REVIEW ARTICLES

Trends in lung cancer incidence and non-small cell lung cancer diagnosis (2008-2022): A global and vietnamese perspective

Duong Hong Quan[1*], Nguyen Thi Hue[2], Nguyen Hai Quan[1], Nguyen Cam Thu[1]

ABSTRACT

Objectives: 1) Describe trends in lung cancer (LC) incidence and 2) Describe trends in Non-Small Cell Lung Cancer (NSCLC) diagnosis in global and in Vietnam during 2008-2022.

Methods: Extensive medical databases, including Medline/PubMed and GLOBOCAN as well as domestic medical journals, research papers, dissertations, and conference reports globally and in Vietnam up to September 2023, were utilized. Zotero 6.0 was employed for document management and citation. The articles and scientific reports on the trends in LC incidence and in NSCLC diagnosis in global and in Vietnam during 2008-2022.

Results: 28 studies and reports in global and in Vietnam were selected for the study. Among them, there were 15 documents about the trends of LC incidence, and 13 documents about the trend NSCLC diagnosis. The incidence of new LC tends to increase in global and in Vietnam, there are differences between men and women and regions in the world, men have a higher incidence rate than women, regions with poor economic conditions. In developed economies, the incidence rate is higher than in areas with less developed economies. The mortality rate due to LC is always high due to late diagnosis in the late stages of the disease. In Vietnam, the number of new cases has increased, but the rate of new cases of LC has gradually decreased after 2012. In global as well as in Vietnam, the rate of new cases of LC in men tends to decrease, while in women it tends to increase. The results of histopathological and immunohistochemical staining techniques are considered the gold standard for NSCLC diagnosis in global and in Vietnam; Especially, liquid biopsy has been applied in the diagnosis and support for treatment of NSCLC patients.

Conclusion: Vietnam is in the trend of increasing the LC incidence in global with men higher than women. The growth rate of new cases in men tends to decrease but increases in women. The results of histopathological and immunohistochemical staining techniques are considered the gold standard for NSCLC diagnosis; Especially, liquid biopsy promises to be highly effective in early diagnosis and support for NSCLC treatment thereby bringing hope for life to patients and their family.

Key words: *Lung cancer (LC); Non-Small Cell Lung Cancer (NSCLC); Trend; Diagnosis; Global; Vietnam.*

INTRODUCTION

Lung Cancer (LC) is a common cancer and the leading cause of cancer death in global (1) as well as in Vietnam (2). According to data from GLOBOCAN in 2020, the total number of new cancer cases worldwide is about 19 million, of which LC accounts for more than 2 million (11.4%), the number of deaths from LC is 1.7 million, accounting for 18.0% of the total number of deaths from cancer (1). The prognosis for LC is very poor, with high morbidity and mortality rates; So far LC has always been a major

Corresponding author: *Duong Hong Quan*
Email: dhq@huph.edu.vn
[1]Hanoi University of Public Health
[2]Bacgiang General Hospital

Submited: 04 January, 2025
Revised version received: 16 February, 2025
Published: 28 February, 2025
DOI: https://doi.org/10.38148/JHDS.0901SKPT25-005

challenge and a health issue of concern for most countries in global (1).

LC is divided into three main groups including Non-Small Cell Lung Cancer (NSCLC), Small Cell Lung Cancer (SCLC) and Lung Carcinoid Tumor (LCT). Of which, NSCLC accounts for about 85% of cases, SCLC accounts for 10-15% and LCT accounts for a small proportion of about 5% of LC cases (3). These groups of diseases have different prognoses and treatment methods, of which NSCLC has a better prognosis and more treatment options. However, the survival prognosis of LC is very poor, the survival rate for stages after 5 years is only less than 13% due to lack of early diagnosis (4). Therefore, early diagnosis methods for NSCLC are essential to reduce mortality in patients with LC. Currently, screening methods for NSCLC are usually based on chest X-ray, sputum cytology, cell biopsy, bronchoscopy, and computed tomography, which have initially been effective in early detection of LC. The development of science and technology, especially in the medical field, has been applying various new and emerging diagnostic tools such as biomarkers, biosensors, radio-genes, and artificial intelligence to help detect, diagnose, and accurately treat LC, thereby improving the quality of life of patients with LC and reducing the burden on families and society caused by this type of cancer. Although LC is currently a major challenge for the health care system worldwide as well as in Vietnam, there has not yet been a comprehensive study or report in Vietnam on the trend of new LC incidence and the trend of applying NSCLC diagnostic methods. Therefore, we conducted this overview study with two objectives including 1) Describe trends in lung cancer (LC) incidence and 2) Describe trends in Non-Small Cell Lung Cancer (NSCLC) diagnosis in global and in Vietnam during 2008-2022.

