Current and Future Development in Lung Cancer Diagnosis

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Abstract

Lung cancer is the leading cause of cancer-related deaths all over the world. One of the reasons lung cancer is at the top of the list is that it is often not diagnosed until the cancer is at an advanced stage. Based on the current knowledge, it looks that there is an urgent need to identify novel biomarkers. The current diagnosis of lung cancer includes different types of imaging complemented with pathological assessment of biopsies, but these techniques can still not detect early lung cancer developments.

In our research, we explored current methods used in diagnosing lung cancer, and we tried to classify patients into different groups to give better treatment

Introduction

The earliest diagnosis of lung cancer is crucial, especially in screening high-risk populations with an urgent need to identify novel biomarkers. Accurate diagnosis is vital for the most suitable treatment of individual patients with lung cancer. Thus, there is an urgent need to identify sensitive and specific biomarkers for early diagnosis.

This study will focus on 2 questions:

- **How to improve earliest diagnosis of lung cancer?**
- **How to apply accurate diagnosis, suitable treatment of individual patients with lung cancer?**

Materials and Methods

Lung Cancer Classification

NSCLC

- Based on the detection of biomarkers provided a channel for subgrouping patients.
- **Serves as a model for the successful application** of “precision medicine” or the concept of using advanced genetic analysis of a patient’s tumor to obtain an individualized therapy plan

Materials and Methods

Lung Tissue Biopsies

Tumor Size (cm)		Lymph Nodes		Metastasis	
T1	<3	N0	No lymph nodes	M0	No
T2	T2a 3–5 T2b 5–7	N1	Ipsilateral bronchopulmonar/hilar lymph nodes	M1	Present
T3	>7	N2	Ipsilateral mediastinal/subcarinal lymph nodes		
T4	Invasion Mediastinal organs Vertebral bodies	N3	Contralateral/hilar/mediastinal supraclavicular lymph nodes		
Stage I			Stage II		
IA	T1, N0, M0		IIA	T2b, N0, M0	
IB	T2a, N0, M0		IIA	T1, N1, M0	
			IIA	T2a, N1, M0	
			IIB	T2b, N1, M0	
			IIB	T3, N0, M0	

Table 1. *TNM of malignant tumor classification.*

Transition to Biomarker Applications

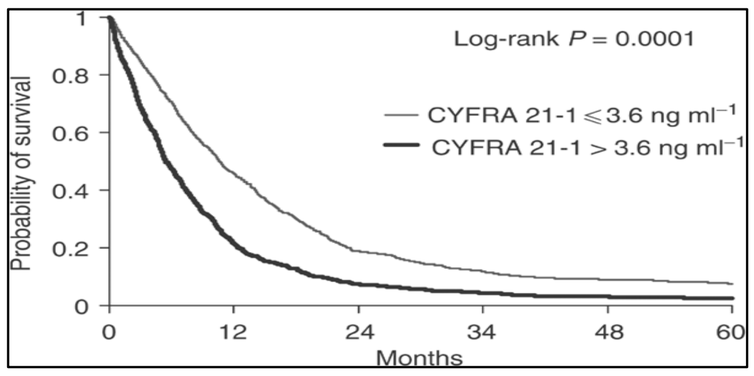

Figure 1. *Probability of survival of non-small-cell lung cancer patients with normal and elevated pretreatment serum CYFRA 21-1 level; Kaplan–Meier curves were constructed taking into account the whole population survival.*

Disparities Factors

Race and Ethnicity

Variables	Bach	LLP	Spitz
Cigarettes smoked per day	Yes	No	No
Smoking duration	Yes	Yes	No
Pack-years	No	No	Yes
Cessation duration	Yes	No	No
Age stopped smoking	No	No	Yes
Age	Yes	Used for LC incidence rate	Used for LC incidence rate and LC-free mortality rate
Sex	Yes	Used for LC incidence rate	Used for LC-specific incidence rate and LC-free mortality rate
Family history	No	Yes	Yes
Asbestos exposure	Yes	Yes	Yes
Wood dust exposure	No	No	Yes
Emphysema	No	No	Yes
Hay fever	No	No	Yes
Pneumonia	No	Yes	No
Malignant tumour	No	Yes	No
LC incidence rate	Yes (1-year recursed 5 times)	Yes (modelled for five years)	Yes (SEER rate)
LC-free mortality rate	Yes (1-year recursed 5 times)	No	Yes (NCHS rate)

Abbreviations: LLP = Liverpool Lung Project; LC = lung cancer; SEER = Surveillance and End Results; NCHS = National Center for Health Statistics.

