Imaging of obscure gastrointestinal bleeding. Utility of abdominal CT scan in establishing the diagnosis.

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Authors: D. I. Fenesan, O. Anton; Cluj-Napoca/RO
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Learning objectives

Abdominal CT scan is an imaging method becoming widely used in the diagnosis of obscure gastrointestinal bleeding. The purpose of this poster is to point out its role and protocol applied.

Further objectives that we propose are:

- To understand the definition of obscure gastrointestinal bleeding and what are the main causes.
- To know and choose the appropriate imaging method based on the clinical condition of the patient.

To know how and when to use abdominal CT for assess obscure gastrointestinal bleeding.
Background

Gastrointestinal (GI) bleeding is a common clinical condition which requires hospitalization, with high morbidity and mortality.

**Obscure GI bleeding (OGIB)** is a relatively rare (5%) form of GI bleeding and is defined as recurrent acute or chronic bleeding with no source identified after upper gastrointestinal endoscopy and colonoscopy [1].

OGIB is classified in two types:

- **Overt gastrointestinal bleeding** represents a clinically evident bleeding without an identifiable cause after endoscopic examination, that persists or reoccurs.
- **Silent (occult) gastrointestinal bleeding** is defined by the presence of positive fecal occult blood test, associated or not with iron deficiency anemia [1,2,3].

OGIB in large amounts (overt gastrointestinal bleeding) is clinically manifested by melena, hematochezia, hematemesis, while, in the occult form, only laboratory abnormalities occur [3]. Therefore, it is very important to closely evaluated the cause of bleeding, guided by clinical status.

**The causes of OGIB** are multiple (Table 1) [4]. After the anatomical origin of the lesion are classified as upper gastrointestinal bleeding (up to ligament of Treitz including esophagus, stomach and duodenum) and lower gastrointestinal bleeding (small bowel, colon, or rectum) [5].

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Table 1 OGIB causes [4]

| Gastric antral vascular ectasia | NSAID enteropathy * |

* NSAID - non steroidal anti-inflammatory drug enteropathy

The most common anatomical location for OGIB is the small bowel. Thus, most often, the cause detection of OGIB is clinically challenging beyond the reach of conventional endoscopy [5]. The most common causes of OGIB, related to the small bowel, are vascular (angiodysplasia found in 30%-60% of examinations) especially affecting elderly patients. Other common causes include neoplasms (5%-10%), ulcerations and Meckel diverticulum; these causes frequently account for obscure gastrointestinal bleeding in younger patients [4,5].

One of the main objectives in managing OGIB is location, characterization, and if indicated, treatment of bleeding lesion [6].

**The most important diagnostic imaging methods** used are small bowel enema, radionuclide imaging, conventional angiography, endoscopy, computed tomography (enteroclysis, enterography, angiography) and wireless capsule endoscopy. Each of these methods has their advantages and disadvantages. It is therefore very important to know them and correlate them with clinical status before deciding which is the most appropriate diagnostic method [4,7].

*Small bowel enema* was a radiological method used in the past, especially in terms of malignancy or Crohn's disease. Currently, it has a limited role in assessing OGIB [1,8,9].

*Scintigraphy of GI bleeding (using technetium 99m -labeled red blood cells)* allows detection of active bleeding (arterial and venous site) at a rate of 0.10 ml/min, being noninvasive. Furthermore, it is useful in detecting intermittent bleeding. Among disadvantages, the lack of cause detection and the impossibility of treatment are the most important [4-8].

