The Gulf Journal of Oncology

Indexed By PubMed and Medline Database

Issue 51, May 2026
ISSN No. 2078-2101



Special Issue Featuring Original Articles and Conference Proceedings

Regional Oncology Conference | 13th GFFCC Annual Conference | Cancer: Reality and Challenges

Scientific Abstracts, Poster Presentations, Conference Recommendations and Highlights

The Official Journal of the Gulf Federation For Cancer Control

Table of Contents

Articles:

Diagnosis and Early Detection of Lung Cancer: Present and Future Approaches 07

Immunohistochemical Expression of BCL2 (B cell lymphoma 2) in Invasive Breast Carcinoma and its Correlation with Clinicopathological Parameters 14

Artificial Intelligence–Augmented Breast Ultrasound: Advancing Diagnostic Precision and Equity in Cancer Care in Kuwait 22

Epstein–Barr Virus Seroprevalence and Associated Risk Factors in Head and Neck Squamous Cell Carcinoma: A Cross–Sectional Study from Aden, Yemen 26

Conference Proceedings

13th GFFCC Annual Conference – Cancer: Reality and Challenges (Kuwait, 02–03 February 2026) 36

Poster Abstracts

Laparoscopic Non–Ischemic Partial Nephrectomy: Case Report 37

Pap Smear Cytology Screening Results in Aden Governmental Health Facilities, Yemen A Prospective Study (December 2024 November 2025) 38

Influence Relationship Between Social Support, Coping Strategies, Spirituality and Psychological Factors Among Breast Cancer Survivors 39

Low Dose Dasatinib is Effective and Safe in Patients with Chronic Myeloid Leukemia, Chronic phase (CML–CP). Kuwait Cancer Control Center Experience 40

A Novel Clinical Risk Score That Can Accurately Predict Survival of Early–Onset Breast Cancer Patients (EOBC) – A UAE Cohort Study 43

Oncology Patients' Willingness and Perspectives on Clinical Trial Participation in the United Arab Emirates: Insights from a Rapidly Growing Oncology Research Ecosystem 47

Real–World Utilization and Outcomes of Trastuzumab Emtansine in HER–2 Positive Breast Cancer: A Retrospective Study from Oman 51

Cervical Cytology Abnormalities and HPV Infection in Kuwait: National Population–Based Data, 2017–2018 53

Mesonephric–like Adenocarcinoma of the Female Genital Tract: A Case Series and Review of Diagnostic Challenges 55

Clinical and Pathological Characteristics of Kaposi Sarcoma in a Large Tertiary Health Care Hospital, Riyadh, Saudi Arabia: A Retrospective Study. 57

Psychological Morbidity at Cancer Diagnosis: A prospective Observational study from Bahrain 59

Neoadjuvant Chemotherapy in ER+/HER2–negative or HER2–low Early Breast Cancer: pCR, Compliance, and Predictors in a Single–Center Cohort 61

- Speaker's Presentation Abstracts 63
- Conference Recommendations and Highlights 77
- News Notes 79
- Advertisements 82
- Scientific Activities 83

Review Article

Diagnosis and Early Detection of Lung Cancer: Present and Future Approaches

Tarig Fadelelmoula

Department of Internal Medicine, College of Medicine and Health Sciences, National University of Science and Technology, Sohar, Sultanate of Oman