METHODS

Subjects: The articles and scientific reports on the trends in LC incidence and in NSCLC diagnosis in global and in Vietnam during 2008-2022.

Sample size and sampling: Research documents were searched from extensive medical databases, including Medline/ PubMed and GLOBOCAN as well as domestic medical journals, research papers, dissertations, and conference reports globally and in Vietnam up to September 2023.

Search Strategy: The English terms used to search for documents in the title or abstract are: ([GLOBOCAN OR Vietnam source GLOBOCAN] AND Lung Cancer (LC) OR Non-Small Cell Lung Cancer (NSCLC)] AND [Incidence OR Epidemiology OR Epidemic OR Trend]) OR ([Lung Cancer (LC) OR Non-Small Cell Lung Cancer (NSCLC)] AND [Lung Cancer (LC) diagnosis OR Non-Small Cell Lung Cancer (LSCLC) diagnosis]).

The Vietnamese terms used to search for documents in the title or abstract are: ([Lung Cancer OR Non-Small Cell Lung Cancer] AND [Incidence OR Epidemiology OR Trends]) AND ([Lung Cancer OR Non-Small Cell Lung Cancer] AND [Non-Small Cell Lung Cancer OR Non-Small Cell Lung Cancer diagnosis]).

Document selection: Zotero 6.0 was employed for document management and citation. The screening of all titles and abstracts retrieved from the document search results will be performed independently by three pairs of researchers working at the Hanoi University of Public Health and Bac Giang General Hospital to determine whether the document meets the inclusion and exclusion criteria. Full text of non-excluded articles will be used for final selection.

Inclusion and exclusion criteria

Inclusion criteria: Studies and reports that have published data in global and in Vietnam during 2008-2022; Studies and reports presenting LC incidence rates: Incidence rates, mortality rates, age-standardized incidence rates divided by region; Select some regions representing continents in the world: Western Europe, North America, South America, Southeast Asia, Australia/ New Zealand, North Africa, East Asia and the World; Studies and reports presenting NSCLC diagnostic methods; Language: English and Vietnamese.

Exclusion criteria: Studies and reports from unreliable sources; Studies and reports on incidence rates in a certain population group other than the general community; Studies and reports that do not specify the population used for standardization; Language: Other.

Document selection and management method: The documents found in the databases will go through two rounds of classification including:

Round 1: Through reading the title and abstract, the documents will be excluded according to the above exclusion criteria;

Round 2: The remaining documents after going through round 1 will be collected in full text. Three pairs of independent research groups will read and analyze the full text to determine whether the document is suitable for the research objectives or not. If there is a disagreement, the person responsible will be consulted for a decision.

Document screening results: Through the general document search for the study, the results showed that 2,452 abstracts were screened from electronic databases that were suitable for the selection criteria of the study. After eliminating 546 duplicate articles and reviewing 916 articles that did not meet the research objectives, research subjects and issues, 118 full-text articles were further screened. Results: 41 articles were excluded due to not reporting data (11 articles); not diagnosing (21 articles); duplication (17 articles). The remaining 28 review articles were eligible for synthesis and analysis of results (Figure 1).

