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Is it possible for mammograms to cause thyroid cancer?

Abstract

Each year more than one million women are diagnosed with breast cancer worldwide over half of whom will die from the disease. One of the best ways to diagnose breast cancer with early stage is screening mammogram once a year. The goal of mammography is the detection, characterization, and evaluation of finding suggestive of breast cancer and other breast diseases. Annual screening mammography of age-appropriate asymptomatic women is currently the only imaging modality that has been proven to significantly reduce breast cancer mortality. In the past 50 years, mammographic *screening* has become one of the most important advances for women's health. Since this annual check was started, the breast cancer death rate has been reduced by more than 30%.[1] But the most important problem that women concern about is, Are the screening mammograms causing thyroid cancer?

In 1995, the National Institute of Cancer in the United States conducted a study of almost 8000 patients who had been performed radiologic studies.[2] Half of them had thyroid cancer and what it was intended to determine was whether they had received a higher dose. The results indicated that the relative risk of thyroid cancer was not significantly associated with the estimated cumulative dose of the thyroid gland after radiological examinations. The next issue to be discussed is how important is to use thyroid shield during screening mammograms? In 2011, the Canadian Association of Radiologists (CAR) and the American College of Radiology (ACR) reiterated that the risk is negligible, since the thyroid gland is not directly exposed to the radiation, and that using a thyroid shield can interfere with the quality of mammography exams.

Keywords: mammograms, thyroid cancer, shielding

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Abbreviations: CAR, Canadian association of radiologists; ACR, American college of radiology; ICRP, institute commission of radiology protection; BEIR, biological effects of ionizing radiation

Introduction

A mammogram is an x-ray exam of the breast that is used to detect and evaluate breast Changes. X-rays were first used to examine breast tissue a century ago, by the German surgeon, Albert Salomon. Modern mammography has only existed since the late 1960s, when special x-ray machines were designed and used just for breast imaging. Since then, the technology has advanced, and today's mammogram is very different even from those of the 1980s and 1990s.[3] The x-ray machines used for mammograms today expose the breast to much less radiation than those used in the past. The x-rays do not go through tissue as easily as those used for routine chest x-rays or x-rays of the arms or legs, which also improves the image quality.

Screening mammograms are x-ray exams of the breasts that are used for women who have no breast symptoms or signs of breast cancer (such as a previous abnormal mammogram). The goal of a screening mammogram is to find breast cancer when it's too small to be felt by a woman or her doctor. It can greatly improve a woman's chance for successful treatment. But one of the important problems that women concern about is: Are the screening mammograms causing thyroid cancer?

Discussion

High dose radiation exposure, especially during childhood, increases the risk of developing Thyroid cancer in susceptible patient. X-ray therapy (high dose radiation) used to treat cancers such as Hodgkin's and breast cancers. During this kind of X-ray therapy, head and neck maybe included exposure and it is caused to develop the risk of thyroid cancer. Based on the survey of American Thyroid Cancer in 2012, routine X-ray such as chest X-ray and mammograms have not been shown to cause thyroid cancer.

In 2008 Dr Sechopolous published the result of his study about relative dose that received from conventional mammography to organs. The results of this study show the values of relative dose of organs about 10% that cannot significantly cause thyroid cancer. For this study he used anthropomorphic phantom and Mon Carlo simulation. In 2012, Dr Sechopolous published the results of his study about related dose of Thyroid gland during mammography in the *American Journal of Roentgenology*.[3] This study based on dose value that the organs received from X-ray examination and the relation between dose value and the sensitivity of the organs based on the document from ICRP (institute commission of Radiology Protection), the result showed that there is no relation between occurring thyroid cancer and received dose from performing mammography to thyroid gland. He used the same method for this study. Dr Sechopolous studied all organ doses from mammography and he found out that the dose of thyroid gland during this x- ray examination was about 0.1 %. Absolutely this dose value cannot cause thyroid cancer.

In 2010, The American College of Radiology had a study to compare dose from conventional mammography and digital mammography. On average the dose for two views in digital mammography for each breast is about 3.7mGy and in conventional mammography this value is about 4.7mGy. At last, based on this study the dose that receives to thyroid gland in digital mammography is about 3.3μGy and 4.3μGy

for a conventional mammography. The report on biological effects of ionizing radiation (BEIR VII) notifies that the risk of suffering thyroid cancer that occurs from radiation is 1 in 166 million in 40 year-old-women. In addition, we can look to this topic from the sight of radiation physics. In mammography examinations we use low x-ray beam energy that the primary attenuation of x-ray done in breast tissue via photoelectric effect absorption (not Compton scattering). So we have minimum scattering in this examination to effect on the other organs, especially thyroid gland.

Conclusion

There is the radioactivity in nature that is named natural radiation or background radiation that it is about 3 mSv per year for each person. This radiation is the best way to compare the value of received radiation to people toward the base value (background radiation). Researches show that in bilateral mammography with 2 incidents, dose can receive to thyroid cancer is about 30 minutes of background dose in a year to 1 person. So we can find out that thyroid gland receives much more dose than bilateral mammography in a year. Because of the different sensitivity of organs to the radiation, the International Commission on Radiological Protection[1] recommends a weighting factor for each organ based on effective dose. So to calculate the total received dose to organ, the individual dose multiplied by the organ weighting factor. Based on the information of ICRP, the thyroid gland weighting factor is 0.04. So by using this factor, the effective dose to thyroid gland from digital mammography is 0.13μSv and for conventional mammography is 0.17μSv which is absolutely insignificant dose.

The next issue to be discussed is how important is to use thyroid shield during screening mammograms? It is important to know that the thyroid gland just receives scatter radiation during the mammography exam. Based on the information from the Canadian Association of Radiologists (CAR) and the American College of Radiology (ACR) thyroid shield may mask some parts of breast during mammography and can decrease the quality of image. So technologist has to repeat the image and it is additional dose that can develop the risk of the cancer.[4-6] Finally it should be pointed out that the incidence of thyroid cancer has significantly grown since 1998 to a same rate, both in women and men who will not perform mammograms.

Acknowledgments

None.

Conflicts of interest

Author declares that there is no conflict of interest.

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