USEFULNESS OF THE CHEST X-RAY IN EVALUATION PRIMARY LUNG CANCER DISEASE

CHAYAKUL NIMSUWAN

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ABSTRACT

The plain chest radiograph is the basic tool in diagnosis and follows up patients in general times with inexpensive imaging and to demonstrate pathological lesions. This retrospective descriptive research aim to investigate the usefulness of the chest x-ray in diagnosing lung cancer and the characteristics of histological lung cancer from the film chest x-rays of patients with lung cancer in Siriraj Hospital, 1998-2004, there were 138 cases (squamous cell carcinoma 35 cases; adenocarcinoma 86 cases; large cell carcinoma 3 cases; and small cell carcinoma 14 cases).

Results revealed that small cell carcinoma and squamous cell carcinoma were most frequent in males and adenocarcinoma was most frequent in females ($p<0.05$). Then, squamous cell carcinoma and small cell carcinoma were most frequent in tumor size in diameter more than 4 cm and adenocarcinoma was most frequent in tumor size in diameter less than 4 cm ($p<0.05$). And then, none squamous cell carcinoma found in cases of the pleural effusion presented with absented infiltration but found instead of small cell carcinoma and adenocarcinoma which there was significantly ($p<0.05$). The accuracy of chest x-ray for evaluated squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma were 69% (95% confidence interval = 54 to 84%), 55% (95% confidence interval = 44 to 66%), 0% and 50% (95% confidence interval = 24 to 76%), respectively. Predictive value were 44% (95% confidence interval = 28 to 60%), 78% (95% confidence interval = 69 to 87%), 0%, and 57% (95% confidence interval = 8 to 58%), respectively.

KEY WORDS: CHEST RADIOGRAPHIC IMAGING / X-RAY / LUNG CANCER / PHATOLOGICAL CELL TYPE / SQUAMOUS CELL CARCINOMA / ADENOCARCINOMA / LARGE CELL CARCINOMA / SMALL CELL CARCINOMA.

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การศึกษาถึงประโยชน์ของภาพถ่ายทางรังสีวิทยาทรวงอกในการวินิจฉัยโรคมะเร็งปอด
(USEFULNESS OF THE CHEST X-RAY IN EVALUATION PRIMARY LUNG CANCER DISEASE)

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บทคัดย่อ

การเอกซเรย์ปอด จัดเป็นขั้นตอนพื้นฐานของการตรวจร่างกายหรือติดตามผลการรักษาที่ใช้กันอยู่ทั่วไปในปัจจุบันนี้ ด้วยค่าใช้จ่ายที่น้อยกว่าและได้ผลการตรวจตามที่ต้องการ ดังนั้นการศึกษาในครั้งนี้จึงเป็นการวิจัยเชิงพรรณนาย้อนหลัง เพื่อศึกษาถึงประโยชน์ของภาพถ่ายทางรังสีวิทยาทรวงอกในการตรวจวินิจฉัยโรคมะเร็งปอดและลักษณะต่าง ๆ ของมะเร็งปอดแต่ละชนิดที่พบได้จากภาพถ่ายทางรังสีวิทยาทรวงอก (ฟิล์มเอกซเรย์) ของผู้ป่วยมะเร็งปอดที่เข้ารับการตรวจทางพยาธิวิทยาและเอกซเรย์ปอด ณ โรงพยาบาลศิริราช ในช่วงปี พ.ศ.2541-2547 จำนวน 138 ราย โดยแยกเป็นเซลล์ชนิด squamous cell carcinoma 35 ราย, adenocarcinoma 86 ราย, large cell carcinoma 3 ราย, และ small cell carcinoma 14 ราย

