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APPLICABILITY OF INTERNATIONAL GUIDELINES FOR THE MANAGEMENT OF PULMONARY NODULES IN UKRAINIAN CLINICAL PRACTICE

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ABSTRACT

Introduction. The increasing detection of pulmonary nodules due to the widespread use of chest imaging has created new challenges for radiologists regarding risk stratification, follow-up, and clinical decision-making. Several international guidelines, including those of the Fleischner Society, the American College of Chest Physicians (ACCP), the British Thoracic Society (BTS), Lung-RADS, and the European Society for Medical Oncology (ESMO), provide evidence-based recommendations for pulmonary nodule management. However, their implementation in routine clinical practice may be influenced by regional epidemiological characteristics, available imaging technologies, and healthcare system organization. In regions with a relatively high prevalence of infectious pulmonary diseases, including tuberculosis, the application of international recommendations may require regional adaptation to help reduce unnecessary invasive procedures while maintaining diagnostic accuracy. Therefore, evaluating the applicability of these guidelines under real-world clinical conditions remains an important issue in thoracic radiology.

Aim. To assess the applicability of current international guidelines for pulmonary nodule management (Fleischner Society, ACCP, BTS, Lung-RADS, and ESMO recommendations) in routine clinical practice based on a Ukrainian single-center cohort and to evaluate the role of digital chest radiography and multislice computed tomography in supporting regional adaptation of these recommendations.

Materials and methods. A retrospective single-center study included 148 patients with pulmonary nodules and mass lesions who underwent digital chest radiography and multislice computed tomography (MSCT). All included lesions underwent histopathological verification by surgery or biopsy. Imaging findings were compared with the recommendations of the Fleischner Society (2017), ACCP (2013), BTS (2015), Lung-RADS (version 2022), and ESMO regarding risk stratification, follow-up intervals, and diagnostic management. Particular attention was paid to the diagnostic performance of digital chest radiography, MSCT densitometry, volumetric assessment, and the applicability of low-dose follow-up protocols in routine clinical practice.

Results. The Fleischner Society, BTS, ACCP, Lung-RADS, and ESMO recommendations provided an appropriate framework for risk stratification and follow-up in most patients; however, several limitations became evident in the Ukrainian clinical setting. Benign granulomatous lesions frequently demonstrated imaging characteristics similar to those of malignant pulmonary nodules, increasing the risk of false-positive classification when recommendations were applied without consideration of regional epidemiology. Digital chest radiography demonstrated an overall sensitivity of 77.7% for the retrospective detection of histopathologically verified pulmonary lesions but showed limited performance for nodules ≤6 mm and subsolid lesions (sensitivity, 8.3%), supporting the need for MSCT in high-risk patients. MSCT densitometry demonstrated high diagnostic performance in differentiating benign from malignant lesions, with an optimal arterial-phase enhancement threshold of 22.5 HU (AUC=0.89). Volumetric assessment and volume doubling time (VDT) provided greater diagnostic value than a single morphological assessment.

Conclusions. International guidelines for pulmonary nodule management provide a reliable framework for diagnostic decision-making; however, their implementation in routine clinical practice should take into account regional epidemiological characteristics and local healthcare resources. The combination of digital chest radiography, multislice computed tomography, quantitative image analysis, and individualized follow-up strategies may improve diagnostic accuracy while supporting radiation safety and reducing unnecessary invasive procedures. The proposed approach may facilitate the practical adaptation of international recommendations to the Ukrainian healthcare setting.

Keywords: solitary pulmonary nodule; radiological parameters; diagnostics; screening algorithm; lung disease; digital image processing; microradiographic analysis; methods of mathematical data analysis; complex treatment; densitometry; radiomics.

INTRODUCTION

The rapid evolution and widespread implementation of chest MSCT in routine clinical practice have substantially increased the detection of incidental pulmonary nodules. While this has improved the early diagnosis of lung cancer, it has also created new diagnostic challenges [1, 2]. Clinicians must distinguish malignant lesions from benign nodules while avoiding unnecessary follow-up examinations, excessive radiation exposure, and invasive procedures. To support clinical decision-making, several international societies have developed evidence-based recommendations for the management of pulmonary nodules.