Abstract

Lung cancer is the leading cause of cancer deaths worldwide, with most cases found late. This review summarizes evidence on lung cancer diagnostics, highlights findings from important screening trials, and discusses new technologies shaping future approaches. It describes recent advances like artificial intelligence, radiomics, and molecular biomarkers for early detection. The review compares diagnostic tools, addresses barriers to their use, and presents new results from recent trials and technologies. By highlighting innovations and contrasting them with current practices, it clarifies the evolving landscape and offers strategies to improve early diagnosis. The review used a comprehensive PubMed search with the terms: "lung cancer AND (screening OR early detection OR diagnosis OR biomarkers OR artificial intelligence OR radiomics)." It included articles from 2010 to April 2024. Only English articles focused on adult human studies were included. The review analyzed original research, systematic reviews, meta–analyses, and major screening trials. Twenty–eight articles met these criteria, including five major screening trials. Five themes are identified: Enhanced Endoscopic Diagnostics, Liquid Biopsy and Molecular Biomarkers, Artificial Intelligence and Radiomics, Novel Biomarkers, and Integrated Screening Approaches. Low–dose computed tomography (LDCT) trials such as National Lung Screening Trial (NLST), Dutch Belgian lung cancer screening trial (NELSON), UK Lung Cancer Screening Trial (UKLS), and Multicentric Italian Lung Detection (MILD) show mortality benefit, but barriers remain. New diagnostic approaches, including liquid biopsy, AI with radiomics, and volatile organic compound profiling, may help overcome these barriers and support current strategies.

Keywords: lung cancer, early detection, screening, low–dose CT, liquid biopsy, artificial intelligence, radiomics, biomarkers

Introduction

Lung cancer is the leading cause of cancer deaths globally, with a rising burden expected by 2050. [1] High Human Development Index (HDI) regions are particularly affected. Early detection is critical, as it strongly influences survival. However, most cases are diagnosed at advanced stages, limiting treatment options and outcomes. [2]

Survival depends mainly on the stage at diagnosis. Only 16% of patients are diagnosed early (stage I–II). [3] During COVID–19, over 50% of patients had advanced disease (stage III–IV), while about 41% were detected at stage 0–II. [4] Another analysis found 25% of lung cancers are diagnosed incidentally. These patients are more likely to have early–stage disease than those with symptoms (51.5% vs 14%). [5]

Low–dose computed tomography (LDCT) screening changed early detection. The National Lung Screening Trial (NLST) in the US studied over 53,000 high–risk smokers and compared LDCT with chest radiography. LDCT reduced lung cancer mortality by 20%. [6] Longer follow–up confirmed the benefit. After about 12 years, the mortality rate ratio was 0.92, and 303 needed to be screened to prevent one death. [7]

The NELSON trial in the Netherlands and Belgium studied over 15,000 people. LDCT reduced lung cancer mortality by 24% in men, with a positive trend in women. [8] The UKLS pilot showed risk–model–based recruitment was feasible. LDCT detected many early–stage cancers.

Corresponding author: Tarig Fadelelmoula, Associate Professor, Department of Internal Medicine, College of Medicine and Health Sciences, National University of Science and Technology, Sohar, Sultanate of Oman, Email: tarigeltoum@nu.edu.om; tel.: +96892939081

[9] Italy's MILD trial found that continued screening beyond five years reduced 10–year mortality. Biennial and annual screening offered similar benefits. [10]

Despite strong trial evidence, barriers remain. Few eligible high–risk people participate. Non–smokers are excluded from many programs. Concerns persist about false positives, overdiagnosis, and cost. Diagnostic delays are still an issue. In a SEER–Medicare study, the median delay from suspicion to diagnosis was about 20 days for non–small cell lung cancer (NSCLC). Longer delays reduced survival. [11] A Spanish study also found delays harmed survival, especially in early–stage disease. [12]

Several strategies address these challenges. Community outreach and education aim to increase participation among high–risk individuals. Risk models can include never–smokers and people with environmental exposure. To reduce false positives, nodule management protocols are being refined. AI is used to improve imaging specificity. Streamlining diagnostic pathways and creating multidisciplinary clinics may reduce delays. Pilot programs use primary care and telemedicine to expand access and speed up evaluations. Table 1 summarizes major lung cancer screening trials.

