Archives of Radiology

ISSN: 2638-521X

Volume 2, Issue 2, 2019, PP: 08-14

The Applicability of Radiography and Computed Tomography in Lung Cancer Diagnosis

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Abstract

Lung cancer is the most common malignant disease worldwide. In Brazil, it was responsible for 26,498 deaths in 2015, and about 85% of cases are associated with smoking. Passive exposure to cigarette smoke and occupational exposure to chemical or physical agents such as radon gas also contribute to the development of this type of tumor. Chest radiography is the initial examination to investigate the suspicion of this disease, with wide accessibility and good cost benefit. In contrast, computed tomography is extremely important for patient survival due to its high resolution, allowing a better visualization of pulmonary anatomical details and smaller nodules, as well as lesion characteristics such as size, location and extension. Through qualitative bibliographic research, scientific articles were selected in Portuguese and English from 2000 to 2019. The objective of this study is to highlight the effectiveness of radiography and computed tomography in the diagnosis of lung cancer, highlighting the advantages and disadvantages found in these. imaging exams, besides identifying the main common aspects in the lifestyle of patients with this malignant neoplasia and analyzing the alterations visualized in both exams. A study by Cornell University researchers found that, despite being of great relevance in the diagnosis of lung cancer, chest X-ray is not able to reveal a tumor at an early stage, which makes computed tomography more effective in this area. diagnosis. Similarly, research by the American Cancer Society found that computed tomography demonstrates more details of this pathology than chest radiography. Therefore, computed tomography stands out over radiography because it allows a better detailing of anatomical structures in addition to diagnosing lung cancer.

Keywords: *lung cancer; diagnosis; risk factors; chest X-ray; computed tomography.*

Introduction

Cancer is the leading cause of death worldwide and is associated with the lifestyle of individuals. Among the various types, lung cancer is the most common and deadly cancer worldwide. Since 1980, lung cancer in Brazil has occupied the first place among cancer deaths in men and, since 2006, has ranked second among women (ARAÚJO, 2017). In 2010, 21,868 deaths from tracheal, bronchial and lung malignancies were recorded in the Mortality Information System (SIM). These neoplasms are directly linked to smoking. Smoking is considered a worldwide public health problem and has been recognized as a chronic disease, being considered the most important risk factor for the development of lung cancer. However, with the early diagnosis of this disease, the chances of cure and patient survival increase significantly (ZAMBONI, 2002).

Pulmonary neoplasia comes in many forms, and there are some ways to diagnose it. The choice of the best method for diagnosis will depend on different aspects related to the tumor, the patient and the ability of the medical team (GIACOMELLI, 2017).

With the advancement of technology, there has been the evolution and creation of new imaging diagnostic methods. Among them, there are radiography and computed tomography (CT). These are imaging tests that help healthcare professionals to accurately assess and properly diagnose a particular condition. These tests help locate the lesion and are extremely useful

in determining the extent of the disease, containing information that shows different and complementary aspects of an individual's health condition. Chest X-ray is used to diagnose the presence of any suspicious tumor image in any of the lungs, and it is possible to locate evidence of grossly rounded lung neoplasms with opacity. In contrast, computed tomography allows to determine the size and location of the tumor in the lung, as well as the presence or absence of metastases in the adrenal glands, liver, brain and other organs that may be affected by the spread of this cancer (INCA, 2017).

This study aims to highlight the effectiveness of radiography and computed tomography in the diagnosis of lung cancer, in addition to identifying the main common aspects in the lifestyle of patients with the disease and to analyze the variations in lung cancer in these imaging studies.

Material and Methods

The study consists of a qualitative bibliographic research through the use of databases such as the Latin American and Caribbean Health Sciences Literature (LILACS); the Scientific Electronic Library Online (SciELO) and Google Scholar, as well as the Walter Santana Library of the IPEMED Faculty of Medical Sciences. The research includes scientific articles in Portuguese and English from 2000 to 2018, and publications in websites and magazines of health institutions such as the World Health Organization (WHO), the American Cancer Society, the Brazilian Journal of Oncology Clinic and the Brazilian Society of Pneumology. The indicators used for the construction of the study were: imaging diagnosis, lung cancer, chest radiography and chest CT, totaling 17 articles. Inclusion criteria were articles, official websites and indexed journals that addressed the topic studied and contained radiography and computed tomography as diagnostic tests. Exclusion criteria were: articles dated before the year 2000, in other languages, that did not address the researched pathology and contained other imaging exams.