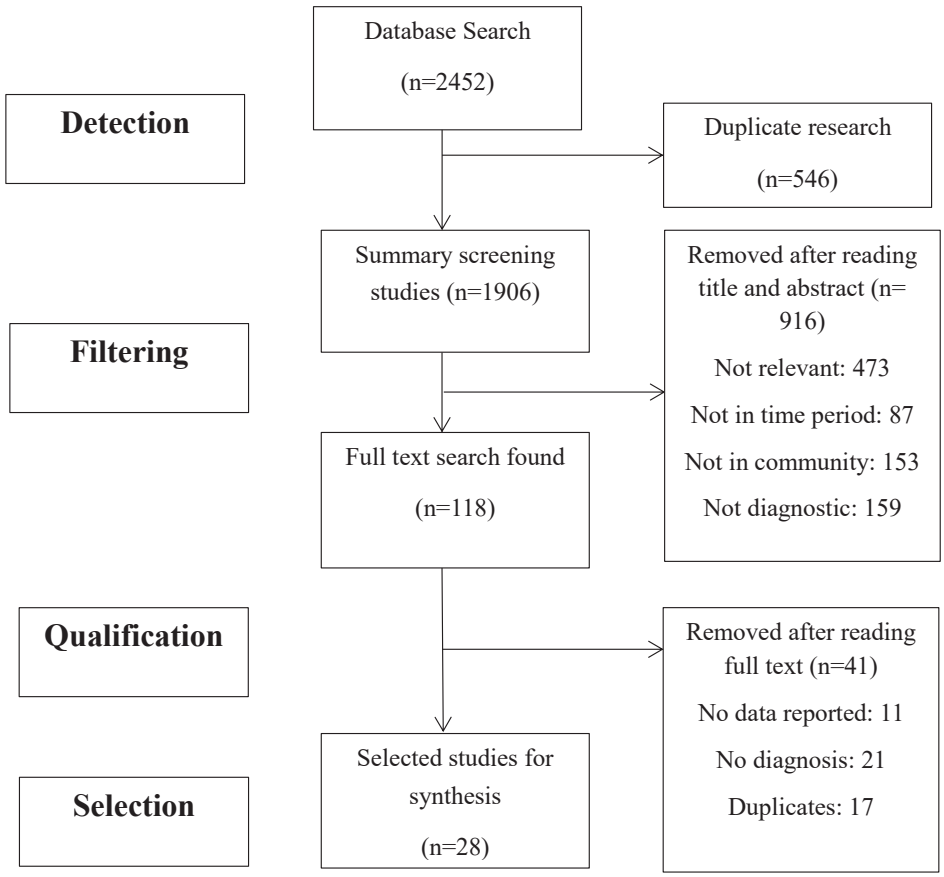

Figure 1. Results of document search and selection.

Characteristics of research documents: According to Figure 1, 28 documents were selected to present research results according to two objectives, including 15 documents on the LC incidence in global and in Vietnam, and 13 documents on methods of diagnosing of NSCLC patients.

Data extraction: The results of the selected documents will be included for analysis in the study.

Processing and analyzing data: Data are stored and managed using excel software; Summary and description of the results found according to the trend of new LC incidence and the trend of applying NSCLC diagnostic methods using tables or charts.

Ethical approval: This review utilized data from internationally published research articles available for secondary analysis, so ethical approval was not required.

RESULT

Trends in new incidence of Lung Cancer (LC) globally

The number of new cases of LC is always at the top of all cancers and has increased steadily over the years from 2008 to 2020 in both men and women, in which, men have the number of new cases and a higher growth rate than women, specifically the number of new cases in men is about two times higher than that of women. In 12 years, the number of new cases in men increased by 340,943 cases from 1,095,000 to 1,435,943 (an average increase of 28,412 cases/year) and for women, it

increased by 257,828 cases from 513,000 to 770,828 (an average increase of 21,486 cases/ year). The number of deaths due to LC ranked 1st in 2008, 2012 and 2018, and ranked 2nd in 2020. It has been steadily increasing in both men and women from 2008 to 2020 and has a number approximately equal to the number of new cases. During 2008-2020, the death/new case ratio in both men and women is high, ranging from 0,79 to 0,88 (Table 1).

