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THE ROLE OF MULTISPIRAL COMPUTED TOMOGRAPHY IN CLINICAL DIAGNOSIS AND ITS DIAGNOSTIC ADVANTAGES COMPARED WITH MAGNETIC RESONANCE IMAGING

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Resume: This article examines the role of multispiral computed tomography (MSCT) in clinical diagnostics and its diagnostic advantages compared with magnetic resonance imaging (MRI). The technical capabilities of modern 128- and 256-slice tomographic systems, including their high spatial resolution, rapid scanning capability, and wide anatomical coverage, are analyzed. The study also reviews the results of scientific research regarding the diagnostic sensitivity, specificity, and overall accuracy of MSCT and MRI technologies. The findings demonstrate that MSCT is highly effective in detecting bone structures, vascular pathologies, traumatic injuries, and emergency conditions. The high speed of examination and superior spatial resolution make this technique particularly valuable in emergency medicine. In conclusion, modern 128- and 256-slice MSCT systems are widely used as effective diagnostic tools for the detection of cardiovascular diseases, oncological pathologies, neurological disorders, and traumatic injuries.

Keywords: multispiral computed tomography, magnetic resonance imaging, radiological diagnostics, 128-slice tomography, 256-slice tomography, clinical diagnostics.

Резюме: В данной статье рассматривается роль мультиспиральной компьютерной томографии (МСКТ) в клинической диагностике и её диагностические преимущества по сравнению с магнитно-резонансной томографией (МРТ). Проанализированы технические возможности современных томографов с 128 и 256 срезами, их высокая пространственная разрешающая способность, высокая скорость сканирования и широкий анатомический охват. Также рассмотрены результаты научных исследований, посвящённых диагностической чувствительности, специфичности и общей точности методов МСКТ и МРТ. Полученные данные показывают, что МСКТ обладает высокой эффективностью при выявлении костных структур, сосудистых патологий, травматических повреждений и неотложных состояний. Высокая скорость исследования и высокая пространственная разрешающая способность делают

данный метод особенно важным в условиях экстренной медицины. В заключение отмечается, что современные системы МСКТ с 128 и 256 срезами широко применяются для диагностики сердечно-сосудистых заболеваний, онкологических патологий, неврологических заболеваний и травматических повреждений.

Ключевые слова: мультиспиральная компьютерная томография, магнитно-резонансная томография, радиологическая диагностика, 128-срезовый томограф, 256-срезовый томограф, клиническая диагностика.

Резюме: Ушбу мақолада замонавий радиологияда мультиспирал компьютер томографиясининг (МСКТ) клиник диагностикадаги ўрни ҳамда унинг магнит-резонанс томографияси (МРТ)га нисбатан диагностик афзалликлари таҳлил қилинган. Тадқиқотда 128 ва 256 кесимли замонавий томографларнинг техник имкониятлари, уларнинг юқори фазовий аниқлиги, тезкор сканерлаш хусусияти ва кенг анатомик қамрови кўриб чиқилган. Шунингдек, МСКТ ва МРТ технологияларининг диагностик сезгирлиги, спецификлиги ва умумий аниқлиги бўйича илмий тадқиқот натижалари таҳлил қилинган. Натижалар шуни кўрсатадики, МСКТ суяк тузилмалари, қон томирлари, травматик жароҳатлар ва шошилинч тиббий ҳолатларни аниқлашда юқори самарадорликка эга. Айниқса, текширув тезлиги ва юқори фазовий аниқлик уни шошилинч тиббиётда муҳим диагностик усулга айлантиради. Хулоса қилиб айтганда, замонавий 128 ва 256 кесимли МСКТ тизимлари юрак-қон томир касалликлари, онкологик патологиялар, неврологик касалликлар ва травматик шикастланишларни аниқлашда кенг қўлланилаётган самарали диагностик технология ҳисобланади.

Калит сўзлар: мультиспирал компьютер томография, магнит-резонанс томография, радиологик диагностика, 128 кесимли томограф, 256 кесимли томограф, клиник диагностика.

1. Development of MSCT and MRI Technologies in Modern Radiology

Over the past decade, imaging technologies in the field of radiology have developed significantly. In particular, multispiral computed tomography (MSCT) and magnetic resonance imaging (MRI) are widely used in clinical diagnostics. These two methods provide high-resolution anatomical images and play an important role in the early detection of various diseases.