Discussion

Lung Cancer

Lung cancer is a malignant neoplasm that affects the lungs, usually after exposure to risk factors, where a normal cell changes in its DNA and becomes a malignant cell that multiplies in a disorderly manner. Tumor cells have specific characteristics different from normal tissues, the main one being the ability to generate metastasis, whose cells with the modified DNA detach from the initial tumor and can be directed to any part of the body, generating new neoplastic lesions (ARAÚJO , 2017; GIACOMELLI, 2017).

Lung cancer can be divided into three subtypes according to cell type and location: adenocarcinomas, squamous cell carcinomas, and large cell carcinomas. Adenocarcinomas are tumors whose cells have begun to develop in the pulmonary alveoli, located outside the lungs, and usually grow slowly compared to other types of this cancer, accounting for 40% of lung cancers. Squamous cell carcinoma (epidermoid) is present in 25 to 30% of cases and is characterized as flat cells lining the interior of the airways. This cell type is related to smoking and tends to be found in the central region of the lungs, near the bronchi. Finally, large cell carcinoma is responsible for 10-15% of lung cancers, and can appear anywhere in this organ, and tends to grow and spread rapidly, which can make treatment difficult (AMERICAN CANCER SOCIETY, 2018) .

Lung Cancer Incidence

According to the Pan American Health Organization (PAHO) (2018), cancer is the leading cause of death worldwide, with one in six deaths being cancer-related, with a total of 9.6 million deaths per year.

Lung cancer is considered to be the most common and deadly cancer worldwide, being the leading cause of death among men in North America and Europe, and rising among populations in Asia, Latin America and Africa. It currently accounts for 13% of all new cancer cases (ZAMBONI, 2002; AMERICAN CANCER SOCIETY, 2018). According to the National Cancer Institute (INCA) (2018), in Brazil, lung cancer is the second most common among men. In 2015, the disease was responsible for 26,498 deaths, with an estimated 31,270 new cases in males and 12,974 in females for 2018.

The American Cancer Society (2018) points out that lung cancer occurs in people with advanced age, since most diagnosed individuals are 65 years or older. Males are more likely to develop this cancer, and the incidence increases in blacks, who are 20% more likely to develop cancer than whites. The latest worldwide estimate made in 2012 by INCA pointed

to 1.24 million new cases of lung cancer in males and 583,000 in females. Thus, the probability is 1:15, that is, for every 15 men, one will develop lung cancer, while for women this probability decreases to 1:17, that is, for every 17 women, one will develop cancer. This probability includes smokers and non-smokers and, for the first group, the risk of developing the disease is higher.

Risk Factors

Smoking is the leading cause of lung cancer, accounting for approximately 85% to 90% of all cases. Cigarette smoke has over 4,000 identified components, with over 60 carcinogens present in tobacco. The respiratory system is severely impaired by the derivatives of this substance since cigarette components can cause ciliary, bronchial, and alveolar lesions, among others. The speed of mucociliary transport decreases by up to 60% and, over time, smokers' epithelial cells suffer very serious lesions. Tobacco derivatives used in inhalation forms (cigar, pipe, straw cigarette) are also harmful to health, lowering the body's defense, and increasing the risk of disease. When consuming these products, various toxic substances are inhaled, including nicotine, which is responsible for chemical dependence. The number of cigarettes smoked per day and the duration of smoking are directly linked to the risk of developing this cancer. Passive smokers also have a high risk of developing the disease, since the smoke generated by burning tobacco products without filtration also has a high concentration of carcinogens (ZAMBONI, 2002; NAVARRO, 2003; TAMASBIRO, 2009; FILHO , 2010).

