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Advantages of Magnetic Resonance Computer Tomography in the Diagnosis of Thyroid Cancer

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Abstract: The data obtained by performing magneticresonance imaging using dynamic contrast and plotting the "signal intensity-time" relationship, which was performed in the preoperative period in patients with malignant neoplasms of the thyroid gland, are analyzed. The analysis of the diagnostic value of high-field Dynamic contrast MRI in the diagnosis of thyroid cancer.

Key words: MRI, dynamic contrast, thyroid cancer.

INTRODUCTION

Improving the methods of radiation diagnostics leads to the search for new pathognomonic signs of nodular formations of various nature in the thyroid gland (TG). Ultrasound examination (US) is the leading method of visualizing thyroid pathology, the method allows detecting various pathological formations at an early stage [1, 2].Sonography, having a high resolution, makes it possible to assess the size and structure of the tumor node, and to study blood flow. Cancer alertness is caused by hypoechoic nodes with a heterogeneous structure, uneven and indistinct contours [11]. Despite the improvement of ultrasound technology, echography does not allow us to exclude or confirm malignant transformation in thyroid nodules with high reliability [4, 6].Fine-needle aspiration biopsy with cytological examination of puncture material has become widely used in the diagnosis of thyroid tumors [8, 9]. The effectiveness of the cytological conclusion for thyroid gland puncture varies within the limits of 58,2–82 % [2, 7, 16]. The technique is highly specific in establishing a pathomorphological diagnosis. Diagnostic difficulties arise in multi-focal pathology, with retrotracheal and retrosternal goiter locations, so X-ray computed tomography and magnetic resonance imaging are increasingly used in this category of patients [12, 16, 17]. Magnetic resonance imaging (MRI), in contrast to ultrasound and computed tomography, has the highest contrast of the soft tissues of the neck. The method is able to provide information about the anatomy of the neck and upper chest structures, while simultaneously detecting bulky formations in the thyroid gland up to 2-3 mm in size and enlarged lymph nodes of the neck [3, 15]. However, it remains an open question about the ability of MRI to determine the nature of the pathological process when studying various combinations of signal intensity from the structures of nodular formations. Some researchers believe that ultrasound with CDK and fine-needle aspiration biopsy is sufficient. Others point to the possibility of obtaining reliable data on the morphological structure of thyroid nodules using MRI, as well as the high efficiency of differential diagnosis of benign foci and thyroid cancer [13-17]. Thus, the question of the availability of objective criteria that determine the role of MRI in the diagnostic algorithm for detecting thyroid cancer remains relevant. Material and methods comprehensive survey was conducted 22 patients with morphologically verified stage T1–4N0–3M0 thyroid cancer who were undergoing treatment. Of these, 18 are women and 4 are men. The age of patients ranged from 27 to 68 years, the mean age was 49.3±1.3 years. Comprehensive diagnostics included examination and palpation of the thyroid gland and cervical lymph nodes, ultrasound examination of the thyroid gland followed by fine-needle aspiration biopsy under ultrasound control, and magnetic resonance imaging of the thyroid gland. In most cases (31.8%), the T2N0M0 stage was detected (table). At % морфологическиthe same time, papillary cancer was morphologically verified in 91%, medullary carcinoma in 4.5 %, and low – grade cancer in 4.5%.

Echography was performed on an Aloka SSD-5500 ProSound PhD ultrasound scanner using 7-11 MHz multi-frequency linear sensor in seroscal scanning (B-mode), color and energy Doppler mapping (CDD and EDC) using tissue harmonics. When detecting focal formations of the thyroid gland, a fine-needle puncture aspiration biopsy was performed under ultrasound control, followed by cytological examination. Magnetic resonance imaging was performed on a 1.5 T MR scanner "Magnetom Essenza". The study began with the implementation of the localizer in 3 planes. Subsequent scan planes with the required number of slices were set using the localizer. The study area started from the area of the parotid salivary glands to the level of tracheal bifurcation. The study protocol included obtaining images in standard pulse sequences on T1-weighted images (TI), T2-VI, a method for suppressing the signal from fat, and DWI with a slice thickness of 3 mm. Initially, a series of images was performed in the coronary plane with suppression of the fat signal. Further, scans were performed in axial and sagittal projections in T1, T2 and DWI images. If necessary, the study protocol was supplemented with a series of axial scans with suppression of the signal from fat (to assess the condition of the lymph nodes). Dynamic contrast-enhanced MRI was performed in an axial projection to obtain T1-VI in the VIbE 3D sequence. At the first stage, one high-contrast series of T1-VI was performed in the axial projection. Using an automatic injector, a paramagnet was bolus-injected at a standard dose of 0.2 ml / kg, followed by 30 ml of saline solution. The use of an injector allowed the contrast agent to be administered directly during the scan and to avoid shifting the patient's body during the study, which is important for further postprocessor analysis and subtraction with the construction of dynamic curves. After the introduction of the paramagnet, a series of T1-VI scans in the axial projection was obtained, made with the same technical parameters as those obtained in the previous experiment.

