Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.287758.3381 Volume 30, Issue 5, August 2024
Manuscript ID ZUMJ-2405-3381 (R1)
DOI 10.21608/ZUMJ.2024.287758.3381
Original Article

The Role of CT-Angiography in the Acute Gastrointestinal Bleeding

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Submit Date 2024-05-07
Revise Date 2024-05-11
Accept Date 2024-05-11

ABSTRACT

Background: CT angiography (CTA), a minimally invasive diagnostic technique, has become popular for looking into acute gastrointestinal hemorrhages.This study aimed to evaluate the validity of Computed tomography angiography (CTA) for diagnosis of the cause of acute GIB and its influence on treatment.

Methods: This study was carried out in Radiodiagnosis Department, Faculty of Medicine, Zagazig University on 24 cases with acute GIB during the period from June 2023 to December 2023 on 24 patients who were acute GIB. Age > 18 years. Both male and female were included as a comprehensive sample.

Results: The most frequent diagnoses detected by CT-angiography among patients were esophageal gastric varices which was detected among (75%) of the patients, while the least frequent diagnoses detected was pancreatic arteriovenous malformations in 25% of patients. There was no significant difference between bleeding type and age or gender (P>0.05). sensitivity of CT angiography in diagnoses bleeding compared to endoscopy is (92.3%), positive predictive value (PPV) is (63.2%), negative predictive value (NPV) is (80.0%),accuracy of Ct angiography in diagnoses bleeding compared to endoscopy is (66.7%).

Conclusions: CT angiography is a valid, noninvasive method that is conveniently accessible. CT angiography has a high sensitivity in identifying the source of current bleeding. The results of CT angiography are useful in guiding the best course of treatment (directed endoscopic intervention, angiographic embolization, or surgery), as well as in determining when these treatments should be carried out

Keywords: Computed tomography angiography; Gastrointestinal Bleeding, Sensitivity, diagnosis.

INTRODUCTION

Gastrointestinal bleeding (GIB) is a symptom of many digestive and/or systemic disorders or drug side effects, which can appear suddenly (i.e., acute forms) or can occur as a chronic/recurrent course. Acute GIB is a potentially life-threatening abdominal emergency, with an estimated annual incidence of 100–200 cases per 100,000 population for the upper gastrointestinal tract and approximately 20–35 cases per 100,000 population for the lower gastrointestinal tract **[1].**

Acute gastrointestinal bleeding is more common in men than women (M/F ratio, 2:1). The incidence increases with age, with 70% of patients older than 65 years**.** In addition, acute gastrointestinal bleeding frequently occurs as a complication in critically ill adults who are admitted with other primary diagnoses and complicates their clinical course **[2].**

For patients with GI bleeding, there is a diverse list of potential causes of bleeding that are generally divided into upper GI, lower GI, and small-bowel sources. Patients with upper GI bleeding commonly present with hematemesis and/or melena, although those with a brisk upper GI source can present with hematochezia. With suspected lower GI bleeding, the source may be located in the upper GI tract in 11%–15% of patients or in the small bowel in 2%–15% of

patients. In patients with obscure GI bleeding, the small bowel is the most common source of bleeding, accounting for approximately 75% of cases **[3]**.

Of relevance, oral anticoagulant, antiplatelet and combined agents are being increasingly prescribed for primary and secondary prevention of cardiovascular events, as well as venous thromboembolism prophylaxis or treatment. Acute GIB is the most common adverse event associated with the use of these therapies with up to a threefold increased risk compared with the general population **[4]**.

Multidetector computed tomography (MDCT) is a first-line diagnostic technique for evaluating the presence and location of intestinal bleeding. It is rapid and minimally invasive with wide anatomical coverage. It helps to choose between surgical treatment, selective embolization, arteriography and colonoscopy **[5]**.

