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Preoperative CT and MRI prediction of non-resectability in patients treated for pseudomyxoma peritonei from mucinous appendiceal neoplasms

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Abstract

Aims: To evaluate computed tomography (CT) and magnetic resonance imaging (MRI) findings for sign of hepatoduodenal ligament and small bowel non-resectability in patients with pseudomyxoma peritonei (PMP) and to compare assessments made by the radiologist based on their experiences.

Methods: Between January 2009 and June 2014, all consecutive patients with PMP selected for curative surgery were scheduled to undergo CT and MRI examinations within two days of their surgery. Several imaging findings of hepatoduodenal ligament and small bowel involvements were retrospectively evaluated by a senior and a junior radiologist and compared with surgical findings.

Results: Of the 82 patients enrolled in the study, 11 had non-resectable lesions with hepatoduodenal ligament infiltration (n = 4) and/or extensive small bowel involvement (n = 9). All patients underwent CT and 73 underwent MRI scan. Infiltration of the adipose tissue of the hepatoduodenal ligament by mucinous tumor was associated with non-resectability. For the senior and junior radiologists, the sensitivity and specificity were 75% and 100%, and 50% and 100% on CT (kappa value (k) = 0.79); 67% and 100%, and 33% and 97% on MRI (k = 0.38), respectively. Diffuse involvement of the mesentery and/or the small bowel serosa was also associated with non-resectability. For the senior and junior radiologists, the sensitivity and specificity were 67% and 100%, and 56% and 99% on CT (k = 0.82); 88% and 100%, and 38% and 100% on MRI (k = 0.58), respectively.

Conclusion: CT and MRI can both contribute to the diagnosis of non-resectability in patients with PMP. The use of MRI to identify small bowel involvement, in particular, benefits from a more experienced radiologist.

Keywords: Pseudomyxoma peritonei; Peritoneal carcinomatosis; Preoperative assessment; Resectability; Computed tomography; Magnetic resonance imaging

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Introduction

Pseudomyxoma peritonei (PMP) is a rare clinico-pathologic condition characterized by the production of mucinous ascites into the peritoneal cavity[1] and mostly originates from appendiceal epithelial neoplasms. The current standard of care includes a combination of cytoreductive surgery (CRS) and hyperthermic intra-operative intraperitoneal chemotherapy (HIPEC).[2,3]

The peritoneal cancer index (PCI) provides a quantitative measurement of the volume and extent of peritoneal tumor found at surgical exploration. The PCI, varying from 1 to 39, combines the distribution of peritoneal tumor at 13 abdominal and pelvic areas with the largest tumor size per region that is scored from zero to three.[4] In patients with PMP, the PCI is identified as an independent prognostic factor associated with outcome[5–7] but does not provide a clear cutoff point for surgical eligibility.[8–11] Indeed, complete cytoreduction in referral center may be achieved with high PCI that is not an absolute exclusion criterion to treatment as long as the tumor does not invade some critical areas.[8–11] The two main causes of non-resectability or incomplete CRS are extensive disease in the upper abdomen and major involvement of the small bowel.[12,13] Due to the anatomy of peritoneal fluid circulation, peritoneal tumors often spread to the right upper quadrant of the abdomen.[14] While some perihepatic lesions may be treated by glissonectomy, hepatoduodenal involvement with liver hilum and portal triad infiltration precludes complete resection.[13] Although mucin-producing cells remain poorly adherent, the large volume of disease can indent the small bowel. Diffuse involvement of the small bowel can similarly make surgical treatment impractical.[15]

Preoperative screening for these complications is pivotal in selecting candidates for surgery and planning surgical procedure. Currently, computed tomography (CT) is the primary imaging modality used to evaluate patients with peritoneal carcinomatosis.[8,16] Its functionality is limited by a lack of contrast resolution. Chua et al. demonstrated that the extent of peritoneal carcinomatosis evaluated by the peritoneal cancer index (PCI) on CT consistently underestimates the peritoneal spread in patients with PMP.[17] Advances in magnetic resonance imaging (MRI) have allowed for fast imaging sequences with high contrast resolution.[18] Recent studies suggest that these MRI scans can better predicted surgical PCI than CT in patients undergoing CRS, but the success of the technique is limited by the experience of the radiologist.[15,19–21]

This study thus aimed to evaluate CT and MRI findings for sign of non-resectability prior to CRS and HIPEC in patients with diagnosed PMP. In light of prior research, it also seeks to compare assessments made by the radiologist based on their experiences.

Materials and methods

Patients selection

This study was approved by our Institutional Review Board and each patient gave their informed consent.

Between January 2009 and June 2014, all consecutive patients with PMP in our tertiary referral center selected for curative surgery were prospectively enrolled in the study. PMP was diagnosed by clinical and radiological presentation, as well as endoscopy and biopsy. All patients were scheduled to undergo CT and MRI examinations of the abdomen and pelvis within 2 days of their surgery. Only patient with PMP from appendiceal origin on final pathological analysis and no prior history of CRS were included in the analysis.

CT scanning

Standard-dose CT acquisitions of the abdomen and pelvis were performed with a 40-rows device (Philips Brilliance, Best, The Netherlands), after intravenous administration of contrast material at the portal venous phase (Xenetix 300, Guerbet, Aulnay, France). No oral contrast material or water preparation was used. The following parameters were used: 40 × 0.625 mm collimation, pitch: 0.874, kV: 120, mAs: auto, standard reconstruction algorithm: 1.5 mm reconstruction thickness, increments: 0.75 mm.

MR imaging

MRI examinations were performed with a 1.5T MR unit (Achieva, Philips Medical Systems, Best, The Netherlands) equipped with an external phased array surface coil (16 elements). Images were acquired at the upper and lower abdomen to encompass the entire abdominopelvic region. To reduce peristaltic movement artifacts, patients received one intravenous 1-mg dose (1 mg/mL) of Glucagon (Novo Nordisk, Copenhagen, Denmark) prior to the MRI examination. MRI protocol included T2-weighted fast spin echo, fat suppressed T1-weighted water only selection (WATS), and diffusion weighted whole-body imaging with background body signal suppression (DWIBS) (b values 0 and 1000 s/mm^2) sequences in the axial plane, followed by fat suppressed T1-weighted WATS sequences in the axial and coronal planes obtained 5 min after intravenous administration of gadobenate dimeglumine 0.2 mL/kg (Multihance) (Bracco, Milano, Italy). Slice thickness was 6 mm with a 1 mm gap for all sequences. The entire MRI examination lasted 30 min.

Surgery and pathological analysis

After a complete exploration of the abdominal cavity, the extent of disease was evaluated using the PCI.[4] The