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Review Article

Role of surgery in gastrointestinal bleeding

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ABSTRACT

With the help of the evolution of endoscopic and angiographic intervention, nonsurgical techniques became the procedures of choice for the diagnosis and treatment of gastrointestinal (GI) bleeding and role of surgery have been decreased. However, surgical operations are still necessary for controlling bleeding lesions when these maneuvers fail and conventional operations continue to be life-saving in many instances. Laparoscopic surgeries have an advantage of less postoperative pain and wound problem, quicker recovery, and shorter hospital stay and been widely used for GI bleeding. An elective laparoscopic resection of the intestine for appropriate indications may be an ideal application of this technique, while emergent use should be tempered by skillful surgeons because most patients are relatively unstable and time-limited. Newly developed technologies will continue to facilitate collaboration and cooperation between gastroenterologists, radiologists, and surgeons by encouraging working in multispecialty teams. This review will address the surgical approach associated with various treatments for GI bleeding according to many kinds of GI bleeding diseases.

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Keyword: Gastrointestinal hemorrhage

Introduction

As a result of a series of technologic developments, the role of surgery for gastrointestinal (GI) bleeding has been gradually replaced by non-operative methods. The revolutions of esophagogastroduodenoscopy (EGD) and colonoscopy have enabled the effective hemostasis of bleeding from the stomach or colon at the same time as diagnosing a bleeding focus. In addition, angiography, together with the transcatheter delivery of vasoactive drugs or embolic materials, has significantly reduced the need for surgery of GI bleeding. Nevertheless, with the development of laparoscopic techniques, surgery remains an important modality to treat many bleeding lesions of the GI tract in patients who are high-risk for GI bleeding, such as the elderly, males, users of alcohol, tobacco, aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), and anticoagulants. Also, morbidity and mortality increase significantly in patients who lost more than 6 units of blood or elderly patients with major comorbid diseases. These patients can be a candidate for early surgical intervention.

Upper Gastrointestinal Bleeding

The causes of upper GI bleeding are best categorized as either

non-variceal sources or bleeding related to portal hypertension that arises from a source proximal to the ligament of Treitz. There are various surgical approaches according to each cause (Table 1). In such cases, EGD is indicated. The non-variceal causes account for approximately 80% of upper GI bleeding, with peptic ulcer disease being the most common.¹ Because variceal bleeding increases morbidity and mortality rates, patients with cirrhosis should generally be assumed to have variceal bleeding and appropriate therapy should be initiated immediately. The best tool for the localization of the bleeding source is EGD, but in 1% to 2% of patients, the source cannot be detected because of excessive blood in the lumen of stomach or duodenum.² In this situation, an aggressive lavage of the stomach with normal saline solution can be helpful.³ If an endoscopy is not available or is unrevealing, an angiography may be appropriate for stable patients.

Non-variceal bleeding

Peptic ulcer disease

Peptic ulcer disease remains the most common cause of upper GI bleeding, accounting for approximately 40% of all cases.⁴ Bleeding is the most frequent indication for operation and the principal cause for death in peptic ulcer disease.⁵ The recent de-

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Table 1 Causes and Surgical Managements of Upper Gastrointestinal Bleeding

Cause	Surgery
Non-variceal bleeding	
Gastric ulcers	Suture ligation and gastrectomy
Duodenal ulcers	Suture ligation and antrectomy with truncal vagotomy
Mallory-Weiss tears	Gastrotomy and oversewing of mucosa
Stress gastritis	Vagotomy with oversewing
Esophageal ulcers and erosions	Esophagotomy, oversewing, and anti-reflux procedure
Dieulafoy lesion	Laparoscopic ligation or gastric wedge resection
Angiodysplasia	Antrectomy
Malignancy	Distal or total gastrectomy
Aortoenteric fistula	Fistula closure and extra-anatomic bypass
Portal hypertensive bleeding	
Hypertensive portal gastropathy	Selective splenorenal shunt

crease of incidence and related complications of ulcer has been attributed to the advancement of medical therapy, including proton pump inhibitors and regimens for eradication of *Helicobacter pylori*. Massive bleeding can occur when duodenal or gastric ulcers penetrate into branches of the gastroduodenal artery or left gastric arteries, respectively.