Bronchoscopic methods are being studied to detect premalignant and early–stage airway lesions. Autofluorescence bronchoscopy (AFB), autofluorescence imaging (AFI), and narrow–band imaging (NBI) are more sensitive than white–light bronchoscopy (WLB) for detecting dysplasia and carcinoma in situ. [13] These techniques are not yet suitable for large–scale screening due to their invasiveness and scalability limitations, but they provide insight into airway carcinogenesis. They may be useful as adjuncts to LDCT in select high–risk groups. Their combination with radiological and molecular diagnostics is part of the broader shift to multimodal early detection. Table 2 summarizes major bronchoscopic screening studies.

These challenges underscore the need for novel diagnostic strategies that complement Bronchoscopic techniques and LDCT, including liquid biopsy, artificial intelligence (AI) and radiomics, volatile organic compound (VOC) profiling, and multimodal risk stratification. To guide the discussion, the following section examines each of these emerging approaches in detail. We begin by exploring enhanced endoscopic diagnostics before moving into developments in molecular and imaging technologies.

Enhanced Endoscopic Diagnostics

Bronchoscopy has traditionally been a diagnostic tool for centrally located lung cancers, but advances in endoscopic imaging have expanded its role in early detection. Conventional white–light bronchoscopy (WLB) is limited in sensitivity for detecting premalignant lesions. In a multicenter trial of 1,173 high–risk patients, Haussinger et al. showed that the addition of autofluorescence bronchoscopy (AFB) significantly improved sensitivity for premalignant and malignant lesions compared to WLB alone (82% vs 58%). [13]

Surveillance approaches combining AFB with spiral CT and sputum cytology have also been explored. Loewen et al. demonstrated that such multimodal surveillance detected central cancers and preinvasive lesions in high–risk individuals with chronic obstructive pulmonary disease (COPD), smoking history, or asbestos exposure, even when sputum cytology was negative. [14]

Similarly, the Pan–Canadian Early Detection of Lung Cancer Study evaluated ~1,300 high–risk participants using low–dose CT (LDCT) combined with AFB. In this study, Tremblay et al. reported dysplasia or carcinoma

Trial/Study	Population	Intervention	Key Findings
NLST Team. [6]	53,454 high–risk smokers, U.S., aged 55–74	Annual LDCT vs chest radiography	20% reduction in lung cancer mortality with LDCT
NLST Team. [7]	NLST cohort, ~12 years follow–up	Annual LDCT vs chest radiography	Sustained mortality benefit; RR ~0.92; NNS ~303
de Koning et al. [8]	15,792 high–risk men and women, Netherlands & Belgium, aged 50–74	Volume–based LDCT at baseline, year 1, year 3, year 5.5	24% mortality reduction in men; trend in women
Field et al. [9]	High–risk individuals aged 50–75, UK	Single LDCT vs usual care	Feasibility confirmed; early–stage cancers detected
Pastorino et al. [10]	High–risk smokers, Italy	Annual or biennial LDCT vs no screening	Prolonged screening (>5 years) reduced 10–year mortality

Table 1. Summary of Major Randomised Trials of LDCT–based Lung Cancer Screening

in situ (CIS) in 5.3% of participants; however, CT–occult invasive cancers were rare (0.15%), highlighting that AFB may be most valuable for detecting preneoplastic lesions in central airways rather than invasive disease. [15]

Chiyo et al. studied additional optical enhancements by comparing WLB, LIFE (light–induced fluorescence endoscopy), and autofluorescence imaging (AFI) in patients with suspected lung cancer. Combining AFI with WLB improved the detection of dysplastic and malignant lesions and showed higher specificity than LIFE alone. [16]

Narrow–band imaging (NBI) is a promising tool. In a large cohort, Zhu et al. showed NBI bronchoscopy improved visualization of vascular patterns and detection of central lung cancers compared to WLB. [17]

In Japanese studies, Hanibuchi et al. evaluated 123 high–risk people and found that 33% of biopsies with WLB plus AFB were premalignant or malignant, confirming AFB's added value. [18]

