The diagnostic methods in gastroenterology

Department of Internal Medicine №1

Plan of the lecture

- I. Introduction
- II. The main symptoms and syndromes
- III. Clinical examination (Inspection – Palpation – Percussion - Auscultation)
- IV. Additional data (Radiological, imaging techniques and endoscopy, laboratory - Helicobacter pylori testing; functional study of the liver and bile ducts; GastroPanel; FibroTest; Hydrogen breath test)

I. Introduction

In developed countries gastrointestinal problems are a common reason for attendance at the primary care clinic as well as the outpatient clinic of the hospital. Many of these consultations (approximately 75%) are for symptoms related to non-organic disease. The clinician's main task is therefore to separate out the patients who require investigation, remembering that 20% of all cancers occur in the gastrointestinal tract.

In developing countries, poor hygiene and malnutrition allow the spread of infective organisms. The clinician's main role here is to treat infections promptly and to help with prevention by encouraging improved sanitation and education.

II. Syndromes

- Anemic syndrome
- Asthenia vegetative syndrome
- Asthenia neurotic syndrome
- Pain syndrome
- Ulcer necrotic syndrome
- Hemorrhage syndrome
- Hypersecretion, hyposecretion
- Dyspeptic syndrome
- Inflammatory
- Intoxication
- Neoplastic

Syndromes and symptoms

Dyspepsia **is the term used by healthcare workers to describe upper abdominal symptoms, e.g. nausea, heartburn, acidity, pain or discomfort, wind, fullness or belching. Patients seldom use the term 'dyspepsia‘ to describe any symptom that is food related. Indigestion is common; 80% of the population will have had indigestion at some time.**

'Alarm' features suggestive of serious disease are:

dysphagia

weight loss

protracted vomiting

anorexia

haematemesis or melaena.

Nausea and vomiting

There are three phases:

- **nausea - a feeling of wanting to vomit, often associated with autonomic effects including hypersalivation, pallor and sweating**
- **retching - a strong involuntary effort to vomit**
- **vomiting - the expulsion of gastric contents through the mouth.**

The vomiting centres are located in the lateral reticular formation of the medulla and are stimulated by the chemoreceptor trigger zones (CTZs) in the floor of the fourth ventricle, and also by vagal afferents from the gut.

These zones are directly stimulated by drugs, motion sickness and metabolic causes. Many gastrointestinal conditions are associated with vomiting, but nausea and vomiting without pain are frequently non-gastrointestinal in origin. *Haematemesis* is vomiting blood or 'coffee-grounds' from the stomach. *Large volumes of vomit* suggest intestinal obstruction; *faeculent vomit* suggests low intestinal obstruction or the presence of a gastrocolic fistula, while *projectile vomiting* is due to gastric-outflow obstruction. *Chronic nausea + vomiting* with no other abdominal symptoms is usually due to a psychological cause. *Early-morning vomiting* is seen in pregnancy, alcohol dependence and some metabolic disorders (e.g. uraemia).

Diarrhoea and constipation

- These are common complaints which are not usually due to serious disease. A single episode of diarrhoea can be due to dietary indiscretion or anxiety. Watery stools of large volume are always due to organic disease. *Bloody diarrhoea* usually implies colonic disease. *Acute diarrhoea* lasting 2-5 days is often due to an infective cause, and stool cultures are necessary. Patients often consider themselves *constipated* if their bowels are not open on most days. The difficult passage of hard stool is also regarded as *constipation*, irrespective of stool frequency

Abdominal pain

Pain is stimulated mainly by the stretching of smooth muscle or organ capsules. Severe acute abdominal pain can be due to a large number of gastrointestinal conditions, and normally presents as an emergency. An 'acute abdomen' can occasionally be due to referred pain from the chest, as in pneumonia, or to metabolic causes, such as diabetic ketoacidosis. In patients with abdominal pain the following should be ascertained:

- the site, intensity, character, duration and frequency of the pain
- the aggravating and relieving factors associated symptoms, including non-gastrointestinal symptoms.

Upper abdominal pain

- ***Epigastric pain*** **is very common; it is often a dull ache, but sometimes acute and severe . Its relationship to food intake should be ascertained. It is a common feature of peptic ulcer disease, but also occurs in functional dyspepsia. In biliary tract disease, the pain is often epigastric.**
- ***Right hypochondrial pain*** **is usually from the gall bladder or biliary tract. Hepatic congestion (e. g. in hepatitis) and sometimes peptic ulcer can present with pain in the right hypochondrium. Chronic, often persistent, pain in the right hypochondrium is a frequent symptom in healthy females suffering from functional bowel disorders. This chronic pain is not due to gall bladder disease.**

Lower abdominal pain

Acute pain **in the left iliac fossa is usually colonic in origin (e.g. acute diverticulitis).**

Chronic pain **is most commonly associated with functional bowel disorders. In females, lower abdominal pain occurs in a number of gynaecological disorders and the differentiation from GI disease is often difficult.**

Persistent pain **in the right iliac fossa over a long period is not due to chronic appendicitis.**

Proctalgia **is a severe pain deep in the rectum that comes on suddenly but lasts only for a short time. It is not due to organic disease.**

Abdominal wall pain

Recurrent localized abdominal pain with local tenderness can very rarely arise from the abdominal wall itself. Causes are thought to include nerve entrapment, external hernias and entrapment of internal viscera (commonly omentum) within traumatic ruptures of abdominal wall musculature.

Flatulence

This is the term used to describe excessive wind. It includes belching, abdominal distension, 'wind' or the passage of flatus per rectum. Some of the swallowed air is passed into the intestine where most of it is absorbed. Intestinal bacterial breakdown of food also produces a small amount of gas. Flatus consists of nitrogen, carbon dioxide, hydrogen and methane. Flatus is normally passed 13-20 times per day.

Weight loss

This is due to anorexia (loss of appetite) and is a frequent accompaniment of all gastrointestinal disease. Anorexia is also common in systemic disease and may be seen in psychiatric disorders, particularly anorexia nervosa. Anorexia often accompanies carcinoma but it is a late symptom and not of diagnostic help. Weight loss with a normal or increased dietary intake occurs with hyperthyroidism. Malabsorption is never so severe as to cause weight loss without anorexia. Weight loss should be assessed objectively as patients often 'think' they have lost weight .

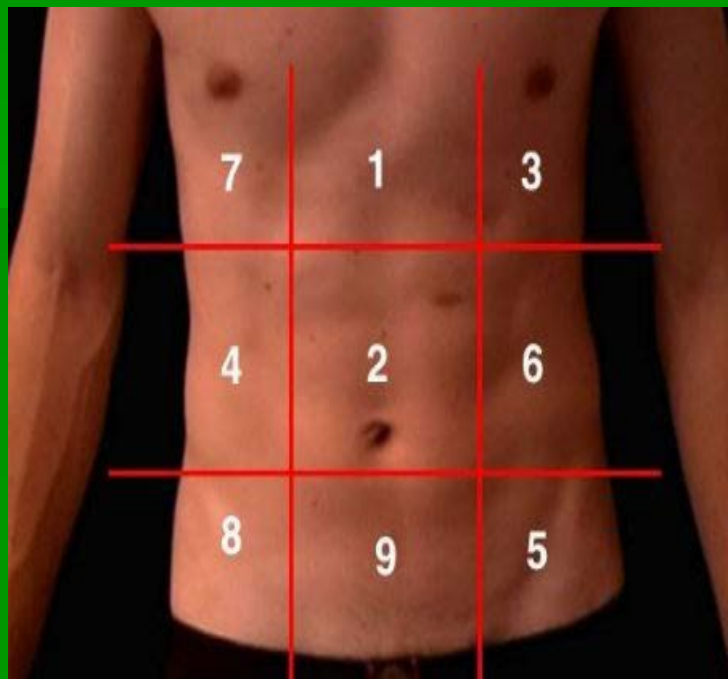
III. CLINICAL EXAMINATION

A general examination is performed, with particular emphasis on the examination of all lymph nodes and noting the presence of anaemia or jaundice.

Detailed examination of the gastrointestinal tract starts with the mouth and tongue, before examining the abdomen with the patient lying flat.

EXAMINATION OF THE ABDOMEN

Inspection – Palpation – Percussion - Auscultation



Inspection

Abdominal distension, whether due to flatus, fat, fetus, fluid or faeces, must be looked for. Lordosis may give the appearance of a distended abdomen; it is a common feature of the 'abdominal distension' seen in functional bowel disorders.

Palpation

Palpation

- The abdominal organs may be felt in some normal subjects but this is not common and some organs are usually only just palpable. A Reidel's lobe is an extension of the lateral portion of the right lobe of the liver and can occasionally be palpated. Any palpable mass is carefully felt to decide which organ is involved and also to evaluate its size, shape and consistency and whether it moves with respiration. The hernial orifices should be examined if intestinal obstruction is suspected.
- A succussion splash suggests gastric outlet obstruction if the patient has not drunk for 2-3 hours; the splash of fluid in the stomach can be heard with a stethoscope laid on the abdomen when the patient is moved.

Percussion

Percussion

Percussion

- This is performed in the usual way to detect the area of dullness caused by the liver and spleen, and possibly bladder enlargement. The presence of fluid in the peritoneal cavity (i.e. ascites) is detected by shifting dullness. The percussion note changes from resonance to dullness when the patient is moved from one side to the other. It is a good physical sign, but 1-2 L of fluid must be present to elicit it. A large ovarian cyst can sometimes produce an enlarged abdomen, but the dullness is more centrally placed than in ascites.

Auscultation

Auscultation

Auscultation is not of great value in gastrointestinal disease, apart from in the evaluation of the acute abdomen. Abdominal bruits are often present in normal subjects, but these are not clinically significant.

IV. INVESTIGATIONS

- **Radiological, imaging techniques and endoscopy are the principal investigations. These are usually preceded by routine haematology and biochemistry.**

Radiological and imaging techniques

The diagnostic procedures for assessing the patients with suspected or known digestive disease include:

- ***Roentgenography (radiography, x-rays);***
- ***Angiography;***
- ***Radionuclide studies;***
- ***Computed tomography;***
- ***Magnetic resonance imaging;***
- ***Ultrasound examination (ultrasonography);***
- ***Cholecystography;***

Plain X-rays

- Plain X-rays of the chest and abdomen are chiefly used in the investigation of an acute abdomen including patients presenting with acute colitis. Analysis of gas shadows gives information about the bowel. Areas of calcification can be seen in chronic pancreatitis. Faecal loading is seen in constipation.

Roentgenography

- The plain radiograph of the upper abdomen is an important investigation in patients presenting with symptoms of acute or chronic disease of the pancreas. In acute pancreatitis it may show the colon ‘cut-off’ sign, a sentinel loop, evidence of stomach displacement or of a pancreatic abscess. Pancreatic calcification may be seen in patients with chronic pancreatitis.

Roentgenography

- Plain abdominal radiographs may provide help to obtain the required information in the majority of cases. Barium sulphate suspension continues to be widely used for routine gastrointestinal tract examination.
- The technique allows the esophagus entire length to be visualized. The separate moments of the esophagus filling and condition of the esophageal mucosa can be assessed. Special barium studies are sometimes indicated, such as cineradiography or videoradiography, which demonstrate peristaltic, contraction ability, and functional abnormalities of the esophagus.

Roentgenography

- The shape, size, position and mobility of the stomach; carcinomas, ulcers and ulcer scars that have a converging fold pattern are easily detected. Small lesions and slight irregularity of the mucosa can be identified.

Barium swallow

- The oesophagus is visualized as barium is swallowed in both the upright and prone positions. Motility abnormalities as well as anatomical lesions can then be observed. Reflux, as demonstrated by the retrograde flow of barium from the stomach into the oesophagus, is best observed with the patient tipped head down. It can be more effectively demonstrated by asking the patient to drink water (water siphon test) or by distension of the stomach with gas by an effervescent agent. Swallowing a lump of bread or a marshmallow coated in barium can be useful in evaluating patients with dysphagia.

