

# Usefulness of Contrast-Enhanced CT on Arrival in Colonic Diverticular Bleeding

Masanobu Kishimoto, Kenji Maejima, Takashi Muroya, Kentaro Kajino, Hitoshi Ikegawa, Yasuyuki Kuwagata

Department of Emergency and Critical Care Medicine, Kansai Medical University, Hirakata, Japan

Email: kishimom@hirakata.kmu.ac.jp

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## Abstract

Contrast-enhanced computed tomography (CT) and colonoscopy are very useful for the diagnosis and treatment of colonic diverticular bleeding. However, the timing of CT has been reported in few cases. The aim of this study was to demonstrate the usefulness of contrast-enhanced CT on arrival in colonic diverticular bleeding. We conducted a review of the data of patients that were diagnosed with colonic diverticular bleeding between July 2010 and December 2021. Eighty-two patients (51 males, 31 females, average age 69.1 years) were admitted with diagnosis of colonic diverticular bleeding after undergoing contrast-enhanced CT. We retrospectively investigated the relationship between the initial diagnosis by contrast-enhanced CT on arrival at the hospital and the results of endoscopic identification. Contrast-enhanced CT showed extravasation of contrast medium in 30 cases. The time from the onset of bloody stool to the implementation of contrast-enhanced CT was significantly shorter in cases with extravasation images in the CT (average 7.9 hours) than in cases without extravasation images in the CT (average 15.3 hours). The identification rate of diverticular bleeding sites with colonoscopy was significantly higher in cases with extravasation images in the CT (83%) than in cases without extravasation images in the CT (36.5%). The final treatment methods were endoscopic hemostasis in 46 cases, medical treatment alone in 26 cases, transcatheter arterial embolization (TAE) in 8 cases, and surgery in 2 cases. For patients suspected of colonic diverticular bleeding, performing contrast-enhanced CT early and estimating the bleeding site before colonoscopy may lead to the success of endoscopic hemostasis. To identify and treat successfully colonic diverticular bleeding by colonoscopy, the early use of contrast-enhanced CT before colonoscopy is highly recommended.

## Keywords

Colonoscopy, Extravasation, Hemorrhagic Stool

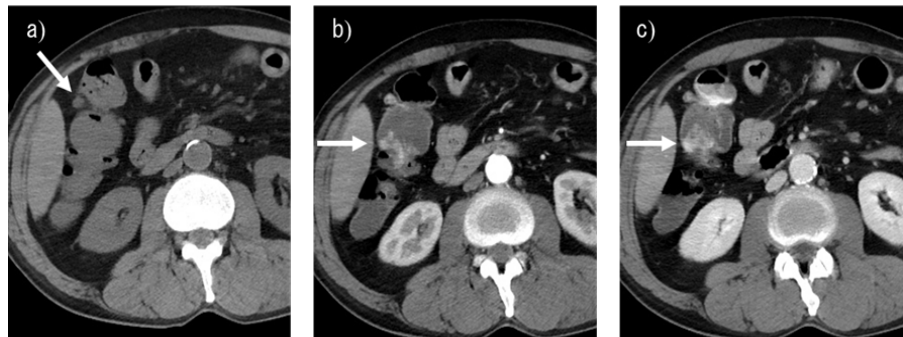
## 1. Introduction

Colonic diverticular bleeding is reported to account for about 35% of painless lower gastrointestinal bleeding and occurs in up to 50% of elderly patients with diverticulosis [1]. Aging of society with an increase in the number of people taking antithrombotic drugs or nonsteroidal anti-inflammatory drugs (NSAIDs) has contributed to the growth in the incidence of colonic diverticular bleeding [2]. This has led to an upsurge in patients with colonic diverticular bleeding getting admitted to Emergency Centers. Diverticular bleeding is arterial and occurs from rupture of the intramural branches of the marginal artery at the dome or neck of the diverticulum. Trauma from mechanical or chemical causes within the lumen of the diverticulum leads to injury to the penetrating vessels and bleeding [3]. Most diverticular bleeding is intermittent, and the amount of bleeding varies from case to case. Appropriate hemostasis treatment is required in many cases. Contrast-enhanced computed tomography (CT) and colonoscopy are very useful for the diagnosis and treatment of diverticular bleeding. We retrospectively examined the relationship between initial diagnosis by contrast-enhanced CT and endoscopic identification in patients with colonic diverticular bleeding.

