



**TOSHKENT TIBBIYOT AKADEMIYASI URGANCH FILIALI
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**COMPARATIVE EVALUATION OF RADIOLOGICAL EXAMINATION METHODS AND
CYTOLOGICAL ANALYSIS RESULTS IN THE DIAGNOSIS OF THYROID CANCER:
ASSESSMENT OF THE ACCURACY OF TWO DIAGNOSTIC APPROACHES**



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Abstract: This article presents a comparative evaluation of the diagnostic significance of radiological examination methods and cytological analysis results in the detection of thyroid cancer. The study examined the diagnostic capabilities of ultrasound, computed tomography, and other imaging techniques, as well as cytological findings obtained through fine-needle aspiration biopsy. The sensitivity of radiological methods and the specificity of cytological analysis were analyzed, and their advantages and limitations were identified. The results demonstrated that the combined use of these diagnostic approaches improves the early detection of thyroid cancer and increases overall diagnostic accuracy. The findings may contribute to more effective clinical decision-making and improved patient management in thyroid oncology.

Keywords: Thyroid cancer, radiological diagnosis, ultrasound examination, cytological analysis, fine-needle aspiration biopsy, diagnostic accuracy, sensitivity, specificity.

**СРАВНИТЕЛЬНАЯ ОЦЕНКА РАДИОЛОГИЧЕСКИХ МЕТОДОВ ИССЛЕДОВАНИЯ И
РЕЗУЛЬТАТОВ ЦИТОЛОГИЧЕСКОГО АНАЛИЗА В ДИАГНОСТИКЕ РАКА
ЩИТОВИДНОЙ ЖЕЛЕЗЫ: ОЦЕНКА ТОЧНОСТИ ДВУХ ДИАГНОСТИЧЕСКИХ
ПОДХОДОВ**

Аннотация: В данной статье проведена сравнительная оценка диагностической значимости радиологических методов исследования и результатов цитологического анализа при выявлении рака щитовидной железы. В ходе исследования изучены диагностические возможности ультразвукового исследования, компьютерной томографии и других методов визуализации, а также результаты цитологического анализа, полученные с помощью тонкоигольной аспирационной биопсии. Проанализированы чувствительность радиологических методов и специфичность цитологического исследования, определены их преимущества и ограничения. Результаты исследования показали, что совместное применение двух диагностических подходов способствует более раннему выявлению рака щитовидной железы и повышению точности диагностики. Полученные данные могут быть использованы для совершенствования клинической практики и повышения эффективности принятия диагностических решений.



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Ключевые слова: Рак щитовидной железы, радиологическая диагностика, ультразвуковое исследование, цитологический анализ, тонкоигольная аспирационная биопсия, диагностическая точность, чувствительность, специфичность.

QALQONSIMON BEZ SARATONINI ANIQLASHDA RADIOLOGIK TEKSHIRUV
USULLARI VA SITOLOGIK TAHLIL NATIJALARINI QIYOSIY BAHOLASH: IKKI XIL
DIAGNOSTIK YONDASHUVNING ANIQLIGINI BAHOLASH

Annotatsiya: Ushbu maqolada qalqonsimon bez saratonini aniqlashda radiologik tekshiruv usullari va sitologik tahlil natijalarining diagnostik ahamiyati qiyosiy baholandi. Tadqiqot davomida ultratovush tekshiruvi, kompyuter tomografiyasi va boshqa radiologik usullarning diagnostik imkoniyatlari hamda nozik ignali aspiratsion biopsiya asosidagi sitologik tahlil natijalari o‘rganildi. Radiologik tekshiruvlarning sezgirligi va sitologik tahlilning spetsifikligi tahlil qilinib, ularning afzalliklari va cheklovlari aniqlandi. Tadqiqot natijalari ikki diagnostik yondashuvni birgalikda qo‘llash qalqonsimon bez saratonini erta aniqlash va tashxis aniqligini oshirishga xizmat qilishini ko‘rsatdi. Olingan ma‘lumotlar klinik amaliyotda diagnostik qarorlar qabul qilish samaradorligini yaxshilashga yordam beradi.

Kalit so‘zlar: Qalqonsimon bez saratonini, radiologik diagnostika, ultratovush tekshiruvi, sitologik tahlil, nozik ignali aspiratsion biopsiya, diagnostik aniqlik, sezgirlik, spetsifiklik.

Introduction

Thyroid cancer is one of the most common malignant tumors of the endocrine system and its incidence has increased significantly worldwide over the past decades. Early and accurate diagnosis of thyroid cancer plays a crucial role in improving patient survival rates, selecting appropriate treatment strategies, and reducing disease-related complications. Therefore, the development and evaluation of reliable diagnostic approaches for thyroid nodules and thyroid malignancies remain important issues in modern medicine. Various radiological imaging techniques are currently used for the diagnosis of thyroid cancer, including ultrasound, computed tomography, and magnetic resonance imaging. These methods provide valuable information regarding the size, location, structure, and extent of thyroid lesions as well as the involvement of surrounding tissues and regional lymph nodes. Among these techniques, ultrasonography is considered the primary imaging modality because of its accessibility, non-invasive nature, and high sensitivity in detecting suspicious thyroid nodules. However, radiological findings alone may not always provide a definitive diagnosis of malignancy.

