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Original Article

Degree of colonic distension: intrapatient comparison between CT colonography and CT with water enema

Matteo Revelli [a,*], Lorenzo Bacigalupo [b], Luca Cevasco [b], Manuele Furnari [c], Francesco Paparo [b], Laura Scopelliti [d], Ilan Rosenberg [a], Gian Andrea Rollandi [b]

[a] Radiology Unit, Department of Services, "San Bartolomeo" Hospital, ASL5, Sarzana, La Spezia, Italy
[b] Radiology Unit, Department of Diagnostic Imaging, E.O. Ospedali Galliera, Genoa, Italy
[c] Gastroenterology Unit, Department of Internal Medicine, University of Genoa, Genoa, Italy
[d] Section of Radiology, Department of Biotechnology and Legal Medicine, University Hospital "P. Giaccone", Palermo, Italy

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ABSTRACT

Purpose: Compare colonic distension using CT colonography (CTC) and CT with water enema (CTWE) in the same patients.
Methods and materials: Twenty-seven patients who underwent both CTC and CTWE, considering separately supine (CTC-S) and prone (CTC-P) acquisition of CTC were included. The colon was divided into six segments, performing both a qualitative and quantitative analysis.
Results: Adequate distension of sigmoid colon was more frequently achieved with CTC-P and CTWE compared to CTC-S ($P<.05$). CTC-P and CTWE showed better distension of the left colon compared to CTC-S ($P<.01$ and $P=.03$ regarding sigmoid colon, respectively; $P=.01$ and $P=.03$ regarding descending colon, respectively).
Conclusions: Computed tomography (CT) studies of the colon should be customized to fulfill the clinical query.

1. Introduction

Adequate luminal distension is a critical issue for Computed tomography (CT) study of the colon because incomplete distension of the colon wall may simulate several pathologic conditions (i.e., inflammatory bowel diseases) or hide the presence of tumors or polypoid lesions. CT colonography (CTC) has been widely used and implemented in recent years and has many different indications for the assessment of the colon, such as after incomplete videocolonoscopy, in frail and elderly patients and when endoscopy is contraindicated or not possible [1]. CTC consists in distending the colon with air or carbon dioxide and allows an excellent evaluation of colonic abnormalities [2]. On the other hand, CT with water enema (CTWE), although used at many institutions, did not receive extensive attention in the medical literature. This technique is based on colonic distension with water (administered through a rectal enema tube) followed by intravenous administration of iodinated contrast media, allowing a more accurate visualization of the intestinal wall [3]. In recent years, a few studies aimed to compare the degree of small and large-bowel distension obtained with different CT protocols [4], but they did not consider patients undergoing CTC in their analysis. Our purpose was to compare the grade of distension of the different colonic segments obtained using CTC and CTWE in the same cohort of patients.

2. Materials and methods

2.1. Inclusion of patients

This was a retrospective, single-center, institutional review board-approved study. Patients were included by performing a search in our single-institution radiology database looking for patients who underwent both CTC and CTWE, searching in an 8-year range. Specific indications were recorded. We enrolled 27 patients who underwent both CTC and CTWE within a mean interval of 32.9 months (S.D.: 27 months) between the two examinations. Demographic distribution was as follows: 9 men (mean age at first examination: 72.8 years, S.D.: 5.9 years) and 18 women (mean age at first examination: 60 years, S.D.: 29.7 years). Seventeen out of 27 patients underwent CTC as first examination, while 10 out of 27 patients underwent first CTWE.

2.2. CTWE and CTC techniques

Bowel cleansing consisted a low-residue diet during the 3 days before both CTWE and CTC examination. The day before the examination, each patient was instructed to drink continuously four doses of a

* Corresponding author. Radiology Unit, Department of Services, "San Bartolomeo" Hospital, ASL5, Via Cisa, loc. Santa Caterina, Sarzana, La Spezia, Italy. Tel.: +39-340-9028517; fax: +39-0187-604784.
E-mail address: matteorevelli@gmail.com (M. Revelli).

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granular powder (Isocolan; Bracco, Milan, Italy), containing polyethylene glycol, anhydrous sodium sulfate, sodium bicarbonate, and potassium chloride, dissolved in 2 l of water.

CTWE technique was performed as previously described by Paparo et al. [4]. All examinations were performed with a 64-slice multidetector CT scanner (Light Speed VCT, GE Medical Systems, Milwaukee, WI, USA) with the patient in supine position and inspiratory apnea. Contrast-enhanced CT was performed using the following scanning parameters: 120 kV, 300–400 mAs (with automatic mA modulation in the z axis), 0.6-s rotation time, detector collimation 40 mm, section thickness 5 mm, and table speed 35 mm per rotation. Bowel hypotonia was obtained by iv injection of 2-ml hyoscine-N-butylbromide 20 mg/ml (Buscopan, Boehringer Ingelheim), in order to reduce abdominal discomfort of patients and to avoid motion artifacts during the acquisition. A lubricated enema tube was inserted into the rectum and connected to a bag containing 2000 ml of lukewarm tap water, which was gently infused through gravity in 3–4 min, with the patient placed supine on the CT table. Bowel wall enhancement was produced by intravenous administration of iodinated contrast medium with an iodine concentration of 350 mg/ml (Iobitridol, Xenetix, Guerbet, Roissy Charles de Gaulle, France). The flow rate was set at 3.2–3 ml/s with an automatic injector, and acquisition was started in the portal phase, 45 s after the arterial peak in the upper abdominal aorta using a bolus-tracking software. The estimated mean effective dose for CTWE protocol was 11 mSv.

