

Modern Methods of Radiologic Staging of Gastric Cancer

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Keywords: review, gastric cancer, radiologic diagnosis In our country, gastric cancer (GC) is one of the of the most common oncological diseases.

ABSTRACT

The patients with gastric cancer (GC) sometimes have a very poor prognosis. In general, it depends on the time of GC verification, which dramatically changes prognosis and treatment plans. This article reflects current data on the epidemiology, mortality rate, and rates of the incidence of gastric cancer in different countries of the world. The most common and clinically convenient classifications and staging systems for gastric cancer are given, the need for the earliest possible diagnosis and verification of the stage of the tumor process is substantiated. There are considered in details the modern methods of the gastric cancer diagnostics, including esophagogastroduodenoscopy (EGD), as the method of choice for the primary detection of gastric cancer, and various methods of radiation imaging, including multispiral computed tomography and endoscopic ultrasonography (EUS), combined with chromoendoscopy, narrow-band tomography, and confocal laser endoscopy.

Particular attention is paid to the presentation of various methods of preoperative T-staging and N-staging of gastric cancer, comparing the diagnostic accuracy of MSCT and endoscopic ultrasonography. Diagnostic accuracy, sensitivity, and specificity of magnetic resonance imaging (MRI) and positron emission tomography (PET) are presented. Special attention is paid to the comparative analysis of the effectiveness of various imaging techniques in assessing the effectiveness of neoadjuvant chemotherapy; the results of tumor volumetry are compared with the histological response according to the Mandard score. Further prospects for the application and development of radiological research techniques are discussed.

vany. In 2022, Iraq was again registered 33,564 patients, and were registered at the end of the year about 140 thousand people with this diagnosis, lethal The rate in the first year was 15.9%.

Ratio in the structure of the incidence of female and male population differs slightly, so, in 2022 in the Iraq Federation in the male population in the structure of morbidity, the proportion of tumors stomach was 9.1% (3rd place), in women 5.8% (4th place). The rate of decline in indicators of incidence of stomach cancer in the Russian Federation from 2000 to 2022 in the male population was 26.6%, in the female 27.0%. At the same time, the risk of developing gastric cancer in the population of the Iraq Federation during life (0-74 years) remains enough high, for men in 2011 it was 2.99%, for women - 1.26%. In the world, this indicator was 2.37 and 1.02%, respectively [1, 2]. At In this respect, on a global scale, WJ is also a erect malignant neoplasm by race prevalence in the world, according to WHO in 2022 989,600 new cases were registered, which accounts for up to 8% of all cancer cases, and 738 thousand deaths, which is 10% of the total number of deaths from oncological diseases [3].

In most developed countries, the growth rate of cases the incidence of gastric cancer over the past 50 years has sharply decreased .the decrease in morbidity was partly explained by a decrease in chronic infection

Helicobacter pylori [4], as well as an increase in the level and intensity of screening studies cases in Japan and Korea, where the incidence is the highest [5]. Adenocarcinoma compositionly at 95% of all cases of gastric cancer. Most of these tumors are polypoid or ulcerated nym [6]. Based on the degree of invasion, RJ subdivided into early gastric cancer and spread strange stomach cancer. Early stomach cancer or the superficial form is limited to the mucous membrane coy and submucosa, regardless of the presence with or without metastases in the lymphatic nodes and can manifest itself as a small limited, sometimes ulcerated thickening walls of the stomach. Anatomical distribution of the stomach in the stomach relatively uniform, 30% tumor lei are in the antrum, 30% in the body stomach, 40% in the fundus of the stomach and cardia.

The most common metastatic sites are lymph nodes (80% of cases) teas), liver (40%), peritoneum (30%), lung(20%), pancreas (17%), retroperitoneal space (12%), adrenal glands (10%), ovarian nicks (5%) and diaphragm (5%) [7, 8].

