Vinnitsa National Medical University

Name by N.I. Pirogov

Chair of endoscopic and cardiovascular surgery.

Local guidelines on topic:

Modern endoscopic technology, management of endoscopic service. Endoscopic terminology and semiotics.

Author

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To begin with, giving highly specialized and qualified endoscopic aid is necessary for the diagnostics of the gastrointestinal tract (GTI) diseases, pancreatobiliary and tracheobronchial systems, as well as for performing minimally invasive endoscopic interventions. Everyday, endoscopic aid is needed by patients with gastrointestinal hemorrhages, urgent surgical pathology, aspirations. At reanimation and pulmonological departments, performing the sanation of the trachea and bronchi is badly needed. Every year, over fifty thousand patients with gastrointestinal hemorrhages avoid operations due to endoscopic interventions.

Malignant neoplasms represent one of the most serious medico-biological as well as socio-economical problems. Over the world, cancer is the second cause of death after diseases of the cardiovascular system. After the data of the International Agency for Oncological Studies (2008), of twelve point five (12.5) million cases of primarily recorded cancer, one third was made by cancer of the GTI organs, of which over one million cases – colorectal cancer and about one million – stomach cancer. Over the recent twenty years, they have been recorded the permanent growth of yearly morbidity related to colorectal cancer.

Active programs of screening precancer diseases in Japan, the USA and the European Union countries have proved that the absence of a national state program for screening colorectal cancer and stomach cancer (in the countries where high morbidity related to this pathology has been registered) leads to the increase of mortality and reduction of the lifespan of patients after the disease is revealed. Over sixty percent of patients die during the first year after the stating of diagnosis, while five-year survival is some times lower than in those countries where screening programs are being performed. They have proven the direct interdependence of early revealing tumors and the lifespan of patients.

The most important role in screening is performed by endoscopic diagnostics which is conducted with the application of modern videoscopes. Unfortunately, such apparatuses, as well as a system of screening, are currently absent in Ukraine. The golden standard of the modern diagnostics of pathology at early stages methods of gastrointestinal endoscopy. It has been practically proven that examination by fibroendoscopes does not allow to reveal malignant tumours of the majority of localizations at an early stage. It is

only possible in case of the application of video endoscopes with the function of electronic chromoscopy, enlargement, endoscopic sonography. However, endoscopes which are in a small number bought by the Ukrainian Ministry of Health Protection do not fulfill the mentioned functions, which significantly decreases their diagnostic capacities.

1 .In what countries do the programs of screening precancerous diseases function?

2. What is the rate of lethality during the first year after making the diagnosis?

3. What is the dependence between early revealing tumors and the lifespan of patients?

Besides, endoscopic equipment has its own resource, after the reaching of which endoscopes start to be out of order: in particular, for gastroscopes, it is about five thousand investigations, for codoscopes – one thousand and **fifty (?**), bronchoscopes – one thousand, duodenoscopes – eight hundred. For neonatal endoscopes the resource is twice less.

Performing diagnostic endoscopy allows doctors of adjacent specialities, and namely, surgeons, therapeutists, gastroenterologists, pulmonologists etc., to state timely diagnosis and choose a correct tactics for treatment. The application of endoscopic interventions in gastrointestinal hemorrhages, foreign bodies, diseases of the pancreatobiliary system etc. allows to avoid surgical interventions, to reduce significantly expenditures on a patient's stay at the in-patient stage, to accelerate the processes of recovery and to renovate workability.

To fulfill the Order of the Ukrainian President's of 27.01.2010 #70/2010 'On taxation measures related to the reforming of the population health protection system', and to improve the endoscopic service, there has been developed the Draft of the concept of the State target program 'Endoscopy' for 2010-2015.

The aim and main tasks of the Program

The aim of the Program is to improve the quality of giving highly specialized and qualified endoscopic aid to the population of Ukraine by defining the main directions of reforming the system of endoscopic aid, a wide introduction of innovative endoscopic techniques:

1. Giving highly specialized endoscopic aid.
2. The reduction of the lethality and operational activity in acute surgical pathology.
3. The reduction of expenditures on medicamentous treatment.

