

Examination of the digestive tract

Digestion of food intake is initiated in the oral cavity, where salivary amylase acts primarily on starch. In the stomach, digestion through the gastric phase continues, where secreted gastric juice by the action of hydrochloric acid and gastric proteinases denatures protein molecules and cleaves their polypeptide chains. This digested food of mushy consistency (so-called chymus) leaves the pyloric part of the stomach and enters the duodenum. Chymus mixes with pancreatic juice and bile, nutrients are intensively processed. The breakdown of proteins, starch, fats continues and the absorption of nutrients in the small intestine. The absorption of water and salts is completed in the large intestine, and the activity of bacteria is also important, various gases (methane, hydrogen, etc.) are produced. The intestinal contents gradually thicken and stool is formed from the rest of the undigested food.

Selected laboratory tests of the stomach

2-3 liters of gastric juice are formed in the stomach daily. In an empty stomach, juice with a neutral to slightly alkaline pH is formed. It consists of mucus, water and ions. Mucus produced by secondary cells is an important part of the stomach's defenses against mucosal digestion. After eating, enzymes and hydrochloric acid are secreted into the gastric juice. Hydrochloric acid is produced by capillary cells at a concentration of 0.5 mol / l. After mixing with other secretions, the pH of gastric juice is 1-2. The main cells produce pepsinogen, which is hydrochloric acid and later also autocatalytically activated to pepsin. An internal factor - a glycoprotein necessary for the absorption of vitamin B12 - is also formed in the main cells of the pyloric part.

Determination of HCl release through the gastric mucosa

Determination of HCl output, ie the amount of HCl produced in a certain time interval, is one of the important indicators of gastric mucosal function. It is determined both on an empty stomach in resting conditions - the so-called *basal acid output* (BAO) and the maximum secretion level after an intense stimulus - MAO (*maximum acid output*) or PAO (*peak acid output*). Although the actual acidity of gastric secretion - pH value - depends significantly on HCl release, it is affected by the volume of gastric contents (fasting volume of secretions and swallowed saliva) and the binding of H⁺ ions by conjugate bases, eg glycoproteins in mucus secretion. To determine HCl output, it is necessary to know the length of the collection period, the volume of gastric secretion and its titratable acidity.

Additional data are the pH value of the secretion, in case of insufficient acidity also the detection of the presence of lactic acid. H⁺ ions perform their function in gastric digestion only in higher concentrations (pH <3).

Preparation of the examinee for collection. The examinee does not smoke, eat or drink before taking 12 hours. A nasogastric tube is inserted into the stomach; the pH of the pumped secretion indicates the correct position of the probe: if the pH is > 5 (and is stained with bilirubin), contamination of the sample with alkaline duodenal content is likely. The contents of the stomach are completely drained; this material is not evaluated, only the removal of the stomach contents begins the first collection period. At short, about two-minute intervals, all gastric secretion is drained and the four 15-minute B1-B4 fractions are obtained by combining these portions. Pentagastrin (a synthetic analogue of gastrin) is then injected subcutaneously at a dose of 6 µg / kg body weight and the gastric secretion is gradually depleted again in four 15-minute fractions S1 - S4. The volume of all eight fractions is measured (the volume is indicated on the sample vial in the exercise) and the pH of all samples is measured using indicator paper. The titratable acidity is further determined in all samples with NaOH solution.

Task: Determination of HCl release through the gastric mucosa - pdf

Demonstration of Helicobacter pylori infection by urease test

Helicobacter pylori is a gram-negative microbe whose presence in the gastric mucosa is considered to be one of the etiopathogenetic factors of peptic ulcer disease. The microbe provides protection against strongly acidic gastric juice by producing ammonia; it is formed by the breakdown of urea by microbial urease

Urease is released from a biopsy specimen of an infected patient, which breaks down urea into ammonia and carbon dioxide. The reaction is indicated by a change in the color of the sensitive pH indicator. A number of other methods have been developed to detect *Helicobacter pylori* infection, such as a urea breath test, histological examination of biopsy specimens, determination of serum antibodies, or stool H. pylori antigen testing. At least two methods are optimal for identification.

Task: Demonstration of *Helicobacter pylori* infection by urease test - pdf

Laboratory tests for pancreatic diseases

Examination in acute pancreatitis

Acute pancreatitis is an acute, life-threatening disease. Its importance lies in the activation of proteolytic enzymes directly in the producing cells with the subsequent destruction of the pancreas. Confirmation of the diagnosis in clinical suspicion of acute pancreatitis is based mainly on the determination of serum pancreatic enzyme levels.

α -amylase (AMS). Serum AMS activity increases within 3-12 hours after the onset of the disease. Its values reach five times or more normal values. The biological half-life of the enzyme is 6-12 hours, so its level in the blood decreases rapidly. AMS can also be detected in the urine, the increase in levels is delayed by several hours after the increase in serum activity. Determination of pancreatic isoenzyme in serum increases the specificity of clinical diagnosis.

Pancreatic lipase. Serum pancreatic lipase activity increases in acute pancreatitis, usually in parallel with amylase activity.

Examination in chronic pancreatitis

In chronic inflammation of the pancreas, the tissue that ensures the function of the pancreas gradually disappears and is replaced by a binder. The basic examinations to prove reduced pancreatic activity are direct and indirect functional tests.

