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Current Status on Lung cancer Screening by Chest Radiography and Low-dose Computed Tomography in Japan

Ikuma Kasuga[1,2,3*], Yoshimi Yokoe[1], Sanae Gamo[1], Tomoko Sugiyama[1], Maiko Noguchi[1], Michiyo Tokura[1], Mayumi Okayama[1], Nariko Ohmori[1], Wakako Hamanaka[1], Tomoko Miki[1], Yoshitsugu Takeda[4], Takeshi Sato[5], Kazuyo Wakabayashi[6], Shigeru Yamamoto[7] and Osamu Ohtsubo[3,8]

[1]Healthcare Center, Shinjuku Oiwake Clinic and Ladies Branch, Seikokai, Tokyo, Japan

[2]Department of Internal Medicine, Faculty of Medicine, Tokyo Medical University, Tokyo, Japan

[3]Department of Nursing, Faculty of Human Care, Tohto University, Saitama, Japan

[4]Healthcare Center, Shinjuku Oiwake Clinic Itabashi Branch, Seikokai, Tokyo, Japan

[5]Healthcare Center, Healthport Clinic, Seikokai, Fukuoka, Japan

[6]Medical Corporation Shadan, Seikokai, Tokyo, Japan

[7]Medical Four Clover Company Limited, Tokyo, Japan

[8]Kenkoigaku Association, Tokyo, Japan

***Corresponding author:**

Ikuma Kasuga,
Healthcare Center, Shinjuku Oiwake Clinic and Ladies Branch, Seikokai, 6-7th floor, 3-1-13, Shinjuku, Shinjuku-ku, Tokyo 160-0022, Japan

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1. Abstract

The utility of chest radiography (CXR) and low-dose computed tomography (LDCT) as screening tools for lung cancer has long been debated and remains controversial. Here, we review the usefulness of CXR and LDCT as veridical methods on the screening of lung cancer. LDCT screening has evidence of early detection of lung cancer by large randomized trial however, it has not been widely used compared with CXR screening to date. The major problems are its high cost and radiation exposure. Therefore, LDCT screening currently has evidence of early detection, it has a difficult way to become widely usage for lung cancer screening. CXR is still the most commonly used imaging modality due to its widespread availability, low radiation exposure, and low cost.

2. Introduction

Japan carries out more medical screenings than anywhere else in the world. In fact, we have its own medical checkup system and most of the people on working age generation (aged 18 - 64 years) take a systemic medical examination at least every year. Chest radiography (CXR) is the most frequently requested tools in radiology [1] and is also the common imaging modality for every year screening. It is widely available and incurs lower radiation exposure and low cost compared to computed tomography (CT). Moreover, the recently developed automated analysis of CXR can help in population screening during health checkups and assist pulmonologists and radiologists in interpretation and triaging, thereby easing their workload [2-4].

However, CXR has a low sensitivity [5] and it is usually considered to be an ineffective screening modality for the detection of lung nodules that are less than 10 mm [6], and lung cancers detected using this method often progress to the advanced stage [7]. On the other hand, recent large randomized trial showed the efficacy of low-dose computed tomography (LDCT) for lung cancer screening [8], however, LDCT is not routinely recommended for initial assessment in health checkups compared to the combination of CXR and sputum cytology in Japan, and it has not been widely used to date.

Therefore, we review the current status of screening on lung cancer by CXR and LDCT.

3. Lung Cancer Screening

Lung cancer is the leading cause of cancer-related deaths because of its aggressive, heterogeneous, and poor prognosis [9-11], despite its lower incidence compared to those of other major cancers such as gastric, colorectal, prostate and breast cancer [12]. Therefore, early detection of lung cancer during health checkups is important for prompt surgical resection and reduction of cancer-related deaths. The utility of CXR and LDCT as

screening tools on lung cancer has long been debated. Several studies showed that screening using LDCT contributed to the early stage detection (Figures 1 and 2) and saves lives from lung cancer when compared with screening using CXR [13-16]. Recently, the National Lung Screening Trial reported in 2011 that adherence to a protocol of annual LDCT lung cancer screening and follow-up reduced lung cancer mortality by 20% compared to CXR screening in smokers [8]. This study is meaningful because this is the first large randomized trial to demonstrate the efficacy of CT in lung cancer screening. On the other hand, another recent randomized controlled trial on lung cancer screening by CXR did not show a reduction in mortality compared to that with usual care [17]. This means that CXR screening did not contribute to the early detection of lung cancer and it might not be a useful modality compared to LDCT for screening.

