CT angiography: imaging findings in GI bleeding

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Learning objectives

The purpose of our educational exhibit is:

• To describe the imaging findings of CTA, in patients with acute gastrointestinal bleeding.

• To address the role of CTA in the management of these patients.

Background

Gastrointestinal (GI) bleeding is a common major medical emergency and an important cause of morbidity and mortality.

The role of the radiologist is to localize, characterize, and when indicated, treat the bleeding lesion. In order to optimize patient care, the radiologist must be familiar with the common causes of GI bleeding.

Upper gastrointestinal bleeding arises proximal to Treitz ligament, and involves the esophagus, stomach or duodenum, corresponding to 70% of the patients. On the other hand, lower gastrointestinal bleeding occurs in the remaining 30% of the patients and affects the small bowel [distal to Treitz ligament], colon or rectum.

The most common causes of upper GI bleeding are erosion or peptic ulcer disease (more than 60% of cases).

Gastric or esophageal varices in the setting of portal hypertension cause about 30% of all episodes of upper gastrointestinal tract bleeding. Other causes include gastritis, oesophagitis, duodenitis, tumors, vascular abnormality (angiodysplasia, vascular ectasia, vascular malformation) and Mallory-Weiss tears.
The source of lower GI bleeding is colorectal in approximately 90% of cases and in the remaining 10% is detected in the small bowel. Colonic diverticula, angiodysplasia, inflammatory lesions, and malignancies are the most common causes of bleeding.

Patients with a high risk of bleeding are those with coagulopathies, and patients being on an antiplatelet or anticoagulant therapy.

Risk factors also include medication (such as NSAID and corticosteroids), prior abdominal surgery or other medical procedures.

The management of GI bleeding often involves a multidisciplinary approach in which radiologists and gastroenterologists play a key role, providing several specialized diagnostic examinations with a variety of imaging modalities as well as therapeutic interventions.

**Endoscopy** is the main diagnostic technique if there is a suspicion of an upper gastrointestinal bleeding. It is able to identify bleeding source in 90% of the cases and is usually successful in the management of the hemorrhage. When endoscopy is negative (10%) or cannot be performed, CT angiography is required to recognize the source of bleeding or its causes.

**Colonoscopy** is performed to identify the site and cause of lower GI bleeding. If a lesion is localized, endoscopic therapy can be performed to stabilize hemorrhage. When an emergency situation occurs, colonoscopy is often less helpful because of unprepared colon and poor visualization of the mucosa due to acute hemorrhage. On the other hand the small bowel cannot be assessed with endoscopy.

Moreover, if a patient is hemodynamically unstable, CTA is the first line imaging technique.

**Role of CTA:**

**CT Angiography** allows perfect visualization of both the small and large bowel without preparation, detects active bleeding with a flow rate as low as 0.35mL/min and distincts arterial from venous bleeding.

CTA detects the presence of contrast extravasation and the site of bleeding.

In the Meta analysis of V. Garcia-Blazquez et al, the overall sensitivity of CT angiography for detecting active acute GI haemorrhage was 85.2 % and the overall specificity of CT angiography was 92.1% (1).
Even in the absence of active bleeding, CTA may be used to identify the underlying lesion and characterize it, as diverticular, vascular, inflammatory or neoplastic.

Abnormalities such as thickening or abnormal enhancement of the bowel wall and hyperattenuating perienteric fat, tumours and vascular abnormalities provide diagnostic information.

The accuracy of CTA for detecting the cause of hemorrhage exceeds 80%.

CTA provides important information for further management of bleeding. The presence of active extravasation is an indication for emergency treatment (embolization, therapeutic endoscopy or surgery).

In haemodynamically stable patients with negative endoscopic and CT results, videocapsule can be used as closed as possible to the acute episode for further investigation of bleeding.

It is important to mention that 75-80% of bleedings are resolved spontaneously with medical treatment alone. The remaining 20-25% of bleedings need further management (surgery, therapeutic endoscopy or embolization).
Findings and procedure details

We present the findings of 41 patients with a history of acute GI bleeding who underwent CT Angiography the last 3.5 years in our hospital.

Patients age ranged between 17-93yr with a mean age of 69years.

From the 41 patients, 28 were male and 13 female.

Twelve of the 41 patients were on antiplatelet therapy though 8/41 patients were treated with anticoagulant agents.

IMAGING PROTOCOL

A three-phase protocol was performed with a 16-detector-row scanner.