Table 1. Trend of Lung Cancer (LC) incidence from 2008 to 2022 (1,5-7)

		2008		2012		2018		2020	
		Number (n)	Rate	Number (n)	Rate	Number (n)	Rate	Number (n)	Rate
Number of new cases	Male	1,095,000	1st	1,242,600	1st	1,368,524	1st	1,435,943	1st
	Female	513,000		582,400		725,352		770,828	
Number of deaths	Male	951,000	1st	1,099,000	1st	1,184,947	1st	1,188,679	2nd
	Female	427,000		491,000		576,060		607,465	
Death rate/ new cases	Male	0,87		0,88		0,87		0,83	
	Female	0,83		0,84		0,79		0,79	

In men, the LC incidence in North Africa, South America, Southeast Asia and Australia/New Zealand is lower than the world average. Particularly, North America, Western Europe and East Asia have higher incidence rates than the world. The age-standardized incidence rate of LC per 100,000 people in men in the period 2008-2020 tended to decrease worldwide, specifically from 34,0 in 2008 to 31,5 in 2020, but not equally among regions. The region with the strongest decrease was North America, down from 48,5 to 35,7, and the South American region had the lowest decrease from 20,4 to 17,8. However, there were also uneven increases and decreases between years, especially after 2012, until 2018 when all regions tended to decrease, except for the North African region (Table 2). Furthermore, in women, the age-standardized incidence rate of LC per 100,000 population tends to increase worldwide, but not evenly across regions. Specifically, the Australia/New Zealand, North America, Western Europe, and East Asia regions have higher incidence rates than the world average. Meanwhile, the North Africa, South America, and Southeast Asia regions have lower incidence rates than the world average. The North America region has the highest incidence rate in all years, while North Africa has the lowest incidence rate. During the period 2008-2020, the Western Europe region had the highest increase in incidence rate from 16,7 to 25,0, while North Africa had the lowest increase in incidence rate from 2,2 to 3,5 (Table 2).

Table 2. Age-standardized incidence rates of Lung Cancer (LC) in men and women per 100,000 population in selected world regions (1,2,5-7)

Year	World		North Africa		South America		Southeast Asia		Australia /New Zealand		North America		Western Europe		East Asia	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2008	34,0	13,5	14,9	2,2	20,4	8,4	29,6	11,9	32,4	19,9	48,5	35,5	44,7	16,7	45,0	19,9
2012	34,2	20,0	15,6	3,1	20,8	10,7	29,6	10,5	32,7	21,7	44,0	33,8	44,0	20,0	50,4	19,2
2018	31,5	14,6	16,8	10,2	16,8	10,2	26,3	9,6	28,4	24,0	39,1	30,7	43,3	25,7	47,2	21,9
2020	31,5	14,6	19,5	3,5	19,5	10,3	26,4	9,6	28,1	22,7	35,7	30,1	41,7	25,0	48,1	22,1

Trends in new incidence of Lung Cancer (LC) in Vietnam

The number of new cases of LC in both men and women increased steadily over the years from 14,652 to 18,685 (men) and from 5,709 to 7,577 (women), of which men had more than twice the number of new cases of LC than women. During 2 years from 2010 to 2012, the number of new cases in men increased the most with 1,430 cases (an average increase of 715 cases/year), then during 8 years from 2012 to 2020 it only increased to 2,603 cases (an average increase of 325 cases/year). For women, in the period of 2018-2020, the number of new cases increased sharply from 6,945 to 7,577, an average increase of 316 cases/year (Table 3).

Table 3. Trends in new incidence of Lung Cancer (LC) in Vietnam (2,8,9)

Gender	Year (n)			
	2010	2012	2018	2020
Male	14,652	16,082	16,722	18,685
Female	5,709	5,783	6,945	7,577

Table 4. Diagnostic techniques for Non-Small Cell Lung Cancer (NSCLC) in globally and Vietnam (3,8-14)

	Method	Type of technique	Type of sample	Purpose	Advantage	Disadvantages
Common diagnostic methods	Imaging diagnosis	Computed tomography (CT)	The patient	Identify tumors	Less damage, and well established	Radiation, Allergic reaction to contrast media
	Biopsy	Punch biopsy, hollow needle biopsy, endoscopic biopsy, tissue biopsy, perioperative biopsy	Surgical specimens	Identify the type of cancer	Highly detailed and accurate data	Highly invasive, and time consuming
	Cytology	Giemsa, Papanicolaou, Diff–Quick, Hematoxyline and Eosin (H.E)	Sputum, bronchial lavage fluid	Look for cancer cells	Fast, easy to do, few complications	Low sensitivity and specificity
	Histopathology	H.E, Periodic Acid Schiff (P.A.S)	Biopsy/surgical specimens	Cancer diagnosis, cancer classification, TNM staging support treatment orientation and prognosis	Identify abnormal antigen expression in tissue. Easy to do, cheaper than immunofluorescence staining	Complicated procedure, high risk of false positive/false negative, high cost