จากผลการศึกษาพบว่า small cell carcinoma และ squamous cell carcinoma พบได้เป็นจำนวนมากน้อยลดลงตามลำดับในผู้ป่วยมะเร็งปอดเพศชาย และ adenocarcinoma พบได้เป็นจำนวนมากในผู้ป่วยมะเร็งปอดเพศหญิงอย่างมีนัยสำคัญ ($p<0.05$) เมื่อดูจากขนาดของก้อนที่ใหญ่กว่า 4 เซนติเมตร มักพบเซลล์ชนิด squamous cell carcinoma และ small cell carcinoma ส่วนขนาดของก้อนที่เล็กกว่า 4 เซนติเมตร มักพบเซลล์ชนิด adenocarcinoma อย่างมีนัยสำคัญ ($p<0.05$) และจะไม่พบเซลล์ชนิด squamous cell carcinoma ในกรณีที่พบ pleural effusion แล้วไม่พบ infiltration แต่มักจะพบเป็นเซลล์ชนิด small cell carcinoma และ Adenocarcinoma แทน อย่างมีนัยสำคัญ ($p<0.05$) ซึ่งรายละเอียดที่พบมีความถูกต้องในการแยกมะเร็งปอดชนิด squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma เท่ากับ 69%(95%CI 54-84), 55%(95%CI 44-66), 0%, และ 50% (95%CI 24-76) ตามลำดับ โดยโอกาสของการทำนายถูกของ squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma เท่ากับ 44%(95%CI 28-60), 78%(95%CI 69-87), 0%, และ 33% (95%CI 8-58) ตามลำดับ

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CONTENTS

LIST OF TABLES

LIST OF TABLES (CONT.)

Page

LIST OF FIGURES

LIST OF FIGURES (CONT.)

Page

LIST OF CHARTS

LIST OF CHARTS (CONT.)

Page

CHAPTER I

INTRODUCTION

1.1 Background and Rationale

Lung cancer is the most common cause of cancer death in the world (1). Incident also differs for different gender, radical and ethnic groups (2). For example, the rates of getting lung cancer are higher among men than women, but the incidence in women is rising (3,4). Black men get lung cancer at higher rates than other men. Asian/Pacific Islander men and Hispanic men have the lowest rates. Among women, while women have the highest rate of getting lung cancer. Asian/Pacific Islander women and Hispanic women have the lowest rates (2).

In the United States of America, lung cancer is the most deadly of all malignant disease in both men and women. Each year, the American Cancer Society (ACS) estimates the number of new cancer cases and deaths expected in the current year and compiles the most recent data on cancer incidence, mortality and survival based on incidence data from the National Cancer Institute (NCI) for health statistic (5,6). Although the incidence rate of lung cancer is lower than for breast and prostate cancer, the mortality rate of lung cancer is the highest for all cancer in both men and women. During 2005 an estimated 172,570 new cases and 163,510 deaths from lung cancer (7). Kentucky has the highest rate of lung cancer in both genders and Utah has the lowest rate of lung cancer in both genders too (2,7). Today, lung cancer is the third most common cause of death in the world (8). According to the World Health Report, 2004 of the World Health Organization estimated 1 million people worldwide die from lung cancer annually. It is the most common diagnosed cancer but with marked regional variation. Over 3 million people have lung cancer, the majority residing in developed countries and 80 percent of new cases are living in developing

countries (7,9). The peak incidence of carcinoma is between ages 40 and 70, the disease being unusual before the age of 30. The clinical features are variable, but the two most frequent presentations are (a) pneumonia or (b) the discovery of an abnormality on the chest radiograph of a patient with no symptoms. Which approximately 25 percent of patients are asymptomatic at the time of diagnosis (3,10).

In Thailand, the Ministry of Public Health's reports are estimated that 45,000 Thai populations die from cancer annually, which is the first cause of deaths. Follow by an accident and a heart and coronary disease is the second through third cause of deaths (9). The National Cancer Institute of Thailand compiles the statistic data in Cancer in Thailand volume III during 1995-1997, published in 2004. Which an estimated 74,006 new cancer cases, comprising approximately 35,539 men and 38,467 women. Lung cancer is the leading cause of cancer death for both men and women. It is the second most frequently diagnosed cancer which liver cancer is the first (11,12). The peak incidence is between ages 50 and 75, the disease is the second most frequently cancer in men and the forth in women (13,14). The Oncological (Cancer) Society of Thailand specify that an average of 26 Thai people who fall ill with lung cancer, 19 Thai people a day to the deadly disease (15) and cancer incidences greatly differed from region to region (16). So that, every November is the fighting lung cancer's month. Because of most lung cancers begin to grow silently, without any symptoms or no specific symptom in early detection. Patients with lung cancer often do not develop symptoms until the cancer is in an advanced stage (17). The prognosis is poorest of all cancers, with a 5-year survival rate of less than 13 percent (18). The screening trials are finding lung cancer in the risk groups before they have any cancer symptom is not worthwhile. Nowadays, there are many current diagnoses such as the plain chest radiograph (x-ray), radionuclide imaging, sputum cytology, computed tomography, bronchoscopy, biopsy or mediastinoscopy. The doctor will choose the suitable diagnosis for individual patient. While, the diagnosis instrument have an expensive and there are in the town. It is the cause of the researcher in finding lung cancer from the plain chest radiograph to classify types of lung cancer and use reference data from the Pathology Department is gold standard. Because the plain chest radiograph is the basic tool in diagnosis, follow-up the

