of less than one centimeter (1, 2). The most commonly used technique for the evaluation of PC is MDCT. Several studies indicate that MRI might benefit from superior soft tissue contrast compared with MDCT (4).

Aim of our study was to evaluate the diagnostic potential of contrast enhanced multiphase dynamic MRI (T1wDCE) in patients with PC in correlation with surgical exploration and histopathologic findings.

Method and Materials: 15 patients with PC scheduled for peritonectomy and hyperthermic intraperitoneal chemotherapy (HIPEC) were included. Surgery included peritonectomy, omentum resection, multivisceral resection of involved intestine and organs.

Mean age of patients was 57.9±8.8 years, range 43-75, 4 male, 11 female. The underlying disease was ovarian cancer (6/15), appendix carcinoma (4/15), colorectal cancer (3/15), tubarian cancer (1/15) and malignant mesothelioma (1/15).

MR examinations were performed on a 1.5T whole body system using two phased array surface coils (Magnetom Avanto, Siemens Health Care, Erlangen, Germany). Multiphase dynamic 3D gradient echo sequences in coronal angulation were acquired prior to contrast injection, 35s, 70s and 105s after injection of 0.15mmol Gd-chelate/kg bw at a flow rate of 2 ml/s (TR 2.9ms, TE 1.1ms, flip angle 18°, slice thickness 1.8mm, matrix 256x256, receiver band width 560 Hertz/pixel, GRAPPA 3, spatial resolution 2.0x2.0x1.8mm). Patient preparation included i.v. injection of 40 mg buscopan to reduce intestinal motion artifacts and oral administration of 2000 ml mannitol solution (2.5%) for distension of the intestine to achieve optimal imaging conditions.

Image analysis was performed by two independent experienced radiologists. MR images were assessed for the presence and extent of PC based on the peritoneal cancer index (PCI) suggested by Sugarbaker et al. (5) consisting of 13 segments, thereof 9 peritoneal and 4 intestinal segments as well as for the presence of visceral, lymphatic or bone metastases. Lesion size was rated on a four point scale (lesion size score 0-4, LS 0 = no tumor detected, LS 1 = tumor<0.5 cm, LS 2 = tumor<5 cm, LS 3 = tumor or conglomerate>5, PCI 0-39)

MR images were compared with the results of total surgical exploration of the complete peritoneal cavity as standard of reference regarding localization and size of PC manifestations.



Fig. 1: 56-year old patient with colorectal cancer: mesenteric nodules (-▶), peritoneal thickening and contrast enhancement (- ◀♦), adhesions of parietal and visceral peritoneum (→), ascites, thickening and contrast enhancement of visceral peritoneum of the small bowel, PCI 35

Fig. 2: 61-year old patient with malignant mesothelioma: peritoneal thickening and contrast enhancement, adhesions of parietal and visceral peritoneum, ascites, thickening and contrast enhancement of visceral peritoneum of the small bowel (- ◀♦), carcinosis of the greater omentum (→), PCI 18.

Fig. 1

Fig. 2

Results: MR-findings included ascites, peritoneal thickening and contrast enhancement, peritoneal nodules, peritoneal masses, adhesions of parietal and visceral peritoneum and omental caking. More discrete findings included diffuse hyperenhancement of the small bowel and adhesions between intestinal structures. The presence of pelvic masses indicated the local recurrence of the underlying disease.

Of 195 segments assessed by MRI, PC was suspected in 122 segments. Surgical exploration detected PC in 140 of 195 segments. PC could not be detected by MRI in 23 segments that were found by surgical exploration to be involved (false negative). Thereof 6 were located in the small bowel. In 5 segments suspected to be affected by PC, findings were not confirmed by surgical exploration (false positive). The mean PCI score was 18.1±12.2 ranging from three to 38 of 39 possible points. MRI yielded a sensitivity of 84% and a specificity of 91% for the presence of PC per segment compared with surgical exploration. The negative predictive value was calculated with 68% and the positive predictive value with 96%. The resulting diagnostic accuracy of MRI for the presence of PC compared with surgical exploration was 86%. The optimal contrast phase varied dependent on the underlying disease.

Conclusion: T1wDCE reliably provides accurate preoperative assessment of PC regarding resectability to ensure optimal patient selection for complete peritonectomy and HIPEC.

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