Computed tomography angiography has been reported in various studies as accurate test in diagnosis of the source gastrointestinal bleeding. The definitive sign of bleeding is contrast material extravasation into the bowel lumen. Currently, Computed tomography (CT) angiography is not widely used in the diagnosis of acute gastrointestinal bleeding. It has the advantage of being a noninvasive test, which diagnoses the site and cause of the bleeding, thereby guiding definitive treatment **[6].**

The Aim of the Study is to evaluate the validity of Computed tomography angiography (CTA) for diagnosis of the cause of acute GIB and the influence of CTA on treatment.

METHODS

This study was carried out in Radiodiagnosis Department, Faculty of Medicine, Zagazig University on 24 patients with acute GIB were included as a comprehensive sample during the period from June 2023 to December 2023

Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (International review board). The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) ZU-IRB (#101050-23/8/2023) for studies involving humans.

Patients with acute GIB, age > 18 years,both male and female were included.

We excluded non-acute bleeding patients, Pregnancy, Allergy to contrast.Patient with acute GIT bleeding and suffer from renal disease arranged to do dialysis after ct scan.

The following was applied to each patient:

collecting the patient's medical history (age, sex, kind of gastrointestinal bleeding (upper, lower, or both), and degree of severity).

complete physical examination, including vital signs, an abdominal exam, and a general assessment.

Laboratory examination: (CBC, PT, PTT, INR, serum ferritin, reticulocyte count, serum iron).

CT Imaging Technique:

Imaging acquisition: For CT scanners with a detector configuration of 128 × 0.625 mm, the following acquisition parameters are recommended: section thickness, 1 mm, with a reconstruction interval of 0.8 mm; pitch factor, 0.828; rotation time, 0.5 second; and tube voltage, 120 kV, with automatic tube current modulation in the x-, y-, and z-axis directions. The scan should include the complete abdomen and pelvis, from the diaphragm to the inferior pubic ramus.Imaging Analysis: ***CT angiography performed to evaluate acute gastrointestinal bleeding, no oral contrast material is routinely administered, because positive contrast material may mask bleeding and because water or other neutral contrast material may dilute the extravasated intravenous contrast material, thereby decreasing the ability to identify the site of bleeding. The CT angiographic examination starts with a preliminary unenhanced imaging series to depict any preexisting intraluminal hyperattenuating material, such as foreign bodies, opaque pills, hemostatic clips, suture material from previous surgery, or residual barium in diverticula, that might be misinterpreted later as active bleeding. A low-radiation-dose technique is recommended for this unenhanced series. Intravenous contrast material is administered through an antecubital vein with a power injector at a rate of 4 mL/sec, followed by a chaser of 50 mL of saline. The dose is adjusted for body weight and iodine concentration, with the total volume of contrast material typically varying between 100 and 125 mL of an agent high in iodine concentration (>300 mg of iodine per milliliter). The arterial phase images are usually obtained by using automated bolus triggering, starting when the attenuation coefficient in the proximal portion of the abdominal aorta reaches 150 HU. Portal venous phase images are then obtained 40–60 seconds later (i.e., 70–90 seconds after the beginning of the injection of contrast material***

Imaging interpretation

CT angiographic results were interpreted prospectively by two radiology consultants , who had more than 10 years of experience and were blinded to the patients' clinical condition. Studies

were interpreted at an independent workstation Axial data sets of the three phases were presented to the radiologists, who were allowed to generate two-dimensional (multiplanar) and three-dimensional (volume rendered, maximum intensity projection) reformations, as needed, to interpret the CT angiograms. The radiologists recorded the following findings: (a) presence and location of active extravasation of contrast-enhanced blood, characterized as an intraluminal focal collection or "jet" visible in the arterial and/or portal venous phase but not on the unenhanced scan; (b) presence of hyperattenuating (.60 HU) intraluminal material on the unenhanced scan, which indicates recent bleeding; and (c) possible cause of acute bleeding (although specifi c criteria for each diagnosis were not set by the investigators). For the purpose of determining the location of acute bleeding, the gastrointestinal tract was divided into three main segments: jejunum and ileum; ascending, transverse, descending colon and rectosigmoid colon.

