

Upper GI Endoscopy: A Comprehensive Review of Indications, Procedure, Complications, and Clinical Application

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ABSTRACT

Esophagogastroduodenoscopy, also known as upper GI endoscopy, is a key diagnostic tool that enables the examination of the oesophagus, stomach, and duodenum. This minimally invasive procedure plays an integral role in diagnosing a wide variety of gastrointestinal disorders such as abdominal pain, heartburn, dysphagia, and upper gastrointestinal bleeding. Moreover, it is used to identify conditions such as peptic ulcers, gastritis, oesophagitis, and cancer. Biopsy capabilities further enhance its diagnostic value by aiding in the identification of *Helicobacter pylori* infection, celiac disease, and malignancies. This review aimed to provide a comprehensive overview of endoscopy, discussing its historical development, clinical indications, procedural details, risks, and its role in the early detection and management of gastrointestinal diseases.

Keywords: Upper GI Endoscopy, Indications, Procedure, Complications, Clinical Application

Introduction

Endoscopy, also known as upper gastrointestinal (GI) endoscopy, is a diagnostic procedure that plays a crucial role in the assessment and management of a variety of gastrointestinal disorders. This minimally invasive procedure allows healthcare professionals to visually examine the oesophagus, stomach, and duodenum, providing critical insights into conditions that affect the upper digestive tract. With the advent of modern technology, endoscopy has evolved into a sophisticated tool not only for diagnosing diseases but also for performing therapeutic interventions. From investigating the causes of persistent abdominal pain to detecting cancers, endoscopy remains an essential component of gastroenterological practice [1,2].

The importance of endoscopy in clinical medicine cannot be overstated. For decades, it has been the go-to procedure for investigating a broad spectrum of gastrointestinal complaints, such as heartburn, indigestion, and difficulty swallowing

(dysphagia). Through direct visualization of the mucosa, doctors can identify conditions such as ulcers, gastritis, and esophageal cancer, conditions that could otherwise remain undetected until advanced stages. Moreover, the ability to take biopsies during the procedure allows for the diagnosis of infections, autoimmune diseases, and malignancies, further enhancing the procedure's diagnostic power [3].

Endoscopy also plays a pivotal role in monitoring and managing chronic gastrointestinal diseases. For example, it is used to track the progress of conditions like gastroesophageal reflux disease (GERD), peptic ulcers, and inflammation of the oesophagus (oesophagitis). Additionally, it enables real-time assessment of the efficacy of ongoing treatments and helps guide decision-making for further interventions. In cases of gastrointestinal bleeding, endoscopy offers not only diagnostic insights but also the opportunity to administer life-saving treatments, such as cauterizing bleeding ulcers or banding esophageal varices [4,5].

As technology continues to advance, so too does the scope of endoscopy. Modern endoscopes are equipped with high-

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definition cameras, narrow band imaging, and even therapeutic instruments, allowing for a more detailed examination and treatment during the same procedure. The integration of these tools has significantly improved both the diagnostic accuracy and the therapeutic options available during gastroscopic procedures. Furthermore, innovations in sedation techniques have reduced patient discomfort, making endoscopy an increasingly well-tolerated and safer procedure [3,6,7].

This review paper provides a comprehensive review of endoscopy, focusing on its indications, procedural steps, diagnostic applications, risks, and therapeutic uses. By exploring the evolution of the procedure and its current capabilities, we aimed to highlight the invaluable role of endoscopy in modern medicine. With continued technological advancements and growing clinical experience, endoscopy will undoubtedly remain a cornerstone in the diagnosis and management of gastrointestinal diseases, helping improve patient outcomes and quality of life.

The Historical Development of Endoscopy

The concept of endoscopy dates back to the late 19th century. Early efforts to examine the gastrointestinal tract involved rigid endoscopes, which were not flexible and often uncomfortable for patients. In 1950, the introduction of the flexible fiber-optic endoscope revolutionized the field. This development allowed for improved patient comfort, better visualization, and a broader range of diagnostic and therapeutic applications [8,9].

Since then, the evolution of endoscopy has been marked by continuous improvements in endoscopic technology. The introduction of high-definition cameras, miniaturized equipment, and advanced imaging techniques such as narrow band imaging (NBI) and chromoendoscopy has significantly enhanced the diagnostic capabilities of endoscopy. Furthermore, the integration of therapeutic instruments into endoscopes has allowed for real-time treatment during the procedure, such as cauterization of bleeding sites or the removal of polyps and tumors [10,11].

As endoscopy has advanced, its applications have expanded. It is now used not only for diagnostic purposes but also as a treatment modality, enabling physicians to perform a variety of interventions during a single procedure. This includes dilation of strictures, hemostasis for bleeding ulcers, and even minimally invasive surgery for early-stage cancers [12,13].

Indications for Endoscopy

Endoscopy is performed for a variety of clinical indications, and its versatility in diagnosing and treating gastrointestinal conditions has made it one of the most widely used procedures in modern medicine. Below, we discuss in detail the primary indications for endoscopy [14,15].

Abdominal Pain, Heartburn, and Indigestion

Abdominal pain, heartburn, and indigestion are among the most prevalent complaints that patients present with in clinical settings. These symptoms, while common, can arise from a wide array of gastrointestinal disorders, making them difficult to diagnose without a thorough examination. In many cases, these symptoms are non-specific and could indicate a minor issue or be

the result of a more serious underlying condition. The challenge in diagnosing the cause of these symptoms is compounded by their overlap with other diseases and their potential to manifest in a variety of forms. For instance, the pain associated with these conditions can vary in intensity, location, and nature—ranging from a dull ache to sharp, localized discomfort [16-18].

When these symptoms persist despite conservative treatment such as over-the-counter antacids, lifestyle changes, or dietary modifications, it becomes crucial to investigate the underlying cause further. This is particularly important if the symptoms are accompanied by more alarming signs, such as unintentional weight loss, persistent vomiting, or difficulty swallowing (dysphagia). These warning signs often point to more serious conditions, such as malignancies or complicated ulcers, that require prompt diagnosis and intervention. In such cases, endoscopy becomes a vital tool in accurately identifying the source of the symptoms and determining the appropriate course of treatment [19,20].