Other factors, such as exposure to air pollution, favors the development of lung cancer, since ambient air has several carcinogens from motor vehicles and different industries, and it is possible that air pollution has relevance in the risk of disease onset. Occupational exposure to chemical or physical agents such as radon gas also increases the risk of developing this condition, as this gas, present in soil and rocks, can be released into the atmosphere or water in varying amounts, depending on ambient temperature, accounting for approximately 1% of cases of lung cancer. Radon decay products emit alpha particles that, when inhaled, pass through the respiratory system and generate carcinogen formation, according to Zamboni (2002). Similarly, exposure to silica increases the risk of developing lung disease as it is a compound of silicon dioxide, a mineral present in the earth's crust, found in rocks and sands. It poses a risk in work environments, such as construction, the ceramics industry, among others. Over time, inhalation of silica dust promotes the formation of fibrous connective tissue in the lungs, which characterizes fibrosis. This connective tissue decreases lung elasticity, hindering the gas exchange process, intensifying the risk of developing lung cancer, so workers exposed to silica are at 2 to 3 times higher risk of developing lung cancer when compared to the non-lung population. has contact with silica (ZAMBONI, 2002; PINTO, 2011; HERRERA, 2013; CARVALHO, 2015; INCA, 2018).

Diagnostic Imaging

To investigate the suspicion of lung cancer and establish the diagnosis of lung cancer, chest radiography and computed tomography are the imaging exams initially used. Although a small percentage of patients with a future diagnosis of lung cancer present, at first, a normal chest x-ray, in most cases it is possible to find evidence of the neoplasia, which is shown in roughly rounded shape with opacity (CARVALHO, 2004).

Bronchoscopy is the most commonly used exam in the diagnosis of all types of lung cancer by collecting airway secretions and tissues, allowing the assessment of the trachea, bronchi and part of the lungs by introducing a tube into the oral cavity or the nasal cavity (NAVARRO, 2003; VIEIRA, 2017).

Another exam also used is thoracoscopy, which is performed when other diagnostic methods are not effective, being useful in the cytological and histopathological confirmation of this neoplasia (NAVARRO, 2003; VIEIRA, 2017).

Chest X-ray

Chest radiography is a simple exam used to initially investigate lung lesions. In addition to having wide availability, the cost-benefit and ease of performing the exam contribute to being the most requested. Chest X-ray can be performed in several incisions, anteroposterior (AP), posteroanterior (PA) and side view, and the orthostatic incidence (if the patient's clinical condition permits) is the most frequent, because in the orthostatic position it is observed that the diaphragm moves inferiorly on inspiration, and allows full aeration of the lungs. Additionally, the profile incidence is considered an important complement in the localization of lesions and in the evaluation of

regions not observed in the PA incidence. In contrast, lateral decubitus and AP are indicated for bedridden patients who need a more accurate diagnosis, as in cases of pleural effusion. For a precise interpretation of the chest x-ray, the patient must be well positioned to identify the structures. For a better evaluation of the radiograph, the lungs from the apex to the costophrenic sinuses should be included for a bilateral comparison of the pulmonary fields, and nodular conditions, masses or cavities can be observed; and from the trachea to the carina, including the sternoclavicular joints in symmetry. In the posteroanterior view (PA), the following anatomical structures can be visualized: clavicles, costal arches, diaphragmatic hemicolas, costophrenic sinuses, cardiophrenic sinuses, pulmonary fields, cardiac silhouette, aortic bulb and pulmonary hilum (ALFARO, 2011 ; HERRERA, 2013; AMERICAN CANCER SOCIETY, 2018).

Usually, the radiography on the PA and lateral views is able to locate and classify the images suggestive of lung cancer, since it is through this examination that the suspicion of lung cancer is initially raised. Investigation of lung cancer on radiography includes determining the size, location and extent of the lesion, considering the presence or absence of bone changes and pleural effusions. When a tumor affects the lung in the central area, the first indicator may be hilar opacity, or secondary signs of endobronchial injury. In general, lung tumors are roughly rounded lesions, but when they reach larger sizes, they have irregularities in the contour. Tumor expansion to the chest wall is noticeable and easily identifiable since costal destruction is adjacent to the tumor. When there is enlargement of the mediastinum, lymph node involvement is suspected and, when very large, may be enough to define the stage of the lesion, eliminating the need to perform computed tomography (NAVARRO, 2003; CARVALHO, 2004).

