II.h) Radiology and imaging

H01

SARCOPENIA IS NOT INDEPENDENTLY ASSOCIATED WITH WORSE OUTCOME AFTER CYTOREDUCTION AND HYPERTHERMIC INTRAPERITONEAL CHEMOTHERAPY

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Objectives

Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) has improved outcomes for peritoneal carcinomatosis (PC) but is associated with significant morbidity. Muscle depletion (sarcopenia) is associated with postoperative morbidity. We investigated the impact of sarcopenia on outcomes after CRS/HIPEC.

Methods

A retrospective review was performed and sarcopenia was assessed using the L3 psoas muscle index (PI) on preoperative imaging within three months of CRS/HIPEC. Sarcopenia was defined as PI < 0.41 cm2/m2 in females and PI < 0.43 cm2/m2 in males.

Results

Fifty-seven patients (age 56 years, 70% female and 70% Caucasian) underwent CRS/HIPEC for appendiceal (56%), colon (18%), ovarian (16%) or other malignancies (10%). The peritoneal cancer index score was 11.0 (1–39), 96% underwent completeness of cytoreduction score of 0/1, and 49 (86%) required multivisceral resection. Median body mass index (BMI) was 31.3 (19–51), preoperative albumin 3.6 (1.7–4.3) and PI 0.63 (0.28–1.33). Eleven patients (19%) had sarcopenia. Sarcopenia was associated with lower BMI (25.2 vs 31.7, p = 0.002), preoperative albumin (2.8 vs 3.6, p = 0.003), and lower PI (0.40. vs 0.68, p < 0.0001) but did not predict higher morbidity (36% vs 39%, p = 687) or mortality (0% vs 4%, p = 0.497). Patients with sarcopenia were more likely to be discharged to inpatient rehabilitation center (20% vs 2%, p = 0.027). Presence of sarcopenia did not portend worse overall survival on multivariate analysis.

Conclusion

The impact of sarcopenia on postoperative morbidity and outcomes for CRS/HIPEC remains inconclusive. While our data suggests there is a delayed recovery necessitating inpatient rehabilitation, further analysis is needed to determine the significance of sarcopenia on PC.

H02

EVALUATION OF MAGNETIC RESONANCE IMAGING VERSUS COMPUTED TOMOGRAPHY IN THE DETECTION OF PERITONEAL DISEASE MALIGNANCIES

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Objectives

Evaluation of the extent of peritoneal disease with imaging remains challenging. Computed tomography(CT) scans remain the modality of choice in many centres. Magnetic resonance imaging(MRI) is known to provide superior soft tissue contrast and has been shown in a handful of studies to be superior to CT in the evaluation of peritoneal disease. We aim to compare MRI to CT against the gold standard of intra-operative assessment for the evaluation of peritoneal disease in our centre.

Methods

36 patients who were being planned for cytoreductive surgery were prospectively recruited. They underwent a CT or Positron Emission Tomography-CT scan and an MRI within 6 weeks of their surgery. The scans were read by 1 of 4 dedicated radiologists. The radiological Peritoneal Carcinomatosis Index(PCI) score(total and each region)and presence or absence of disease in the porta hepatits and lesser sac were recorded. The same scoring system was used intra-operatively. Sensitivity of the imaging scan was measured by the ability of the said imaging scan to detect tumour that was noted intra-operatively. Specificity of the imaging scan when compared to intra-operative findings.

Results

Both MRI and CT achieved 100% sensitivity and 100% specificity to detect tumour in the 36 patients. Based on the ordinal PCI score of each PCI region, the ability of both MRI and CT to detect tumour accurately across the 468 PCI regions of the 36 patients was comparable (MRI: 49% sensitivity; CT: 48% sensitivity; p = 0.332). Both MRI and CT had higher sensitivity ranging between 58%–79% to detect tumour in PCI region 1 (right upper), region 3 (left upper), region 4 (left flank), region 5 (left lower), region 6 (pelvis), region 7 (right lower) and region 8 (right flank) (Table 2). While there were no significant differences in the sensitivity of MRI and CT to detect tumour in each of the 13 PCI regions, the sensitivity of MRI to detect tumour in the jejunum and ileum (region 9–12) were numerically higher than those of CT.

Conclusion

MRI and CT scans are comparable in terms of detecting and evaluating the extent of peritoneal disease when compared to the gold standard of intra-operative findings. MRI may be able to better predict disease along the small bowel which may preclude curative surgery. Further work is needed in this field to improve imaging for peritoneal disease.

H03

A COMPREHENSIVE COMPARISON OF THE FIVE LEADING SCORING SYSTEMS FOR PERITONEAL CARCINOMATOSIS FROM COLORECTAL ORIGIN TO SELECT CRS/HIPEC CANDIDATES WITH MRI.