*Catheter-directed angiography* is a method of diagnosis and treatment for overt OGIB. It provides the exact location if the bleeding rate is more than 0.5 ml / min. In addition, it can diagnose also non bleeding lesions (such as inflammatory diseases, tumors and vascular ectasias). Invasiveness, ischemic bowel complications or contrast material reactions makes angiography to be an option for patients with massive life-threatening bleeding and should be used as targeted therapeutic ideally procedures [4,8,9].
**Endoscopy** (esophageal endoscopy or colonoscopy) is the first method used managing the obscure gastrointestinal bleeding. It allows visualization of gastrointestinal mucosa, biopsy and therapeutic approaches [3,4]. But in terms of massive bleeding, its utility in viewing spot bleeding decreases. In addition, the risks of the procedure (pancreatitis or visceral perforation) and the inability to visualize the entire small bowel are among the major limitations for this technique [8,9].

**Wireless Capsule Endoscopy** allows to visualize the entire small bowel mucosa and it seems to be useful in cases of recent active bleeding [7]. The biggest problem for this technique is the transit (around 8 hours) and data interpretation time (further 2 hours) associated with inability to perform biopsies or treat lesions [2,3,4].

**Abdominal Computed Tomography (CT)** is an imaging method more and more used in diagnosis of GIB.

The main goal of this poster is to describe this method and its role managing OGIB.
**Findings and procedure details**

Even though endoscopy forms the mainstay of diagnosis and treatment for GI hemorrhage, imaging and radiological techniques are useful, especially when bleeding from small bowel is suspected [7].

**Abdominal Computed Tomography (CT)**

In 1989 was first time reported the CT contribution in diagnosis of active GIB. Most studies regarding the role of CT in GIB were focused on acute bleeding. The multidetector technology with submillimeter collimation, faster scanning speeds with 3 phases acquisition (arterial, portal venous and delay phase) may help finding the exact cause of bleeding [4,10,11]. Regarding silent OGIB, a standard abdominal pelvic CT may reveal large lesions in digestive tract. Thus, using small bowel distention may help in revealing wall enhancing lesions [4].

There are several abdominal CT techniques used in diagnosis of OGIB who provides valuable information about the location and cause of bleeding, such as:

1. CT enterography
2. CT enteroclysis
3. CT angiography [6,7]

First two techniques involve the introduction of neutral oral contrast agents to obtain luminal distension (in CT enterography by ingestion, and in CT enteroclysis by nasojejunal tube) [11].

**Technique:**

The technique for CT enterography and CT enteroclysis is the same:

Detector configuration: at least a 16 slice

Section thickness: 1 mm

Table movement: 15 mm/rotation

Rotation time: 0.5 sec

Contrast material used:
• After a 6 hour fast- 1500-1600 ml of neutral oral contrast: Fortrans (64g of Macrogol) plus water
• The administration of oral contrast material:

A) in CT enterography divided into 4 oral doses: the first 450 ml one hour before the examination begins; 20 minutes later the next 450 ml; after another 10 minutes 300 ml; 5 minutes later- last dose of 300 ml. For the stomach visualization: 100 ml in the examination room, before starting the acquisition.

B) in CT enteroclysis the contrast material is administrated through a nasojejunal tube at a rate of 60-120 ml.

• Intravenous administration of a spasmolytic drug to minimize bowel motion artifact
• 150 ml of intravenous iodinated contrast material at a rate of 4 ml/sec

Scan delay:

• A bolus -triggered arterial phase
• 20-25 seconds (enteric phase)
• 70-75 seconds (delayed phase)

Area scanned: Domes of diaphragm to the symphysis pubis

Peak Voltage (Kv): 120Kv

Effective (mAs): 225 eff mAs

CT enterography- enteroclysis have a high utility in diagnosis of occult OGIB. The bowel distention using neutral enteric contrast material provides a background against which enhancing bowel wall lesions and active bleeding can be detected. In addition, the utilization of this method can detect extra intestinal causes that could explain gastrointestinal bleeding [6,7,11,12].

Among the disadvantages of CT enterography-enteroclysis include prolonged exposure to radiation (3 phases), delay in diagnosis due preparation before the procedure and preexisting high-attenuation material within the bowel which limits the detection of active bleeding [4].