Despite significant advances in endoscopic therapy, approximately 10% of patients with bleeding ulcers still require surgical intervention for effective hemostasis.⁵ To determine the appropriate timing of surgery, the presence of shock and a low hemoglobin level at presentation should be checked. Ulcers larger than 2 cm and located in the posterior duodenum have a significantly higher risk of re-bleeding.^{6,7} Patients with these ulcers need more intensive monitoring and earlier surgical intervention. Indications for surgery have traditionally been based on blood transfusion requiring more than 6 units. Current indications of surgery for peptic ulcer hemorrhages are failure of endoscopic hemostasis, recurrent hemorrhages after initial stabilization, shock, and continued slow bleeding with a transfusion requirement exceeding 3 units/day.

Duodenal ulcer: The first step in the operative management for a duodenal ulcer is exposure of the bleeding site. Because most of these lesions are in the duodenal bulb, longitudinal duodenotomy or duodenopyloromyotomy is performed. When ulcers are positioned anteriorly, four-quadrant suture ligation with non-absorbable thread usually suffices. A posterior ulcer eroding into the pancreaticoduodenal or gastroduodenal artery may require suture ligation of the vessel proximal and distal to the ulcer as well as placement of a U-stitch underneath the ulcer to control the pancreatic branches. The choice between various operations has been based on the hemodynamic condition of the patient and whether there is a long-standing history of refractory ulcer disease. Because the pylorus is often opened in a longitudinal fashion to control the bleeding, closure as a pyloroplasty is combined with a truncal vagotomy is the most frequently used operation for bleeding duodenal ulcers to reduce acid secretion. In a patient who has a known history of refractory duodenal ulcer disease or who has failed to respond to more conservative surgery, an antrectomy with a truncal vagotomy may be more appropriate.

However, this procedure is more complex and should be undertaken rarely in a hemodynamically unstable patient.

Gastric ulcer: Although the immediate control of bleeding may initially require gastrotomy and suture ligation, these alone are associated with a high risk of re-bleeding in almost 30% of cases. Because of a 10% incidence of malignancy, gastric ulcer resection is generally suggested if feasible. Simple excision alone is associated with re-bleeding in as many as 20% of patients, so gastrectomy is generally preferred.

Mallory-Weiss tears

Accounting for approximately 5% to 15% of acute upper GI bleeding, Mallory-Weiss tears are related to forceful vomiting, retching, coughing, or straining following binge drinking.⁸ Most tears occur along the lesser curvature and less commonly on the greater curve of the stomach. Supportive therapy is often all that is necessary because 90% of bleeding episodes are self-limited, and the mucosa often heals within 72 hours. In rare cases of severe ongoing bleeding, failed endoscopic treatments or failed angiographic hemostases, high gastrotomies and direct oversewing of the mucosal tear are recommended.

Stress gastritis

Stress-related gastritis is characterized by the appearance of multiple superficial erosions of the entire stomach as severe or life-threatening bleeding.⁹ When stress ulceration is associated with major burns, these lesions are referred to as Curling ulcers. In contrast to NSAID-associated lesions, significant hemorrhage from stress ulceration is common phenomenon. In those who develop significant bleeding, acid suppressive therapy is often successful in controlling the hemorrhage. In rare cases of failing endoscopic or angiographic treatment, surgery should be considered. Surgical choices include vagotomy and pyloroplasty with oversewing of the hemorrhage site or a near-total gastrectomy.^{10,11}

Esophageal ulcers and erosions

The esophagus is an infrequent source of significant hemorrhages. Most esophageal ulcers result from Barrett's metaplastic epithelium. The superficial mucosal ulcerations generally do not bleed acutely and manifest as anemia or guaiac-positive stools. With infection, hemorrhage can occasionally be massive. Treatment typically includes acid suppressive therapy and endoscopic control. In the rare circumstance bleeding requires surgical intervention, an esophagotomy and over-sewing of the bleeding site is performed. This surgery should be accompanied by an anti-reflux procedure, such as a Nissen fundoplication, to reinforce the esophagotomy closure and to prevent further reflux injury.¹²

