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No catheter angiography is needed in patients with an obscure acute gastrointestinal bleed and negative CTA

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ABSTRACT

Purpose: To evaluate the negative predictive power of computed tomography angiography (CTA) for the identification of obscure acute gastrointestinal (GI) bleeding (GI bleeding not visualized/treated by endoscopy) on subsequent mesenteric angiography (MA) with the intention to treat.
Materials and methods: A retrospective chart review of patients was performed who underwent mesenteric angiography for the evaluation/treatment of acute GI bleeding between November 2012 and July 2016. Patients with negative CTA examinations that proceeded to MA were identified. Negative predictive value (NPV) was calculated.
Results: 20 patients (14 male, 6 female; average age: 73.1 ± 12.8 years) underwent 20 negative CTA examinations for the evaluation and treatment of GI bleeding followed by mesenteric angiography. Eighteen of 20 patients had negative subsequent MA (negative predictive value, NPV = 90%). Both false negative cases were upper GI bleed (vs 0 lower GI bleed); this difference was significant ($p < 0.05$).
Conclusions: The high NPV of CTA for the evaluation of GI bleeding suggests utility for excluding patients that are unlikely to benefit from MA and subsequent endovascular therapy. CTA may be considered for the first line diagnostic study for the evaluation of obscure GI bleeding.

1. Introduction

Approximately 75% of upper and 80% of lower gastrointestinal (GI) bleeds will resolve spontaneously with supportive measures alone. Nearly a quarter of cases recur and require intervention to localize and treat the source. A multidisciplinary approach comprising gastroenterology, surgery, and radiology is utilized to diagnose and treat these patients. First line diagnostic and therapeutic management of upper and lower GI bleeds include esophagogastroduodenoscopy (EGD) for upper GI bleeds (above the ligament of Treitz) and colonoscopy for lower GI bleeds, although colonoscopy may be difficult in the acute setting due to the need for bowel pre-procedure preparation. When no source of bleeding is identified or the source of bleeding is difficult to identify (obscure bleeding), diagnostic imaging is used to identify the source of bleeding and to guide treatment [1]. Obscure gastrointestinal bleeding may be intermittent and cease spontaneously, often presenting a diagnostic and therapeutic dilemma. Obscure GI bleeding is defined by the American Gastroenterological Institute "bleeding from the GI tract that persists or recurs without an obvious etiology after esophagogastroduodenoscopy (EGD), colonoscopy, and radiologic evaluation of small bowel such as small bowel follow-through or enteroclysis." [2].

Technetium 99m-labeled tagged red blood cells (RBC) scintigraphy (nuclear medicine scintigraphy, NMS) is currently the standard for radiologic diagnosis of GI bleeding. High sensitivity allows detection of bleeding rates as low as 0.1 mL/min [3]. Furthermore, prolonged scanning time allows for detection of intermittent bleeding. A potential pitfall of scintigraphy is poor localization of bleeding in the small bowel or in patients with variant anatomy. Finally, Technetium 99m must be available on site and a nuclear medicine technologist available to prepare/administer radiopharmaceutical and perform the examination. Mesenteric angiography can detect bleeding rates of approximately 0.5 mL/min and allows for concurrent treatment [1]. However, it has a low sensitivity as it requires active bleeding for diagnosis. In the absence of active bleeding, the examination may have no therapeutic benefit.

Computed tomography angiography (CTA) has emerged as a noninvasive imaging modality to evaluate patients for GI bleeding. CTA can be performed rapidly and can detect bleeding rates as low as 0.3 mL/min

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[4]. The accuracy of CTA for the detection of acute GI bleed was evaluated in a systematic review and meta-analysis of 672 patients. The authors report the sensitivity and specificity to be 85.2% (95% CI 75.5% to 91.5%) and 92.1% (95% CI 76.7% to 97.7%), respectively with likelihood ratios for positive and negative test results were reported to be 10.8 (95% CI 3.4 to 34.4) and 0.16 (95% CI 0.1 to 0.27), respectively [2]. However, investigational reference standards differed amongst included studies and verification bias may be influenced by a low sensitivity reference standard: clinical follow-up. Awais et al. demonstrated a higher accuracy for CTA compared to NMS in detecting and localizing acute GI hemorrhage on angiography [5]. Nevertheless, discordance exists between CTA and scintigraphy in detection of GI bleed [6]..

An aim of diagnostic imaging is to distinguishing patients who will benefit from invasive therapy from patient who should not undergo MA and associated risks. In this study, we evaluate the utility of CTA for obscure GI bleeding by calculating the negative predictive value (NPV) in patients who underwent subsequent MA after a negative CTA.

