

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Feinman M, Haut ER. Upper gastrointestinal bleeding. <i>Surg Clin North Am.</i> 2014;94(1):43-53.	Review/Other-Tx	N/A	To review UGIB.	UGIB is still associated with significant morbidity and mortality. The cornerstone of management is initial stabilization, followed by localization and treatment of the bleeding. Medical management and minimally invasive treatments are used primarily and are often successful. Surgery is reserved for patients who fail conservative management.	4
2. Geffroy Y, Rodallec MH, Boulay-Coletta I, Julles MC, Ridereau-Zins C, Zins M. Multidetector CT angiography in acute gastrointestinal bleeding: why, when, and how. <i>Radiographics.</i> 2011;31(3):E35-46.	Review/Other-Dx	N/A	To provide a structured approach in the diagnosis of GIB with multidetector CTA.	The use of multidetector CTA in the diagnostic workup of patients with acute GIB continues to grow because of improvements in scanning technology and favorable results published in several recent articles. Positive contrast-enhanced MDCT can define with a high degree of accuracy the location and at times the cause of active GIB. Contrast-enhanced MDCT with ready availability offers clear advantages in anatomic detail and can provide a rapid assessment that reveals underlying bowel disease and can map anatomy for angiography or surgery.	4

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<p>3. Gerson LB, Fidler JL, Cave DR, Leighton JA. ACG Clinical Guideline: Diagnosis and Management of Small Bowel Bleeding. <i>Am J Gastroenterol</i>. 2015;110(9):1265-1287; quiz 1288.</p>	<p>Review/Other-Dx</p>	<p>N/A</p>	<p>To provide recommendations on the diagnosis and management of small bowel bleeding.</p>	<p>The term small bowel bleeding is therefore proposed as a replacement for the previous classification of OGIB. We recommend that the term OGIB should be reserved for patients in whom a source of bleeding cannot be identified anywhere in the GI tract. A source of small bowel bleeding should be considered in patients with GIB after performance of a normal upper and lower endoscopic examination. Second-look examinations using upper endoscopy, push enteroscopy, and/or colonoscopy can be performed if indicated before small bowel evaluation. VCE should be considered a first-line procedure for small bowel investigation. Any method of deep enteroscopy can be used when endoscopic evaluation and therapy are required. VCE should be performed before deep enteroscopy if there is no contraindication. CT enterography should be performed in patients with suspected obstruction before VCE or after negative VCE examinations. When there is acute overt hemorrhage in the unstable patient, angiography should be performed emergently. In patients with occult hemorrhage or stable patients with active overt bleeding, multiphasic CT should be performed after VCE or CT enterography to identify the source of bleeding and to guide further management. If a source of bleeding is identified in the small bowel that is associated with significant ongoing anemia and/or active bleeding, the patient should be managed with endoscopic therapy. Conservative management is recommended for patients without a source found after small bowel investigation, whereas repeat diagnostic investigations are recommended for patients with initial negative small bowel evaluations and ongoing overt or occult bleeding.</p>	<p>4</p>

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<p>4. Barkun AN, Bardou M, Kuipers EJ, et al. International consensus recommendations on the management of patients with nonvariceal upper gastrointestinal bleeding. <i>Ann Intern Med.</i> 2010;152(2):101-113.</p>	<p>Review/Other-Tx</p>	<p>N/A</p>	<p>A multidisciplinary group of 34 experts from 15 countries developed this update and expansion of the recommendations on the management of acute nonvariceal UGIB from 2003.</p>	<p>Recommendations emphasize early risk stratification, by using validated prognostic scales, and early endoscopy (within 24 hours). Endoscopic hemostasis remains indicated for high-risk lesions, whereas data support attempts to dislodge clots with hemostatic, pharmacologic, or combination treatment of the underlying stigmata. Clips or thermocoagulation, alone or with epinephrine injection, are effective methods; epinephrine injection alone is not recommended. Second-look endoscopy may be useful in selected high-risk patients but is not routinely recommended. Preendoscopy proton-pump inhibitor therapy may downstage the lesion; IV high-dose proton-pump inhibitor therapy after successful endoscopic hemostasis decreases both rebleeding and mortality in patients with high-risk stigmata. Although selected patients can be discharged promptly after endoscopy, high-risk patients should be hospitalized for at least 72 hours after endoscopic hemostasis. For patients with UGIB who require a nonsteroidal anti-inflammatory drug, a proton-pump inhibitor with a cyclooxygenase-2 inhibitor is preferred to reduce rebleeding. Patients with UGIB who require secondary cardiovascular prophylaxis should start receiving acetylsalicylic acid again as soon as cardiovascular risks outweigh GI risks (usually within 7 days); acetylsalicylic acid plus proton-pump inhibitor therapy is preferred over clopidogrel alone to reduce rebleeding.</p>	<p>4</p>

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5. Szary NM, Gupta R, Choudhary A, et al. Erythromycin prior to endoscopy in acute upper gastrointestinal bleeding: a meta-analysis. <i>Scand J Gastroenterol.</i> 2011;46(7-8):920-924.	Meta-analysis	4 studies	A meta-analysis was performed comparing the efficacy of erythromycin infusion prior to endoscopy in acute UGIB.	4 studies (N = 269) met the inclusion criteria. Erythromycin prior to endoscopy in UGIB demonstrated a statistically significant improvement in visualization of the gastric mucosa (OR 4.89; 95% CI, 2.85–8.38, $P<0.01$), a decrease in the need for a second endoscopy (OR 0.42; 95% CI, 0.24–0.74, $P<0.01$), and a trend for less units of blood transfused (weighted mean difference -0.48; 95% CI, -0.97 to 0.01, $P=0.05$) with erythromycin as compared with no erythromycin.	M
6. Fitzpatrick J, Bhat R, Young JA. Angiographic embolization is an effective treatment of severe hemorrhage in pancreatitis. <i>Pancreas.</i> 2014;43(3):436-439.	Review/Other-Tx	9 patients	To analyze the role of radiologic embolization as a diagnostic and therapeutic modality for severe hemorrhage in pancreatitis.	9 separate bleeding episodes were treated with embolization (mean age, 56 years). This consisted of 6 patients who underwent primary angiographic embolization, with 3 patients requiring further embolization because of repeated bleeding from a different site. Most patients (83%) had chronic disease. The causative arteries were identified as splenic (6/9 patients), gastroduodenal (1/9 patients), left gastric (1/9 patients), and a small branch of the inferior mesenteric (1/9 patients). Clinical presentations were abdominal pain (3/9 patients), melena (3/9 patients), bleeding into retroperitoneal drain (2/9 patients), and hematemesis (1/9 patients). Bleeding was severe with an average drop in hemoglobin level of 6.3 g/dL. Of the 3 patients who required further embolization, all had splenic artery pseudoaneurysms and 2 patients experienced chronic pancreatitis with necrosis and proven peripancreatic infections. In all cases (9/9 patients), angiography succeeded in identifying and embolizing the causative vessel with a 1-year mortality of 0%.	4

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7. Zhan XB, Guo XR, Yang J, Li J, Li ZS. Prevalence and risk factors for clinically significant upper gastrointestinal bleeding in patients with severe acute pancreatitis. <i>J Dig Dis.</i> 2015;16(1):37-42.	Review/Other-Dx	18 UGIB patients; 83 non-UGIB patients	To investigate the prevalence and risk factors of UGIB in patients with severe acute pancreatitis.	In total, 18 (17.8%) patients developed UGIB and 13 received endoscopic examination, which yielded 6 cases of acute gastric mucosal lesions, 5 of peptic ulcers and 2 of pancreatic necrotic tissue invading the duodenal bulb and presenting as multilesion, honeycomb-like ulcer. The mortality rate of UGIB patients was much higher than that of non-UGIB patients (44.4% vs 10.8%, $P=0.0021$). Univariate analysis revealed that the risk factors for UGIB included the Acute Physiology and Chronic Health Evaluation II (APACHE II) score, CT severity index, Ranson score, arterial blood pH and PaO ₂ , serum blood urea nitrogen and creatinine concentrations, platelet count, shock, sepsis and organ failure, mechanical ventilation, heparinized continuous renal replacement therapy and total parenteral nutrition. Multivariate logistic regression revealed that APACHE II score and CT severity index were significant risk factors while PaO ₂ was the protective factor for UGIB in severe acute pancreatitis.	4
8. Anil G, Tan AG, Cheong HW, Ng KS, Teoh WC. Emergency gastroduodenal artery embolization by sandwich technique for angiographically obvious and oblivious, endotherapy failed bleeding duodenal ulcers. <i>Clin Radiol.</i> 2012;67(5):468-475.	Review/Other-Tx	15 patients	To determine the feasibility, safety, and efficacy of adopting a standardized protocol for emergency TAE of the gastroduodenal artery with a uniform sandwich technique in endotherapy-failed bleeding duodenal ulcers.	Active contrast-medium extravasation was seen in 3 patients (20%). Early re-bleeding was noted in 2 patients (13.33%). No patient required surgery. There was 100% technical success, while primary and secondary clinical success rates for TAE were 86.6% and 93.3%, respectively. Focal pancreatitis was the single major procedure-related complication. There was no direct bleeding duodenal ulcers-related death. The response time of the interventional radiology service averaged 150 min (range 60–360 min) with mean value of 170 min.	4

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9. Katanuma A, Maguchi H, Yane K, et al. Factors predictive of adverse events associated with endoscopic ultrasound-guided fine needle aspiration of pancreatic solid lesions. <i>Dig Dis Sci</i> . 2013;58(7):2093-2099.	Observational-Tx	316 patients	To examine post-procedural events and determine risk factors associated with endoscopic US-fine needle aspiration of pancreatic solid lesions.	The incidence of post-procedural adverse events, including moderate to mild pancreatitis, mild abdominal pain, and mild bleeding, was 3.4%. Univariate analysis showed that the incidence of post-procedural events was significantly increased in patients with tumors ≤ 20 mm in diameter ($P < 0.001$), those with pancreatic neuroendocrine tumors ($P = 0.012$), and patients who had intervening normal pancreas for accessing the lesion ($P = 0.048$). Multivariate analysis identified tumors measuring ≤ 20 mm in diameter (OR 18.48; 95% CI, 3.55–96.17) and case of pancreatic neuroendocrine tumors (OR 36.50; 95% CI, 1.73–771.83) were an independent risk factors.	3
10. Koc B, Bircan HY, Adas G, et al. Complications following endoscopic retrograde cholangiopancreatography: minimal invasive surgical recommendations. <i>PLoS One</i> . 2014;9(11):e113073.	Review/Other-Tx	28 patients	To present a retrospective review of our experience with post endoscopic retrograde cholangiopancreatography-related perforations, reveal the type of injuries and management recommendations with the minimally invasive approaches.	Between March 2007 and March 2013, 2972 endoscopic retrograde cholangiopancreatography were performed, 28 (0.94%) of which resulted in endoscopic retrograde cholangiopancreatography-related perforations. 10 of them were men (35.8%) and 18 women (64.2%). Mean age was 53.36 +/- 14.12 years with a range of 28 to 78 years. 14 (50%) patients were managed conservatively, while 14 (50%) were managed surgically. In 6 patients, laparoscopic exploration was performed due to the failure of non-surgical management. In 6 of the patients that endoscopic retrograde cholangiopancreatography-related perforation was suspected during or within 2 hours after endoscopic retrograde cholangiopancreatography, underwent to surgery primarily. There were 2 mortalities. The mean length of hospitalization stay was 10.46 +/- 2.83 days. The overall mortality rate was 7.1%.	4

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11. Park KS, Huh KC, Hwang I, et al. Multi-center study regarding the risk factors for bleeding in gastrointestinal stromal tumor. <i>Hepatogastroenterology</i> . 2013;60(122):235-239.	Review/Other-Dx	49 bled GIST cases vs 96 non-bled cases	To analyze the clinical characteristics of bled GISTs and to find risk factors of bleeding by comparing with non-bled cases.	Female predominance (58.6%) was noted and the mean age of the included patients was 58.4+/-13.1 years. In univariate analysis, location of jejunum, prolonged prothrombin time, presence of surface dimpling in CT, cellular pleomorphism and positivity of S100 was significantly dominant in the bled cases. Multivariate analysis showed significant differences in the location of jejunum ($P=0.004$, OR=3.533), prolonged prothrombin time ($P=0.003$, OR=19.643), presence of surface dimpling ($P=0.026$, OR=6.250) in CT, and positivity of S100 ($P=0.001$, OR=12.941).	4
12. Oh SJ, Song HY, Nam DH, et al. Bleeding after expandable nitinol stent placement in patients with esophageal and upper gastrointestinal obstruction: incidence, management, and predictors. <i>Acta Radiol</i> . 2014;55(9):1069-1075.	Review/Other-Tx	1,485 patients	To evaluate the incidence, management strategies, and predictors of bleeding after placement of self-expandable nitinol stents in patients with esophageal and upper GI obstruction.	Bleeding occurred in 25/1485 (1.7%) patients 0 to 348 days after stent placement. Early stent-related bleeding occurred in 10 patients (40%) and angiographic embolization was used for 5/10. Late bleeding occurred in 15 patients (60%) and endoscopic hemostasis was used for 7/15. 22/25 (88%) patients with bleeding had received prior radiotherapy and/or chemotherapy.	4