Dieulafoy lesion

Dieulafoy lesions are vascular malformations of the proximal gastric corpus. An abnormally large submucosal artery (1–3 mm) is typically found within 6 cm of the gastroesophageal junction on the lesser curvature of the stomach.¹³ Initial attempts at endoscopic control are often successful. In cases of failed endoscopic or angiographic therapy, a gastrotomy and oversewing of the bleeding site may be necessary. In a case in which the bleeding point is not identified, a partial gastrectomy may be necessary.¹⁴ With endoscopic guidance, laparoscopic ligation of the feeding vessel and laparoscopic gastric wedge resection have been successfully accomplished.^{15–18}

Angiodysplasia (gastric antral vascular ectasia, GAVE)

Gastric antral vascular ectasia is characterized by a collection

of dilated venules appearing as linear red streaks converging on the antrum in a longitudinal fashion, giving it the appearance of a watermelon. Intermittent non-exsanguinating bleeding is the rule and occult blood loss is typically present between episodes of overt bleeding. Endoscopic therapy with argon plasma coagulation was suggested for persistent, transfusion-dependent bleeding and has been reportedly successful in up to 90% of patients. Patients failing to respond to endoscopic therapy should be considered for an antrectomy.

Malignancy

Anemia related to gastric malignancy is common, but gross hemorrhages are unusual. Although endoscopic therapy is often successful in controlling these bleeding points, the re-bleeding rate is high. Therefore, when a malignant neoplasm accompanied with bleeding is diagnosed, surgical resection is recommended. The combination of an upper GI endoscopy and a laparoscopic wedge resection has been used to treat bleeding gastric polyps as well as benign or malignant stromal tumors.^{19–21} A standard cancer operation is performed whenever a cure appears possible, depending on the hemodynamic stability of the patient. Gastric malignancies generally require a distal or total gastrectomy, whereas esophageal cancers require a partial or total esophagectomy. Duodenal cancers often require pancreaticoduodenectomy.¹² For certain cases, laparoscopic distal gastrectomy might be applied.²²

Aortoenteric fistula

Primary aortoenteric fistulas are rare lesions and likely to be fatal as they indicate a rupture of the aorta to the bowel. Most aortoenteric fistulas develop after abdominal aortic aneurysm repair and involve the proximal anastomotic suture line of an aortic prosthetic graft and the distal duodenum.²³ There is generally an underlying graft infection with pseudoaneurysm formation and subsequent fistulization occurs through the adjacent duodenal wall.²⁴ Hemorrhages are often massive, recurrent and fatal unless immediate surgical intervention is undertaken. An emergency laparotomy should be performed if the diagnosis is considered by the urgent upper endoscopy. Operative management should include ligation of the aorta proximal to the graft, removal of the infected prosthesis, closure of the duodenal fistula, and an extra-anatomic bypass to revascularize the lower extremities.^{23,24}

Bleeding related to portal hypertension

Serious hemorrhages related to portal hypertension are most commonly the result of bleeding from varices. Although these varices are most commonly seen in the distal esophagus, they may also develop in the stomach (snakeskin-like appearance with cherry-red spots) and the hemorrhoidal plexus of the rectum. Gastrogastroesophageal varices develop in approximately 30% of patients with cirrhosis and portal hypertension, and 30% of this group experience variceal bleeding.¹⁰ Compared with non-variceal bleeding, variceal hemorrhages are associated with an increased risk of re-bleeding, need for transfusions and mortality. The hepatic functional reserve, estimated by Child's criteria, correlates closely, with outcomes in these patients.²⁵

Management

Treatment of variceal bleeding focuses on two aspects of care: controlling the acute hemorrhage and reducing the risk of re-bleeding. Fluid resuscitation in patients with cirrhosis requires a delicate balance. Coagulopathy is common and should be aggressively corrected. A significant percentage of patients with variceal

bleeding have underlying sepsis that may be associated with an aggravation of portal hypertension and leads to variceal bleeding. Studies have demonstrated that a seven day empirical course of a broad-spectrum antibiotic will lower the risk of re-bleeding.²⁶

With regard to management, pharmacologic management with somatostatin or terlipressin, endoscopic management, and others, including using a Sengstaken-Blakemore tube or a transjugular intrahepatic portosystemic shunt (TIPS) play a major role.