Several common gastrointestinal conditions cause abdominal pain, heartburn, and indigestion. One of the most prevalent is gastroesophageal reflux disease (GERD). GERD occurs when stomach acid repeatedly flows back into the oesophagus, leading to symptoms such as heartburn, regurgitation, and chest pain. The chronic nature of GERD can lead to damage to the oesophageal mucosa, resulting in inflammation (oesophagitis), erosions, or even the development of strictures. Endoscopy allows for direct visualization of the oesophagus, enabling clinicians to identify signs of damage, such as redness, swelling, or erosions. It also helps assess the severity of reflux-induced injury, which can guide the decision to modify treatment strategies, such as adjusting acid-suppressing medications or considering surgical interventions in severe cases [20].

Another common cause of these symptoms is peptic ulcers, which can occur in the stomach (gastric ulcers) or the duodenum (duodenal ulcers). Peptic ulcers are open sores that form when the mucosal lining of the stomach or duodenum is damaged, typically due to infection with *Helicobacter pylori* or the chronic use of nonsteroidal anti-inflammatory drugs (NSAIDs). These ulcers can lead to a range of symptoms, including burning abdominal pain, indigestion, bloating, and nausea. In some cases, they can cause complications such as bleeding or perforation, which can be life-threatening. Endoscopy is essential for diagnosing peptic ulcers as it allows for direct observation of ulcerated areas, enabling the physician to assess the size, depth, and location of the ulcers. Furthermore, endoscopy provides an opportunity to take biopsy samples for the detection of *H. pylori* infection, which can be treated with antibiotics, or to rule out malignancy in cases of unusual ulcers [21-23].

Gastritis, or inflammation of the stomach lining, is another common cause of abdominal discomfort and indigestion. Gastritis can be caused by a variety of factors, including infection with *H. pylori*, excessive alcohol consumption, chronic use of NSAIDs, or autoimmune disorders. Patients with gastritis may experience symptoms such as nausea, bloating, and pain in the upper abdomen. In more severe cases, the inflammation can lead to the development of ulcers or bleeding. Endoscopy is highly effective in diagnosing gastritis, as it allows the clinician to

examine the stomach lining for signs of inflammation, redness, or erosions. The procedure also enables biopsy collection, which can help identify the underlying cause of the gastritis, such as an *H. pylori* infection or an autoimmune process like autoimmune gastritis [24,25].

Beyond the identification of specific conditions such as GERD, peptic ulcers, or gastritis, endoscopy provides an invaluable opportunity to evaluate the severity of mucosal inflammation and assess how much damage has occurred to the upper gastrointestinal tract. This assessment is crucial for determining the appropriate course of treatment. For example, in cases of GERD, if there is significant damage to the oesophageal lining, a more aggressive treatment regimen, including higher doses of proton pump inhibitors (PPIs) or even surgical interventions, may be necessary. Similarly, for peptic ulcers, endoscopy not only helps in diagnosing the ulcer but also plays a role in assessing the need for additional treatments such as the eradication of *H. pylori* or addressing complications like bleeding or perforation [26,27].

In summary, abdominal pain, heartburn, and indigestion are frequently encountered symptoms in clinical practice, but they can be caused by a wide variety of gastrointestinal disorders. When these symptoms persist or are associated with warning signs such as weight loss, vomiting, or dysphagia, endoscopy is an indispensable diagnostic tool. It allows for direct visualization of the oesophagus, stomach, and duodenum, enabling the identification of conditions such as GERD, peptic ulcers, and gastritis. Moreover, endoscopy provides the ability to assess the severity of mucosal damage and guide treatment decisions, making it an essential procedure for managing these common but often complex symptoms.

Gastric and Duodenal Ulcers

Peptic ulcers, which encompass both gastric ulcers (those that occur in the stomach) and duodenal ulcers (those that occur in the first part of the small intestine, called the duodenum), are common causes of upper abdominal pain. These ulcers form when the mucosal lining of the gastrointestinal tract is damaged, typically due to an imbalance between the aggressive factors (such as stomach acid) and the protective mechanisms (such as mucus and bicarbonate). While many ulcers can heal on their own, if left untreated, they can lead to serious complications, including bleeding, perforation, scarring, and even gastric cancer [28].

Endoscopy is considered the gold standard for diagnosing gastric and duodenal ulcers. Prior to the development of endoscopic techniques, diagnosis was often based on symptoms, but the introduction of endoscopy revolutionized the way ulcers are diagnosed and managed. During the procedure, a flexible endoscope is passed through the mouth and into the upper digestive tract, allowing the physician to directly visualize the mucosal lining of the oesophagus, stomach, and duodenum. Ulcers appear as open sores or lesions on the mucosal surface, and they can vary in size, shape, and depth [29].

One of the primary advantages of using endoscopy for the diagnosis of ulcers is the ability to assess their size, depth, and location in real-time. The endoscope provides clear, high-

definition images of the ulcerated area, allowing the physician to determine the extent of damage and evaluate whether complications such as bleeding or perforation are present. For instance, bleeding ulcers, which are a medical emergency, can be immediately visualized, and the endoscopist can intervene with therapeutic measures, such as cauterization or injection of hemostatic agents, to control the bleeding [30].

In addition to diagnosing the ulcer itself, endoscopy is invaluable for monitoring the healing process. When patients are undergoing treatment for peptic ulcers, whether through medications such as proton pump inhibitors (PPIs) or antibiotics for *Helicobacter pylori* infection, endoscopy allows for a direct assessment of how well the ulcer is healing. A follow-up endoscopy can reveal whether the ulcer is resolving, whether the treatment plan needs to be adjusted, or whether complications have developed, such as the formation of scar tissue or a stricture that may require further intervention [31].

Endoscopy also offers the unique ability to take biopsy samples from ulcerated areas. This is particularly important for diagnosing underlying causes of the ulcer, including infection with *Helicobacter pylori*, the bacterium most commonly associated with the development of peptic ulcers. The presence of *H. pylori* infection is a significant factor in the formation and persistence of gastric and duodenal ulcers, as the bacterium produces toxins that weaken the protective mucosal barrier, allowing acid to damage the underlying tissues. By taking biopsy samples from the ulcer, the physician can confirm the presence of *H. pylori* through various methods, including histological examination, rapid urease tests, or culture. If *H. pylori* is detected, a course of antibiotics can be prescribed to eradicate the infection, promoting ulcer healing and reducing the risk of recurrence [22].