Gold standard test: Optical endoscopy was performed by gastroenterologists with more than 5 years of experience, who decided on the basis of clinical and laboratory data on the timing and the need and type of intestinal preparation.

Standard of Reference : The medical records of all patients were reviewed then conducted after the interpretation of findings of CT angiography was completed. Results of endoscopy and, when available, conventional angiography were recorded to establish standard of reference for comparison with findings of CT angiography.

Statistical analysis: SPSS 26.0 for Windows was used to gather, tabulate, and statistically analyze all of the data (SPSS Inc., Chicago, IL, USA). The mean ± SD and range were used to convey quantitative data, while absolute frequencies (number) and relative frequencies (%) were used to express qualitative data. Two groups of normally distributed variables were compared using the t (student 't) test. The non-normally distributed variables across the two groups were compared using the Mann-Whitney test. To compare two paired normally distributed variables, the paired t test was employed. The Chi-square test was utilized to compare the percentage of categorical variables. Every test had two sides. A p-value of less than 0.05 was deemed statistically noteworthy. A p-value of less than 0.05 was regarded as statistically unimportant. Receiver Operating Characteristic (ROC) was used to calculate Sensitivity (true positive rate), Specificity (true negative rate); Accuracy equal summation of true positive+ true negative divide to all studied patients.

RESULTS

Table (1) showed that the study included 24 individuals presented with acute gastrointestinal bleeding. Their ages ranged between 20 to 72 with a mean ± SD of 52.9 ± 15.5. Most of the patients (37.5%) were older than 60 years, while (25%) were younger than 40 years old, (70.8%) were males and (29.2%) were females. Table (2) shows that (62.5%) of the patients had lower gastrointestinal bleeding, while (20.8%) had upper gastrointestinal bleeding, while (16.7%) of the patients had combined upper and lower gastrointestinal bleeding. Table (3) shows that the most frequent diagnoses detected by CT-angiography among patients with lower GI bleeding were hepatic artery pseudoaneurysm which was detected among (26.7%) of the patients, followed by diverticulitis, rectal mass and jejunal AVM which were detected among (13.3%) of the patients, while the least frequent diagnoses detected were descending colon mass, intestinal polypoidal mass, hepatic flexure mass, diverticulosis and sigmoidal mass which were detected among (6.7%) of the patients. Table (4) shows that the most frequent diagnoses detected by CT-angiography among patients with upper GI bleeding was peptic ulcer which was detected among (40%) of the patients, while the least frequent diagnoses detected were duodenal ulcer, gastric mass and gastric GIST which were detected among (20%) of the patients. Table (5) shows no significant difference between type of bleeding and age or gender (P>0.05). Table (6) shows that sensitivity of CT angiography in diagnoses bleeding compared to endoscopy is (92.3%), positive predictive value (PPV) is (63.2%), negative predictive value (NPV) is (80.0%),accuracy of CT angiography in diagnoses bleeding compared to endoscopy is (66.7%).

Case of Common hepatic artery pseudoaneurysm" 65 years old female presented with melena and hematemesis post whipple surgery represented in Fig. (1)**.**

Case of Pancreatic Arteriovenous malformation " 40 years old male presented with hematemesis and melena represented in Fig. (2)**.**

Case of Intestinal polypoidal mass " 39 years old male presented with bleeding per rectum ,abdominal pain and multiple cutaneous lesions represented in Fig. (3)

Table 1: Demographic data among studied patients

Variable	**All patients (n=24)**
Age (years) Mean ± SD Range	 52.9 ± 15.5 (20 – 72)
Age groups (N. %) < 40 years 40 – 50 years 50 – 60 years >60 years	 6 (25%) 3 (12.5%) 6 (25%) 9 (37.5%)
Sex (N. %) Male Female	 17 (70.8%) 7 (29.2%)

Table 2: Type of bleeding among studied patients

Variable (N. %)	**All patients (n=24)**
Lower GI bleeding	15 (62.5%)
Upper GI bleeding	5 (20.8%)
Upper & Lower GI bleeding	4 (16.7%)

