Original Investigation

# Prognostic Value of the Diverticular Disease Severity Score Based on CT Colonography: Follow-up in Patients Recovering from Acute Diverticulitis

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**Rationale and Objectives:** To assess the prognostic value of a diverticular disease severity score (DDSS) based on computed tomography colonography (CTC) after acute diverticulitis (AD).

**Materials and Methods:** Of 252 patients who had an AD episode, we finally selected 46 patients who underwent both conventional CT at the acute event and CTC after 9 ± 7 weeks. Of these 46 patients, 17 underwent elective surgery after CTC. Disease severity was assessed with a 0–4 modified Hinchey CT-based score and a 1–4 CTC-based DDSS. A phone survey was performed 27 months later (range 4–52) for the 29 patients not surgically treated.

**Results:** Significant correlation was found between CTC-based DDSS and clinical follow-up ($P = 0.022$) or elective surgery ($P = 0.007$), but not between clinical follow-up and CT-based score, extraluminal gas, C-reactive protein serum level, age, gender, or first versus recurrent AD episode. CTC demonstrated relevant additional findings in five of 46 (11%) patients: two AD complications (enterocolic and enterotubal fistulae), two colon cancers, and one extracolonic (lung) cancer.

**Conclusions:** The CTC-based DDSS showed a prognostic value and correlated with the risk of undergoing surgery, and clinically relevant additional findings were found in more than 10% of patients. CTC could be the preferred test in patients recovering after AD.

**Key Words:** Diverticular disease; Acute diverticulitis; Colon; Abdominal CT; CT colonography.



**Acad Radiol 2015; ■:■■–■■**

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http://dx.doi.org/10.1016/j.acra.2015.08.022

## INTRODUCTION

The appropriate follow-up of patients recovering from an acute episode of colonic diverticulitis is controversial. In particular, some authors (1,2) are not in favor of further testing because an increased risk of colon cancer was not observed in these patients. On the contrary, others deem follow-up useful (3–7) because it allows an opportunity to monitor the severity of the diverticular disease, and to confirm the absence of any other mimicking disease (e.g. colorectal cancer), which may not have been diagnosed in the acute stage. Recently, computed tomography colonography (CTC) has been proposed as a useful test in the evaluation of patients recovering from acute diverticulitis (AD) (8–10). Advocates point out the advantages of CTC compared to

alternative tests routinely performed in the past, namely double-contrast barium enema and conventional colonoscopy. In particular, Flor et al. (9) have proposed a diverticular disease severity score (DDSS) based on CTC findings performed after the acute episode. While some authors aimed at testing the validity and prognostic value of conventional CT examination performed at the time of an acute inflammatory episode (11,12), there are no similar evaluation studies for CTC in patients recovering after AD.

Hence, the purpose of our work was to assess the prognostic value of CTC in patients recovering after AD by using the DDSS and to evaluate the clinical relevance of any additional information gained from CTC in this setting.

## MATERIALS AND METHODS

### Population

The original cohort comprised 252 patients who had an acute episode of AD and were visited at the emergency department of our university Hospital (Azienda Ospedaliera San Paolo, Milan) from March 2010 to December 2013. For the aim of this study, we searched for patients who underwent both conventional abdominal contrast-enhanced CT during the acute event and follow-up CTC after recovery (mean time interval, 9 ± 7 weeks; range, 4–36 weeks), excluding those who underwent conventional abdominal CT only ($n = 80$) or CTC only ($n = 15$). In particular, clinicians and/or surgeons ordered follow-up CTC for different reasons: to confirm the diagnosis of diverticular disease in selected cases to rule out a superimposed colorectal cancer; to obtain information on the extent of the disease in patients who are potential candidates for elective surgery; and to exclude the presence of AD complications. We excluded patients ($n = 5$) who underwent follow-up CTC too early, within 4 weeks from the acute event.

