INTRODUCTION

Lung cancer kills more patients each year than breast, colon and prostate cancer combined ***(Terrance et al., 2011)***.

Patients with advanced non-small cell lung carcinoma (NSCLC) have a median survival time of 6-8 months and a 1-year survival rate of only 10-20% ***(Kelekis et al., 2006)***.

Surgical resection remains the treatment of choice for patients with early-stage non small cell lung cancer. However, some patients are not surgical candidates because of medical problems. Therefore, alternative therapies are considered in these medically inoperable patients. Radiofrequency ablation has been used clinically for more than 12 years, with many studies reporting its safety and efficacy ***(Terrance et al., 2011)***.

The effectiveness of radical Radiotherapy for stage I/II medically inoperable NSCLC patients, overall five-year survival ranged 0-42% ***(Rowell et al., 2003)***.

The role of chemotherapy in NSCLC has primarily been for patients with more advanced disease alone or in conjunction with radiotherapy ***(Strauss et al., 2004)***.

RFA of lung malignancies is performed with two basic rationales in the first group it is used with an intention of achieving definitive therapy, in the second group it is used as a palliative measure ***(Dupuy et al., 2000)***.

Underlying principle of thermal ablation is that coagulative necrosis and cell death occur immediately at temperatures greater than 60-C. In clinical practice, RFA of lung tumors routinely achieves temperatures greater than 70-C ***(Terrance et al., 2011)***.

Multiple imaging techniques [ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET)] have been used to guide the percutaneous placement of the RF energy applicators. For lung lesions, CT and MRI are the only modalities that can be used ***(Kelekis et al., 2006)***.

Intra-parenchymal hemorrhage typically resolves without intervention; however, Proper patient selection for ablation therapy, by means of excluding all possible causes of coagulopathy, and a refined technique of avoiding traversing pulmonary vasculature in the ablation track, can prevent catastrophic results ***(Nour-Eldin et al., 2011)***.

Re-RF ablation for lung tumors was completed successfully without any major complications. However, re-RF ablation for unresectable lung tumors previously treated with RF ablation showed a high rate of local progression ***(Okuma et al., 2009)***.

The main objectives of pulmonary tumor ablation therapy (and other malignancies) are: 1) to eradicate all viable malignant cells in the target volume, with a safety margin to ensure complete eradication, 2) Minimizing the damage to certain targeted volume will provide a good functioning reserve of the rest of the lung. This is particularly important for patient with limited pulmonary functions due to extensive underlying emphysema and fibrosis ***(Lencioni et al., 2008; Hiraki et al., 2007)***.

The potential advantages of local tumor ablation therapy over surgical resection might include: 1) selective damage, 2) minimal treatment morbidity and mortality, 3) less breathing impairment in patients with borderline lung function through sparing healthy lung tissue, 4) repeatability, 5) fairly low costs, 6) excellent imaging during the procedure and for follow-up and last but not least 7) the gain in quality of life with less pain, much shorter hospitalization times with the interventions performed on an outpatient base or with overnight stays and thus a quicker re-access to social life ***(Steinke 2008; de Baere 2011)***.

AIM OF THE WORK

The purpose of the essay is to review the principles of radiofrequency ablation, its clinical application and role in the management of primary and metastatic lung tumors.

RADIOLOGICAL ANATOMY

Lungs

Each lung is conical in shape, and has

- Apex
- Base
- Three borders
- Two surfaces

Apex

- Rounded
- Extends 2.5 to 4 cm into the root of the neck

Base

- Broad and concave
- Rests upon the convex surface of the diaphragm

Surfaces

- Costal surface
- Mediastinal surface

Borders

- Inferior border
- Posterior border
- Anterior border ***(Gruden et al., 2000)*.**