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13. Gwon DI, Ko GY, Sung KB, Shin JH, Kim JH, Yoon HK. Endovascular management of extrahepatic artery hemorrhage after pancreatobiliary surgery: clinical features and outcomes of transcatheter arterial embolization and stent-graft placement. <i>AJR Am J Roentgenol.</i> 2011;196(5):W627-634.	Observational-Tx	27 patients	To analyze the technical and clinical outcomes of endovascular treatment of patients with extrahepatic artery hemorrhage after pancreatobiliary surgery.	Bleeding sites were located in the gastroduodenal artery stump (n = 14), proper hepatic artery (n = 10), and common hepatic artery (n = 3). In the TAE group, the initial technical and clinical success rates were 100% and 90%, respectively. 2 patients died of hepatic failure and multiorgan failure within 7 days after TAE. Hepatic ischemia and infarction were observed in 6 (33.3%, 6/18) and 8 (44.4%, 8/18) patients, respectively. Hepatic abscess was observed in 1 patient (5.6%, 1/18) with hepatic infarction. The development of hepatic infarction was significantly associated with a serum aspartate aminotransferase level of more than 700 IU/L and a serum alanine transferase level of more than 500 IU/L ($P=0.031$ for both, Fisher exact test). In the stent-graft group, the initial technical and clinical success rates were 100% for both. Early stent thrombosis with bile duct necrosis was observed in 1 patient (14.3%). During the mean follow-up period of 22.8 months (range, 8–43 months), the intrahepatic arteries were patent on follow-up CT.	2
14. Gilbert DA, Silverstein FE, Tedesco FJ, Buenger NK, Persing J. The national ASGE survey on upper gastrointestinal bleeding. III. Endoscopy in upper gastrointestinal bleeding. <i>Gastrointest Endosc.</i> 1981;27(2):94-102.	Review/Other-Dx	2,225 patients	Prospectively conducted survey to determine if there are subgroups of patients in whom outcome from a bleeding episode is predictably poor despite application of all advances in conventional therapy.	At least 1 diagnostic abnormality was identified in 91.9% of endoscopies. The frequency of finding an active bleeding source was observed to decrease as the admission to endoscopy interval increased. Active bleeding observed more often when endoscopy done during the first 24 hours. Patients with oozing or pumping lesion had statistically significant increase in mortality. In almost all patients with a duodenal, stomal or gastric ulcer seen on endoscopy, bleeding was attributed to this lesion. Esophagitis deemed responsible in only 50% of patients in whom it was seen. Varices listed as final diagnosis for cause of bleeding in only 66.2% of patients in whom they were observed. Complication rate of endoscopy was 0.9%.	4

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15. Silverstein FE, Gilbert DA, Tedesco FJ, Buenger NK, Persing J. The national ASGE survey on upper gastrointestinal bleeding. I. Study design and baseline data. <i>Gastrointest Endosc.</i> 1981;27(2):73-79.	Review/Other-Dx	Study data base of 2,225 patients submitted by 269 physicians	Study design and baseline data: American Society for Gastrointestinal Endoscopy (ASGE) survey on UGIB.	2,427 cases from 277 physicians during 18-month period were received. Number of patients per physician varied widely. Of 2,427 data forms 85% were copied and returned to the participants for correction and/or completion. Participants corrected and returned 92% of these forms.	4
16. Sugawa C, Steffes CP, Nakamura R, et al. Upper GI bleeding in an urban hospital. Etiology, recurrence, and prognosis. <i>Ann Surg.</i> 1990;212(4):521-526; discussion 526-527.	Review/Other-Dx	469 patients	Retrospective study to describe the various causes of UGIB and describe the various endoscopic techniques available for treatment.	Majority of UGIB cases can be treated without operation, including endoscopic treatment, when diagnostic endoscopy establishes the source. Subsequent operation in selected patients can be done with low morbidity and mortality rates.	4
17. van Leerdam ME. Epidemiology of acute upper gastrointestinal bleeding. <i>Best Pract Res Clin Gastroenterol.</i> 2008;22(2):209-224.	Review/Other-Dx	N/A	Review epidemiology of acute UGIB.	Most surveys focusing on peptic ulcer disease showed a significant decrease in admission and mortality of peptic ulcer disease. Recent epidemiological surveys show a decrease in incidence of all cause UGIB.	4
18. Pollentine A, Mortimer A, McCoubrie P, Archer L. Evaluation of two minimal-preparation regimes for CT colonography: optimising image quality and patient acceptability. <i>Br J Radiol.</i> 2012;85(1016):1085-1092.	Observational-Dx	100 consecutive patients	To compare a 2 day bowel preparation regime of barium, iodine and a mild stimulant laxative with a 1 day iodine-only regime for CT colonography.	The proportion of colons producing none/scattered stool (score 1) was 90.3% with Regime 1 and 65.0% with Regime 2 ($P<0.005$). Any residual stool was significantly better tagged with Regime 1 (score 5), with 91.7% of Regime 1 exhibiting optimum tagging vs 71.3% of Regime 2 ($P<0.05$). No significant differences in side-effects between the bowel preparation regimes for CT colonography were elicited. Bowel preparation for barium enema was tolerated significantly worse than both of the CT colonography bowel preparation regimes.	2

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19. Gonzalez JM, Giacino C, Pioche M, et al. Endoscopic ultrasound-guided vascular therapy: is it safe and effective? <i>Endoscopy</i> . 2012;44(5):539-542.	Review/Other-Tx	8 patients	To highlight the utility of endoscopic US-guided vascular therapy.	Causes of bleeding were gastric varices secondary to portal hypertension (n = 3); gastroduodenal artery aneurysm or fundal aneurysmal arterial malformation (n = 3); and Dieulafoy's ulcer (n = 2); the latter 5 patients having arterial bleeding. During the procedures, the bleeding vessel was punctured with a 19-gauge needle then injected with a sclerosing agent (cyanoacrylate glue [n = 6] or polidocanol 2% [n = 2]) under Doppler control. The median follow-up time was 9 months (3–18 months). In all 10 endoscopic procedures were performed. The procedure was successful at the first attempt in 7 out of 8 patients (87.5%). No clinical complications were observed, although in 1 case there was diffusion of cyanoacrylate in the hepatic artery. The 7 successful cases all showed immediate and complete disappearance of the Doppler flow signal at the end of the procedure.	4
20. Baxter M, Aly EH. Dieulafoy's lesion: current trends in diagnosis and management. <i>Ann R Coll Surg Engl</i> . 2010;92(7):548-554.	Review/Other-Tx	45 studies	To review the current trends in the diagnosis and management of Dieulafoy's lesion.	There is no consensus on the treatment of Dieulafoy's lesions. Therapeutic endoscopy can control the bleeding in 90% of patients while angiography is being accepted as a valuable alternative to endoscopy for inaccessible lesions. Currently, surgical intervention is kept for failure of therapeutic endoscopic or angiographic interventions and it should be guided by preoperative localization.	4

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21. Kovacs TO, Jensen DM. Endoscopic therapy for severe ulcer bleeding. <i>Gastrointest Endosc Clin N Am.</i> 2011;21(4):681-696.	Review/Other-Tx	N/A	To discuss the important aspects of the diagnosis and treatment of bleeding from ulcers, with a focus on endoscopic therapy.	UGIB secondary to ulcer disease occurs commonly and results in significant patient morbidity and medical expense. After initial resuscitation, carefully performed endoscopy provides an accurate diagnosis of the source of the UGI hemorrhage and can reliably identify those high-risk subgroups that may benefit most from endoscopic hemostasis. Effective endoscopic hemostasis of ulcer bleeding can significantly improve outcomes by reducing rebleeding, transfusion requirement, and need for surgery, as well as reduce the cost of medical care.	4
22. Schenker MP, Majdalany BS, Funaki BS, et al. ACR Appropriateness Criteria(R) on upper gastrointestinal bleeding. <i>J Am Coll Radiol.</i> 2010;7(11):845-853.	Review/Other-Dx	N/A	Evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.	N/A	4
23. Papanikolaou IS. UEG week 2012 report: putting endoscopy into perspective. <i>Endoscopy.</i> 2013;45(5):377-391.	Review/Other-Tx	N/A	To review oral presentations and selected poster presentations from the 20th United European Gastroenterology Week in light of recent literature.	No results stated in abstract.	4
24. Papanikolaou IS, Rosch T. UEGW 2010 Report. Putting endoscopy into perspective. <i>Endoscopy.</i> 2011;43(4):345-359.	Review/Other-Tx	N/A	To report on oral presentations, with a few selected poster presentations, from the 18th United European Gastroenterology Week, and to review them briefly in the context of recent literature in the respective fields of GI endoscopy.	No results stated in abstract.	4
25. Papanikolaou IS, Siersema PD. UEG Week 2013 highlights: putting endoscopy into perspective. <i>Endoscopy.</i> 2013;45(12):1047-1053.	Review/Other-Tx	N/A	To highlight oral presentations of the most important and exciting topics in GI endoscopy from the 21st United European Gastroenterology (UEG) Week, and review them in the context of current knowledge.	No results stated in abstract.	4

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26. Sonnenberg A. Test sequence in the management of gastrointestinal bleeding. <i>Endoscopy</i> . 2012;44(1):43-47.	Review/Other-Tx	N/A	To investigate which test sequence should be utilized in managing GIB.	A threshold represents the lowest expected probability of success, for which a test would still be indicated. In a workup including all possible management options, the threshold associated with laboratory tests and gastric lavage was 1%, EGD 8%, colonoscopy 9%, nuclear scan 9%, enteroscopy 11%, CTA 14%, CE 23%, and angiography with transcatheter embolization 25%. Varying sets of thresholds were calculated for different clinical scenarios. The thresholds of EGD and colonoscopy remained low in most scenarios. In sensitivity analysis, rising risk of complications or costs of a procedure also lead to rising threshold values for it, potentially rendering the particular procedure untenable.	4
27. Chak A, Cooper GS, Lloyd LE, Kolz CS, Barnhart BA, Wong RC. Effectiveness of endoscopy in patients admitted to the intensive care unit with upper GI hemorrhage. <i>Gastrointest Endosc</i> . 2001;53(1):6-13.	Observational-Dx	214 patients	Retrospective, multicenter study to determine the effectiveness of 3 EGD factors, visualization, accurate initial diagnosis, performance within 24 hours of admission (early EGD), and appropriate intervention in the management of patients admitted to ICU with UGI hemorrhage.	Inaccurate diagnosis occurred in 10% of patients at initial EGD and was associated with significant increases in risk of recurrent bleeding (70% vs 11%, $P<0.001$), rate of surgery (20% vs 4%, $P<0.05$), length of hospital stay (median 7.5 vs 5 days, $P<0.005$), length of ICU stay (median 4 vs 2 days, $P<0.005$), and rate of readmission to ICU (20% vs 0.6%, $P<0.001$). These associations persisted after adjusting for severity of illness. Early EGD performed in 82% of patients was associated with significant severity-adjusted reductions in hospital (-33%: 95% CI [-45%, -18%]) and ICU (-20%: 95% CI [-24%, -3%]) stay. Appropriate intervention at initial EGD, performed in 84% of patients, was associated with reductions in severity-adjusted length of ICU stay (-18%: 95% CI [-32%, 0%]) and rate of recurrent bleeding (OR = 0.37, 95% CI [0.13, 1.06]).	3
28. Esrailian E, Gralnek IM. Nonvariceal upper gastrointestinal bleeding: epidemiology and diagnosis. <i>Gastroenterol Clin North Am</i> . 2005;34(4):589-605.	Review/Other-Dx	N/A	Review article focusing on the epidemiology and diagnosis of nonvariceal UGIB.	Summarizes recent international data on causes of UGIB. Discusses role of endoscopy and risk stratification.	4

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29. Adler DG, Leighton JA, Davila RE, et al. ASGE guideline: The role of endoscopy in acute non-variceal upper-GI hemorrhage. <i>Gastrointest Endosc.</i> 2004;60(4):497-504.	Review/Other-Dx	N/A	Guideline to review role of endoscopy in acute nonvariceal UGI hemorrhage.	Endoscopy is effective in diagnosing and treating most causes of UGIB.	4
30. American College of Radiology. ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA). Available at: http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Body_CTA.pdf .	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4
31. Abdel-Aal AK, Bag AK, Saddekni S, Hamed MF, Ahmed FY. Endovascular management of nonvariceal upper gastrointestinal hemorrhage. <i>Eur J Gastroenterol Hepatol.</i> 2013;25(7):755-763.	Review/Other-Dx	N/A	To discuss the current strategies for rendering a specific diagnosis of nonvariceal UGIB, and focus on the various TAE techniques for its management.	The majority of patients with nonvariceal UGIB that is refractory to endoscopic treatment is successfully treated with minimally invasive TAE and can avoid undergoing surgery.	4
32. Song JS, Kwak HS, Chung GH. Nonvariceal upper gastrointestinal bleeding: the usefulness of rotational angiography after endoscopic marking with a metallic clip. <i>Korean J Radiol.</i> 2011;12(4):473-480.	Review/Other-Dx	16 patients	To assess the usefulness of rotational angiography after endoscopic marking with a metallic clip in UGIB patients with no extravasation of contrast medium on conventional angiography.	Of the 16 patients, 7 (44%) had positive results after high pressure angiography as close as possible to the clip and they underwent TAE with microcoils. 9 patients without extravasation of contrast medium underwent TAE with microcoils as close as possible to the clip. The bleeding was stopped initially in all patients after treatment of the feeding artery. 2 patients experienced a repeat episode of bleeding 2 days later. Of the 2 patients, 1 had subtle oozing from the ulcer margin and that patient underwent endoscopic treatment. 1 patient with malignant ulcer died due to disseminated intravascular coagulation 1 month after embolization. Complete clinical success was achieved in 14/16 (88%) patients. Delayed bleeding or major/minor complications were not noted.	4
33. Laing CJ, Tobias T, Rosenblum DI, Banker WL, Tseng L, Tamarkin SW. Acute gastrointestinal bleeding: emerging role of multidetector CT angiography and review of current imaging techniques. <i>Radiographics.</i> 2007;27(4):1055-1070.	Review/Other-Dx	N/A	Review the role of CTA in the evaluation and localization of acute, active GI hemorrhage and examine the role of other imaging modalities (radionuclide imaging, catheter-directed angiography, and endoscopy) that are usually used for the diagnosis and treatment of acute GIB.	MDCT is a promising first-line modality for the time-efficient, sensitive, and accurate diagnosis or exclusion of active GI hemorrhage and may have a profound impact on the evaluation and subsequent treatment of patients with acute GIB.	4