GC is an aggressive carcinoma with a 5-year survival from 3% in case of stage IV tumors up to 85–90% in case of stage I tumors [9–11]. There are several classification systems for cancer. stomach, such as the international histological classification (WHO 2010), which is based on the cellular structure of the tumor, histological classification of stomach cancer according to Lauren (1965) [2], describing diffuse, intestinal and mixed type of gastric cancer, also distinguish macroscopic classification of stomach cancer, which unites the endoscopic classification of early gastric cancer of the Japanese Endoscopic Society properties (Japanese Endoscopic Society) and classification gastric cancer according to Borrmann (1926) [4].

In addition to the main classifications, there are also staging systems for gastric cancer. Most commonly used staging system for RJ was developed by the American Association Committee on Cancer (AJCC) TNM system[12]. This staging system evaluates the tumour, depth of invasion of the stomach wall(T); lymph nodes with metastases (N); distant metastases (M). It is also often used in oncosurgery one classification developed in Japan (Japanese Gastric Cancer Society classification) [13].

There are some differences between them, which are associated with different aggressive approaches to surgical treatment. Japanese classification- description characterizes the tumor itself in more detail, describing not only the depth of invasion in tissues, but also the phological structure, form of growth, as well as topography for the classification of lymphatic collectors, for a more accurate determination volume of lymph node dissection D0–3 during surgical intervention erratic, to improve the prognosis of survival.

Accurate preoperative staging of gastric cancer is necessary for planning the optimal method yes treatment, including minimally invasive procedures. In recent years, there has been an innovation

rational development of all diagnostic technologies, if previously operated the principle of sequential transfer move from a simple research method to a complex one, then in recent years, according to Hansen M. Lundsgaard(2014), A. Tashiro (2022), K. Furukawa (2022) believe appropriate choice of the most effective, including an expensive diagnostic method, or combination of methods to obtain the maximum fast and efficient results. This approach leads to improved treatment outcomes, including the level of five-year survival in patients patients with stomach cancer [14–16]

According to the recommendations of the Ministry of Health of the Russian Federation for the diagnosis gastric cancer (2017) to the required minimum of examinations methods for making a diagnosis, determining the client stage and development of a treatment plan for wives include the following procedures:

- ✓ history and physical examination;
- ✓ examination by a gynecologist in women and digital rectal examination in men;
- ✓ endoscopy of the upper gastrointestinal tract with biopsy;
- ✓ histological, cytological research biopsy material;
- ✓ radiography of the stomach;
- ✓ Ultrasound of the abdominal organs, retroperitoneal space, small pelvis or CT with oral and intravenous contrast; - X-ray of the chest;
- ✓ endosonography (required for planning endoscopic treatment or dissemination tumors on the cardia and esophagus for objective assessment of the level of the upper limit of the lesion);
- ✓ Ultrasound of the cervical-supraclavicular areas;
- ✓ detailed clinical and biochemical blood tests;
- ✓ ECG;
- ✓ tumor markers CEA, SA 72-4, Ca 19;9;
- ✓ analysis of a tumor biopsy for HER2-neu, if diagnosed or suspected metastases;
- ✓ colonoscopy.

Due to the limited scope of this article and the fact that not all of the listed diagnostic methods ki can be attributed to modern, we are in this brief review were limited to modern methods ladies diagnosing gastric cancer, having a direct relation to the subject of our scientific work.

Esophagogastroduodenoscopy (EGDS) is method of choice for primary detection of gastric cancer, method also useful for obtaining histological results logical study of suspicious formations ny and damage of various kinds. Nevertheless up to 6.7% of cases of GC with endoscopy may not be diagnosed rated [17].

Beam imaging techniques are useful for believing stage and prevalence have already been discovered female gastric cancer, but sometimes they can not detect previously diagnosed cancers.

A number of studies have noted an accuracy of 90% and more when using a multi-spiral computerized tomography (MSCT) to detect RJ using multiplanar methods reconstruction and virtual gastroscopy. However, according to other authors, MSCT detection RJ is moderately effective with precise ranging from 44 to 70% [18, 19].