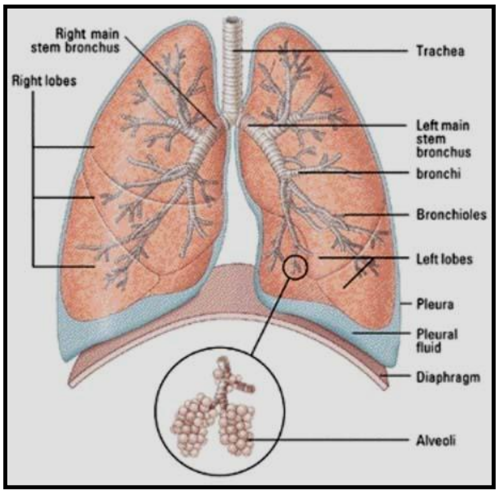

Figure (1): Lobar Anatomy of the lungs ***(Gruden, et al, 2000)***.

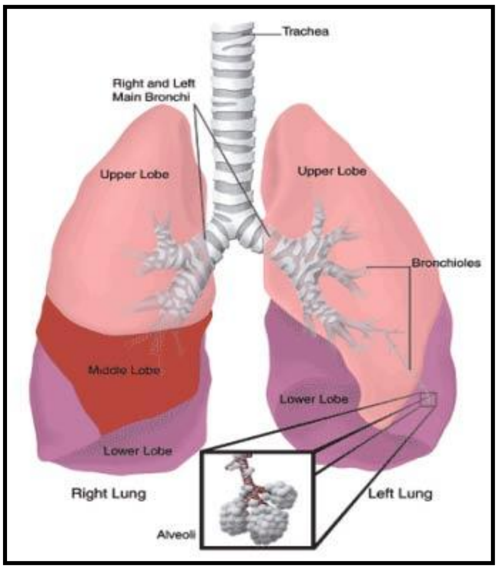

Figure (2): Lobar Anatomy of the lungs ***(Gruden, et al, 2000)***.

Fissures and Lobes of the Lungs (Fig. 1,2)

<u>Left lung</u>

- **<u>Fissure</u>**
  - Oblique fissure, which extends from the costal to the mediastinal surface of the lung both above and below the hilum, divides left lung into upper and lower lobes.
- **<u>Lobes</u>**
  - Upper lobe, Lies above and in front of this fissure, and includes the apex, the anterior border, and a considerable part of the costal surface and the greater part of the mediastinal surface of the lung.
  - Lower lobe, the larger of the two, is situated below and behind the fissure, and comprises almost the whole of the base, a large portion of the costal surface, and the greater part of the posterior border ***(Gruden et al., 2000)*.**

<u>Right lung</u>

- **<u>Fissures</u>**
  - Oblique fissure separates lower lobe from upper and middle lobe, Right oblique fissure is more vertical than left.
  - Transverse fissure separates middle lobe from upper lobe, Transverse fissure begins in the oblique fissure near the posterior border of the lung, and, running horizontally forward, cuts the anterior border on a level with the

sternal end of the fourth costal cartilage; on the mediastinal surface it may be traced backward to the hilum ***(Gruden et al., 2000)***.

- **Lobes**
  - Upper lobe
  - Middle lobe
  - Lower lobe

Hilum

- By which the lung is connected to the heart and the trachea.
- The structures composing the root of each lung are arranged similarly.
  - The upper two pulmonary veins in front
  - The pulmonary artery in the middle
  - The bronchus and the bronchial vessels posteriorly ***(Gruden et al., 2000)*.**

Relationships

- The root of the right lung
  - lies behind the superior vena cava and part of the right atrium
  - Below the azygos vein.

- The left lung root
    - passes beneath the aortic arch and in front of the descending aorta
- Pulmonary ligament is below on both sides ***(Gruden et al., 2000)*.**

Tracheo-bronchial tree (Fig. 3)

Trachea

- Trachea divides at the level of Loui's angle into right and left main bronchi (**Carina).**

Right main stem bronchus Is short 2.5cm in length and vertical.