Table 3: CT-Angiographic findings among patients with lower GI bleeding

Variable (N. %)	**Lower GI bleeding (n=15)**
Hepatic artery pseudo aneurysm	4 (26.7%)
Descending colon mass	1 (6.7%)
Intestinal polypoidal mass	1 (6.7%)
Hepatic flexure mass	1 (6.7%)
Diverticulitis	2 (13.3%)
Diverticulosis	1 (6.7%)
Rectal mass	2 (13.3%)
Sigmoidal mass	1 (6.7%)
Jejunal AVM	2 (13.3%)

AVM: arteriovenous malformations

Table 4: CT-Angiographic findings among patients with upper GI bleeding

Variable (N. %)	**Upper GI bleeding (n=5)**
Duodenal ulcer	1 (20%)
peptic ulcer	2 (40%)
Gastric mass	1 (20%)
Gastric GIST	1 (20%)

GIST : gastrointestinal stromal tumor

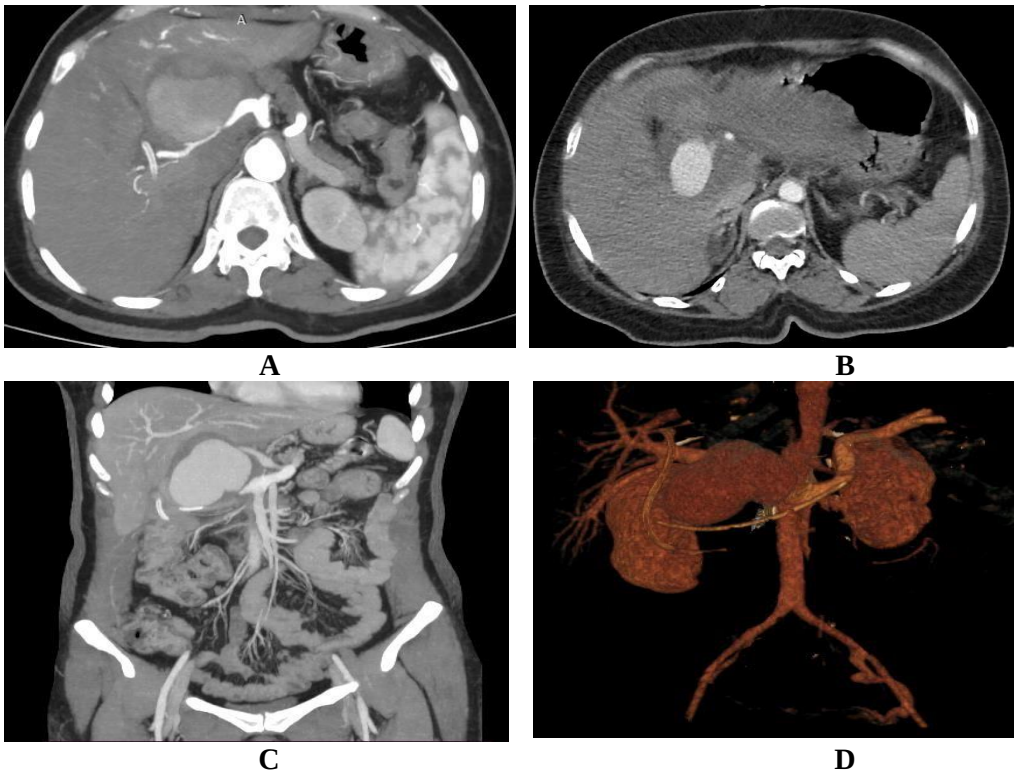
Table 5: Relation between type of bleeding and gender among studied patients

Variable	Lower GI bleeding (n=15)	Upper GI bleeding (n=5)	Upper & Lower GI (n=4)	P Value
Age (years) Mean ± SD Range	 51.9 ± 16.9 (20 – 72)	 53.2 ± 16.1 (35 – 70)	 56.3 ± 12 (40 – 69)	 0.92[1]
Sex (N. %) Male Female	 10 (66.7%) 5 (33.3%)	 4 (80%) 1 (20%)	 3 (75%) 1 (25%)	 0.83[2]