patients and diagnoses asymptomatic patients which the doctor found by chance from chest x-ray and to consist of an early diagnosis are not a profit. Annually a diagnosis does not to help the patients have a long life. Now, we can not diagnosis lung cancer in early like any cancer is better than x-ray and this diagnosis are not an expensive. Every hospital has service, safe cost, easy to use and make the research (8,19,20).

1.2 Scope of Research

This study was investigating patients with primary lung cancer disease by the chest radiographic imaging. The patients were identified through the databases from Department of Pathology of Siriraj Hospital in between 1998-2004 by restricted to case with histologically proven squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma. Then, look up film from Division of Diagnostic imaging, the Department of Radiology, Siriraj Hospital. After that, the radiologists reviewed film and recorded a characteristic of tumor and chest radiographic findings. Discrepancies in interpretation between radiologists were resolved by consensus.

1.3 The Study Objectives

1.3.1 Study to evaluate the chest radiographic imaging patterns of primary lung cancer base on pathologic cell type.

1.3.2 Study the chest radiographic imaging characteristics of primary lung cancer cell types.

1.4 The Advantages from Research

1.4.1 Know a chest radiographic imaging patterns of primary lung cancer

1.4.2 Know a characteristic of primary lung cancer cell type

1.4.3 Reusable old film chest x-ray.

CHAPTER II

LITERATURE REVIEW

2.1 Background of Lung Cancer

Cancer occurs when normal cells undergo a transformation that causes them to grow and multiply without the normal controls. The cells form a mass or tumor that differs from the surrounding tissues from which it arises. Tumors are dangerous because they take oxygen, nutrients, and space from healthy cells. Most lung tumors are malignant. This means that they invade and destroy the healthy tissues around them. The tumors can also spread to nearby lymph nodes or through the bloodstream to other organs. This process is called metastasis. When lung cancer metastasizes, the tumor in the lung is considered the primary tumor, and the tumors in other parts of the body are called secondary tumors or metastatic tumors. Some lung tumors are metastatic from cancers elsewhere in the body. The lungs are a common site for metastasis (17,21).

2.1.1 Cause of Lung Cancer (1,22,23)

Lung cancer is the common cancer in the country and the other. Now, it doesn't know a certain cause of lung cancer. Believe that, there are many cause of lung cancer. By far the most important risk factor for the development of lung cancer is exposure to tobacco smoke, accounting for approximately 90% of the cases in males and 80% of cause in females. A variety of other factors play a contributory role. These are summarized below.

- Smoking: tobacco smoke contains a variety of known carcinogens. The development of lung cancer is insidious with an interval of up to 30 years before the onset of symptomatic disease. There is no apparent threshold in the dose response relationship between exposure to tobacco smoke and incidence of lung cancer but higher incidence rates of the disease are associated with higher lifetime levels of tobacco consumption and with an early age of starting the habit. In non-smokers the risk of developing lung cancer is increased by exposure to environmental tobacco smoke.
- Radon: exposure to the radioactive gas, radon, can increase the risk of developing lung cancer. The effect of radon is markedly exacerbated by exposure to tobacco smoke.
- Asbestos: asbestos fibers can easily break, giving rise to fine particles which can lodge in the lungs, damage cells and increase the risk of lung cancer, especially in association with tobacco smoking. Malignant mesothelioma is clearly related to asbestos exposure in the vast majority of cases.
- Environmental exposure: exposure to certain air pollutants, such as by-products of combustion, has been linked to the risk of development of lung cancer. (Micro-particularly diesel engine, are thought to be particularly potent in this respect). Other substantial risks to small groups of industrial workers that result from exposure to chromates and arsenic, and from the refining of nickel, chromium and copper, have been identified.
- Lung diseases: some infectious diseases, such as tuberculosis, which cause scarring of the lung, tend to increase the risk of developing lung cancer.
- Family history: although the molecular and genetic events underlying the pathogenesis of lung cancer are under active investigation, no genetic or familial abnormality has conclusively defined the risk of lung cancer. There is, however a small excess risk of developing lung cancer in individuals with a family history of the disease.
- Nutrition: increased intake of fruit, yellow/green vegetables and fish is associated with a decreased risk of lung cancer and increased red meat consumption has been shown to be associated with an increased risk of lung cancer.