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34. Sos TA, Lee JG, Wixson D, Sniderman KW. Intermittent bleeding from minute to minute in acute massive gastrointestinal hemorrhage: arteriographic demonstration. <i>AJR Am J Roentgenol.</i> 1978;131(6):1015-1017.	Review/Other-Dx	3	To report on 3 patients in whom clinically documented acute gastrointestinal hemorrhage was demonstrated by only 1 of 2 or 3 identical selective arteriograms performed within a few minutes.	Failure to demonstrate active bleeding by angiography therefore may not prove cessation of bleeding or indicate an inadequate examination.	4
35. Jairath V, Kahan BC, Logan RF, et al. National audit of the use of surgery and radiological embolization after failed endoscopic haemostasis for non-variceal upper gastrointestinal bleeding. <i>Br J Surg.</i> 2012;99(12):1672-1680.	Review/Other-Tx	4478	To examine the use, clinical characteristics and outcomes of patients receiving salvage surgery or TAE after failed endoscopic hemostasis for nonvariceal UGIB.	Data were analyzed from 4478 patients involving 212 UK centers. Some 533 (11.9%) experienced further bleeding, of whom 163 (30.6%) proceeded to salvage therapy with surgery (97), TAE (60) or both (6). Among surgical patients (mean age 71 years), 66.0% (68/103) had a Rockall score of at least 3 and emergency surgery was carried out between midnight and 08.00 hours in 21%, with a consultant surgeon present in 89% of operations. Some 9% of patients had further bleeding after TAE, resulting in later surgery. The mortality rate was 29% after surgery, 10% after TAE and 23.2% among those with further bleeding after the index endoscopy that was managed by endoscopy alone. The strongest predictors of endoscopic failure were coagulopathy (OR 3.27, 95% CI, 2.37 to 4.53) and a hemoglobin level of 10 g/dL or less (OR 2.22, 1.71 to 2.87, for hemoglobin 8–10 g/dL).	4
36. Loffroy R, Rao P, Ota S, De Lin M, Kwak BK, Geschwind JF. Embolization of acute nonvariceal upper gastrointestinal hemorrhage resistant to endoscopic treatment: results and predictors of recurrent bleeding. <i>Cardiovasc Intervent Radiol.</i> 2010;33(6):1088-1100.	Review/Other-Tx	N/A	To define the role of embolotherapy for acute nonvariceal UGI hemorrhage that fails to respond to endoscopic hemostasis and to summarize data on factors predicting angiographic and embolization failure.	No results stated in abstract.	4
37. Walker TG, Salazar GM, Waltman AC. Angiographic evaluation and management of acute gastrointestinal hemorrhage. <i>World J Gastroenterol.</i> 2012;18(11):1191-1201.	Review/Other-Dx	N/A	To review the current role of angiography, TAE and infusion therapy in the evaluation and management of nonvariceal GI hemorrhage.	No results stated in abstract.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
38. Aina R, Oliva VL, Therasse E, et al. Arterial embolotherapy for upper gastrointestinal hemorrhage: outcome assessment. <i>J Vasc Interv Radiol.</i> 2001;12(2):195-200.	Observational-Tx	75 consecutive patients	To determine short- and long-term results and predictors of outcome after arterial embolization for UGI hemorrhage.	Primary clinical success with cessation of bleeding occurred in 57 patients (76%). Arterial embolotherapy for UGI hemorrhage is safe, effective, and durable. Presence of coagulopathy and use of coils as only embolic agent were associated with higher risk of rebleeding.	2
39. Miller M, Jr., Smith TP. Angiographic diagnosis and endovascular management of nonvariceal gastrointestinal hemorrhage. <i>Gastroenterol Clin North Am.</i> 2005;34(4):735-752.	Review/Other-Dx	N/A	Review current roles of diagnostic angiography and transcatheter therapy for the patient with nonvariceal bleeding.	Although diagnostic angiography is essential in the diagnosis of GIB, transcatheter therapy appears to be a viable treatment alternative. However, there has been no randomized trial to compare the 2 techniques. Small patient series suggest that the results of the 2 techniques are essentially equal, and ischemic complications appear more prevalent with embolotherapy.	4
40. Shin JH. Recent update of embolization of upper gastrointestinal tract bleeding. <i>Korean J Radiol.</i> 2012;13 Suppl 1:S31-39.	Review/Other-Tx	N/A	To provide an update on the embolization technique of UGIB.	Nonvariceal UGIB remains an often serious clinical challenge. A multidisciplinary approach of endoscopists, surgeons, and interventional radiologists is important. With improvements in catheter-based therapy and endovascular device development, angiography and embolization procedures is considered the gold standard for acute nonvariceal UGIB refractory to endoscopy. Interventional radiologists should also be familiar to several clinical and technical factors which affect the clinical outcome of embolotherapy in certain settings.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
41. Kohler G, Koch OO, Antoniou SA, et al. Relevance of surgery after embolization of gastrointestinal and abdominal hemorrhage. <i>World J Surg.</i> 2014;38(9):2258-2266.	Observational-Tx	54 patients with 55 bleeding events	To evaluate the role of surgery in the management of patients after embolization.	54 patients with 55 bleeding events were included. The bleeding source could be localized angiographically in 80%, and the primary clinical success rate of embolization was 81.8% (45/55 cases). Early recurrent bleeding (<30 days) occurred in 18.2% (10/55) of the patients, and delayed recurrent hemorrhage (>30 days) developed in 3.6% (2/55). The mean follow-up was 8.4 months, and data were available for 85.2% (46/54) of the patients. Surgery after embolization was required in 20.4% of these patients (11/54). Failure to localize the bleeding site was identified as predictive of recurrent bleeding ($P=0.009$). More than 1 embolization effort increased the risk of complications ($P=0.02$) and rebleeding ($P=0.07$).	2
42. Nanavati SM. What if endoscopic hemostasis fails? Alternative treatment strategies: interventional radiology. <i>Gastroenterol Clin North Am.</i> 2014;43(4):739-752.	Review/Other-Tx	N/A	To review the role of interventional radiologic techniques in the management of acute UGIB.	No results stated in abstract.	4
43. Abe N, Takeuchi H, Yanagida O, Sugiyama M, Atomi Y. Surgical indications and procedures for bleeding peptic ulcer. <i>Dig Endosc.</i> 2010;22 Suppl 1:S35-37.	Review/Other-Tx	N/A	To review recent important insights into the surgical treatment of bleeding peptic ulcer.	Although the widespread use of endoscopic treatment and interventional radiology has reduced the number of surgical cases, surgery still plays a pivotal role in managing bleeding peptic ulcer. Failure to stop the bleeding by endoscopy and/or interventional radiology is the most important indication for emergency surgery. An early elective/planned surgery after the initial endoscopic control to prevent life-threatening rebleeding seems justified in patients who have risk factors for rebleeding, although its true efficacy still remains controversial. The surgical procedures in emergency situations should be limited to safe hemostasis. The addition of acid-reduction surgery may be unnecessary as a result of the increasing utilization of proton pump inhibitors. Angiographic embolization may be a less invasive alternative to surgery, and may further enhance endoscopic hemostasis.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
44. Wong TC, Wong KT, Chiu PW, et al. A comparison of angiographic embolization with surgery after failed endoscopic hemostasis to bleeding peptic ulcers. <i>Gastrointest Endosc.</i> 2011;73(5):900-908.	Observational-Tx	88 total patients	To compare the outcomes of TAE and salvage surgery for patients with peptic ulcers in whom endoscopic hemostasis failed.	32 patients underwent TAE and 56 underwent surgery. In those who underwent TAE, the bleeding vessels were gastroduodenal artery (25 patients), left gastric artery (4 patients), right gastric artery (2 patients), and splenic artery (1 patient). Active extravasation was seen in 15 patients (46.9%). Embolization was attempted in 26 patients, and angiographic coiling was successful in 23 patients (88.5%). Bleeding recurred in 11 patients (34.4%) in the TAE group and in 7 patients (12.5%) in the surgery group ($P=.01$). More complications were observed in patients who underwent surgery (40.6% vs 67.9%, $P=.01$). There was no difference in 30-day mortality (25% vs 30.4%, $P=.77$), mean length of hospital stay (17.3 vs 21.6 days, $P=.09$), and need for transfusion (15.6 vs 14.2 units, $P=.60$) between the TAE and surgery groups.	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
45. Lee L, Iqbal S, Najmeh S, Fata P, Razek T, Khwaja K. Mesenteric angiography for acute gastrointestinal bleed: predictors of active extravasation and outcomes. <i>Can J Surg.</i> 2012;55(6):382-388.	Observational-Tx	83 patients	To identify predictors of positive angiographic study (active contrast medium extravasation) and characterize outcomes of embolization for acute GIB.	18/83 (22%) patients had active extravasation on initial angiography and 25 (30%) were embolized. Patients with active extravasation had more packed RBC (5.3 vs 2.8 units, $P<0.001$) and fresh frozen plasma (4.8 vs 1.7 units, $P=0.005$) transfusions 24 hours preangiography and were more likely to be hemodynamically unstable at the time of the procedure (67% vs 28%, $P=0.001$) than patients without active extravasation. Each unit of packed RBC transfused increased the risk of a positive study by 30% (hazard ratio 1.3, 95% CI, 1.2–1.6 per unit). Embolization did not decrease recurrent bleeding (53% vs 52%) or length of stay in hospital (28.1 vs 27.5 d, $P=0.95$), but was associated with a trend toward fewer emergency surgical interventions (13% vs 26%, $P=0.31$) and greater 30-day mortality (33% vs 7%, $P=0.006$) than nonembolization. Blind embolization was performed in 10/83 (12%) patients and was found to be an independent predictor of death in patients without active extravasation (hazard ratio 9.2, 95% CI, 1.5–55.9).	2
46. Mensel B, Kuhn JP, Kraft M, et al. Selective microcoil embolization of arterial gastrointestinal bleeding in the acute situation: outcome, complications, and factors affecting treatment success. <i>Eur J Gastroenterol Hepatol.</i> 2012;24(2):155-163.	Observational-Tx	44 patients	To evaluate microcoil embolization in the interventional treatment of acute upper and lower GIB.	The primary technical success rate of microcoil embolization for acute GIB was 88.6% with a clinical success rate of 56.8%. Minor and major complications occurred in 13.6% and 18.2% of patients, respectively. Intervention-associated mortality, due to intestinal ischemia, accounted for 4.6% of the total 18.2% mortality rate. Patients with technically successful embolization had a statistically significant increase in hemoglobin ($P<0.01$) after the intervention and a decrease in need for packed RBC, ($P<0.01$), fresh frozen plasma ($P<0.01$), and coagulation products ($P<0.01$). A smaller postinterventional fresh frozen plasma requirement was associated with a better clinical outcome ($P=0.02$).	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
47. Meehan T, Stecker MS, Kalva SP, Oklu R, Walker TG, Ganguli S. Outcomes of transcatheter arterial embolization for acute hemorrhage originating from gastric adenocarcinoma. <i>J Vasc Interv Radiol.</i> 2014;25(6):847-851.	Observational-Tx	10 patients	To evaluate the indications, complications, and clinical outcomes of TAE for acute hemorrhage associated with gastric adenocarcinoma.	Between March 2002 and March 2012, 10 patients (8 men; mean age, 61.1 y +/- 15.3) underwent TAE for GI hemorrhage caused by gastric adenocarcinoma. Endoscopic therapy had failed in all patients before embolization. Embolization involving branches of the left gastric artery was performed in all patients. No deaths or complications related to the procedure were identified. Mean survival was 301 days, but with a wide range, from 1 day to 1,852 days and counting. Those with unresectable disease (n = 7; 70%) had a median survival time of 9 days, significantly worse ($P < .01$) than those with resectable disease (n = 3; 30%), who had a median survival of 792 days. 6 patients, all with unresectable disease, did not live beyond 30 days. 2 of the 3 patients with resectable disease had subsequent curative resection.	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
48. Banshodani M, Kawanishi H, Moriishi M, Shintaku S, Sato T, Tsuchiya S. Efficacy of intra-arterial treatment for massive gastrointestinal bleeding in hemodialysis patients. <i>Ther Apher Dial.</i> 2014;18(1):24-30.	Review/Other-Tx	8 patients	To evaluate the efficacy of intra-arterial treatment for GIB in hemodialysis patients.	Between January 2006 and June 2012, 8 hemodialysis patients with GIB were treated with superselective transarterial embolization. Of the 8 cases, 1 was duodenal bleeding, 2 were jejunal bleeding, 1 was ileocecum bleeding, 2 were ascending colonic bleeding, and 2 were sigmoid colonic bleeding. After examining the site of bleeding by endoscopy or contrast-enhanced CT, embolizations with microcoils, gelatin sponges, or N-butyl cyanoacrylate were performed through interventional radiology. In all cases, blood transfusions were frequently administered. 6 of the 8 patients with GIB were successfully salvaged by transarterial embolization. In 1 case, duodenal bleeding was refractory to endoscopic treatment. Embolization was performed twice in this case; however, the patient died of an aneurysm rupture at the embolization site 24 days after the embolizations. In another case, massive jejunal bleeding and disseminated intravascular coagulation were identified at the time of the first examination, and the patient died of multiorgan failure 26 days after the embolization.	4
49. Dunne R, McCarthy E, Joyce E, et al. Post-endoscopic biliary sphincterotomy bleeding: an interventional radiology approach. <i>Acta Radiol.</i> 2013;54(10):1159-1164.	Review/Other-Tx	11 patients	To evaluate the technical and clinical success of TAE via microcoils in the management of bleeding post-endoscopic sphincterotomy.	12 embolization procedures were performed in 11 patients. Technical success was achieved in 11 of 12 procedures. Branches embolized included the gastroduodenal artery in 11 cases, the superior pancreaticoduodenal artery in 1 case, and the inferior pancreaticoduodenal artery in 4 cases. Clinical success was achieved in 10 of 11 patients. 1 patient was referred for surgical intervention due to rebleeding from the inferior pancreaticoduodenal artery.	4
50. Busch OR, van Delden OM, Gouma DJ. Therapeutic options for endoscopic haemostatic failures: the place of the surgeon and radiologist in gastrointestinal tract bleeding. <i>Best Pract Res Clin Gastroenterol.</i> 2008;22(2):341-354.	Review/Other-Tx	N/A	Review roles of the surgeon and radiologist in the management of GI tract bleeding.	Role of radiologist has become important for diagnostic modalities and therapeutic embolization to control bleeding. Role of the surgeon is limited to the situation where both these less invasive techniques have failed to stop the bleeding.	4