Liquid Biopsy and Molecular Biomarkers

Liquid biopsies analyze circulating tumour DNA (ctDNA), circulating tumour cells (CTCs), extracellular vesicles (EVs), and non–coding RNAs, offering minimally invasive approaches for diagnosis, treatment monitoring, and recurrence detection. [19] They allow real–time disease tracking and hold promise in minimal residual disease (MRD) detection. [20] Advances in fragmentomics and methylation assays further enhance sensitivity, especially for early–stage disease. [21] However, widespread adoption is limited by variability in assay platforms, low ctDNA shedding in some patients, and the need for large–scale prospective validation. Several major prospective studies are currently underway to address these gaps, including the Circulating Cell–free Genome Atlas (CCGA) study, the NELSON liquid biopsy substudy, and the DETECT–A trial, which collectively aim to validate the clinical utility and accuracy of liquid biopsy technologies for lung cancer screening and early detection. The results of these and other ongoing trials will be critical for informing future implementation and guideline development.

Study	Population / Setting	Bronchoscopic Method	Key Findings	Limitations / Notes
Haussinger et al. [13]	1,173 high–risk patients (mean age ~59)	WLB vs WLB + AFB	AFB increased detection of pre–invasive lesions; sensitivity 82% vs 58% with WLB alone	Not general population; modest specificity; potential overdiagnosis
Loewen et al. [14]	High–risk (COPD, smoking, asbestos, prior aerodigestive cancer)	AFB + Spiral CT + sputum cytology	Detected central cancers and premalignant lesions even with negative sputum cytology	Surveillance study; may not reduce mortality; resource intensive
Tremblay et al. [15]	~1,300 high–risk participants (≥2% 5–year risk)	LDCT + AFB	Dysplasia/CIS found in 5.3%; 0.15% were CT–occult invasive cancers	CT is more sensitive for invasive cancers; AFB mainly for premalignant lesions
Chiyo et al. [16]	Patients with known/ suspected lung cancer	WLB, LIFE, AFI	AFI + WLB detected dysplasias and cancers; higher sensitivity vs WLB/ LIFE; better specificity than LIFE	Small, selected patient group; early/suspected disease focus
Zhu et al. [17]	Large cohort, central lung cancer evaluation	Narrow–Band Imaging (NBI)	Improved detection of central cancers and vascular patterns; better visualization vs WLB	Peripheral lesions not assessed; diagnostic rather than population screening
Hanibuchi et al. [18]	123 high–risk individuals, Japan	AFB + WLB	Among 282 biopsies, 33% were premalignant/malignant: AFB improved sensitivity	Small cohort; bronchial lesions; survival benefit not assessed

Table 2. Summary of major studies of bronchoscopy–based Lung Cancer Screening

Artificial Intelligence and Radiomics

Radiomics enables the extraction of quantitative imaging features that can characterize tumours beyond human visual assessment. Radiomic models have demonstrated utility in predicting histology, prognosis, and treatment response. [22] AI applied to LDCT has shown improvements in nodule detection, false–positive reduction, and malignancy prediction compared with radiologists. [23] However, a systematic review of CE–marked AI software found improved sensitivity (5–20% for actionable nodules) but reduced specificity, leading to more follow–up scans. [24] Challenges include variability in imaging protocols, need for explainability, and integration into clinical workflows.

Novel Biomarkers

Breath analysis for VOCs offers a non–invasive diagnostic approach. Machine learning applied to VOC profiles has shown encouraging accuracy in distinguishing lung cancer patients from healthy controls. [25] A recent framework proposed standardization for VOC analysis, though results remain influenced by confounders such as smoking, diet, and comorbidities. [26]

Integrated Screening Approaches

The integration of LDCT, AI, and biomarkers may optimize screening. AI–driven risk models combined with LDCT could increase specificity and reduce unnecessary biopsies. [27] Moreover, expanding screening programs to also capture comorbid conditions such as COPD and cardiovascular disease may improve cost–effectiveness and public health acceptance. [28] However, several real–world barriers to implementing such integrated approaches remain. These include the high costs of advanced imaging and biomarker assays, limited infrastructure and digital capacity in many healthcare settings, and the need for substantial workforce training to utilize new technologies effectively. Equity concerns also exist, as access to cutting–edge diagnostics may be limited by geographic, socioeconomic, or insurance–related disparities. Addressing these practical challenges will be vital to ensure that technological advances in lung cancer screening translate into widespread clinical benefit.