Endoscopic ultrasonography (EUS) is combined method of high-frequency ultra- sound (5–12 Hz) and endoscopy, which allows evaluate the wall of the digestive tract and medially adjacent structures. EUS demon- strates the normal wall of the stomach as a five-layer new structure. RJ

is identified in EUS as area of focal thickening, irregularity or destruction of layers [20].

The EUS has been in use since the 1980s. Sensitive but and specificity for assessing serous lesions range fluctuates between 77.8 and 100% and between 67.9 and 100%, respectively. It is reported that common levels of sensitivity to T-stages are from 88.1% for T1 cancer, 82.73% for T2, 89.7% for T3 and 99.2% in T4 cancer [21]. Another recent metalysis showed that EUS can distinguish T1–2 tumors from T2-4 tumors with a sensitivity of 0.86 (95% confidence interval 0.81–0.90) and specific with a value of 0.91 (0.89–0.93). The presence of ulcers, large tumors sizes, features of tumor localization and diffuse histological structure of the tumor are important factors influencing the accuracy ness of diagnosis in EUS. Study cannot be carried out adequately if complete Tumor volume cannot be estimated due to pronounced strictures. Possibility of erroneous diagnosis may arise due to discrepancies in interpreting additional echoes, occurring between different histological layers [20, 22].

The overall accuracy of the EUS in determining research on the nature and degree of damage to the lymphatic nodes (N-stage) can be as low as 30%, but, according to the results of most studies, the composition of ranges from 66 to 90%. EUS demonstrates low sensitivity validity in detecting stages N2–3, which are technically difficult to visualize. With the use of EUS - fine needle aspiration (TIA) the diagnostic efficiency of the method has increased, and sensitivity, specificity and positive EUS-TIA predictive value is 92; 98 and 97%, respectively [23].

To improve the detection of abnormal mucosal changes during endoscopy Several methods have been developed, in particular chromoendoscopy, narrow-band tomography and con- focal laser endomicroscopy [12].

Multislice computed tomography is considered the best method for diagnosing preoperative staging of gastric cancer. With the advent of MSCT, the accuracy of the degree gastric wall invasion improved significantly - from 69–84% for CT with a single detector to 80–89% on MSCT [24].

For normal walls of the stomach, MSCT is characterized by terns are multilayer structures with one, two or three layers, regardless of hypotension. Characteristic for gastritis, a symptom is a violation of multiple bare-layer pattern of the stomach wall. Based on the multilayer structure of the stomach wall with MSCT, several authors have proposed various classification of T-staging of gastric cancer in computed tomography [18, 20, 24, 25].

Diagnostic accuracy of MSCT for T-staging The incidence of a stomach tumor varies from 77 to 89%. The use of multiplanar reconstructions (MPR) improves the accuracy of T-staging, since MPRs allow a better assessment of the degree tumor invasion. In one of the conducted research ings, the overall accuracy of diagnosing the T-stage tumor whether the stomach in 106 cases when using MPR increased from 77 to 84% [25]. In Chen's study et al. combined virtual gastroscopy VG and MPR, which increased the overall accuracy of preoperative diagnostics of T-stages of the tumor from 73 to 89%.

It is shown that the new method of CT reconstruction, so called "vessel probing" in the MPR mode, improves the diagnostic accuracy of T-staging RJ [9]. General accuracy, sensitivity and special the specificity of determining stage N in MSCT composition 79% (69–92%), 84.6% (78–92%) and 73.9% (62–85.7%, respectively) [9, 25]. Usage MPR during staging of lymphatic lesions nodes according to Kim et al. did not lead to reliable significant improvement in diagnosis - 62% and 64% for axial images and MPR, respectively. In other a large study by Chen et al.using MPR and VG diagnostics of N-stages also did not improve significantly, but remained at the level of 78%. The multiplanar reconstruction technique structure is very informative for the diagnosis of T- stages of gastric cancer [10, 25].

The accuracy of diagnosing distant metastases in assistance of MDCT using transaxial images according to S. J. Wakelin et al. amounted to 72%. In another study, the identification metastases

did not improve with MPR, the accuracy was 86% for both methods [11].