* See Last Page for Key

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
51. Defreyne L, De Schrijver I, Decruyenaere J, et al. Therapeutic decision-making in endoscopically unmanageable nonvariceal upper gastrointestinal hemorrhage. <i>Cardiovasc Intervent Radiol.</i> 2008;31(5):897-905.	Observational-Tx	46 arteriographed and 51 operated patients	Retrospective study to identify endoscopic and clinical parameters influencing the decision-making in salvage of endoscopically unmanageable, nonvariceal UGI hemorrhage and to report the outcome of selected therapy.	Univariate analysis revealed a higher number of patients with a coagulation disorder in the catheterization group (41.4% vs 20.4% in the laparotomy group; P=0.044). With multivariate analysis, the identification of a bleeding peptic ulcer at endoscopy significantly steered decision-making toward surgical rescue (OR = 5.2; P=0.021). Taking into account reinterventions, hemostasis was achieved in nearly 90% of cases in both groups. Overall therapy failure (no survivors), rebleeding within 3 days (OR = 3.7; P=0.042), and corticosteroid use (OR = 5.2; P=0.017) had a significant negative impact on survival. The odds of dying were not different for embolotherapy or surgery.	2
52. Eriksson LG, Ljungdahl M, Sundbom M, Nyman R. Transcatheter arterial embolization versus surgery in the treatment of upper gastrointestinal bleeding after therapeutic endoscopy failure. <i>J Vasc Interv Radiol.</i> 2008;19(10):1413-1418.	Observational-Tx	91 patients	Retrospective study to compare TAE with surgery in the treatment of UGIB after therapeutic endoscopy failure.	Patients treated with TAE were older and had slightly more comorbidities compared to patients who underwent surgery. The 30-day mortality rate in patients treated with TAE was 1 of 40 (3%) compared to 7/51 (14%) in patients treated with surgery (P<.07). Most repeat bleeding could be effectively treated with TAE, both in the surgical and TAE groups.	2
53. Holme JB, Nielsen DT, Funch-Jensen P, Mortensen FV. Transcatheter arterial embolization in patients with bleeding duodenal ulcer: an alternative to surgery. <i>Acta Radiol.</i> 2006;47(3):244-247.	Observational-Tx	40 consecutive patients	Retrospective study to evaluate the efficacy and safety of TAE in patients with bleeding/rebleeding duodenal ulcers.	26/40 patients (65%) had lasting hemostasis. Transfusion requirement was reduced from median 14 (range 3–35) units of blood before TAE to 2 (range 0–53) units after TAE. 10 patients died; 5 from continuous bleeding. TAE is effective and safe in most patients.	3
54. Ripoll C, Banares R, Beceiro I, et al. Comparison of transcatheter arterial embolization and surgery for treatment of bleeding peptic ulcer after endoscopic treatment failure. <i>J Vasc Interv Radiol.</i> 2004;15(5):447-450.	Observational-Tx	70 patients	Retrospective study to compare the outcomes of embolotherapy and surgery as salvage therapy after therapeutic endoscopy failure in the treatment of UGI peptic ulcer bleeding.	Patients who had embolotherapy were older and had greater incidences of heart disease and previous anticoagulation treatment. No differences in the rest of the pretreatment variables. No differences were found between the embolotherapy and surgery groups in the incidence of recurrent bleeding (29% vs 23.1%), need for additional surgery (16.1% vs 30.8%), or death (25.8% vs 20.5%).	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. Dixon S, Chan V, Shrivastava V, Anthony S, Uberoi R, Bratby M. Is there a role for empiric gastroduodenal artery embolization in the management of patients with active upper GI hemorrhage? <i>Cardiovasc Intervent Radiol.</i> 2013;36(4):970-977.	Observational-Tx	40 patients	To assess the relative efficacy of empiric gastroduodenal artery embolization in reducing recurrent hemorrhage compared to image-guided targeted embolization.	The technical and clinical success rates for embolization in groups 1 and 2a were, respectively, 100% vs 95%, and 85% vs 80%. There was no statistical significance in the recurrent hemorrhage rate, reintervention rate, or 30 day mortality between targeted and empiric embolization groups. There were no complications attributed to embolization within this study cohort.	2
56. Ichiro I, Shushi H, Akihiko I, Yasuhiko I, Yasuyuki Y. Empiric transcatheter arterial embolization for massive bleeding from duodenal ulcers: efficacy and complications. <i>J Vasc Interv Radiol.</i> 2011;22(7):911-916.	Observational-Tx	59 patients	To evaluate the efficacy and safety of empiric TAE for patients with massive bleeding from duodenal ulcers.	The technical and clinical success rates of TAE were 100% and 83%. The recurrent bleeding rate, clinical success, duodenal stenosis, and 30-day mortality after TAE were not significantly different between the empiric and identifiable TAE groups.	2
57. Padia SA, Geisinger MA, Newman JS, Pierce G, Obuchowski NA, Sands MJ. Effectiveness of coil embolization in angiographically detectable versus non-detectable sources of upper gastrointestinal hemorrhage. <i>J Vasc Interv Radiol.</i> 2009;20(4):461-466.	Observational-Tx	108 patients	Retrospectively review patient charts to determine whether the effectiveness of arterial embolization in patients with acute UGI hemorrhage is related to the visualization of contrast medium extravasation at angiography.	The gastroduodenal artery was embolized in 26/36 patients (72%) with extravasation, and the left gastric artery was embolized in 10 (28%). The gastroduodenal artery was embolized in 64/72 patients (89%) without extravasation, and the left gastric artery was embolized in 13 (18%). After embolization, 23/36 patients (64%) with extravasation and 44/72 (61%) without extravasation required additional blood product transfusions. 7/36 patients (19%) with extravasation and 16/72 (22%) without extravasation required subsequent surgery secondary to bleeding. 30-day hemorrhage-related mortality was 17% (6/36 patients) in the positive extravasation group and 22% (16/72 patients) in the negative extravasation group. The treatment success rate was 44% (16/36 patients) in the positive extravasation group and 44% (32/72 patients) in the negative extravasation group.	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
58. Tandberg DJ, Smith TP, Suhocki PV, et al. Early outcomes of empiric embolization of tumor-related gastrointestinal hemorrhage in patients with advanced malignancy. <i>J Vasc Interv Radiol.</i> 2012;23(11):1445-1452.	Observational-Dx	26 patients	To report short-term results of empiric transcatheter embolization for patients with advanced malignancy and GI hemorrhage directly from a tumor invading the GI tract wall.	Active extravasation was demonstrated in 3 cases. Angiographic abnormalities related to a GI tract tumor were identified on 35/37 angiograms, including tumor neovascularity (n = 21), tumor enhancement (n = 24), and luminal irregularity (n = 5). In the absence of active extravasation, empiric embolization with particles and/or coils was performed in 25 procedures. Cessation of hemorrhage (ie, clinical success) occurred more frequently when empiric embolization was performed (17/25 procedures; 68%) than when embolization was not performed (2/9; 22%; <i>P</i> = .03). Empiric embolization resulted in clinical success in 10/11 patients with acute GIB (91%), compared with 7/14 patients (50%) with chronic GIB (<i>P</i> = .04). No ischemic complications were encountered.	3
59. Loffroy R, Guiu B, Mezzetta L, et al. Short- and long-term results of transcatheter embolization for massive arterial hemorrhage from gastroduodenal ulcers not controlled by endoscopic hemostasis. <i>Can J Gastroenterol.</i> 2009;23(2):115-120.	Review/Other-Tx	60 patients	Retrospective review to examine the efficacy and long-term outcomes of transcatheter embolization after failed endoscopic treatments was assessed in high operative-risk patients.	Embolization was feasible and successful in 57 patients. Sandwich coiling of the gastroduodenal artery was used in 34 patients, and superselective occlusion of the terminal feeding artery (with glue, coils or gelatin particles) was used in 23 patients. Early rebleeding occurred in 16 patients and was managed with endoscopy (n=8), reembolization (n=3) or surgery (n=5). No major embolization-related complications occurred. 16 patients died within 30 days after embolization (including 3 who died from rebleeding) and 11 died thereafter. No late bleeding recurrences were reported.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
60. Lundgren JA, Matsushima K, Lynch FC, Frankel H, Cooney RN. Angiographic embolization of nonvariceal upper gastrointestinal bleeding: predictors of clinical failure. <i>J Trauma</i> . 2011;70(5):1208-1212.	Observational-Dx	48 patients	To contribute to the body of information describing the technical and clinical success rates of angiographic embolization, the complications of the procedure, and the causes of mortality after angiographic embolization.	Of 48 total angiographic embolization cases, 17 patients (35.4%) had clinically failed angiographic embolization. Mortality rate was significantly higher in patients with angiographic embolization clinical failure than in patients with angiographic embolization clinical success (64.7% vs 12.9%, $P=0.001$). Factors associated with angiographic embolization clinical failure include anticoagulant use before admission ($P=0.001$), use of corticosteroids before admission ($P=0.045$), pre-angiographic embolization vasopressor use ($P=0.038$), and embolization using either coils alone ($P=0.05$) or using coils with or without additional embolic materials ($P=0.018$).	4
61. Schenker MP, Duszak R, Jr., Soulen MC, et al. Upper gastrointestinal hemorrhage and transcatheter embolotherapy: clinical and technical factors impacting success and survival. <i>J Vasc Interv Radiol</i> . 2001;12(11):1263-1271.	Observational-Tx	163 patients	Retrospective review of patients to identify clinical and technical factors influencing the outcome of transcatheter embolotherapy for nonvariceal UGI hemorrhage and to quantify the impact of successful intervention on patient survival.	None of the procedural variables analyzed had a significant influence on clinical success. Several clinical variables did impact clinical success, including multiorgan system failure (OR, 0.36; $P=.030$), coagulopathy (OR, 0.36; $P=.026$), and bleeding subsequent to trauma (OR, 7.1; $P=.040$) or invasive procedures (OR, 6.5; $P=.009$). Regardless of their clinical condition at intervention, patients who underwent clinically successful embolization were 13.3 times more likely to survive than those who had an unsuccessful procedure (CI, 4.54–39.2; $P=.000$). Nevertheless, patients with multiorgan system failure were 17.5 times more likely to die, independent of the outcome of the procedure (CI, 0.014–0.229; $P=.000$).	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
62. Garcia-Blazquez V, Vicente-Bartulos A, Olavarria-Delgado A, Plana MN, van der Winden D, Zamora J. Accuracy of CT angiography in the diagnosis of acute gastrointestinal bleeding: systematic review and meta-analysis. <i>Eur Radiol.</i> 2013;23(5):1181-1190.	Meta-analysis	22 studies; 672 patients	To assess the diagnostic accuracy of CTA in the evaluation of patients with an episode of acute GI hemorrhage.	22 studies were included and provided data on 672 patients (range of age 5–74) with a mean age of 65 years. The overall sensitivity of CTA for detecting active acute GI hemorrhage was 85.2% (95% CI, 75.5% to 91.5%). The overall specificity of CTA was 92.1% (95% CI, 76.7% to 97.7%). The likelihood ratios for positive and negative test results were 10.8 (95% CI, 3.4 to 34.4) and 0.16 (95% CI, 0.1 to 0.27), respectively, with an area under the curve of 0.935 (95% CI, 0.693 to 0.989). The sources of heterogeneity explored had no significant impact on diagnostic performance.	M
63. Tabibian JH, Wong Kee Song LM, Enders FB, Aguet JC, Tabibian N. Technetium-labeled erythrocyte scintigraphy in acute gastrointestinal bleeding. <i>Int J Colorectal Dis.</i> 2013;28(8):1099-1105.	Observational-Dx	100 consecutive TRBC scans	To evaluate the clinical outcomes of the technetium-labeled RBC scan in patients presenting with acute GIB.	Of the 80 Tc-99m RBC scans, 29 (36%) were positive and 51 (64%) were negative for bleeding. 8 (10%) were incorrect positive (leading to 5 incorrect operations), 12 (15%) true positive, 9 (11%) unconfirmed positive, 17 (21%) false negative, and 34 (43%) unconfirmed negative. The cause of bleeding was confirmed in 31 cases, of which the scan result was incorrect positive in 2 (7%), true positive in 12 (39%), and false negative in 17 (55%).	3
64. Jaeckle T, Stuber G, Hoffmann MH, Jeltsch M, Schmitz BL, Aschoff AJ. Detection and localization of acute upper and lower gastrointestinal (GI) bleeding with arterial phase multi-detector row helical CT. <i>Eur Radiol.</i> 2008;18(7):1406-1413.	Observational-Dx	36 consecutive patients	To evaluate the accuracy of MDCT for detection and localization of acute upper and lower GI hemorrhage or intraperitoneal bleeding.	Correct site of bleeding was identifiable on MDCT in 24/26 patients with GIB. In 20/24 patients, active contrast media extravasation was apparent during the exam. On 10 patients with intraperitoneal hemorrhage, MDCT correctly identified the bleeding source in 9 patients. Findings suggest fast and accurate localization of acute GI and intraperitoneal bleeding is achievable on MDCT.	3
65. Wu LM, Xu JR, Yin Y, Qu XH. Usefulness of CT angiography in diagnosing acute gastrointestinal bleeding: a meta-analysis. <i>World J Gastroenterol.</i> 2010;16(31):3957-3963.	Meta-analysis	9 studies; 198 patients	To analyze the accuracy of CT angiography in the diagnosis of acute gastrointestinal GIB.	A total of 9 studies with 198 patients were included in this meta-analysis. Data were used to form 2 x 2 tables. CTA showed pooled sensitivity of 89% (95% CI: 82%–94%) and specificity of 85% (95% CI: 74%–92%), without showing significant heterogeneity (chi(2) = 12.5, P=0.13) and (chi(2) = 22.95, P=0.003), respectively. Summary receiver operating characteristic analysis showed an area under the curve of 0.9297.	M