Images were acquired with the following parameters: section thickness, 5 mm for the unenhanced phase and 1.25 mm for the arterial and portal-venous phases; pitch, 1.375; 120 kVp; rotation time, 0.6 seconds; auto mA.

• No oral contrast was administered because positive contrast material may obscure the bleeding.

• Non-contrast scan was needed to exclude any intraluminal hyperattenuating material such as foreign bodies, clips or coproliths that might be misinterpreted as active bleeding.

• The entire abdomen was scanned following iv contrast administration in a late arterial (~35sec) and portal venous phase (40sec later). The late arterial phase allowed the detection of slower bleeding rates.
We administered 100-120 mL intravenous contrast material with a rate of 3.5ml/sec.

Active bleeding was identified as a focal area of high attenuation (>90HU) within the bowel lumen during the arterial phase that increased during the portal-venous phase.

Pre contrast CT images were compared with those obtained after the administration of the intravenous contrast in order to avoid pitfalls.

Postprocessing was performed with a 3D workstation. All studies were reviewed in the axial plane and with multiplanar reformation (MPR) images. Maximum-intensity projection (MIP) and MPR images were useful for localizing the bleeding bowel segment and for determining the artery responsible for the bleeding. They also provided information on vascular anatomy variants that proved useful for transcatheter arterial embolization or surgery.

**Positive CTA findings were detected in 33/41 patients (81%).**

**Active bleeding was detected in 17 of the 41 patients (42%).**

CTA revealed the site of bleeding and the underlying cause in **8/17 patients** [diverticulas (n=6), arteriovenous malformation (n=1), postoperative bleeding (n=1)]. In the remaining **9/17pts** the cause of bleeding was not recognized in the CTA images.

In all of the above cases the site of bleeding was in lower GI.

**In 16 of the 41 patients (39%)** there were no findings of active bleeding but CTA revealed the cause of bleeding: diverticulas (n=6), ischaemic colitis (n=4), tumors (n=2), Crohn's disease (n=1), arteriovenous malformation (n=1), ectopic varices (n=1), pseudoaneurysm (n=1). In all but one cases the site of bleeding was in lower GI. One patient with upper GI bleeding proved to had hemobilia due to an hepatic pseudoaneurysm.

**CTA was normal in 8/41 patients (19%).** In these patients, diagnostic endoscopy, videocapsule or both were performed for further investigation of bleeding.

Colonoscopy detected the underlying cause in 3/8 patients [solitary rectal ulcer (n=1), colonic polyp (n=1), anal tumor (n=1)].

Videocapsule detected the underlying cause in 4/8 patients [arteriovenous malformations (n=3), ectopic varices (n=1)].
The remaining one patient underwent both colonoscopy and videocapsule with negative findings and the cause remained unknown.

In Table 1 we analyze the underlying causes of GI bleeding in all 41 patients who underwent CT angiography in our institution.

The *overall sensitivity* of CTA for detecting the site and the cause of GI bleeding was of 84.62 % [95% CI: 69.46 % to 94.10 %] though the *specificity* was 100.00 % [95% CI: 19.29 % to 100.00 %].

**Patient management**

- **17/41 patients** were treated in an emergency setting, and specifically

  - **12/17 patients** with positive CTA findings of active extravasation were treated with transcatheter embolization [n=6], therapeutic endoscopy by means of adrenaline injection or sclerotherapy [n=5] and surgery [n=1].

  - **3/16 patients** with negative findings of active bleeding but with vascular abnormalities detected with the CTA, underwent also transcatheter embolization.

  - **2/8 patients** with negative CTA but positive findings in colonoscopy or videocapsule were treated with therapeutic colonoscopy and metal clip placement [n=1] and transcatheter embolization [n=1].