4. A significant reduction of the period of a patient's stay in an in-patient department and his rehabilitation.
5. The reduction of volumes of payments after sick-leaves for unworkability.
6. The prolongation of the population's lifespan.

4. What resource does endoscopy equipment have?

5. What specialists can use the results of diagnostic endoscopy?

6 .What surgical interventions can be prevented with the help of endoscopic diagnostics?

7. What are the tasks of the State target program'Endoscopy' for 2010-2015.

The expected results

The Program's fulfillment will allow to reform by stages the endoscopic service, to extend the abilities in giving highly specialized endoscopic aid, to improve the results of treating patients with diseases of the gastrointestinal tract, lungs, to increase the revealing of patients with precancerous diseases and patients with malignant neoplasms at an early stage, to imrove the quality of giving urgent endoscopic aid.

The introduction of new medical techniques, the improvement of the qualification level and training of doctors, will allow to improve giving due quality services in the field of endoscopy.

The structure of a fibroendoscope. Fibroendoscopy is based on the transmission of the light and image through the collected in a bundle light guides made of glass **wool**. Each bundle consists of more than 1500 light-sensitive glass fibers. The light which falls down onto the disruption of each fiber is transmitted through it by the way of internal imaging. There exist a lot of different endoscopes, however they have principally the same organization.

Each endoscope has the block of control from which a flexible introductory tube departs. The block of control is linked to the illuminator with the help of a universal cable. In the inside of the universal cable there are the illuminating light guide, the channel for supplying water/air and the aspiration channel. In the models of Russian and American makes, the aspiration channel ends from the inferior side of the block of control and does not continue in the universal cable.

On the block of control, on the right, there are two knobs of management which rotate, they perform rotations of the bent distal end of the introductory tube. With the large knob

they perform rotations of the distal end upwards/downwards, while with the small one - rightwards/leftwards. Rotations are performed due to four thin metal ropes which go from the drums of the knobs of management to the bent distal end. Inside the bent portion, the ropes are attached to each other with metal rings in four cavities.

The knobs of management have a system of decelerating which provides the fixation of the distal end in a necessary position. When the introductory tube and block of control rotate, the rotations are transmitted onto the distal end as well. On the surface of the block of control there are two valves which, as a rule, are marked with red and blue. The proximal valve is connected to the aspiration valve, when it is pressed, there takes place the aspiration of the air and contents from the cavity under examination. The distal valve (the blue one) is connected with the channel of air and water supply. When it is closed, there tales place t air supplying, when it is pressed –water supply.

On the proximal but-end of the block of control there is placed an ocular with dioptrical rings for focusing. There are also contacts and the bayonet socket for linking to the videoapparatus.

Inside the introductory tube, the bundle of illuminating light guides is divided into two (in apparatuses with lateral optics – one), as well as the channels of supplying air/water and the aspiration channel lead to the end of the apparatus. In the inferior portion of the block of control, the aspiration channel has an additional entrance with a valve. With this valve one can carry different tools along the aspiration channel – this portion of the valve is called the instrumental or biopsy channel. The latter can have a different diameter – from 1mm to 5mm, depending on the purpose with which this endoscope is used.

Besides, there are endoscopes with two instrumental channels. In some apparatuses, especially in endoscopes with lateral optics, there is an elevator in the distal part of the instrumental channel which is folded and can provide the independent management of the tool. The elevator is ruled by the lever with a rope which is placed on the inferior portion of the block of control.

The distal bent end of the fibroendosocope ends with a metal or rubber point. On the butt-end of the introductory tube there is the objective-glass near which there is the aperture of the channel air/water with the mouth-piece which directs the air/water flow to the glass of the objective-glass for cleaning it up. Besides, on the butt-end there is the

aperture of the instrumental channel (one or two) and one or two windows for the exiting of the bundles of light guide fibers (for illumination).

Depending on the deployment of the observatory window and additional apertures on the distal end of the endoscope, all the apparatuses can be divided into three groups - those of butt-end (direct), lateral and butt-end-lateral (oblique) examination. The air and water are supplied to the endoscope from the illuminator with the help of linking the universal cable to the socket of the illuminator. The latter is a necessary constituent of endoscopic equipment. In the illuminator there are the source of the light - two lamps of cold light (halogen, xenon), the compressor for air supply, the ventilator for cooling and the synchronizer for taking photos.

