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NARROW-BAND IMAGING IMPROVES DETECTION OF COLORECTAL PERITONEAL METASTASES: A CLINICAL STUDY COMPARING ADVANCED IMAGING TECHNIQUES

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Objectives

Cytoreduction and hyperthermic intraperitoneal chemotherapy (HIPEC) improve survival of patients with colorectal PM. Complete cytoreduction is crucial for oncologic outcome, but depends on visual inspection and tumor palpation by the surgeon. Advanced imaging techniques might improve detection of PM, leading to improved cytoreduction rates and better survival. This study compared three advanced imaging techniques to conventional white light imaging for detection of colorectal peritoneal metastases (PM): narrow-band imaging (NBI), near-infrared indocyanin green fluorescent imaging (NIR-ICG) and spray-dye chromoendoscopy (SDCE).

Methods

This prospective clinical feasibility study included patients with colorectal PM. During exploratory laparoscopy prior to cytoreduction and HIPEC all abdominal regions were inspected with (1) conventional white light imaging, (2) NBI, (3) NIR-ICG, and (4) SDCE. Biopsies were taken of all visualized lesions. Primary endpoints were sensitivity and specificity for detection of PM, using pathological examination of all lesions as reference standard. Safety was assessed for all techniques.

Results

Between May 2016 and January 2018, 28 patients were included and analyzed with four different techniques, resulting in 169 biopsies (50 malignant, 119 benign). Sensitivity for detection of PM was 80.0% with conventional white light imaging, and increased to 96.0% (p = 0.008) and 85.7% (p > 0.5) with NBI and SDCE, respectively. Lesions were not fluorescent using NIR-ICG. Specificities for white light imaging, NBI, and SDCE were 74.8%, 71.4%, and 79.5%, respectively (not statistically significant). No adverse events related to the imaging techniques occurred in any of the patients.

Conclusion

Narrow-band imaging substantially and significantly increased detection of PM. This method is safe and feasible for improving detection of metastatic lesions and optimizing cytoreduction in patients with PM.

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MRI OF PERITONEAL MALIGNANCY: 28 YEAR EXPERIENCE WITH PREOPERATIVE EVALUATION AND SURVEILLANCE MRI OF PATIENTS UNDERGOING CRS AND HIPEC

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Objectives

To review our 28-year experience using MRI for preoperative evaluation and surveillance following CRS and HIPEC. Limited contrast resolution of CT and spatial resolution of PET hinder their use for imaging peritoneal metastases. MRI with gadolinium-enhanced imaging, diffusion imaging, and perfusion imaging offers significant advantages for the radiologist in staging peritoneal malignancy and in detecting recurrence.

Methods

We will discuss the technical issues surrounding peritoneal imaging including patient preparation, MRI protocols, and MR image interpretation. For patients being considered for CRS and HIPEC we compare preoperative MRI PCI with surgical PCI. Following CRS and HIPEC patients were followed with serial serum tumor markers and routine surveillance MRI every 6 months to detect recurrence.

Results

For preoperative evaluation prior to CRS and HIPEC there was no significant difference between the preoperative MRI PCI and surgical PCI. MRI correctly categorized tumor volume found at surgery in 29 (88%) of 33 patients. MRI accurately categorized the tumor volume as small volume (PCI 0–9) in 89% of patients, moderate volume (PCI 10–20) in 75% of patients, and large volume (PCI >20) in 90% of patients. In a comparison of MRI and CT the mean operative PCI of 33 agreed with the MRI PCI of 36 while CT PCI of 15 consistently underestimated the volume of tumor. Notably in the small bowel areas MRI had an accuracy of 92% versus 48% for CT.

For determining resectability of tumors preoperative MRI routinely depicts sheets of tumor cells involving the small bowel serosa and mesentery that is typically not seen on CT or PET.

For patients in surveillance following CRS and HIPEC we found that in 50 patients with appendiceal neoplasm MRI detected tumor recurrence earlier than serial tumor markers. During surveillance MRI detected recurrent tumor in 28 patients including 11 patients with normal laboratory values (sensitivity 0.93, specificity 0.95, accuracy 0.94, PPV 0.97, and NPV 0.90). Serial laboratory values showed tumor recurrence in 14 patients (sensitivity 0.48, specificity 1.00, accuracy 0.69, PPV 1.0, and NPV 0.57).

Conclusion

MRI provides superior depiction of small volume peritoneal tumor compared to CT. Preoperative MR PCI score is accurate in categorizing the volume of tumor found at surgery. Following HIPEC, patient surveillance with MRI can detect early tumor recurrence prior to a rise in serum tumor markers.

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WHOLE-BODY DIFFUSION WEIGHTED MR-IMAGING (DW-MRI) TO PREDICT A COMPLETE RESECTION IN OVARIAN CANCER PATIENTS; A PILOT STUDY

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Objectives

To assess the potential of DW-MRI in predicting the tumor load in the abdominal cavity, by using the peritoneal cancer index (PCI) score to determine whether a complete resection in ovarian cancer patients, considered for debulking surgery, can be achieved.