However, a recent population-based study identified a key problem in implementing LDCT screening, as used in the trial setting, in everyday practice [18]. The prevalence of CT screening among eligible people has remained virtually stagnant over the past few years: 3.3 % in 2010 and 3.9 % in 2015, and the majority of cigarette smokers continue to undergo screening with CXR rather than LDCT [18, 19]. The acceptance rate of LDCT for lung cancer screening is much lower than that of other disease screening tests; for example, more than half of the eligible women attend screening mammography in many countries [20]. The main reason of the low prevalence of CT screening is its high cost. LDCT screening takes approximately JPY 12,000 per test and is much expensive than CXR screening (JPY 2,000). Another problem which we should discuss is that CT imaging also involves more radiation exposure than CXR imaging. The average dose for a conventional standard chest CT is approximately 7 - 8 mSv, which results high exposure to radiation (21). Whereas, the average dose for LDCT imaging is approximately 1.5 mSv, which is half the dose of the natural ambient exposure of approximately 3 mSv per year [22]. In addition, the average dose of radiation exposure with LDCT is less than that of the upper gastrointestinal series (UGI) [23], which is widely performed every year during health checkups in Japan. Even if LDCT screening is repeated every 3 months, the dose of radiation exposure with LDCT imaging per year is less than that of standard CT. For this reason, LDCT screening might not cause an undue increase in radiation exposure. Currently, UGI and mammography are performed for gastric and breast cancer screening respectively in Japan as mentioned above; however, LDCT has not still been recommended for lung cancer screening. It should also be added that LDCT takes less time and is less uncomfortable than UGI, and it is less painful than mammography.

Another important aspect should also be discussed when evaluating the usability of CXR and LDCT as cancer screening methods. There is a false positive scan of no cancer-related nodules. This false-positive finding of benign lesions often occurs especially during LDCT screening [24, 25]. These cases were followed up periodically owing to small pulmonary nodules and clinicians and patients are often distressed during the follow-up period.

Thus, LDCT screening has evidence of early detection on lung cancer screening, it has a difficult way to become widely usage because of its high cost, radiation exposure and frequently occurred false-positive scan compared to CXR screening.

