The use of flexible endoscopy in the management of gastrointestinal diseases has proliferated in the last three decades. With the technology advancement and development of innovative endoscopic accessories, flexible endoscopy not only plays a significant diagnostic role in most gastrointestinal diseases and offers an effective therapeutic option at the same time. In particular, therapeutic endoscopy now plays an important role in the management of a variety of gastrointestinal diseases such as acute upper gastrointestinal bleeding (variceal and non-variceal), foreign body ingestion, acute cholangitis, acute biliary pancreatitis and distal colonic obstruction. This article aims to highlight the indications and recent advances in therapeutic endoscopy.

Gastrointestinal Bleeding

Peptic Ulcer Bleeding

Eighty percent of ulcer bleeding patients stop spontaneously without intervention. A subgroup of patients who have uncontrolled bleeding or clinical rebleeding requires aggressive intervention. Prior to the development of endoscopic haemostasis, surgery was the only effective means to control bleeding. With the bleeding point being well visualised during the endoscopy, endoscopic haemostasis is feasible and thus avoids laparotomy. Three endoscopic techniques can be used to control acute gastrointestinal bleeding: injection, thermal / laser coagulation, and application of mechanical haemostatic or ligation devices.

1. Endoscopic Injection

Injection is the most simple and safe means to control bleeding. No specialised instrument or endoscope is necessary. Success rates of 80-100% have been reported in uncontrolled and also controlled trials. Agents that have been used include adrenaline1-3 hypertonic saline4, sclerosants such as absolute alcohol5 or pilidocanol 6. These substances are injected directly into the bleeding ulcer area by a flexible injection needle inserted through the biopsy channel of the endoscope. Adrenaline and saline injections control bleeding by local tissue oedema to tamponade the bleeding vessel and the effect is immediate. Vasoconstriction induced by adrenaline is a later effect. Sclerosants induce tissue inflammation and thrombosis. The tissue damage induced may cause perforation and injection of sclerosants requires more attention and post-treatment monitoring.

2. Thermal Methods

Thermal method to coagulate bleeding vessel is by contact probes which compress the bleeding vessel and apply heat energy simultaneously. The most popular contact thermal probes are heater probe system7-8 and the bipolar electrocoagulation (BICAP)9-10. Both have a portable generator with the probe pass through the biopsy channel of the endoscope. They both have a wash channel which allows the lesion to be washed clean prior to coagulation.

Laser light energy is absorbed by the target tissue and changed into heat which coagulates the bleeding vessel. Nd-YAG and Argon lasers11-12 have been used. However the laser unit is bulky, inconvenient, expensive and may cause transmural injury.

3. Mechanical Methods

Arterial clips13 can be applied endoscopically by a spring-loaded system. Since the initial description of endoscopic metallic clips application in 1975, various authors reported the use of endoscopic clips in hemostasis, marking lesions, closure of perforations, fistulas and anastomotic leaks. Hemoclip placement is also effective in offering primary hemostasis and prevent rebleeding in cases with severe bleeding in GI tract. The technique of clip placement could be cumbersome and difficult in some anatomical positions. An endoscopic sewing machine and banding device has been described but has not been used clinically.

There is no doubt that endoscopic haemostasis is the treatment of choice for most patients with bleeding ulcers. Indeed, the value of endoscopic haemostasis has been validated in 2 meta-analysis studies of published control trials14-15. Compared to standard therapy for bleeding peptic ulcers, patients who underwent endoscopic therapy had 69%, 62% and 30% reduction rate in rebleeding, emergency surgery and mortality respectively. In addition, comparison studies on injection therapy, electrocoagulation and heater probe suggested that they are equally effective and safe to control ulcer bleeding.

Dr. Angus CW Chan
MB ChB (Hons), MD (CUHK), FRCS (EDIN), FCSSH, FHKAM (Surgery)
Specialist in General Surgery
Honorary Associate Professor, Department of Surgery, The Chinese University of Hong Kong & University of Hong Kong
Assistant Director of Surgery Centre

Dr. Wing-tai Siu
MB ChB (CUHK), FRCS (EDIN), FRCS Ed (Gen), FCSSH, FHKAM (Surgery)
Specialist in General Surgery
Honorary Consultant, Surgery Centre, Hong Kong Sanatorium & Hospital
Honorary Associate Professor, Department of Surgery, The Chinese University of Hong Kong

Dr. Angus CW Chan
Dr. Wing-tai Siu
However it must be remembered that 80% of ulcers stop bleeding spontaneously. A selective policy should be adopted for endoscopic haemostasis. Active bleeding ulcers (Forrest’s Type I) are no doubt to be treated at the time of endoscopy. In patients with visible vessel (Type IIA) or adherent clots (Type IIB) and associated with haemodynamic instability on admission, we prefer to treat them prophylactically in an attempt to prevent rebleeding. Ulcers with flat pigment spot (Type IIC) or clean ulcers (Type III) should not be treated in view of negligible chance of rebleeding.