Double-contrast barium meal

- This is performed to examine the stomach and duodenum. A small amount of barium is given together with effervescent granules to produce carbon dioxide so that a double contrast between air and barium is obtained. This test has a high accuracy rate for the detection of significant pathology - ulcers and cancer - but requires good technique to achieve high-quality pictures. Gastroscopy is a more sensitive test for small superficial mucosal lesions and for bleeding and enables biopsy of any suspicious area.

Barium contrast studies

Barium contrast studies

Roentgenography

- **Barium-meal examination of the small intestine is normally made following examination of esophagus, stomach and duodenum. It is indicated when disorders causing morphological changes in the small intestine, such as Crohn's disease, tuberculosis, neoplasms, radiation damage, ischemia or diverticulum, are suspected. The functional properties can be also assessed by x-ray study. Cancers of the small intestine have no specific radiological patterns.**

Barium contrast studies

Small bowel follow-through

- This is used to examine the small bowel and ideally should be performed separately from a barium meal as a different technique is employed . Barium is swallowed and X-rays are taken as the barium passes through the jejunum and ileum into the right colon, which usually takes about 1 hour. The fold pattern and calibre of the small bowel can be assessed, and specific views of the terminal ileum are obtained using compression to separate the loops of bowel and particularly to identify early changes in patients with suspected Crohn's disease.

Small bowel enema (enteroclysis)

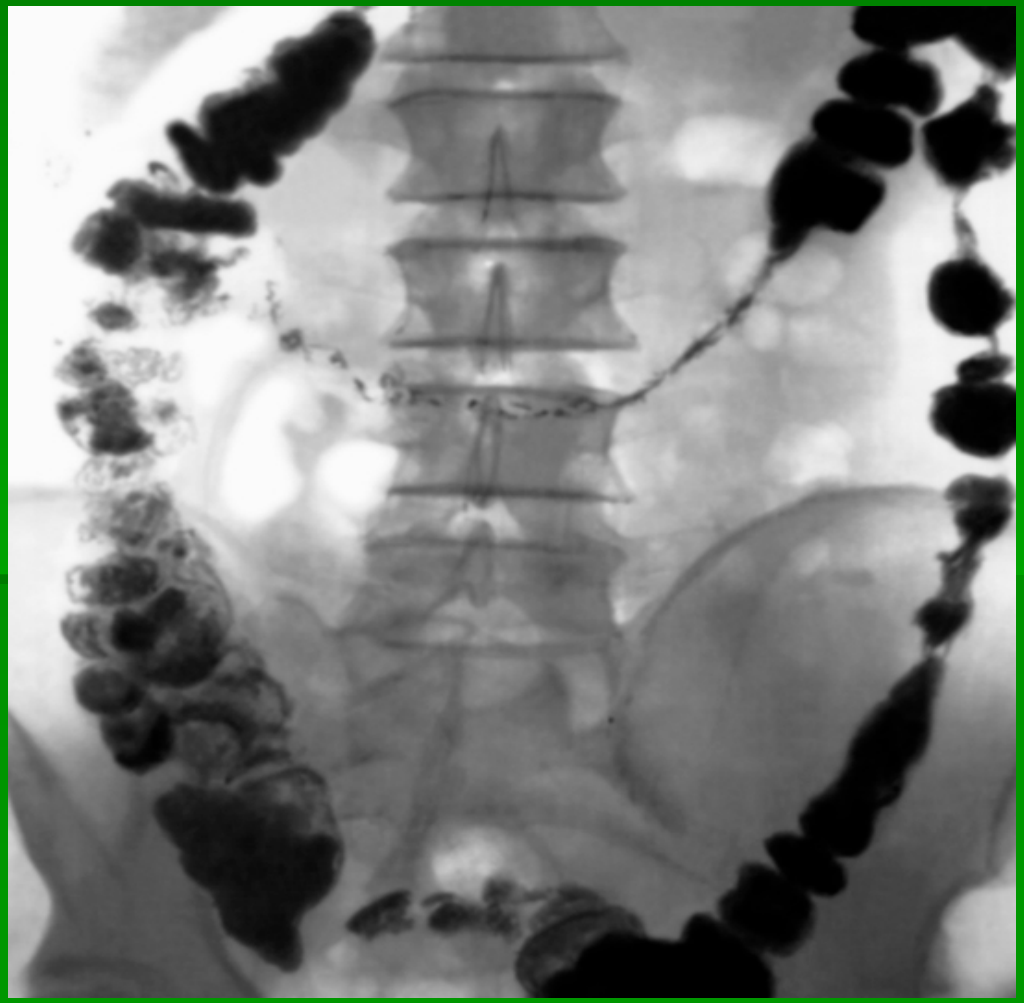
- A tube is passed through the duodenum and a large volume of dilute barium is introduced. In some centres this is the examination of choice for the assessment of small bowel disease. It is particularly useful when there is suspicion of intermit tent bowel obstruction to demonstrate strictures or adhesions.

Roentgenography

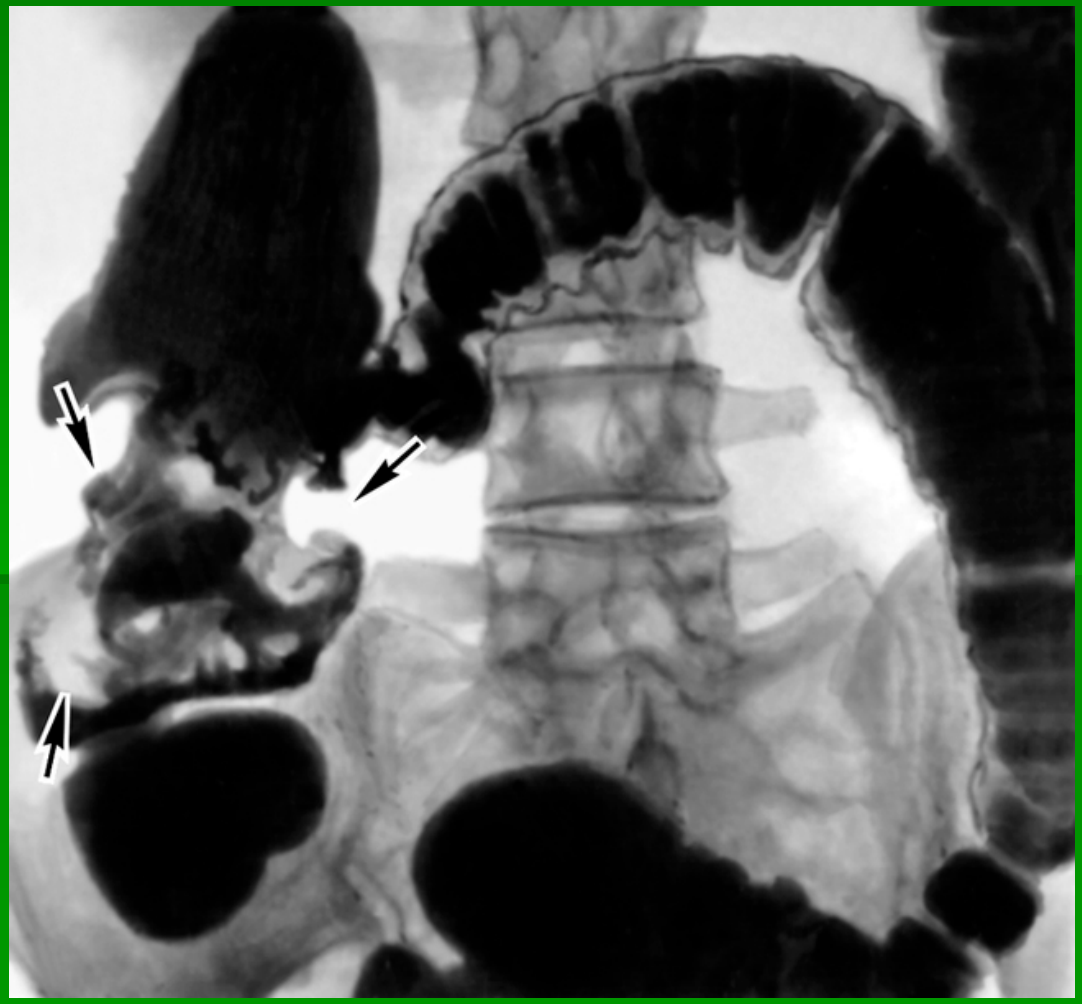
- The barium examination of the large intestine is important diagnostic procedure that gives information about its motor function, length, position, shape, and tone.

Barium contrast studies

Barium contrast studies



Barium contrast studies



Barium enema

Patients are given a low-fibre diet for 3 days and the colon thoroughly cleansed with oral laxative preparations. Barium and air are insufflated via a rectal catheter and double-contrast views obtained of the entire colon. Rectal examination and sigmoidoscopy should precede this examination. Some patients find the examination rather difficult to tolerate particularly the elderly, frail or immobile in whom other tests such as CT should be used. An 'instant ' barium enema involving no bowel preparation is very occasionally used in colitis .

Roentgenography

- Enlargement of the liver may be identified on plain radiographs, but adds little to clinical examination. Calcification is occasionally seen in the liver and the most common causes are old granulomatous disease and hydatid cyst.
- Plain radiographs are normally the initial diagnostic procedure in patients with acute symptoms of disease of the biliary tract. The plain film may show pathological calcification of the gallbladder, opaque calculi, gas in the biliary tree, or radio-opaque bile in the gallbladder.

Angiography

- *Gastrointestinal angiography.* Selective visceral angiography is indicated in certain patients who present with bleeding from the gastrointestinal tract.
- Angiography is done for two reasons in patients with acute bleeding - to locate the source of bleeding when it is unknown, and to stop the bleeding by selective infusion of drugs or embolic material into the bleeding area.

Angiography

- ***Coeliac-axis angiography*** **is useful in identifying hemangiomas, as they have feeding vessels of normal size but with a slow contrast flow through the lesion. Angiography will help to differentiate hepatic tumors and may be done during computed tomography to maximize the detection of metastases, but is more commonly used to identify the exact site and blood supply of neoplasms before partial hepatectomy.**

Cholecystography

- About 80-85% of gallstones are not radio-opaque and oral cholecystography remains the method of choice for examining the gallbladder with contrast medium to detect calculi when ultrasound is not available or is inconclusive. Abnormalities causing a change in the outline of the gallbladder such as adenomyomatosis are well demonstrated at oral cholecystography.

Stool examination

This can be useful occasionally to confirm the patient's symptoms (e.g. passing of blood or steatorrhoea). The shape and size may be helpful (e.g. rabbity stools in the irritable bowel syndrome). Stool charts for recording volume and frequency of defecation are useful in inpatients to follow the progress of diarrhoea.

EXAMINATION OF THE RECTUM AND SIGMOID COLON

- ***Digital examination*** **of the rectum should be performed in all patients with a change in bowel habit and rectal bleeding.**
- ***Rigid sigmoidoscopy*** **should, in hospital, be part of the routine examination in all cases of diarrhoea and in patients with lower abdominal symptoms such as a change in bowel habit or rectal bleeding.**
- ***Proctoscopy*** **is performed in all patients with a history of bright red blood per rectum; the narrow sigmoidoscope does not distend the lumen and haemorrhoids can be missed.**

Flexible sigmoidoscopy

- The rigid sigmoidoscope allows inspection of only the lower 20-25 cm of the bowel. A 60 cm flexible sigmoidoscope can be readily used in the outpatient department after minimal bowel preparation (a disposable enema). At least 50% of colonic neoplasms occur within the range of the flexible sigmoidoscope It is used to biopsy lesions in the sigmoid area seen on barium enema and for the follow-up of patients with distal colitis. It is useful as an initial test for patients with left-sided colonic symptoms and rectal bleeding but a full colonoscopy will be needed if no pathology is found.

Ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI)

- These techniques are used to define the intra-abdominal organs (e.g. liver, spleen, pancreas) but also to detect thickened bowel, masses, abscesses or fistulae. Ultrasound is often performed first as it is cheap and easy to perform although very operator dependent.

Ultrasound examination (ultrasonography)

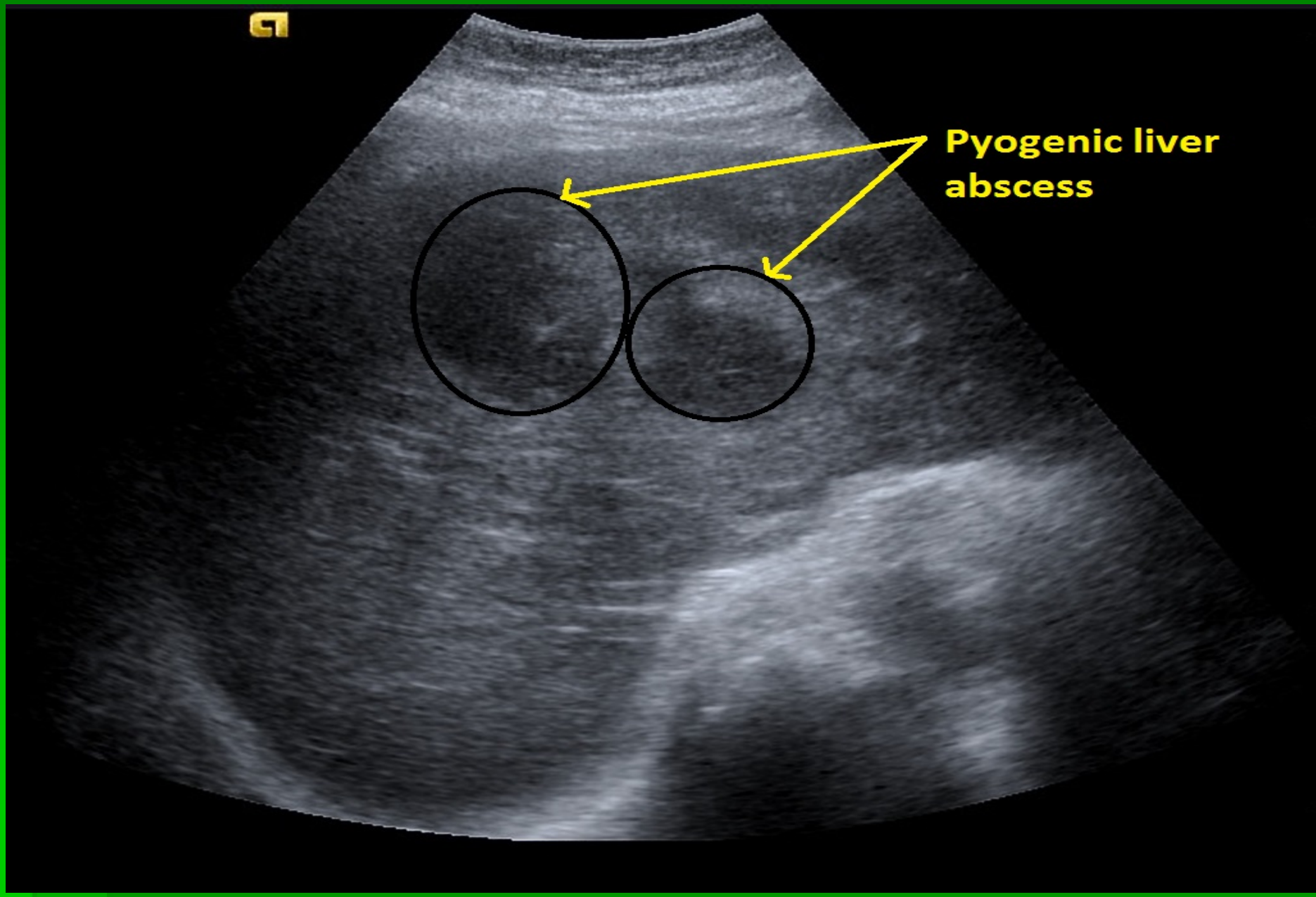
- High-definition sector scanners provide an excellent real-time image of the gallbladder, and the intrahepatic and extrahepatic bile ducts.
- Ultrasonography allows the measurement of size and the visualization of parenchyma of the pancreas. Acute pancreatitis, neoplasms and pseudocysts may be identified.

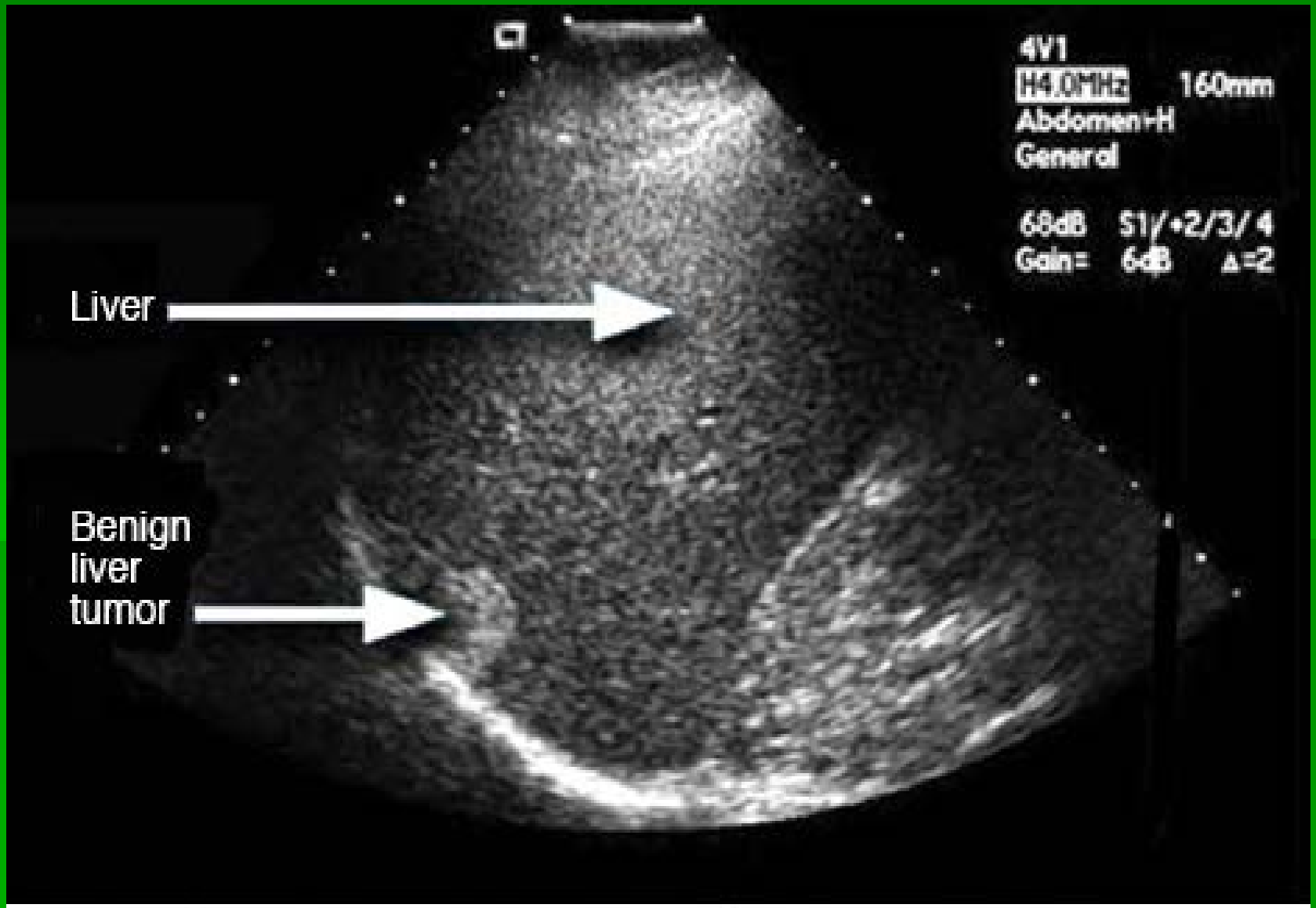
Ultrasound examination (ultrasonography).

- This involves no exposure to radiation and is the first -line investigation for the liver, gall bladder, spleen and pancreas. It will show dilated fluid - filled loops of bowel where there is obstruction, and thickening of the bowel wall when inflamed or infiltrated. It is valuable when ascites is suspected or when there is suspicion of abscess when it can be used to guide percutaneous drainage. In the acute abdomen, ultrasound can diagnose cholecystitis, appendicitis, enlarged mesenteric glands and other inflammatory conditions

Ultrasound examination (ultrasonography).

- Ultrasound examination of the liver is safe, cheap, and accurate in experienced hands. Abscesses appear as black transonic areas surrounded by high-intensity echoes, while cysts have black transonic areas surrounded by a thin echogenic border. Neoplasma produces areas of discontinuity in the homogeneous pattern of the liver.


Pyogenic liver
abscess


4V1
160mm
Abdomen+H
General
Liver
Benign
liver
tumor

Ultrasound

Endoscopic ultrasound (EUS)

- A gastroscope incorporating a high-frequency ultrasound probe at the tip is used to assess abnormalities arising in the oesophageal or gastric wall. It is particularly valuable in the detailed staging of oesophageal/gastric cancer, including detection of local lymph nodes. It is also a sensitive technique for detection of small pancreatic tumours.
- Endoanal ultrasonography involves the passage of a transducer into the rectum. It is used to define the anatomy of the anal sphincters, to detect perianal disease and to stage rectal carcinomas.

Endoscopic retrograde cholangiopancreatography

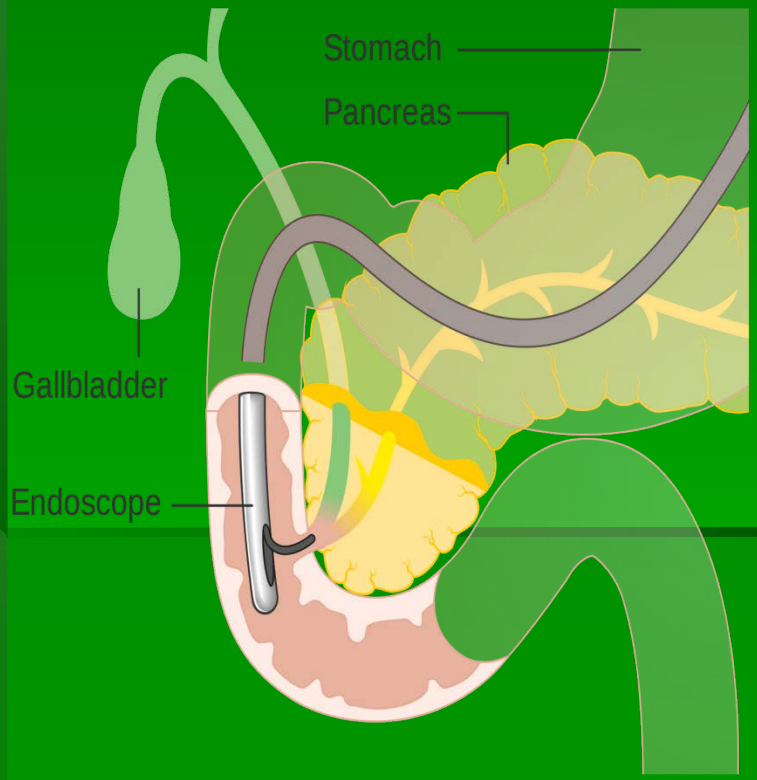
- **is frequently used to demonstrate the ducts in patients with obstructive jaundice.**

Endoscopic sphincterotomy can be done during the procedure, thus allowing bile-duct calculi to pass freely into the duodenum, and frequently relieving bile-duct obstruction due to calculi.