Fleischner Society Guidelines (2017). These guidelines are widely used for incidentally detected pulmonary nodules in asymptomatic adults aged 35 years and older without a history of malignancy. They recommend follow-up according to nodule size and individual patient risk, aiming to reduce unnecessary follow-up examinations for low-risk lesions [3, 4].

British Thoracic Society (BTS, 2015). The BTS guidelines use a quantitative approach based on a lower surveillance threshold (5 mm or 80 mm^3). They emphasize semi-automated volumetric assessment, volume doubling time (VDT), and validated malignancy prediction models, including the Brock model for the initial assessment and the Herder model when PET-CT is available [5].

American College of Chest Physicians (ACCP, 2013). These recommendations focus on estimating the pre-test probability of malignancy in patients with indeterminate pulmonary nodules measuring 8-30 mm. They emphasize comparison with previous imaging to confirm long-term stability (assessing two-year stability to rule out slow-growing benign lesions) and recommend PET-CT before invasive diagnostic procedures when appropriate [6, 7].

European Society for Medical Oncology (ESMO, 2023-2024): Frameworks center primarily on oncological staging and differential diagnosis with metastatic disease. ESMO highlights the role of PET-CT for nodal/distant staging, MSCT-guided transthoracic needle biopsy for peripheral lesions, and the mandatory involvement of multidisciplinary Tumor Boards for complex or metabolically active nodules [8, 9].

Lung-RADS (v2022): This reporting system, developed by the American College of Radiology, standardizes the interpretation and management of pulmonary nodules detected during low-dose MSCT lung cancer screening [10, 11].

Despite the clinical utility of these international guidelines, their direct application in specific regional settings presents notable challenges. A primary issue stems from overdiagnosis bias. As demonstrated in major randomized screening trials such as NLST and NELSON, high-sensitivity low-dose MSCT frequently detects minor, clinically inert nodules that would never progress to overt malignancy [12]. This may initiate cascades of redundant follow-up examinations and invasive procedures. Repeated MSCT examinations also increase cumulative radiation exposure, highlighting the importance of adhering to the ALARA (As Low As Reasonably Achievable) principle described in ICRP Publication 147 [13, 14].

Another limitation is that international guidelines are predominantly adapted to populations with a low background prevalence of infectious pulmonary diseases. In regions such as Ukraine, where the endemic burden of tuberculosis and specific infectious granulomatous lesions remains high, solid pulmonary nodules frequently display morphological and metabolic features that mimic peripheral carcinomas. Standard management algorithms may present high false-positive rates, leading to unwarranted thoracic surgeries or, conversely, diagnostic delays due to atypical presentations.

Therefore, evaluating the real-world applicability of major international guidelines within a Ukrainian clinical context and identifying necessary adaptations based on local epidemiology and quantitative imaging parameters remains a critical task in thoracic radiology.

AIM

To assess the applicability of major international guidelines for pulmonary nodule management (Fleischner Society, ACCP, BTS, Lung-RADS, and ESMO) in a Ukrainian single-center cohort and to determine whether quantitative findings from digital chest radiography and multislice computed tomography for the chest support regional adaptation of these recommendations.

MATERIALS AND METHODS

This retrospective single-center study included 148 adult patients with indeterminate solid or subsolid pulmonary nodules and mass lesions examined during 2024-2026 period at the Municipal Non-Profit

Enterprise "Mykolaiv Regional Oncology Center" of the Mykolaiv Regional Council.

The study was approved by the institutional ethics commission, and informed consent was obtained from all participants in accordance with the Declaration of Helsinki and national regulations.

Diagnostic Verification

Pulmonary nodules were classified as benign or malignant using one of the following reference standards. All final diagnoses were established by histopathological examination obtained from CT-guided biopsy, surgical resection, or postoperative histological examination. Serial MSCT examinations performed before definitive treatment were used exclusively for quantitative assessment (densitometry and VDT) and comparison with guideline-recommended surveillance strategies. Histopathological evaluation was performed according to the WHO Classification of Thoracic Tumours (5th edition, 2021).