Prevention of re-bleeding: The risk of re-bleeding is highest in the initial few hours to days after the first episode. Medical therapy, including a nonselective beta blocker and an antiulcer agent are combined with endoscopic band ligation, is repeated every 10 to 14 days until all varices have been eradicated.²⁷ In non-compliant or intolerable patients, elective portal decompression should be considered between TIPSS and operative decompression in a stable patient depends residual liver function. In general, patients with poor liver reserves who are on the liver transplant list should be considered for TIPSS. In those with good liver function, surgical decompression, such as with a selective distal splenorenal shunt, is preferred because of lower hepatic encephalopathy than TIPSS.

Lower Gastrointestinal Bleeding

Lower GI bleeding occurs less frequently, than upper GI bleeding,²⁸ but it is slowly increasing by 20% between 1998 and 2006. The mortality rate of lower GI bleeding is at around 30%, but this rate increases with age to more than 50% in those 85 years or older. The clinical presentation of lower GI bleeding ranges from severe hemorrhaging in conjunction with diverticular disease or vascular lesions to a minor inconvenience secondary to anal fissure or hemorrhoids.²⁹

Diagnosis

The difficulty in diagnosis stems from the often intermittent nature and spontaneous healing of the bleeding and up to 25% of people with lower GI hemorrhage, the bleeding source is never accurately identified. A colonoscopy is the method of choice because it allows for both the visualization of the pathological process and the therapeutic intervention in colonic, rectal, and distal ileal sources of bleeding. In addition, radionuclide scanning with technetium Tc-99m, computed tomography (CT) or the conventional angiography can be helpful.^{30–34}

Surgical intervention

Regardless of which non-operative diagnostic and therapeutic methods are chosen, a subset of patients requires urgent operative intervention. The criteria of operation are similar to those with upper GI hemorrhages, although there is a stronger tendency for delay until the site is clearly localized (Table 2). In these patients, a full exploratory laparotomy is mandatory with thorough examination of the entire GI tract. If blood is present only in the large intestine of a patient with hemodynamically significant ongoing bleeding, the patient likely has a competent ileocecal valve, and the source of bleeding is almost certainly within the large intestine. After this visualization, the entire GI tract should be carefully inspected and palpated, beginning proximally at the ligament of Treitz, to search for bleeding sources, such as small or large bowel tumors, Meckel's or other bowel diverticula.

A segmental bowel resection that includes the offending lesion, followed by a primary anastomosis is usually safe and ap-

Table 2 Causes and Surgical Managements of Lower Gastrointestinal Bleeding

Cause	Surgery
Diverticulitis	Segmental resection
Angiodysplasia	Right colectomy
Neoplasia	Segmental resection
Hemorrhoids	Hemorrhoidectomy
Fistula in ano	Fistulotomy or fistulectomy
Anal fissure	Lateral sphincterotomy
Ischemic colitis	Segmental resection with or without end ostomy

appropriate in the most stable patients. Although the short-term and long-term morbidities of the operation are significant, the re-bleeding rate is less than 10%, and most patients eventually achieve acceptable postoperative bowel function.^{35,36}

Laparoscopic surgeries have also been widely used for lower GI bleeding.³⁷⁻³⁹ Although an elective laparoscopic resection of the intestine for appropriate indications may be an ideal application of this technique, emergent use should be tempered by skillful surgeons because most patients are relatively unstable and time-limited.

One additional option is an emergency laparotomy with an intraoperative colonoscopy to identify the bleeding site, followed by a segmental colectomy.⁴⁰ This approach may be effective and safe when performed by a team consisting of an experienced surgeon and a skilled endoscopist. A segmental bowel resection that includes the offending lesion, followed by a primary anastomosis, is usually safe and appropriate for all patients.

Diverticular disease

In the United States, diverticula are the most common cause of significant lower GI bleeding. Bleeding from diverticula is a relatively rare event affecting only 3% to 15% of patients with diverticulosis.⁴¹

The best method of diagnosis and treatment is a colonoscopy, which can identify and inject epinephrine, using electrocautery and endoscopic clips to control bleeding. Another option includes using an angiography with embolization.⁴² When bleeding continues unabated and is not amenable to endoscopic or angiographic therapy, a colonic resection is recommended. In stable patients, the operation consists of a segmental resection and anastomosis. Fecal diversion with the creation of an ileostomy or colostomy is safer for an unstable patient or one with risky comorbid illness.