Table 2. *Smoke prevalence, lung cancer incidence and mortality by race*

Environmental and Occupational Exposures

Sample	USPSTF	PLCOm2012, Threshold ≥ 1.51%	*p* Value[a]
All	52.3	69.3	<0.0001
White	62.4	70.5	0.003
African American	50.3	74.1	<0.0001
Sample	USPSTF	PLCOm2012, Threshold ≥ 1.70%	*p* Value
All	52.3	66.1	<0.0001
White	62.4	66.0	0.203
African American	50.3	71.3	<0.0001
Sample	USPSTF	PLCOm2012, Threshold ≥ 2.00%	*p* Value
All	52.3	61.2	<0.0001
White	62.4	60.6	0.583
African American	50.3	66.1	<0.0001

[a]*p* Value by McNemar's exact test. The *p* values are based on applying the summary proportions obtained from the multiply imputed data sets to the actual size of the study sample and subsamples.
USPSTF, United States Preventive Services Task Force.

Table 3. *Sensitivity (%) of the USPSTF Criteria Versus the PLCOm2012 Risk Prediction Model With Varying Thresholds for Positivity Stratified by Race*

Results

Lung Cancer Classification

- **NSCLC** : using biomarkers in early diagnosis and follow-up of a treatment and even choosing a treatment protocol
- **Lung Tissue Biopsies:** Bridging between Traditional and New Screening Methods. Costly, prone to complications, and a possible need for more sample

Antigen Name	Type	Sensitivity (%)	Specificity (%)
CYFRA			
	SCLC	34	95
	NSCLC	49	95
	ND	43	89
	ND	85.1	88.3
	NSCLC	59	94
	SQC	68	94
	SCLC	19	94
	NSCLC	40	95
CEA			
	NSCLC	29	95
	ND	69	68
	ND	55	79.6
	NSCLC	42	95
SCC			
	NSCLC	17	95
	ND	35.6	71.2
	SQC	95	32
	NSCLC	19	95
NSE			
	SCLC	54	95
	ND	23.4	91.2

Table 4. *Sensitivity and specificity analysis of common antigens found in lung cancer.*

Disparities Factors

Race/Ethnicity	Smoking Prevalence*			Lung Cancer Incidence†			Lung Cancer Mortality†		
	Overall	Male	Female	Overall	Male	Female	Overall	Male	Female
White	16.6	17.2	16.0	56.7	63.5	51.8	42.7	51.7	35.6
Black	16.7	20.9	13.3	56.2	73.5	44.6	44.3	62.1	32.4
Hispanic	10.1	13.1	7.1	29.8	36.1	25.4	19.2	26.6	13.8
AI/AN	21.9	19.0	24.0	37.8	43.3	33.9	27.7	33.6	23.1
API	7.0	12.0	2.6	36.0	46.3	28.2	22.7	30.2	17.3

Table 5. *Smoke prevalence, lung cancer incidence and mortality by race*

Conclusions

- **The trend of developing more reliable tests for early diagnosis of lung cancer** :Should focus on biomarker discovery that will alleviate the discomfort of the patients and the burden for the health authorities
- **Racial differences** in smoking behaviors, lung cancer incidence, age at presentation, and mortality**:** should be considered
- **Outcomes for high-risk individuals and patients with lung cancer** will equalize once disparities in lung cancer screening eligibility and access to care are considered.
- **Professional organizations caring** for patients with lung cancer to be addressed the disparities discussed in this review and translate them into actionable policy recommendations.

Reference

1.Mercer, R. Canadian Cancer Statistics: A 2020 Special Report on Lung Cancer; Canadian Centre for Applied Research in Cancer Control: Vancouver, BC, Canada, 2020.
2.Horeweg, N.; Scholten, E.T.; de Jong, P.A.; van der Aalst, C.M.; Weenink, C.; Lammers, J.-W.J.; Nackaerts, K.; Vliegenthart, R.; ten Haaf, K.; Yousaf-Khan, U.A.; et al. Detection of Lung Cancer through Low-Dose CT Screening (NELSON): A Prespecified Analysis of Screening Test Performance and Interval Cancers. Lancet Oncol. ***2014****, 15, 1342–1350. [CrossRef]*