*[1]Kruscal-Wallis test, [2]Chi-square test, Non-significant: P >0.05, Significant: P ≤0.05

Table 6: Diagnostic accuracy of CT angiography and endoscopy among studied patients

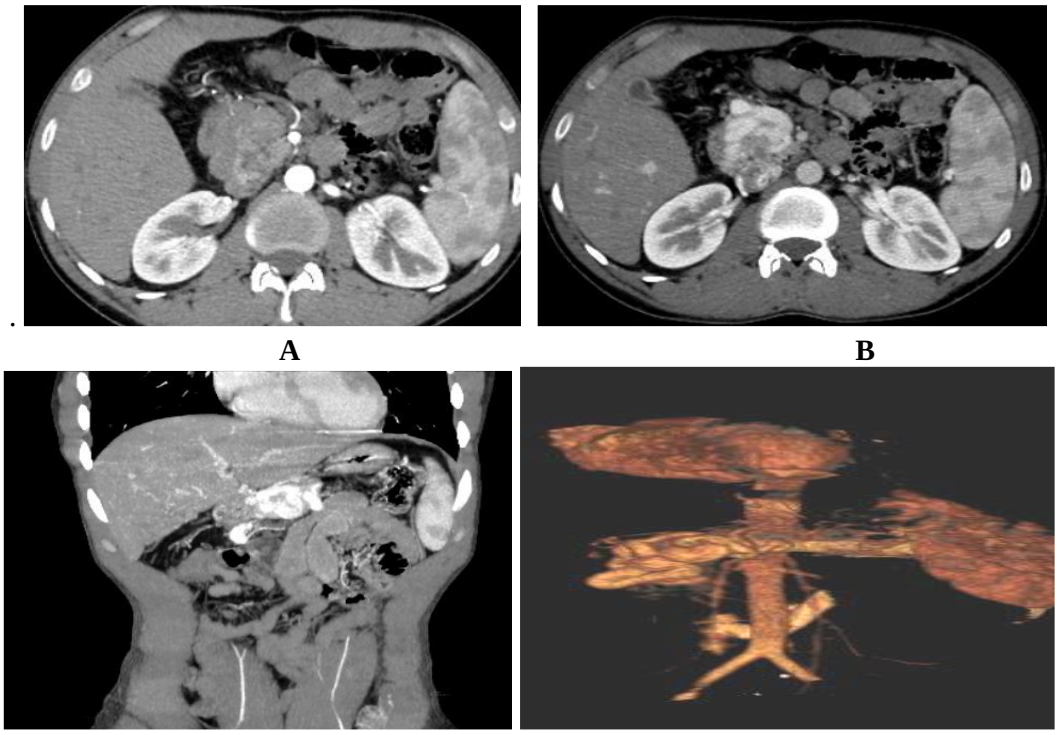
		Endoscopy		Total
		Diagnostic	**Non diagnostic**	
CT angiography	**Diagnostic**	12	7	**19**
	Non diagnostic	1	4	**5**
	Total	**13**	**11**	**24**