Comparative analysis of lung cancer diagnosis

The comparative analysis in Table 3 highlights the complementary strengths and limitations of different diagnostic approaches for lung cancer, including conventional imaging and biopsy, bronchoscopic methods, liquid biopsy, AI and radiomics, breath–based VOC profiling, and Integrated approaches that combine imaging, biomarkers, and AI.

Conclusion

Low–dose computed tomography (LDCT) remains the foundation of lung cancer screening, as confirmed by landmark randomized trials. However, important gaps remain, including false positives, overdiagnosis, diagnostic delays, and exclusion of non–smokers from screening programs. Advances in bronchoscopy, particularly autofluorescence bronchoscopy (AFB), autofluorescence imaging (AFI), and narrow–band imaging (NBI), have demonstrated improved detection of central airway premalignant and malignant lesions. However, their role in population–level screening remains limited due to concerns about invasiveness and scalability. Liquid biopsy, AI–enhanced radiomics, and volatile organic compound (VOC) profiling are emerging as powerful, minimally invasive approaches that can complement existing imaging. Each modality has unique strengths but also limitations in sensitivity, specificity, and implementation.

It is important to acknowledge several pieces of evidence in the current literature. Many landmark studies included selected high–risk populations, often older smokers, which restricts generalizability to broader patient groups. Study heterogeneity, such as differences in study design, eligibility criteria, and diagnostic technology, complicates direct comparisons across trials or settings. Some emerging modalities, like liquid biopsy and AI–based diagnostics, still lack large–scale, prospective validation and standardized protocols, raising questions about reproducibility and clinical utility. Furthermore, variations in study quality and reporting limit the ability to perform meta–analyses or draw definitive conclusions in certain areas. These constraints should be considered when interpreting reported benefits and the potential for implementation.

The comparative overview demonstrates that no single method is sufficient for early detection across all patient groups. The most promising future lies in integrated, multimodal diagnostic strategies that combine LDCT with bronchoscopic imaging, molecular biomarkers, and AI–driven risk models. Such an approach may optimize accuracy, reduce unnecessary interventions, and expand screening to diverse populations. Rigorous prospective trials, cost–effectiveness analyses, and equitable access strategies will be critical to ensure these technological advances translate into improved survival and reduced lung cancer mortality worldwide.