Table 1. Histopathological characteristics of morphologically verified pulmonary lesions

Histological type	Number (n)	Percentage in the group (%)
Malignant lesions (n=95):		
- Adenocarcinoma	41	43,2
- Squamous cell carcinoma	34	35,8
- Adenosquamous carcinoma	8	8,4
- Poorly differentiated non-small cell carcinoma	12	12,6
Benign lesions (n=53):		
- Chondromatous hamartoma	32	60,4
- Tuberculoma	12	22,6
- Organizing pneumonia / Abscess	6	11,3
- Others (encapsulated infarction, fibrosis)	3	5,7

Imaging Protocols

Digital chest radiography. Standard posteroanterior and lateral chest radiographs were acquired using digital radiography systems. Images were assessed for lesion visibility, masking by normal anatomical structures (ribs, mediastinum, and diaphragm), and diagnostic sensitivity according to nodule size (<6 mm or ≥6 mm) and attenuation (solid or subsolid/ground-glass).

Multislice computed tomography. Chest MSCT was performed using multidetector scanners with a slice thickness and reconstruction interval ≤1.0 mm. Follow-up examinations were performed using low-dose protocols whenever appropriate to reduce radiation exposure.

Patients with indeterminate solid nodules measuring 8-30 mm underwent contrast-enhanced MSCT. Attenuation values were measured on unenhanced images and again during the arterial phase (30-35 s after intravenous administration of a non-ionic iodinated contrast agent (dose according to body weight)).

Contrast enhancement (ΔHU) was calculated as:

$$\Delta HU = HUarterial - HUunenhanced$$

Volumetric analysis. Semi-automated software was used to measure nodule volume (mm^3) and calculate Volume Doubling Time (VDT) according to the equation:

$$VDT = \frac{\ln(2) \times \Delta t}{\ln\left(\frac{V2}{V1}\right)}$$

where V_1 and V_2 represent the initial and follow-up nodule volumes, respectively, and Δt is the time interval between examinations.

The diagnostic pathway for each patient was compared with the recommendations of five international guidelines:

- Fleischner Society (2017);
- British Thoracic Society (2015);
- American College of Chest Physicians (2013);
- Lung-RADS version 2022;
- European Society for Medical Oncology (2023-2024).

Statistical analyses were performed using MedCalc® Statistical Software version 22.0. Diagnostic sensitivity, specificity, and overall accuracy were calculated. Receiver operating characteristic (ROC) analysis was used to determine the optimal ΔHU threshold for differentiating benign and malignant nodules, and the area under the ROC curve (AUC) was calculated with 95% confidence intervals. Continuous variables are presented as mean ± standard deviation (SD) or median with interquartile range (IQR). Concordance between actual clinical management and guideline recommendations was assessed according to recommended surveillance intervals, indications for additional diagnostic procedures, and criteria for invasive verification.

RESULTS

Among 148 patients, digital chest radiography demonstrated an overall sensitivity of 77.7% for the retrospective detection of morphologically verified pulmonary lesions, supporting its potential role as an accessible first-line imaging modality for initial

detection. However, its diagnostic performance depended strongly on nodule size and attenuation. For nodules ≤6 mm and pure ground-glass nodules (pGGNs), sensitivity decreased to 8.3%. Most undetected lesions were associated with anatomical superimposition, particularly involving the ribs, mediastinum, and diaphragm. These findings confirm the limited role of chest radiography in the evaluation of small or subsolid nodules and emphasize the need for MSCT, consistent with current international recommendations. Overall, 44.6% of pulmonary nodules were detected during routine preventive examinations, and 28.4% of malignant lesions were diagnosed in asymptomatic patients. This detection rate exceeded national registry data (<5%) and likely reflects the use of double independent image review together with referral to a specialized oncology center.

Contrast-enhanced MSCT improved the characterization of indeterminate solid pulmonary nodules measuring 8-30 mm. Unenhanced attenuation values alone did not reliably differentiate benign from malignant lesions because of substantial overlap between inflammatory granulomas and malignant tumors. In contrast, arterial-phase enhancement (ΔHU) provided a useful quantitative marker of malignancy. Malignant nodules demonstrated significantly greater enhancement than benign lesions.