A **B**

C **D**

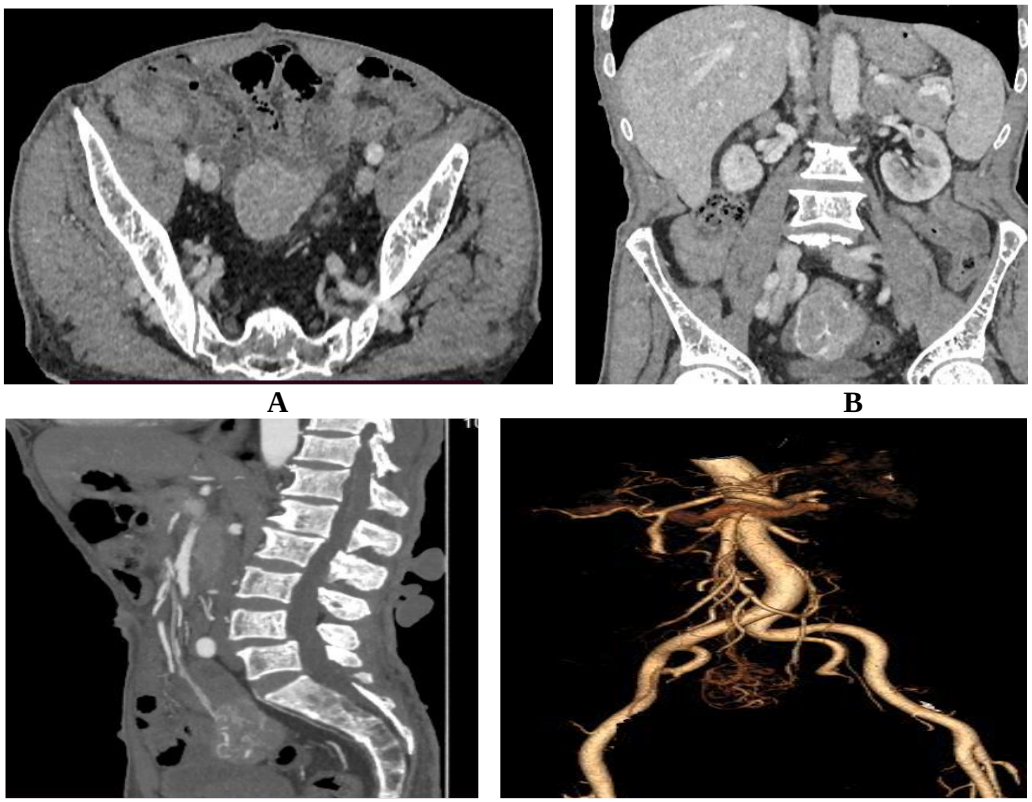
Fig. (1) **"A"**: MDCT Axial arterial image reveals large anterior located pseudo aneurysm at porta hepatis compressing common hepatic artery and portal vein .It measures 7x5.6x7.6 cm in maximum anteroposterior, transverse and cranio caudal dimensions. It connected to common hepatic artery 3cm distal to its origin from celiac trunk . **"B &C"**: MDCT Axial &Coronal MIP late Arterial and early venous images reveal more enhancement denoting active bleeding. **" D":** 3D volume rendering (VR) image show the pseudo aneurysm compressing common hepatic artery and portal vein.



A **B**

C **D**

Fig. (2) " **"A&B"**: MDCT Axial arterial and venous images reveal multiple dilated tortuous vascular channels seen surrounding the pancreatic head. **"C&D"**: MDCT Coronal MIP &3D volume rendering (VR) images reveal pancreatic avm with feeding artery from superior mesenteric artery and splenic artery, draining veins into splenic vein and portal confluence. N.B: Early enhancement of splenic vein denoting A-V shunting.



A **B**

C **D**

Fig. (3) **""A&B"**: MDCT Axial &coronal early venous images reveal well defined enhanced exophytic polypoidal mass arising from ileal bowel loop wall . **"C & D":** MDCT Sagittal MIP &3D volume rendering (VR) images show the polypoidal mass receiving feeding arterial branches from superior (mainly) and inferior mesenteric arteries associated with multiple scattered pedunculated cutaneous lesions . N.B:

Hamartomatous intestinal polyp together with multiple Mucucutaneous papillomatous papules and renal lipomas suggesting multiple hamartomata syndrome for genetic testing.

DISCUSSION

Acute gastrointestinal (GI) bleeding is a common cause of both emergency department visits and hospital admissions. If acute GI bleeding is not diagnosed promptly and adequately treated, morbidity and mortality are high, reaching 40% in patients who are haemodynamically unstable. Diagnosis and treatment requires a multidisciplinary approach that may involve diagnostic and interventional radiology, emergency medicine, internal medicine, gastroenterology and general surgery. Imaging is playing a growing role in the management of acute GI bleeding by localizing the source of bleeding, differentiating the underlying disease processes and aiding decisions to proceed to endovascular therapies to treat many causes of GI bleeding **[7]**.