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Objectives

Multiple surgical scoring systems have been developed to assess the extent of peritoneal carcinomatosis in colorectal patients. These scoring systems are used as important predictors of surgical outcome in cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (CRS/HIPEC). Diffusion weighted magnetic resonance imaging (DW-MRI) could allow for the assessment of these surgical scores preoperatively and non-invasively. The purpose of the study is to compare the performance of these scoring systems determined on MR images, for predicting whether a complete resection was feasible in CRS/HIPEC candidates with colorectal cancer.

Methods

Between February 2016 and October 2017, colorectal cancer patients considered for CRS/HIPEC who underwent DW-MRI were included. The DW-MRI images were, retrospectively, assessed by 2 abdominal radiologists and clinical parameters were obtained from the patient files. The five most used models were selected, namely the Peritoneal Surface Disease Severity Score (PSDSS), Region Count, Simplified Peritoneal Cancer Index (SPCI), Peritoneal Cancer Index (PCI), and the Colorectal Peritoneal Metastases Prognostic Surgical Score (COMPASS). The performance of the scoring systems was assessed by receiver operator characteristics (ROC) analysis for predicting complete resection and the area under the curve (AUC) was calculated for every model.

Results

In 82 patients, the scores could be accurately constructed for all five methods. The mean age was 62.80 ± 10.53 and 56% (46/82) of the patients were female. Of these patients 70% (58/82) had undergone a successful surgical procedure with a curative intent, of which 84% (49/58) underwent a CRS/HIPEC procedure. In 20 patients, an inoperable amount of peritoneal carcinomatosis was determined. ROC curve analysis for predicting a complete resection showed AUCs of 0.79, 0.79, 0.82, 0.83, and 0.89 for PSDSS, Region Count, SPCI, PCI, and COMPASS, respectively.

Conclusion

This study shows that DW-MRI, using surgical scoring systems, might be used for less invasive and preoperative patient selection of colorectal patients considered for CRS/HIPEC. The COMPASS model was the best model to select CRS/HIPEC candidates with MRI.

H04

FDG PET WITH LOW DOSE CT VERSUS CONTRAST ENHANCED CT AS QUANTIFICATION METHOD TO ASSESS THE EXTENT OF PERITONEAL CARCINOMATOSIS PREVIOUS CYTOREDUCTIVE SURGERY-HIPEC

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Objectives

The aim of the study was to compare FDG PET with Low Dose CT (FDG PET-CT) versus Contrast Enhanced CT (CE-CT) in pre-surgical quantification of peritoneal carcinomatosis using the Peritoneal Cancer Index (PCI) and to correlate both PCI values with surgical and histological (AP) findings.

Methods

Retrospective study from 2014 to 2016 of 18 patients (11 women, 7 men; mean age 57 years old) with peritoneal carcinomatosis due to colon adenocarcinoma (8), ovarian serous carcinoma (9) and appendicular mucinous adenocarcinoma (1). All of them were candidate to cytoreductive surgery and HIPEC.

The image studies were performed during the 3 months before the surgery.

The extent of peritoneal carcinomatosis was quantified using PCI score (0–39) considering size and localization of the findings in 13 abdominal regions. PCI was calculated independently by a nuclear physician and by a radiologist in FDG PET-CT and in CE-CT respectively. A Pearson's correlation was calculated.

Results

Median value of PCI was 6 [IQR 2–7] in FDG PET-CT, 3 [IQR 2–9] in CE-CT, 8 [IQR 4–12.7] in surgical PCI and 5.5 [IQR 2–12.7] in AP PCI.

A positive correlation between PCI of FDG PET-CT and CE-CT was detected (r = 0.63; p < 0.01).

Both FDG PET-CT and CE-CT PCI values resulted in a high positive correlation with surgical PCI (r = 0.81 and r = 0.83 respectively; p < 0.01).

Surgical PCI had a correlation with AP PCI (r = 0.98; p < 0.01).

Conclusion

There is a good correlation between FDG PET-CT and CE-CT in pre-surgical evaluation of peritoneal carcinomatosis in patients candidate to cytoreductive surgery with HIPEC using PCI score.

Surgical and histological findings have a good correlation with both imaging techniques with no differences.

A combined FDG PET with Contrast Enhanced CT study could be the election technique in pre-surgical evaluation of patient with peritoneal carcinomatosis.

H05

PERITONEAL MAGNETIC RESONANCE IMAGING: PRELIMINARY DATA FROM A RECENTLY IMPLEMENTED PROTOCOL

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sA413

Objectives

Peritoneal Magnetic Resonance Imaging (P-MRI) has been described as a more accurate imaging method to evaluate the extension of peritoneal malignant disease. Is a tool with potential superiority over Computed Tomography (CT) and Positron-Emission Tomography (PET-CT). However, description of the potential challenges of implementing a new P-MRI protocol, adequate strategy, and results at initial experience are scarce in the literature.