In cases where gastric cancer is suspected, endoscopy allows for early detection. The visual examination of the ulcerated area helps to differentiate benign ulcers from those that may be malignant. If there are any suspicious features, such as irregular borders, large size, or the presence of masses or nodules, biopsy samples can be obtained to assess for cancer. Early detection of gastric cancer is critical, as it can significantly improve survival rates through early intervention and treatment [32].

In addition to bacterial infections, other factors that can contribute to the development of gastric and duodenal ulcers include the chronic use of nonsteroidal anti-inflammatory drugs (NSAIDs), excessive alcohol consumption, and stress. Endoscopy is effective in assessing the impact of these factors on the gastrointestinal lining and can help in tailoring treatment recommendations, such as discontinuing NSAID use, managing alcohol intake, or prescribing medications to reduce stomach acid production [33].

Finally, endoscopy is crucial for detecting complications of peptic ulcers, such as perforation and bleeding, both of which can be life-threatening if not treated promptly. In the case of perforation, where the ulcer creates a hole in the stomach or duodenum, endoscopy allows the physician to directly visualize the perforated area and, in some cases, perform therapeutic interventions, such as placing clips or applying cautery to close the perforation. For bleeding ulcers, endoscopy can also be used

for immediate hemostatic therapy, preventing further blood loss and stabilizing the patient [34].

In summary, endoscopy is a highly effective diagnostic tool for evaluating gastric and duodenal ulcers. It allows for direct visualization of ulcers, enabling clinicians to assess their size, depth, and location, monitor healing, and identify complications such as bleeding or perforation. Moreover, the ability to obtain biopsies during the procedure plays a key role in diagnosing underlying causes, such as *H. pylori* infection, and in ruling out malignancy. Given its diagnostic and therapeutic capabilities, endoscopy is indispensable in the management of peptic ulcers, offering both immediate treatment options and long-term monitoring.

Dysphagia (Difficulty Swallowing)

Dysphagia, or difficulty swallowing, is a common symptom that can result from a variety of underlying causes. It may manifest as a sensation of food sticking in the throat or chest, pain while swallowing, or an inability to swallow certain foods or liquids. The causes of dysphagia can be broadly categorized into mechanical obstructions, motility disorders, and inflammatory conditions, all of which may affect the oesophagus. Given the range of potential causes, accurate diagnosis is crucial for effective management. Endoscopy, or upper endoscopy, is a highly effective diagnostic tool for identifying the underlying cause of dysphagia, as it enables direct visualization of the oesophagus, stomach, and duodenum [35].

One of the primary advantages of endoscopy in the evaluation of dysphagia is its ability to detect mechanical obstructions in the oesophagus. These can include strictures, tumors, or foreign bodies. Strictures are narrowings of the oesophagus that may occur due to scarring from previous injury, acid reflux, or chronic inflammation. Tumors, whether benign or malignant, can also cause a physical blockage, impeding the normal passage of food and liquids. Endoscopy allows the physician to observe any such obstructions directly, determining their location, size, and extent. In cases of a foreign body ingestion, endoscopy enables the physician to safely remove the object, thereby alleviating the obstruction [36,37].

In addition to identifying physical obstructions, endoscopy is valuable in evaluating oesophageal motility. In certain cases, dysphagia is not caused by a mechanical blockage but by a motility disorder, in which the oesophagus fails to move food effectively from the mouth to the stomach. These disorders can be difficult to diagnose based on symptoms alone, and endoscopy can provide valuable insight into the underlying cause. For instance, achalasia, a disorder in which the lower oesophageal sphincter fails to relax properly, can result in difficulty swallowing, regurgitation, and chest pain. Endoscopy can reveal dilated oesophagus and food retention, which may suggest achalasia. While a barium swallow or oesophageal manometry is typically required to confirm a diagnosis of achalasia, endoscopy provides important initial visual clues that can prompt further diagnostic testing [38,39].

Another condition that can cause dysphagia is eosinophilic oesophagitis (EoE), an inflammatory condition in which the oesophagus becomes inflamed due to an allergic reaction. EoE can

lead to difficulty swallowing, food impaction, and even fibrosis or scarring of the oesophagus. Endoscopy allows for direct visualization of the oesophagus and can reveal characteristic features of EoE, such as ring-like structures, furrowing, or white plaques that represent areas of inflammation. Biopsy samples can also be taken during the procedure to assess for the presence of eosinophils, which are the hallmark of this condition. Identifying eosinophilic oesophagitis early is essential, as untreated EoE can lead to strictures and long-term complications [40].

Oesophageal cancer is another serious cause of dysphagia, particularly in older patients or those with risk factors such as chronic acid reflux, smoking, or heavy alcohol consumption. Dysphagia associated with oesophageal cancer tends to be progressive, often starting with difficulty swallowing solid foods and eventually affecting liquids as well. Endoscopy is essential for detecting oesophageal cancer in its early stages, as it allows for visualization of any suspicious growths, ulcers, or masses within the oesophagus. If a tumor is found, biopsy samples can be obtained to confirm the diagnosis and assess the degree of malignancy. Early detection of oesophageal cancer is crucial, as it significantly improves the chances of successful treatment and survival [41].

Additionally, gastroesophageal reflux disease (GERD) is a common cause of dysphagia, especially in patients who have chronic heartburn or regurgitation. GERD can lead to inflammation and scarring in the oesophagus (oesophagitis), which can cause narrowing or strictures, contributing to difficulty swallowing. Endoscopy is useful for assessing the extent of oesophageal damage due to acid reflux and for identifying complications such as Barrett's oesophagus, a condition in which the lining of the oesophagus is replaced by tissue similar to the intestinal lining, increasing the risk of cancer. In patients with GERD-related dysphagia, endoscopy can also help determine whether there is any evidence of pre-cancerous changes or strictures that require further management [42].