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
66. Huprich JE, Fletcher JG, Alexander JA, Fidler JL, Burton SS, McCullough CH. Obscure gastrointestinal bleeding: evaluation with 64-section multiphase CT enterography--initial experience. <i>Radiology</i> . 2008;246(2):562-571.	Observational-Dx	22 patients	To retrospectively evaluate the findings depicted at CT enterography performed with a 64-section CT system and by using neutral enteric contrast material and a 3-phase acquisition in patients with OGIB. Findings compared with capsule and traditional endoscopic, surgical, and angiographic findings.	CT enterographic findings were positive for a bleeding source in 10/22 (45%) patients. 8/10 positive findings at CT enterography were also positive at CE or subsequent clinical diagnosis. CT enterography helped correctly identify 3 lesions undetected at CE. Results suggest multiphase, multiplanar CT enterography may have a role in the evaluation of OGIB. Larger study needed.	3
67. Jain TP, Gulati MS, Makharia GK, Bandhu S, Garg PK. CT enteroclysis in the diagnosis of obscure gastrointestinal bleeding: initial results. <i>Clin Radiol</i> . 2007;62(7):660-667.	Observational-Dx	21 patients	To evaluate the usefulness of CT enteroclysis in patients with OGIB.	Adequate distension of the small intestine was achieved in 20/21 (95.2%) patients. Potential causes of GIB were identified in 10/21 (47.6%) patients using CT enteroclysis. The cause of the bleeding could be detected 9/14 (64.3%) patients with overt, OGIB. However, for patients with occult, OGIB, the cause of the bleeding was identified in only 1 of the 7 (14.3%) patients. The lesions identified by CT enteroclysis included small bowel tumors (n=2), small bowel intussusceptions (n=2), intestinal tuberculosis (n=2), and vascular lesions (n=3). All vascular lesions were seen equally well in both the arterial and venous phases.	4
68. Kim J, Kim YH, Lee KH, Lee YJ, Park JH. Diagnostic Performance of CT Angiography in Patients Visiting Emergency Department with Overt Gastrointestinal Bleeding. <i>Korean J Radiol</i> . 2015;16(3):541-549.	Observational-Dx	111 patients	To investigate the diagnostic performance of CTA in identifying the cause of bleeding and to determine the clinical features associated with a positive test result of CTA in patients visiting emergency department with overt GIB.	To identify a definite or potential bleeding focus, the diagnostic yield of CTA was 61.3% (68/111). The overall sensitivity, specificity, PPV, and NPV were 84.8% (67/79), 96.9% (31/32), 98.5% (67/68), and 72.1% (31/43), respectively. Positive CTA results were associated with the presence of massive bleeding ($P=0.001$, OR: 11.506).	3
69. Yoon W, Jeong YY, Shin SS, et al. Acute massive gastrointestinal bleeding: detection and localization with arterial phase multi-detector row helical CT. <i>Radiology</i> . 2006;239(1):160-167.	Observational-Dx	26 consecutive patients	To prospectively evaluate accuracy of arterial phase MDCT for detection and localization of acute massive GIB, with angiography as reference standard.	Overall location-based sensitivity, specificity, accuracy, PPV and NPV values of MDCT for detection of GIB were 90.9% (20/22), 99% (107/108), 97.6% (127/130), 95% (20/21), and 98% (107/109), respectively. Overall patient-based accuracy of MDCT for detection of acute GIB was 88.5% (23/26). Arterial phase MDCT is accurate for detection and localization of bleeding sites in patients with acute massive GIB.	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
70. Huprich JE, Barlow JM, Hansel SL, Alexander JA, Fidler JL. Multiphase CT enterography evaluation of small-bowel vascular lesions. <i>AJR Am J Roentgenol.</i> 2013;201(1):65-72.	Review/Other-Dx	N/A	To review the unique patterns of enhancement and lesion morphology seen on multiphase CT enterography and how those findings enable detection and characterization of specific lesions in many cases.	Because of the high prevalence in nonbleeding patients and frequent multiplicity of angioectasias, determining the clinical benefit from their detection by multiphase CT enterography and endoscopy is problematic. Although arterial lesions are less commonly encountered clinically, their detection is critically important because of a high risk of life-threatening bleeding. Along with wireless CE and balloon-assisted endoscopy, multiphase CT enterography is a useful tool for the evaluation of patients with OGIB due to small-bowel vascular lesions.	4
71. Huprich JE, Fletcher JG, Fidler JL, et al. Prospective blinded comparison of wireless capsule endoscopy and multiphase CT enterography in obscure gastrointestinal bleeding. <i>Radiology.</i> 2011;260(3):744-751.	Observational-Dx	58 patients	To compare the performance of multiphase CT enterography with that of CE in a group of patients with OGIB.	58 adult patients, referred for the evaluation of OGIB (occult, 25 patients [43%]; overt, 33 patients [57%]), underwent both tests. A small bowel bleeding source was identified in 16/58 patients (28%). The sensitivity of CT enterography was significantly greater than that of CE (88% [14/16 patients] vs 38% [6/16 patients], respectively; $P=.008$), largely because it depicted more small bowel masses (100% [9/9 patients] vs 33% [3/9 patients], respectively; $P=.03$). No additional small bowel tumors were discovered during the follow-up period (range, 5.6–45.9 months; mean, 16.6 months).	2
72. Lee SS, Oh TS, Kim HJ, et al. Obscure gastrointestinal bleeding: diagnostic performance of multidetector CT enterography. <i>Radiology.</i> 2011;259(3):739-748.	Observational-Dx	65 patients	To evaluate the diagnostic performance of CT enterography in identifying the source of OGIB and to determine clinical features associated with a higher diagnostic yield of CT enterography.	CT enterography helped identify the source of OGIB in 16 (24.6%) of 65 patients. The sensitivity, specificity, PPV, and NPV of CT enterography were 55.2% (16/29), 100% (32/32), 100% (16/16), and 71.1% (32/45), respectively. Among patients' clinical features, a history of massive bleeding (diagnostic yield, 58.3% [7/12]; adjusted OR, 7.2; $P=0.01$) was independently associated with a higher diagnostic yield for CT enterography.	3
73. Lee SS, Park SH. Computed tomography evaluation of gastrointestinal bleeding and acute mesenteric ischemia. <i>Radiol Clin North Am.</i> 2013;51(1):29-43.	Review/Other-Dx	N/A	To discuss current techniques, the findings in correlation with pathophysiology, and the proper use of MDCT in the diagnostic evaluation and management of these patients.	No results stated in abstract.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
74. Howarth DM. The role of nuclear medicine in the detection of acute gastrointestinal bleeding. <i>Semin Nucl Med.</i> 2006;36(2):133-146.	Review/Other-Dx	N/A	Review role of nuclear medicine in the detection of acute GIB.	Tc-99m-labeled erythrocytes and Tc-99m sulfur colloid are usually used to detect active bleeding. Both tests are useful.	4
75. Charbonnet P, Toman J, Buhler L, et al. Treatment of gastrointestinal hemorrhage. <i>Abdom Imaging.</i> 2005;30(6):719-726.	Observational-Dx	107 patients	To assess the value of selective arteriography in the diagnosis and management of acute gastrointestinal hemorrhage.	Of 129 angiographic studies, 36 correctly revealed the bleeding site and 93 were negative. Extravasation was seen in 24 cases at the level of stomach (n = 2), duodenum (n = 1), small bowel (n = 5), or colon (n = 16). Indirect signs of bleeding sources were identified in 12 patients (stomach in 1, small bowel in 4, large bowel in 4, and liver in 3). Transcatheter embolization induced definitive hemostasis in 11/15 patients (73%), namely in the stomach (n = 2), small bowel (n = 3), colon (n = 7), and liver (n = 3). 3 patients required surgery after embolization.	4
76. Howarth DM, Tang K, Lees W. The clinical utility of nuclear medicine imaging for the detection of occult gastrointestinal haemorrhage. <i>Nucl Med Commun.</i> 2002;23(6):591-594.	Observational-Dx	137 patients	To determine the clinical utility of Tc-99m labelled RBC imaging and Meckel's scan imaging in a series of 137 patients admitted over a 5 year period to hospital for management of acute GIB.	Of the 137 patients, 70 had positive Tc-99m RBC studies. 11/24 patients who had imaging performed beyond 3 h had positive scans that would otherwise have been missed. Only 47 patients had a definite final diagnosis at the time of hospital discharge, of which 6 were negative on Tc-99m RBC imaging. The correct site of bleeding was localized in 7/21 patients with foregut bleeding, and 15/20 patients with colonic bleeding. Endoscopy yielded a diagnosis in 13/47 patients (28%). 11 patients had Meckel's scans but all were negative. Angiography was diagnostic in one of 17 patients studied.	3
77. Rajnish A, Sudhakar P, Rammurti S, Radhakrishna N, Regulagedda A. Scintigraphic localization of lower gastrointestinal haemorrhage of obscure origin. <i>Asian Ocean J Radiol.</i> 1999;5(4):217-220.	Observational-Dx	15 patients	To evaluate the diagnostic efficacy of Tc-99m-RBC bleed scan in lower GI hemorrhage of obscure origin in comparison to digital angiography and/or surgical findings.	Scintigraphy was found to be more sensitive than angiography (93% vs 80%). Scintigraphy was positive in 14 patients, while angiography detected bleeding in 12. Scintigraphy correctly localized bleeder in 13 of 15 patients (87%). In 3 patients, scintigraphic localization of bleeding was found correct on surgical exploration, when arteriogram was negative.	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
78. Aksoy T. Obscure and occult gastrointestinal bleeding: role of radionuclide imaging. <i>Abdom Imaging</i> . 2012;37(2):309-310; author reply 311-302.	Review/Other-Dx	N/A	N/A	N/A	4
79. Asghar AH, Khan A, Khan AA, Khan AM, Shah S, Saddique B. Role of Tc-99m labeled RBC scan in evaluation of gastrointestinal bleed. <i>J Coll Physicians Surg Pak</i> . 2002;12(6):335-337.	Observational-Dx	28 patients	To evaluate the role of Tc-99m RBC scan in detection of GIB.	Out of 16 (group-1), 14 (87%) showed focus of bleed on scan while 2 (13%) were having false negative scan. Findings were confirmed either on laparotomy (n=4) or by contrast angiography (n= 12). In group-2 (n=12), 11 (92%) were having true negative scan while 1 (8%) was having false positive scan. Negative scan patients were followed for next 3 months to see any episode of bleed. Sensitivity of test came out to be 87%, while specificity 92%.	3
80. Brunner T, Klebl F, Mundorff S, et al. Significance of scintigraphy for the localisation of obscure gastrointestinal bleedings. <i>World J Gastroenterol</i> . 2008;14(32):5015-5019.	Observational-Dx	92 patients	To determine the role of scintigraphy in patients with GIB of unknown localization.	73% of all scintigraphies showed a positive result. In 4.5% of the positive results, the source was located in the stomach, in 37% the source was the small bowel, in 25% the source was the right colon, in 4.5% the source was the left colon, and in 20% no clear localization was possible. Only 4% of all scintigraphies were false positive. A reliable positive scintigraphy was independent of the age of the examined patient. A provocation test for bleeding with heparin resulted in an additional 46% of positive scintigraphies with a reliable localization in primary negative scintigraphies.	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
81. Dolezal J, Vizd'a J, Bures J. Detection of acute gastrointestinal bleeding by means of technetium-99m in vivo labelled red blood cells. <i>Nucl Med Rev Cent East Eur.</i> 2002;5(2):151-154.	Observational-Dx	31 patients	To assess the detection of acute gastrointestinal bleeding by means of Tc-99m in vivo labelled RBC.	21 patients had positive scintigraphy with in vivo labelled RBCs—9 patients were already positive on dynamic scintigraphy, and 12 patients were positive on static images. Scintigraphy with in vivo labelled RBCs was negative in 10 patients. GIB stopped spontaneously in these 10 patients with negative scintigraphy. These patients did not undergo intra-operative enteroscopy or surgery. The final diagnosis of the 21 patients with positive scintigraphy was determined in 16 patients by push-enteroscopy (6 patients), intra-operative enteroscopy (6 patients) or by surgery (4 patients). Of these 16 patients the correct place of bleeding was determined by scintigraphy with labelled RBCs in 11 (69%) patients. Final diagnoses of our 16 patients with positive scintigraphy with autological labelled RBCs were: bleeding small bowel arteriovenous malformation (6 patients), uraemic enteritis with bleeding erosions in ileum and jejunum (2 patients), Osler-Rendu-Weber disease (1 patient), pseudocyst of the pancreas with bleeding vessel communicating to the transverse colon (1 patient), bleeding submucose varix in jejunum (1 patient), carcinoid of the ileum (1 patient), bleeding from the ileosigmoideoanastomosis 6-days after hemicolectomy for Crohn's disease (1 patient), bleeding from an ulcer close to the papilla of Vater (1 patient), bleeding from ulcer at jejunum after previous NSAIDs treatment (1 patient), bleeding inflammatory polyp at ileotransversoanastomosis (1 patient). GIB stopped spontaneously in 5 patients with positive scintigraphy. Therefore these patients did not undergo intraoperative enteroscopy or surgery and we could not determine the final diagnosis.	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
82. Dolezal J, Vizda J, Kopacova M. Single-photon emission computed tomography enhanced Tc-99m-perchnetate disodium-labelled red blood cell scintigraphy in the localization of small intestine bleeding: a single-centre twelve-year study. <i>Digestion</i> . 2011;84(3):207-211.	Review/Other-Dx	26 patients	The authors present their experience with the detection of bleeding in the small intestine by means of scintigraphy with in vivo-labelled RBCs in the period of 1998-2009.	A total of 26 patients had a positive scintigraphy with in vivo-labelled RBCs and 14 patients had negative scintigraphy. The final diagnosis was confirmed in 20/26 patients with a positive scintigraphy by push enteroscopy (6/20), intraoperative enteroscopy (7/20), surgery (4/20), duodenoscopy (1/20), double-balloon enteroscopy (1/20) and X-ray angiography (1/20). The correct location of the bleeding site was identified by RBC scintigraphy in 15/20 (75%) patients with the confirmed source. The locations of the bleeding site identified by scintigraphy and enteroscopy (push, intraoperative) and surgical investigations were highly correlated in patients with a positive scintigraphy within the first 3 hours. 11/20 correctly localized studies and none of the incorrectly localized studies were positive in the dynamic phase of imaging. In 5 patients (all erroneously localized), scintigraphy was positive only at a period longer than 18 hours.	4
83. Dusold R, Burke K, Carpentier W, Dyck WP. The accuracy of technetium-99m-labeled red cell scintigraphy in localizing gastrointestinal bleeding. <i>Am J Gastroenterol</i> . 1994;89(3):345-348.	Observational-Dx	153 patients	To evaluate the success of Tc-99m-labeled RBC scintigraphy in localizing the site of gastrointestinal bleeding, and to identify the clinical and technical factors that contribute to scan accuracy.	Of a total of 153 patients, 90 (59%) had positive scans, whereas, in 63 (41%), they were negative. Of the 90 patients who had positive scans, it was possible to assess scan accuracy in 44 who had corrective surgery or an additional diagnostic procedure which definitively localized the site of bleeding. Of those 44 patients, the correct bleeding site was identified by RBC scanning in 33 patients (75%) overall and in all 6 patients with a left colon bleeding site. In this group of 44 patients, 22 scans were positive within 2 h, and of these the scan was accurate in localizing the bleeding site in 19/22 (86%). When the three subjects with UGIB were excluded, the scan was positive in 100% of the remaining 19 patients.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Friebe B, Wieners G. Radiographic techniques for the localization and treatment of gastrointestinal bleeding of obscure origin. <i>Eur J Trauma Emerg Surg.</i> 2011;37(4):353.	Review/Other-Dx	N/A	To give a summary of the diagnostic and interventional treatment of acute GIB with an emphasis on radiological methods.	Clinical risk scores are useful tools to triage patients for appropriate treatment. High-risk patients should undergo emergency endoscopy within 24 h. If endoscopic control of the bleeding cannot be achieved, a CTA should be done. If active bleeding (or if an active bleeding site) is found, in most cases, TAE should be performed prior to surgery because of the equal mortality rates with lower complication rates. If the site of bleeding is not identified and the patient is stable, a “watch-and-wait” strategy can be pursued. Especially for intermittent bleeding, scintigraphy with tagged RBC can be useful.	4
85. Strate LL, Syngal S. Predictors of utilization of early colonoscopy vs. radiography for severe lower intestinal bleeding. <i>Gastrointest Endosc.</i> 2005;61(1):46-52.	Observational-Dx	118 patients	To assess factors associated with early (within 24 hours of presentation) colonoscopy vs radiographic evaluation of patients with severe acute lower intestinal bleeding in routine practice.	A total of 118 patients met criteria for severe bleeding; 33 (28%) underwent an initial, early colonoscopy and 20 (17%) underwent an initial, early radiographic procedure (17 radionuclide scintigraphy, 3 angiography). Independent factors related to early colonoscopy were post-polypectomy bleeding (OR 6.3: 95% CI, [1.4, 28.0]), admission on a weekday (OR 3.0: 95% CI, [1.0, 8.6]), and admission late in the day (OR 2.7: 95% CI, [1.0, 7.0]). Independent factors related to early radiography were tachycardia (OR 5.1: 95% CI, [1.7, 14.9]), syncope (OR 3.8: 95% CI, [1.1, 13.2]) and bleeding during the first 4 hours after admission (OR 3.1: 95% CI, [1.0, 9.0]). Colonoscopy was associated with shorter hospital stay ($P=0.025$), increased diagnostic yield ($P=0.005$), and fewer RBC transfusions ($P=0.024$). Rates of therapeutic intervention, surgery, and death did not differ significantly between the 2 strategies.	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
86. Mellinger JD, Bittner JGt, Edwards MA, Bates W, Williams HT. Imaging of gastrointestinal bleeding. <i>Surg Clin North Am.</i> 2011;91(1):93-108.	Review/Other-Dx	N/A	To summarize the current literature with regard to radiological imaging and its role in the care of the patient with GIB.	Scintigraphic, CTA, and enterographic techniques are sensitive tools in identifying the source of bleeding and may be useful in identifying patients likely to have a benign course and in selecting patients for therapeutic intervention. Angiography plays a key role in bleeding localization, and modern embolization techniques make this a viable therapeutic option. With the refining developments in body imaging and related reconstructive techniques, it is likely that radiological interventions will play an expanding and critical role in evaluating patients with GI hemorrhage in the future.	4
87. Sudheendra D, Venbrux AC, Noor A, et al. Radiologic techniques and effectiveness of angiography to diagnose and treat acute upper gastrointestinal bleeding. <i>Gastrointest Endosc Clin N Am.</i> 2011;21(4):697-705.	Review/Other-Dx	N/A	To summarize the use of catheter-based techniques and, when possible, compare them with other methods such as surgery and endoscopy.	The nonsurgical (ie, transcatheter) approach to the treatment of patients with UGIB requires knowledge of anatomy and angiographic techniques. Monitoring of patients in an ICU is mandatory. Transcatheter embolotherapy or infusion of vasopressin may prove to be lifesaving in patients who are poor surgical candidates, or in patients who refuse surgery or require stabilization. Therapy using transcatheter techniques is often definitive. The use of embolotherapy, as opposed to infusion of vasopressin, is believed to have a more durable clinical result (ie, less chance of rebleeding). Use of vasopressin is not without risk, and the trend is to use superselective catheterization techniques to treat patients with UGIB.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
88. Yap FY, Omene BO, Patel MN, et al. Transcatheter embolotherapy for gastrointestinal bleeding: a single center review of safety, efficacy, and clinical outcomes. <i>Dig Dis Sci.</i> 2013;58(7):1976-1984.	Observational-Tx	95 patients	To assess safety, efficacy, and clinical outcomes following TAE of acute GIB.	Bleeding etiology included peptic ulcer disease (45/95, 47%), cancer (14/95, 15%), diverticulosis (13/95, 14%), and other (23/95, 24%). Vessels embolized (n = 109) included gastroduodenal (42/109, 39%), pancreaticoduodenal (22/109, 20%), gastric (21/109, 19%), superior mesenteric (12/109, 11%), inferior mesenteric (8/109, 7%), and splenic (4/109, 4%) artery branches. Technical success with immediate hemostasis was achieved in 93/95 (98%) cases. Most common embolic agents included coils (66/109, 61%) and/or gelatin sponge (19/109, 17%). Targeted vs empiric embolization were performed in 57/95 (60%) and 38/95 (40%) cases, respectively. Complications included bowel ischemia (4/95, 4%) and coil migration in 3/95 (3%). 30-day rebleeding rate was 23% (22/95). Overall 30-day mortality rate was 18% (16/89). Empiric embolization resulted in similar rebleeding (23% vs 24%) but higher mortality (31% vs 9%) rates compared to embolization for active extravasation.	2
89. Murugesan SD, Sathyanesan J, Lakshmanan A, et al. Massive hemobilia: a diagnostic and therapeutic challenge. <i>World J Surg.</i> 2014;38(7):1755-1762.	Review/Other-Dx	20 patients	To evaluate the challenges involved in the diagnosis and management of massive hemobilia.	Causes of hemobilia were blunt liver trauma (n = 9), hepatobiliary intervention (n = 4), post-laparoscopic cholecystectomy hepatic artery pseudoaneurysm (n = 3), hepatobiliary tumors (n = 3), and vascular malformation (n = 1). Melena, abdominal pain, hematemesis, and jaundice were the leading symptoms. All patients had undergone upper GI endoscopy, abdominal US, and CT of the abdomen. An angiogram and therapeutic embolization were done in 12 patients and was successful in 9 but failed in 3, requiring surgery. Surgical procedures performed were right hepatectomy (n = 4), extended right hepatectomy (n = 1), segmentectomy (n = 1), extended cholecystectomy (n = 1), repair of the pseudoaneurysm (n = 3), and right hepatic artery ligation (n = 1).	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
90. Chua AE, Ridley LJ. Diagnostic accuracy of CT angiography in acute gastrointestinal bleeding. <i>J Med Imaging Radiat Oncol.</i> 2008;52(4):333-338.	Meta-analysis	8 studies (129 patients)	Systematic review to determine the accuracy of CTA in the diagnosis of acute GIB.	CTA showed pooled sensitivity of 86% (95% CI 78%–92%) and specificity of 95% (95% CI 76%–100%), without showing significant heterogeneity ($\chi^2 = 3.5, P=0.6$) and ($\chi^2 = 5.4, P=0.6$), respectively. Summary receiver operating characteristic analysis showed an area under the curve of 0.93.	M
91. Jaeckle T, Stuber G, Hoffmann MH, Freund W, Schmitz BL, Aschoff AJ. Acute gastrointestinal bleeding: value of MDCT. <i>Abdom Imaging.</i> 2008;33(3):285-293.	Review/Other-Dx	N/A	Review current diagnostic modalities in assessing GI tract hemorrhage, with emphasis on new MDCT technology.	Contrast-enhanced MDCT is becoming a rapid, noninvasive and accurate diagnostic method in suspected acute GIB.	4
92. Scheffel H, Pfammatter T, Wildi S, Bauerfeind P, Marincek B, Alkadhi H. Acute gastrointestinal bleeding: detection of source and etiology with multi-detector-row CT. <i>Eur Radiol.</i> 2007;17(6):1555-1565.	Observational-Dx	18 patients	To determine the ability of MDCT to identify the source and etiology of acute GIB. CT scans were reviewed to determine conspicuity of bleeding source, underlying etiology, and for potential causes of false-negative prospective interpretations. Bleeding sources were prospectively identified with CT in 15 (83%) patients, and 3 (17%) bleeding sources were visualized in retrospect, allowing the characterization of all sources of bleeding with CT.	Contrast extravasation was shown with CT in all 11 patients with severe bleeding, but only in 1/7 patients with mild bleeding. The etiology could not be identified on unenhanced CT scans in any patient, whereas arterial-phase and portal venous-phase CT depicted etiology in 15 (83%) patients. Underlying etiology was correctly identified in all 8 patients with mild GIB. MDCT enables the identification of bleeding source and precise etiology in patients with acute GIB.	3
93. Hara AK, Leighton JA, Sharma VK, Heigh RI, Fleischer DE. Imaging of small bowel disease: comparison of capsule endoscopy, standard endoscopy, barium examination, and CT. <i>Radiographics.</i> 2005;25(3):697-711; discussion 711-698.	Review/Other-Dx	N/A	Review CE compared to standard endoscopy, barium exam and CT in the evaluation of small bowel disease.	CE is easy to perform, well tolerated by patients, and, allows noninvasive endoscopic evaluation of the entire small bowel.	4
94. Stunell H, Buckley O, Lyburn ID, McGann G, Farrell M, Torreggiani WC. The role of computerized tomography in the evaluation of gastrointestinal bleeding following negative or failed endoscopy: a review of current status. <i>J Postgrad Med.</i> 2008;54(2):126-134.	Review/Other-Dx	N/A	Review current literature and discuss the current status of CT as a modality in investigating the patient with GIB.	In many centers, CT has become the ‘next step’ technique in identifying a bleeding source within the GIB following negative or failed endoscopy in the acute setting.	4
95. Tew K, Davies RP, Jadun CK, Kew J. MDCT of acute lower gastrointestinal bleeding. <i>AJR Am J Roentgenol.</i> 2004;182(2):427-430.	Review/Other-Dx	13 patients; 14 MDCT exams	Retrospective study to evaluate the use of MDCT in the diagnosis and management of lower GIB (hematochezia).	MDCT is proposed as an alternative first-line investigation to locate lower GIB before placing the patient under observation or performing embolization or surgery.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
96. Kuhle WG, Sheiman RG. Detection of active colonic hemorrhage with use of helical CT: findings in a swine model. <i>Radiology</i> . 2003;228(3):743-752.	Review/Other-Dx	16 exams in 14 swine	To evaluate the feasibility of helical CT as an imaging modality for depicting active colonic hemorrhage in a swine model.	16 swine exams yielded 16 contrast material-enhanced blood dilution curves. An excellent fit of the model to each dilution curve was achieved (mean R2 value of 0.8402). Helical CT has the potential to depict active colonic hemorrhage at rates of 0.5 mL/min or less.	4
97. Roy-Choudhury SH, Gallacher DJ, Pilmer J, et al. Relative threshold of detection of active arterial bleeding: in vitro comparison of MDCT and digital subtraction angiography. <i>AJR Am J Roentgenol</i> . 2007;189(5):W238-246.	Observational-Dx	Test phantom	To determine the relative sensitivity and the lowest threshold of bleeding detectable with DSA and with MDCT using an in vitro physiologic system. Cine loops of MDCT and DSA images were examined by 2 blinded observers.	The threshold to detect bleeding was as follows for each study: For IV contrast-enhanced MDCT (study 1), it was 0.35 mL/min; DSA with a catheter 10 cm proximal to the holes (study 2), 0.96 mL/min; DSA with a catheter at the holes (study 3), 0.05 mL/min [corrected] or lower; and intra-arterial selective MDCT (study 4), 0.05 mL/min [corrected] or lower. The ease of detection improved with increasing mean arterial pressure and larger volumes of leakage. Interobserver correlation was excellent. In vitro, IV contrast-enhanced MDCT is more sensitive than first-order aortic branch-selective DSA in detecting active hemorrhage unless the catheter position is highly superselective and is close to the bleeding artery. Results suggest that MDCT can be used as the initial imaging technique in the diagnosis of active hemorrhage if the clinical condition of the patient allows.	2
98. Chang WC, Tsai SH, Chang WK, et al. The value of multidetector-row computed tomography for localization of obscure acute gastrointestinal bleeding. <i>Eur J Radiol</i> . 2011;80(2):229-235.	Observational-Dx	92 patients	To use a risk scoring system to determine a cutoff value for performing MDCT and tried to establish the value of MDCT for localization of obscure acute GIB.	Of the 92 patients, 62 (67.4%) were classified as high-risk patients. Blatchford scores of high-risk patients were significantly greater than those of low-risk patients. Sensitivity for MDCT diagnosing obscure acute GIB was 81% in high-risk patients, as compared with 50% in the low-risk. When used in conjunction with selection of the cut-off value of 13 in Blatchford scoring system, the sensitivity and specificity of MDCT were 70.9% and 73.7%, respectively. Contrast extravasation was the most specific sign of acute GIB (k=.87), recognition of which would have improved diagnostic accuracy.	2