	Method	Type of technique	Type of sample	Purpose	Advantage	Disadvantages
New techniques	Immunohistochemistry (IHC)	Staining biomarkers as TTF1, AE1/AE3, CK7, beta catenin, Napsin A, HER2, ATTF1, p53, p40, p63, CK5/6, WT1, D2-40, calretinin, EGFR	Surgical specimens	Support for definitive diagnosis and classification of cancer in difficult cases, support for targeted treatment and prognosis	Identify abnormal antigen expression in tissue. Easy to do, cheaper than immunofluorescence staining	Complicated procedure, high risk of false positive/negative results, high cost
	In situ hybridization	Fluorescence In Situ Hybridization (FISH), Chromogenic In Situ Hybridization (CISH), Dual-ISH	Surgical specimens	Support for targeted therapy and disease prognosis	Determining HER2 amplification expression, CISH and Dual-ISH are simpler to invest and less harmful to the eyes than FISH	Complex process, difficult to read results, high cost
	Molecular Biology	Gene mutation detection: EGRF, KRAS, ALK, ROS1, BRAF, NTRK, RET, HER2, MET, SMARCRA4	Surgical specimens	Diagnosis, treatment guidance and prognosis	High precision	Complex process, high cost
	Liquid biopsy		Blood, plasma, pleural fluid, alveolar fluid, bronchial fluid specimens			

Trends in non-small cell lung cancer (NSCLC) diagnosis in global and in Vietnam

Table 4 shows the methods of diagnosing NSCLC patients in global and in Vietnam. Diagnostic methods are increasingly providing accurate results with modern technology and simpler- and easier-to-collect specimens from imaging diagnosis, cytology, histopathology and molecular biology. Conventional diagnostic methods including imaging diagnosis, cytology, histopathology can only support the definitive diagnosis of cancer and have little value in guiding and predicting targeted treatment, so new techniques

have emerged including immunohistochemistry (IHC), in situ hybridization (FISH, CISH, dual-ISH), molecular biology and liquid biopsy to some extent to overcome the limitations of conventional methods. Particularly, molecular biology techniques using biomarkers are a potential method for cancer diagnosis and detection of gene mutations, thereby shortening the time for targeted treatment in NSCLC patients. The most prominent is the liquid biopsy method of DNA, RNA, and exosomes that can help diagnose NSCLC patients who cannot obtain biopsy tissue. The liquid biopsy method has low sensitivity but high specificity, especially when analyzing gene mutation status on tumor cells freely circulating in the blood. The combination of diagnostic methods will help clinicians diagnose LC early, prescribe appropriate treatment methods and accurately predict the prognosis for patients, contributing to improving the effectiveness of LC treatment in clinical practice.

