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Usefulness of hydrogel-CT for detecting and staging of rectosigmoid colon cancer

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ABSTRACT

Purpose: To demonstrate the usefulness of hydrogel-CT for detecting and staging of rectosigmoid colon cancer.

Materials and methods: Fifty-four patients with rectosigmoid colon cancers underwent routine CT without (n = 27) and with (n = 27) rectum distension using a sonographic gel. Rectum distensibility and tumor visualization were evaluated. T and N stages on CT independently recorded by two radiologists were correlated with pathologic staging. Staging accuracies were compared using Fisher's exact test. Diagnostic performances in differentiating <T3 from ≥T3 and N0 from ≥N1 were evaluated using areas under the receiver operating characteristic curves (A_Z).

Results: Rectum distensibility (3.52) and tumor visualization (3.70) were significantly more scored in the distended group than in the control group (1.44 and 2.04) (P < 0.0001). Pathologic and CT staging were more correlated in the distended group in both reviewers. Accuracy for staging was higher in the distended group (T: 50–85.2%/N: 59.3–92.6%) than in the control group (T: 45.5–62.5%/N: 33.3–59.3%) without statistical significance except N staging for reviewer 2 (P = 0.0091). A_Z values for T and N staging in the distended group (T: 0.827–0.989/N: 0.858–0.980) were also higher than in the control group (T: 0.817–0.907/N: 0.544–0.654).

Conclusion: Hydrogel-CT can provide better diagnostic performance for T and N staging of rectosigmoid colon cancer.

1. Introduction

The prognosis of rectosigmoid colon cancer is closely related to its stage at diagnosis and the choice of treatment involved [1,2]. As appropriate preoperative treatment decision-making requires knowledge of the exact stage of a tumor, accurate radiologic T (depth of cancer invasion) and N staging (lymph node metastasis) present great clinical importance. At present, radiologic staging can be performed using endorectal sonography (ERUS), CT, and MRI. Although ERUS and MRI have shown promise in the field of rectosigmoid colon cancer staging, CT has been the most commonly used method for the staging of rectosigmoid colon cancer. However, its accuracy is still a matter of debate with some studies reporting high accuracy while others have reported less satisfactory results [3]. The major sources of staging errors reported thus far have been due to CT's inability to separate the rectal wall layers and the inability to detect small rectosigmoid lesions especially when the rectosigmoid colon has collapsed [3]. Thus, to improve the diagnostic performance of CT in T staging of primary rectal cancers, water has been used to induce rectal distention [4–6]. However, although water is cheap and easy to handle, it creates an air-fluid level that may cause beam hardening artifacts at the interface, which in turn would result in a limited capacity to evaluate rectal cancers in the anterior wall [7]. In addition, water can easily move upward through the sigmoid colon resulting in inadequate distention of the rectum.

To the contrary, the sonography transmission gel is inert and semisolid, while still remaining inexpensive and easy to handle [8]. Indeed, its usefulness for the visualization of rectosigmoid colon cancer in hydrogel-MRI has been proven in a previous study [8]. However, to the best of our knowledge, there has been no study in which this agent was used to evaluate rectosigmoid colon cancer staging with CT. Furthermore, there have been no studies in

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which radiologists' performance using hydrogel-CT for the staging of rectosigmoid colon cancer has been compared with that of conventional CT without rectum distention.

Therefore, the purpose of our study is to demonstrate the usefulness of hydrogel-CT for the detection and staging of rectal cancer by comparing radiologists' performance without and with rectum distention.

2. Materials and methods

2.1. Patients

This retrospective study was approved by our institutional review board and the requirement for informed consent was waived as the sonography transmission gel has been used for rectal MRI for several years at our institute. Between July 2013 and April 2014, a total of 33 patients who underwent CT with rectum distention using a sonography transmission gel (Supersonic, Sung Heung Medical Co., Pucheon-si, Korea) were selected. Among them, we only included patients who fulfilled the following criteria: (a) patients pathologically proven to have rectosigmoid colon cancer either through endoscopic mucosal resection or surgery and (b) patients who did not undergo neoadjuvant concomitant chemoradiotherapy (CCRT). From the above criteria, we excluded six patients who had rectal mesenchymal tumors (n = 2), patients whose rectal lesions were confirmed only by biopsy (n = 2), and patients who underwent neoadjuvant CCRT (n = 2). Finally, 27 patients comprised our study population and were designated as our rectum distended group. As control, we separately selected 250 patients with surgically proven rectosigmoid colon cancers who underwent conventional CT without rectum distention between January 2010 and February 2012. Control patients were matched at a 1:1 ratio in terms of age, sex, and T stage with patients who underwent hydrogel-CT with rectum distention. Thus, 27 patients were matched and designated as the control group. Because tumor relationship to anterior peritoneal reflection is important for tumor staging and for deciding treatment strategy, we tried to identify the anterior peritoneal reflection and its relationship to the tumor on axial and sagittal (if available) CT images. On axial image, the apex of the peritoneum attaches to the anterior rectal wall in a V-shaped configuration. In men, this is generally at a point just above the tip of the seminal vesicle while in women, the point of attachment is more variable. We categorized the tumor into three groups; tumors entirely above anterior peritoneal reflection, tumors saddling anterior peritoneal reflection, and tumors entirely below anterior peritoneal reflection. For distended group, 4, 7, and 16 tumors were located entirely above, saddling, and entirely below anterior peritoneal reflection, respectively. For control group, 5, 6, and 16 tumors were located entirely above, saddling, and entirely below anterior peritoneal reflection, respectively. Patients' demographics including pathologic T and N staging in both the distended and control groups are presented in Table 1.

