Lung Cancer Screening with Low-Dose Spiral CT

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BACKGROUND

Lung cancer has a high prevalence and poor prognosis when detected by clinical symptoms. Overall 5-years survival rate for lung cancer worldwide is 13 to 15%, and has not significantly improved over the last several decades (1). Individuals with stage I lung cancer have 5-year survival rates of 60~80%, indicating that early detection, usually at the asymptomatic stage, and resultant early intervention decrease mortality.

Previous randomized controlled studies of lung cancer screening using chest radiography and sputum cytology in the early 1980s failed to demonstrate any significant decrease in lung cancer mortality (2~6). Thus, lung cancer screening using these methods has not been generally recommended, even in high-risk individuals, although controversy persists over the true significance of previous studies (7,8) and many physicians do not agree with this recommendation and continue to screen. Until the early 1990s chest radiography and sputum cytology had been used in combination for mass screening, but without entirely satisfactory results, and the effectiveness of mass screening for lung cancer continues to be questioned (9). Soda et al. identified a number of factors that make it difficult to detect lesions on screening chest radiographic films, including superimposition of the lesion on normal chest structures, small lesion size, and lesion density being too similar to that of adjacent pulmonary tissues (10). Therefore, a more sensitive imaging method is required as a screening tool for lung cancer and recent interest has focused on the potential use of CT.

CT AS A NEW SCREENING METHOD

Computed tomography (CT) is a sensitive method for detecting small pulmonary nodules, but its use as a screening tool is associated with a relatively high level of radiation exposure. Recent studies have shown that low-dose spiral CT can be used for the detection of small pulmonary nodules with a significant reduction in the associated radiation dose (11~14); to only 10% of conventional CT and ten times that of chest radiograph. Another benefit of low-dose spiral CT compared to conventional CT is the significant shortening of scan time. Therefore, lung cancer screening programs using low-dose spiral CT promise reliable detection in the early stages of lung cancer.

In the Japanese report by Kaneko et al. (15) of the results of biannual lung cancer screening using posteroanterior and lateral radiographs and low-dose spiral CT scans of 1,369 individuals with high risk for lung cancer, peripheral lung cancer was detected in 15 of 3,457 examinations (0.3%). Among the 15 cases, chest radiography results were negative in 11 (73%), and the tumors were detected only at low-dose spiral CT. Fourteen (93%) of the 15 tumors were stage I. They concluded that low-dose spiral CT was superior to chest radiography in the screening and detection of peripheral lung cancer in high-risk individuals. Sone et al. (16) reported the results of mass screening using a mobile CT scanner in 5483 individuals. The lung cancer detection rate with CT was 0.48%, significantly higher than the 0.03~0.05% achieved by standard mass assessments done previously in the same area.

In USA, the Early Lung Cancer Action Project (ELCAP) has, since its commencement in 1993, enrolled 1000 asymptomatic persons, 60 years of age or older, with at least 10 pack-years of cigarette smoking, no prior cancer and a level of fitness adequate to undergo thoracic surgery (17). On low-dose CT, as compared to chest radiograph at baseline, malignancies were detected four times as commonly and Stage I malignancies six times as commonly. On annual repeat low-dose CT screening, 15% exhibited newly detected non-calcified nodules which did not resolve on antibiotics. Within this group, 41% had a documented malignancy. Among all lung cancer patients, 85% were Stage I. The researchers concluded that annual CT screening provided for detection at an earlier and more curable stage than chest radiography, and in a cost-effective manner.

Recently, the Society of Thoracic Radiology (STR) stated their opinion of a consensus view in not recommending mass screening for lung cancer at this time. However, they did strongly encourage appropriate subjects to participate in trials so that the true effectiveness of lung cancer screening with low-dose helical CT can be determined at the earliest possible time (18).

LUNG CANCER SCREENING IN KOREA

Lung cancer screening using low-dose spiral CT is still in its infancy in Korea, having been performed only in some university and general hospitals within the last few years. They are Samsung Medical Center, Seoul National University Hospital, Gil Medical Center, and St. Vincent’s Hospital of The Catholic University of Korea. Last year, the first meeting regarding lung cancer screening using spiral CT was held by the
Korean Society of Thoracic Radiology (KSTR). In Korea this screening procedure has been performed either annually or biannually. At our own St. Vincent’s Hospital, from January 2000, low-dose spiral CT, posteroanterior and lateral chest radiographs, and cytologic sputum examinations have been performed on consenting high-risk patients.

1) CT protocol for screening

The low-dose spiral CT protocol used in St. Vincent’s hospital is similar to that of other hospitals in Korea. The CT scanner used was a Philips Tomoscan AV plus (Philips, Netherlands). The scanning parameters used were 120 kVP, 50 mA, one x-ray tube rotation per second, and a table speed of 20 mm/sec (pitch of 2 : 1), with 10 mm collimation. The whole lung CT images were obtained in a single breath-hold of about 15 seconds duration. The images were reconstructed at 10 mm intervals, and both lung and mediastinal window settings were displayed on laser films for reading.

2) Workup strategies according to low-dose spiral CT findings

In the development of guidelines for the use of LD (low-dose) CT findings, modifications were made to the methods of Kaneko and Sone (15,16). In the case of a normal CT finding, annual FU CT was recommended. For benign lesions such as calcified nodules and linear opacities (Fig. 1A, 1B), annual follow-up LDCT was also recommended. For indeterminate lesions such as non-calcified nodules and focal haziness (Fig.
2A, 2B), a follow-up LDCT was usually recommended three to six months later, or occasionally an immediate thin-section or high-resolution CT. The latter was always recommended in the case of suspected lung cancer (Fig. 3).

In the case of immediate thin-section or high-resolution CT scans, workup strategies were developed according to CT findings. When the nodule was calcified, this being considered benign, annual FU schedule was recommended. If the nodule was non-calcified, the following strategies were applied according to nodule size. In modifying the ELCAP recommendations (17), because there are too many small nodules due to the incidence of previous tuberculosis in Korean, the size criteria were increased; for nodules less than 10 mm in size, follow up by thin-section or high-resolution CT at intervals of 3, 6, 12, and 24 months; for nodules of 10 to 20 mm, follow up by thin-section or high-resolution CT at intervals of 3, 6, 12, and 24 months or biopsy; and for nodules larger than 20 mm, biopsy. If the size of the nodule increased on follow-up thin-section or high-resolution CT, biopsy or surgical resection was considered.

3) Recent results and problems to solve

In Korea, of around 800 total cases of CT screening until May 2001, 10−50% of non-calcified nodules were detected on screening CT, but there was no case of early lung cancer. This result may possibly be due to the relative youth of the individuals screened, the loss of follow up, and the high prevalence of tuberculosis in Korea.

There are several problems to overcome. Because of the high prevalence of tuberculosis in Korea, tiny to small nodules are very common findings and the differentiation of these nodules from truly significant, small, non-calcified nodules is quite difficult (Fig. 4A, 4B). The assessment of calcification within the nodule and that of the nodule growing on follow-up CT are other problems. In our hospital, effective education concerning the importance of lung cancer screening in the high-risk group is also an important point, particularly for further workup and regular follow-up.

CONCLUSION

In conclusion, it is evident that there are some significant
changes in trend between screening and not screening for lung cancer. This follows from the facts that about two-thirds of lung cancers detected by CT screening are at stage I, and that detection at this early stage results in an improved prognosis with better rates of survival. As screening CT is likely to identify a large number of small nodules, which may not represent malignant disease, the establishment of a uniform strategy for the management of these cases is urgently required.

REFERENCES