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Challenges and Opportunities in Lung Cancer Screening in Pakistan: Bridging the Gap in Early Detection and Care

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Abstract

Lung cancer remains one of the leading causes of cancer-related mortality globally, with its burden rising in low- and middle-income countries like Pakistan. Despite being among the five most common cancers in the country, accurate data on lung cancer incidence are limited due to underreporting and inadequate cancer registries. Smoking, air pollution, and biomass fuel use are key risk factors contributing to its prevalence. Early detection through low-dose computed tomography (LDCT) screening has been shown to reduce lung cancer mortality significantly, as evidenced by international studies like the NELSON trial.

However, Pakistan faces significant barriers to implementing such screening programs, including insufficient CT scanner availability, a shortage of trained healthcare personnel, and logistical challenges. Furthermore, the high prevalence of lung infections, particularly tuberculosis, increases the likelihood of false positives during screenings, adding complexity to diagnostic efforts.

Integrating smoking cessation counseling into screening programs and cost-effective diagnostic techniques like CT-guided biopsies could enhance the overall impact of lung cancer screening. Additionally, advancements in artificial intelligence offer opportunities to alleviate the workload of radiologists, although these technologies require further development for reliable automated evaluations.

While infrastructural and resource limitations hinder immediate implementation, addressing these gaps could make lung cancer screening a vital tool in combating the disease's growing burden in Pakistan.

Keywords: Computed Tomography, Lung Cancer Screening, Pakistan

The Epidemiology of Lung Cancer in Pakistan

Lung cancer is one of the deadliest forms of cancer worldwide, and its burden is increasing in low- and middle-income countries like Pakistan. Over the past decades, lung cancer has emerged as a significant public health challenge in Pakistan, driven by rising smoking rates among both men and women, as well as exposure to other risk factors such as air pollution and the use of biomass fuels for cooking and heating. This underscores the urgent need for effective strategies for early detection and treatment of lung cancer.

Lung cancer is among the five most common cancers in Pakistan, with a distinct gender disparity showing higher incidence among men than women. According to data from Globocan 2020, the incidence of lung cancer is rising and is projected to increase to 19140 cases by 2040.[1] However, these figures may be underreported due to inadequate cancer registries and the lack of a robust healthcare surveillance system, which means that not all cases of lung cancer are documented. This adds to the challenge of understanding the true burden of the disease in Pakistan.[2]

Smoking is the primary risk factor for lung cancer in Pakistan, with approximately 19% of the adult population identified as smokers, including a growing trend among youth.[2] Other significant risk factors include passive smoking, exposure to industrial pollutants, and the widespread use of charcoal, wood, and other biomass fuels in households.[3] Air pollution is also a major concern, particularly in urban areas such as Karachi, Lahore, and Islamabad, where PM2.5 levels frequently exceed the recommended limits set by the World Health Organization.[4]

CT Scanner Capacity in Pakistan

One of the critical barriers to implementing widespread lung cancer screening in Pakistan is the insufficient number of CT scanners across the country. There is limited recent data published on the number of CT scanners available in Pakistan, however it is significantly lower than the availability in developed countries.[5] This limited capacity makes it challenging to conduct low-dose computed tomography (LDCT) screenings, especially in rural and underserved areas.

Most CT scanners are concentrated in large urban centers, such as Karachi, Lahore, and Islamabad, leaving a significant portion of the population without access to advanced diagnostic tools. Additionally, many healthcare facilities lack trained personnel to operate these machines and interpret the results effectively.[5] This shortage underscores the need for investment in diagnostic infrastructure and capacity building to enable impartial access to lung cancer screening services.

Expanding CT scanner availability and ensuring their optimal use will require coordinated efforts from both the public and private sectors. Partnerships with international organizations and donor agencies could help fund the procurement of additional scanners and support training programs for healthcare professionals. Establishing mobile diagnostic units equipped with CT scanners could also improve access in remote areas.

Insights from the NELSON Study

The NELSON study, a landmark randomized controlled trial conducted in Europe, provided compelling evidence for the effectiveness of LDCT screening in reducing lung cancer mortality. The study demonstrated a 24% reduction in lung cancer-related deaths among men and an even higher reduction of up to 33% in women who underwent LDCT screening compared to those who did not.[6] These findings underscore the potential of LDCT screening in identifying lung cancer at an earlier and more treatable stage.

In both Europe and the United States, implementation studies are now underway to explore how lung cancer screening can be integrated into healthcare systems. These studies aim to address practical challenges such as participant recruitment, follow-up protocols, and management of incidental findings. One notable example is the TIDL study in Norway, which focuses on optimizing the screening process to ensure its feasibility and effectiveness in real-world settings.[7] Such initiatives provide valuable insights that could inform the development of tailored screening programs in Pakistan.

The NELSON study also emphasized the importance of a structured screening program with well-defined protocols for participant selection, follow-up, and management of findings. Lessons from this study and implementation studies in other countries could inform the development of similar programs in Pakistan,

adapted to local epidemiological and resource constraints. However, implementing such programs in Pakistan would require overcoming significant logistical and infrastructural barriers, including improving CT scanner capacity and training healthcare personnel.