Endoscopic retrograde cholangiopancreatography (ERCP)

- ERCP is a technique that combines the use of endoscopy and fluoroscopy to diagnose and treat certain problems of the biliary or pancreatic ductal systems. Through the endoscope, the physician can see the inside of the stomach and duodenum, and inject a contrast medium into the ducts in the biliary tree and pancreas so they can be seen on radiographs.
- ERCP is used primarily to diagnose and treat conditions of the bile ducts and main pancreatic duct, including gallstones, inflammatory strictures (scars), leaks (from trauma and surgery), and cancer. ERCP can be performed for diagnostic and therapeutic reasons, although the development of safer and relatively non-invasive investigations such as magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound has meant that ERCP is now rarely performed without therapeutic intent.

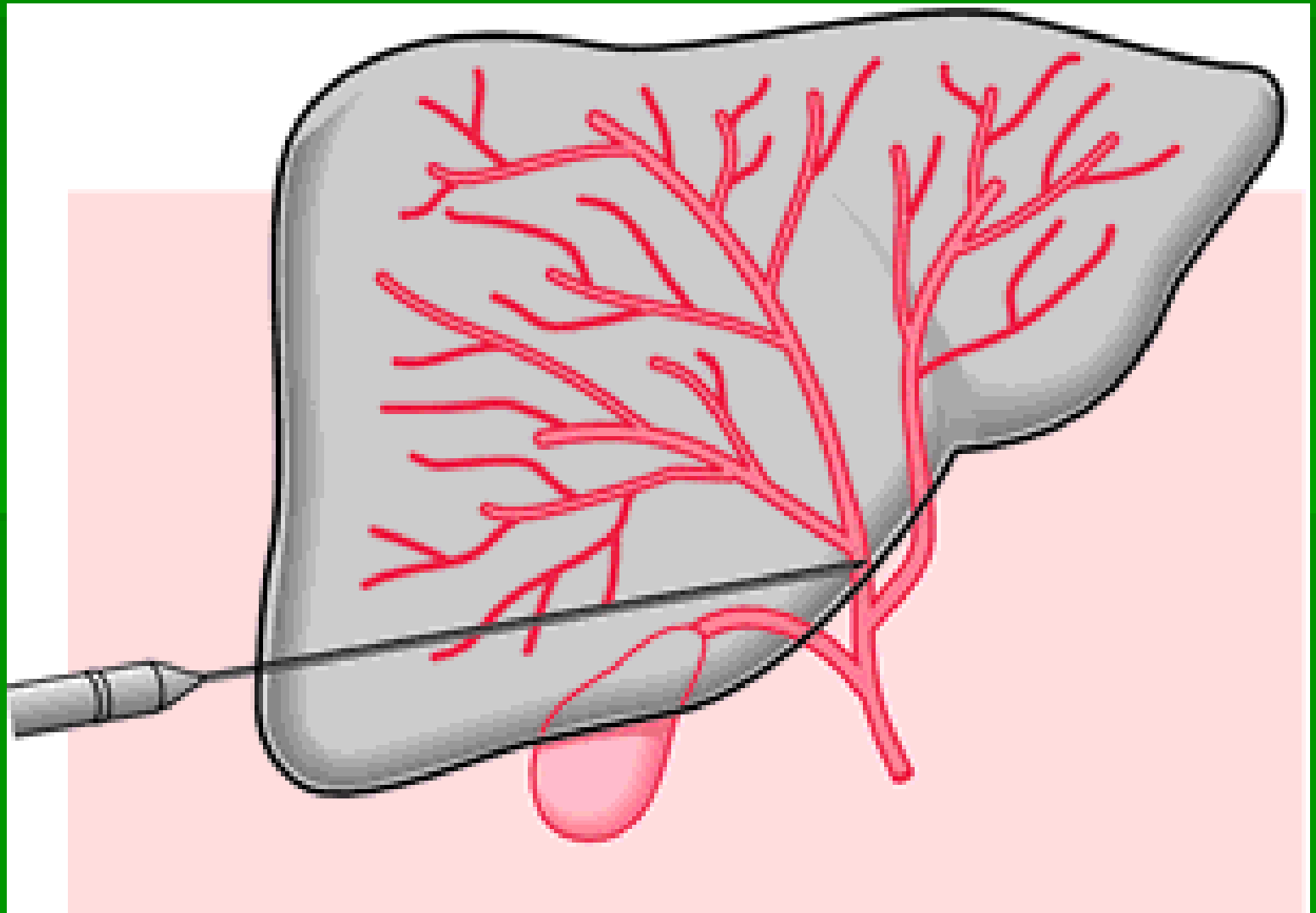
Endoscopic retrograde choledochopancreatography



Percutaneous transhepatic cholangiography

- ***Percutaneous transhepatic cholangiography*** **is widely used for demonstrating the bile ducts in obstructive jaundice.**

Percutaneous transhepatic cholangiography



Percutaneous transhepatic cholangiography revealed an obstruction of the first-order branch of the left bile duct, the inferior segmental bile duct and the posterior segmental bile duct

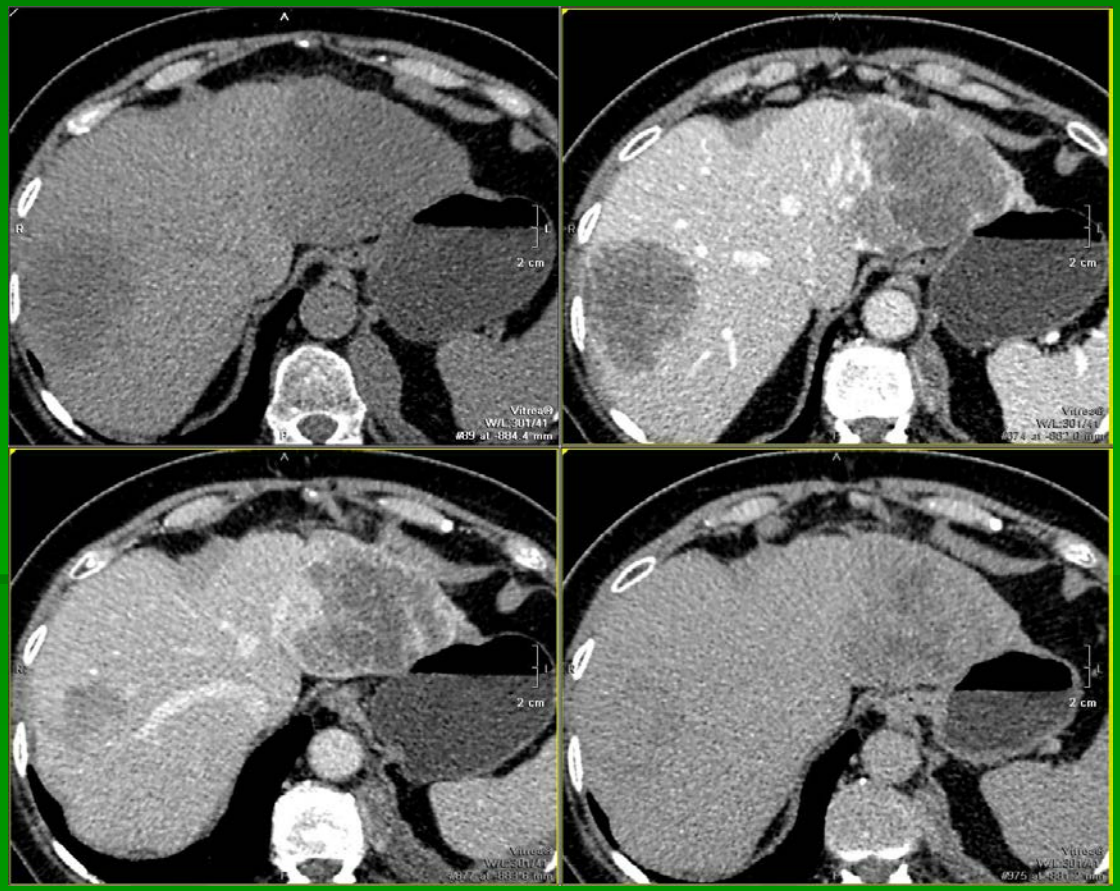
Computed tomography

- is useful in demonstrating metastatic disease and primary liver neoplasia. Cysts and abscesses also show well on computed tomography, but cirrhosis may be difficult to identify with certainty. The ability of high-resolution computed tomography to detect small intrapancreatic pseudocysts, pseudocysts containing gas or solid contents, pancreatic calcification, and peripancreatic fascial thickening make it the most accurate method for evaluating pancreatitis.

Computed tomography

- CT, particularly thin-section spiral CT, gives excellent anatomical definition. Modern multi-slice fast scanners are also able to evaluate the vascularity of an abnormality using intravenous contrast. The bowel wall and mesentery are well seen, together with the retroperitonal structures. It is used as a first-line investigation for the acute abdomen in many centres. Small volumes of gas from a perforated viscus can be detected as well as leakage of contrast from the gut lumen. Abscesses, appendicitis, diverticulitis, Crohn's disease and its complications can be demonstrated as well as the presence and cause of high- grade bowel obstruction. It is widely used in cancer staging and as guidance for fine-needle biopsy of tumour or lymph nodes. CT pneumocolon/CT colonography (virtual colonoscopy) involves air insufflation into the colon and provides a valuable alternative for evaluation of colon mass lesions. It is being used as a screening test for colon cancer with sensitivities of over 90% for > 10 mm polyps

Computed tomography



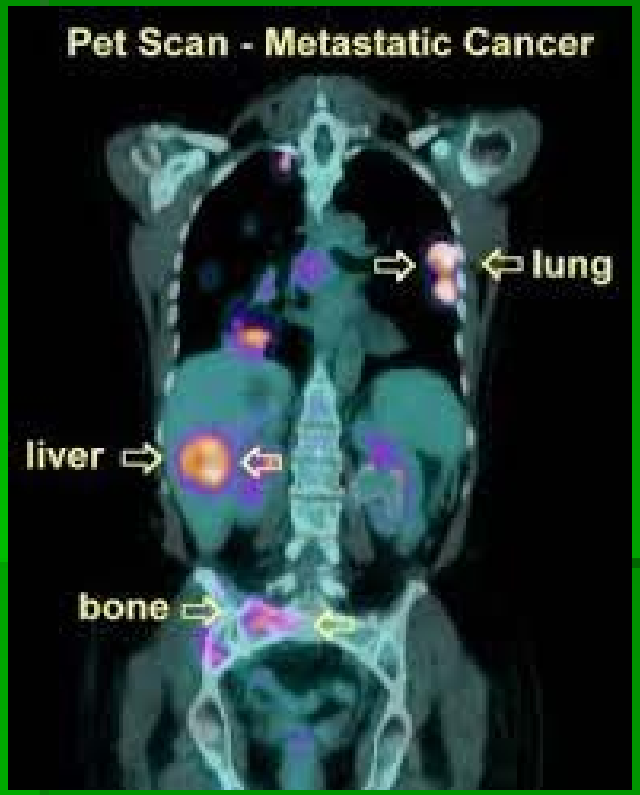
Magnetic resonance imaging

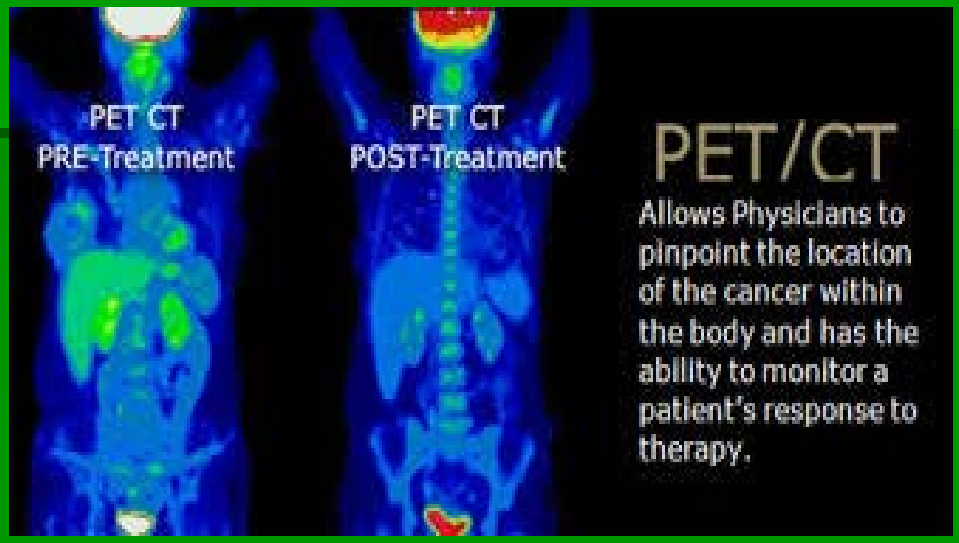
- MRI has the advantage of using no ionizing radiation. It is particularly useful in the evaluation of abscesses and fistulae in perianal region and its use is evolving in the evaluation of luminal gut disease. MRI is used more in hepatobiliary and pancreatic disease.