ROC analysis identified an optimal threshold of ΔHU=22.5 HU, with high diagnostic performance (AUC=0.89; 95% CI, 0.82-0.95). These findings indicate that quantitative MSCT densitometry may complement existing guideline-based management, particularly for indeterminate nodules.

Semi-automated volumetric analysis and volume doubling time (VDT) provided additional diagnostic information compared with linear diameter assessment during follow-up. Among benign nodules, including hamartomas and inactive tuberculomas, volumetric stability was observed in 93.2% of cases during the available follow-up period.

In contrast, an increase in the solid component of ≥2 mm in subsolid nodules was strongly associated with invasive adenocarcinoma, supporting the follow-up criteria proposed by current international guidelines.

The applicability of international guideline systems was evaluated by comparing their recommendations with the clinical and imaging findings obtained in our cohort (Table 2).

Overall, the Fleischner Society, BTS, ACCP, Lung-RADS, and ESMO recommendations provided

Table 2. Proposed adaptation of pulmonary nodule management pathways based on international guidelines and quantitative MSCT findings

Solid nodule size	Fleischner Society (2017)	BTS (2015)	ACCP (2013)	Lung-RADS v2022	Proposed practical adaptation based on study findings
<5 mm	No follow-up (low risk); optional CT at 12 months (high risk)	No follow-up	No follow-up if stable	Category 1-2	Consider regional epidemiology (tuberculosis, granulomatous disease); no additional imaging if benign features are present.
5-6 mm	CT at 12 months (high risk)	CT at 12 months	CT at 12 months	CT at 12 months	Individualize follow-up according to clinical risk and CT morphology rather than size alone.
6-8 mm	CT at 6-12 months; consider CT at 18-24 months	CT at 3 and 12 months	CT at 6-12 months; consider CT at 18-24 months	Category 3 (6-month LDCT)	Add volumetric assessment and VDT to improve risk stratification and reduce unnecessary follow-up.
>8 mm	CT at 3 months, PET-CT and/or biopsy	Brock model → management according to risk	Management based on clinical probability, PET-CT or biopsy	Category 4 (3-month LDCT, PET-CT and/or tissue diagnosis)	Incorporate contrast-enhanced MSCT densitometry (ΔHU ⩾22.5 HU) before invasive procedures in indeterminate nodules.
Main decision criterion	Diameter (mm)	Volume (mm^3) and VDT	Clinical probability	Lung-RADS category	Combined assessment using morphology, volumetry, VDT, and quantitative MSCT densitometry, taking regional epidemiology into account.

an appropriate framework for risk stratification and follow-up in most patients. However, several limitations became evident in the Ukrainian clinical setting. Benign granulomatous lesions, including inactive tuberculomas, frequently demonstrated imaging characteristics similar to malignant pulmonary nodules, increasing the likelihood of false-positive classification when recommendations were applied without considering regional epidemiology. In these cases, quantitative MSCT parameters, particularly contrast enhancement and volumetric assessment, improved diagnostic confidence and reduced diagnostic uncertainty.

DISCUSSION

Applicability of International Guidelines

Our findings indicate that the Fleischner Society, BTS, ACCP, Lung-RADS, and oncological principles outlined by ESMO recommendations provide a reliable framework for the evaluation and follow-up of pulmonary nodules. However, their application in a Ukrainian clinical setting requires consideration of regional epidemiological characteristics and the complementary use of quantitative MSCT parameters.

The main limitation observed in our cohort was the frequent occurrence of benign granulomatous lesions with imaging features resembling malignant nodules. In regions with a high prevalence of tuberculosis, management strategies based solely on nodule size or clinical probability may increase the number of false-positive findings and unnecessary invasive procedures. These observations support the need for regional adaptation rather than direct adoption of existing international recommendations.

The present study showed that quantitative MSCT parameters improved diagnostic confidence in patients with indeterminate pulmonary nodules.