Approach	Sensitivity for early–stage detection	Specificity	Invasiveness	Scalability	Strengths	Limitations	References
Conventional Imaging & Biopsy	Moderate; limited for small nodules	High with biopsy; CT false positives common	Biopsy invasive; CT carries radiation burden	Infrastructure– and resource–intensive	Established gold standard; definitive diagnosis	Radiation exposure; limited early detection	NLST Team.[6] de Koning et al.[8]
Bronchoscopic Methods	High for central lesions; AFB/NBI improve dysplasia and CIS detection	Better than WLB; risk of sampling error stays	Moderately invasive; procedural risk	Requires expertise; limited scalability	Direct visualization; detects airway premalignancy	Not population–suitable; no survival benefit shown	Haussinger et al.[13] Tremblay et al.[15] Zhu et al.[17] Hanibuchi et al.[18]
Liquid Biopsy	Improving with ctDNA, methylation, and fragmentomics	Tumor–informed assays improve specificity	Minimally invasive; blood–based	Costs decreasing; challenges in LMICs	Dynamic monitoring; minimally invasive	Variable sensitivity: standardization needed	She et al.[19] Gristina et al.[21]
AI & Radiomics	Strong for subtle imaging features and nodule classification	Can reduce false positives but variable	Non–invasive after imaging acquisition	Scalable after validation and deployment	Enhances imaging interpretation; risk prediction	Algorithm variability; integration challenges	Boubnovski et al.[22] Geppert et al.[24]
VOC Biomarkers	Promising in pilot studies; affected by confounders	Variable; influenced by smoking, diet, comorbidities	Non–invasive, patient–friendly	Low–cost potential; needs standardization	Easy to collect; patient compliance high	Reproducibility concerns; confounding factors	Vinhas et al.[25] Jia et al.[26]
Integrated Approaches	Highest when combining imaging, biomarkers, and AI	Integration reduces unnecessary biopsies	Balances invasiveness by tailoring pathways	Improves efficiency and cost–effectiveness	Maximizes strengths of each modality	Requires infrastructure; cost–effectiveness validation	Duranti et al.[27] Mulshine et al.[28]

Table 3: Comparative Overview of Advances in Lung Cancer Diagnosis

Acknowledgement

The author would like to thank the National University of Science and Technology for supporting the publication of this review.

Conflict of Interest

The authors declare that they have no competing interests.

Abbreviations

AFB: Autofluorescence bronchoscopy; **AFI**: Autofluorescence imaging; **AI**: Artificial intelligence; **CIS**: Carcinoma in situ; **COPD:** Chronic obstructive pulmonary disease; **CTCs**: Circulating tumor cells; **ctDNA**: Circulating tumor DNA; **EVs**: Extracellular vesicles; **HDI**: Human Development Index; **LDCT**: Low–dose computed tomography; **LIFE:** Light Induced Fluorescence Endoscopy; **MILD**: Multicentric Italian Lung Detection; **NBI**: Narrow–band imaging; **NELSON**: Nederlands–Leuvens Longkanker Screenings Onderzoek (Dutch–Belgian lung cancer screening trial); **NLST**: National Lung Screening Trial; **NNS**: Number needed to screen; **NSCLC**: Non–small cell lung cancer; **SEER**: The Surveillance, Epidemiology and End Results**; UKLS**: UK Lung Cancer Screening Trial; **VOC**: Volatile organic compounds; **WLB**: White–light bronchoscopy.