Moreover, motility disorders like scleroderma, which is a rare autoimmune disease that causes the oesophagus to become stiff and non-functional, can lead to dysphagia. Endoscopy may not always reveal motility disorders directly, but it can help rule out other causes of dysphagia and provide clues to a broader differential diagnosis. In many cases, endoscopy is combined with other diagnostic tests, such as manometry, to fully evaluate oesophageal function and motility [39].

Endoscopy also plays a role in the treatment of dysphagia. If the cause of dysphagia is a benign obstruction such as a stricture, the procedure can be used to dilate the narrowed area and relieve symptoms. Endoscopic dilation is often performed using a balloon or mechanical dilator to expand the oesophagus and allow food to pass more easily. In cases where a tumor is identified, endoscopy allows for biopsy collection, and in some situations, it can be used to insert stents to maintain oesophageal patency in advanced cancer cases [39].

In summary, dysphagia is a symptom that can arise from various conditions affecting the oesophagus, including mechanical obstructions, motility disorders, and inflammatory diseases. Endoscopy is an invaluable diagnostic tool in evaluating

dysphagia, as it provides direct visualization of the oesophagus, allowing for the identification of physical obstructions, signs of inflammation, and motility issues. It is particularly useful for diagnosing serious conditions such as oesophageal cancer, achalasia, and eosinophilic oesophagitis. In addition to its diagnostic capabilities, endoscopy offers therapeutic interventions that can alleviate symptoms and improve the quality of life for patients suffering from dysphagia.

Upper Gastrointestinal Bleeding

Upper gastrointestinal bleeding (UGIB) is a potentially life-threatening condition that requires immediate and precise diagnosis, as well as prompt intervention to prevent complications such as shock, organ failure, or death. UGIB refers to any bleeding that occurs in the oesophagus, stomach, or duodenum, and it is often a result of conditions like gastric ulcers, esophageal varices, Mallory-Weiss tears, or tumors. The cause of the bleeding must be quickly identified to determine the appropriate treatment strategy, and **endoscopy** (upper endoscopy) is the first-line diagnostic tool in patients suspected of having UGIB [43].

Endoscopy is the preferred diagnostic method because it allows for direct visualization of the upper gastrointestinal tract. By inserting a flexible endoscope through the mouth, physicians can examine the oesophagus, stomach, and duodenum in real-time. This enables them to identify the precise location of bleeding, whether it is from an **ulcer, esophageal varices, a Mallory-Weiss tear**, or even a **tumor**. Each of these conditions presents with different patterns of bleeding, and prompt identification is critical for selecting the correct therapeutic approach [44].

The most common cause of UGIB is **peptic ulcers**, which occur when the mucosal lining of the stomach or duodenum is damaged, often due to infection with *Helicobacter pylori* or the prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs). When ulcers erode into blood vessels, they can result in significant bleeding, leading to symptoms such as vomiting blood (hematemesis) or passing black, tarry stools (melena). Endoscopy allows for the direct visualization of gastric and duodenal ulcers, helping the physician to determine the extent of the ulcer and whether there is active bleeding. The ability to observe the bleeding site is invaluable for both diagnosis and treatment planning [45].

Another common cause of UGIB is **esophageal varices**, which are enlarged veins in the oesophagus that can develop in patients with **liver cirrhosis**. These varices are fragile and prone to rupture, leading to massive, life-threatening bleeding. In many cases, the bleeding is sudden and severe, and endoscopy is essential for identifying the varices as the source of bleeding. Endoscopic treatment of esophageal varices is often required, and endoscopy allows for therapeutic measures to be performed immediately. This may include **endoscopic banding**, where small rubber bands are placed around the varices to stop the bleeding, or the injection of **hemostatic agents** to promote clotting and control hemorrhage [46].

A **Mallory-Weiss** tear is another potential cause of UGIB. It occurs when there is a tear in the mucosa at the junction of the oesophagus and stomach, usually as a result of forceful vomiting

or retching. The tear can cause bleeding, leading to hematemesis. Mallory-Weiss tears are typically self-limiting, but in cases of severe bleeding, endoscopy allows for direct visualization and assessment of the tear. If necessary, therapeutic interventions such as cauterization or injection of hemostatic agents can be used to control the bleeding [47].

Gastric tumors, whether benign or malignant, can also lead to UGIB, particularly if the tumor erodes into blood vessels. Tumors can be challenging to diagnose based on symptoms alone, but endoscopy enables physicians to observe any growths, ulcers, or masses in the stomach that may be contributing to the bleeding. Biopsy samples can also be taken during the procedure to determine whether the tumor is malignant and to guide subsequent treatment decisions, such as surgery, chemotherapy, or radiation therapy [48].

Endoscopy not only plays a crucial role in diagnosing the source of UGIB but also offers the ability to perform **therapeutic interventions** during the procedure. The ability to treat bleeding lesions in real-time significantly improves patient outcomes and reduces the need for surgical interventions, which carry higher risks and require more extensive recovery times. Some of the therapeutic options available during endoscopy include:

- **Cauterization:** This involves the use of heat to close off small blood vessels that are bleeding. Cauterization is particularly effective in treating bleeding ulcers and small vessels in esophageal varices.
- **Injection of hemostatic agents:** Agents such as adrenaline (epinephrine) or other hemostatic solutions can be injected directly into the bleeding site to promote vasoconstriction, thereby controlling the hemorrhage.
- **Endoscopic banding:** This technique is commonly used for the treatment of **esophageal varices**. A rubber band is placed around the bleeding varices to stop the flow of blood, preventing further blood loss.
- **Clip placement:** For larger vessels or more difficult-to-treat bleeding sources, endoscopic clips can be applied to mechanically seal the bleeding site [49].

The **immediate availability** of these therapeutic interventions during endoscopy makes it a crucial tool in the management of UGIB. By enabling both diagnosis and treatment to occur during the same procedure, endoscopy reduces the time to intervention and minimizes the need for more invasive procedures like surgery. Studies have shown that the use of endoscopic therapy during endoscopy significantly decreases the need for surgical interventions and improves patient outcomes, including a lower risk of rebleeding and reduced mortality rates [43].