Angiodysplasia

Angiodysplasia is thought to be degenerative lesions acquired from dilated normal vessels and is associated with aortic stenosis and renal failure, especially in patients older than 50 years. Bleeding occurs primarily distal ileum, cecum, and ascending colon.⁴³ Endoscopic therapy may include sclerotherapy or electrocautery. Acutely bleeding patients have been successfully treated with intra-arterial vasopressin, and selective gel-foam embolization via angiography.

Operative management is usually reserved for patients with continued bleeding, anemia, repetitive transfusion requirements, and failure of endoscopic management and angiographic intervention. In the absence of preoperative localization, an intraop-

erative endoscopy should be strongly considered, and a segmental resection, most commonly a right colectomy should be performed.⁴⁴

Neoplasia

Colon and rectal tumors account for approximately 5% to 10% of all hospitalization for lower GI bleeding. Major or massive bleeding is rarely due to a colorectal neoplasm, whereas chronic intermittent and painless hemorrhaging is common. Juvenile polyp and GI stromal tumors (GISTs) are not uncommon in lower GI bleeding. The left sided colon cancer and rectal cancer may often be confused with hemorrhoidal bleeding.

Anorectal disease

There are various causes of lower GI bleeding, such as hemorrhoids, anal fissures, and colorectal neoplasia. In general, bright red blood visible on toilet tissue or the surface of the stool is indications of lower GI bleeding. In younger patients, a hemorrhoidectomy may be needed after a sigmoidoscopy.¹² Anal fissure and internal hemorrhoids should be treated with medication and used by numerous office-based intervention, including rubber band ligation, injectable sclerosing agents, and infrared coagulation. If these measures fail, a lateral sphincterotomy will be required.

Colitis

Colitis is caused by various disease processes such as inflammatory bowel disease, infectious colitis, and radiation proctitis. Ulcerative colitis may present with massive bleeding accompanied with crampy abdominal pain and tenesmus. Surgical treatment is rarely indicated in acute setting except a toxic megacolon forms or hemorrhages that are refractory to steroid medication, such as 5-aminosalicylic acid, and immunomodulatory agents. Surgical treatment must be chosen as a last resort because of possible a relapsing and remitting. Infectious colitis and radiation proctitis can usually be controlled through medications and supportive care except when massive bleeding is present.

Mesenteric ischemia

Ischemic colitis may be related with cardiovascular disease, recent abdominal surgery, hypercoagulable states, inotropic medications, and vasculitis. It can cause abdominal pain and bloody diarrhea. About 15% of patients with ischemic colitis require surgical intervention because of progressive ischemia and sepsis. During the surgery, resection of the ischemic intestine and creation of an end ostomy are required.⁴⁵

Obscure Gastrointestinal Bleeding

Obscure GI bleeding is defined as intermittent bleeding for which no source has been determined despite rigorous endoscopic and radiologic investigation.¹² More than 5% of patients with GI bleeding have obscure GI bleeding, and it is characterized by iron deficiency anemia or guaiac-positive stools without visible bleeding.

In a sample of 200 patients with obscure bleeding, the small bowel was identified as the source of bleeding in more than 60% of cases. In these patients, the most common cause was small bowel ulcers and erosions secondary to Crohn's disease, Meckel's diverticulum, or NSAIDs.⁴⁶ When repeated endoscopy fails to

identify an obscure-overt bleeding source, investigation of the small bowel is warranted.

Surgical intervention

Despite various aggressive diagnostic measures, operative exploration is often required in a significant percentage of patients with obscure GI bleeding.^{44,47} Exploratory laparotomies are performed with meticulous examination of the entire GI tract. Trans-illumination of the intestine with a fiber-optic light source in a darkened room may be useful in detecting otherwise occult vascular lesion by passing with the surgeon's assistance through the small intestine or stoma. Any suspicious areas are marked for possible resection or are dealt with endoscopically if feasible. In most cases of obscure GI bleeding, resection of the segment of the small intestine or colon containing the reluctant lesion is curative.⁴⁸ In conclusion, if the above-mentioned techniques are unsuccessful in defining the bleeding lesion, a split ileostomy should be considered. This temporary stoma allows access for an enteroscopic evaluation of the bleeding site postoperatively, facilitating eventual successful management.⁴⁹

Angiodysplasia

Angiodysplasias are a common cause of small intestinal bleeding, accounting for 10% to 20% of cases.⁵⁰ In cases of severe hemorrhages requiring emergent operative intervention, an intraoperative endoscopy may be helpful. These lesions have a high re-bleeding rate, and segmental small bowel resection may be required.