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
99. Kennedy DW, Laing CJ, Tseng LH, Rosenblum DI, Tamarkin SW. Detection of active gastrointestinal hemorrhage with CT angiography: a 4(1/2)-year retrospective review. <i>J Vasc Interv Radiol</i> . 2010;21(6):848-855.	Observational-Dx	74 patients; 86 CT angiograms	To retrospectively evaluate the ability of CT to detect and localize GIB.	26% of CTs were positive for hemorrhage. Of the negative CTs, 92% required no further therapy. Sensitivity and specificity were 79% and 95%, respectively. CTA provides valuable information that can be used to determine the appropriateness of catheter angiography and guide mesenteric catheterization if a bleeding source is localized. The authors' experience with this study cohort supports its use before angiography in those patients with acute GIB of an unknown source who are being considered for catheter-directed intervention.	3
100. Batouli A, Kazemi A, Hartman MS, Heller MT, Midian R, Lupetin AR. Dieulafoy lesion: CT diagnosis of this lesser-known cause of gastrointestinal bleeding. <i>Clin Radiol</i> . 2015;70(6):661-666.	Review/Other-Dx	N/A	To summarize the pathophysiology, epidemiology, diagnosis, and management of Dieulafoy lesions with a focus on diagnostic findings at enhanced CT imaging.	No results stated in abstract.	4
101. Dobritz M, Engels HP, Schneider A, Bauer J, Rummeny EJ. Detection of intestinal bleeding with multi-detector row CT in an experimental setup. How many acquisitions are necessary? <i>Eur Radiol</i> . 2009;19(12):2862-2869.	Observational-Dx	10 negative controls and 26 complete datasets	To evaluate MDCT acquired in different acquisitions (unenhanced, and arterial and portal venous phase following IV contrast medium) for detection of intestinal bleeding using an experimental bowel model.	Dual-phase MDCT with arterial and portal venous acquisitions provided the highest sensitivity for detection of small intestinal bleeding compared with single-phase CT. We therefore recommend arterial and portal venous acquisitions for the diagnostic workup of patients with acute GI hemorrhage.	2
102. Hara AK, Walker FB, Silva AC, Leighton JA. Preliminary estimate of triphasic CT enterography performance in hemodynamically stable patients with suspected gastrointestinal bleeding. <i>AJR Am J Roentgenol</i> . 2009;193(5):1252-1260.	Observational-Dx	48 patients	To retrospectively evaluate the performance of triphasic CT enterography and identify causes of false-negative CT results in hemodynamically stable patients with suspected GIB.	The overall sensitivity and specificity of triphasic CT enterography for detecting GIB was 33% (7/21) and 89% (24/27), respectively. Sensitivity and specificity were higher in first-episode GIB cases (42% and 100%, respectively) than in OGIB cases (22% and 85%). In the subset of patients undergoing CE (n = 17), only triphasic CT enterography identified 2 of 3 bleeding sources. Triphasic CT enterography did not identify 6 ulcers, 4 vascular malformations, 2 hemorrhoids, a duodenal mass, and a bleeding colonic diverticulum. The missed findings at triphasic CT enterography were attributed to being CT occult (n = 9), perception errors (n = 4), and technical errors (n = 1). If perception errors are excluded, the sensitivity of triphasic CT enterography increases to 52% (11/21).	3