GI bleeding is usually categorized according to the site of bleeding as upper GI bleeding (UGIB) and lower GI bleeding (LGIB). UGIB is a bleeding above the ligament of Treitz, which includes esophagus, stomach and duodenum. Main causes of UGIB are peptic ulcer disease, esophageal and gastric varices, Malory-Weiss syndrome, esophagitis and gastritis, arteriovenous malformation. Contrary to UGIB, LGIB refers to the GI bleeding below the ligament of Treitz, which includes small bowel, colon, and rectum. Major causes of LGIB are diverticular disease, angiodysplasia, colitis and inflammatory bowel disease, neoplasm, and coagulopathy **[8]**.

The presentation of gastrointestinal bleeding can range from asymptomatic or mildly ill patients requiring only conservative treatments to severely ill patients requiring immediate intervention. Identifying the source of the bleeding can be difficult due to the wide range of potential causes, the length of the gastrointestinal tract and the intermittent nature of the bleeding. The diagnostic and therapeutic approach is fully dependent on the nature of the bleeding and the patient's haemodynamic status. Radiologists should be aware of the appropriate uses of computed tomography angiography and other imaging modalities in patients with acute gastrointestinal bleeding, as well as the semiotics of bleeding and diagnostic pitfalls in order to appropriately diagnose and manage these patients **[1].**

Many useful diagnostic modalities could assist in the diagnostic evaluation of GI bleeding, which include endoscopy (upper endoscopy and colonoscopy), radionuclide imaging, catheter angiography, and computed tomography (CT) angiography. With the recent advances in technology, CT angiography has become an effective method for imaging the cause of GI bleeding **[7]**.

This study was carried out in Radiodiagnosis Department, Faculty of Medicine, Zagazig University on 24 cases with acute GIB during the period from June 2023 to December 2023 to evaluate the predictive value of CTA for diagnosis of the cause of acute GIB and the influence of CTA on treatment and to identify the most common and uncommon features of acute gastrointestinal bleeding and its obscure form.

The current study included 24 individuals presented with acute gastrointestinal bleeding. Their ages ranged from 20 to 72 with mean ± SD of 52.9 ± 15.5. Most of the patients (37.5%) were older than 60 years, while (25%) were younger than 40 years old, (70.8%) were males and (29.2%) were females. In the same line **Shotar et al., [8]** in a study included 49 patients with acute overt gastrointestinal bleeding (AOGIB)., there were 30 men and 19 women, with a mean age of 65.4 ± 15.6 (SD) years [range, 34—91 years]. Also **Mohammadinejad et al., [9]** carried a study included One hundred seventy-six patients with a median age of 64.5 (20–94) years met the inclusion criteria (36.4% women; 63.6% men).

The current study showed that (62.5%) of the patients had lower gastrointestinal bleeding, while (20.8%) had upper gastrointestinal bleeding, while (16.7%) of the patients had combined upper and lower gastrointestinal bleeding. Similarly **Kim et al., [10]** found that according to type of bleeding among 111 patients, their were 31 patients (27.1%) had upper GI bleeding and 80 patients (72.1%) had lower GI bleeding, there was no combined upper & lower GI bleeding. Alsp=o, **Chan et al., [11]** found that in total of 180 patients had 202 CTAs for acute GI bleeding, of the 202 CTAs performed, 87 (43.1%) were for upper GI bleed and 115 (56.9%) for lower GI bleed.

The current study showed that the most frequent diagnoses detected by CT-angiography among patients with lower GI bleeding were hepatic artery pseudoaneurysm which was detected among (26.7%) of the patients, followed by diverticulitis, rectal mass and jejunal AVM which were detected among (13.3%) of the patients, while the least frequent diagnoses detected were descending colon mass, intestinal polypoidal mass, hepatic flexure mass, diverticulosis and sigmoidal mass which were detected among

(6.7%) of the patients. While, **Chan et al., [11]** reported that diagnoses detected by CT-angiography of lower GI bleed in this patient group included diverticular disease (59 %), enterocolitis or inflammatory bowel disease (14 %), angiodysplasia (13 %), colonic polyp (8 %), colonic tumor (5 %), and vasculitis (1 %).