1. **Right upper lobe bronchus** takes off 2.5 cm. from the bifurcation of the trachea giving.
    - **RUL segments (Fig. 4)**
        - Apical
        - Anterior
        - Posterior

2. Right intermediate bronchus divides into:

- **Right middle lobe bronchus** takes off anteriorly

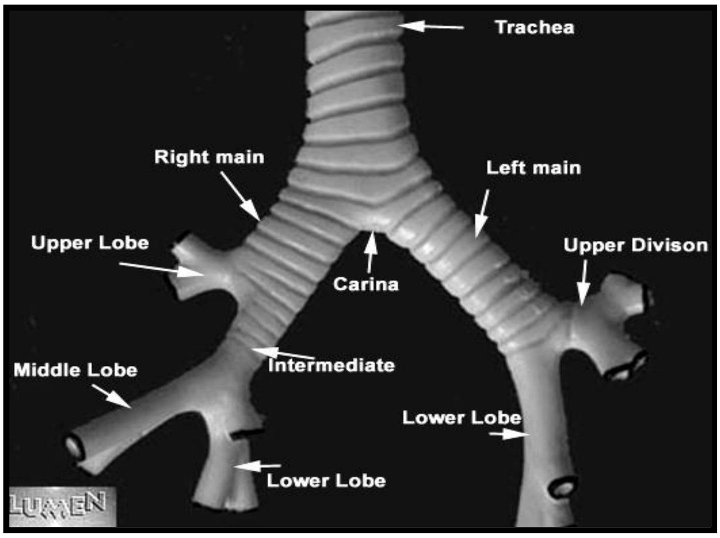

Figure (3): The tracheo-bronchial tree ***(Gruden et al., 2000)***

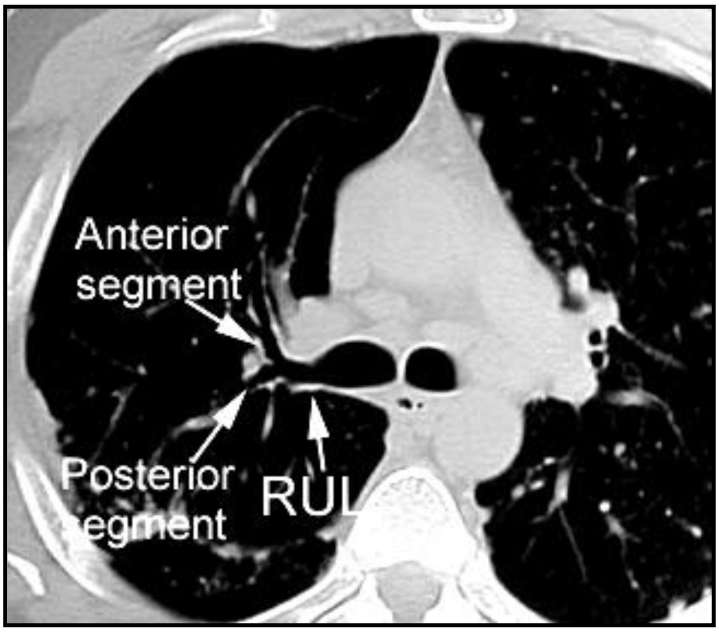

Figure (4): axial CT cuts of the segmental branches of the right main bronchus ***(Gruden et al., 2000)***

- **RML segments (Fig. 5)**
    - Medial
    - Lateral

- **RLL segments (Fig. 6)**
    - Apical
    - Medial, first branch
    - Anterior
    - Posterior
    - Lateral ***(Gruden et al., 2000)***.