Finally, 46 patients (23 women, 23 men; mean age, 59 ± 13 years) composed our study cohort.

### Imaging Protocol

Abdominal CT was performed before and after intravenous contrast material in 43 of 46 (93%) patients with the following protocol. All examinations were performed using a 16-row CT (BrightSpeed, General Electric Healthcare, Waukesha, Wisconsin, USA). After an unenhanced CT data acquisition, a second scan was acquired 60–70 s after intravenous injection of 100 mL of nonionic iodinated contrast material (Iomeron 400, Bracco SpA, Milan, Italy) followed by 50 mL of saline flush, both at a flow rate of 3 mL/s, thus obtaining images during the portal venous phase. The CT acquisition protocol was as follows: gantry rotation, 0.8 s; slice thickness, 1.25 mm; table speed, 27.5 mm/s; pitch, 1.375; reconstruction interval, 1.25 mm; and 120 kVp (140 in obese patients), modulated mA ranged from 80 to 440. The three patients studied with unenhanced CT had contraindications to the administration of iodinated contrast material.

### CT Colonography

CTC was performed with low-dose technique in 43 of 46 patients (93%) with the following protocol. All examinations were performed using a 64-row CT (LightSpeed VCT, General Electric Healthcare). Immediately before imaging, carbon dioxide was delivered to the colon by an automated insufflator (PROTOCO$_2$L colon insufflator and administration set, Bracco, Milan, Italy) through a small flexible rectal catheter with a retention balloon. Twenty milliliters of hyoscine butylbromide (Buscopan, Boehringer Ingelheim, Florence, Italy) was intravenously injected before colonic distension in all but four patients who had contraindications (recent myocardial infarction or glaucoma). Each patient was first placed in the left lateral decubitus position until about 1–1.5 L of carbon dioxide was insufflated, then in the supine position for 1 or 2 min, and then in the right lateral decubitus position to reach a total of approximately 3–4 L of carbon dioxide. Thereafter, a CT scout image was taken. If colon distension was deemed adequate, the volumetric CT data acquisition was initiated during end expiration with the patient in the supine position. The patient was rolled prone and a second scout image was acquired, followed by full acquisition. After the last CT data acquisition, carbon dioxide delivery was stopped, the cuff was deflated, and the rectal catheter was removed. In three of 46 patients, the second CT data were acquired 60–70 s after intravenous injection of 100 mL of nonionic iodinated contrast material (Iomeron 400, Bracco SpA) followed by 50 mL of saline flush, both at a flow rate of 3 mL/s, thus obtaining images during the portal venous phase. The CT acquisition protocol was as follows: gantry rotation, 0.5 s; slice thickness, 1.25 mm; table speed, 27.5 mm/s; pitch, 1.375; reconstruction interval, 1 mm; 120 kVp (140 in obese patients), 100 mA (300 in obese patients); in the case of contrast-enhanced CT data acquisition, modulated mA ranged from 80 to 440.

CTC was performed with at least two conventional scan positions (supine and prone); we performed an additional lateral decubitus scan in 27 of 46 patients (59%) to ameliorate sigmoid colon visualization (13).

Bowel cleansing regimen for CTC consisted of one sachet of mild laxative per os (Movicol [Blinded (Movicol; Macrogol, Norgine Italia S.r.l.)]) after breakfast, lunch, and dinner for the 3 days before CTC. Over these 3 days, patients were instructed to drink at least 1 L of water per day and to follow a low-fiber diet. On the day of CTC, at least 3 h before the examination, approximately 1 mL/kg of iodinated contrast material (Gastrografin, Schering, Berlin, Germany) diluted in 500 mL of water was administered orally for fecal tagging.

### Image Analysis

A radiologist with a 14-year experience in abdominal CT and an 8-year experience in CTC, blinded to clinical results of both CT and CTC examinations, retrospectively analyzed all the examinations. For each patient, the severity of disease was calculated with a modified Hinchey classification (Table 1)