The variceal columns at the inferior half of oesophageal wall are first injected so as to prevent blood obscuring the superior wall columns. 2 ml of STD are injected at each puncture site but not exceeding a maximum of 20 ml. Brisk bleeding sometimes results when the needle is withdrawn from the varice. Tamponade of the area by inserting the scope into the stomach can usually control the bleeding. Fever and retrosternal pain are almost universal after sclerotherapy. Oesophageal ulceration is common at the site of injection and results in later stricture formation in some cases. Delayed perforation from excessive injection of sclerosant is rare but frequently fatal.

Band ligation of the oesophageal varices has almost replaced injection sclerotherapy as the treatment of choice for bleeding varices. It has fewer treatment complications, particularly stricture formation. The ligation device comprises an outer “friction-fit” adaptor which fits on the end of the endoscope, an inner cylinder preloaded with an elastic “O” ring and a trip wire for pulling the inner cylinder into the adaptor to release the ring. In the earliest model, an overtube is first inserted to the oesophagus and the device is loaded onto the endoscope. To reduce the complications related to overtube insertion and problem with reloading, multiple bands have been preloaded in a single shooter (4-shooter, 6-shooter, 8-shooter) and is more convenient to the endoscopist to perform the banding. Similar to injection sclerotherapy, banding usually starts at the cardia and working upwards. When a variceal column is chosen, strong suction is activated to draw the varix into the inner cylinder and the band is released by pulling the trip wire. Then the suction is released to allow inspection. The ligation procedure is repeated until all columns are banded. An average of 4 sessions per patient is required for variceal obliteration.

Foreign Body Ingestion

Lodgment of foreign bodies in the upper digestive oesophagus is one of the common complaints for emergency room attendance. In Hong Kong, most of the foreign bodies are fish bones. Young children often swallow a wide variety of objects such as coins and batteries. With the availability of expertise and various endoscopic accessories, great majority of foreign bodies nowadays can be removed with the aid of flexible oesophagoscope without general anaesthesia.

For patients with history of fish bone ingestion, the oropharynx and hypopharynx should be examined before proceeding to oesophagoscopy. Most of these fish bones reside in the vallecula and the piriform fossa. These areas can be viewed with direct laryngoscope (rigid or flexible) and fish bones can be removed accordingly. Patients who complain of retrosternal pain on swallowing are indicated for oesophagoscopy.

The pharynx, hypopharynx and oesophagus are carefully examined for laceration, haematoma and foreign bodies. When a foreign body is found, the accessories should be chosen according to the size and shape of the object. Small fish bones can be grasped with biopsy forceps. Crocodile forceps have a firmer grip and are suitable for larger fish bones or pork bones. Coins are best grasped...
at the edge by the rat tooth forceps. Food boluses are better pushed into the stomach rather than removed. For larger objects such as false dentures that cannot be passed into the over-tube, they are pushed down to the stomach and fragmented into small pieces before removal. Laser is particularly useful in this situation to fragment the hard object\(^\text{17}\). Once the object has passed to the stomach, most of them will be gradually propelled through the rest of the bowel uneventfully and passed out. However, sharp objects such as needle, long sharp fish bone which can perforate the bowel wall and disc batteries which can erode the bowel wall, should be removed from the stomach.

Before attempting to remove large sharp foreign body from the oesophagus, an over-tube should be inserted over the endoscope to protect the oesophagus and pharynx from laceration by sharp pointed objects and prevent dropping the object into the trachea on pulling out the scope. Attempts to remove a sharp object from the oesophagus without protection will result in full thickness perforation in a long segment of oesophagus. The over-tube is pre-loaded onto the endoscope and slide into place after the endoscope is passed into oesophagus. Foreign body lodged at the upper oesophagus may need to be pushed down to the distal oesophagus to allow the passage of the over-tube. After the foreign body is securely grasped into the over-tube, the endoscope and the foreign body together with the over-tube are removed.

Close co-operation between the endoscopist and the assistant is essential during the procedure. A video-monitoring system that allows the assistant to see what he is to catch will be particularly helpful. After the removal of foreign body, a full examination of the oesophagus is essential to exclude malignant stricture at the site of impaction or other mucosal lesion.

**Treatment of Biliary Tract Diseases**

Therapeutic endoscopy is also used in the treatment of numerous pathological conditions of the biliary tree and pancreas.