Positron emission tomography (PET)

- fludeoxyglucose F18 is used for staging oesophageal, gastric and colorectal cancer and in the detection of metastatic and recurrent disease.

PET scans


Pet Scan - Metastatic Cancer
lung
liver
bone


PET CT
PRE-Treatment
PET CT
POST-Treatment
PET/CT
Allows Physicians to pinpoint the location of the cancer within the body and has the ability to monitor a patient's response to therapy.

Radioisotope imaging

- Radionuclides are used to a varying degree depending on local enthusiasm and expertise.

Indications are:

- to demonstrate oesophageal reflux using [99mTc] technetium-sulphur colloid
- to determine the rate of gastric emptying using [99mTc] technetium-sulphur colloid or mIn-DTPA
- to demonstrate a Meckel's diverticulum using [99mTc] pertechnetate, which has an affinity for gastric mucosa
- to show the extent of inflammation and the presence of any inflammatory collections in inflammatory bowel disease using 99mTc HMPAO labelled white cells
- neuroendocrine tumours using radiolabelled octreotide and whole-body scanning.

Radioisotope imaging

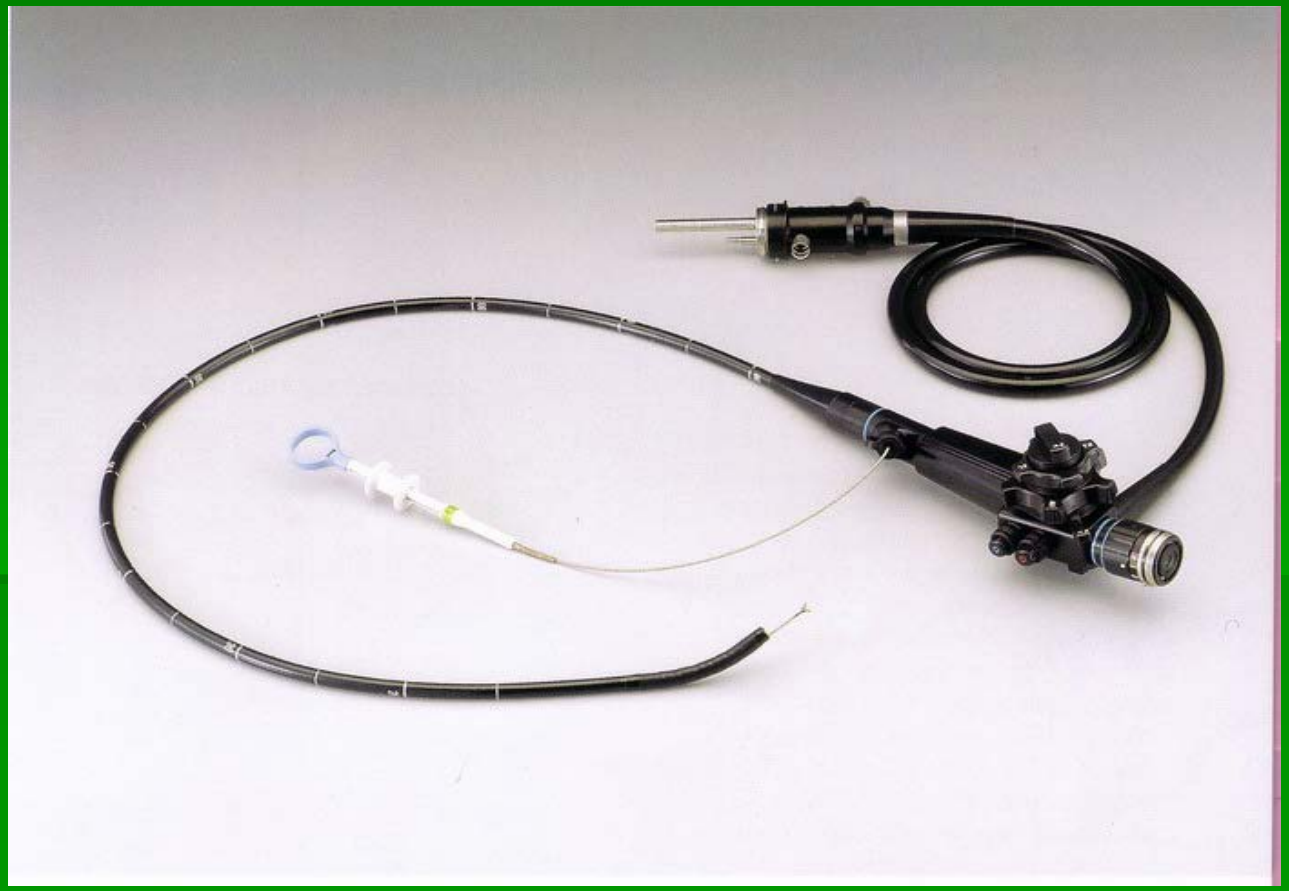
- Isotopes can also be used for assessing:
  - gastrointestinal loss of red cells by giving 51Cr red cells and measuring radioactivity in the faeces, or by label ling red cells with 99mTc and scanning the abdomen, e.g. Meckel's diverticulum
  - albumin loss in the stools in protein-losing enteropathy by giving 51CrCl3 intravenously (p. 306)
  - bile salt malabsorption by whole-body scanning and counting the activity in the faeces following oral 7:>Sehomochoyl taurine (SeHCAT)
  - urea breath test
  - bacterial overgrowth by measuring 14CO2 in the breath following 14C glycocholic acid orally.

Endoscopy

Endoscopy

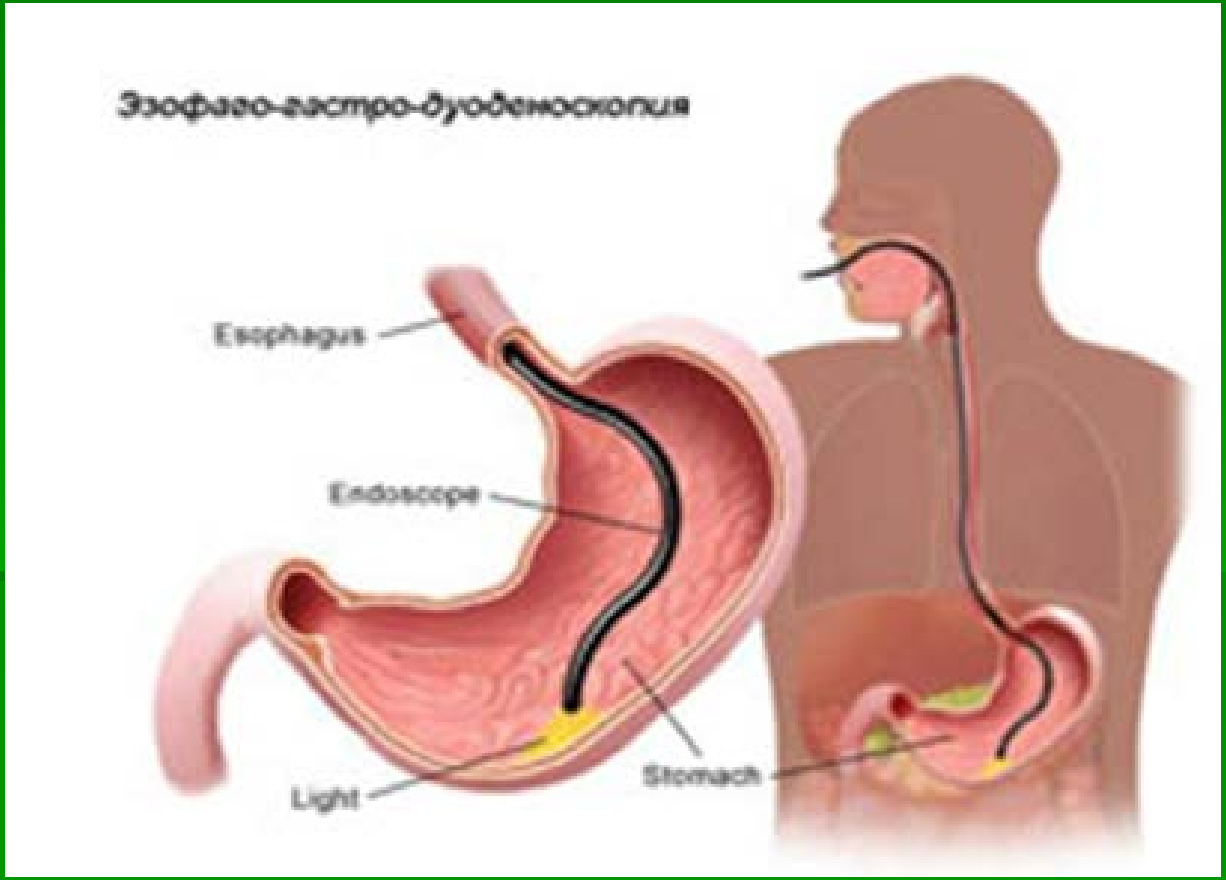
- Video endoscopes have largely replaced the old fibreoptic types. They have three chips (for blue, green and red light) mounted at the tip of the instrument. These chips relay colour images via an image processor to a television monitor. A permanent record of the procedure can be obtained. The tip of the endoscope can be angulated in all directions. Channels are present in the endoscope for air insufflation, water injection, suction and for the passage of biopsy forceps or brushes for obtaining tissue. These latter channels can also be used for other therapeutic interventions (e.g. injection of varices).

Endoscopy



Oesophagogastroduodenoscopy (OGDS).

Oesophagogastroduodenoscopy (OGDS)



Oesophagogastroduodenoscopy (OGD)

- This is often used as the investigation of choice for upper GI disorders by gastroenterologists because of easy access, the possibility of interventional therapy and obtaining mucosal biopsies. Relative contraindications include severe chronic obstructive pulmonary disease, a recent myocardial infarction, or instability of the atlanto-axial joints . The mortality for diagnostic endoscopy is 0.001% with significant complications in 1:1000, usually when performed as an emergency (e.g. GI haemorrhage).