DISCUSSION

Trend of new lung cancer (LC) incidence in global and in Vietnam

LC is the leading cancer in terms of new cases in globally and is one of the leading causes of death in both men and women, with men having twice the number of new cases than women (1,5-7). Cigarette smoking is considered one of the greatest threats to public health and is a factor that increases the risk of both an active and passive LC (15, 16). With approximately 2/3 LC deaths worldwide attributable to smoking (1), the disease can be prevented through tobacco control programs, including measures to prevent smoking, accelerate smoking cessation, and limit exposure to environmental tobacco smoke. LC has a high mortality rate, ranking 1st among cancers, especially the number of deaths from LC accounts for a very high proportion compared to the number of new cases. This rate did not show a decreasing trend but remained high during 2008-2022, because LC is a malignant tumor with a poor prognosis, it is initially asymptomatic and is often detected at a late stage (17). During 2008-2022, the age-standardized incidence rate of LC in men worldwide tended to decrease, but not evenly across regions. In the selected regions, all incidence rates decreased, except for the two regions of North Africa and East Asia, where incidence rates increased. Smoking is common in developed Western countries such as Western Europe, North America, Australia/New Zealand and peaked in the middle of the last century, then smoking rates in men gradually decreased with the implementation of tobacco control policies in these regions, so the incidence rate of LC in men gradually decreased (17, 18). East Asia has an increasing prevalence of LC in male, as China, which accounts for 1/5 the world's population, has the largest number of smokers in the world, and consumes about 40% of the world's cigarettes each year. Furthermore, about 70% of the Chinese population is exposed to passive smoking every year, and rapid industrialization and transportation have led to air pollution, leading to an increased risk of LC (17). Despite many tobacco control efforts, the North African region still has an increasing prevalence of LC. Due to poor health care systems, late diagnosis, high rates of smoking, especially among adolescents aged 13-15 years, and increasing air pollution, these are factors that increase the risk of LC (19, 20). In contrast to the decreasing trend in male, the prevalence in female has an increasing trend in all selected regions and in global. Smoking among women is still common in developed countries; Especially, in developing countries, social barriers are increasingly relaxed, the rate of female smoking is also increasing, plus indoor exposure to smoke from cooking or heating with coal or combustible materials without ventilation can also increase the risk of LC in non-smoking women (17, 18). Moreover, in selected regions, there are Western Europe, North America, East Asia and Australia/New Zealand regions with higher LC incidence rates in both men and

women than the world average. This region has developed countries, high smoking rates, the development of industrialization causes air pollution, increases particulate matter in the atmosphere, increases the risk of LC. At the same time, in countries in this region, more attention has been paid to early screening for LC. The National Comprehensive Cancer Network, the European Society of Radiology/European Respiratory Society, and the National Cancer Center of China have successively issued LC screening guidelines and recommended risk assessment for high-risk individuals, thus the detection rate of new LC cases has also increased significantly (17, 18, 21).

During 2010-2012, the number of new LC cases increased by an average of 715 cases/year (male), after 2012, the number of new cases tended to increase but the rate of increase decreased to 325 cases/year (male). High smoking rates, lack of LC screening programs and limited access to diagnostic and treatment methods are risk factors causing the LC incidence rate in Vietnam to continue to increase (22). In November 2011, WHO in conjunction with the Vietnamese Government organized a tobacco harm prevention communication campaign, followed by the draft law on tobacco harm prevention. In 2012, the law on tobacco harm prevention was issued, a new step forward in efforts to reduce smoking rates, raise people's awareness of the harmful effects of tobacco, thereby slowing down the rate of increase in the number of new LC cases. In addition, the government needs to identify top priority measures to reduce the negative impact of LC on public health such as early LC screening programs, improvevent of the care quality and effective smoking cessation measures. The increasing burden of LC in the coming years will place high demands on infrastructure to provide care services, new diagnostic and treatment methods, so there needs to be a plan for coordination and synchronous implementation between relevant departments to help forecast the situation of new LC cases, helping the diagnosis and treatment support of LC in Vietnam become more effective to bring a better life to patients and their families.

Trends in non-small cell lung cancer (NSCLC) diagnosis in global and in Vietnam

Along with the development of science and technology applied in public health care, not only in global but also in Vietnam, LC diagnostic methods are increasingly developed in a modern direction, meeting the requirements of early, accurate, effective, simple diagnosis and not much impact on patients (Table 4). In particular, conventional diagnostic methods such as imaging diagnosis, biopsy, cytology and histopathology are continuously improved towards more accurate results. CT was introduced in 1973, the first CT-based scanner that could scan a depth of 80 - 80 cm in 5 minutes, to assess the size and location of tumors in the lungs, the degree of invasion of neighboring organs, as well as detect the spread of the disease to lymph nodes and other organs with the advantage of not causing pain to the patient and early detection of LC (23). However, this technique uses radiation, and some patients who are allergic to contrast agents cannot use this technique. In the current generation, low-dose computed tomography (LDCT) has shown remarkable effectiveness in the early diagnosis of LC, allowing the identification of pulmonary nodules using the lowest possible radiation dose. Through the image of pulmonary nodules, it is possible to investigate the benign or malignant tumor. However, CT also has disadvantages including increased radiation exposure, high cost, false positive or negative results. Therefore, LDCT is only recommended for high-risk subjects (3, 24). On the other hand, biopsy is a highly specific LC diagnostic technique, the gold standard in the diagnosis of cancer in general. This technique can be used to diagnose benign and malignant tumors but cannot diagnose lung lesions. Although it is the gold standard in oncology, biopsy depends heavily on the accuracy of the location of the diseased tissue taken, the technique is highly