Neoplasia

Small bowel tumors are not common but can be sources of occult or obvious GI bleeding. GISTs have the greatest propensity for bleeding. Treatment involves surgical resection.

Diverticula

Meckel's diverticulum is a true diverticulum in that it contains all layers of the small bowel wall. Bleeding from a Meckel's diverticulum is usually from an ulcerative lesion on the ileal wall opposite the diverticulum, resulting from acid production by ectopic gastric mucosa. Surgical management usually requires a segmental resection to incorporate the opposing ileal mucosa.

Summary

In GI bleeding, advanced diagnostic tools, such as high qualified endoscopy, video capsule endoscopies, CT angiographies, selective visceral arteriographies, and nuclear scintigraphies, have permitted more accurate and targeted operations. Moreover, safe and effective non-operative therapeutic interventions have obviated the need for surgery in many patients. Nowadays, most GI bleeding events are initially managed by endoscopic or angiographic control measures and are often definitive in attaining hemostasis. In spite of the less frequent need for surgical intervention, conventional operations continue to be life-saving in many instances.

The development of laparoscopic surgery has formed the application of minimally invasive techniques to selected patients with GI bleeding. Intraoperative endoscopy has been widely used for the accurate localization of bleeding focuses requiring exci-

sion. It is expected that new developed technologies will continue to facilitate collaboration and cooperation between gastroenterologist, radiologists, and surgeons.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