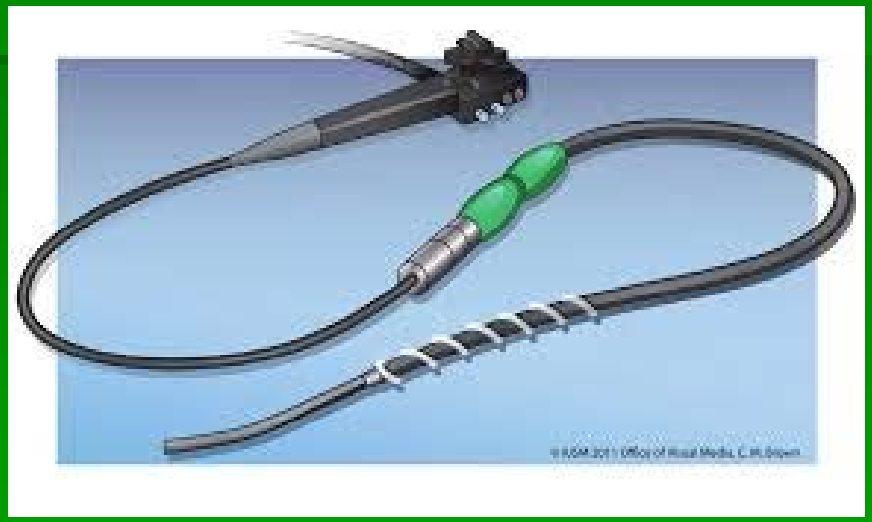
Endogastric pH-metry

- **Fasting: Greatly acid 0.9-1.9**
- **Medium 2.0-2.9**
- **Moderate 3.0-4.9**
- **Poor acid 5.0-6.9**
- **Alkaline 7.0-8.9**
- **Basal: Hyperacidity Less than 1.5**
- **Normal acidity 1.6-2.0**
- **Hypoacidity 2.1-5.9**
- **Unacidity More than 6.0**

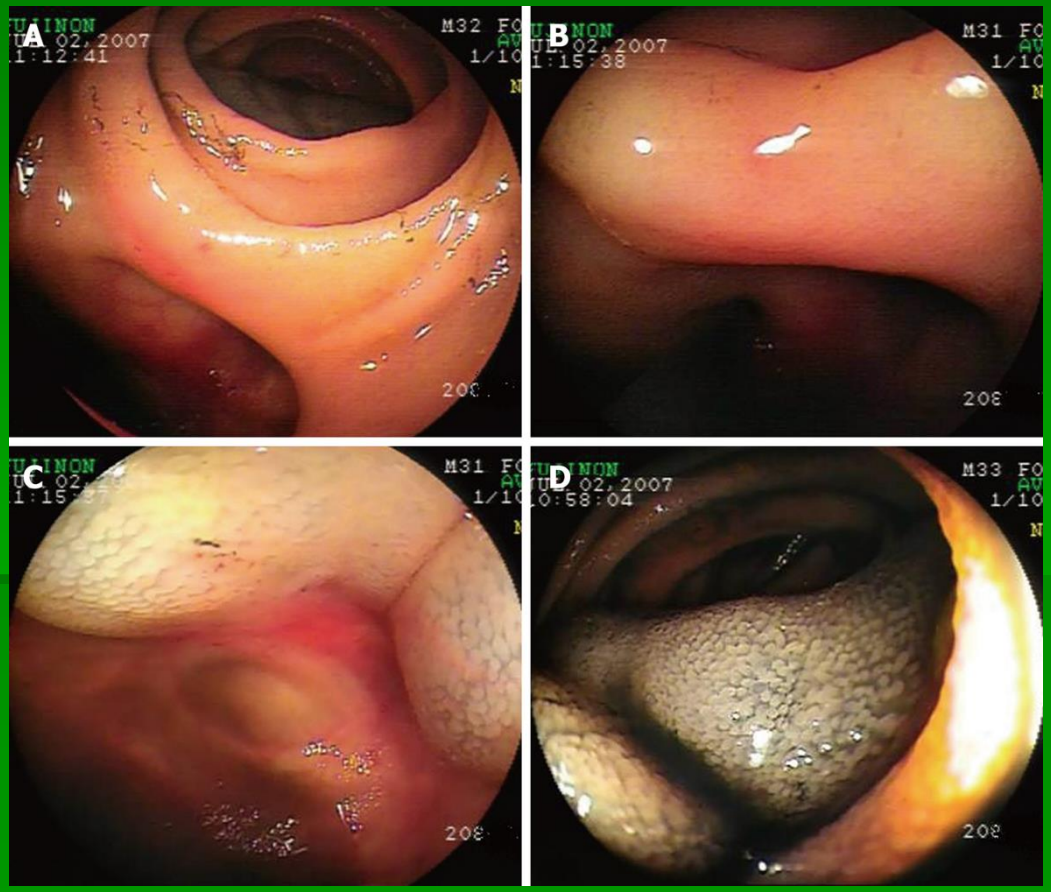
Enteroscopy

- The small bowel from the duodenum to the ileum can be visualized by enteroscopes. The indications for this technique are limited; the instruments are expensive, and consequently they are used only in a few centres.

Enteroscopy



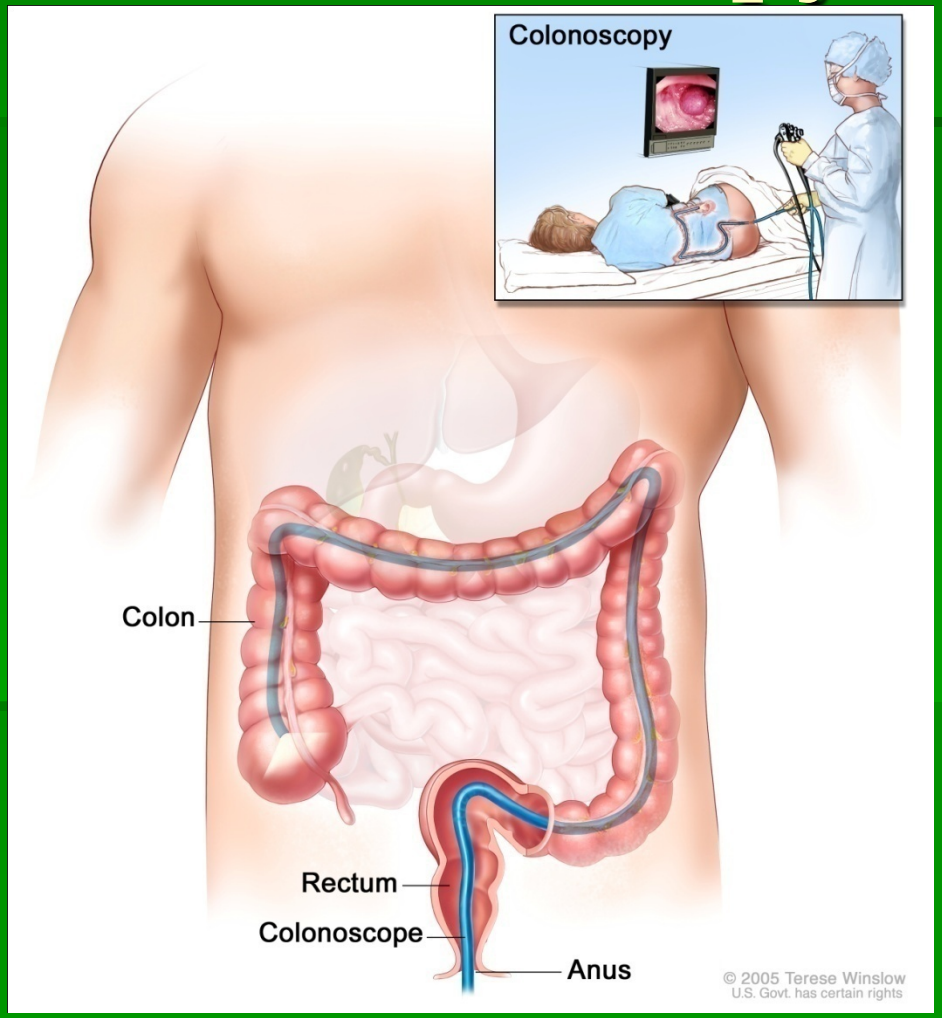
Enteroscopy



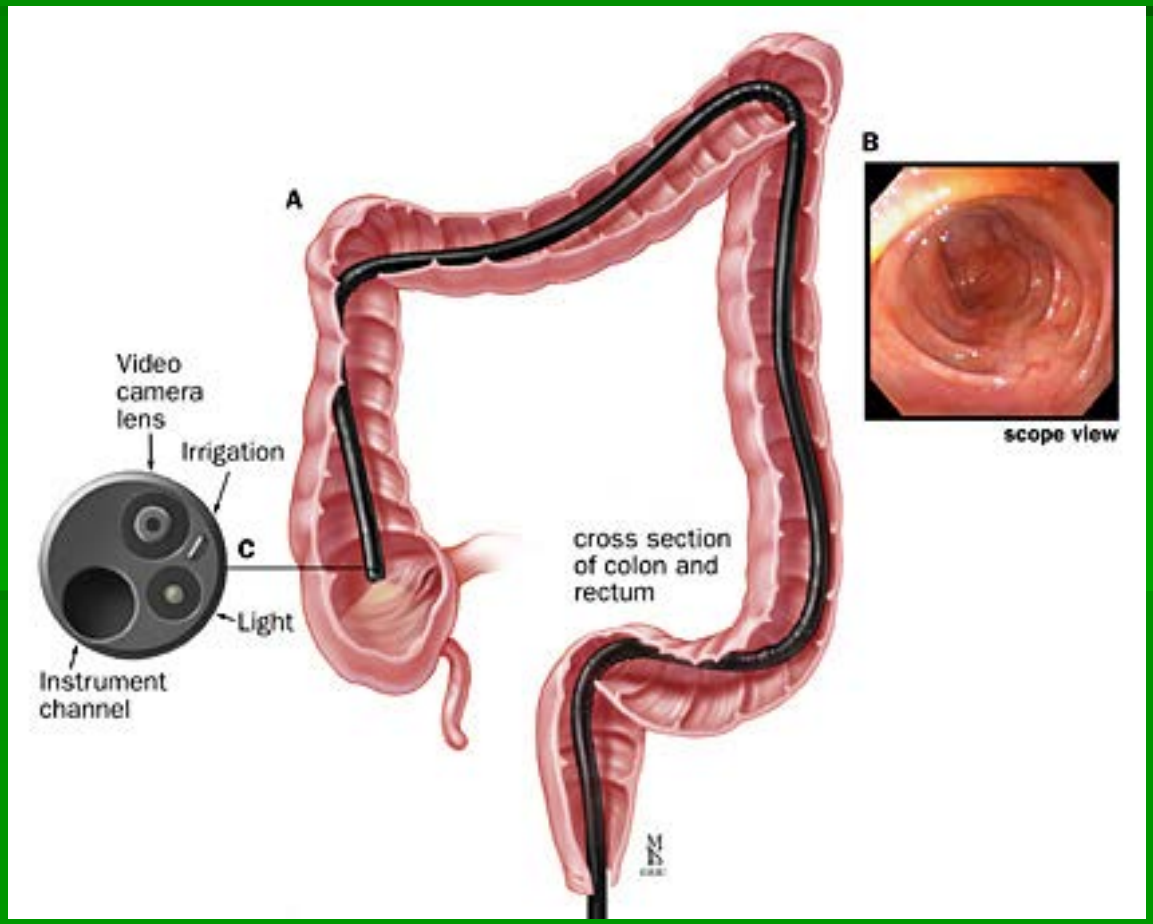
Colonoscopy

- This allows good visualization of the whole colon and terminal ileum. Biopsies can be obtained and polyps removed. The success rate for reaching the terminal ileum is approximately 90%. Perforation occurs in 1 : 2500 examinations and in 2% after polypectomy. The mortality is 0.02% for diagnostic colonoscopy.