Contrast-enhanced densitometry demonstrated high diagnostic performance, with an optimal threshold of ΔHU = 22.5 HU for differentiating benign from malignant lesions. Likewise, volumetric assessment and Volume Doubling Time (VDT) provided more reliable information during follow-up than linear diameter measurements alone, particularly in patients with stable benign nodules.

These findings suggest that quantitative imaging biomarkers may complement current guideline-based algorithms and help reduce unnecessary biopsy or surgery in selected patients.

Overdiagnosis and Radiation Exposure

Our results also support concerns regarding overdiagnosis reported in large lung cancer screening trials, including NLST and NELSON. Increased detection of small pulmonary nodules may lead to additional imaging examinations and, in some patients, invasive diagnostic procedures.

Although low-dose CT substantially reduces radiation exposure, repeated examinations remain a concern, particularly in younger patients and those requiring long-term surveillance. Therefore,

Table 3. Practical limitations of international pulmonary nodule management guidelines and study-based strategies for regional adaptation

Diagnostic limitation	Clinical impact	Proposed strategy based on the present study
Low sensitivity of chest radiography for nodules ⩽6 mm and pure ground-glass nodules	Delayed detection or missed diagnosis due to anatomical overlap	Early MSCT for suspected small or subsolid nodules rather than prolonged radiographic follow-up.
Benign granulomatous lesions mimicking lung cancer	Increased false-positive rate and unnecessary invasive procedures	Interpret imaging findings in the context of regional tuberculosis prevalence and incorporate quantitative MSCT parameters before biopsy.
Limited specificity of conventional CT morphology	Difficulty differentiating benign from malignant solid nodules	Add contrast-enhanced MSCT densitometry; ΔHU ⩾22.5 HU improved discrimination between benign and malignant lesions.
Reliance on linear diameter measurements	Small volumetric changes may remain undetected during follow-up	Use semi-automated volumetric analysis and Volume Doubling Time whenever feasible.
Repeated CT examinations during surveillance	Increased cumulative radiation exposure	Individualize follow-up intervals according to quantitative imaging findings while adhering to the ALARA principle.
Automated volumetric segmentation errors (juxtavascular, pleural, and subsolid nodules)	Inaccurate volume measurements and false assessment of growth	Combine automated measurements with expert radiologist review and manual correction when required.

improving risk stratification by incorporating quantitative MSCT parameters may help optimize follow-up schedules while remaining consistent with the ALARA principle.

Volumetric analysis has become an important component of pulmonary nodule assessment; however, several technical limitations remain. Automated segmentation may be inaccurate for juxtavascular nodules because adjacent vessels can be included in the calculated volume. Similar difficulties may occur with pleural or subpleural lesions, for which manual contour correction is often required. In addition, subsolid nodules with poorly defined margins remain challenging for automated volumetric analysis because of their low contrast with the surrounding normal lung parenchyma. These limitations should be considered when interpreting quantitative imaging results in routine clinical practice.

Clinical Implications

Based on our findings, international recommendations appear applicable to patients treated in a Ukrainian specialized oncology center but should be supplemented by quantitative MSCT parameters and interpreted in the context of local epidemiology. Contrast-enhanced densitometry, volumetric assessment, and VDT may improve diagnostic accuracy in indeterminate pulmonary nodules, particularly in regions where granulomatous diseases are common.

CONCLUSIONS

1. International guidelines and oncological recommendations (Fleischner Society, BTS, ACCP, Lung-RADS), supplemented by oncological recommendations from ESMO, provide a useful framework. However, in regions with a high prevalence of granulomatous diseases, their application may require additional quantitative MSCT-based risk stratification.

2. Digital chest radiography remains a useful first-line imaging method, with an overall sensitivity of 77.7% for retrospective detection of morphologically verified pulmonary lesions in our cohort. However, its sensitivity was only 8.3% for nodules ≤6 mm and pure ground-glass nodules, supporting the role of low-dose MSCT in the assessment of these lesions.