References

- Enestvedt BK, Gralnek IM, Mattek N, Lieberman DA, Eisen G. An evaluation of endoscopic indications and findings related to nonvariceal upper-GI hemorrhage in a large multicenter consortium. *Gastrointest Endosc.* 2008;67:422-9.
- Cheng CL, Lee CS, Liu NJ, Chen PC, Chiu CT, Wu CS. Overlooked lesions at emergency endoscopy for acute nonvariceal upper gastrointestinal bleeding. *Endoscopy.* 2002;34:527-30.
- Barkun AN, Bardou M, Kuipers EJ, Sung J, Hunt RH, Martel M, et al. International consensus recommendations on the management of patients with nonvariceal upper gastrointestinal bleeding. *Ann Intern Med.* 2010;152:101-13.
- Rockey DC. Gastrointestinal bleeding. *Gastroenterol Clin North Am.* 2005;34:581-8.
- Wang YR, Richter JE, Dempsey DT. Trends and outcomes of hospitalizations for peptic ulcer disease in the United States, 1993 to 2006. *Ann Surg.* 2010;251:51-8.
- Guglielmi A, Ruzzenente A, Sandri M, Kind R, Lombardo F, Rodella L, et al. Risk assessment and prediction of rebleeding in bleeding gastroduodenal ulcer. *Endoscopy.* 2002;34:778-86.
- Chung IK, Kim EJ, Lee MS, Kim HS, Park SH, Lee MH, et al. Endoscopic factors predisposing to rebleeding following endoscopic hemostasis in bleeding peptic ulcers. *Endoscopy.* 2001;33:969-75.
- Sugawa C, Benishek D, Walt AJ. Mallory-Weiss syndrome. A study of 224 patients. *Am J Surg.* 1983;145:30-3.
- Laine L. Upper gastrointestinal tract hemorrhage. *West J Med.* 1991;155:274-9.
- Laine L, Peterson WL. Bleeding peptic ulcer. *N Engl J Med.* 1994;331:717-27.
- Steffes C, Fromm D. The current diagnosis and management of upper gastrointestinal bleeding. *Adv Surg.* 1992;25:331-61.
- Stabile BE, Stamos MJ. Surgical management of gastrointestinal bleeding. *Gastroenterol Clin North Am.* 2000;29:189-222.
- Veldhuyzen van Zanten SJ, Bartelsman JF, Schipper ME, Tytgat GN. Recurrent massive haematemesis from Dieulafoy vascular malformations—a review of 101 cases. *Gut.* 1986;27:213-22.
- Bech-Knudsen F, Toffgaard C. Exulceratio simplex dieulafoy. *Surg Gynecol Obstet.* 1993;176:139-43.
- Bouillot JL, Aubertin JM, Fomes P, Petite JP, Alexandre JH. Dieulafoy's ulcer: combined endoscopic and laparoscopic treatment. *Endoscopy.* 1996;28:394-5.
- Ferzli GS, Ozuner G, Shaps J, Kiel T. Combined use of laparoscopy and endoscopy in diagnosing and treating Dieulafoy's vascular malformations of the stomach. *Surg Endosc.* 1994;8:332-4.
- Karanfilian RG, Yang HK, Gendler S. Resection of Dieulafoy's lesion by a combined endoscopic and laparoscopic approach. *J Laparoendosc Surg.* 1996;6:345-8.
- Mixter CG 3rd, Sullivan CA. Control of proximal gastric bleeding: combined laparoscopic and endoscopic approach. *J Laparoendosc Surg.* 1992;2:105-9.
- Di Lorenzo N, Sica GS, Gaspari AL. Laparoscopic resection of gastric leiomyoblastoma. *Surg Endosc.* 1996;10:662-5.
- Leong HT, Siu WT, Li MK. Gasless laparoscopic excision of bleeding gastric polyp. *J Laparoendosc Surg.* 1996;6:189-91.
- Lukaszczuk JJ, Preletz RJ Jr. Laparoscopic resection of benign stromal tumor of the stomach. *J Laparoendosc Surg.* 1992;2:331-4.
- Ballesta-Lopez C, Bastida-Vila X, Catarci M, Mato R, Ruggiero R. Laparoscopic Billroth II distal subtotal gastrectomy with gastric stump suspension for gastric malignancies. *Am J Surg.* 1996;171:289-92.
- Peck JJ, Eidemiller LR. Aortoenteric fistulas. *Arch Surg.* 1992;127:1191-3.
- Wilson SE, Van Wagenen P, Passaro E Jr. Arterial infection. *Curr Probl Surg.* 1978;15:1-89.
- Jamal MM, Samarasena JB, Hashemzadeh M, Vega KJ. Declining hospitalization rate of esophageal variceal bleeding in the United States. *Clin Gastroenterol Hepatol.* 2008;6:689-95.
- Herrera JL. Management of acute variceal bleeding. *Clin Liver Dis.* 2014;18:347-57.
- de la Peña J, Brullet E, Sanchez-Hernández E, Rivero M, Vergara M, Martin-Lorente JL, et al. Variceal ligation plus nadolol compared with ligation for prophylaxis of variceal rebleeding: a multicenter trial. *Hepatology.* 2005;41:572-8.
- Zhao Y, Encinosa W. Hospitalizations for gastrointestinal bleeding in 1998 and 2006: statistical brief #65. In: Agency for Healthcare Research and Quality, editor. Healthcare Cost and Utilization Project (HCUP) statistical briefs. Rockville, MD: Agency for Health Care Policy and Research; 2006.
- Ghassemi KA, Jensen DM. Lower GI bleeding: epidemiology and management. *Curr Gastroenterol Rep.* 2013;15:333.
- Baum S, Rösch J, Dotter CT, Ring EJ, Athanasoulis C, Waltman AC, et al. Selective

