COMPUTER-AIDED DIAGNOSIS (CAD) SYSTEM FOR 3-D VISUALIZATION OF MALIGNANT NODULES – A KEY FOR AN EARLY STAGE SURGICAL PLANNING OF LUNG CANCER

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EDITORIAL

Lung cancer is the foremost cause of cancer-related deaths world-wide (Siegel et al, 2012; Jemal et al, 2009). It affects 100,000 Americans of the smoking population every year of all age groups, particularly those above 50 years of the smoking population (American cancer society 2009). In India, 51,000 lung cancer deaths were reported in 2012, which include 41,000 men and 10,000 women (Behera, 2012; Manikandan & Bharathi, 2016). It is the leading cause of cancer deaths in men; however, in women, it ranked ninth among all cancerous deaths (Statistics on lung cancer 2012).

The most common symptoms of lung cancer are persistent cough, shortness of breath, persistent fatigue, cough up blood/ blood in sputum, loss of appetite, weight loss, persistent chest pain and pain in bone/shoulder/neck/arm.Less common symptoms are: Hoarseness of voice, wheezing, difficulty in swallowing, frequent/unexplained fever, swelling in the face/neck/feet and frequent headache/dizziness/seizures (Quadrelli et al. 2015; Manikandan & Bharathi 2014).

In order to diagnose the lung cancer, physician may recommend the following tests:

A. Imaging tests

An X-ray image of lungs discloses an abnormal nodule or mass. Even small lesions in the lungs can be detected by the Computed Tomography (CT) images which could not be detected in the X-ray images. It is proven that CT offers better contrast than the X-ray images between nodule and background with no overlapping structures and detects earlier stage nodules with higher sensitivity.

B. Sputum Cytology

Looking at the sputum produced by cough, under microscope, sometimes may give the presence of lung cancer cells.

C. Tissue Sample (biopsy)

A section of unusual cells may be removed in a procedure called biopsy. Biopsy can be performed in number of ways:

Bronchoscopy: Examining the abnormal areas of lungs using a lighted tube that is passed in to the lungs through the throat.

Mediastinoscopy: Incision is made at the base of neck and surgical tools are inserted behind the breastbone to take the tissue section from the lymph nodes.

Needle biopsy: X-ray or CT images to guide a needle through the chest wall and into the lung to collect doubtful cells.

Once lung cancer has been diagnosed, doctor will work to determine staging of the cancer. It refers to the severity (spread) of the cancer in to the human body (Yang et al. 2010). Staging helps the doctor to determine the appropriate treatment. The stages of lung cancer are divided into:

A. Stage I

Cancer is restricted to the lungs and has not extended to the lymph nodes. Generally, tumor is smaller (>3 mm and ≤20 mm size).

B. Stage II

Tumor has grown larger than 20 mm (21 mm to 30 mm size) and also may have extended to the nearby lymph nodes.

C. Stage III

Tumor has grown very large and extends to other organs near the lungs. This stage may have larger tumor (31 mm to 70 mm) and extended further away from the lungs.

D. Stage IV

Cancer has extendedoutside the affected lung to the other lung or other distinct areas of the body (>71 mm).

The stages I and II are called initial stage or early stage of cancer. The stages III and IV are called advanced stage or later stage of cancer. Depending on the staging, symptoms of lung cancer differ. Patients' survival rate with cancer depends on its staging and treatment. Patients with early stage have better chances of survival than its later stage.

Radiographic imaging plays an important role to detect and diagnose the abnormalities in the lungs. Lung nodules are the round shaped growth in the lungs. In people less than 35 years of age, the probability that a lung nodule cancerous is less than 1%, whereas above the age of 50 years, half the lung nodules in people are malignant (cancerous). The other factor that increases the lung cancer includes, smoking history, occupation, medical history, shape and growth. The primary radiographic imaging tool for lung nodule detection is Computed Tomography (CT), which has replaced the earlier film-based projection radiography. The cancerous nodules can grow double in size on an average of every four months (Manikandan & Bharathi 2016). The growth can be evaluated through a series of CT scans over a period of time.

Computer-Aided Diagnosis (CAD) is a currently applied computerized analysis of medical images and is widely used as a tool in detection and diagnosis of abnormalities in medical imaging. In clinical practice, CAD has become a major research subject in clinical radiology for the detection of pulmonary nodules in chest CT images (Wook-Jin & Tae-Sun 2013). In radiology, CAD system supports the radiologist, who uses the output from a computerized analysis of medical images as a second opinion to assess the detection of abnormalities, quantification of disease progress, and differential diagnosis of lesions. Thus, CAD system is a very significant tool for early detection of lung cancer.

Early stage of treating lung cancer is surgical removal of the diseased portion of the lung lobe or treating it with chemotherapy or radio therapy or sometimes combinations of these. For this, the surgeons need to know the exact location and volume of the cancerous nodules in the lung lobes (Wei et al. 2009). In current clinical practice, surgeons read stacks of CT images for assessing the spatial relationships among anatomic structures of lung cavities, specifically identifying the diseased portion of the lung lobes. Reading CT slices is highly subjective task and requires enormous mental work to map the anatomic structures from the 2-D images onto the 3-D actual lung cavities (Manikandan & Bharathi 2015). This leads to long planning times, heavy workload and low accuracy in the predicted surgeries. Thus, the 3-D CAD systems help the surgeons to visualize the actual location of the cancerous nodules in the lung lobes, by reconstructing the 2-D CT slices in 3-D and could be a key for an early stage surgical planning of lung cancer.

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