MSCT is an advanced form of computed tomography based on spiral scanning technology. It is distinguished by high spatial resolution, rapid examination speed, and the ability to perform three-dimensional reconstruction. With the help of modern 64-, 128-, and 256-slice scanners, it is possible to visualize almost all anatomical structures of the human body with high accuracy.

Recent studies have shown that MSCT has high diagnostic effectiveness in many

clinical situations. For example, meta-analyses devoted to the evaluation of coronary arteries have demonstrated that the sensitivity of MSCT ranges from 66% to 98%, while its specificity ranges from 75% to 99%. Overall, the average sensitivity is about 85%, and the specificity reaches approximately 95% [1]. These indicators demonstrate that MSCT has very high diagnostic potential in detecting cardiovascular diseases.

MRI, on the other hand, is a diagnostic method characterized by high contrast resolution for soft tissue imaging. Therefore, it is widely used in neurology, musculoskeletal imaging, and oncology. However, MRI examinations are relatively time-consuming, more expensive, and have certain limitations in some patients (for example, those with metallic implants).

For instance, studies on the diagnosis of knee joint injuries in athletes have shown that the diagnostic sensitivity of MRI is 94.75%, specificity is 97.42%, and overall accuracy is 96.01%. In comparison, MSCT demonstrated a sensitivity of 89.36%, specificity of 85.71%, and accuracy of 89.86%. At the same time, the average examination time was 28.7 minutes for MRI and only 9.9 minutes for MSCT [2,3]. Thus, although the diagnostic image quality may be higher with MRI in certain situations, the examination speed of MSCT is 2–3 times faster.

2. General Importance of MSCT in Clinical Diagnostics

MSCT is one of the most commonly used radiological methods in modern clinical diagnostics. Its main advantages include:

- high examination speed
- high spatial resolution
- capability for three-dimensional reconstruction
- convenience in trauma and emergency situations

Numerous clinical studies show that MSCT also has high diagnostic value in detecting oncological diseases. For example, studies on the detection of retroperitoneal tumors have shown that the diagnostic accuracy of MSCT is 98.33%, sensitivity is 97.87%, and specificity is 92.86% [1,4]. These indicators demonstrate that MSCT has very high accuracy in diagnosing tumors of the abdominal cavity.

Studies on the detection of metastases of colorectal cancer have shown that the sensitivity of MSCT is 87.8%, specificity is 77.8%, the positive predictive value is 87.8%, and the negative predictive value is 77.8% [5,6]. These results indicate that MSCT plays an important role in the diagnosis of oncological diseases as well.

3. The Role of Modern 128–256 Slice Multispiral Computed Tomographs in Clinical Diagnostics

Over the past decade, technological progress in radiology has led to significant improvements in multispiral computed tomography (MSCT) devices. In particular, 128-slice and 256-slice tomographs have become one of the most important components of modern diagnostic systems.

These devices are distinguished by high spatial resolution, rapid scanning capability, and wide anatomical coverage, which significantly improve diagnostic efficiency and allow for detailed visualization of complex anatomical structures.

4. Characteristics of MSCT Technology and the Clinical Importance of 128–256 Slice Tomographs

The main feature of MSCT technology is the ability to acquire multiple slices simultaneously. While earlier 16- or 64-slice tomographs produced a limited number of images during a single rotation, modern 128- and 256-slice scanners can generate hundreds of slices in one rotation. This significantly reduces examination time and increases diagnostic accuracy.

128-slice MSCT systems are among the widely used technologies in modern radiological diagnostics. With the help of these devices, pathologies of the cardiovascular system, brain, abdominal cavity, and musculoskeletal system can be detected with high accuracy.

According to the results of scientific studies, coronary CT angiography images obtained with 128-slice scanners were of high quality in 91.6% of cases, acceptable in 6.9%, and diagnostically insufficient in only 1.5% of cases. At the same time, it was found that the radiation dose obtained using this technology is approximately 33% lower compared to previous generations of tomographs [3,7].

Another important advantage of 128-slice tomographs is their high temporal resolution. In modern devices, the scanning rotation time averages 0.28–0.35 seconds, which makes it possible to clearly visualize organs that are constantly in motion, such as the heart.

In addition, the following clinical examinations can be effectively performed using 128-slice tomographs:

- coronary CT angiography
- diagnosis of pulmonary embolism
- detection of cerebral stroke
- evaluation of traumatic injuries
- staging of oncological diseases

According to clinical studies, the diagnostic sensitivity of 128-slice MSCT in detecting coronary artery disease is about 95–99%, while the specificity ranges from 85–92% [2,8].