Computed Tomography

Computed tomography is the junction of X-rays with digital detectors and a computer, and is an imaging exam that adds significantly to the diagnosis and staging of lung neoplasms. With the advancement of technology and, consequently, the reduction of acquisition time, CT made it possible to acquire images of "mobile" anatomical regions, such as abdomen and thorax, which previously presented images with low clarity due to respiratory and peristaltic movements. The role of CT in imaging can confirm abnormalities seen on a chest radiograph and detect non-visible lesions (CARVALHO, 2007).

Early detection of lung cancer is extremely important for patient survival. Computed tomography is widely used in the screening of this neoplasm due to the high contrast resolution in relation to chest radiography, favoring the detection of lung lesions (HAESEGAWA, 2000 apud FRONER, 2015). In addition, on CT it is possible to obtain the histological diagnosis and the stage of the lesion, and the image obtained can be used to define the most appropriate therapeutic intervention for each patient. Some basic principles apply to the CT device following specific protocols. Collimation around 5mm is ideal for assessing most chest cancer processes, while for details of the bronchial tree, collimation around 2mm is used (FISHMAN, 2003; LOPES 2005).

Increasing technological advancement and high resolution computed tomography devices allow a better view of the anatomical details of the lung and diseases of the lung parenchyma, such as a chest CT with a small nodule identified as early stage lung cancer, and a Chest CT with normal anatomical aspects (FRONER, 2015).

The American Cancer Society (2019) states that low-dose computed tomography demonstrates greater detail than chest radiography, based on the national lung screening test, which was a clinical trial comparing CT with radiographs in people with high risk of lung cancer. The study included more than 50,000 people aged 55 to 74, smokers or former smokers. The latter could enter the survey only if they had quit smoking at least 15 years ago.

The research excluded people who had a family history of lung cancer, who had removed part of the lung, or who needed oxygen. Selected candidates underwent 3 low-dose CT scans or 3 chest x-rays, each one year apart. After several years, the study found that people who underwent low-dose CT had a 20% lower chance of dying from lung cancer than those who underwent chest radiography, because CT scanning helped their survival. at higher risk of lung cancer. Therefore, for individuals at higher risk for this type of tumor, annual CT scans before the onset of symptoms help to reduce the risk of death from this disease.

Another study entitled "Early Lung Cancer Action

Project" to assess initial and annual low-dose computed tomography screening in people at high risk of lung cancer used 1000 symptom-free volunteers with 60 years or older. Chest radiographs and low-dose computed tomography were performed on each participant. Diagnostic research has shown that noncalcified nodules were detected in 233 participants using low-dose CT, compared with 68 subjects who underwent chest radiography. Malignant disease was detected in 27 by tomography and 7 by radiography. It can be concluded that low-dose computed tomography can significantly improve the probability of detection of small noncalcified lung nodules (HENSCHKEN, 2001; NETO, 2013).

From 2002 to 2004, a survey was conducted that included 53,454 people most likely to develop lung cancer. Three annual low-dose computed tomography examinations were performed in 26,722 patients and a chest radiograph in 26,732 patients. Of the CT scans performed, 96.4% were positive for lung cancer, while of the chest radiographs, 94.5% were false positive for lung cancer. Research has concluded that chest X-ray can show erroneous results and is therefore not the best option. In contrast, low-dose CT screening decreases lung cancer mortality, as early-detected cancer increases the patient's chances of survival (BERG, 2004).

Conclusion

Chest radiography and computed tomography are exams capable of diagnosing pulmonary neoplasia. Studies prove that, although radiography is the most requested exam due to its low cost and wide accessibility, CT stands out because it allows a better detailing of anatomical structures, favoring better visualization and detection of nodules with smaller diameters in the lung due to of its high resolution.

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Citation: **Dayane Evelyn Ribeiro, Felipe Coelho dos Santos Ferreira, Christiana Vargas Ribeiro**. *The Applicability of Radiography and Computed Tomography in Lung Cancer Diagnosis. Archives of Radiology. 2019; 2(2): 08-14.*