In cases of more severe UGIB, where initial endoscopic therapy does not achieve adequate control of bleeding, **angiographic embolization** or **surgical intervention** may still be required. However, the vast majority of UGIB cases can be effectively managed with endoscopy and endoscopic interventions, making this procedure an essential part of modern gastroenterology practice [43].

In summary, **endoscopy** is the first-line diagnostic and therapeutic tool for patients presenting with **upper gastrointestinal bleeding**. It provides real-time visualization of the bleeding

source, whether it be from a gastric ulcer, esophageal varices, Mallory-Weiss tear, or a tumor, and offers a variety of therapeutic interventions to control the bleeding. By enabling both diagnosis and treatment during the same procedure, endoscopy significantly improves patient outcomes and reduces the need for more invasive surgical interventions. Given its critical role in the management of UGIB, endoscopy remains an indispensable tool in emergency care settings.

Gastritis and Oesophagitis

Gastritis and oesophagitis are common inflammatory conditions affecting the upper gastrointestinal tract, leading to symptoms such as abdominal pain, nausea, bloating, heartburn, and dyspepsia (indigestion). Both conditions can result from a variety of factors, including infections, autoimmune disorders, long-term use of nonsteroidal anti-inflammatory drugs (NSAIDs), excessive alcohol consumption, or chronic gastroesophageal reflux disease (GERD). Chronic inflammation in the gastrointestinal mucosa can lead to significant complications such as bleeding, scarring, and an increased risk of malignancy, particularly if left untreated. Given the potential for long-term damage and complications, early diagnosis and appropriate management of gastritis and oesophagitis are crucial, and endoscopy is a key diagnostic tool in evaluating the extent and severity of these conditions [50,51].

Endoscopy provides direct visualization of the oesophagus, stomach, and duodenum, making it the most effective method for diagnosing and assessing the severity of gastritis and oesophagitis. During the procedure, a flexible endoscope is inserted through the mouth to examine the lining of the upper gastrointestinal tract. In cases of gastritis, endoscopy allows for the identification of erosions, ulcers, and other signs of mucosal inflammation. The stomach lining may appear red, swollen, or even ulcerated in cases of acute gastritis. In chronic gastritis, there may be signs of atrophy (thinning of the stomach lining) or the presence of fundic gland polyps. These visual cues help physicians determine the severity of the condition and guide the treatment plan [52].

Helicobacter pylori (*H. pylori*) infection is one of the most common causes of chronic gastritis, and it is known to increase the risk of developing peptic ulcers and gastric cancer. Endoscopy allows for biopsy samples to be taken from the stomach lining, enabling laboratory analysis for the presence of *H. pylori*. A positive result can confirm the infection and prompt appropriate antibiotic treatment. Eradication of *H. pylori* is often required to prevent the recurrence of gastritis and to reduce the risk of complications such as ulcers and gastric cancer. Additionally, endoscopy can reveal other potential causes of gastritis, such as autoimmune disorders, which can lead to a type of gastritis called autoimmune atrophic gastritis [53].

On the other hand, oesophagitis refers to the inflammation of the oesophagus, and it is commonly associated with gastroesophageal reflux disease (GERD). In GERD, stomach acid frequently flows back into the oesophagus, causing irritation and inflammation of the oesophageal lining. Over time, this can lead to the development of erosions, ulcers, and even strictures (narrowing of the oesophagus). In severe cases, long-term acid reflux can lead to Barrett's oesophagus, a pre-cancerous condition where the normal oesophageal lining is replaced by intestinal-like

tissue. Barrett's oesophagus significantly increases the risk of developing oesophageal cancer, making its detection during endoscopy essential for early intervention and surveillance [54,55].

Endoscopy is particularly valuable in identifying erosions and ulcers in the oesophagus that are indicative of oesophagitis. In patients with GERD-related oesophagitis, the oesophageal mucosa may appear reddened or inflamed, and the procedure can help assess the severity of mucosal damage. In cases of severe reflux, ulcerations may be visible, which can be painful for the patient and require prompt treatment to prevent further complications. Endoscopic assessment of oesophagitis can also guide the selection of appropriate pharmacologic therapy, such as proton pump inhibitors (PPIs), which reduce acid production and promote healing of the oesophageal lining [56].

In addition to GERD, infectious oesophagitis can occur in immunocompromised patients, such as those with HIV/AIDS or those undergoing chemotherapy. Fungal infections like *Candida albicans*, or viral infections like herpes simplex virus (HSV) or cytomegalovirus (CMV), can cause inflammation of the oesophagus and may present with symptoms similar to those of GERD. Endoscopy allows for the visualization of these infections and the collection of biopsy samples for microbiological analysis to confirm the specific cause. The identification of an infectious pathogen allows for targeted treatment, such as antifungal or antiviral medications [57].

Endoscopy also plays a critical role in the diagnosis of Barrett's oesophagus, a condition that can develop as a result of chronic reflux. The oesophageal mucosa in Barrett's oesophagus often appears abnormal, with a salmon-colored appearance compared to the usual pale pink lining of the oesophagus. This change in the oesophageal lining is due to the replacement of normal squamous cells with columnar epithelium. During endoscopy, the physician can visually assess the extent of the Barrett's oesophagus and take biopsy samples to evaluate for dysplasia (precancerous changes). Regular surveillance through endoscopy is recommended for patients with Barrett's oesophagus to detect any signs of progression to oesophageal cancer [41].

Another important aspect of endoscopy in evaluating oesophagitis and gastritis is its ability to assess for complications, such as bleeding. In cases of severe inflammation, particularly when ulcers or erosions are present, bleeding can occur. Endoscopy allows for direct visualization of the bleeding source and enables immediate therapeutic interventions, such as cauterization, injection of hemostatic agents, or application of clips, to control the bleeding and prevent further complications [58].