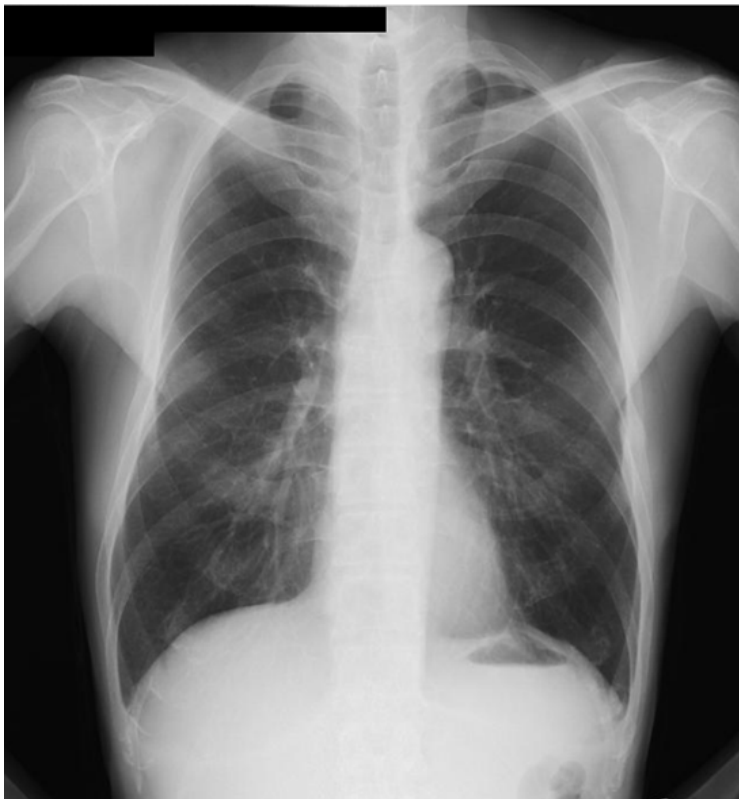


Figure 1: CXR of the current case shows no abnormality on bilateral lung field.

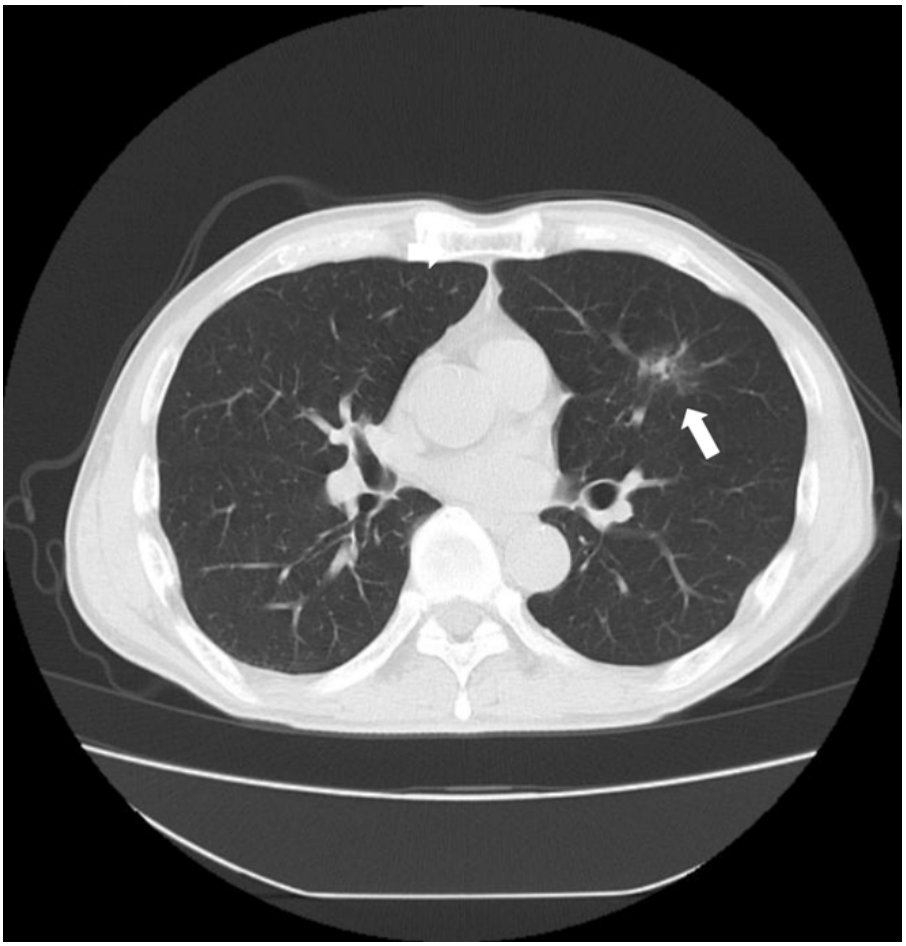


Figure 2: LDCT of the same case detected ground-glass opacity on left lung field (white arrow). This case was diagnosed as stage I lung cancer and the tumor were successfully resected.

4. Conclusion

Currently, LDCT screening is considered to be a useful method for facilitating the early detection and treatment of lung cancer, however, it has a difficult way to become widely usage. In contrast, CXR is still the most commonly used imaging modality due to its widespread availability, low radiation exposure, low cost, and rich literature addressing automated detection.

5. Conflict of Interest

The authors declare that they have nothing to disclose regarding funding or conflicts of interest with respect to this manuscript.

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