References

1. Zhou J, Xu Y, Liu J, Feng L, Yu J, Chen D. Global burden of lung cancer in 2022 and projections to 2050: Incidence and mortality estimates from GLOBOCAN. Cancer Epidemiol. 2024;93(102693):102693. http://dx.doi.org/10.1016/j.canep.2024.102693.
2. Cao W, Chen H–D, Yu Y–W, Li N, Chen W–Q. Changing profiles of cancer burden worldwide and in China: a secondary analysis of the global cancer statistics 2020. Chin Med J (Engl). 2021;134(7):783–91. http://dx.doi.org/10.1097/cm9.0000000000001474.
3. Howlader N, Forjaz G, Mooradian MJ, Meza R, Kong CY, Cronin KA, et al. The effect of advances in lung cancer treatment on population mortality. N Engl J Med. 2020;383(7):640–9. http://dx.doi.org/10.1056/nejmoa1916623.
4. Flores R, Alpert N, McCardle K, Taioli E. Shift in lung cancer stage at diagnosis during the COVID–19 pandemic in New York City. Transl Lung Cancer Res. 2022;11(7):1514–6. http://dx.doi.org/10.21037/tlcr–22–191.
5. Kawachi R, Watanabe S–I, Asamura H. Clinicopathological characteristics of screen–detected lung cancers. J Thorac Oncol. 2009;4(5):615–9. http://dx.doi.org/10.1097/jto.0b013e3181a0d95f.
6. The National Lung Screening Trial Research Team. Reduced lung–cancer mortality with low–dose computed tomographic screening. N Engl J Med. 2011;365(5):395–409. http://dx.doi.org/10.1056/nejmoa1102873.
7. National Lung Screening Trial Research Team. Lung cancer incidence and mortality with extended follow–up in the National Lung Screening Trial. J Thorac Oncol. 2019;14(10):1732–42. Available from: http://dx.doi.org/10.1016/j.jtho.2019.05.044.
8. de Koning HJ, van der Aalst CM, de Jong PA, Scholten ET, Nackaerts K, Heuvelmans MA, et al. Reduced lung–cancer mortality with volume CT screening in a randomized trial. N Engl J Med. 2020;382(6):503–13. http://dx.doi.org/10.1056/nejmoa1911793.
9. Field JK, Vulkan D, Davies MPA, Baldwin DR, Brain KE, Devaraj A, et al. Lung cancer mortality reduction by LDCT screening: UKLS randomised trial results and international meta–analysis. Lancet Reg Health Eur. 2021;10(100179):100179. http://dx.doi.org/10.1016/j.lanepe.2021.100179.
10. Pastorino U, Silva M, Sestini S, Sabia F, Boeri M, Cantarutti A, et al. Prolonged lung cancer screening reduced 10–year mortality in the MILD trial: new confirmation of lung cancer screening efficacy. Ann Oncol. 2019;30(7):1162–9. http://dx.doi.org/10.1093/annonc/mdz117.
11. Romine PE, Sun Q, Fedorenko C, Li L, Tang M, Eaton KD, et al. Impact of diagnostic delays on lung cancer survival outcomes: A population study of the US SEER–Medicare database. JCO Oncol Pract. 2022;18(6):e877–85. http://dx.doi.org/10.1200/op.21.00485.
12. Candal–Pedreira C, Ruano–Ravina A, Calvo de Juan V, Cobo M, Cantero A, Rodríguez–Abreu D, et al. Analysis of diagnostic delay and its impact on lung cancer survival: Results from the Spanish thoracic tumor registry. Arch Bronconeumol. 2024;60:S38–45. http://dx.doi.org/10.1016/j.arbres.2024.07.006.
13. Haussinger K, Becker H, Stanzel F, Kreuzer A, Schmidt B, Strausz J, et al. Autofluorescence bronchoscopy with white light bronchoscopy compared with white light bronchoscopy alone for the detection of precancerous lesions: a European randomised controlled multicentre trial. Thorax. 2005;60(6):496–503. http://dx.doi.org/10.1136/thx.2005.041475.
14. Loewen G, Natarajan N, Tan D, Nava E, Klippenstein D, Mahoney M, et al. Autofluorescence bronchoscopy for lung cancer surveillance based on risk assessment. Thorax. 2007;62(4):335–40. http://dx.doi.org/10.1136/thx.2006.068999.
15. Tremblay A, Taghizadeh N, McWilliams AM, MacEachern P, Stather DR, Soghrati K, et al. Low prevalence of high–grade lesions detected with autofluorescence bronchoscopy in the setting of lung cancer screening in the Pan–Canadian lung cancer screening study. Chest 2016;150(5):1015–22. http://dx.doi.org/10.1016/j.chest.2016.04.019.

16. Chiyo M, Shibuya K, Hoshino H, Yasufuku K, Sekine Y, Iizasa T, et al. Effective detection of bronchial preinvasive lesions by a new autofluorescence imaging bronchovideoscope system. Lung Cancer. 2005;48(3):307–13. http://dx.doi.org/10.1016/j.lungcan.2004.11.023998.

17. Zhu J, Liu R, Wu X, Li Q, Gong B, Shen Y, et al. The value of narrow–band imaging bronchoscopy in diagnosing central lung cancer. Front Oncol. 2022;12:998770. http://dx.doi.org/10.3389/fonc.2022.998770.