Colonoscopy



Colonoscopy



Helicobacter pylori testing

- is used to diagnose an infection due to the bacteria and to evaluate the effectiveness of treatment. *H. pylori* infection is associated with an increased risk of developing ulcers (peptic ulcer disease), chronic gastritis, and gastric (stomach) cancer.
- There are several different types of *H. pylori* testing that can be performed. Some require a sample of breath or stool while others are more invasive and require a tissue sample obtained using a procedure called endoscopy.

Helicobacter pylori testing

- Testing may be ordered when someone is experiencing gastrointestinal pain and has signs and symptoms of an ulcer, which may include:
- Abdominal pain that comes and goes over time
- Unexplained weight loss
- Indigestion
- Feeling of fullness or bloating
- Nausea
- Belching

Noninvasive

- **Stool/fecal antigen test**
- Detects the presence of *H. pylori* antigen in a stool sample
- **Urea breath test**
- ***H. pylori* antibody testing**

Urea breath test

- A person drinks a liquid containing a low level of radioactive material that is harmless or a nonradioactive material. If *H. pylori* is present in the person's gastrointestinal tract, the material will be broken down into "labeled" carbon dioxide gas that is expelled in the breath.

H. Pylori antibody testing

- Test not recommended for routine diagnosis or for evaluation of treatment effectiveness. Detects antibodies to the bacteria and will not distinguish previous infection from a current one. If test is negative, then it is unlikely that a person has had an *H. pylori i*nfection. If ordered and positive, results should be confirmed using stool antigen or breath testing

Invasive

- ***With Endoscopy: tissue biopsy sample obtained;***

  good tests but less frequently ordered because invasive

Histology

- Tissue examined under a microscope by a pathologist, who will look for

H. pylori bacteria and any other signs of disease that may explain a person's symptoms.

Rapid urease testing

- ***H. pylori*** **produces urease, an enzyme that allows it to survive in the acidic environment of the stomach. The laboratory test can detect urease in the tissue sample.**

Culture

- The bacteria are grown on/in a nutrient media; results can take several weeks. This test is necessary if the health practitioner wants to evaluate which antibiotic will likely cure the infection.

PCR (polymerase chain reaction)

- **Fragments of *H. pylori* DNA are amplified and used to detect the bacteria; primarily used in a research setting.**

Test result

- A positive *H. pylori* stool antigen, breath test, or biopsy indicates that a person's gastrointestinal pain is likely caused by a peptic ulcer due to these bacteria. Treatment with a combination of antibiotics and other medications will be prescribed to kill the bacteria and stop the pain and the ulceration.

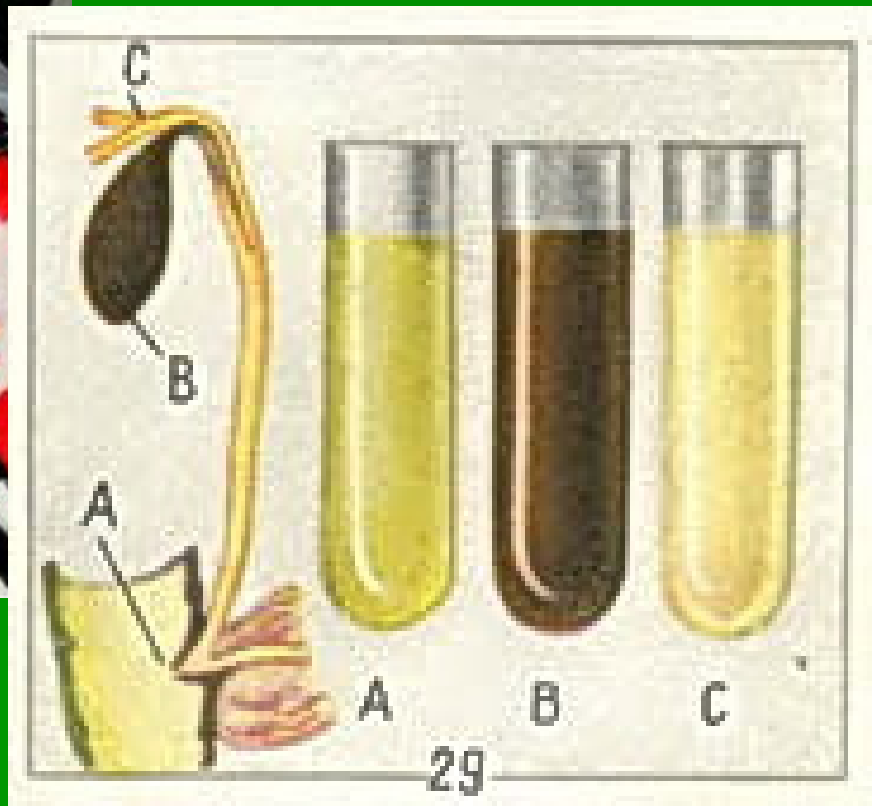
Test result

- **A positive blood test for *H. pylori* antibody may indicate a current or previous infection. A different test for *H. pylori* such as the breath test may need to be done as follow up to determine whether the infection is a current one.**

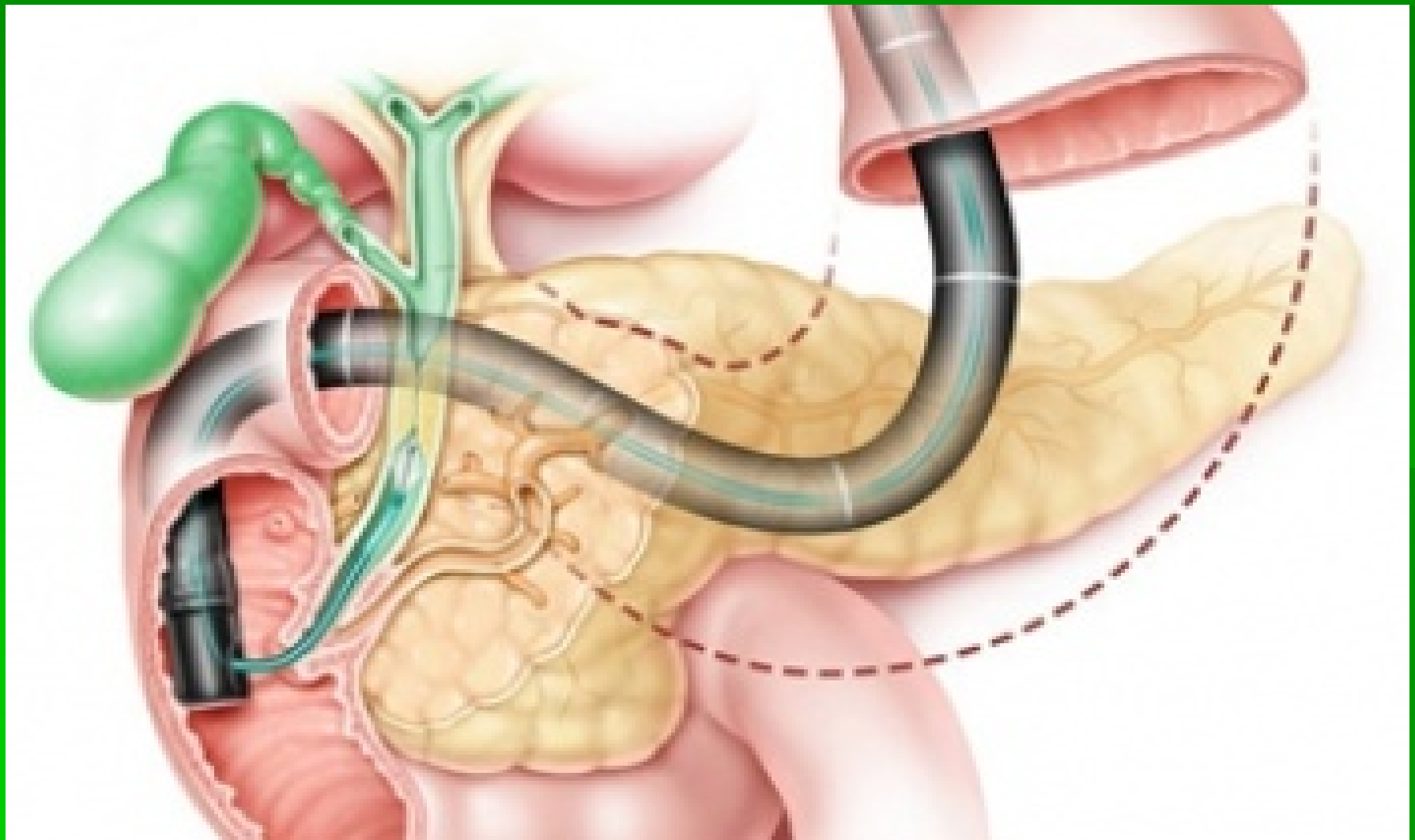
Test result

- A negative test result means that it is unlikely that the individual has an *H. pylori* infection and their signs and symptoms may be due to another cause. However, if symptoms persist, additional testing may be done, including the more invasive tissue biopsy, to more conclusively rule out infection.

Duodenal tube test



Duodenal tube test



Functional study of the liver and bile ducts
Pigment metabolism

- **Total bilirubin - 8.5-20.5 mcmol/L**

  ***Direct* bilirubin - 2.2-5.1 mcmol/L**

  ***Undirect* bilirubin - 6.3-15.4 mcmol/L**

Pigment metabolism

- ***Total bilirubin*** **level increasing is observed in damage of hepatic cells of inflammatory, toxic and neoplastic genesis; obstruction of the liver ducts (obstructive jaundice); hemolytic conditions; physiological infant jaundice.**
- ***Direct bilirubin*** **level increasing suggests liver cells damage (hepatitis, liver cirrhosis), bile ducts obstruction, cholestasis, liver abscess, and pregnancy jaundice.**
- **Undirect bilirubin increasing can be infectious hepatitis, hemolytic anemia, chronic hepatitis and liver cirrhosis caused by.**

Pigment metabolism

- **Increased amount of bilirubin in urine is called *bilirubinuria,* and appears when direct bilirubin level in the blood elevates to 0.01-0.02 g/L**
- **Bilirubinuria is an early sign of liver dysfunction, and occur in hepatic, subhepatic jaundice, and in liver cirrhosis.**

Protein metabolism

- **Normally, the total protein content in the blood serum is 70-90 g/L.**
- **Total protein consists of two fractions: *albumins* (56.5-66.5%) and**
- ***globulins (*33.5-43.5% *).***
- **Increasing of total protein level indicates chronic diseases of the liver, hyperimmunoglobulinemia, macroglobulinemia, dehydration or venous congestion.**
- **Decreasing of the total protein level suggests grave affection of the liver with hepatic-cellular failure (liver cirrhosis, fatty liver dystrophy, chronic hepatic failure, protein loosing in gastroenteropathy, peritonitis.**

Protein metabolism

- Globulins are subdivided into four fractions: α_1-globulins (2.5-5%), α_2-globulins (5.1-9.2%), β-globulins (8.1-12.2%), and γ-globulins (12.8-19.0%).
- Globulins levels increasing reflect activity of chronic hepatitis and indicate immunoinflammation:
- α_1-globulins (reaction of the acute phase) - acute, subacute and chronic inflammatory processes, malignant tumor;
- α_2- globulins - subacute and chronic inflammatory processes, hemolysis, malignant tumor;
- β-globulins - primary and secondary hyperlipoproteinemia;
- γ -globulins - chronic diseases of the liver, chronic infections, autoimmune hepatitis, liver cirrhosis