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They were compared with similar images prior to contrast agent administration. At the end of the study, postprocessor analysis was performed in the form of mathematical processing of the obtained images with the method of digital subtraction and plotting graphs of contrast agent capture and removal, which were used to assess the degree of accumulation and dynamics of contrast agent passage in nodular formations, as well as in the unchanged thyroid parenchyma for comparative analysis. The analysis data were presented as a graphical dependence of the signal intensity change on time during the passage of a paramagnetic contrast agent. Results and discussion According to magnetic resonance imaging, the tumor size ranged from 8 mm to 83 mm, with an average size of 23 ± 6 mm. Neoplasms, as a rule, were localized in one of the lobes, in 76.2% they were located within the gland capsule and did not spread to surrounding structures. In 81.8%, malignant thyroid tumors had indistinct and uneven contours, in 22.7%, invasion of surrounding organs (fiber, trachea, vascular structures) was noted. At the same time, in 18.2%, the formations had clear and even contours (which is more typical for benign formations), but there was no clear capsule. The tumor structure was heterogeneous. Malignancies had mainly an iso-or weakly hyperintensive signal on T1-VI and an isointensive signal on T2-VI.VI, with the presence of various types of inclusions. At the same time, hyperintensive areas on T2-VI were caused by the accumulation of protein elements (such as colloid, amyloid) and a weak severity of fibrosis. Linear hypointensive areas on T1-VI (72.2 %) and T2-VI corresponded to fibrous inclusions, and small (2-3 mm) areas of reduced MR signal on T1-and T2 - VI corresponded to calcification areas-22.2% and 27.8%, respectively. MRI revealed the true boundaries of the tumor, the relationship with the adjacent anatomical structures. In 13.6% of cases, the tumor infiltration spread to surrounding areas blood vessels (internal jugular vein, common carotid artery), which was characterized by indistinct contours between the formation and the adjacent wall, and in some cases narrowing of the lumen of the vessel. In 4.7%, the tumor infiltrated the walls of the trachea with the formation of an exophytic component in its lumen. In 18.2%, the tumor spread retrosternally, and according to sonography data, there were difficulties in assessing the true boundaries of the formation. The maximum size of the retrosternal tumor reached 83 mm (Fig. 1), while it pushed back and squeezed the surrounding structures (trachea, esophagus). The examination algorithm included the assessment of neck lymph nodes, starting from the level of parotid lymph nodes and ending with the level of the upper paratracheal group. Thus, in 13.6% of cases, enlarged paratracheal lymph nodes were detected that were not visualized according to ultrasound data. In 22.7% of cases, enlarged lymph nodes larger than 15 mm were detected, which were determined as metastatic by morphological examination of the surgical material. As a rule, these were nodes on the affected side,

When analyzing the parameters of a dynamic MR scans were evaluated using the following main criteria:: the type of contrast agent accumulation and elimination curve, the time to peak, and the degree of maximum contrast. According to the literature, there are several types of intensity-time curves [5, 10]. Unchanged in the parenchyma of the thyroid gland accumulation of contrast agent looked like gradual increase in signal intensity followed a uniform decrease over time (Fig. 2). The results of our research in 63.6% of cases is typical of the type of curve reflecting early intensive signal amplification, with the formation of a sharp peak at 12-17 th sec (rapid accumulation), after reaching – phase excretion of contrast agent, called in the literature "wash out" and reflecting the process of rapid washout (Fig. 2). In other cases, the type of curve that is more typical for benign formations was observed: early and intense signal amplification for 14-23 seconds, followed by slow elimination and / or plateau (lack of dynamics). Thus, when assessing the parameters of dynamic contrast in 36.4 % of cases, it was difficult to unambiguously state the presence of a malignant tumor, but it was impossible to completely exclude the presence of cancer in the detected foci, which was confirmed by the results of morphological research. It should also be noted that the evaluation of the results was complicated by the high degree of vascularization of the normal thyroid parenchyma, since in comparison with other organs, the thyroid gland has a small volume and intensive vascularization. Conclusion MRI should be considered the most accurate non-invasive method for the diagnosis of thyroid cancer. The advantages of this method are obtaining an image in any projection without losing its quality and no radiation load on patients. The use of MRI in patients with a low-lying thyroid gland, anatomical features of the neck structure, as well as in the presence of a pathological process spreading retrosternally, had an undoubted advantage over ultrasound in identifying the true boundaries of the tumor, the spread of the formation to surrounding structures, and in assessing paratracheal lymph nodes, which are not always visualized during ultrasound examination. Thyroid cancer was characterized by indistinct, uneven contours, signal heterogeneity, which was mainly due to hypointensive inclusions of both linear and lumpy nature on T2-VI. When spreading outside the capsule, the infiltrative nature of growth was noted with the involvement of surrounding structures in the pathological process. Dynamic contrast analysis revealed an early increase in signal intensity with the formation of an acute peak, followed by a predominance of the phase of contrast agent removal. Thus, the inclusion of MRI in the examination algorithm complements the sonography data on the prevalence of the pathological process and the state of the regional lymphatic system.

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