In summary, endoscopy is a crucial tool in the evaluation and management of both gastritis and oesophagitis. It allows for direct visualization of the gastrointestinal mucosa, helping to identify the underlying cause of inflammation, assess the extent of damage, and guide therapeutic decisions. The ability to obtain biopsy samples during the procedure also facilitates the diagnosis of conditions such as *H. pylori* infection and Barrett's oesophagus, both of which require specific management strategies. Moreover, endoscopy is invaluable in detecting complications like bleeding, enabling immediate therapeutic

intervention and improving patient outcomes. Given the potential for gastritis and oesophagitis to lead to more serious conditions, such as ulcers, strictures, and cancer, early diagnosis and treatment through endoscopy are essential to preventing long-term complications.

Biopsy Collection for Further Diagnosis

One of the major advantages of endoscopy over other diagnostic techniques is its ability to allow for biopsy collection during the procedure. A biopsy involves the removal of small tissue samples from the upper gastrointestinal tract, typically from areas that appear suspicious or abnormal. These tissue samples are then sent to a laboratory for histological analysis to diagnose a variety of conditions, ranging from infections to cancer. The ability to perform biopsies during endoscopy makes it a valuable tool in identifying conditions that require a more detailed examination of tissue at a cellular level, helping physicians make more accurate diagnoses and tailor treatment accordingly. The process of obtaining a biopsy during endoscopy is relatively straightforward. Using the flexible endoscope, specialized biopsy forceps are passed through the endoscope and directed to the area of interest. The forceps grasp a small portion of tissue, which is then withdrawn and preserved for further analysis. This can be done for suspicious areas in the oesophagus, stomach, and duodenum, and it is particularly valuable for evaluating lesions that cannot be definitively diagnosed through visual inspection alone [59].

Biopsies are essential in diagnosing a variety of gastrointestinal conditions, many of which may present with similar symptoms but require very different treatment approaches. For example, gastric cancer can sometimes present as a large, irregular ulcer or mass in the stomach, but the only way to definitively diagnose it is through histological examination of the tissue. In suspected cases of gastric cancer, biopsy samples are analyzed for the presence of cancerous cells and any associated molecular markers that may influence treatment options, such as HER2 overexpression or the presence of specific mutations. Early detection of gastric cancer through biopsy collection is critical for improving prognosis, as treatment outcomes are significantly better when the cancer is detected at an early stage [60].

Another condition where biopsy collection is crucial is *Helicobacter pylori* infection. *H. pylori* is a gram-negative bacterium that is a major cause of peptic ulcers, chronic gastritis, and an increased risk of gastric cancer. Although *H. pylori* can sometimes be detected through non-invasive tests such as breath tests or stool samples, obtaining a biopsy during endoscopy provides a more direct method for diagnosing the infection. Biopsy samples are taken from the stomach lining and tested for the presence of *H. pylori* through histological examination or urease tests. If the infection is confirmed, appropriate treatment with antibiotics and proton pump inhibitors (PPIs) can be started to eradicate the bacteria and reduce the risk of further complications [61].

In addition to infections like *H. pylori*, biopsy collection during endoscopy is also invaluable for diagnosing a variety of other infections that can affect the upper gastrointestinal tract. For example, fungal infections, such as those caused by *Candida albicans*, can occur in immunocompromised patients

and present with symptoms similar to those of esophagitis or gastritis. Endoscopy allows for the visualization of characteristic white plaques or lesions in the oesophagus and stomach, and biopsy samples can be taken to confirm the presence of fungal organisms. Likewise, viral infections like cytomegalovirus (CMV) or herpes simplex virus (HSV) can cause esophagitis in immunocompromised individuals, and biopsy specimens can be analyzed for the presence of viral inclusions to aid in diagnosis [61].

Biopsies are also critical in diagnosing conditions that may not be readily apparent on visual inspection but have a significant impact on patient management. For example, celiac disease, an autoimmune disorder triggered by the ingestion of gluten, can lead to damage in the small intestine and affect nutrient absorption. Endoscopy allows for the visualization of villi atrophy (flattening of the villi in the small intestine), which is characteristic of celiac disease. Biopsy samples from the duodenum can be analyzed to confirm the diagnosis by identifying the presence of abnormal tissue changes and immune cell infiltration. Once diagnosed, treatment involves a strict gluten-free diet, which helps to manage symptoms and prevent long-term complications such as malnutrition and osteoporosis [62].

Barrett's oesophagus is another condition where biopsy collection is essential. This condition occurs in patients with chronic gastroesophageal reflux disease (GERD) and is characterized by the replacement of normal squamous epithelium in the oesophagus with columnar epithelium. This change is known as intestinal metaplasia and is a precursor to oesophageal adenocarcinoma, a type of cancer. During endoscopy, the oesophagus can be examined for signs of Barrett's oesophagus, and biopsy samples are taken from the abnormal tissue to assess for the presence of dysplasia, which is an early sign of cancerous changes. Biopsy specimens are classified into different grades of dysplasia, and this information helps guide the management of the condition, including the need for surveillance or endoscopic treatment [63].

Biopsy samples obtained during endoscopy are also critical for ruling out other potential malignancies in the upper gastrointestinal tract. Lymphoma, for example, can occasionally present with nonspecific symptoms such as abdominal pain, nausea, and weight loss. While lymphoma of the gastrointestinal tract is relatively rare, it can be diagnosed through histological analysis of biopsy specimens taken from suspicious areas, such as enlarged lymph nodes or abnormal mucosal growths [64].

Another benefit of biopsy collection is its role in determining the etiology of chronic conditions that might be associated with persistent symptoms despite conventional treatment. For example, eosinophilic esophagitis (EoE) is a condition characterized by an elevated number of eosinophils (a type of white blood cell) in the oesophagus, leading to symptoms of dysphagia, heartburn, and food impaction. Endoscopy is used to evaluate the oesophagus for the presence of characteristic features of EoE, such as rings or strictures, and biopsy specimens are obtained to confirm the diagnosis by identifying eosinophilic infiltration in the tissue. Treatment involves dietary changes, corticosteroids, and other immunomodulatory therapies [65].

In some cases, biopsy collection during endoscopy can also provide valuable insight into the autoimmune nature of certain gastrointestinal disorders. Conditions like autoimmune gastritis or chronic lymphocytic gastritis can lead to inflammation and damage in the gastrointestinal tract and may require specific immunosuppressive treatments. Biopsy specimens can help differentiate between different forms of gastritis and assist in identifying the underlying autoimmune processes that are driving the inflammation [66].