- Prior history of lung cancer: survivors of lung cancer have a greater risk than the general population of developing a second lung cancer. Survivors of non-small cell lung cancers have an additive risk of 1-2% per year for developing a second lung cancer. In survivors of small cell lung cancers the risk for development of second cancers approaches 6% per year.

2.1.2 **Pathology and Classification** (1,24,25,26)

The histologic classification on primary lung cancer was initially developed by the World Health Organization (WHO) in 1967. It was subsequently revised in 1981 and most recently 1999. The most recent WHO histological classification of lung and pleural tumors, with a focus on epithelial tumors, appear in Table 2-1 (1).

Table 2-1. World Health Organization 1999 histologic classification of lung cancer and pleural tumors (abbreviated)

1. Epithelial tumors
    - 1.1 Benign
        - 1.1.1 Papillomas
        - 1.1.2 Adenomas
    - 1.2 Preinvasive lesions
        - 1.2.1 Squamous dysplasia/carcinoma in situ
        - 1.2.2 Atypical adenomatous hyperplasia
        - 1.2.3 Diffuse idiopathic pulmonary neuroendocrine cell hyperplasia
    - 1.3 Malignant
        - 1.3.1 Squamous cell carcinoma
            - 1.3.1.1 Papillary
            - 1.3.1.2 Clear cell
            - 1.3.1.3 Small cell
            - 1.3.1.4 Basaloid

Table 2-1. World Health Organization 1999 histologic classification of lung cancer and pleural tumors (abbreviated) (conc.)

- 1.3.2 Small cell carcinoma
  - 1.3.2.1 Combined small cell carcinoma
- 1.3.3 Adenocarcinoma
  - 1.3.3.1 Acinar
  - 1.3.3.2 Papillary
  - 1.3.3.3 Bronchioloalveolar
    - 1.3.3.3.1 Nonmucinous
    - 1.3.3.3.2 Mucinous
    - 1.3.3.3.3 Mixed mucinous and nonmucinous or indeterminate cell type
  - 1.3.3.4 Solid carcinoma with mucin formation
  - 1.3.3.5 Adenocarcinoma with mixed subtypes
  - 1.3.3.6 Variants
- 1.3.4 Large cell carcinoma
  - 1.3.4.1 Large cell neuroendocrine carcinoma
  - 1.3.4.2 Basaloid carcinoma
  - 1.3.4.3 Lymphoepithelioma-like carcinoma
  - 1.3.4.4 Clear cell carcinoma
  - 1.3.4.5 Large cell carcinoma with rhabdoid phenotype
- 1.3.5 Adenosquamous carcinoma
- 1.3.6 Carcinoma with pleomorphic sarcomatoid or sarcomatous elements
- 1.3.7 Carcinoid tumor
  - 1.3.7.1 Typical carcinoid
  - 1.3.7.2 Atypical carcinoid

Table 2-1. World Health Organization 1999 histologic classification of lung cancer and pleural tumors (abbreviated) (conc.)

1.3.8 Carcinomas of salivary gland type
1.3.8.1 Mucoepidermoid carcinoma
1.3.8.2 Adenoid cystic carcinoma
1.3.8.3 Others
1.3.9 Others
2. Soft tissue tumors
3. Mesothelial tumors
3.1 Benign
3.2 Malignant mesothelioma
4. Miscellaneous tumors
5. Lymphoproliferative diseases
6. Secondary tumors
7. Unclassified tumors
8. Tumorlike lesions

Source: From Travis WD, Colby TV, Corrin B, et al. World Health Organization international histological classification of tumors: histological typing of lung and pleural tumors, 3rd ed. Berlin; Springer-Verlag, 1999:1-156, with permission.