## 2. Materials and Methods

This single-center retrospective study was conducted at Kansai Medical University Hospital in compliance with the Declaration of Helsinki and the “Ethical Guidelines for Medical Research for Humans”. The ethics committee of Kansai Medical University approved this study. The subjects were the patients who were transported to our emergency and critical care center during the period from July 2010 to December 2021 and were diagnosed with colonic diverticular bleeding.

The medical institution has a policy of hospitalizing and scrutinizing all cases of suspected colonic diverticular bleeding. The definition of colonic diverticular bleeding is based on the criteria previously reported by Jensen *et al.* [4]. It is based on cases with acute onset bloody stools that require hospitalization; 1) those with active bleeding from the diverticulum, 2) those with blood clot, erosion, and exposed blood vessel in the diverticulum, and 3) those with colonic diverticula were also included. Cases, where bleeding organs could not be identified at the time of observation, were excluded. Also, in cases where it was diagnosed as bleeding from other organs, they too were excluded. In those cases, suspected of colonic diverticular bleeding, contrast-enhanced CT was performed after arrival at the hospital for cases without renal dysfunction or allergies to contrast media. In order to confirm the depiction of the extravasation image, iodine contrast medium was rapidly injected (3 mL/sec), and two-phase imaging was performed from the region of the diaphragm to the pelvic floor in the arterial phase and the parenchymal phase (Figure 1). Cases of extravasation of contrast media from the gastrointestinal tract other than the colon were excluded.



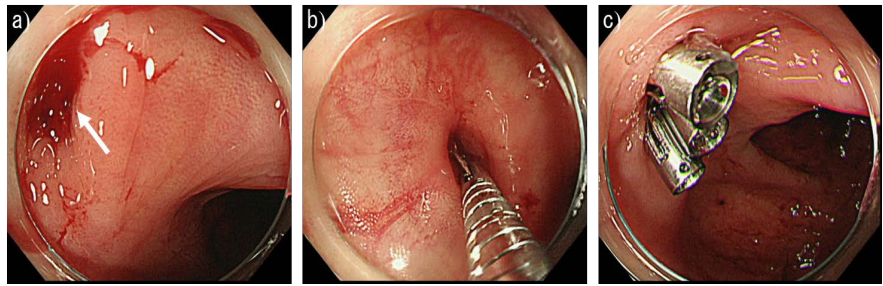
**Figure 1.** CT images of a case. (a) Plain CT shows diverticulum (arrow) in the ascending colon. (b) Contrast-enhanced CT in arterial phase shows contrast material extravasation (arrow) in the ascending colon. (c) In parenchymal phase, contrast material extravasation (arrow) expands.

Cases with intestinal wall thickening, which was suspected of inflammation or tumor in the gastrointestinal tract were also excluded.

Colonoscopy was performed on the target patients, after the hemodynamics became stable. A colonoscope (PCF-Q260AZI or PCF-H290I, manufactured by Olympus) was used, and the tip attachment (D-201-12704, manufactured by Olympus) was attached. The lavage fluid used for anterior water supply was an oral bowel irrigation agent. The diverticulum suspected of bleeding was carefully washed, blood clots were removed as much as possible, and the bleeding site in the diverticulum was observed. Endoscopy was employed to identify the bleeding site and was clinically managed with endoscopic hemostasis using a clip as the first choice (**Figure 2**). Medical therapy alone was performed on cases where the bleeding site in the diverticulum was unknown using colonoscopy. In cases where it was difficult to stop bleeding with endoscopic hemostasis, these patients underwent transcatheter arterial embolization (TAE) and surgery. After successful completion of endoscopic hemostasis and without bloody stool anymore, the patient went on a normal diet. No further follow-up endoscopy was done on the patient and the patient was subsequently discharged from the hospital by the physician-in-charge.

The data of individual patients were obtained from the medical record at Kansai Medical University Hospital. These data included age, gender, history of diverticular bleeding, oral medications (antithrombotic drugs, NSAIDs, and steroids), systolic blood pressure, pulse rate, hemoglobin, bleeding area, method of treatment, and the time from the onset of bloody stool to the CT performing. For each target patient, we confirmed whether extravasation was found in contrast-enhanced CT image and whether the endoscopic approach to the bleeding site was successful. And the relationship between the two groups was analyzed statistically.

Statistical analysis was performed using the chi-square test, Mann-Whitney U test, and Student's t-test was done on the data and the statistical significance was set at  $p < 0.05$ .



**Figure 2.** Findings in the ascending colon by colonoscopy. (a) Active bleeding (arrow) was observed from diverticulum. (b) Hemostasis using Hemostasis Clip (SureClip™, Micro Tech) was done in diverticulum. (c) Hemostasis of the bleeding point was completed successfully.

