Application of three-dimensional NLS-diagnostics in oncology. New trends and prospects of development

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ABSTRACT

The article presents modern principles of three-dimensional image rendering in accordance with NLS-graphy data. It also gives a generalized evaluation of three-dimensional NLS-graphy effectiveness in revealing oncological diseases in comparison with conventional two-dimensional NLS-graphy studies.

Key words: therapy; oncology; diagnostics; NLS.

Diagnostics and treatment of malignant neoplasms are the most urgent issues in modern medicine. Oncologists face not only problems of primary and updating diagnostics of tumoral diseases, but also evaluation of various methods of tumor treatment efficiency and well-timed diagnosis of recurrent tumors after treatment procedures. The introduction of new three-dimensional technologies of NLS-pictures acquiring into clinical practice allows the solving of the abovementioned diagnostic problems at a qualitatively new and higher level.

Application of three-dimensional visualization of organs and tissues significantly extended the potential of NLS-diagnostics [1]. Today we may speak of truly early diagnostics of tumoral diseases at the first, pre-clinical stage of patient examination. Three-dimensional NLS-examination allows not only to reveal minimal structural changes in organs and tissues, but precise evaluation of tumoral process spreading extent. Further, when combined with the use of spectral-entropy analysis, it makes possible to identify disease stage and choose the adequate method of patient treatment [6]. The Institute of Practical Psychophysics has great experience of three-dimensional NLS-graphy applications which is impossible to be properly described in an article of this limited extent [2]. Due to this fact, we decided to dwell on those issues of three-dimensional NLS-diagnostics which have great practical importance, but are still not widely spread in clinical practice.

In group of malignant tumors of liver, metastatic invasion holds leading positions. It is well-known that the most frequent reasons for liver metastatic disease are malignant tumors of the large intestine, rectum, stomach, pancreas, mammary glands and lungs [8]. At metastatic disease, the shape, structure, size of parenchyma and vascular pattern of the liver are more or less changed, depending on tumor existence duration, as well as number and size of tumoral nodes. In addition to three-dimensional NLS-graphy, diverse variants of dopplerography (initially energy color mapping) may be used to solve the problem of differential diagnostics of benign and malignant changes in the liver parenchyma. **Three-dimensional NLS-graphy method** allows the visualization of a three-dimensional picture of vessel location and form, marking them by a certain color in the background of the organ's normal picture. In this aspect, the method is rather close to x-ray angiography and allows to accurately visualize large and minute vessels.

Vascular pattern in single metastases is broken due to the constriction and dislocation of certain vessels' hepatic branches. In massive affection, there is significant breach of vascular pattern. In some cases a physician may detect local, chaotic changes of vascular pattern, when hypervascularization of tumoral nodes is present. However, tumoral nodes in liver metastatic disease may have both increased and decreased vascularization. Due to this fact, data acquired with NLS-graphy is not always sufficient and should be complemented with results of x-ray angiography.

Differential diagnostics of tumoral affection of the liver is complicated by not only the marked multiformity of changes, but also by its frequent combination with diffuse and dystrophic changes of the organ's parenchyma. All of the above stipulate the necessity for wide **application of spectral-entropy analysis of affection nidus**. Our experience proves that availability of NLS-diagnostics equipment allows for a detailed examination of three-dimensional hepatic neoplasms sized less than 3mm. Therefore, at the early stages of pathology development, a clinician is able to update the morphological substrate of detected changes and obtain sufficient information for diagnosis updating.

It is well-known that one of the leading methods of solitary hepatic metastases treatment is surgical operation. Proof of operation efficacy is the absence of metastases in other parts of the liver. This problem may be successfully **solved using three-dimensional NLS-ultramicroscopy with the application of spectral-entropy analysis** [5]. For a long time, widespread application of ultramicroscopic NLS-examination was limited by the absence of special equipment with high resolution. Nowadays, devices with super-high frequency non-linear generators (40GHz) are available, making it possible to carry out three-dimensional ultramicroscopic revision and evaluation of chromosomal aberrations of almost any cell in the human organism. Three-dimensional NLS-research may help specify character, localization and number of pathological nidi when the clinician plans liver resection due to metastatic disease. Our experience shows that the application of three-dimensional NLS-graphy in cancer metastases of the large intestine allows the detection of additional nidi, not registered by any type of introscopy, in 20% of the cases. Data acquired using three-dimensional NLS-graphy of the liver makes it possible to evaluate the extent of the operation; avoid unjustified surgical interventions; and decrease the risk of developing post-operative complications.

Joint application of video-laparoscopy and NLS-research allows the physician to combine proper examination of abdominal organs and tissues with a study of their structure by applying spectral-entropy analysis in selected areas, and carry out updating diagnostics of tumoral diseases of organs in the abdominal cavity and the retroperitoneal space. In stomach cancer, the number of mistakes in pre-operative diagnostics of liver metastatic disease reaches 25% - 30%. The first application of such research technology proves that the number of mistakes decreases to 3% - 5%.

Nowadays, onco-urology is the sphere in which methods of three-dimensional NLS-graphy may also be widely applied. However, until today, the application of three-dimensional NLS-research on patients operated for urinary bladder tumor consisted in the dynamic monitoring of the organ's condition, in order to detect recurrent tumors and metastases at an early stage. The introduction of three-dimensional NLS-methods in clinical practice will allow a complete change in our point of view to this problem. We believe that this issue is in fact topical, since the majority of surgically operated patients were subjected to traumatic transurethral resections.

Three-dimensional NLS-research with the application of spectral-entropy analysis, carried out during surgical oncotomy, allowed us to detect additional tumoral neoplasms, not registered by two-dimensional NLS research in 37% of the patients. Application of three-dimensional methods makes it possible to specify the extent of tumor local spreading process; control the depth of urinary bladder wall resection; and decrease the risks of developing complications during the oncotomy.

Usually, the diagnostics and morphological verification of rectal cancer does not present difficulties. However, evaluating the organ wall's degree of invasion is not always possible using standard diagnostic methods [7]. Traditional two-dimensional NLS-research is already widely used as a diagnostics method of recurrent rectal cancer after organ extirpation [3]. Nevertheless, primary diagnostics of the disease using two-dimensional NLS-graphy is hindered due to several reasons; first and foremost, given that in two-dimensional NLS-scanning the rectum is visualized only partially (80% of the whole organ surface area).

Application of **three-dimensional NLS-graphy** makes it possible to accurately differentiate between all layers of rectum walls, and thus to diagnose the depth of tumor infiltration and identify the stage of the disease, using spectral-entropy analysis [4]. This method helps detect changed lymph nodes over 1.5mm in size in pararectal lymph node metastatic disease. During the monitoring of pre-operational radiotherapy, three-dimensional NLS-graphy helps detect accurately the decrease in tumor size; identify changes in their structure, related to medical pathomorphism; and identify the decrease in pararectal tissue tumoral infiltration. Therefore, three-dimensional NLS-graphy may be considered as a method of rectal cancer primary diagnostics. It allows physicians to resolve the most important diagnostic issues, related to identifying tumoral process length, the extent of the tumor's local spreading and monitoring pre-operative treatment efficiency. In organ-preserving operations, three-dimensional NLS-graphy may be used as an efficient method of recurrent tumors early diagnostics in the anastomosis area.

In conclusion, as to the characteristics of modern, three-dimensional NLS-graphy method, we should like to emphasize that this method allows efficient meeting of such objectives as detection of tumoral changes, identifying disease stage and qualitative evaluation of treatment.

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