Several classification schemes of lung cancer have been proposed. The most widely accepted is that of the World Health Organization (WHO), published in 1999. According to this classification, there are four main histologic types of lung cancer: adenocarcinoma, squamous cell carcinoma, small cell carcinoma, and large cell carcinoma. These four variants constitute about 95% of all lung cancers. The remaining types are uncommon.

Although a specific histopathologic classification is highly desirable, the distinction between small cell lung carcinoma (SCLC) and non-small cell lung carcinoma (NSCLC) is most critical in determining an approach to therapy.

2.1.2.1 Small cell lung carcinoma

Small cell lung cancer (SCLC) accounts for about 20% of all lung cancer. It has an aggressive clinical course with frequent widespread metastases. It is considered a distinct clinicopathologic entity, owing to the many characteristic clinical manifestations, the unique pathologic features, and the sensitivity to chemotherapy. SCLC tends to occur most frequently in current heavy cigarette smokers. Approximately 90% to 95% occur centrally, apparently arising in lobar or main bronchus. Histologically, the tumor cells are small and round or fusiform in shape. Cytoplasm is minimal and necrosis is common. Radiologically, usually presents as a central mass formed by the combination of primary tumor and affected lymph nodes. Mediastinal lymph node enlargement is also present in the most cases. Other common findings include narrowing and displacement of major vessels and bronchi, evidence of mediastinal invasion, and pleural effusion. In 5% to 10% of cases, SCLC presents as a peripheral nodule without associated lymphadenopathy. Most of these lesions have smooth but lobulated margins. Spiculation may occur due to local lymphatic invasion. Marginal ground-glass attenuation is seen in some cases, reflecting the presence of edema and hemorrhage.

2.1.2.2 Non-small cell lung carcinoma

2.1.2.2.1 Squamous cell carcinoma

In the past, squamous cell carcinoma was the most common histologic subtype of all lung cancer. In the 1970s, squamous cell carcinoma comprised almost 40% of all lung cancer, but it now comprised approximately 25% to 30%. Two thirds of squamous cell carcinomas present as central lung tumors, while one third are

peripheral. Squamous cell carcinoma occurs almost exclusively in cigarette smokers and is much more common in men than in women. They are characterized histologically by keratinization and/or prominent intercellular bridges. Most originate in lobar, segmental, or proximal subsegmental bronchi. They tend to grow into the airway lumen as polypoid or papillary tumors and therefore are usually associated with features of airway obstruction in the distal lung. The most common radiologic abnormality consists of atelectasis and obstructive pneumonitis involving a segment, a lobe, or the entire lung. The combination of a hilar bulge due to a large central mass and atelectasis secondary to the airway obstruction results in an inverse S configuration, a finding known as the S-sign of Golden. A small percentage of squamous cell carcinomas presents as intraparenchymal nodules that lack apparent connection to a bronchus. Grossly and radiologically, these are similar to peripheral adenocarcinomas. The borders of the nodule are often irregular or lobulated. Approximately 10% of squamous cell carcinomas cavitate. The cavities are usually thick walled and have a nodular inner surface. The latter is probably related to local differences in necrosis and growth rate within the tumor.

2.1.2.2.2 Adenocarcinoma

During the past tree decades, adenocarcinoma has emerged as the most common histologic subtype of all lung cancer, now accounting for approximately 40% of all lung cancer. It is the most common histologic subtype in woman and in nonsmokers. It characterized histologically by the formation of glands and papillary structures or by the presence of mucin secretion. The most physicians consider the tumors in two groups: bronchioloalveolar and nonbronchioloalveolar.

- Nonbronchioloalveolar adenocarcinoma

Grossly, nonbronchioloalveolar adenocarcinoma typically presents as a peripheral nodule or mass that is spherical or (more frequently) lobulated in shape. It may be well circumscribed or have speculated margins; some tumors show both

patterns, reflecting the presence of more than one clone of neoplastic cell. Central fibrosis is common, particularly in tumors adjacent to the pleura. Grossly evident necrosis is often minimal or absent in tumors less than 3 cm in diameter; it is more frequent in large ones. Peripheral tumors may directly invade the pleura and chest wall; rarely, subsequent pleural spread results in circumferential growth around the lung, resembling mesothelioma.