2.2. CT techniques

For rectum distention in 27 patients, approximately 80–100 ml of a sonography transmission gel was administered using an enema syringe with the patient placed on the CT Table in the right lateral genupectoral position with their knees on their chest [8]. The administration was stopped immediately if the patient experienced intolerable pain. After the administration, the patient was placed in the supine position. Anti-peristaltic agents were not administered in any patient.

A variety of CT scanners were used in our study owing to its retrospective design. All patients underwent MDCT with 4, 8, 16, 32, 64, 128, or 320 detector-rows either at our institution (n = 50) or at outside hospitals (n = 4). The parameters used for these MDCTs were as follows: detector configuration, 0.63–1 mm; pitch, 0.89–1.35; rotation time, 0.5–0.75 s; tube voltage, 120 kVp; tube current, 150–250 mAs; slice thickness, 2–5 mm; and reconstruction interval, 2–3 mm.

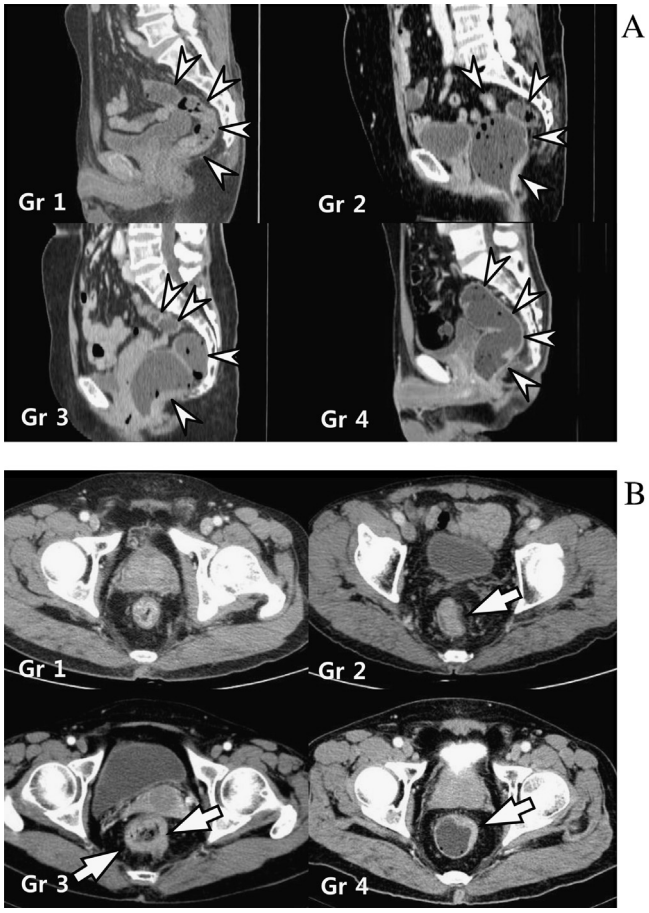

Fig. 1. Semi-quantitative grading for the degree of rectum distention (A) and tumor visualization (B) on CT images. (A) Grading for the degree of rectum distention on sagittal CT images. Grade 1 is defined as when the entire rectum (arrowheads) is collapsed; grade 2 when the rectum (arrowheads) is partially distended with more than one collapsed segment; grade 3 when the rectum (arrowheads) is suboptimally distended with one collapsed segment; grade 4 when the entire rectum (arrowheads) is fully distended without a collapsed segment. (B) Grading for the degree of tumor visualization on axial CT images. Grade 1 is defined as when the tumor could not be identified; grade 2 when the tumor (arrow) is identified but its intraluminal margin is not defined; grade 3 when the tumor (arrows) is identified and its intraluminal margin is partially defined; grade 4 when the whole tumor margin (arrow) is well defined.

Contrast-enhanced CT images were obtained after administration of an iodinated contrast agent (Ultravist 370, Bayer Schering Pharma, Berlin, Germany) at a dose of 1.5 ml/kg and at a rate of 3–5 ml/s using an automatic power injector. In most cases (n = 45, 83.3%), dynamic enhanced images during arterial and portal phases were obtained. The remaining nine patients underwent single phase CT using the portal phase only.

2.3. Image analysis

For all CT images of the 54 patients, the degree of rectal distention and tumor visualization was assessed by two radiologists (with 4 years of experience and with 18 years of experience) in consensus using criteria reported in previous studies [7,8]. Optimal rectal distention was assessed on a 4-point scale [8] (Fig. 1A). Grade 1 is