2. Methods

2.1. Study population and experimental design

The protocol for this study was reviewed by the Institutional Review Board at our institution. We performed a retrospective chart review of patients who underwent mesenteric angiography for the evaluation/treatment of acute GI bleeding between November 2012 and July 2016 using the McKesson Radiology™ Picture Archiving and Communication Systems (PACS, McKesson Corporation, San Francisco, CA) throughout our hospital system. Patients with negative CTA examinations that underwent subsequent MA were identified. Demographic data, pertinent past medical history, diagnostic radiologic examination findings, and treatment information were recorded. Both upper and lower GI bleeds were include in the analysis as the predictive power of a negative CTA was thought to be independent of bleeding location. Upper GI bleed was defined as above the ligament of Trietz.

2.2. Data analysis

Negative CTA examinations that had subsequent mesenteric angiography translated to the negative predictive power of identifying patients not amenable to endovascular therapy:

Negative predictive values were calculated using the following formula: $NPV = TN / [TN + FN]$

- NPV = negative predictive value
- TN = true negative (negative on both mesenteric angiography and prior diagnostic study [CTA])
- FN = false negative (negative on prior diagnostic study (CTA) but positive on mesenteric angiography)

2.3. Statistical methods

Statistical comparison between groups was performed using Fisher's exact test for categorical variables and Student's *t*-test for continuous variables. Two-tailed tests were performed for each scenario and significance level was set at $p < 0.05$. These were performed using Microsoft Office Excel 2007 (Microsoft Corp., Redmond, WA).

3. Results

From November 2012–July 2016, 20 patients (14 male, 6 female; mean age 73.1 ± 12.8 years) underwent 20 mesenteric angiography procedures for the evaluation/treatment of acute GI bleeding with recent negative CTA examinations. Six CTAs were performed for upper GI bleeds and 14 were performed for lower GI bleeds. There were no differences in demographics between groups (Table 1) Eighteen patients had subsequent negative MA and two patients had a subsequent positive MA, resulting in treatment. Both false negative cases were in patients with upper GI bleeds; a statistically significant difference ($p < 0.05$; Table 2). CTA was able to predict a negative MA in 90% of cases (negative predictive value (NPV) = 90%; Table 3).

Table 1
Demographic data analysis between groups.

		Upper GI	Lower GI	p value
Sex	Male	5	9	$p > 0.05$
	Female	1	5	
Average Age in years (range)		72 (60–83)	73.5 (32–86)	$p > 0.05$
Note: no significant differences exist between groups				

4. Discussion

In the setting of obscure GI bleeding – bleeding not identified and/or treated on endoscopy – radiologic evaluation is often employed to localize and possibly treat a symptomatic lesion. Scintigraphy is considered by many the standard of care for the evaluation of obscure GI bleeding. After a positive result on NMS, patients frequently present to interventional radiology for MA to identify the causative lesion with intention to treat. However, the high sensitivity for detection of intermittent bleeding on a Technetium 99m-labeled red blood cell scan may lead to the detection of treatable bleeds that, despite being seen on subsequent MA, would otherwise be self-limiting, resulting in unnecessary treatment and exposing the patient to risks i.e. non-target embolization. This may also help explain the poor predictive value of NMS to identify a possible treatable lesion [2]. Furthermore, NMS may identify lesions that are angiographically occult and would not benefit from endovascular treatment, thus subjecting the patient to an unnecessary invasive procedure. The positive predictive power of CTA has been shown to be higher than NMS as the intrinsic sensitivity of CTA more closely approximates the bleeding threshold rate of mesenteric angiography [5,6]. CTA may therefore be more helpful in determining which patients require surgical/endovascular treatment [7]. However, it is crucial that patients are imaged while they demonstrate active bleeding clinically in order to identify a lesion and retain timely treatment options. The high PPV has been confirmed in other studies using many different reference standards [8].

The high negative predictive power of CTA reassures that a negative study, even one in which the patient demonstrates clinical bleeding, would not benefit from subsequent mesenteric angiography, obviating the need for an unnecessary procedure. Only 2 patients of 20 had a positive finding on mesenteric angiography which compares well to Awais et al. [5], which reported 0/10. Chan et al. demonstrated the strong negative predictive power of CTA for patients with lower GI bleed in a larger series, however repeat bleeding was used as a reference standard [9]. In comparison to NMS, CTA provides additional diagnostic information, allowing for the evaluation of underlying pathology in many cases (i.e. diverticulosis, cancer) which may impact treatment and identify cases in which surgical treatment maybe preferred over angiography and catheter-directed treatment [10]. Furthermore, CTA provides the interventional radiologist with information for pre-procedure planning, for example by identifying the culprit vessel which can be the target of catheter directed therapy, which may be crucial in the emergent setting of severe bleeding where time may be of the essence [11]..

Table 2
Predictive analysis between groups.

		Upper GI	Lower GI	p value
Sex	False positive	2	0	$p < 0.05$[a]
	True negative	4	14	

[a] Indicates significance.