In this study the strategy to implement the P-MRI protocol, and the comparative results to the surgical Peritoneal Cancer Index (PCI) are described.

Methods

Since July 2015 all patients candidate to cytoreductive surgery and HIPEC in a new PSM program, and without a previous preoperative MRI, were evaluated with P-MRI. Clinical data was collected from a prospective registry approved by local ethical committee.

To an evaluation purpose, PCI was divided in 3 categories: low (1–10), medium (11–20), high (>20). In order to asses de accuracy of P-MRI, it was considered satisfactory if the radiological PCI was concordant with the surgical PCI in terms of category, or if the deviation was up to 10% (4 points in PCI).

Results

Twenty-four patients were operated between July 2015 and March 2018. The most frequent indication for surgery was Pseudomyxoma Peritonei (46%). 16 patients already had an abdominal MRI at the first evaluation and did not receive an additional P-MRI. Eight patients were preoperatively formally evaluated with P-MRI and underwent a complete abdominal exploration, cytoreductive surgery and HIPEC, and evaluation of surgical PCI.

The technical protocol adopted in our program is based on the French RENA-RAD guidelines.

After each surgical intervention, the surgeon analyzed the images with the only radiologist responsible for the P-MRI. Image details were retrospectively assessed in order to identify qualitative and quantitative mistakes in the radiological evaluation.

Following the above descripted criteria, 6 of the 8 P-MRI (75%) were considered accurate.

Conclusion

The implementation of a P-MRI protocol is challenging. It is more related to the correct interpretation of the exam than to technical details about de acquisition of the images. A close collaboration between the radiologist and the surgical team is essential to overcome the initial learning curve.

H06

INFRARED THERMOGRAPHY MONITORING IN CLOSED HIPEC TO MAINTAIN HOMOGENOUS INTRAPERITONEAL TEMPERATURE DISTRIBUTION

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Objectives

Homogenous intraperitoneal hyperthermia is an essential part of hyperthermic intraperitoneal chemotherapy (HIPEC). The selective destruction of malignant cells by hyperthermia in the range of 41 to 43°C and its additive effect has been already demonstrated. The aim of our study was to assess the impact of infrared thermography on intraperitoneal thermal homogeneity during closed-abdomen HIPEC.

Methods

We conducted a Bland-Altman method-comparison study based on the quantification of the agreement between two quantitative temperature measurements (with [IRC] and without [NOIRC] infrared thermography) by studying the mean difference and constructing limits of agreement.

Preliminary data on thirty-eight consecutive patients undergoing 40 cytoreductive surgery and HIPEC procedures were performed until August of 2016. We assessed the agreement of the mean temperature between supramesocolic (SMC), inframesocolic (IMC), and pelvic (PEL) regions in those patients who received HIPEC either with infrared thermography (IRC: n = 17) or without infrared thermography (NOIRC: n = 13).

New data from August 2016 to August 2018 of further 40 closed HIPEC procedures will be presented at the 11th international workshop on peritoneal surface malignancy 2018 in Paris.

Results

Preliminary data of 1827 temperature measuring points of the SMC, IMC and PEL regions from 30 patients who underwent cytoreductive surgery + closed HIPEC with and without infrared thermography were assessed. Mean intraperitoneal temperature estimated with IRC and NOIRC were 41.1 ± 0.7 and 40.8 ± 1.1 (P < 0.001), respectively.

The limits of agreement for the mean intraperitoneal temperature in IRC were:

SMC-IMC: Mean difference (md): -0.19 (95% limits of agreement (LoA): -1.60 to 1.21) P = n.s.

SMC-PEL: md: -0.10 (95% LoA: -1.98 to 1.78) P = n.s. IMC-PEL: md: 0.09 (95% LoA: -1.57 to 1.75) P = n.s.

The limits of agreement for the mean intraperitoneal temperature in NOIRC patients were:

SMC-IMC: md: -0.91 (95% LoA: -2.71 to -0.76) P < 0.001 SMC-PEL: md: -0.32 (95% LoA: -2.30 to 1.66) P = 0.003 IMC-PEL: md: 0.59 (95% LoA: -1.70 to 2.87) P = 0.09.

Conclusion

The Bland-Altman plots of our preliminary data show a statistically significant better agreement between mean temperatures of SMC-IMC-PEL regions in IRC patients indicative for a homogenous intraabdominal temperature distribution during closed HIPEC. Infrared thermography temperature control of the abdominal surface during closed HIPEC is a novel, save, and feasible method.