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
103. Kim JW, Shin SS, Yoon W, et al. Diagnosis of acute gastrointestinal bleeding: comparison of the arterial, the portal, and the combined set using 64-section computed tomography. <i>J Comput Assist Tomogr.</i> 2011;35(2):206-211.	Observational-Dx	46 patients	To compare the respective capabilities of the arterial, the portal, and the combined set in the detection and localization of acute GIB with 64-section CT.	For each observer, the Az values were 0.915 and 0.931 for the arterial set, 0.903 and 0.933 for the portal set, and 0.919 and 0.911 for the combined set, respectively. The differences were not statistically significant among the 3 data sets for each observer ($P>0.05$). Both observers correctly detected the bleeding site in 81.3% and 84.4% on the arterial set, in 81.3% and 84.4% on the portal set, and in 84.4% and 84.4% on the combined set, respectively.	2
104. Palma J, Laurent M, Marius M, Olivier M, Frank P. Multidetector computed tomography in acute lower gastrointestinal bleeding. <i>Reports in Medical Imaging.</i> 2010;3:107-113.	Observational-Dx	34 patients	To evaluate MDCT in acute massive lower GIB, with endoscopy and surgery as reference examinations.	Extravasation of the contrast agent was found in 30/34 patients (88%). The bleeding site seen on CT was always the same as on endoscopic or surgical examinations (100%). Sensitivity of MDCT scan was 94%, specificity 100%, PPV 100%, and NPV 50% ($P<0.001$). 12 diverticulum bleedings were seen on MDCT scan compared with 13 (92%) on endoscopic or surgical examinations. Angiodysplasia was overestimated by MDCT scan.	3
105. Gerson LB. Is there a role for angiography in patients with obscure overt bleeding? <i>Am J Gastroenterol.</i> 2012;107(9):1377-1379.	Review/Other-Dx	N/A	To review the role of angiography in OGIB.	A recent randomized controlled trial comparing immediate VCE to angiography demonstrated a superior diagnostic yield for VCE compared with angiography. However, long-term outcomes, including rebleeding, hospitalization rates, and death, did not differ between the 2 cohorts.	4
106. Pai M, Frampton AE, Virk JS, et al. Preoperative superselective mesenteric angiography and methylene blue injection for localization of obscure gastrointestinal bleeding. <i>JAMA Surg.</i> 2013;148(7):665-668.	Review/Other-Dx	4 patients	To describe 4 patients with OGIB who had preoperative localization of small-bowel bleeding sites using superselective mesenteric angiography and intraoperative methylene blue injection.	4 patients had preoperative localization of the bleeding site with superselective mesenteric angiography, which was confirmed by the use of intraoperative methylene blue injection. This novel technique allowed us to identify the abnormal pathology, and, consequently, resection of the implicated segment of small bowel was performed without any postoperative complications. Final histology showed that 2 patients had arteriovenous malformations: 1 had a benign hemangioma of the small bowel, and the other had chronic ischemic ulceration in the ileum.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
107. Gong PY, Li JX, Huang LY, Zhang LM, Xie HZ, Sui YB. Prospective Blinded Comparison of Computed Tomographic Enterography and Small Bowel Endoscopy in Obscure Gastrointestinal Bleeding. <i>Hepatogastroenterology</i> . 2014;61(132):984-988.	Observational-Dx	30 patients	To investigate the value of CT enterography with new techniques, such as multi-planar reformation, curved planar reformation, and blood vessel reformation technique, in evaluation of OGIB by comparing CT enterography and small bowel endoscopy.	Among the 30 patients retrospectively examined by CT enterography and small bowel endoscopy, the clinical diagnostic accuracy of the 2 methods was 70% (21/30) and 80% (24/30), respectively. CT enterography and small bowel endoscopy showed no statistical difference in the diagnosis of OGIB ($P=0.37$).	3
108. Jeon SR, Jin-Oh K, Gun KH, et al. Is there a difference between capsule endoscopy and computed tomography as a first-line study in obscure gastrointestinal bleeding? <i>Turk J Gastroenterol</i> . 2014;25(3):257-263.	Observational-Dx	98 patients, 99 cases	To evaluate the efficacy of CT as a first-line study in OGIB and to determine whether the order of diagnostic methods makes a clinical difference.	Overt OGIB was present in 92% of patients. Mucosal lesions (46%) were the most common diagnoses, while tumors accounted for 7%. The diagnostic yield of CE was significantly higher than that of CT for both groups (CT first group, $P<0.001$; CE first group, $P=0.013$). In the CT first group, the diagnostic yield using both CT and CE (48/75; 64%) was significantly higher than that for CT alone (12/75; 16%, $P=0.005$). In the CE first group, the diagnostic yield with both CT and CE vs CE alone was 70.9% vs 62.5%, respectively, with a significant difference ($P=0.045$).	3
109. He B, Gong S, Hu C, et al. Obscure gastrointestinal bleeding: diagnostic performance of 64-section multiphase CT enterography and CT angiography compared with capsule endoscopy. <i>Br J Radiol</i> . 2014;87(1043):20140229.	Experimental-Dx	127 patients	To compare the diagnostic capabilities between CE and multislice CT enterography in combination with multislice CTA for assessment of OGIB.	Administration of anisodamine markedly increased the satisfaction rate of bowel filling (94.67% vs 28.57%; $P<0.001$) but not the diagnostic yield ($P=0.293$) of multislice CT. Compared with multislice CT, CE showed an improved overall diagnostic yield (68.66% vs 47.56%; $P=0.010$), which was also observed in overt bleeding patients (ie, patients with continued passage of visible blood) (76.19% vs 51.02%; $P=0.013$) and in patients aged <40 years of age (85% vs 51.28%; $P=0.024$). However, CE had similar positive rates to multislice CT ($P>0.05$). Among the 22 cases in whom both examinations were conducted, CE showed no significantly different diagnostic capability compared with multislice CT ($P=0.4597$).	1