Histologically, most nonbronchioloalveolar adenocarcinomas show a mixture of patterns, including acini, tubules, and sheets of cells without structural evidence of glandular differentiation. It commonly has spread to regional lymph nodes at presentation; the prevalence of such spread appears to be greater than that associated with bronchioloalveolar and squamous cell carcinoma.

The characteristic radiologic presentation of adenocarcinoma consists of a solitary nodule or mass with a lobulated or speculated margin. The histologic correlate of the speculation is variable and may correspond to strands of fibrous tissue that extend from the tumor margin into the lung, to direct infiltration of tumor into the adjacent parenchyma, to small foci of parenchymal collapse as a result of bronchiolar obstruction by expanding tumor, or to spread of tumor in lymphatic channels and interstitial tissue of adjacent vessels, airways, or interlobular septa (lymphangitic spread).

- Bronchioloalveolar carcinoma

Bronchioloalveolar carcinoma (BAC) is characterized histologically by spread of tumor cells on the surface of the lung parenchyma without its destruction. Tumor cells may be arranged in a single layer or may form small papillary projections into the alveolar air spaces. Grossly, the tumors may appear as a peripheral nodule or as a poorly defined area of consolidation, with the latter sometimes affecting an entire segment or lobe. In either case, normal structures such as interlobular septa, membranous bronchioles, and pulmonary vessels are identifiable with the tumor.

The most common radiologic presentation of BAC is as a solitary nodular opacity, a pattern seen in 60% of cases.

The second most common radiographic presentation of BAC is an area of ground-glass opacification or airspace consolidation. Air bronchograms are commonly present. Production of copious amounts of mucin may result in lobar expansion and bulging of the interlobar fissure. It should be noted, that this sign can be observed in various other conditions, including lobar pneumonia, lymphoma, lipoid pneumonia, infarction, and edema.

A third and relatively uncommon radiologic pattern of BAC is multiple nodules. They may consist of poorly defined areas of ground-glass attenuation, consolidation, or both.

2.1.2.2.3 Large cell carcinoma

Large cell carcinoma accounts for approximately 5% of all lung cancer. It is a poorly differentiated carcinoma that does not have features of squamous cell carcinoma, adenocarcinoma, or SCLC. Most patients are elderly cigarette smokers. Grossly, this tumor arises peripherally as a solitary mass and is often large, well-circumscribed masses with extensive necrosis at time of presentation. Histologically, they consist of sheets of cells that have large, often vesicular, nuclei; prominent nucleoi; and abundant cytoplasm. By definition, features of squamous or glandular differentiation are absent. However, evidence of neuroendocrine differentiation may be seen, in which case the tumor is classified as large cell neuroendocrine carcinoma. Although multiple foci of necrosis are characteristic, cavitation is common. About 70% present radiologically as a parenchymal mass usually measuring greater than 3 cm in diameter. The margins of the mass are usually poorly defined and lobulated.