Secretin-pancreosmin test. This is a direct test. The patient is inserted into the duodenum after 12 hours of fasting. After depletion of the duodenum content, secretin is also administered at a dose of 1 U / kg body weight. Secretin stimulates the production of pancreatic juice, especially its amount and the production of bicarbonate. This is followed by the first collection period (30–60 min), when duodenal juice is pumped out at short intervals. At the end of the first collection period, pancreosmin (cholecystokinin) is given, which increases the secretion of pancreatic enzymes and at the same time causes the gallbladder to contract. During the second harvest period, duodenal juice is pumped out again. The volume and concentration of bicarbonate are determined in the duodenal juice from the first collection period, and the activity of pancreatic enzymes in the portion taken after the administration of pancreozymin. In chronic pancreatitis, HCO₃ values are less than 90 mmol / l.

NBT-PABA test. It is one of the indirect tests. The patient is orally administered *N*-benzoyl-L-tyrosyl- *p*-aminobenzoate (NBT-PABA). *By the action of pancreatic chymotrypsin, p*-aminobenzoic acid (PABA) is cleaved from it in the small intestine, which is absorbed into the blood in the intestine and then excreted in the urine. It is determined in 6 hours of urine collection. It is indicative of pancreatic insufficiency if <30% of the administered amount of PABA is excreted in the urine.

Breath tests in gastroenterology

Recently, some classical tests in gastroenterology have been replaced by breath tests. The principle of these tests is to detect the relative ratio of ¹³C-CO₂/¹²C-CO₂ (dCO₂) in exhaled air after oral administration of a ¹³C-labeled substance. There are three methodological approaches to exhaled air analysis and dCO₂ determination. dCO₂ can be measured by *Isotope Ratio Mass spectrometry (IRMS)*. The method requires only a small number of samples (several microliters), but is relatively expensive. The second approach is the detection of dCO₂ in the infrared spectrum (IR) based on the different absorption maxima of the two carbon isotopes in the region of 4350 nm of the infrared spectrum. Analyzers of this type are orders of magnitude cheaper, smaller, do not require special maintenance and are of the Point of Care Testing (POCT) type, suitable, for example, for outpatient clinics. The third type is the LARA analyzer based on optogalvanic measurement.

Breath tests for testing pancreatic function. Substrates are pancreatic lipase-cleavable substances. For example, the substrate ¹³C-MTG (¹³C *mixed triglyceride*) is triacylglycerol with ¹³C-octanoate in position 2 and stearate in positions 1 and 3. After cleavage by pancreatic lipase, fatty acids undergo β -oxidation and ¹³CO₂ (derived from ¹³C-octanoate) is excreted in the exhaled air. The patient must be fasting and the pancreatic replacement must be discontinued at least 24 hours before the start of the test. Indirect stimulation with the test meal includes crispy, cornbread with 50 g of fat (preferably vegetable margarine), to which 100 mg of ¹³C is added. ¹³C-labeled triacylglycerol. An air sample is taken before serving the test meal and then for 6 hours at 30-minute or 60-minute intervals. The evaluation is the cumulative output in 6 hours, which in percent of the administered substrate expresses the degree of pancreatic insufficiency.

Detection by *Helicobacter pylori* breath test. The ¹³C (¹³C UBT) urea-labeled urea breath test is now considered the gold standard for *Helicobacter pylori* infection. The principle of the test is based on the detection of labeled carbon dioxide, which is formed by the cleavage of the substrate - urea by an enzyme, urease, which is produced as a surface protein by the bacterium *Helicobacter pylori*. The test method was described as early as 1987 and there are a number of modifications, which differ mainly in the amount of substrate administered (50-100 mg), administration of citric acid solution or natural orange juice and the time interval for exhaled air sampling.

One of the variants is the so-called European standard protocol, where the test is as follows:

- The patient must be fasting to perform the test (must not eat, drink or smoke for at least 2 hours).
- Two or three exhaled air samples are taken in a test tube, it is important to ensure that air is collected from the final exhalation phase.
- This is followed by drinking 200 ml of citric acid solution or natural unsweetened orange juice, and after 5-10 minutes, 100 mg of ¹³C-labeled urea are given (children are given half the amount of 50 mg).
- After exactly 30 minutes, two or three exhaled air samples are taken into the tubes in the same way as at the beginning of the test.
- The air samples in the test tubes are analyzed by IRMS. The protocol variant for IR-POCT analyzers differs only in that exhaled air samples are taken in aluminum foil bags and analyzed immediately in an outpatient clinic or laboratory.
- The test result is known within 10 minutes.

Digestive tract occult bleeding test

Occult (hidden) bleeding is often an early sign of serious colon disease. It is most important for the early detection of colorectal cancer, where microscopic bleeding may be the only symptom of this serious disease for a long time. Its early detection can help to detect the early stages of the disease and initiate effective treatment. The examination consists of capturing traces of blood in the stool.

Diet before examination. Three days before collection, the person examined must exclude from his diet raw and uncooked meat, sausages, food containing blood, liver, bananas, leafy vegetables, tomatoes, radishes, horseradish and kohlrabi. Medicines containing ascorbic acid or acetylsalicylic acid must not be used.

OK The test is based on the detection of hemoglobin, which is caused by hemolysis of blood present in the stool. The principle of detection is similar to that of hemoPHAN diagnostic strips. The patient performs stool samples himself. Strictly adheres to the instructions for use.

Task: Test for occult bleeding in the digestive tract – pdf

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