**Acute Cholangitis**

Patients with bile duct stones often present with acute cholangitis with the classic Charcot’s triad i.e. acute abdominal pain, fever and jaundice. The cholangitis can be due to an isolated obstructed segment within the liver (intrahepatic stones) or more commonly due to the presence of common duct stones. The initial management on admission includes nil by mouth, fluid resuscitation and intravenous antibiotics. The preferred antibiotic regimen consists of a second or third generation cephalosporins and metronidazole to cover the anaerobes. More than 80% of patients respond to the initial treatment and definitive treatment can be scheduled.

The endoscopic management for patients with acute cholangitis should be adjusted according to the clinical condition of the patients. Clinically stable patients with mild attack of cholangitis can be managed successfully with papillotomy and stone extraction at the first session of ERCP. However, urgent intervention is mandatory for patients with confusion and septicemia shock (Reynold’s pentad). These patients have high intrabiliary pressure and require urgent drainage decompression.

In acute phase the aim is to decompress the infected biliary system as soon as possible. The role of endoscopic drainage by naso-biliary drain is now firmly established in various studies\(^{18,19}\). The mortality rate was much reduced compared to emergency exploration. In patients with common ductal stones, a 7-holes naso-biliary catheter is inserted to the intrahepatic duct to provide drainage of the common duct and intrahepatic duct. Turbid bile or pus will drain out once the duct is deep cannulated. In patients with obstructed intrahepatic segment, a 4-holes naso-biliary catheter is preferred which facilitates subsequent check cholangiogram to delineate the obstructed segment. In this situation, the difficulty lies in the localisation of the obstructed segment during ERCP, particularly in those cases with associated biliary stricture that may not appear on the initial cholangiogram. When the bile duct is deep-cannulated, the bile should be aspirated out for examination. Purulent bile may suggest a non-drained obstructed intrahepatic segment. Balloon cholangiogram at the hilar level may be required to show up the segment in some of the cases. Once the segment is identified, the guide-wire is directed to the segment and bile is aspirated for confirmation. Purulent bile indicates the correct segment and a 4-holes naso-biliary catheter is inserted for temporary drainage.

However, it was not uncommon to have the naso-biliary catheter dislodged spontaneously or being pulled out by the confused septic patients. In addition, patients often complained of nasal discomfort and sore throat due to the irritation of the catheter. These problems could be avoidable if an in-dwelling plastic biliary stent is used to provide temporary biliary drainage.

Occasionally, patients with failed cannulation or failure to negotiate the guide-wire into the correct segment due to the angulation or stricture, emergency percutaneous transhepatic drainage (PTBD) under ultrasound...
guidance can be offered. Subsequent stone clearance can be done with the combined endoscopic techniques. With these approaches, emergency surgical exploration is now a rarity.

For patients with malignant obstruction or blocked biliary stents, emergency biliary decompression can be similarly achieved with the change of stent or nasobiliary drain insertion.

Acute Biliary Pancreatitis
Prospective randomised trials have demonstrated the safety and benefit of early ERCP in biliary pancreatitis. Emergency ERCP reduces the morbidity in patients with severe pancreatitis and CBD stones compared to conservative group. The procedure is safe and biliary decompression can be performed with nasobiliary drain or stent extraction after endoscopic papillotomy if the patient's condition allows.

Post-operative Bile Leaks
Temporary decompression of the bile duct with drainage of bile collection is indicated for treatment of persistent bile leakage from slippage of cystic duct stump clip or ligatures, damaged bile ducts and Duct of Luschka after cholecystectomy and hepatectomy. Endoscopic decompression of bile duct by endoscopic papillotomy, naso-biliary catheter or plastic biliary stent can be performed with low morbidity. In general, biliary stenting with plastic endoprosthesis is the preferred method of choice. Stent will be removed after 4-6 weeks when there is no leakage on repeat cholangiogram. However, surgical repair should be offered to patients with major duct injuries that carry a long term morbidity and mortality.

Benign Biliary Stricture
Endoscopic balloon dilatation and stenting can be a safe alternative treatment option for patients with benign biliary strictures as a result of recurrent cholangitis, sclerosing cholangitis, iatrogenic bile duct injury and chronic pancreatitis. Medium and long term success rates of maintaining bile duct patency have been reported in 80% of selected patients although there was no randomised trial to compare surgical bypass.

