Clinic-Based Lung Cancer Screening in Urayasu

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In Urayasu City, lung cancer screening was initiated in April 1988. The city has adopted a clinic-based individual screening method using chest X-ray images. Here, we present indices associated with quality control of the lung cancer screening conducted over the period of 27 years until March 2015. The total number of persons screened was 293,263. During this 27-year period, the city’s population grew 1.6 times, while the annual number of persons screened for lung cancer grew 5 times. The mean screening rate for the 6 years from 2008 through 2014 was 56.1%, higher than the percentage targeted by the Cancer Control Act. The recall rate was 1%, lower than the national average of 2.6%. Excluding those with other active pulmonary diseases from the cases recalled to undergo detailed examination, the recall rate was approximately 0.7%. The detailed examination rate among those recalled for such an examination used to be high, exceeding 80%, but has been on a declining trend in recent years. The lung cancer detection rate for the aforementioned 27-year period was 64.8/100,000 persons, higher than the national average. Since the Great East Japan Earthquake, population growth has ceased and the lung cancer detection rate has been on a declining trend. The positive predictive value fluctuates from year to year but has remained within the range of 4–7%. These indices compared favorably with those in other municipalities in Chiba Prefecture. Particularly, the city's screening rate was higher than the rates in municipalities using mass screening.

The age-adjusted mortality from lung cancer in Urayasu is declining on an annual basis, which may be attributable to lung cancer screening, along with anti-smoking measures.

Key words: lung cancer, clinic-based-screening, screening rate, age-adjusted mortality

Introduction

With the aging of society, the percentage of deaths caused by malignant neoplasms is on the rise. Particularly, the number of deaths from lung cancer, which occurs more commonly in older adults, has increased significantly; it exceeded 73,000 in 2014 (both sexes combined), more than doubling from 1990 (Figure-1). In response to this situation, the Cancer Control Act was established in 2006 with the aim of lowering the mortality rate for malignant neoplasms by 20% in people aged 75 years and younger. In addition to making the systems for medical consultations and research activities more efficient, the Act also addressed the need for measures to deal with social factors and presented specific numerical targets for the lowering of smoking rates and improvement of cancer screening rates. These two approaches are especially important for the prevention of lung cancer. In Urayasu City, lung cancer screening has been conducted since 1988. As screening methods, both group and individual screening strategies are employed. For both methods, evidence has been
obtained of effectiveness in reducing the risk of lung cancer death\textsuperscript{1,2}, but quality control plays a vital role.

Urayasu has adopted clinic-based individual lung cancer screening. In this report, we present the screening results obtained from April 1988 to March 2015, along with the indices associated with quality control.

Results

The screening method: Individuals 40 years of age and older are eligible for lung cancer screening. Once notified by the city, the individual visits his/her primary physician or a local clinic to undergo a direct chest X-ray, and a doctor at the chosen facility then interprets the image (first reading). The same image is then sent to two more doctors from member clinics of the Urayasu City Medical Association, and each doctor interprets the image independently of the other (second reading). If any of the three doctors finds an abnormality, the image is reviewed by the image reading committee that includes a respiratory specialist to make the final determination. If lung cancer is suspected, the individual is referred to a medical institution to undergo detailed examination.

The number of persons screened: From 1988 to 2015, the total number of persons screened for lung cancer was 293,263. In the first year, more than 3,000 individuals were screened. At present, over 17,000

\[\text{Figure-1} \quad \text{Annual number of deaths by lung cancer in Japan}\]

\[\text{Figure-2} \quad \text{Changes in the annual number of persons screened for lung cancer in Urayasu}\]
people undergo lung cancer screening each year, more than a five-fold increase from the first year (Figure-2). Meanwhile, the population of Urayasu grew 1.6 times, from around 100,000 to 160,000.

**Screening rate:** The screening rate is calculated as the number of persons screened divided by the number of screening-eligible persons multiplied by 100 (%). The methods used to calculate the number of screening-eligible persons vary slightly among municipalities. Since 2008, Urayasu has been using the National Cancer Center’s data on the estimated numbers of screening-eligible persons by municipality. The screening rate has since reached a steady level, in the range of 50-60%, with the average rate now being 56.1% (Figure-3).