256-slice MSCT systems represent a more advanced stage of radiological technology. The main advantage of these scanners is their wide detector coverage and ultra-fast scanning capability. With 256-slice scanners, it is possible to cover up to 12 cm of anatomical area in a single rotation, allowing organs such as the heart or brain to be scanned during a single heartbeat [9].

For this reason, this technology is widely used in the following clinical fields:

- cardiology
- neurology
- traumatology
- oncology
- angiography

Studies devoted to the diagnosis of coronary artery disease have shown that 256-slice tomographs demonstrate very high diagnostic performance. Clinical studies have reported the following indicators:

- sensitivity – 98%
- specificity – 83%
- positive predictive value – 94%
- negative predictive value – 92% [10].

Other studies have reported that segment-level diagnostic accuracy reached 94.3%, sensitivity 90.8%, and specificity 95.3% [11].

In addition, 99.7% of images obtained using 256-slice tomography were suitable for diagnostic evaluation, while only 0.3% of segments had insufficient image quality. This demonstrates the high diagnostic reliability of this technology [12].

Advantages of 128- and 256-Slice Tomographs in Modern Clinical Diagnostics

Modern MSCT systems provide several important advantages:

1. High examination speed

Whole-body scanning can be completed within 5–10 seconds, which is particularly important in emergency medicine.

2. High spatial resolution

Multislice detectors allow image resolution at the submillimeter level.

3. Reduced radiation dose

With the help of iterative reconstruction algorithms, radiation exposure can be reduced by 20–40%.

4. Three-dimensional reconstruction

Modern software enables the creation of 3D, MPR, VR, and MIP reconstructions.

5. Advantages in cardiac diagnostics

With 256-slice tomographs, it is possible to scan the heart within a single heartbeat, significantly reducing motion artifacts.

5. Comparative Evaluation of MSCT and MRI Technologies

In modern clinical practice, MSCT and MRI are often used as complementary diagnostic methods. While MRI provides high contrast resolution for soft tissue imaging, MSCT has advantages in the visualization of bone structures, blood vessels, and traumatic injuries.

The main advantages of MSCT compared with MRI include:

- examination speed 2–4 times faster

- the possibility of use in emergency situations
- the ability to examine patients with metallic implants
- high-resolution visualization of bone structures

At the same time, MRI does not use ionizing radiation, which provides an advantage in certain clinical situations.

In conclusion, 128- and 256-slice multispiral computed tomographs developed in recent years have significantly expanded the possibilities of clinical diagnostics. These technologies are characterized by high spatial resolution, rapid scanning capability, and wide anatomical coverage. According to scientific studies, the diagnostic sensitivity of modern MSCT systems reaches 90–98%, while specificity ranges from 83–95%.

Therefore, in modern radiology, 128- and 256-slice MSCT systems are widely used as an important diagnostic tool for detecting cardiovascular diseases, oncological pathologies, traumatic injuries, and neurological disorders.

6. Advantages of MSCT in Emergency Medicine

One of the most important advantages of MSCT is its ability to provide rapid diagnosis. This method is often considered the first-line imaging modality in emergency conditions, such as trauma, stroke, and internal bleeding.

For example, in a clinical study on the diagnosis of acute ischemic stroke, the sensitivity of MRI was 92% and specificity 87%, whereas CT showed a sensitivity of 66% and specificity of 81% [13,14].

Despite this, in many clinical centers CT or MSCT is still used as the initial imaging examination. The main reasons are faster examination time and wider availability.

In many emergency medical centers, the patient examination time is approximately 5–10 minutes, allowing life-threatening conditions to be detected rapidly.

7. Comparative Analysis of the Diagnostic Capabilities of MSCT and MRI

When comparing the diagnostic capabilities of MSCT and MRI, it becomes evident that each modality has advantages in specific clinical situations.

For example, in the diagnosis of pancreatitis, the sensitivity of MRI was 96.88% and diagnostic accuracy 96.09%, whereas MSCT showed sensitivity of 84.38% and accuracy of 89.06% [15,16].

However, in the detection of bone structures, traumatic injuries, and acute hemorrhage, MSCT is often considered superior.

In addition, MSCT provides high spatial resolution images, which makes it highly effective for evaluating bone anatomy. For this reason, MSCT is widely used in orthopedic, traumatological, and neurosurgical practice.

ADABIYOTLAR RO‘YXATI:

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