CT angiography is a promising noninvasive diagnostic tool particularly for detecting overt OGIB with a rate of bleeding less than 0,35- 0,5 ml/min [4,5]. The acquisition technique is similar with CT enterography-enteroclysis (the choice of scanning phases differs- non contrast, arterial and venous phase) [6,7]. Among the disadvantages of this technique is noted relative utility in case of intermittent bleeding. The examination must be made as quickly as possible, while the patient is bleeding actively [4, 11,12,13].
**Imaging interpretation:**

- active bleeding when extravased contrast material with a focal area of high attenuation (90 UH) is seen within the bowel lumen during the arterial phase, increases during the portal venous phase and not viewed during the non contrast phase[3,5].
- the extravasation of contrast material may have a linear, jet like, swirls, ellipsoid or pool configuration, or may feel the entire bowel lumen.
- other associated signs that may indicate the source of hemorrhage in a patient in whom bleeding has stopped: mass tumor, vascular nidus, large draining vein indicating angiodysplasias, hyperenhancing/thickened bowel wall (enteritis/early ischemia) and perienteric stranding in inflammatory condition.
- abnormal enhancement, thickening of bowel wall.

**Findings:**

# Meckel diverticulum (Figure 1)
Fig. 1: Female patient presenting upper gastrointestinal bleeding. Axial CT enterography - arterial phase shows a digestive structure attached to the distal ileum with "finger glove" appearance and hyperattenuating mucosa. The appearance is suggestive of a MERCKEL DIVERTICULUM.

References: Hiperdia, Cluj-Napoca/ RO

# Dieulafoy lesion (Figure 2)

Fig. 2: Patient with pain in right iliac fossa and lower gastrointestinal bleeding. Axial angio CT shows obvious contrast material extravasation in jejunal lumen, more likely cause DIEULAFOY ULCER (endoscopically confirmed).

References: Hiperdia, Cluj-Napoca/ RO

# Angiodysplasia (Figure 3)
Fig. 3: Hemodynamically unstable patient with hematochezia. B) Axial CT angiography and C) coronal reconstruction-arterial phase, shows important extravasation of contrast material in the jejunum lumen, dilated vessels within the bowel wall and early filling veins unviewed on A) axial non enhanced CT.(ANGIODYSPLASIA)

References: Hiperdia, Cluj-Napoca/ RO

# Crohn disease (Figure 4)
Fig. 4: Patients known with CROHN’S DISEASE and anemia. Axial CT enterography - arterial phase shows thickened enhanced bowel wall and positive "comb sign" (hypervascular appearance of the mesentery).

References: Hiperdia, Cluj-Napoca/ RO

# NSAID enteropathy (Figure 5)
**Fig. 5:** Patient with iron deficiency anemia and ileal ulcers viewed after capsule endoscopy. Coronal reconstruction CT enterography - arterial phase shows thickening enhanced wall (on the mesenteric side) of an ileal subhepatic loop (NSAID enteropathy).

**References:** Hiperdia, Cluj-Napoca/ RO

# Ileal varices- cirrhosis (Figure 6)
**Fig. 6**: Cirrhotic patient with lower gastrointestinal bleeding. Axial CT angiography-arterial phase shows blood within right colon and ileal loops with possible contrast material extravasation from ileal dilated vein (VARICOSE VEINS).

**References**: Hiperdia, Cluj-Napoca/ RO

# Haemosuccus pancreaticus (Figure 7)
Fig. 7: CT angiography highlights three pancreatic cystic formations located cephalic and corporeal. A) Axial non enhanced CT shows a spontaneous high attenuation content of cephalic cyst which communicate with splenic artery in B) arterial phase. C) Cysts seem to communicate with Wirsung duct which looks like an artery (intensely extravasated contrast material). In turn, cysts are filled with contrast material, more evident in the caudal cyst (CT aspect in favor of active bleeding at the time of examination). D) Appearance may correspond to Intraductal Papillary Muconous Tumor (IPMT) which is responsible for a bleeding in the duodenum -wirsungorrhage (haemosuccus pancreaticus).