Protein metabolism

- **Globulins level decreasing observes in:**
- **α_1-globulins - deficiency of α-antitripsine;**
- **α_2-globulins - pancreatitis, diabetes mellitus;**
- **β -globulins - hypobetalipoproteinemia;**
- **γ-globulins - physiological in 3-4 month infants, congenital hypo- and ungammaglobulinemia.**

Protein metabolism

- ***Thymol test*** **- is so-called protein sedimentation test that reflects shift of albumin-globulin fractions. Normally, thymol test is 0-5 Units. The test is always positive in virus hepatitis, toxic hepatitis, chronic hepatitis, chronic cholecyctitis, and liver cirrhosis. It is negative in obstructive jaundice.**

Protein metabolism

- ***Prothrombin index*. Protrombin - is protein that is synthesized in the liver with participation of vitamin K. Not absolute its amount is measured, but in relation to standard of healthy person. Normal prothrombin index is 90-105 %. Elevation of prothrombin index occurs in obstructive jaundice, K-hypovitaminosis, damage of the liver parenchyma and intestinal dysbacteriosis.**
- **Prothrombin index decreasing reflects degree of hepatic-cellular failure.**

Lipid metabolism

- **Normally, *total cholesterol* content in the blood is less than 5.2 mmol/L.**
- **Increasing of total cholesterol revealed in the hepatic diseases accompanied by the bile congestion in the liver (obstructive jaundice, cholestatic hepatitis, malignant tumor of the pancreas).**
- **Decreasing of the total cholesterol in the blood arises in the liver cirrhosis, hepatic-cellular failure, and the liver malignant tumor.**
- **Normal β-*lipoprotein* content in the blood serum is less than 4.9 mmol/L. Increasing of the β-lipoprotein level is typical to acute hepatitis; decreasing - observes in long-standing starvation.**

Liver enzymes

- ***Aldolase*** **normal content is 0.09-0.57 mmol/h×L. Elevated aldolase levels are found in acute hepatitis (infectious and toxic), chronic hepatitis, tumor of the liver, hemolytic anemia.**

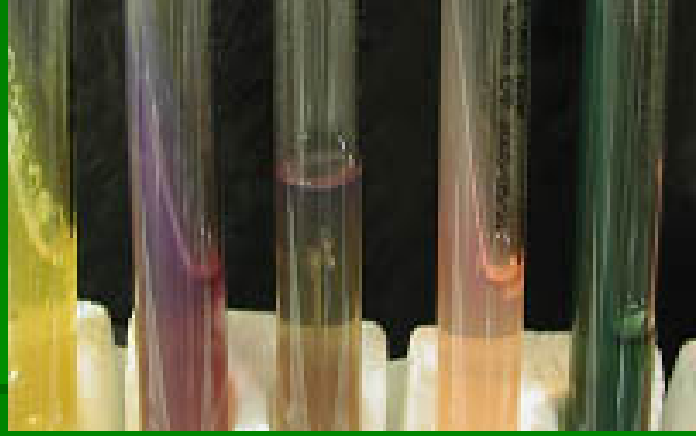
Liver enzymes

- ***Alanine aminotransferases*** **(ALT) normal level is 0.1-0.68 mmol/h×L. Increasing of ALT blood level are revealed in necrosis of the liver cells, acute and chronic hepatitis, cholangitis, fatty hepatic dystrophy, liver cirrhosis, obstructive jaundice, liver tumor, hemolytic conditions.**

Liver enzymes

- ***Aspartate aminotransferases*** **(AST) normal content is 0.1-0.45 mmol/h×L. Increased AST blood levels occur in necrosis of liver cells, obstructive jaundice, acute and chronic hepatitis, fatty dystrophy of the liver.**

GastroPanel



- GastroPanel - test panel for nonendoscopical diagnostics, laboratory tests blood complex to evaluate the anatomic and functional state of the stomach, including the study of the presence of Hp infection by serological method, determination of serum peptinogen-1(PG I) and serum gastrin-17 (G-17).

Indexes

- Antibodies to Helicobacter pylori (IgG) - presence of Hp infection;
- Pepsinogen 1 - a protein produced by main cells of the bottom and the body of the stomach. Reducing its concentration in the blood indicates atrophy of the stomach body mucous;
- Gastrin-17 - a hormone that regulates the secretion of hydrochloric acid, motility and maturation of cells of the gastric mucosa. Its level can vary depending on the level of gastric secretion (acidity) - rise in its reduction or decrease with increasing.

Information

- allows the diagnosis of Helicobacter pylori infection and to determine the need for treatment;
- allows the diagnosis of atrophic gastritis;
- assess the likelihood of the presence of various states of the gastric mucosa (normal, gastritis, atrophy);
- assess the risk of gastric cancer;
- assess the risk of peptic ulcers;
- assess the risk of GERD and Barrett's esophagus;
- give advice on feasibility of gastroscopy and histological examination.

Indications

- patients with complaints of pain or discomfort in the stomach;
- close relatives of patients with gastric cancer;
- patients with contraindications to endoscopic examination;
- patients with vitamin B12 deficiency with nerves system disorders (depression, neuropathy, dementia);
- patients with high levels of homocysteine, diseases of the cardiovascular system (atherosclerosis, stroke, heart attack);
- persons over 45 and smokers, to preventive medical examination.

Contraindications

- Allergy to soybean, dairy, eggs, chocolate is a contraindication for conducting Gastropanel-test, these products are part of the protein cocktail used during the stimulation.

Preparation for research

- 1 week before the study should refrain from taking drugs affecting gastric secretion, for 1 day to refrain from taking medicines that neutralize the hydrochloric acid. It is also necessary to refrain from physical activity, alcohol for 24 hours before blood sampling; sleep on the eve of the usual time and get up no later than one hour prior to blood collection. Morning of the study did not smoke, eat, drink.

GastroPanel

- The research conducted strictly on an empty stomach (fasting period of at least 12 hours). In the patient blood sample from a vein is carried out, then offer to drink 100 ml of the cocktail with a high content of soy protein (stimulant secretion of gastrin-17). After 20 minutes of taking stimulant secretion repeat blood sampling carried out.

Normal results

Parameter	Norm
Pepsinogen 1	40 - 130 mg / L
Gastrin-17	6 - 45 pmol / L

Antibodies for H. pylori IgG <30 U

FibroTest

FibroTest

- non-invasive method for diagnosing fibrosis developed in France and is officially recognized by the European and the American Association of liver disease as a tool for assessing liver fibrosis stage and necro-inflamative activity, as an alternative to invasive method - liver biopsy. For analysis and calculation using biochemical parameters 6-10 fibrosis formation markers (FibroTest, FibroMax) associated with inflammation, fibrotic changes and metabolic degeneration of the liver.

FibroTest

Signs and symptoms of liver fibrosis

- The early stage of fibrosis is difficult to diagnose because it is often asymptomatic. Blood test - in liver enzymes ALT and AST in the blood can judge the severity of fibrosis. It is believed that the level of AST has a strong connection with fibrosis than ALT levels. Value AST / ALT> 1 is a reliable indicator of severe stage liver fibrosis (including cirrhosis).

Signs and symptoms of liver fibrosis

- The initial stage of liver disease characterized by fibrosis in the increasing size of the liver. Further, a decrease in the level of white blood cells, platelets and red blood cells. As a result, the patient has anemia and thrombocytopenia observed. An indication that the disease moves to the stage of cirrhosis are enlarged spleen, and the esophagus varicose veins hemorrhage.

FibroTest

- FibroTest detect liver fibrosis stage in quantitative and graphical formats to assess changes in accordance with the international system METAVIR in stages (F0-F4). The second component is the estimated scale ActiTest, and provides a quantitative and Graphic picture of the necroinflammative activity (A0-A3) stage under evaluation METAVIR system.
- Sensitivity is 70%, specificity - 80% -100% to F1 and F2, F3 and F4.

Fibrotest

- FibroTest essence lies in identifying the specific patient's blood biomarkers that indicate the presence and severity of liver tissue fibrosis.
- In addition, fibrotest detect steatosis - fatty liver in which liver cells accumulates excess fat, losing its functionality.

Indications

- Chronic hepatitis, including viral;
- Hepatitis virus carrier;
- Obesity: diagnosis of fatty liver;
- Diabetes, fibrotest required to detect diabetic liver damage;
- Hypercholesterolemia;
- Alcohol abuse: for early diagnosis of Alcoholic liver.

Contraindications

- In some pathological conditions the result of the test may be wrong, so please refuse the test in acute hepatitis, acute hemolysis, nonliver jaundice, and Gilbert's disease, after liver transplantation.

Interpretation of results

- The results of the test severity of fibrosis denoted by the letter F and the corresponding figure where no fibrosis - 0, 1 - fibrosis without signs of connective tissue strands (septum), 2 - single sept, 3 - presence of multiple sept and 4 - symptoms of cirrhosis.
- Necrotic inflammation processes are marked with the letter A and numbers from 0 to 3, steatosis - the letter S with rungs from 0 to 4.
- The result of the test is calculated by taking into account the protocol anthropometric data (age, height and weight of the patient).

FibroTest: advantages

- High accuracy of results and the ability to detect early Stage fibrosis and fatty liver.
- Complexity research: makes it possible to evaluate several components that characterize the structural state of the liver and it's functionality.
- Low invasiveness, blood sampling carried out in the usual way - by puncture of a vein in the crook of the elbow.
- Lack necessary training.
- Ample evidence for the test: research possible in cases where the patient does not allow for a liver biopsy.

FibroMax

- FibroMax is a combination of five non-invasive tests: FibroTest (diagnosis of liver fibrosis) SteatoTest (diagnosis of fatty degeneration of the liver), AktyTest (score necroinflammative activity) AshTest (diagnosis of alcoholic steatohepatitis in alcohol abuse patients) NashTest (diagnosis of nonalcoholic steatohepatitis in patients with metabolic syndrome).

Conclusion

- **Thus, the results FibroTest and FibroMax are high at all stages of fibrosis, which allows the use of these tests in clinical practice to monitor progression of fibrosis and antifibrotic therapy evaluation.**

Hydrogen breath test

- Express method for determination of the small intestine disbiosis.
- Hydrogen test performed at the Gastrolayzer device. The principle study is in determining the concentration of hydrogen in exhaled air. Because hydrogen production is the result of life anaerobic bacteria there is a direct link of their number to its concentration. Thus, excessive anaerobic growth is accompanied by increasing concentration of hydrogen in exhaled air. Hydrogen test conducted for 2 hours

Indications

- Irritable bowel syndrome
- The syndrome of bacterial overgrowth in the small intestine in a number of gastrointestinal diseases, including:

- Exocrine pancreatic insufficiency
- Cirrhosis
- The failure of the ileocecal valve, resulting inreproach bacteria from the colon into the small
- Small intestine diverticulosis
- Gallbladder disease
- Chronic inflammatory bowel disease (often combined with malabsorption of carbohydrate)
- Diarrhea
- flatulence, bloating, flatulence
- steatorrhea (increased fat in the stool)
- creatorrhea (violations digestion of protein)
- Control of celiac disease and other diseases with atrophy of intestinal villi
- Timing orocecal passage

Research conducting

1. 24 hours before the study to exclude the use of apples, cabbage, onions, garlic, beans, pickled vegetables, meats, milk, juice, chocolate, gums.
2. At least 14 hours before the test do not eat, you can drink only water.
3. No smoking for 12 hours before.
4. On the morning of the test exclude the use of adhesives for dentures.
5. 2 hours before the test did not sleep, did not perform physical load.
6. In the morning brush your teeth.

Contraindications

- 1. Hereditary lactulose intolerance
- 2. Hypoglycemia starvation (postprandial hypoglycemia)
- 3. The use of antibiotics at last 4 weeks
- 4. Colonoscopy at last 4 weeks
- 5. Renthenologycal research of intestines
- 6. The use of laxatives, in particular lactulose, in the last 4 days

The procedure