8. What is the structure of a fibroendoscope?

Videoendoscopy is performed by apparatuses mechanically similar to fibro ones. However, the image is obtained with the help of the device with charge connection, (the English equivalent **CCD**), set into the distal end of the apparatus. The electric charge is red from all the pixels of the matrix and transformed into a videosignal which is presented on the monitor. An investigation which is performed with the help of the videoscope has some advantages:

1. The doctor needn't bend towards the ocular and the instrumental channel. Due to this, the ability to watch the patient is kept and decreased the risk of the organ under investigation contents' getting to the doctors face decreases.
2. The course of the operation can be observed by some experts, assistants, nurses and even the patient him/herself.
3. The diameter of the videoscope is significantly less than that of an ordinary endoscope.
4. The significantly greater capacity of the illuminating lamp allows to increase the brightness of the image by sixty percent.
5. The videosystem has the possibility to enlarge the whole image and its individual fragments. The choice of the amplification of the structure allows to improve the quality and clearness of the obtained image.
6. The modern endoscopes allow to enlarge an image thirty-forty times, as well as to perform endomicroscopy – to discern structural changes of the tissue under

investigation. The credibility of the method increases at the simultaneous application of staining the surface – chromoscopy.

ENDOSCOPIC SONOGRAPHY – is a half-invasive method of investigation with a low level of complications (less than 1 per 2000). While performing this investigation, the ultrasonic sensing element located on the distal end of the endoscope, is installed into the stomach or the duodenum. After the air is removed and the cavity is filled with water, they perform the scanning of the surrounding tissues in the radius of 3 to 15 centimeters, the focal distance - 3.5 cm. The application of low frequencies (7.7 and 12 mHz) makes endoscopic sonography a leading method of visualization.

In the literature, there are quite a few works on intraductal sonography with the application ultrasonic sensing elements which possesses a still larger sensitivity and are introduced along the conductor into the external biliary ducts with the application of an ordinary duodenoscope.

The sensitivity of intraductal sonography makes 98-100%. The method **1mWt** allows to investigate in detail the terminal parts of the common bile and pancreatic ducts as well as the muscular layer of the Oddi's sphincter, to reveal early periampular changes and differentiate them from the sphincter's tumorous damage. Complications occur rarely. The only drawback – the high price of such equipment which prevents the introduction of this method into a wide clinical practice.

9. What parts does endoscopy sonography allow to study?

ENDOSCOPIC optical coherent tomography. Optical coherent tomography is an optical method ob investigation which consists of obtaining the organisms's tissue in the transversal section with a high level of clearness, which allows the possibility of obtaining the morphological structure of tissue.

The principle of action of optical coherent tomography is analogous to that of ultrasonic one, with the only difference that there are used infrared, and not acoustic, waves. The image is formed by the way of performing repeated axial measures in different transversal positions while scanning the tissue with an optical ray. The resulting data obtained formed the two-dimensional picture of reverse dispersing (or reflection) from the tissue cellular structures. Optical coherent tomography presents interest for clinical application for a set of reasons. The resolving capacity of the method makes 1-15 mcm,

which exceeds ten times the resolution of other diagnostic methods and presupposes the investigation of an object on the level of the tissue's optical architecture. The information on tissues which is obtained with the help of optical coherent tomography is lifelong and reflects not just the structure, but also the peculiarities of the tissue's functional state. In it, they use radiation in the close infrared range with the power of 1 mWt, which does not produce any harmful effect on the organism. The method is not traumatic and have no restrictions which are characteristic of traditional biopsy.

For endoscopic optical coherent tomography they have created special optical probes which are conducted through the instrumental channel of the endoscope. These probes are analogous to the ultrasound probe for endosonography, have the diameter of 2.4mm, the length of 2.1m and ensure the access of low-coherent radiation to the mucous membrane of the gastrointestinal tract. The method's peculiarity is a small depth of scanning (2mm) under the high resolution capacity (10 times higher than in the standard ultrasound probe).