invasive, causing discomfort to the patient (25). In addition to biopsy, cytology is also a method with reliable results, including two techniques including sputum cytology and pleural fluid cytology. Sputum cytology uses sputum samples from LC patients to find abnormal cells in the sputum sample, thereby detecting LC early. Sputum sample testing is the simplest, non-invasive, easy-to-perform technique, however, the sensitivity is low and has a high false positive rate. The presence of malignant cells in pleural fluid can be a sign of cancer, so pleural fluid cytology is used to detect LC when X-ray cannot detect it. Pleural fluid cytology has a sensitivity of about 60-70%, higher than sputum cytology (3).

IHC staining is a method to help diagnose the histopathological type of LC when the H.E-stained slides of lung biopsy samples or cell blocks do not have clear tumor structure. LC is often classified into two main groups including NSCLC and SLCL; In NSCLC, to determine whether tumor cells are differentiated in a glandular or squamous direction, it is necessary to stain with IHC biomarkers such as CKEA1/EA3, CK7, TTF1, CK5/6 and/or P63. The IHC staining method has high sensitivity and accuracy, and can also identify mutated genes to help patients with targeted therapy increase their survival time (26). Furthermore, biomarkers are naturally occurring molecules, genes or other biological entities that undergo certain changes in the disease state and therefore can be used to detect abnormal cell functions that often occur in cancer patients. Based on the characteristics of biomarkers, they are classified into two types including imaging biomarkers (used with PET and LDCT) and molecular biomarkers (miRNA, peptides and proteins) (27). Techniques using biomarkers have very high sensitivity and faster diagnosis time, but require sample preparation and high level of analytical expertise. Recently, the focus of diagnosis has shifted to biomarkers due to several advantages such as detection efficiency at low biomarker concentrations, multiple biomarkers can be used in parallel to make the process faster and more cost-effective (28). In particular, liquid biopsy is an emerging technique that uses ctDNA in the blood to detect LC. With this new technique, it can be performed completely at testing centers easily and is a minimally invasive technique that helps increase patient compliance. In 2013, the US Food and Drug Administration (FDA) approved the first blood test for NSCLC, the Cobas EGFR mutation test v1 (3). In 2016, the Cobas EGFR mutation test v2 was approved by the US FDA, which includes the addition of the T790 M mutation for better LC detection. It detects EGFR mutations in the blood and helps monitor the prognosis of patients. This is a very promising technique, which can be easily performed and helps target patients when combined with gene sequencing techniques.

CONCLUSION

The incidence rate of LC always ranks 1st among all types of cancer, new cases are constantly increasing and there are differences between men and women, and in regions of the world, men have a higher incidence rate than others. In women, areas with developed economies have higher incidence rates than areas with less developed economies. The mortality rate due to LC is always high, the incidence rate of LC in men tends to decrease and increases in women. In Vietnam, the number of new cases has increased in both gender; In particular, the number of new cases of LC in men is twice as high as in women. Biopsy, histopathology and IHC staining are techniques used as the gold standard in NSCLC diagnosis with high sensitivity and accuracy. Modern methods using biomarkers, radio-genes, and artificial intelligence in NSCLC diagnosis have initially shown positive results, especially the liquid biopsy method.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates

of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209-249.
2. https://gco.iarc.fr/today/data/factsheets/populations/704-viet-nam-fact-sheets.pdf.
3. Prabhakar B, Shende P, Augustine S. Current trends and emerging diagnostic techniques for lung cancer. Biomed Pharmacother. 2018;106:1586-1599.
4. Chen L, Jin H. MicroRNAs as novel biomarkers in the diagnosis of non-small cell lung cancer: a meta-analysis based on 20 studies. Tumor Biol. 2014;35(9):9119-9129.
5. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68(6):394-424.
6. Ferlay J, Soerjomataram I, Dikshit R, et al. Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015;136(5):E359–E386.
7. Ferlay J, Shin HR, Bray F, et al. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. Int J Cancer. 2010;127(12):2893–2917.
8. Pakzad R, Mohammadian-Hafshejani A, Ghoncheh M, et al. The incidence and mortality of lung cancer and their relationship to development in Asia, Transl Lung Cancer Res. 2015;4(6):763-774.
9. Pham T, Bui L, Kim G, et al. Cancers in Vietnam—Burden and Control Efforts: A Narrative Scoping Review. Cancer Control. 2019;26(1):1073274819863802.
10. Duma N, Santana-Davila R, Molina JR. Non-Small Cell Lung Cancer: Epidemiology, Screening, Diagnosis, and Treatment. Mayo Clin Proc. 2019;94(8):1623-1640.
11. Park HJ, Lee SH, Chang YS. Recent advances in diagnostic technologies in lung cancer. Korean J Intern Med. 2020;35(2):257-268.
12. Decision 4825/QD-BYT. (2018) Professional document Guidance on diagnosis and treatment of lung cancer.
13. Dao Ngoc Bang, Ta Ba Thang. Update of methods for early diagnosis of lung cancer. J Military Pharma-Med. 2023;1:50-62.
14. Cainap C, Balacescu O, Cainap SS, et al. Next Generation Sequencing Technology in Lung Cancer Diagnosis. Biology (Basel). 2021;10(9):864.
15. Fukumoto K, Ito H, Matsuo K, et al. Cigarette smoke inhalation and risk of lung cancer: a case–control study in a large Japanese population. Eur J Cancer Prev. 2015;24(3):195-200.
16. GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. Lancet. 2017;389(10082):1885-1906.
17. Chao L, Shaoyuan L, Li D, et al. Global burden and trends of lung cancer incidence and mortality. Chin Med J. 2023;136(13):1583-1590.
18. Wong MCS, Lao XQ, Ho KF, et al. Incidence and mortality of lung cancer: global trends and association with socioeconomic status. Sci Rep. 2017;7:14300.
19. Khanmohammadi S, Saeedi Moghaddam S, Azadnajafabad S, et al. Burden of tracheal, bronchus, and lung cancer in North Africa and Middle East countries, 1990 to 2019: Results from the GBD study 2019. Front Oncol. 2023;12:1098218.
20. Kimman M, Norman R, Jan S, et al. The Burden of Cancer in Member Countries of the Association of Southeast Asian Nations (ASEAN). Asian Pac J Cancer Prev. 2012; 13(2):411-420.
21. Chen X, Mo S, Yi B. The spatiotemporal dynamics of lung cancer: 30-year trends of epidemiology across 204 countries and territories. BMC Public Health. 2022;22(1):987.
22. Tran HTT, Nguyen S, Nguyen KK, et al. Lung Cancer in Vietnam. J Thor Oncol. 2021;16(9):1443-1448.
23. Rubin GD. Computed tomography: revolutionizing the practice of medicine for 40 years. Radiology. 2014;273(2 Suppl):S45-74.
24. Nooredeen R, Bach H. Current and future development of lung cancer diagnosis. Int J Mol Sci. 2021;22(16):8661.
25. Li W, Liu JB, Hou LK, et al. Liquid biopsy in lung cancer: significance in diagnostics, prediction, and treatment monitoring. Mol Cancer. 2022;21(1):25.
26. Pham Nguyen Cuong, Doan Phuoc Thi, Tran Dinh Hung, et al. Research on histopathological and immunohistochemical characteristics of lung cancer at the Department of Pathology - Hue Central Hospital. J Clin Med Hue Central Hospital. 2020;66:23-28.
27. Atala A, Allickson JG. Translational Regenerative Medicine. Boston: Academic Press, 2015.
28. Strimbu K, Tavel JA. What are biomarkers? Curr Opin HIV AIDS. 2010;5(6):463-466.