Malignant Biliary Stricture
Malignant biliary obstruction as a result of inoperable hepatobiliary-pancreatic cancers can be palliated by surgical bypass or endoscopic biliary stenting. Conventional plastic biliary stenting has the advantages of easy insertion, less morbidity and mortality rates compared to surgical bypass operation. However, these patients often require stent replacement at 2-3 month intervals due to stent clogging. Controlled studies have shown stents with larger luminal diameter had longer time of patency and a minimum of 10F size plastic stent should always be used in stenting. Non-covered self-expandable metal stents with larger inner diameter (8-10mm) have been developed to improve patency rate and several different types of metal stents are now commercially available. Randomised studies have demonstrated that metal stents had significantly less stent blockage in mid and distal bile duct obstruction. The probability of stent patency was 78% at 7 months. Stent clogging was still due to tumour ingrowth into the metal mesh and tumour overgrowth below & distal to the stent, which can be re-treated with insertion of second plastic stenting. Newer model of covered metal stent is also being made to reduce tumour ingrowth and its benefit needs to be confirmed on further randomised studies.

Treatment of Polyps and Neoplasia

Polypectomy
Polypectomy can be applied to any part of the alimentary tract, and is commonly performed for colonic polyps. It decreases the development of neoplastic changes in colon from adenoma to adenocarcinoma. Majority of the small polyps can be resected by ordinary or hot biopsy forceps, while stalked polyps are removed by snare with a blended cutting and coagulation current. Bleeding or perforations are potential complications of the procedure.

Mucosectomy and Endoscopic Submucosal Dissection
Endoscopic mucosal resection is an established method for treating intramucosal gastric and oesophageal neoplasms. Conventional endoscopic mucosal resection has predominantly been performed using strip biopsy, or cap method. En bloc resection is often difficult when dealing with lesions > 10 mm using conventional methods. Moreover, specimens resected piecemeal often cannot be used to judge curability.

Endoscopic submucosal dissection has recently been introduced by Japanese endoscopists using new devices such as an insulation-tip diathermic knife. The target lesion is marked by needle knife. Glycerin containing a small amount of indigocarmine dye is injected into the submucosal layer around the lesion to lift and detach the mucosal lesion. After cutting mucosa around the marking spots, the submucosal layer was dissected using the IT-knife, flex knife or hook knife and lesions were able to be completely resected in one piece.

Percutaneous Endoscopic Gastrostomy (PEG) / Jejunostomy
Under gastroscopy guidance, percutaneous endoscopic gastrostomy tube can be placed into the stomach through the abdominal wall. PEG tubes may also be extended into the small bowel. The procedure is primarily indicated as a long-term means of providing nutrition to patients who cannot productively take food orally. PEGs may also be inserted to decompress the stomach in cases of gastric volvulus.
Self-expanding Metallic Stent Placement for Palliation of Upper and Lower Digestive Tracts Malignancies

Oesophageal Stenting
Self-expandable metal stents provide effective palliation of malignant dysphagia and tracheo-oesophageal fistulation. The procedures are associated with few complications and highly preferable for patients with limited life-span. Successful use of self-expandable stents depends on knowledge of the properties of these stents and tumour configurations. Controlled trials are required to compare different stents in difficult tumour configurations to improve the choice of stents in malignant dysphagia.

Gastric Outlet Obstruction
In the past, patients with malignant gastric outlet obstruction due to pancreatic cancer compression or gastric cancer were only amenable to surgical bypass (gastrojejunostomy) in case the tumour was not resectable. This bypass operation required general anaesthesia and often carried a significant morbidity due to poor nutrition reserve of the patients. Metallic stenting across the obstructive antral-duodenal region provides an alternative treatment option that can be done under sedation and thus laparotomy is avoided.

Acute Distal Colonic Obstruction
Recently, expandable metal enteral stent has been used to relieve obstruction caused by recto-sigmoid tumours with success. It offers a palliative option for patients with obstructive rectosigmoid cancers and metastatic diseases. Besides, stent placement can also relieve acute large bowel obstruction and thus avoid emergency surgery. It allows better patient preparation for elective definitive surgery at one setting. Primary anastomosis is thus safer in this situation and defunctioning colostomy can be avoided with better bowel preparation.

This enteral stent has the advantage of being able to be inserted via the operating channel of the endoscope (3.7mm diameter) and is deployed under direct visualisation and with the aid of fluoroscopy. It thus can be passed safely inside the sigmoid colon despite of the looping.

Natural Orifice Transluminal Endoscopic Surgery (NOTES)
This technique uses the flexible endoscope to create a controlled transvisceral incision, usually in the stomach, rectum or vagina, to enter the peritoneal cavity as an alternative to conventional surgery. Reports describing various NOTES procedures have primarily been studied in animal models and the techniques are still experimental at the current stage.

Conclusion
Therapeutic endoscopy has progressed enormously in recent years. Endoscopic procedures are minimally invasive in nature and able to offer new treatment options for patients with various digestive tract pathologies, conventional open surgical procedures are thus avoided.

References