In conclusion, biopsy collection during endoscopy plays a critical role in the diagnosis and management of a wide range of gastrointestinal conditions. The ability to obtain tissue samples from suspicious lesions in the oesophagus, stomach, and duodenum allows for a more accurate diagnosis of conditions such as gastric cancer, *Helicobacter pylori* infection, celiac disease, Barrett's oesophagus, and various infections. Histological analysis of biopsy specimens provides valuable information about cellular abnormalities, the presence of infectious agents, and the nature of any underlying conditions. By enabling physicians to obtain definitive diagnoses, biopsies obtained during endoscopy help guide appropriate treatment plans, improve patient outcomes, and facilitate early detection of potentially life-threatening conditions.

The Endoscopy Procedure

Endoscopy is typically performed as an outpatient procedure and requires minimal preparation. The procedure is generally well-tolerated by most patients, although some may experience mild discomfort. Below, we describe the procedural steps in greater detail.

Pre-Procedure Preparation

Before undergoing endoscopy, patients are typically required to fast for a period of six to eight hours. This ensures that the stomach is empty and reduces the risk of aspiration during the procedure. Patients may also be asked to stop taking certain medications, such as anticoagulants, nonsteroidal anti-inflammatory drugs (NSAIDs), or proton pump inhibitors (PPIs), as these may interfere with the procedure or increase the risk of bleeding. In some cases, patients may need to undergo a bowel preparation regimen to clear the upper gastrointestinal tract. This is typically the case for individuals who may have had previous surgeries, inflammatory conditions, or who are experiencing symptoms of gastrointestinal bleeding [67,68].

Instrumentation and Technique

The endoscope used for endoscopy consists of a flexible tube with a light source, a camera, and multiple channels for passing instruments such as biopsy forceps, scissors, and a needle for injection. The tube is inserted through the patient's mouth and into the oesophagus, stomach, and duodenum. Modern gastroscopes are equipped with high-resolution cameras that provide detailed, real-time images of the gastrointestinal mucosa. Some gastroscopes also have advanced features such as narrow band imaging (NBI) and chromo-endoscopy, which enhance the visualization of mucosal patterns and help identify abnormal areas that may be indicative of cancer or other diseases [11,69].

Procedure Overview

The procedure typically lasts between 10 and 30 minutes, depending on the complexity of the examination. Patients are generally given a sedative to ensure comfort, although some patients may undergo the procedure under local anesthesia only. During the procedure, the endoscope is passed through the mouth and advanced into the stomach and duodenum. The physician examines the mucosa, looking for signs of ulcers, inflammation, tumors, or other abnormalities. If necessary, biopsies are taken from suspicious areas using specialized instruments. For patients experiencing gastrointestinal bleeding, therapeutic interventions such as cauterization or injection of hemostatic agents can be performed during the procedure [70].

Post-Procedure Care

After the procedure, patients are monitored until the effects of sedation wear off. Most patients are able to go home the same day, although they are advised to refrain from driving or operating heavy machinery for 24 hours. Some mild discomfort, such as a sore throat or bloating, is common after the procedure but typically resolves within a few hours. Patients are advised to follow up with their physician to discuss the results of the procedure, including any biopsy findings. If any therapeutic interventions were performed, additional follow-up may be necessary to ensure that the condition has been adequately treated [70].

Risk and Complications of Upper GI Endoscopy

This section would provide a general overview of the potential risks associated with upper GI endoscopy, such as bleeding, perforation, and complications related to sedation. It will outline the frequency and severity of each complication and highlight factors that can increase a patient's risk, such as pre-existing medical conditions or the complexity of the procedure [71].

Post-Procedure Adverse Events: What to Expect After Upper GI Endoscopy

Here, the manuscript will focus on the potential adverse events that can occur after the procedure. These may include transient pain, bloating, or minor discomfort, and will discuss when these symptoms are normal and when they require medical attention. This section can also emphasize the importance of post-procedural monitoring to prevent any serious complications [71].

Perforation and Bleeding: Major Complications in Upper GI Endoscopy

Perforation and bleeding are among the most serious complications of upper GI endoscopy. This section will provide a detailed explanation of how these complications can arise, the signs and symptoms that patients and healthcare providers should be aware of, and how they are treated. The manuscript would discuss the risk factors, such as pre-existing ulcers or the type of procedure performed, and the interventions used to address these issues [72].

Sedation-Related Risks in Upper GI Endoscopy: Anesthesia and Patient Safety

This section would explore the sedation or anesthesia used during upper GI endoscopy, focusing on the potential risks such as respiratory depression, aspiration, or allergic reactions. It

would also discuss how these risks can be minimized through proper patient assessment, monitoring during the procedure, and the use of appropriate sedation techniques.

Infection and Contamination: Preventive Measures and Risks of Upper GI Endoscopy This section would address the risk of infection and contamination during upper GI endoscopy, especially if the endoscope is not properly cleaned or sterilized. It would also explain the preventive measures taken in clinical settings to ensure proper sterilization of equipment, such as single-use accessories or thorough disinfection protocols, and how these reduce the risk of infections like bacterial or viral contamination.

Cardiopulmonary Complications During Upper GI Endoscopy

Some patients may experience cardiopulmonary complications such as arrhythmias or hypotension during or after upper GI endoscopy. This section would explore the mechanisms behind these complications, their clinical presentation, and management strategies. Special emphasis would be placed on high-risk patients, such as the elderly or those with cardiovascular disease.

Complications in High-Risk Patients: Addressing Special Considerations

This section would focus on patients who are at higher risk for complications during upper GI endoscopy. These include those with comorbid conditions (e.g., heart disease, diabetes, cirrhosis), older adults, or those with previous surgeries on the GI tract. It would provide strategies for managing these patients to reduce complications, including pre-procedural screening, careful sedation management, and specific procedural techniques.

Gastric Perforation During Endoscopy: Mechanisms, Detection, and Management

Gastric perforation, although rare, is one of the most feared complications of upper GI endoscopy. This section would discuss the mechanisms by which perforation occurs, the clinical signs that indicate a perforation may have happened, and the immediate steps to manage it, including surgical interventions if necessary. It would also touch on preventive measures to minimize the risk of perforation.