Cytological examination, particularly fine-needle aspiration cytology, is widely recognized as an essential diagnostic tool for evaluating thyroid nodules. This method allows microscopic assessment of cellular morphology and helps differentiate benign lesions from malignant tumors. Cytological analysis is often considered the reference method for preoperative diagnosis and plays an important role in determining the need for surgical intervention. Despite their widespread use, both radiological and cytological approaches have specific advantages and limitations. Radiological imaging is highly effective for identifying structural abnormalities and guiding further investigation, whereas cytological analysis provides direct cellular evidence of malignancy. The diagnostic performance of these methods may vary depending on tumor type, lesion characteristics, and operator experience. Consequently, comparing the accuracy and effectiveness of radiological examinations with cytological findings is essential for optimizing diagnostic strategies in thyroid cancer management.

Relevance

Thyroid cancer represents one of the most rapidly increasing malignancies worldwide and has become a significant public health concern. Advances in diagnostic technologies have led to a growing number of detected thyroid nodules and early-stage thyroid cancers. Despite these



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developments, distinguishing malignant lesions from benign thyroid abnormalities remains a major clinical challenge. Accurate diagnosis is essential for selecting appropriate treatment strategies, preventing unnecessary surgical procedures, and improving patient outcomes.

Aim

To compare the diagnostic value of radiological examination methods and cytological analysis in the detection of thyroid cancer and to evaluate the accuracy of these two diagnostic approaches.

Main part

Thyroid cancer is the most common malignant tumor of the endocrine system and represents a growing health concern worldwide. The incidence of thyroid cancer has increased considerably over recent decades due to improvements in diagnostic technologies and increased screening practices. Although the disease can occur at any age, it is more frequently diagnosed in adults, particularly women. Several risk factors contribute to the development of thyroid cancer, including exposure to ionizing radiation, genetic predisposition, environmental influences, hormonal factors, and iodine imbalance. Histologically, thyroid cancer is classified into papillary, follicular, medullary, and anaplastic types, each having distinct biological behavior and prognosis. Papillary thyroid carcinoma is the most common form and generally has a favorable outcome when detected early. Clinical manifestations may include a painless neck mass, enlarged lymph nodes, difficulty swallowing, hoarseness, and neck discomfort. However, many patients remain asymptomatic during the early stages of the disease. Therefore, early detection through reliable diagnostic methods is essential for successful treatment.

Radiological imaging plays a crucial role in the initial evaluation of thyroid nodules and suspected thyroid malignancies. Ultrasound examination is the primary imaging modality due to its accessibility, safety, cost-effectiveness, and high sensitivity. It allows clinicians to assess nodule size, shape, margins, echogenicity, vascularity, and the presence of calcifications. Certain ultrasound features, such as irregular borders, microcalcifications, and marked hypoechogenicity, are associated with a higher risk of malignancy. Computed tomography and magnetic resonance imaging are valuable for evaluating large tumors, extrathyroidal extension, and regional metastases. These techniques provide detailed anatomical information that can assist in surgical planning. Nuclear medicine imaging may also be used in selected cases to evaluate thyroid function and metastatic disease. Despite their advantages, radiological methods cannot always differentiate benign from malignant lesions with complete certainty. Interpretation of imaging findings may vary depending on operator experience and equipment quality.

Cytological examination is considered one of the most important methods for evaluating thyroid nodules. Fine-needle aspiration cytology is widely used because it is minimally invasive, relatively inexpensive, and highly informative. During the procedure, cellular material is obtained from a thyroid nodule and examined microscopically. Cytological assessment enables the identification of cellular atypia, architectural abnormalities, and other morphological features suggestive of malignancy. The Bethesda System for Reporting Thyroid Cytopathology provides a standardized framework for interpreting and classifying cytological findings. This classification system assists clinicians in determining the appropriate management strategy for each patient. Cytological analysis can significantly reduce unnecessary surgeries by accurately identifying benign lesions. However, limitations exist, particularly in cases involving indeterminate or follicular-patterned lesions where cytology alone may not provide a definitive diagnosis. Sampling errors and inadequate specimens may also affect diagnostic reliability.

Comparing radiological and cytological methods is essential for understanding their respective contributions to thyroid cancer diagnosis. Radiological examinations primarily evaluate structural and anatomical characteristics of thyroid lesions, while cytological analysis focuses on cellular and morphological abnormalities. Imaging techniques are highly sensitive in detecting suspicious nodules, whereas cytology generally offers greater specificity for confirming malignancy.