1. <u>Left main stem bronchus</u>

5cm long and oblique, Passes below the level of the pulmonary artery before it divides

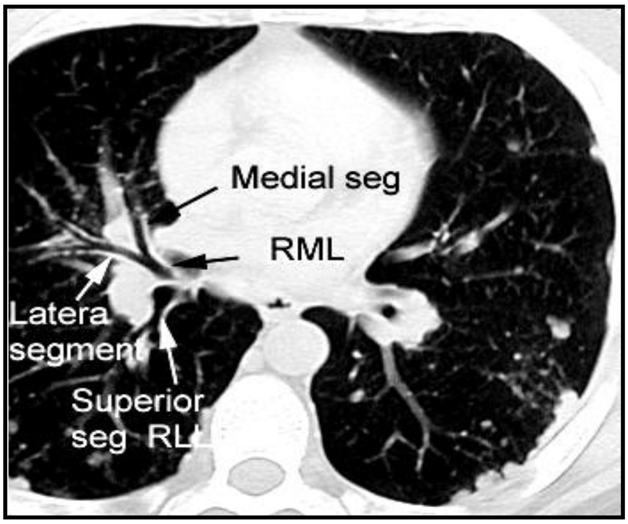

Figure (5): axial CT cuts of the segmental branches of the right main bronchus ***(Gruden et al., 2000)***

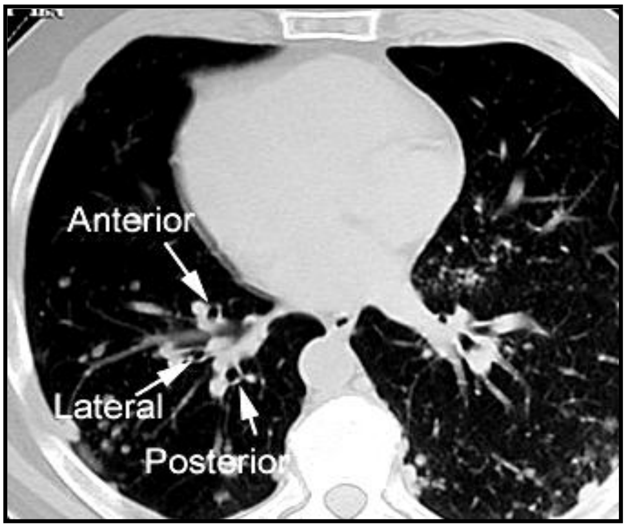

Figure (6): axial CT cuts of the segmental branches of the right main bronchus ***(Gruden et al., 2000)***

2. **Left upper Lobe division**

❖ **Left upper lobe**

- **LUL segments (Fig. 7)**
  - Apical posterior
  - Anterior

❖ **Lingula**

- **Lingular segments (Fig. 8)**
  - superior
  - Inferior

a. Left lower lobe bronchus

- **LL segments (Fig. 9)**
  - Superior
  - Andromeda
  - Posterior

Lateral ***(Gruden et al., 2000)***.

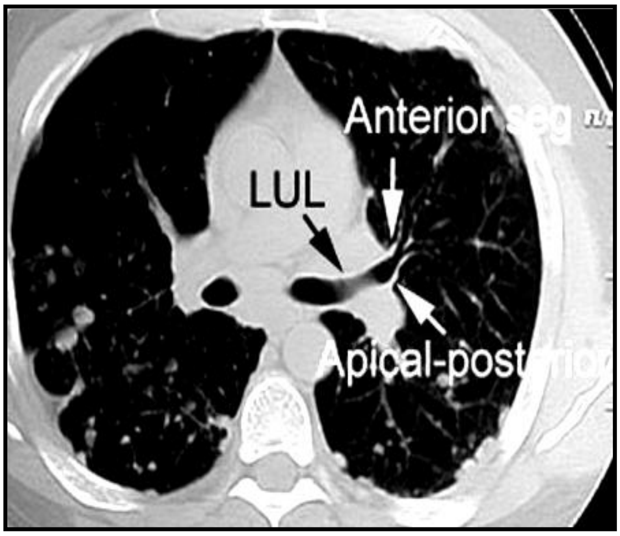

Figure (7): axial CT cuts of the segmental branches of the Lift main bronchus ***(Gruden, et al, 2000)***.