**Recall rate:** The recall rate is calculated as the number of cases recalled to undergo detailed examination (the number of cases suspected of having lung cancer) divided by the number of persons screened multiplied by 100 (%). There was a period of time when people suspected of having lung cancer and those with other active pulmonary diseases (such as pulmonary tuberculosis) were both included among the cases recalled to undergo detailed examination. During this period, the recall rate was approximately 1.1%, lower than the national average of 2.6-2.9% (Figure-4). Since 2009, when individuals with other active pulmonary diseases were excluded from the cases recalled to undergo detailed examination, the recall rate has further decreased (Figure-5).

**Detailed examination rate:** The detailed examination rate is calculated as the number of persons undergoing a detailed examination divided by the number of cases recalled for such an examination multiplied by 100 (%). From the beginning, the detailed examination rate often exceeded 80%; however, the rate has been declining over the past few years, which is an alarming trend and a cause for concern (Figure-6).

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Figure-3  Lung cancer screening rate in Urayasu

Figure-4  T Distribution of recall rates in Japan (Nakayama T: Haigan, 2005; 45: 183)

Figure-5  Lung cancer recall rates in Urayasu

Figure-6  Lung cancer detailed examination rate in Urayasu
Lung cancer detection rate: The lung cancer detection rate is expressed as the number of lung cancer cases detected through screening per 100,000 persons screened. The lung cancer detection rate from 1988 to March 2015 was 64.8/100,000 persons, which is higher than the estimated national average of 50/100,000 persons. However, the rate in Urayasu has been on a declining trend for the past several years (Figure-7).

Positive predictive value: The positive predictive value is calculated as the number of lung cancer cases detected through screening divided by the number of cases recalled for a detailed examination multiplied by 100 (%). In Urayasu, the recall rate (the denominator) is relatively small, at slightly less than 1%, and the number of lung cancers detected through screening actually exceeds the national average. Thus, its positive predictive value has been consistently high, remaining in the range of 4–7%.

Comparisons with other municipalities in the prefecture: In 2011, the screening rate in Urayasu was higher than those in other municipalities (Figure–8), and clinic-based individual screening tended to have higher rates than mass screening. The recall rate, lung cancer detection rate, and positive predictive value all compared favorably with those in other municipalities.

Discussion

Lung cancer screening and anti-smoking measures are pillars which form the foundation of efforts to reduce the number of lung cancer deaths. Generally, low cancer screening rates have been a problem in Japan. Urayasu was no exception at first, but the number of persons screened for lung cancer has gradually grown, at a faster rate than the city’s population. The screening rate has also steadily remained above 50%, which is the percentage targeted by the Cancer Control Act. This indicates that lung cancer screening is becoming a norm. When compared with other municipalities in Chiba Prefecture, clinic–based individual screening tends to have higher rates than mass screening. The screening rate in Urayasu is also significantly higher than the prefectural average. This may be due to clinic–based screening being less time–constrained than mass screening.

The city’s recall rate is less than 1.1%, relatively low when rates for the entire country are taken into account. If this rate becomes too high, it increases burdens on persons screened and the local government. When too low, it increases the possibility of failing to detect lung cancer cases. The optimal recall rate is considered to be less than 3%. In Urayasu, recall rates are low, but positive predictive values and lung cancer detection rates have been sustained at favorable levels, indicating that radiograph interpretations have been performed appropriately.

However, lung cancer detection rates have been on a declining trend for the past few years. In general, the detection rate tends to decline when the population ceases to grow and demographic movement stabilizes. Such has been the case with Urayasu since the Great East Japan Earthquake. Nonetheless, a decline in detailed examination rates is problematic as it can lead to a decrease in the
detection rate. Further investigations are needed to ascertain whether there are people who do not receive a detailed examination despite abnormal chest X-ray findings or whether data collection has lacked consistency.

Fortunately, in Urayasu, the age-adjusted mortality from lung cancer has gradually been decreasing on a yearly basis (Figure-9). Together with anti-smoking measures, the effectiveness of lung cancer screening is thus suggested.

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References