- mesenteric arterial infusions in the management of massive diverticular hemorrhage. *N Engl J Med*. 1973;288:1269-72.
31. Gordon RL, Ahl KL, Kerlan RK, Wilson MW, LaBerge JM, Sandhu JS, et al. Selective arterial embolization for the control of lower gastrointestinal bleeding. *Am J Surg*. 1997;174:24-8.
 32. Ledermann HP, Schoch E, Jost R, Decurtins M, Zollikofer CL. Superselective coil embolization in acute gastrointestinal hemorrhage: personal experience in 10 patients and review of the literature. *J Vasc Interv Radiol*. 1998;9:753-60.
 33. Peck DJ, McLoughlin RF, Hughson MN, Rankin RN. Percutaneous embolotherapy of lower gastrointestinal hemorrhage. *J Vasc Interv Radiol*. 1998;9:747-51.
 34. Rahn NH 3rd, Tishler JM, Han SY, Russinovich NA. Diagnostic and interventional angiography in acute gastrointestinal hemorrhage. *Radiology*. 1982;143:361-6.
 35. DeMarkles MP, Murphy JR. Acute lower gastrointestinal bleeding. *Med Clin North Am*. 1993;77:1085-100.
 36. Drapanas T, Pennington DG, Kappelman M, Lindsey ES. Emergency subtotal colectomy: preferred approach to management of massively bleeding diverticular disease. *Ann Surg*. 1973;177:519-26.
 37. Chung RS. Laparoscopy-assisted jejunal resection for bleeding leiomyoma. *Surg Endosc*. 1998;12:162-3.
 38. Franklin ME Jr, Dorman JP, Jacobs M, Plasencia G. Is laparoscopic surgery applicable to complicated colonic diverticular disease? *Surg Endosc*. 1997;11:1021-5.
 39. Phillips E, Hakim MH, Saxe A. Laparoendoscopy (laparoscopy assisted enteroscopy) and partial resection of small bowel. *Surg Endosc*. 1994;8:686-8.
 40. Bery AR, Campbell WB, Kettlewell MG. Management of major colonic haemorrhage. *Br J Surg*. 1988;75:637-40.
 41. Niikura R, Nagata N, Shimbo T, Aoki T, Yamada A, Hirata Y, et al. Natural history of bleeding risk in colonic diverticulosis patients: a long-term colonoscopy-based cohort study. *Aliment Pharmacol Ther*. 2015;41:888-94.
 42. Lipof T, Sardella WV, Bartus CM, Johnson KH, Vignati PV, Cohen JL. The efficacy and durability of super-selective embolization in the treatment of lower gastrointestinal bleeding. *Dis Colon Rectum*. 2008;51:301-5.
 43. Foucht PG, Rex DK, Lieberman DA. Prevalence and natural history of colonic angiodysplasia among healthy asymptomatic people. *Am J Gastroenterol*. 1995;90:564-7.
 44. Ress AM, Benacci JC, Sarr MG. Efficacy of intraoperative enteroscopy in diagnosis and prevention of recurrent, occult gastrointestinal bleeding. *Am J Surg*. 1992;163:94-8.
 45. Walker AM, Bohn RL, Cali C, Cook SF, Ajene AN, Sands BE. Risk factors for colon ischemia. *Am J Gastroenterol*. 2004;99:1333-7.
 46. Shinozaki S, Yamamoto H, Yano T, Sunada K, Miyata T, Hayashi Y, et al. Long-term outcome of patients with obscure gastrointestinal bleeding investigated by double-balloon endoscopy. *Clin Gastroenterol Hepatol*. 2010;8:151-8.
 47. Desa LA, Ohri SK, Hutton KA, Lee H, Spencer J. Role of intraoperative enteroscopy in obscure gastrointestinal bleeding of small bowel origin. *Br J Surg*. 1991;78:192-5.
 48. Szold A, Katz LB, Lewis BS. Surgical approach to occult gastrointestinal bleeding. *Am J Surg*. 1992;163:90-2.
 49. Irgau I, Reilly PM, Abdel-Misih RZ. Paired temporary loop ileostomies in the localization of small bowel hemorrhage of obscure origin. *Am Surg*. 1995;61:1099-101.
 50. Min YW, Kim JS, Jeon SW, Jeon YT, Im JP, Cheung DY, et al. Long-term outcome of capsule endoscopy in obscure gastrointestinal bleeding: a nationwide analysis. *Endoscopy*. 2014;46:59-65.

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SGI is a unique multidisciplinary society to encourage and facilitate clinical and scientific collaboration

between radiologists, surgeons and gastroenterologists.



Our Goals:

-  **Multi-disciplinary Collaboration to promote world-wide Expertise**
Establish a comprehensive GI intervention network among endoscopists, interventional radiologists and gastrointestinal surgeons for multidisciplinary collaboration and interaction
-  **Sharing and advancing technological Innovations**
Inform, promote and globalize the many outstanding technological innovations of each of the specialties
-  **Foster future Specialists**
Aid young brilliant doctors to make an early debut on the international stage through SGI
-  **Become a Role Model**
Showcasing the benefits of multi-disciplinary collaboration in science, education and clinical practice