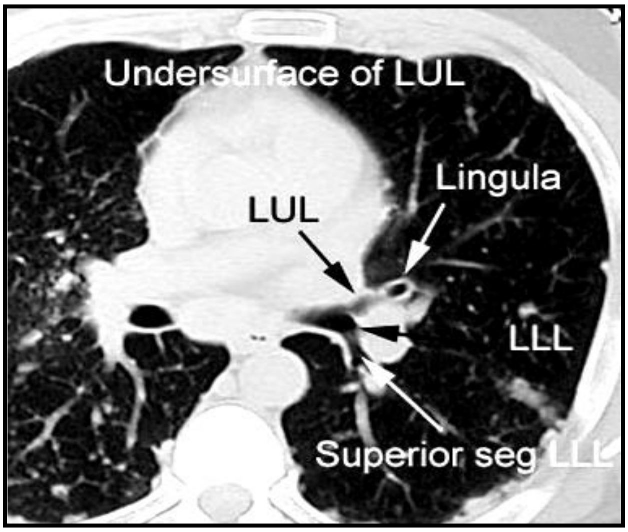

Figure (8): axial CT cuts of the segmental branches of the Lift main bronchus ***(Gruden, et al, 2000)***.

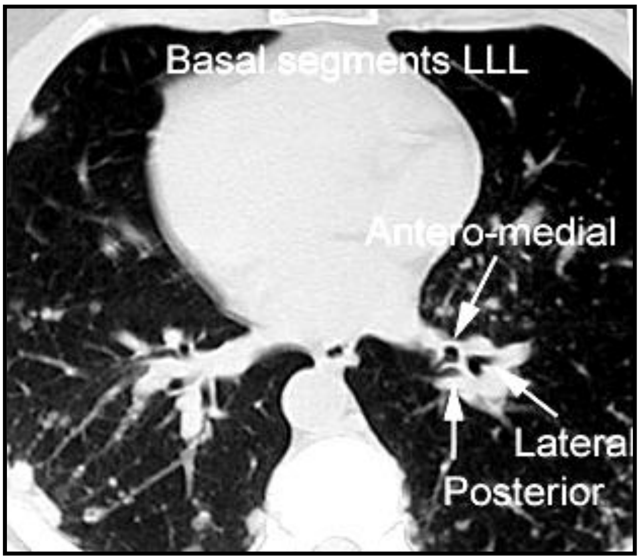

Figure (9): axial CT cuts of the segmental branches of the Lift main bronchus ***(Gruden, et al, 2000)***.

Normal Sonographic Anatomy:

Ultrasound is a reliable and efficient imaging method to evaluate a wide range of clinical problems in the chest and to guide diagnostic and therapeutic procedures. Although the ribs, spine, and air filled lung act as barriers to ultrasound visualization of intrathoracic diseases, the presence of fluid in the pleural space and tumor, consolidation, or atelectasis in the lung provide ample sonographic windows for evaluation ***(McLoud et al., 1991).***

Up to 99% of the ultrasound wave is reflected in the healthy lung. Intrapulmonary processes can be detected by sonography only when they extend up to the visceral pleura or can be imaged through a sound-conducting medium such as fluid or consolidated lung tissue ***(Beckh et al., 2002).***

A high-resolution linear transducer of 5-10 MHz is suitable for imaging the thoracic wall and the parietal pleura ***(Mathis et al., 2007).***

More recently introduced probes of 10-13 MHz are excellent for evaluating lymph nodes, pleura and the surface of the lung ***(Gritzmann et al., 2005).***

For investigation of the lung a convex or sector probe of 7-10 MHz provides adequate depth of penetration. The investigation is performed as far as possible with the patient seated, during inspiration and expiration, if necessary in combination with respiratory maneuvers such as coughing or "sniffing." Raising the arms and crossing them behind the head causes intercostal spaces to be extended and facilitates access. The transducer is moved from ventral to dorsal along the longitudinal lines in the thorax ***(Mathis et al., 2007). (*Fig.10*)***

- Parasternal line.
- Mid clavicular line.
- Anterior, middle and posterior axillary line.
- Lateral and medial scapular line.
- Para vertebral line ***(Mathis et al., 2007).(*Fig 10*)***