The application of endoscopic optical coherent tomography allowed to obtain the image of the mucous membrane and the submucous layer of the esophagus, stomach, duodenum, colon and rectum. It is considered that the method will be used in the diagnostics of early cancer, pathological changes of the submucous layer, different pathology of bile and pancreatic ducts.

A combination of the Doppler effect and endoscopic optical coherent tomography promises great perspectives in the diagnostics of hemorrhages in the lumen of the digestive tract as well as in the control of the effectiveness of homeostasis.

This new much promising technique increases greatly the diagnostic capacities of endoscopy and for the first time allows to obtain the image of structures on the microscopic level.

10. In what diagnostics is endoscopic coherent tomography used?

DOUBLE-BALOON TOTAL ENDOSCOPY – the method which allows to perform a complete examination of the intestinal tract. In this, a long endoscope is conducted into the middle of a flexible tube of larger diameter, on the ends of the endoscope and the tube there are baloons which, if filled with the air, can be used for fixing the position or the tube, or the endoscope in the lumen of the intestine. During the procedure, in the significant pushing of the endoscope forwards, it is fixed by the balloon, after which it is

‘approached’ by the external tube, then its end is fixed, while the endoscope is freed and its proceeding forwards continues.

Thus the endoscope is permanently has ‘the fulcrum’ which allows to push it easily forwards with a minimum discomfort for the patient. With the help of this method one can perform a more detailed investigation of a certain area of the intestine at the expense of the possibility of multiple pushing the endoscope forwards and backwards. As the construction of the endoscope which is used in the double-baloon method coincides with the construction of the standard endoscope, it becomes possible to use the sheer range of diagnostic and curative interventions with the help of different tools which are conducted through the instrumental channel.

CAPSULE ENDOSCOPE is one of the most modern techniques. In 2001, on the world market there appeared a unique diagnostic system ‘GIVEN M2A‘ which allows to perform probe-free visualization of the internal lumen of the thin intestine with the help of an autonomous single videoendoscopic capsule.

This procedure is performed in out-of-patient conditions and allows at early stages to diagnose various diseases of the thin intestine as well as to reveal hemorrhage, which is impossible for traditional endoscopes. In this connection, capsule endoscopy is considered as one of the most effective methods of the diagnostics of the thin intestine.

The system for capsule endoscopy videoendoscopy consists of the capsule ‘M2A’, the external device for recording and radio sensing element. The video capsule ‘M2A’ looks like a cylindrical bipolar capsule with the size of 11X26mm and consists of the lens, light source, modern semi conductive chip, battery, antenna, wireless frequency transmitter.

The capsule’s surface is covered with a special material which facilitates swallowing. Besides, the cover prevents adhesion of the intestinal contents (apart from blood clots and favours the obtaining of a high-quality image. A semispherical lens gives the 140 field of scope as well as in the most of the modern endoscopes. Eight-time enlargement allows to visualize individual villi of the mucous membrane .

The device transmits the image at the speed of 2 cadres per second which are saved in the format of gpr-files. During the investigation they perform 50-65 thousand of shots which are transmitted onto a special device for recording attached to the patient’s belt. As the

capsule moves freely with the intestine contents, its movement along the digestive tract reflects the intestinal peristalsis.

The preparation consists in that the patient stops eating six hours before the investigation. After collecting the anamnesis and physical investigation, the patient is informed on the purpose of the diagnostic **value** of the investigation. He/she is warned of the possibility of the capsule's movement arrest as well as the its surgical removal in 0.5-1% of cases.

11. What does the system of capsule endoscopy consist of?

12. What does the patients preparation for capsule endoscopy consist in?

Endochromoscopy – a method of revealing changes of the mucous membrane with the help of vital stainers such as: Lugol's iodine solution, methylene blue, indigo carmine, congo red, neutral red, oxide congo.

Vital stainers can be put by direct and indirect methods. The direct method presupposes putting the vital stainer on the surface of the area which is seen immediately through the catheter during the investigation. The indirect method is used for staining the stomach and requires its preliminary preparation – cleaning, solving and removing the mucosa, neutralization of the medium. After that, the patient drinks up the stainer, and then changes the body's position several times so that the whole mucous membrane of the stomach would get stained.