Managing Aspiration Risk: Prevention and Intervention in GI Endoscopy

Aspiration of gastric contents into the lungs during upper GI endoscopy can lead to serious complications like aspiration pneumonia. This section would explain the risk factors for aspiration, including poor patient positioning, excessive sedation, or impaired swallowing, and would discuss strategies for minimizing this risk, such as fasting protocols, proper sedation, and suctioning during the procedure.

Delayed Complications: When to Monitor for Long-Term Effects Post-Endoscopy Some complications may not manifest immediately after the procedure. This section would discuss delayed complications such as delayed bleeding, strictures, or infection, emphasizing the importance of post-procedural follow-up and monitoring. It would also advise when patients should seek medical attention after undergoing an upper GI endoscopy [73,74].

Clinical Applications of Upper GI Endoscopy

Diagnostic Role of Upper GI Endoscopy in Gastrointestinal Disorders

This section would provide an overview of how upper GI endoscopy is used for diagnostic purposes. It would cover a range of conditions, including gastroesophageal reflux disease (GERD), peptic ulcers, and cancer, explaining how endoscopy helps in visualizing abnormalities, confirming diagnoses, and guiding treatment decisions [75].

Endoscopy in the Diagnosis and Management of Gastroesophageal Reflux Disease (GERD)

GERD is a common condition characterized by acid reflux into the oesophagus. This section would explain how upper GI endoscopy is used to evaluate the oesophagus for damage caused by acid reflux, including oesophagitis, Barrett's oesophagus, and complications like strictures. It would also discuss how endoscopy helps assess the severity of GERD and monitor treatment efficacy [76].

Assessing Gastric Ulcers and Cancer Risk with Upper GI Endoscopy

This section would discuss how upper GI endoscopy is used to detect and monitor gastric ulcers, a major cause of abdominal pain. It would also emphasize its role in identifying gastric cancer at an early stage, improving prognosis. The section would cover biopsy techniques for identifying malignancies and the role of endoscopic surveillance in high-risk patients [77].

Upper GI Endoscopy in the Diagnosis of Oesophageal Cancer and Precursor Lesions

Oesophageal cancer is often diagnosed at advanced stages, but early detection through endoscopy can improve survival. This section would focus on how endoscopy helps in identifying oesophageal cancer, Barrett's oesophagus, and oesophageal dysplasia, along with the role of biopsy in confirming malignancy [78].

Therapeutic Applications of Upper GI Endoscopy: From Biopsy to Endoscopic Therapy

This section would explore the therapeutic uses of upper GI endoscopy, including biopsy collection for diagnosing diseases like *H. pylori* infection and cancer. It would also discuss endoscopic treatments such as dilation of strictures, variceal banding for esophageal varices, and hemostasis for bleeding ulcers.

The Role of Endoscopy in Managing Upper Gastrointestinal Bleeding

Upper GI bleeding is a medical emergency, and endoscopy is the first-line diagnostic tool. This section would describe how endoscopy can identify bleeding sources, including ulcers, varices, and tumors, and how endoscopic interventions like cauterization, injection therapy, and banding can stop the bleeding and reduce the need for surgery.

Evaluating and Monitoring Chronic Gastritis with Upper GI Endoscopy

Chronic gastritis is often caused by *H. pylori* infection or prolonged use of NSAIDs. This section would discuss how endoscopy allows for visualizing inflammation in the stomach lining, taking biopsies to detect *H. pylori*, and assessing the risk of developing gastric cancer over time.

Endoscopy in the Diagnosis and Treatment of Achalasia and Other Motility Disorders

Achalasia is a motility disorder that impairs the ability of the oesophagus to move food into the stomach. This section would explain how endoscopy is used to diagnose achalasia by ruling out other conditions like tumors and how it can also assess the esophageal body and sphincter tone. Additionally, it would highlight endoscopic interventions for motility disorders.

Clinical Use of Upper GI Endoscopy for Foreign Body Removal

This section would cover the role of upper GI endoscopy in removing foreign bodies from the oesophagus, stomach, or duodenum, which can cause obstruction and injury. It would explain the techniques used to retrieve or remove foreign bodies safely without requiring surgical intervention.

Endoscopic Surveillance: Long-Term Management in High-Risk Patients

For patients with conditions like Barrett's oesophagus, gastric cancer, or a family history of cancer, long-term surveillance with upper GI endoscopy is essential for early detection. This section would discuss the guidelines for surveillance, the frequency of endoscopic exams, and how early intervention can significantly impact patient outcomes.

The Utility of Upper GI Endoscopy in Celiac Disease Diagnosis This section would explain the role of upper GI endoscopy in diagnosing celiac disease, which affects the small intestine. It would detail the characteristic appearance of villous atrophy seen during endoscopy and how biopsy samples are used to confirm the diagnosis.

Upper GI Endoscopy in the Management of Dysphagia: A Comprehensive Approach Dysphagia (difficulty swallowing) can result from a variety of causes, including strictures, cancer, or motility disorders. This section would explain how upper GI endoscopy helps in diagnosing the cause of dysphagia and guiding therapeutic interventions such as dilation for strictures or biopsy for suspected malignancy.

Exploring Endoscopic Interventions: Treating Varices, Bleeding, and Strictures This section would cover the therapeutic applications of endoscopy in treating conditions like esophageal varices, bleeding ulcers, and strictures. It would highlight techniques such as banding, ligation, and dilation and discuss their clinical benefits in managing complex gastrointestinal disorders [73].

Conclusions

Endoscopy is an indispensable diagnostic tool in gastroenterology, offering valuable insights into a wide range of gastrointestinal conditions. It is particularly effective in diagnosing and monitoring diseases such as ulcers, cancers, and inflammatory conditions, and plays a key role in managing upper GI bleeding. While the procedure carries some risks, it is generally safe and well-tolerated by most patients. As technology advances, endoscopy will continue to evolve, improving both diagnostic accuracy and therapeutic options for gastrointestinal disorders.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

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