Screening and Early Detection of Lung Cancer

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Objective: *To review current risk factors for lung cancer, identify screening and early detection guidelines while describing new approaches that use genomic technologies.*

Data Sources: *Published scientific literature, clinical literature, and published lung cancer screening guidelines from the United States and Canada.*

Conclusion: *Nurses are caring for lung cancer patients who, historically, do not live for long periods after diagnosis. Research is revealing promising screening methodologies that can detect lung cancer 1 to 4 years earlier than the current approaches.*

Implications for Nursing Practice: *Current knowledge about screening for lung cancer is a vital tool for nurses working with persons at high risk for this potentially aggressive and life-threatening malignancy. While old methods remain the standard of care, new detection methods use a variety of genomic-based technologies. These developing approaches emphasize the need for nurses at all levels of practice to have a working knowledge of genetics to educate patients and conference with colleagues.*

Key Words: *lung cancer screening, early detection, cell free DNA (cfDNA), circulating tumor cells (CTCs), miRNA, LDCT, spiral CT.*

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Screening for lung cancer has come of age at a time when traditional approaches to mass screening are being challenged. Conversations about cancer screening increasingly occur in the context of personalized medicine, individualized risk assessment, and shared decision making. Future screening methods are incorporating the use of genomic technologies to promote very early detection of lung cancer. The objective of this article is to review current risk factors for lung cancer and identify screening guidelines while describing new approaches that use genomic technologies for early detection.

Epidemiology

Comparable to multiple decades previously, cancer of the lung continues to be the most common type of cancer diagnosed globally.[1] In 2016, almost 13% of all cancer diagnoses were caused by this malignancy, with more than 50% occurring in less industrialized areas of the world.[1] Men continue to have the higher incidence rate, especially in North America, Europe, Eastern Asia, and Uruguay, with the lowest rates in sub-Saharan Africa. Like males, the lung cancer rates in women are higher in North American and Europe, though the countries of Australia, New Zealand, North Korea, and China also have a higher overall incidence. Of interest, Chinese females have a lower prevalence of smoking than women in European countries. This is believed to reflect indoor air pollution from coal-fueled stoves and cooking fumes that are unvented.[2]

In the United States (US) lung cancer continues to be the second most commonly diagnosed cancer in both genders. For 2017, 222,500 new cases of lung and bronchus cancers are anticipated in the US, almost 120,000 in men and 106,000 in women. This is about 25% of all cancer diagnoses.[3] Though incidence rates have been declining in men since the mid 1980s, statistics are similar with more men expected to die from this malignancy than women; approximately 85,000 and 71,000, respectively.[3] The most recent age-adjusted lung cancer rates identified Kentucky as having the highest incidence, while Utah had the lowest.[4] Smokers, regardless of gender, are about 25 times more likely to develop cancer than non-smokers.[2]

Lung cancer is categorized into two subtypes: non-small cell cancer (NSCLC) and small cell lung cancer. NSCLC represents 85% of cases of lung cancer and is further sub-categorized as adenocarcinoma, squamous, small, or large cell carcinoma.[2,5] Small cell lung cancer represents 14% to 15% of all lung cancer and more than 30,000 new case are diagnosed each year in the US.[3] All of these categories of lung cancer have different profiles of morphology and genetics from the others and evolve in distinct areas of the lung.[5] Of note, the 5-year survival rate for lung cancer continues as the lowest for all malignancies (10% to 15%), with surgical resection at an early stage associated with 50% to 70% survival rates for 5-years post diagnosis.[3]

Etiology and Risk Factors

Multiple factors have been identified to cause or are associated with the development of lung cancer.[6] Globally, smoking is identified as the primary cause of lung cancer.[2]

Smoking

Active smoking has the greatest influence on the development of lung cancer. Inhalation of smoke from tobacco products increases the risk of lung cancer, including cigarettes, pipes, cigars, and exposure to passive smoking.[6-8] Even the use of e-cigarettes has an element of risk.[9]

Research shows that inhalation of smoke can cause mutations in oncogenes and a loss of heterozygosity of tumor suppressor genes which become the "drivers" of carcinogenesis in sporadic (somatic) lung cancers. A sentinel paper by Kondo et al.[10] identified that as the number of cigarettes smoked increased, the greater the number of *TP53* mutations in patients with lung cancer. Other researchers studying lung cancer patients from a variety of ethnic populations have found mutations in *KRAS* (predictor of prognosis and treatment resistance in sporadic lung cancer) and other genes on 15q25.[11-13]

Passive smoking exposure can be checked by testing for the primary metabolite of nicotine, cotinine, in the saliva, urine, or blood.[7] Since 2008, exposure to passive smoke (also known as environmental tobacco smoke or second-hand smoke) has declined. The 2007–2008 National Health and Nutrition Examination Survey identified that non-Hispanic blacks, children, plus persons living below the federal poverty level or renters were at highest risk for exposure to environmental tobacco smoke.[8] Second-hand smoke increases the risk of lung cancer in non-smokers by at least 20%, with a suggestion that environmental tobacco smoke is increasing not decreasing.[14] Lung cancer risk increases by the amount of smoking. If active or passive smoking is stopped, the risk of cancer decreases.

Genetics

A family history of lung cancer places persons at increased risk for the future development of lung cancer. The risk elevates if a relative is diagnosed with lung cancer at a young age or if multiple relatives have a history of this disease.[15] In 2008, a