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In many cases, ultrasound findings guide the selection of nodules for fine-needle aspiration. Studies have demonstrated that combining imaging and cytological information improves diagnostic performance compared with using either method alone. Radiological methods provide valuable information regarding tumor extent and regional lymph node involvement, while cytology confirms the pathological nature of the lesion. Diagnostic discrepancies may occur when imaging findings suggest malignancy but cytological results are benign, or vice versa. Such situations require additional evaluation and clinical judgment.

Diagnostic accuracy is one of the most important parameters for evaluating the effectiveness of medical investigations. Sensitivity refers to the ability of a test to correctly identify patients with disease, whereas specificity reflects its ability to correctly identify individuals without disease. Ultrasound examination generally demonstrates high sensitivity in detecting suspicious thyroid nodules but may have variable specificity. Cytological analysis typically exhibits high specificity and good overall accuracy, particularly for papillary thyroid carcinoma. The accuracy of both methods depends on several factors, including lesion characteristics, technical quality, operator expertise, and interpretation criteria. False-positive results may lead to unnecessary interventions, whereas false-negative findings can delay treatment and worsen prognosis. Numerous studies have reported improved diagnostic performance when radiological and cytological methods are used together. Evaluating sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy provides valuable insight into the strengths and limitations of each diagnostic approach.

Recent advances in medical technology have expanded the possibilities for thyroid cancer diagnosis. Artificial intelligence, radiomics, molecular testing, and genetic analysis are increasingly being integrated into diagnostic workflows. These innovations have the potential to enhance the accuracy of both radiological and cytological assessments. Combining imaging findings with molecular markers may improve risk stratification and reduce diagnostic uncertainty in indeterminate cases. Multidisciplinary collaboration among radiologists, pathologists, endocrinologists, and surgeons is essential for achieving optimal patient care. Integrated diagnostic approaches allow clinicians to obtain comprehensive information regarding both structural and cellular characteristics of thyroid lesions. This strategy improves diagnostic confidence, facilitates individualized treatment planning, and minimizes unnecessary procedures. Future research should focus on developing standardized protocols that combine traditional and emerging diagnostic techniques. Such efforts may further improve early detection, increase survival rates, and enhance the overall quality of care for patients with thyroid cancer.

Results

The study demonstrated that both radiological examination methods and cytological analysis are effective diagnostic tools for the detection of thyroid cancer. Radiological imaging, especially ultrasonography, successfully identified suspicious thyroid nodules and provided important information regarding their size, structure, margins, vascularity, and relationship with surrounding tissues. Several imaging features, including irregular borders, microcalcifications, and hypoechogenicity, were strongly associated with malignant lesions. Cytological analysis performed through fine-needle aspiration revealed a high level of diagnostic reliability in differentiating benign and malignant thyroid nodules. The majority of cytological findings corresponded with radiological observations. The results indicated that radiological methods exhibited high sensitivity in detecting suspicious lesions, whereas cytological examination demonstrated greater specificity in confirming malignant changes at the cellular level. The combined use of radiological and cytological approaches increased overall diagnostic accuracy and reduced the probability of diagnostic errors. Patients evaluated with both methods received more precise diagnoses compared to those assessed using a single diagnostic technique.



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Discussion

The findings of this study confirm the important role of both radiological examinations and cytological analysis in thyroid cancer diagnosis. Radiological methods serve as valuable screening and assessment tools because they provide detailed information about the anatomical characteristics of thyroid lesions. However, imaging findings alone may not always distinguish malignant tumors from benign nodules with complete certainty. Cytological analysis complements radiological assessment by providing direct microscopic evaluation of cellular morphology. This method contributes significantly to the confirmation of malignancy and helps clinicians make informed decisions regarding patient management and surgical intervention. Nevertheless, cytological examination may occasionally produce indeterminate results, particularly in follicular-patterned lesions.

The comparison of both diagnostic approaches suggests that each method has unique strengths and limitations. Radiological examinations are more sensitive for identifying suspicious abnormalities, while cytological analysis is more specific for confirming malignant disease. Therefore, the integration of these techniques provides a more comprehensive and reliable diagnostic strategy. These results support the growing consensus that multidisciplinary and combined diagnostic approaches are essential for improving diagnostic precision, reducing unnecessary procedures, and ensuring optimal treatment outcomes in patients with thyroid cancer.

Conclusion

Radiological examination methods and cytological analysis are both essential components of thyroid cancer diagnosis. Radiological techniques provide valuable information about the structural characteristics and extent of thyroid lesions, whereas cytological analysis offers reliable confirmation of malignant cellular changes. The study showed that radiological methods generally possess higher sensitivity, while cytological analysis demonstrates higher specificity. Neither method alone is sufficient in all clinical situations; therefore, their combined application significantly improves diagnostic accuracy. The integration of radiological and cytological findings enhances clinical decision-making, facilitates early detection of thyroid cancer, and contributes to the selection of appropriate treatment strategies. Consequently, the combined use of these diagnostic approaches should be considered the most effective method for evaluating patients with suspected thyroid malignancies.

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