3. Contrast-enhanced MSCT provided additional differentiation capability of benign and malignant solid pulmonary nodules. An arterial enhancement threshold of ΔHU ≥22.5 HU showed high diagnostic performance (AUC = 0.89) and may serve as an additional quantitative criterion in patients with indeterminate nodules.

4. Volumetric assessment and Volume Doubling Time (VDT) provided more reliable follow-up information than linear diameter measurements alone. Incorporating these quantitative parameters into routine practice may improve diagnostic confidence while helping to optimize follow-up intervals and limit unnecessary radiation exposure.

5. The findings of this study support the integration of quantitative MSCT parameters with existing international recommendations rather than replacing current guideline-based management. Further multicenter studies are needed to validate these proposed regional adaptations.

Article Declarations

Prospects for further research. Future studies should focus on prospective multicenter validation of the proposed quantitative MSCT parameters and their integration into pulmonary nodule management algorithms. Particular attention should be given to:

- validation of the arterial enhancement threshold (ΔHU ⩾22.5 HU) for differentiation between benign and malignant solid pulmonary nodules in larger patient populations;
- development of regional registries including patients with infectious granulomatous lung diseases to improve risk prediction models in populations with a high prevalence of tuberculosis;
- further optimization of volumetric assessment and Volume Doubling Time (VDT) monitoring protocols, especially for small and subsolid pulmonary nodules;
- evaluation of automated quantitative imaging approaches, including radiomics and artificial intelligence-based analysis, as potential complementary tools for improving diagnostic accuracy.

Addressing current diagnostic limitations requires the integration of artificial intelligence (AI) radiomics, multiparametric PET/MRI mapping, and multidisciplinary tumor boards into standardized clinical decision-support systems.

Study limitations. This study has several limitations. First, its retrospective single-center design and relatively small sample size (n = 148) may limit the generalizability of the findings. In addition, the study population was recruited from a specialized regional oncology center, which may have introduced selection bias toward patients with a higher probability of clinically significant pulmonary nodules. Second, automated volumetric segmentation demonstrated technical limitations in specific types of nodules, including juxtavascular, subpleural, and subsolid lesions. In these cases, manual correction of segmentation boundaries was required, which may increase measurement variability. Finally, the high prevalence of tuberculosis and granulomatous lung disease in the studied population should

be considered when interpreting the results. Therefore, validation in populations with different epidemiological characteristics is required before broader implementation of the proposed adaptations.

Primary data and materials. The study did not use identifiable primary medical documentation. The analysis was performed using anonymized imaging data and study-specific clinical and diagnostic parameters extracted according to the research protocol.

Research ethics. The study was conducted in accordance with the ethical standards of the biomedical research ethics committee, current Ukrainian healthcare legislation, and the principles of the Declaration of Helsinki (2000). All data were anonymized prior to analysis.

Declaration of AI use. Artificial intelligence tools were not used for data generation, statistical analysis, interpretation of results, or preparation of scientific content. Language editing was performed by the authors.

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ЗАСТОСОВНІСТЬ МІЖНАРОДНИХ РЕКОМЕНДАЦІЙ ЩОДО ВЕДЕННЯ ПАЦІЄНТІВ ІЗ ЛЕГЕНЕВИМИ ВУЗЛАМИ В УМОВАХ УКРАЇНСЬКОЇ КЛІНІЧНОЇ ПРАКТИКИ

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РЕЗЮМЕ

Вступ. Збільшення частоти виявлення легеневих вузлів унаслідок широкого застосування методів візуалізації органів грудної клітки створило нові виклики для лікарів-рентгенологів щодо стратифікації ризику, визначення тактики динамічного спостереження та прийняття клінічних рішень. Низка міжнародних рекомендацій, зокрема керівництва Fleischner Society, Американської колегії лікарів пульмонологів (ACCP), Британського торакального товариства (BTS) та системи Lung-RADS, містять доказово обґрунтовані підходи до ведення пацієнтів із легеневими вузлами. Водночас їх застосування в умовах реальної клінічної практики може залежати від регіональних епідеміологічних особливостей, доступності сучасних методів візуалізації та організації системи охорони здоров'я. У регіонах із високою поширеністю інфекційних захворювань легень, зокрема туберкульозу, використання міжнародних рекомендацій потребує адаптації з урахуванням локальних умов для зниження кількості необґрунтованих інвазивних втручань при збереженні високої діагностичної точності. Тому оцінка можливості застосування міжнародних рекомендацій у реальних клінічних умовах є актуальним завданням сучасної торакальної радіології.