The current study showed that the most frequent diagnoses detected by CT-angiography among patients with upper GI bleeding was peptic ulcer which was detected among (40%) of the patients, while the least frequent diagnoses detected were duodenal ulcer, gastric mass and gastric GIST which were detected among (20%) of the patients. Similarly, **Chan et al., [11]** reported of the 87 CTAs performed for upper GI bleed, peptic ulcer disease (67 %), esophagitis or gastritis (14 %), gastric tumor (6 %), pancreatic tumor (6 %), dieulafoy lesion (4 %), Mallory–Weiss tear (2 %), and aorto-enteric fistula (1 %).

The current study showed that there was no significant difference between type of bleeding and age or gender *(P>0.05)*. which in agreement with the study of **Brahmbhatt et al., [12]** who found that there was no difference across the studied patients with respect to age, gender according to type of bleeding. In the same manner, **Erno et al., [13]** reported that in the multivariate analysis, age, hematocrit, and heart rate appeared to be associated with identification of a source of bleeding by CTA.

Adhikari & Mandal [14] found that out of 72 patients, gastric ulcer was seen in 20 (27.8%) of patient, variceal bleeding in 18(25%), gastric erosion in 12(16.7%) ,duodenal ulcer 9(12.5%), Mallory weiss tear in 6(8.3%), gastric varices in 3(4.2%), carcinoma esophagus in 3(4.2%) and normal endoscopic finding in 1 (1.4%) patient.

The current study showed that sensitivity of CT angiography in diagnoses bleeding compared to endoscopy is (92.3%), positive predictive value (PPV) is (63.2%), negative predictive value (NPV) is (80.0%),accuracy of Ct angiography in diagnoses bleeding compared to endoscopy is (66.7%). In the same manner **Kennedy et al., [15]** found that the overall sensitivity, accuracy, and positive and negative predictive value of CT angiography for the detection of active GI hemorrhage within the study population was 79%, 95%, 91%, 86%, and 92%, respectively. Similarly to **Kim et al., [10]** who found that Univariable and multivariable logistic regression analyses revealed that positive CTA result was significantly associated with the presence of massive bleeding ($p < 0.001$, odds ratio = 11.506). Other clinical characteristics such as bleeding type, whether bleeding was recurrent or not, and the presence of comorbidities including diabetes, hypertension, and CVD were not significantly associated with positive CTA results.

Erno et al., [13] reported that univariate and multivariate analyses was also performed to determine predictors of a positive CTA for GI bleeding. In the multivariate analysis, age, hematocrit, and heart rate appeared to be associated with identification of a source of bleeding by CTA. **García-Blázquez et al., [21]** found that the overall sensitivity of CT angiography for detecting active acute gastrointestinal haemorrhage was 85.2 %. Although multiple factors can influence the ability to visualize a definite or potential bleeding focus in CTA, the severity and nature of a bleeding lesion, such as the bleeding rate or intermittence, are known to be important factors in determining CTA accuracy.

Limitation of the study:

The present study had a number of limitations. First, the study was a single-center study with a relatively small sample size. Therefore, multi-center studies with larger sample sizes should be performed to confirm the present results.

CONCLUSIONS

CT angiography is a valid, noninvasive method that is conveniently accessible. CT angiography has a high sensitivity in identifying the source of current bleeding. The results of CT angiography are useful in guiding the best course of treatment (directed endoscopic intervention, angiographic embolization, or surgery), as well as in determining when these treatments should be carried out.

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To Cite:

Bayoumi, S., Abo Alezz, A., Abdlsed, A., Ali shabaan, R. The Role of CT-Angiography in the Acute Gastrointestinal Bleeding. *Zagazig University Medical Journal*, 2024; (1832-1840): -. doi: 10.21608/zumj.2024.287758.3381