Cancer screening by FDG-PET: benefit or risk?

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Murano of National Cancer Center, Japan, and his colleague reported a risk–benefit analysis for cancer screening in healthy people by means of dedicated PET or PET/CT with FDG [1]. They conducted a nationwide survey of FDG-PET cancer screening in 2006 and analyzed the screening situation in 67 institutions. Radiation exposure doses were calculated on the basis of mean values of FDG injection radioactivity and CT scanning parameters. External and internal radiation exposure doses were calculated according to the ImPACT simulation software [2, 3] and ICRP Publication 80 [4], respectively. The benefit was calculated for dedicated PET and PET/CT separately on the basis of the National Cancer Statistics [5] and the Japanese nationwide FDG-PET survey conducted in 2005, in which mean detection rate, sensitivity, positive predictive value for dedicated PET and PET/CT were reported [6].

Their report demonstrated several important evidences of the cancer screening for healthy people. First, there was remarkable difference in mean radiation exposure between the dedicated PET (4.4 mSv) and PET/CT (13.5 mSv). This difference induced higher risk–benefit break-even age in the PET/CT than the dedicated PET. For example, the PET/CT cancer screening was beneficial in women more than 60 years of age while the dedicated PET cancer screening was beneficial in women more than 30 years of age when the constant amount of radioactivity of FDG was administered. The present study indicated that the risk–benefit break-even age was much affected by the radiation exposure of the CT.

Second, the CT scanning parameters of PET/CT was remarkably variable among the institutions. Tube current was fixed in 14 institutions ranging from 20 to 220 mAs. Tube current was variable in 43 institutions, and unknown in 6 institutions. Helical pitch ranged from 0.75 to 1.75 mm. Tube voltage was 120 kV in 25 institutions and 140 kV in 24 institutions. Mean effective dose by the CT was 10.1 ± 7.58 mSv ranging from less than 5 mSv to more than 25 mSv. Each institution should evaluate external radiation exposure by the CT by means of ImPACT software as shown in the present study. The risk of PET/CT and risk–benefit break-even age in the PET/CT can be calculated in each institution based on Table 11 or 12. As the dedicated PET scanner would be replaced by the PET/CT in the future, the reduction of radiation exposure by the CT is essential in cancer screening of healthy people.

Thirdly, the present risk–benefit analysis assumed single examination. Cancer screening is usually recommended to be repeated during appropriate interval. The average repeated rate of FDG-PET cancer screening with 1 year interval was 26.2% in 2004 and 2005 [6]. The guideline of FDG-PET cancer screening by the Japanese Society of Nuclear Medicine [7] claimed that the benefit of repeated examination has not been proven yet and that the appropriate interval remained unclear. The risk may be increased by the cumulative radiation exposure, while sensitivity, detectability, or accuracy of cancer screening may be improved by the repeated studies. Therefore, both the benefit (NT) and the risk ($S_{(u)}$) in Table 9, 10, 11, and 12 should be revised for repeated FDG-PET.

Recently the combined PET/MRI was developed for clinical use [8]. The PET/MRI contributed to reduce external radiation exposure by replacing CT by MRI in pediatric and gynecological patients. The PET/MRI would be a choice of modality in cancer screening of healthy people.

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