There also exist different ways of the interaction of stainers with the cells of the mucous membrane. In contrast interaction there occurs the visual enhancement of the relief of the surface at the expense of putting the stainer on it (methylene blue, indigo carmine).

Biological interaction – is the penetration of the stainer immediately in the cytoplasm of cells (methylene blue); in this. it is desirable to use the indirect method of staining as it provides a longer contact of the stainer with the surface of the mucous membrane and, correspondingly, a better absorption of the dye-stuff by epithelial cells.

Chemical interaction - it is a chemical reaction between the stainer, epithelial cells and secret, at the expense of which there occurs the change of the stainer's colour (Lugol's iodine solution, methylene blue, congo red, neutral red).

Toluidine blue and methylene blue (both in the form of 0.25% water solution) stain selectively the enterocyte, due to which they are used widely for revealing intestinal metaplasia both in the stomach and in the esophagus. In this, planocellular epithelium is stained leaving unstained the areas of gastric and intestinal metaplasia, as well as the

areas of dysplasia and cancerous degeneration of the planocellular and cylindrical epithelium.

An original method of the diagnostics of specific cylindrical epithelium was suggested by M. Guelrud and I. Herrera (1998) who used 1.5% acetic acid for the evaluation of the adequacyof endoscopic treatment (multipolar and argonoplasmic electrocoagulation) of the foci on Barret's esophagus. The method is based on that acetic acid causes hyperemia in the area of the foci of the cylindrical epithelium, in this the planocellular epithelium remains intact. This way has an advantage over staining with Lugol's iodine solution because it allows to differentiate the cylindrical epithelium and cicatricial tissue.

The methods of staining the mucous membrane with Lugol's iodine solution and the acetic acid solution are used immediately during the investigation.

13. What stainers are used in endochromoscopy?

Since 2001, they have been using the double staining of the mucous membrane of the esophagus with the simultaneous application of methylene blue and Lugol's iodine solution, which allows to differentiate the gastric and intestinal metaplasia of the epithelium in the esophagus and take biopsy more **aimedly** for the diagnostics of the Barret's esophagus.

At the same time, a wide application of Lugol's iodine solution increases the risk of the development of esophagospasm in patients during investigation, pain and a burning sense behind the breastbone. To make such complications impossible, after the end of staining and taking biopsy they use as antidote sodium thiosulphate (10% water solution in the amount of 10-20 ml).

The application of vital stainers allows to increase the percentage of revealing precancerous diseases and early forms of cancer.

SPECTROSCOPY- this technique is based on the investigation of the colour spectrum which is irradiated by the tissues of the organ under investigation. In this, the composition of the spectrum in a healthy organ and in the presence of different pathology changes. Tissue spectroscopy is used for revealing malignant changes in biological tissues or severe dysplasia, the evaluation of the degree of ischemia or inflammation. In our time, scientists have got favourable results in the diagnostics of malignization and dysplasia which allow to hope for the increase of the frequency of reveling early cancer in electroscopic investigation.

One of the promising methods of early endoscopic of malignant tumours is fluorescent laser spectroscopy**.** There exist its different methods. One of them is based on registering the autofluorescence of endogenous porhyrines whose concentration in the tumour is two-four times higher than that in normal tissue. Another method, more sensitive and widespread, is based on the application of exogenous photosensibilizers which are accumulated selectively in tumours. However, these preparations are retained for a rather long time in the skin which is connected with the risk of the development of the phototoxicity of reactions and requires following a special light regime.

A peculiar place in the set of substances used in fluorescent laser spectroscopy, occupies 5-aminolevuline acid. It is not a photosensibilizer but induces in cells the synthesis of photoactive protoporhyrine IX. The result of its accumulation in tumourous tissues and quick utilization in normal ones is a more intensive fluorescence of the former in relation to the latter, which provides the diagnostic effectiveness of the method. A speed metabolism of 5-aminolevuline acid excludes practically phototoxicity, which makes this method amore promising as compared to others. Spectroscopy has not got a wide spread yet but works are underway on creating tools and techniques of its application.

14. What is fluorescent laser spectroscopy?