- **The remaining 24/41 patients** were treated conservatively with cessation of anticoagulant/antiplatelet therapy and blood transfusion. Surgery or endoscopic polypectomy were scheduled for patients with tumors, polyps or diverticulas.
Images for this section:
<table>
<thead>
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<th>Cause of bleeding</th>
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<td>Colonic diverticula</td>
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<tr>
<td>Arteriovenous malformations</td>
<td>9</td>
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<tr>
<td>Tumors</td>
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Table 1: The underlying causes of GI bleeding in all 41 patients who underwent CT Angiography
**Fig. 1:** Active left colonic diverticular bleeding in a 93-year-old woman who was on anticoagulant therapy. Axial arterial [a] and portal-venous phase [b] CT images demonstrate active bleeding in the sigmoid. Patient was treated conservatively.
Fig. 2: Active bleeding of a right colonic diverticula in a 56-year-old man who presented with hematochezia. Axial unenhanced image [a] shows hyperattenuating content in a diverticula (77HU). Axial and coronal MPR portal venous phase images [b, c, d] demonstrate pooling of extravasated contrast material [arrow] within the diverticula (160HU). Patient was treated surgically.
**Fig. 3:** 78-year-old man with small bowel angiodysplasia. Oblique MPR [a] and MIP [b] images from arterial phase show a nodular contrast enhancement of the small bowel wall (arrows). Angiography demonstrated a small bowel angiodysplasia and coil embolization was performed. The presence of endovascular aneurysm repair (EVAR) complicated the transcatheter embolization.

**Fig. 4:** Acute lower gastrointestinal tract bleeding in a 40-year-old man. CT angiography (axial MIP image [a]) revealed a hypervascular exophytic mass originating from the wall of the ileum; there was no evidence of active bleeding. The mass was resected, and a gastrointestinal stromal tumor (GIST) verified at pathology. Coronal arterial and portal-venous phase CT MIP images [b, c] show the hypervascular mass with the tortuous vessels and tumor's feeding vessels originated from ileal branches of SMA.
Fig. 5: Active left colonic bleeding in a 55-year-man who was on double antiplatelet therapy. Axial arterial phase [a] demonstrates extravasation of contrast material in the large bowel [arrow]. Axial portal venous phase CT image [b] shows pooling of extravasated contrast material within the bowel lumen [arrow]. Gastroenterologists performed colonoscopy and a bleeding polyp was diagnosed. Hemostasis with adrenaline was initially performed and a polypectomy was scheduled.

Fig. 6: A 75 year-old man presented with hematochezia. CT angiography showed no evidence of active bleeding. Axial CT images [a,b] show circumferential and diffuse mural thickening with submucosal edema (target sign) of the sigmoid and rectum. The findings were attributed to ischemic colitis. Patient was treated conservatively.
Fig. 7: Meckel's diverticular active bleeding in a 17-year-old man. Axial [a] and coronal [b] MPRs portal venous phase CT demonstrate pooling of contrast material [arrow] due to a bleeding Meckel's diverticulum. Patient was treated surgically.

Fig. 8: Varices in a 70-year-old man with cirrhosis. Axial image [a] demonstrate cirrhotic liver. CT angiography showed no active bleeding. Oblique portal venous phase MIP [b] and MPR images[c] show segmental bulbous dilatation of intramural veins in the jejunum (arrow), a finding that represents ectopic varices. A probable variceal source of bleeding was determined. Patient was treated successfully with transcatheter embolization.
Fig. 9: Solitary rectal ulcer in a 85-year-old woman who presented with brisk hematochezia. Axial arterial phase CT image [a] depicts a jet of extravasated contrast material [arrow] arising from the wall of the rectum. Axial portal venous phase CT image [b] shows pooling of extravasated contrast material [arrow]. Coronal MPR reformatted image [c] shows distension of the rectum with diffuse wall congestion. Colonoscopy was performed and a solitary rectal ulcer was diagnosed. Adrenaline was injected endoscopically and hemostasis achieved.
Fig. 10: A 70-year-old woman presented with melena, a week after percutaneous transhepatic cholangiography and biliary metal stents placement due to malignancy. CTA-coronal MPR [a] and MIP [b] arterial phase images demonstrate a pseudoaneurysm arising from the right hepatic artery (arrow), complicated by an arterioportal fistula. Patient was treated with transcatheter embolization.

Fig. 11: Postoperative acute bleeding in a 68-year-old woman who has undergone Whipple procedure, presented with hemorrhagic fluid drained from a percutaneous catheter. The site of bleeding was detected at the duodenal-jejunal anastomosis (arrow). Axial [a] and MIP [b] arterial phase images demonstrate extravasation of contrast material in the small bowel lumen (arrow) at the level of the surgical clips (open arrow in [b]). There is also high density fluid collection attributable to hemoperitoneum. Patient was treated with transcatheter embolization.
Conclusion

• GI bleeding is a common medical emergency and CT Angiography plays a key role in the management of these patients.

• CTA is a reliable, non-invasive and effective method of localizing the site of GI bleeding.

• CTA also provides information regarding the underlying causes of GI bleeding and is instrumental to guide treatment planning.

Personal information

References