### 3. Results

During the period from July 2010 to December 2021, 90 patients were admitted with a diagnosis of colonic diverticular bleeding. Among these cases, 82 patients (51 males, 31 females, average age of 69.1 years) who underwent contrast-enhanced CT early after arrival at the hospital prior to colonoscopy were targeted for the analysis. Among the target patients, 20 cases had histories of diverticular bleeding, 30 cases had received antithrombotic drugs, 11 cases had received NSAIDs, and 1 case had received steroids. The most common bleeding area was the ascending colon in 51 cases (62.2%), while the sigmoid colon in 12 (14.6%), transverse colon in 7 (8.5%), and descending colon in 3 (3.7%). Besides, there were 9 cases (11%) with multiple diverticula in which the bleeding area remained unidentifiable. Endoscopic hemostasis was successfully performed in 46 cases (56.1%), while medical treatment alone was effective in 26 cases (31.7%). Moreover, TAE were performed in 8 cases (9.8%), and surgery was needed in 2 cases (2.4%). The 82 target patients were divided into two groups according to the CT findings: a group with extravasation image (30 cases) and a group without extravasation image (52 cases).

The Characteristics and findings on arrival of the patients in the two groups are shown in **Table 1**. A comparative study of age, gender, history of diverticular bleeding, oral medications (antithrombotic drugs, NSAIDs, and steroids), blood pressure, pulse rate, and Hemoglobin at the time of admission showed no significant difference between the two groups. The average time from the onset of bloody stool to the implementation of contrast-enhanced CT was 7.9 hours in the case group with extravasation image, while it was 15.3 hours in the case group without any extravasation image. This elapsed time was significantly shorter in the former group compared to the latter group ( $p = 0.03$ ; **Figure 3**). The relationship between CT findings and the endoscopic identification of diverticular bleeding sites is presented in **Table 2**. The identification rate of diverticular bleeding sites by the first colonoscopy was 83% in cases with extravasation images in the CT, while it was 36.5% in cases without extravasation images ( $p < 0.001$ ).

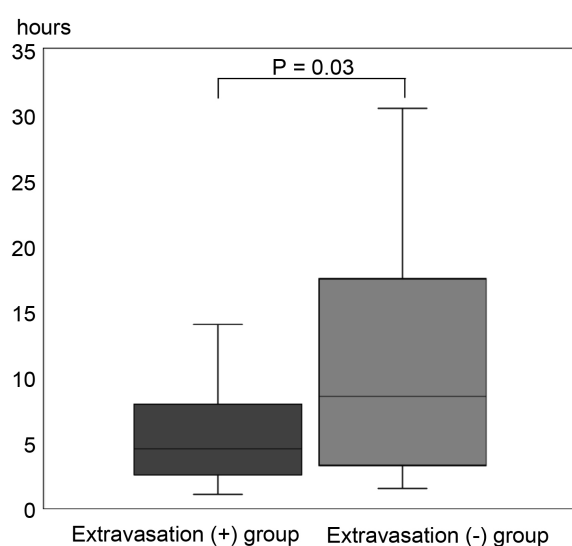
**Table 1.** Characteristics and findings on arrival of the patients.

	Extravasation (+) group (n = 30)	Extravasation (-) group (n = 52)	P Value
Age (year)	72	67	0.08
Gender male	15 (50%)	36 (69%)	0.08
History of diverticular bleeding	8 (27%)	12 (23%)	0.98
<i>Oral medications</i>			
Antithrombotic drugs	10 (33%)	20 (38%)	0.64
NSAIDs	6 (20%)	5 (10%)	0.18
Steroids	0 (0)	1 (2%)	0.44
<i>Findings on arrival</i>			
Systolic blood pressure (mmHg)	136	129	0.21
Pulse rate (times/min)	84	82	0.56
Hemoglobin (g/dl)	10.1	10.5	0.45

NSAIDs: nonsteroidal anti-inflammatory drugs.

**Table 2.** Relationship between CT findings and the endoscopic identification. The presence or absence of extravasation images in CT correlates with the endoscopic identification of bleeding sites ( $p < 0.001$ ).

