

Background information

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RSNA 2016 in Chicago: South Building, Hall A, Booth 1936

Early detection of lung cancer using low-dose CT screening

- **Lung cancer is the most frequent gender-independent cause of cancer death worldwide**
- **Symptoms often do not emerge until an advanced stage**
- **Trials with heavy smokers show reduction in mortality as a result of low-dose CT screening**

At this year's Annual Meeting of the Radiological Society of North America (RSNA) in Chicago, USA, the separately managed healthcare business of Siemens AG is presenting itself for the first time under its new brand name, Siemens Healthineers. The new name underlines the company's pioneering spirit and its engineering expertise in the healthcare industry. With a new strategic direction, Siemens Healthineers aims to enable healthcare providers around the world to meet their current challenges and to excel in their respective environments. Through products and solutions designed to increase efficiency and to reduce costs, Siemens Healthineers is setting new trends in healthcare together with its customers – working under the motto “Engineering Success. Pioneering Healthcare. Together.”

Early detection of diseases plays a key role in improving care, while at the same time harbouring potential cost-cutting opportunities. Promising developments are on the horizon in the early detection of lung cancer. With 1.6 million deaths each year, lung cancer is by far the most frequent gender-independent cause of cancer mortality worldwide. This is because the symptoms generally do not emerge until an advanced stage, when the chances of recovery are very low – particularly where metastasis has already occurred. At present, only 15 percent of patients survive beyond five years following a positive diagnosis. Probability of survival, and in particular patient recovery rates, improve significantly when lung carcinomas are detected at an early stage.

Lung cancer, known in medical terminology as bronchial carcinoma, describes a tumor in the respiratory tract. More than half of all such tumors occur in the upper part of the lung, which is more heavily aerated during breathing, resulting in greater exposure to harmful substances. As there are no pain receptors in the lung tissue itself, an early stage carcinoma rarely causes pain, while its small size prevents the occurrence of symptoms indicative of carcinoma. Consequently, lung cancer is often diagnosed by chance, for example during an X-ray examination for pneumonia. In the advanced stage, certain complaints can be construed as symptoms. These include persistent coughing, coughing up blood, chest pain, weight loss, wheezing, or venous congestion.

Conventional diagnostic methods

Various diagnostic methods are available to test for suspected lung cancer. A standard examination is chest X-ray, which provides an image of the patient's thorax. However, conventional X-ray images of this sort rarely provide an unambiguous result, and can only confirm the existence of suspicious lesions. In order to accurately determine the size, shape, and spread of tumors in the lungs and surrounding organs, tissue structures or lymph nodes, computed tomography (CT) imaging is indispensable. This method provides detailed cross-sectional images with a high spatial resolution. Reducing the radiation exposure this involves has been a key focus of the technological developments pursued by Siemens Healthineers for many years. Minimizing radiation exposure is a fundamental consideration in the risk-benefit assessment, as many healthy people also have to be subjected to radiation. Studies have shown that Somatom Force from Siemens Healthineers can deliver diagnostic lung scans at 0.1 millisievert – a radiation dose which was previously only sufficient for conventional X-ray images with substantially less diagnostic detail.

If an urgent diagnosis is required, the physician collects tissue samples from the affected area, for example via bronchoscopy. These samples are then tested for cancer cells in the lab. In order to establish the extent to which a carcinoma has metastasized to other areas, the brain, spinal cord, and skeleton can be examined using magnetic resonance imaging (MRI). Positron emission tomography (PET) is also sometimes used. In this procedure, a radioactively labeled sugar is injected to enable closer monitoring of metabolic activity. Tumors and metastases display higher metabolic activity than healthy tissue, with the result that they show up clearly on a PET scan. MRI and PET play also a big role in treatment planning and monitoring.

Promising opportunity of early detection

By the time tumors and metastases are detected, for many patients it is already too late. Nine out of ten affected patients die within a very short time of diagnosis. Accordingly, lung cancer is a difficult threat to counter both on account of its frequency and the difficulty of timely diagnosis. In the search for an early detection method, the National Lung Screening Trial (NLST) was launched in the U.S. in 2002 to establish whether lung cancer screening using low-dose CT (LDCT) can reduce mortality. Around 54,000 heavy smokers aged 55 to 74 were classified as a high-risk group. Heavy smokers were defined as those smoking a pack of cigarettes every day in a year. Participants were examined using either an LDCT scan or a conventional X-ray. The focus of the examinations was on the diameter of a lesion and the likelihood of it being a carcinoma. The study found that using LDCT scans reduced mortality by 20 percent compared with the control group examined by X-ray.

Nonetheless, there are reasons to view the study in a critical light. In total, suspicious findings were reported for 24 percent of participating patients. These findings trigger additional examinations such as CT/PET scans or biopsies. However, 96 percent of the abnormalities detected in the course of the study turned out to be benign tumors. Such results are known as false-positive rates. The patient has to be kept under observation, as nodules of this kind could also represent an early-stage carcinoma. As a result, uncertainty remains during the period between the annual screenings as to whether the detected nodule might degenerate. This can have a major impact on the patient's quality of life, in addition to incurring potential diagnostic follow-up costs.

The Nelson Study, launched in 2003 in the Netherlands, takes a similar approach. Early detection screening is also performed using LDCT scans and conventional X-rays, but in this case it is not the diameter of the pulmonary nodule that is measured, but its volume. For small nodules in particular, volume changes and growth can be more accurately measured. This improved specificity helps to limit the number of suspicious findings, and consequently false-positive rates, thereby reducing diagnostic follow-up costs. Early results show that suspicious findings were reported for less than three percent of the roughly 16,000 participants, with false-positive rates down to around 64 percent.

Both studies demonstrate the potential of CT screening as an early detection tool. The U.S. Preventive Service Task Force has acknowledged the benefits of LDCT screening, and issued

a recommendation for yearly examinations using this method in late 2014. The target group are persons aged 55 to 74 who have smoked a pack of cigarettes daily for 30 years, or have given up smoking in the last 15 years. Furthermore, as of January 1, 2015, this screening method is covered by U.S. health insurance providers.

Sources

National Lung Screening Trial: <http://pubs.rsna.org/doi/full/10.1148/radiol.10091808b>

Nelsen lung cancer screening study: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3266562/>

Center for disease control and prevention: <http://www.cdc.gov/cancer/international/statistics.htm>

Robert Koch Institut:

http://www.krebsdaten.de/Krebs/DE/Content/Krebsarten/Lungenkrebs/lungenkrebs_node.html

The products/features (here mentioned) are not commercially available in all countries. Due to regulatory reasons their future availability cannot be guaranteed. Further details are available from the local Siemens organizations.

The statements by Siemens' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

Further information on RSNA is available at www.siemens.com/press/rsna2016.

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