Methods

For this observational prospective pilot study, we included 22 ovarian cancer patients considered for debulking surgery and scheduled for surgical staging, either by diagnostic laparoscopy or exploratory laparotomy. Patients underwent a 3T DW-MRI scan prior to surgery by a maximum of 43 days (mean = 13 days). The MR protocol consisted of a T1 and T2 weighted, a dynamic contrast enhanced T1 weighted, and a diffusion weighted (b0, b1000) sequence. The PCI was determined on MR images by two abdominal radiologists independently and were compared to the PCI as determined by gynecologists at surgery. Receiver operating characteristics curves were calculated for predicting complete resection with the PCI of surgery and of both readers. The inter-observer agreement of the radiological findings was determined.

Results

Staging with DW-MRI showed a high correlation to gynecological staging with a Pearson's correlation coefficient (ρ) 0.92 and 0.86 for reader 1 and 2, respectively. Good correlation was also found comparing PCI scores from small bowel regions alone (ρ = 0.84 and 0.75). The PCI scores of both reader 1 and 2 (AUC = 0.98 and 0.96) showed similar predictive values for complete resection as the gynecological PCI (AUC = 0.94). The most optimal cut-off point to select patients with complete resection, here, is at a PCI of 11 with a sensitivity and specificity of 0.93 and 1.00. Inter-observer agreement showed excellent with an intra-class correlation coefficient of 0.89 (95% CI: 0.67–0.96).

Conclusion

This pilot study shows that DW-MRI seems to be able to accurately predict the PCI and predict complete resection ovarian cancer patients.

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ACCURACY OF FDG-PET/CT FOR THE SELECTION OF PATIENTS WITH COLORECTAL PERITONEAL METASTASES UNDERGOING CYTOREDUCTIVE SURGERY AND HEATED INTRA-PERITONEAL CHEMOTHERAPY

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Objectives

To study the utility of pre-operative PET-CT in estimating peritoneal cancer index (PCI) of colorectal cancer patients being evaluated for cytoreductive surgery (CRS) and heated intraperitoneal chemotherapy (HIPEC).

Methods

A retrospective review of pre-operative imaging, MDT-decision & operative notes at a high-volume centre of patients with colorectal peritoneal metastases. Efficacy of PET-CT was evaluated by comparing radiological and intra-operative lesion sizes and PCI scores stratified by the Sugarbaker et al abdominopelvic regions. Regional sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), agreement (weighted-kappa) and lesion size accuracy were all calculated.

Results

129 patients were included: 74 males, median age 58, median time between PET-CT and surgery (OT) was 52 days.

Overall, median PET-PCI was 4 (range 0–27) and median OT-PCI was 9 (range 0–22, p < 0.001, weighted kappa 0.44, 95%CI, 0.31–0.57). Significant variability was seen across abdominopelvic regions for sensitivity (2–58%), specificity (73–98%), PPV (25–90%) and NPV (44–80%). Highest sensitivities were in left flank and pelvis (>50%) whereas small bowel regions had lowest sensitivity (<10%) and PPV (<60%). Accuracy varied significantly with lesion size: lowest rates for small-medium sized lesions: 0.009 (LS-1) and 0.18 (LS-2) vs. 0.41 (LS-3) although good accuracy was seen for disease exclusion (0.89 for LS-0).

To our knowledge this is the largest study in the literature on the accuracy of pre-operative PET-CT in staging patients with colorectal peritoneal metastases.

Conclusion

Pre-operative staging continues to under-estimate extent of colorectal peritoneal disease, even with routine PET-CT. It is necessary to investigate alternative modalities such as diffusion-weighted MRI to avoid futile invasive staging i.e. laparoscopy/laparotomy.

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OPTICAL IMAGING FOR PERITONEAL METASTASES DETECTION IN OVARIAN CANCER

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Objectives

The aims of this study are to evaluate the role of ICG-Fluorescence Imaging (FI) for the detection of peritoneal metastasis and tumoral cells in RS (post NAC).

Methods

Patients admitted for primary or interval CS with stage III/IVa from September 2013 to August 2016 were elected for the study. Free ICG (0.25 mg/kg) was IV injected intraoperatively before CS. Fluorescence intensity and tumor to background ratio (TBR) was calculated for all peritoneal nodules (PN) and RS.

Results

Twenty patients including 17 seropapillar adenocarcinoma, and 3 others type of tumors were included. A total of 108 PN and 25 RS were imaged, resected and analyzed by histopathology. Amongst PN, 73 were malignant (67.6%) and 35 benign (32.4%). The mean of the TBR (ex vivo) was 1.8 (SD 1.3) in malignant nodules and 1.0 (SD 0.79) in benign nodules (p = 0.007). With a TBR cut-off of 1.3, sensitivity and specificity are respectively 72.6% (53/73) and 45.7% (16/35). Amongst the 25 RS, the mean TBR (in vivo) was 2.06 (SD 1.15) in malignant (n = 2) and 1.21 (SD 0.50) in benign nodules (n = 23). The positive predictive value of ICG-FI to detect tumoral cells in scars was 57.1%.

Conclusion

ICG-FI is able to discriminate between benign and malignant PN, but not sufficient specific for the detection of tumoral cells in RS post NAC.