The Importance of Early Detection

Early detection of lung cancer can significantly reduce mortality by enabling faster and more effective treatment. Screening for lung cancer using low-dose computed tomography (LDCT) has been recommended as an effective method for early diagnosis in high-risk populations, such as smokers and former smokers. High-risk individuals are typically identified based on factors such as age, smoking history, and cumulative smoking exposure measured in pack-years. Risk calculators like the PLCOm2012 model are increasingly being used to refine risk assessment, ensuring that those most likely to benefit from screening are identified.[8]

Additionally, LDCT screening offers an opportunity to detect other smoking-related diseases, such as chronic obstructive pulmonary disease (COPD) and ischemic heart disease, which are also major contributors to morbidity and mortality in Pakistan.[9]

Early detection through LDCT screening can also prove to be cost-effective in the long run. When lung cancer is identified at an early stage, patients are often eligible for minimally invasive surgical interventions, such as video-assisted thoracoscopic surgery (VATS)[10], which is less resource-intensive and has a shorter recovery period compared to traditional surgery. Moreover, early-stage diagnosis reduces the need for expensive treatments like chemotherapy and immunotherapy, which are typically required for advanced stages of cancer. By enabling curative treatment options at an earlier phase, screening not only improves survival rates but also reduces the overall economic burden on healthcare systems and patients.[11,12]

The Importance of Smoking Cessation Counseling

Integrating smoking cessation counseling into lung cancer screening programs is essential, as continued smoking not only increases the risk of developing lung cancer but also worsens outcomes for those already diagnosed. Studies from the Danish Lung Cancer Screening Trial (DLCST) have shown that providing smoking cessation counseling during screening appointments significantly improves quit rates among participants [12].

Screening appointments offer a unique opportunity to engage with individuals who are at high risk and often motivated to make lifestyle changes. Counseling sessions can be tailored to address the specific needs of participants, providing them with personalized advice, nicotine replacement therapy, and resources to quit smoking. Implementing structured smoking cessation programs as part of screening can enhance the overall effectiveness of lung cancer control efforts by addressing both prevention and early detection simultaneously.

CT-Guided Lung Biopsies in Pakistan

CT-guided lung biopsies are an essential diagnostic tool in the early detection and management of lung cancer. This minimally invasive procedure allows for the precise collection of tissue samples from lung nodules, even those as small as a few millimeters, enabling accurate pathological diagnosis. CT-guided biopsies are considered relatively safe, with low complication rates compared to other methods, making them a preferred choice for obtaining tissue from suspicious nodules identified during screenings [13].

In Pakistan, the availability and utilization of CT-guided lung biopsies are limited due to infrastructural constraints and a shortage of trained radiologists. Most facilities capable of performing CT-guided biopsies are located in major urban centers, leaving patients in rural areas without access to this critical diagnostic service. Additionally, the high cost of the procedure and lack of insurance coverage further restrict access for a significant portion of the population. Expanding the availability of CT-guided biopsy services and training more healthcare professionals in this technique could significantly enhance the diagnostic capabilities for lung cancer in Pakistan, enabling earlier and more accurate detection.

A Norwegian study emphasized the importance of capacity. Their findings highlight the need for practical training workshops and knowledge

transfer initiatives to empower local healthcare providers in adopting advanced diagnostic techniques, such as CT-guided biopsies.[13]These measures are crucial for improving early diagnostic rates and facilitating effective treatment planning for lung cancer patients in Pakistan.

The Challenge of High Incidence of Lung Infections

Pakistan has a high incidence of lung infections, particularly tuberculosis (TB), which poses a significant challenge for lung cancer screening programs. Tuberculosis shares many radiological features with lung cancer, such as nodules and masses visible on CT scans, which increases the risk of false-positive results during screening.[14] This overlap can lead to unnecessary biopsies, anxiety for patients, and additional costs for the healthcare system.

Moreover, the prevalence of TB in Pakistan is among the highest globally, with over 500,000 new cases reported annually.[15] The co-existence of TB and lung cancer further complicates diagnosis, as individuals with TB are also at an elevated risk of developing lung cancer due to chronic inflammation and scarring in lung tissues. Addressing this issue will require integrating TB control efforts with lung cancer screening initiatives, as well as investing in advanced diagnostic tools that can differentiate between these conditions more accurately.

Challenges and Opportunities

While there are significant challenges associated with lung cancer screening in Pakistan, there is also potential for progress. Public health campaigns can play a pivotal role in reducing smoking and exposure to other risk factors. Additionally, international collaborations and donor programs can help fund screening initiatives and build capacity within the healthcare sector.

Technological advancements and increased access to digital health platforms can also enhance detection and follow-up of lung cancer. Mobile applications and telemedicine can be leveraged to reach patients in remote areas, providing information on symptoms, screening, and treatment options. Artificial intelligence (AI) tools hold promise in reducing the workload of radiologists by identifying cancer-suspect nodules on CT scans. However, these technologies are not yet fully developed for automated evaluation of CT images, requiring further research and validation.[16]. At the same time, investment in training healthcare professionals and establishing regional centers for early diagnostics can contribute to improving the situation.

Conclusion

Lung cancer poses a growing health burden in Pakistan, and there is an urgent need to implement strategies for early detection and treatment. However, the significant challenges in terms of limited CT scanner capacity and shortage of trained healthcare professionals make widespread implementation of screening programs difficult in the short term. Addressing these infrastructural barriers is critical to ensure the feasibility and sustainability of such initiatives.

If these challenges can be overcome through strategic investments and collaborations, lung cancer screening could play a pivotal role in reducing the burden of the disease in Pakistan. Given the high prevalence of lung cancer and its associated mortality, early detection through LDCT screening has the potential to significantly improve patient outcomes and reduce the economic impact of the disease on the healthcare system.

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Authors Contribution:

Haseem Ashraf: Conceptualized the study, critically evaluated the literature, written the manuscript and proof read it, agree to be held accountable for all aspects of study.

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