	Identified	Unidentified	Total	Rate
Extravasation (+) group	25	5	30	83%
Extravasation (-) group	19	33	52	37%
Total	44	38	82	54%

**Figure 3.** Interval time between the onsets of hemorrhagic stool and CT scan.

## 4. Discussion

The most common symptom of colonic diverticular bleeding is painless bloody stool. The affected patients underwent medical interviews followed by rectal examination and evaluation of the amount of bleeding using vital signs such as blood pressure and pulse rate [5]. Diverticular hemorrhage will cease spontaneously in about 90% of cases [6]. On the other hand, it was also reported that 2.5% of patients admitted with colonic diverticular bleeding died in hospital and that 26.1% of the patients needed blood transfusion [7]. If the hemodynamics are stable, initial medical treatments can be performed over a relatively long period of time. But if the hemodynamics are unstable, the stabilization of the hemodynamics by infusion or blood transfusion should be prioritized. In the initial medical care, it is recommended to evaluate first the hemodynamics followed by diagnostic imaging.

Jaekle *et al.* [8] reported the usefulness of contrast-enhanced CT examination for diagnostic imaging of gastrointestinal bleeding. Furthermore, contrast-enhanced CT has been used to help triage patients into those who require urgent colonoscopy versus those who can be treated more conservatively and thereafter increases the diagnostic yield of colonoscopy [9]. However, there are few reports investigating colonic diverticular bleeding. This study might be the first report investigating colonic diverticular bleeding, regarding the timing of CT after the onset of bloody stools.

Our clinical strategy for the patients suspected of colonic diverticular bleeding is to perform contrast-enhanced CT as much as possible. Contrast-enhanced CT can be performed immediately at the time of bleeding. Because the influence of the contents of the intestinal tract is small, there is a high possibility that the bleeding focus lesion can be detected. And it is also useful for the diagnosis of diseases other than the diverticulum. Regarding evaluating CT, first search for the presence or absence of extravasation images. When an extravasation image is found, the tumor and diverticulum around it should be searched thoroughly. Besides, in cases where no extravasation was observed, one should estimate the bleeding area by the presence of intestinal hematoma. Images in CT are useful for the estimation of the bleeding area. This locational information about bleeding lesions makes it easier to approach the bleeding site in the diverticulum with colonoscopy.

The results show that the time from the onset to the contrast-enhanced CT was significantly shorter in the cases with extravasation image than in the cases without it. This suggests that early CT performance increases the detection rate of extravasation images. We suggest that it is desirable to perform contrast-enhanced CT as early as possible after the onset of bloody stool to confirm diverticular bleeding. Therefore, it is recommended that contrast-enhanced CT should be performed early in the hospital visit for patients with the symptom of bloody stool.

Another diagnostic imaging tool is bleeding scintigraphy. Bleeding scintigra-

phy is minimally invasive and can diagnose even a very small amount of bleeding (0.01 to 0.1 mL/min or more) [10]. It has been reported that the identification rate of bleeding sites with colonoscopy alone is about 50% for patients with active lower gastrointestinal hemorrhage, and it is about 75% with bleeding scintigraphy [11]. However, nuclear medicine examinations in urgent situations are difficult to perform. Contrast-enhanced CT is considered to be highly useful as a diagnostic tool for colonic diverticular bleeding based on speed, convenience, safety, and objectivity.

Endoscopic hemostasis for colonic diverticular bleeding has been reported to be useful for stopping active bleeding, preventing rebleeding, and avoiding blood transfusion and surgery [4] [12]. It is often difficult to identify the bleeding site in the diverticulum because many patients have multiple diverticula in the colon. Poor vision and the presence of clots in the diverticulum also make colonoscopy difficult. There is a strong need for a diagnostic method to efficiently identify the site of bleeding in order to reliably perform endoscopic treatment. Our study has shown that early use of contrast-enhanced CT leads to diagnosis and treatment with colonoscopy for colonic diverticular bleeding. It is possible that an extravasation image visualized by contrast-enhanced CT examination before colonoscopy contributes to success of endoscopic hemostasis. Clinical strategies for emergency patients complaining of bloody stools should be centered on a combination of early use of contrast-enhanced CT and subsequent colonoscopy.

The limitations of this study are namely—it is a single-center, retrospective observational study, and may have included cases other than colonic diverticular bleeding. Also, the number of patients involved in the study was small. Further, the effect of the relationship between extravasation images in the CT and therapeutic results has not been examined. Although this study was limited in its scope, the use of contrast-enhanced CT prior to the treatment of diverticular bleeding is especially useful.

## 5. Conclusion

We investigated the usefulness of early use of contrast-enhanced CT for colonic diverticular bleeding. Performing of contrast-enhanced CT early after the symptom onset makes it easier to approach the bleeding site in the diverticulum with colonoscopy. It is important to pre-estimate the bleeding site by contrast-enhanced CT examination early after arrival at the hospital, in order to make a success in colonoscopy for colonic diverticular bleeding.

## Conflicts of Interest Statement

There is no conflict of interest of the author related to the content of this paper.

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