Мета. Оцінити можливість застосування сучасних міжнародних рекомендацій щодо ведення пацієнтів із легеневими вузлами (Fleischner Society, ACCP, BTS, Lung-RADS та рекомендацій ESMO) у рутинній клінічній практиці на основі даних одноцентрового дослідження в Україні, а також визначити роль цифрової рентгенографії органів грудної клітки (РГ) та мультиспіральної комп'ютерної томографії (МСКТ) у процесі регіональної адаптації цих рекомендацій.

Матеріали та методи. Проведено ретроспективне одноцентрове дослідження за участю 148 пацієнтів з об'ємними утвореннями легень, яким виконано РГ ОГК та МСКТ ОГК з подальшою патоморфологічною верифікацією за результатами оперативного втручання або біопсії. Результати променевих досліджень порівнювали з положеннями рекомендацій Fleischner Society (2017), ACCP (2013), BTS (2015) та Lung-RADS (версія 2022) щодо стратифікації ризику, інтервалів динамічного спостереження та вибору подальшої діагностичної тактики. Окремо оцінювали діагностичну ефективність цифрової рентгенографії органів грудної клітки, денситометрії при МСКТ, об'ємної оцінки легеневих утворень та можливість застосування низькодозових протоколів динамічного контролю у повсякденній клінічній практиці.

Результати. Рекомендації Fleischner Society, BTS, ACCP, Lung-RADS та рекомендації ESMO забезпечують ефективну основу для стратифікації ризику та визначення тактики спостереження у більшості пацієнтів, однак при їх застосуванні в українських клінічних умовах були виявлені певні обмеження. Доброякісні гранульоматозні зміни часто мали променеві характеристики, подібні до злоякісних легеневих вузлів, що підвищувало ризик хибнопозитивної оцінки за умови застосування рекомендацій без урахування регіональних епідеміологічних особливостей. Цифрова рентгенографія органів грудної клітки продемонструвала загальну чутливість 77,7% при ретроспективному виявленні морфологічно верифікованих патологічних утворень легень, однак мала обмежену діагностичну ефективність щодо вузлів розміром ≤6 мм та субсолідних утворень (чутливість 8,3%), що підтверджує необхідність застосування МСКТ у пацієнтів групи високого ризику. Денситометричний аналіз при МСКТ продемонстрував високу діагностичну ефективність у диференціації доброякісних та злоякісних утворень із визначенням оптимального порогового значення приросту щільності після контрастного підсилення в артеріальну фазу на рівні 22,5 HU (AUC = 0,89). Об'ємна оцінка утворень та визначення часу подвоєння об'єму (VDT) мали вищу діагностичну значущість порівняно з одноразовою морфологічною оцінкою.

Висновки. Міжнародні рекомендації щодо ведення пацієнтів із легеневими вузлами є надійною основою для прийняття діагностичних рішень, однак їх впровадження у клінічну практику має враховувати регіональні епідеміологічні особливості та можливості локальної системи охорони здоров'я. Поєднання цифрової рентгенографії органів грудної клітки, МСКТ ОГК із контрастним підсиленням, кількісного аналізу зображень та індивідуалізованих стратегій динамічного спостереження дозволяє підвищити точність діагностики, забезпечити дотримання принципів радіаційної безпеки та зменшити кількість необґрунтованих

інвазивних процедур. Запропонований підхід сприяє практичній адаптації міжнародних рекомендацій до умов системи охорони здоров'я України.

Ключові слова: солітарний легеневий вузол; рентгенологічні показники; діагностика; алгоритм скринінгу; захворювання легень; цифрова обробка зображень; мікрорентгеноструктурний аналіз; методи математичного аналізу даних; комплексне лікування; денситометрія; радіоміка.

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