CTC technique was performed as described in previous works [5]. The preimaging protocol for CTC included bowel preparation (as described for CTWE) and, 3 h before examination, fecal tagging with 100 ml of oral iodinated contrast media. Gas distension of the colon was obtained with room air gently pumped using a handheld squeeze bulb in the rectum through a short cannula. Supine and prone acquisitions in inspiratory apnea were obtained with the same 64-slice multidetector CT scanner using the following protocol: 120 kV, 80 mA, 0.6-s rotation time, detector collimation 40 mm, section thickness 5 mm, and table speed 35 mm per rotation. No intravenous iodinated contrast medium was administered. The CTC protocol had an average effective dose of 6 mSv.

2.3. Image analysis

All CT examinations were reviewed on a dedicated workstation (ADW4.5, General Electric Medical Systems), using the 1.25-mm thickness reconstructed images to obtain multiplanar reconstructions. Both quantitative and qualitative analyses were performed in consensus by two radiologists (LC, MR) with 5 years and 8 years of experience in abdominal imaging, respectively. CTC and CTWE examinations were reviewed in a random order, performing an independent evaluation for supine (CTC-S) and prone (CTC-P) acquisition of CTC. For purposes of analysis, the large bowel was divided into six segments: rectum, sigmoid colon, descending colon, transverse colon, ascending colon, and cecum, as proposed by Ajaj et al. [6]. The quantitative analysis of intestinal distension was performed measuring (in millimeters) the largest cross-sectional diameter (from outer wall to outer wall) of each bowel segment, considering either the axial or the coronal plane reconstructed images, both on CTC and CTWE examinations (Fig. 1). Distension measurements were taken in correspondence to healthy, unaffected bowel segments. The qualitative analysis was also performed on a per-segment basis using a continuous 3-point scale (0, *poor*; 1, *good*; 2, *optimal*), as described by Megibow et al. [7]. Score 2 (optimal) was assigned when the segment was distended, the wall was uniformly visualized, and a fold pattern could be recognized. A poor score (0) meant that the segment was collapsed without any luminal separation, the walls could not be seen, and a fold pattern could not be recognized. The last two degrees of distension (i.e., good and optimal) were considered as a satisfactory result. The percentage of bowel segments with an adequate distension for diagnostic purposes was obtained summing the relative percentages of segments that received both good and optimal scores, as described by Paparo et al. [4].

2.4. Statistical analysis

Statistical analysis was performed to assess the presence of a significant difference between the grade of bowel distension obtained with CTC-S, CTC-P, and CTWE protocols on a per-segment basis. The

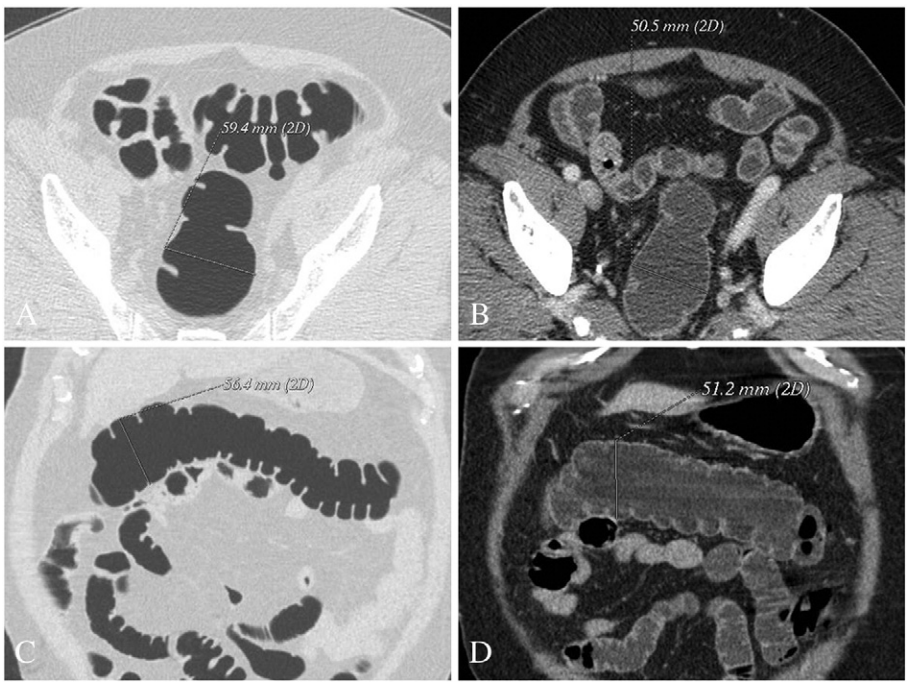

Fig. 1. Axial (A, B) and coronal (C, D) reformatted images of CTC (A, C) and CTWE (B, D) examinations of the same patient: the largest cross-sectional diameters were measured in millimeters on a per-segment basis.