Virtual gastroscopy is one of reconstruction techniques, intraluminal perspective 3D image that simulates intraluminal views at endoscopy. Shown that GV improves detection of gastric cancer and gives the ability to make a non-invasive evaluation stages and morphology of gastric cancer. VG is especially useful in the diagnosis of early stages of gastric cancer. In the research according to Kim et al. VG had significantly more higher diagnostic value than the results standard two-axis MSCT when detecting and staging of early forms of gastric cancer — sensitive validity and specificity were 91.9 and 74% and 62.9 and 82.9% respectively. PriVG was also higher accuracy was noted (0.89, $p < 0.038$) when detecting of early stages of gastric cancer compared with accuracy 0.78 and 0.81 for axial images and images MPR, respectively [26].

The role of MSCT in the diagnosis of gastric cancer is increasing as technology improves. In several studies comparing these two methods have been it has been shown that the accuracy of CT increases and approaches to that for EUS in the diagnosis of T-stages [12, 19, 25] reported a comparable accuracy of 87.5 and 83.3% between EUS and MSCT, respectively. Ahnet al. evaluated the accuracy of MSCT with MPR in comparison with EUS for preoperative stage diagnostics gastric cancer in 434 patients. Accuracy at T-stage determining and determining negative prognostic values for damage to the lymph nodes for MSCT/EUS was 92.2%/94.1% and 90.1%/92.6%, respectively. In another research

In this study, the authors compared EUS and MSCT with MPR for pre-operational diagnosis according to T- and N-stadium in 277 patients with gastric cancer. Overall accuracy for staging T and N in EUS (75 and 66%) and MDCT (77 and 63%) did not differ significantly. Furukawa and others compared the diagnostic value of MSCT with VG and EUS in the detection of gastric cancer and the accuracy of additional rational diagnosis of T-stages in 176 patients.

Sensitivity and specificity of EUS for detection ascites reductions were 60.7 and 99.4%, respectively, which was largely due to the presence effect of carcinomatous seeding of the peritoneum ($p < 0.001$) [15, 27].

Positron emission tomography - PET with 2-fluoro-2-deoxy-D-glucose (FDG) in combination with CT has been recognized as a useful diagnostic method in clinical oncology. PAT is of limited value in the diagnosis of early stages of stomach cancer, the main advantage FDG-PET/CT is the detection of distant metastases to the liver, lungs and skeleton. In revealing peritoneal metastases, the technique has limitations private application. Most informative examination for the diagnosis of peritoneal complications of gastric cancer remains MSCT [25]. Studies Comparing FDG-PET/CT and MSCT showed that FDG-PET/CT has lower or comparable sensitivity and accuracy in detecting primary tumors stomach and nodal metastases [29].

GC stage can be downgraded to surgery with neoadjuvant chemotherapy, which allow radical surgery resection with improved progressive and general survival. Evaluation of tumor response to treatment research is currently carried out with the help of MSCT and/or FDG-PET/CT. With MSCT to determine the clinical response tumors for therapy is used classification of response evaluation criteria in patients patients with solid tumors (RECIST — Response Evaluation Criteria in Solid Tumors). Ng et al. when examining 21 patients with German tastatic gastric cancer found that recently developed methods, including will- tumor mometry using CT, and FDG-PET/CT in dynamics were more informative us compared to CT. It has been shown that the reduction tumor volume reduction by 15%, diagnosed using MSCT, correlates with histological response to neoadjuvant chemotherapy with sensitivity 100% validity and 53% specificity ($p > 0.05$). Absorption change FDG-PET/CT more than twice reliably testified on tumor size reduction in patients with a histological response ($p < 0.01$). In another pro- a

prospective study by Lee et al. compared CT with FDG-PET/CT in 33 patients with advanced gastric cancer of the stomach. Reducing the volume of the tumor 35.6% had a sensitivity of 100% and specificity 58.8% in diagnosing a response to neoadjuvant chemotherapy [30].