References: Hiperdia, Cluj-Napoca/ RO

# Aortoenteric fistula (Figure 8)
Fig. 8: Axial CT angiography reveals an aortic aneurism with aortoenteric fistula.

References: Hiperdia, Cluj-Napoca/ RO

# Skin arterial fistula of the ileostomy (Figure 9)
Fig. 9: Axial CT angiography shows continuous contrast material extravasation at the junction between ileostomy and skin (arterial fistula of the ileostomy)

References: Hiperdia, Cluj-Napoca/ RO

# Activ bleeding of digestive anastomosis (Figure 10, Figure 11)
**Fig. 10:** Patient with operated pancreatic cancer presents with anemia and hematemesis. Coronal reconstruction CT angiography shows contrast material extravasation at the gastroenteric anastomosis site.

**References:** Hiperdia, Cluj-Napoca/ RO
Fig. 11: Patient with alcoholic chronic pancreatitis and cholecystectomy and coledocojejunooanastomosys, presented for repeated episodes of melena. Axial A) non enhanced and C) venous phase CT shows dilatation of intrahepatic bile ducts, pneumobilia and blood in the common hepatic duct. B) and D) the same changes are found on sagittal reconstructions.

References: Hiperdia, Cluj-Napoca/ RO

# Tumors (Figure 12)
**Fig. 12**: Patient with intense abdominal pain, fatigue and iron deficiency anemia. Axial CT angiography (arterial phase) revealed an ulcerated cecal tumor with active bleeding.

*References*: Hiperdia, Cluj-Napoca/RO

# Intestinal ischemia in volvulus (Figure 13), arterial (Figure 14) and venous thrombosis (Figure 15).
Fig. 13: Patient with GI bleed and signs of intestinal obstruction. a) b) Axial and coronal CT angiography-arterial phase, shows acute arterial and venous mesenteric ischemia by intestine-mesenteric volvulus in a patient with total gastrectomy for gastric cancer.

References: Hiperdia, Cluj-Napoca/RO
**Fig. 14:** Patient with gastrointestinal bleeding and severe abdominal pain. CT angiography -arterial phase illustrate complete thrombosis of the celiac and superior mesenteric artery with extended intestino-mesenteric infarction.

*References:* Hiperdia, Cluj-Napoca/RO
Fig. 15: Patient with hematochezia and signs of intestinal subocclusion. A) Coronal and B) sagittal reconstructions of CT angiography identifies massive thrombosis of portal and superior mesenteric vein with rigid proximal jejunal loops, with stasis and hyperattenuating thickening wall (haemorrhage).

References: Hiperdia, Cluj-Napoca/ RO

Pitfalls of CT to detect OGIB:

- Lack of non-contrast acquisition does not allow differentiation blood of other hyper dense structures such as suture material, clips, foreign bodies, drugs or coprolite [4,11].
- Cone beam artifacts (hyper attenuation at the interfaces between normal bowel fluids and air) and intense mucosal enhancement in the arterial phase (normal) can lead to false positive diagnosis of active bleeding [5].
- OGIB can often settle spontaneously or it can be subtle [4,5].
Images for this section:

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Conclusion

- OGIB requires a multidisciplinary management involving the gastroenterologist, radiologist and the surgeon.

- Utility of CT in diagnosis of obscure intestinal bleeding is important, especially when clinical localization of bleeding to the upper or lower GI tract is difficult or unreliable.

- The use of abdominal CT in diagnostic work-up of patients with OGIB has become accepted as a noninvasive imaging technique for evaluating small bowel diseases.

- It allows a rapid evaluation of enteric and extra enteric abnormalities.

- Ultimately, CT enterography-enteroclysis is useful in the diagnosis of occult OGIB and CT angiography requires active bleeding of the time of imaging for identify and locate the hemorrhage.
References