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
110. Wang Z, Chen JQ, Liu JL, Qin XG, Huang Y. CT enterography in obscure gastrointestinal bleeding: a systematic review and meta-analysis. <i>J Med Imaging Radiat Oncol.</i> 2013;57(3):263-273.	Meta-analysis	18 studies	To provide a comprehensive and update overview of clinical application of CT enterography in the evaluation of OGIB.	A total of 18 studies (n = 660) reported the yield of CT enterography in evaluating OGIB and the pooled yield was 40% (95% CI: 33%–49%). 7 studies (n = 279) compared the yield of CT enterography with CE. The yield for CT enterography and CE for all findings was 34% and 53%, respectively (IY = -19%, 95% CI = -34% to -4%). When considering the types of identified lesions, the yield was significantly different for vascular and inflammatory lesions but not significantly different for neoplastic or other lesions. 2 studies (n = 63) compared the yield of CT enterography with DBE. The yield for CT enterography and DBE was 38% and 78%, respectively (incremental yield = -40%, 95% CI = -55% to -25%). 3 studies (n = 49) compared the yield of CT enterography with DSA. The yield for CT enterography and DSA was 64% and 60%, respectively (incremental yield = 4%, 95% CI = -40% to 47%).	M
111. Yen HH, Chen YY, Yang CW, Liu CK, Soon MS. Clinical impact of multidetector computed tomography before double-balloon enteroscopy for obscure gastrointestinal bleeding. <i>World J Gastroenterol.</i> 2012;18(7):692-697.	Observational-Dx	31 patients	To evaluate the clinical impact of MDCT before DBE for patients with OGIB.	From April 2004 to April 2010, a total of 75 patients underwent DBE for overt OGIB. 31 cases received MDCT followed by DBE for OGIB. The overall diagnostic yields of DBE and MDCT was 93.5% and 45.2%. The MDCT had a high diagnostic yield of tumor vs nontumor etiology of OGIB (85.7% vs 33.3%, $P=0.014$). Additionally, the choice of initial route of DBE was correct in those with a positive MDCT vs negative MDCT (100% vs 52.9%, $P=0.003$).	3
112. Abdel Samie A, Theilmann L. Detection and management of spontaneous intramural small bowel hematoma secondary to anticoagulant therapy. <i>Expert Rev Gastroenterol Hepatol.</i> 2012;6(5):553-558; quiz 559.	Review/Other-Dx	N/A	To review the detection and management of spontaneous intramural small bowel hematoma.	Diagnosis can be readily identified with sonography and confirmed with CT. Early diagnosis is crucial as most patients can be treated successfully without surgery. Conservative treatment is recommended for intramural intestinal hematomas, when other associated complications needing laparotomy have been excluded.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
113. Agrawal JR, Travis AC, Mortelet KJ, et al. Diagnostic yield of dual-phase computed tomography enterography in patients with obscure gastrointestinal bleeding and a non-diagnostic capsule endoscopy. <i>J Gastroenterol Hepatol.</i> 2012;27(4):751-759.	Observational-Dx	52 patients	To determine the diagnostic yield of dual-phase CT enterography in patients with OGIB and a nondiagnostic CE.	CE was performed in 52 patients; 26 patients (50%) had occult GIB and 26 patients (50%) had overt GIB. CT enterography was then performed in 25 of the 48 patients without a definitive source of bleeding seen on CE. The diagnostic yield of CT enterography was 0% (0/11) in patients with occult bleeding vs 50% (7/14) in patients with overt bleeding ($P<0.01$). Using clinical follow up as the gold standard, for the 25 patients with a nondiagnostic capsule, CT enterography had a sensitivity of 33% (95% CI, 0.15, 0.56) and a specificity of 75% (95% CI, 0.22, 0.99).	2
114. Heo HM, Park CH, Lim JS, et al. The role of capsule endoscopy after negative CT enterography in patients with obscure gastrointestinal bleeding. <i>Eur Radiol.</i> 2012;22(6):1159-1166.	Observational-Dx	30 patients	To evaluate the role of CE in patients with OGIB after negative CT enterography.	Based on CE results, a definitive diagnosis was made for 17 patients (57%): ulcer in 9 patients (30%), active bleeding with no identifiable cause in 5 (17%), angiodysplasia in 2 (7%) and Dieulafoy's lesion in 1 (3%). 2 patients with jejunal ulcers were diagnosed with Crohn's disease. 7 patients (41%) with positive CE received double balloon enteroscopy and 2 patients (12%) received steroid treatment for Crohn's disease. Patients with overt bleeding, a previous history of bleeding, or who received large amounts of blood transfusions were more likely to show positive CE.	3
115. Alavi A, Dann RW, Baum S, Biery DN. Scintigraphic detection of acute gastrointestinal bleeding. <i>Radiology.</i> 1977;124(3):753-756.	Review/Other-Dx	21 dogs	To determine the rate of acute GIB which could be detected using Tc-99m sulfur colloid in an animal model of GIB.	In induced bleeding experiments in dogs Tc-99m sulfur colloid was a suitable agent for detecting the bleeding site in the small intestine. Bleeding sites were detectable at rates as low as 0.1mL/min. When induced in the sigmoid or descending colon, the site was demonstrated on scintigraphy with Tc-99m sulfur colloid.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
116. Bunker SR, Lull RJ, Tanasescu DE, et al. Scintigraphy of gastrointestinal hemorrhage: superiority of 99mTc red blood cells over 99mTc sulfur colloid. <i>AJR Am J Roentgenol.</i> 1984;143(3):543-548.	Observational-Dx	100 patients	Multicenter study. Prospective evaluation of Tc-99m sulfur colloid and in vitro-labeled Tc-99m RBC in localization GI hemorrhage.	38 true positive scintigrams were obtained with Tc-99m RBC, whereas, Tc-99m sulfur colloid detected only 5-sites of hemorrhage. Scintigraphic findings were corroborated by clinical, endoscopic, arteriographic and surgical findings. Tc-99m RBC was superior, with sensitivity 93%, specificity 95% and overall accuracy 95% in detecting and localizing GI hemorrhage. The anatomic distribution of true positive scintigraphic findings showed a predominance of ascending colonic and rectosigmoid sites of hemorrhage.	3
117. Bentley DE, Richardson JD. The role of tagged red blood cell imaging in the localization of gastrointestinal bleeding. <i>Arch Surg.</i> 1991;126(7):821-824.	Observational-Dx	162 patients	Retrospectively review records of patients with Tc-99m-tagged RBC scans for localization GI hemorrhage.	Tagged scans accurately localized site of bleeding in 52% of cases. Arteriography diagnostic in 14/26 (54%) with positive scans. 5/9 (56%) patients with negative scans had positive angiogram. Positive RBC scans no more likely than negative scan to yield positive angiogram.	4
118. Winzelberg GG, McKusick KA, Froelich JW, Callahan RJ, Strauss HW. Detection of gastrointestinal bleeding with 99mTc-labeled red blood cells. <i>Semin Nucl Med.</i> 1982;12(2):139-146.	Observational-Dx	100 patients	Comparative study to determine the efficacy of Tc-99m RBC for detection of recurrent or active GI hemorrhage. Scintiscans were compared to angiography, endoscopy, and contrast radiography and at surgery.	Of 62 patients with melena or bright red blood per rectum, 62 had positive scintiscans. In comparison with results of angiography, endoscopy, surgery and contrast radiography, scintigraphy correctly identified the site of bleeding in 83%. 85% of scans were positive at 1-hour or greater after onset of imaging and would therefore, not have been detected with Tc-99m sulfur colloid. The Tc-99m RBC scintiscan was more sensitive than angiography in identifying the site of bleeding.	3
119. Robinson P. The role of nuclear medicine in acute gastrointestinal bleeding. <i>Nucl Med Commun.</i> 1993;14(10):849-855.	Review/Other-Dx	N/A	To define the current role and limitations of nuclear medicine in the evaluation of acute GIB.	Endoscopy will localize most bleeding sites. Radionuclide methods using transient labeling of blood (eg, Tc-99m sulfur colloid) and techniques using stable blood pool labeling (eg, Tc-99m labeled) RBC are preferred agents. Most useful application of radionuclide studies is in patients with recurrent or prolonged bleeding, those with inconclusive endoscopic or barium studies and those who are high-risk surgical candidates.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
120. Rebibo L, Fuks D, Blot C, et al. Gastrointestinal bleeding complication of gastric fistula after sleeve gastrectomy: consider pseudoaneurysms. <i>Surg Endosc</i> . 2013;27(8):2849-2855.	Review/Other-Dx	40 patients	To describe our experience of GIB of gastric fistula after sleeve gastrectomy, and suggest a procedure for the standardized management of this life-threatening complication.	40 patients were treated for post- longitudinal sleeve gastrectomy gastric fistula in our institution, 18 of whom (45%) had been referred by tertiary centers. 4 patients presented UGIB (10%): 2 had undergone primary longitudinal sleeve gastrectomy, 1 had undergone simultaneous gastric band removal and longitudinal sleeve gastrectomy, and 1 had undergone repeat longitudinal sleeve gastrectomy. The median time interval between gastric fistula and UGIB was 15 days. The 4 cases of UGIB included 3 pseudoaneurysms (75%, with 2 affecting the left gastric artery and 1 affecting the upper pole of the splenic artery) and 1 case of bleeding related to stent-induced gastric ulceration. CT enabled diagnosis of the pseudoaneurysm in all cases. 2 of the 4 patients (50%) were treated with selective embolization during arteriography, and 2 (50%) were treated surgically with arterial ligation. One of the surgically treated patients died during follow-up.	4
121. Zhou CG, Shi HB, Liu S, et al. Transarterial embolization for massive gastrointestinal hemorrhage following abdominal surgery. <i>World J Gastroenterol</i> . 2013;19(40):6869-6875.	Review/Other-Tx	26 patients	To evaluate the clinical results of angiography and embolization for massive GI hemorrhage after abdominal surgery.	Angiography showed that a discrete bleeding focus was detected in 21 (81%) of 26 patients. Positive angiographic findings included extravasations of contrast medium (n = 9), pseudoaneurysms (n = 9), and fusiform aneurysms (n = 3). Transarterial embolization was technically successful in 21 (95%) of 22 patients. Clinical success was achieved in 18 (82%) of 22 patients. No postembolization complications were observed. 3 patients died of rebleeding.	4
122. Johnson JO. Diagnosis of acute gastrointestinal hemorrhage and acute mesenteric ischemia in the era of multi-detector row CT. <i>Radiol Clin North Am</i> . 2012;50(1):173-182.	Review/Other-Dx	N/A	To discuss GI hemorrhage and mesenteric ischemia in the light of current available diagnosing modalities, such as MDCT.	No results stated in abstract.	4

**Nonvariceal Upper Gastrointestinal Bleeding
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
123. Wu CH, Wang LJ, Wong YC, et al. Contrast-enhanced multiphase computed tomography for identifying life-threatening mesenteric hemorrhage and transmural bowel injuries. <i>J Trauma</i> . 2011;71(3):543-548.	Observational-Dx	106 patients	To investigate whether findings on multiphase CT can identify life-threatening mesenteric hemorrhage and bowel injuries. IV contrast used in CT.	Mesenteric contrast extravasation had 73.5 positive likelihood ratio and 75% sensitivity for active mesenteric hemorrhage. Hemorrhage first appeared at arterial phase and portal phase was active and life threatening, different from a contained hemorrhage appeared only at equilibrium phase. For transmural bowel injuries, positive likelihood ratio of full-thickness bowel wall abnormality and extraluminal air was large at 32.5 and 26.9, respectively. However, increased mesenteric fat density and peritoneal fluid had high NPV at 98.9 and 97.8. Mean radiodensity of peritoneal fluid in transmural bowel injuries was significantly lower (30 vs 44 Hounsfield unit, $P=0.008$).	2
124. Steiner K, Gollub F, Stuart S, Papadopoulou A, Woodward N. Acute gastrointestinal bleeding: CT angiography with multi-planar reformatting. <i>Abdom Imaging</i> . 2011;36(2):115-125.	Review/Other-Dx	N/A	To present cases that demonstrate that a meticulous and systematic approach to image interpretation is necessary, in particular, to detect focal sites of contrast extravasation and small pseudoaneurysms.	No results stated in abstract.	4
125. Mathias J, Mathias E, Jausset F, et al. Aorto-enteric fistulas: a physiopathological approach and computed tomography diagnosis. <i>Diagn Interv Imaging</i> . 2012;93(11):840-851.	Review/Other-Dx	N/A	To review a physiopathological approach and CT diagnosis of aorto-enteric fistulas.	A CT scan is the examination of choice, the criteria providing evidence of a fistula being the presence of gaseous images in a periprosthetic fluid collection, thickening and/or retraction of the intestinal walls in contact, the existence of a false aneurysm, and finally, very rarely, extravasation of contrast agent into the intestinal lumen.	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

CE = Capsule endoscopy

CI = Confidence interval

CT = Computed tomography

CTA = Computed tomography angiography

DBE = Double-balloon endoscopy

DSA = Digital subtraction angiography

EGD = Esophagogastroduodenoscopy

GIB = Gastrointestinal bleeding

GIST = Gastrointestinal stromal tumor

ICU = Intensive care unit

IV = Intravenous

MDCT = Multidetector computed tomography

MR = Magnetic resonance

NPV = Negative predictive value

OGIB = Obscure gastrointestinal bleeding

OR = Odds ratio

PPV = Positive predictive value

RBC = Red blood cells

TAE = Transcatheter arterial embolization

UGIB = Upper gastrointestinal bleeding

US = Ultrasound

VCE = Video capsule endoscopy