18. Hanibuchi M, Yano S, Nishioka Y, Miyoshi T, Kondo K, Uehara H, et al. Autofluorescence bronchoscopy, a novel modality for the early detection of bronchial premalignant and malignant lesions. J Med Invest. 2007;54(3–4):261–6. http://dx.doi.org/10.2152/jmi.54.261.

19. She W, Garitaonaindia Y, Lin Y. The latest advances in liquid biopsy for lung cancer–a narrative review. Transl Lung Cancer Res. 2024;13(11):3241–51. http://dx.doi.org/10.21037/tlcr–24–828.

20. Borea R, Saldanha EF, Maheswaran S, Nicolo E, Singhal S, Pontolillo L, et al. Cancer in a drop: Advances in liquid biopsy in 2024. Crit Rev Oncol Hematol. 2025;213(104776):104776. http://dx.doi.org/10.1016/j.critrevonc.2025.104776.

21. Gristina V, Russo G, Bazan Russo TD, Busuito G, Iannì G, Pisapia P, et al. Recent advances in the use of liquid biopsy for the diagnosis and treatment of lung cancer. Expert Rev Respir Med. 2024;18(12):991–1001. http://dx.doi.org/10.1080/17476348.2024.2423824.

22. Boubnovski Martell M, Linton–Reid K, Chen M, Aboagye EO. Radiomics for lung cancer diagnosis, management, and future prospects. Clin Radiol. 2025;86(106926):106926. http://dx.doi.org/10.1016/j.crad.2025.106926.

23. Quanyang W, Yao H, Sicong W, Linlin Q, Zewei Z, Donghui H, et al. Artificial intelligence in lung cancer screening: Detection, classification, prediction, and prognosis. Cancer Med. 2024;13(7). http://dx.doi.org/10.1002/cam4.7140.

24. Geppert J, Asgharzadeh A, Brown A, Stinton C, Helm EJ, Jayakody S, et al. Software using artificial intelligence for nodule and cancer detection in CT lung cancer screening: systematic review of test accuracy studies. Thorax. 2024;79(11):1040–9. http://dx.doi.org/10.1136/thorax–2024–221662.

25. Vinhas M, Leitao PM, Raimundo BS, Gil N, Vaz PD, Luis–Ferreira F. AI applied to volatile organic compound (VOC) profiles from exhaled breath air for early detection of lung cancer. Cancers (Basel). 2024;16(12):2200. http://dx.doi.org/10.3390/cancers16122200.

26. Jia Z, Jiang Y, Shang T, Cao H, Li J, Cong L, et al. Advanced strategy for cancer detection based on volatile organic compounds in breath. J Nanobiotechnology. 2025;23(1). http://dx.doi.org/10.1186/s12951–025–03526–4.

27. Duranti L, Tavecchio L, Rolli L, Solli P. New perspectives on lung cancer screening and artificial intelligence. Life (Basel). 2025;15(3):498. http://dx.doi.org/10.3390/life15030498.

28. Mulshine JL, Pyenson B, Healton C, Aldige C, Avila RS, Blum T, et al. Paradigm shift in early detection: Lung cancer screening to comprehensive CT screening. Eur J Cancer. 2025;218(115264):115264. http://dx.doi.org/10.1016/j.ejca.2025.115264.

KFAS
مؤسسة الكويت للتقدم العلمي
Kuwait Foundation for the Advancement of Sciences

The Gulf Journal of Oncology is published with the financial support from the Kuwait Foundation for the Advancement of Sciences



الاتحاد الخليجي
لمكافحة السرطان
Gulf Federation
for Cancer Control

Contact :
The Gulf Federation for Cancer Control
P. O. Box 26733 Safat 13128 Kuwait
Tel. (00965) 22530186 / 22530184 Fax: (00965) 22510137
website : http://www.gffcc.org
email : gffccku@yahoo.com

Electronic Edition
www.gffcc.org/journal