Studies Comparing FDG-PET/CT and MSCT, did not reveal a significant difference in diagnostic value of methods for verification of recurrence of stomach cancer. Sensitivity, specificity, accuracy, as well as positive and negative predictive values for FDG-PET/CT upon detection of recurrent gastric cancer were significantly higher than MSCT [10, 26, 27]. Perfusion CT (P-CT) measures physiological parameters associated with tumor perfusion and is an established marker of angiogenesis. Conducted P-CT studies in gastric cancer showed that the volume of blood was significantly increased with tumor compared with the volume of normal gastric mucosa. Method allows you to visualize changes in the vascular physiology of tumors. These changes in dynamics can serve as a biomarker of therapeutic response and for chemotherapy. With the advent of the multidetector- new scanners and improved reconstruction methods images, larger anatomical structures and whole organs can be visualized and analyzed during a single study.

Preoperative chemotherapy improves overall and disease-free survival rate, which is confirmed by several randomized research and meta-analyses. Individual frequency of response to chemotherapy varies from 30 up to 60% depending on the assessment methods based on either on histological analysis or on clinical indicators. Early imaging modality response to chemotherapy allows you to optimize and individualize treatment, which is evidenced by the undeniable value of perfusion CT. Martin Lundsgaard Hansen et al. (2014) give the results of a survey of 28 patients with adenocarcinoma of the esophagogastric junction and stomach. Patients received three series of chemotherapy before surgery. All patients underwent CT perfusion scan before treatment, after the first series, and after three series of chemotherapy. Tumor volume and perfusion parameters (arterial flow, blood volume and permeability) were measured by two radiologists, with discussion and comparing results. Response to chemotherapy assessed on two levels. Clinical response was defined as a decrease in tumor size by more than 50%. Histological response was assessed based on residual tumor cells in surgical specimen using a standardized Mandard Score 1–5, in which values 1 and 2 were classified as signs of response to chemotherapy, and 3–5 as no response. As a result, scientific studies found that the reduction of parameters of tumor perfusion after the first series of chemotherapy was positively correlated with clinical response after three series of chemotherapy.

Decrease in volume with volumetrics at 25% reduction tumor perfusion showed a sensitivity 69% and specificity 58% at predicting a clinical response [30].

Conclusion. Thus, the exact preoperative rational diagnosis of gastric cancer stage is necessary for planning the optimal surgical treatment. Fluoroscopy and radiography of the stomach currently in modern clinical practice are still applied, however, due to the fact that the tasks of radiation diagnosticians are expanding and today not only primary diagnostic tools, but also assessment in the course of treatment, in the last years choose the most productive, including including an expensive method or a combination of methods to obtain the fastest and most efficient positive result. Currently along with EGDS, EUS and ultrasound, MSCT is also accurate and a highly specific method for diagnosing and verification of gastric cancer stages. Endoscopic ultrasonography (EUS) is regarded as a highly accurate method for determining the depth of invasion in the early stages of gastric cancer, but similar to CT in relation to damage to T2 or T3 and is limited in case of large stenosing tumors. EUS can also be used to detect perigastric lymph nodes, but is not reliable method for detecting distant metastases. Informativity of MSCT for diagnostic staging and evaluation of early GC stages can be improved through the use of MPR and VG, respectively. MRI, despite better contrast soft tissue and good visualization, less preferred over MSCT because of the long scan

time and higher cost, in foreign literature at present the use of MRI for the diagnosis of gastric cancer is not recommended. recommended. FDG-PET/CT is most useful for detection of distant metastases and recurrences roaring RJ. Both MSCT and FDG-PET/CT are useful methods for determining tumor stage and assessment of gastric cancer response for the treatment being carried out. In general, EUS, MSCT and PET best used in combination, as a mutual complementary methods in the field of stage diagnostics tumors and evaluation of the effectiveness of gastric cancer treatment.

Recent advances such as CT volumetry and virtual gastroscopy, can provide additional information for preoperative verification of the gastric cancer stage and assessment of the response of the tumor whether the stomach for treatment. Perfusion CT can be useful for characterizing features structure of the tumor and the biological response of its cells current on ongoing treatment to optimize the goal- directed therapy.

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