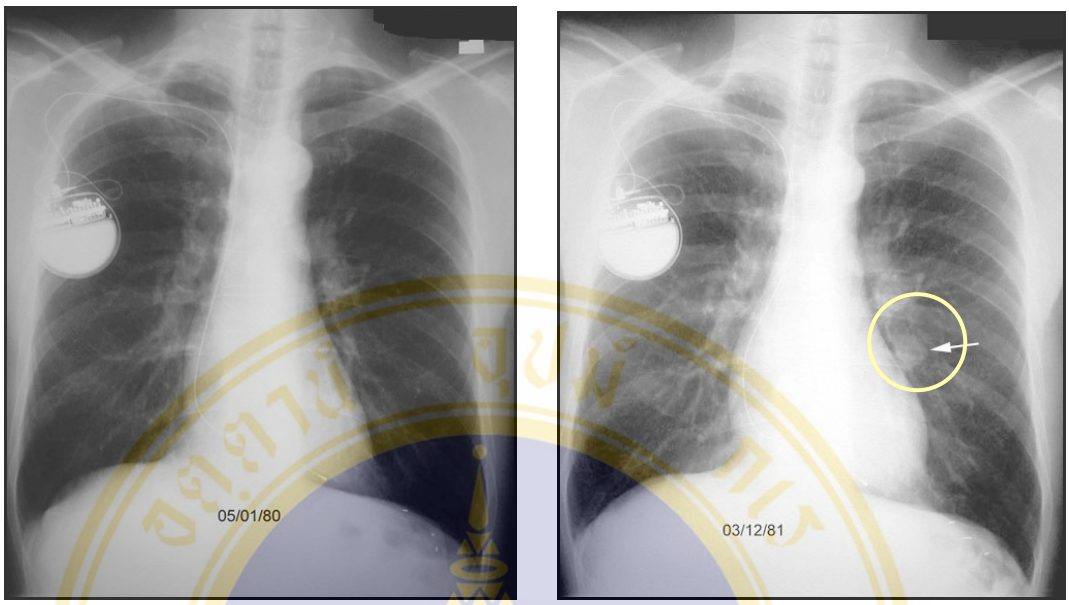
2.1.3 Signs and Symptoms

The natural history of lung cancer can be described by breaking down its course of existence into a sequence of a few simple phases based on the way we experience the disease clinically (28).

- Pre-detectable: carcinoma of the lung always passes through a pre-detectable phase, beginning with its biological onset (the development of the first frankly malignant cell) and beginning when the disease may first be shown to exist whether through sputum cytology or chest radiography. It has been claimed that by the time a tumor is 10 mm. in diameter it has already doubled in size 30 times, contains at least one billion cells, and has completed three-fourths of its anticipated existence. It is likely that during the majority of a lung tumor's existence it will be undetectable by any currently available diagnostic technique.

Table 2-2. Doubling time of lung cancer (29)

Histology	Doubling time (days)	Mean doubling time (days)	Time from malignant change to 1 cm. masses (years)
Squamous cell carcinoma	88 – 103	88	7.2
Adenocarcinoma	161 – 187	161	13.2
Large cell carcinoma	86 - 100	86	7.1
Small cell carcinoma	29 – 33	29	2.4



(a) (b)

Figure 2-1. Chest x-rays showed doubling time of lung cancer
(a) Chest x-ray as before
(b) Chest x-ray as after

- Detectable-asymptomatic: most cases of lung cancer are felt to enter a phase in which presence of the disease is potentially demonstrable, yet continues to be without symptoms. The disease is detectable if the tumor is radiographically evident (5-10 mm. in diameter), or sputum is positive for malignant cells. The duration of presymptomatic-detectable phase is heavily dependent on the cell type involved and on location of the primary tumor. Sputum cytology can be positive for several years before symptoms occur in a progress from undetectable to unresectable within a few short months. Unfortunately, only about 5% of lung cancer diagnoses are made in this phase.

- Symptomatic phase: about 95% of all lung cancer diagnoses are made during the phase when the disease has become symptomatic. Carcinoma discovered at this point in its natural history is almost always well advanced. With very few but significant exceptions, symptomatic lung cancer carries poor prognosis. This is

because the vast majority of symptoms in this disease are caused by either locally unresectable or metastatic tumor.

One fourth of all people with lung cancer have on symptoms when the cancer is diagnosed. These cancers are usually identified incidentally when a chest x-ray is performed for another reason. The other three fourths of people develop some symptoms. The symptoms are due to direct effects of the primary tumor include cough, coughing up blood, chest pain, and shortness of breath; to effects of metastatic tumors in other parts of the body depend on the location and size; or to malignant disturbances of hormones, blood, or other systems by so called paraneoplastic syndromes (29).

2.1.4 Staging of Lung Cancer

Once the diagnosis of lung cancer has been established, an assessment of the extent of disease by surgical-pathologic staging provides a basis for determining the appropriate therapy. A TNM (tumor-node-metastasis) staging system for lung cancer has been in use for more than two decades, mainly for NSCLC (1). Where T describes the primary tumor, N the regional lymph nodes and M distant metastases, is widely used. The International Staging System (ISS) based on the TNM system is designed to be used by thoracic surgeons considering tumor resection and by radiotherapists and oncologists treating more extensive disease (3). And the ISS for lung cancer was introduced by Mountain in 1986 and revised in 1997. This staging system was subsequently adopted by the American Joint Committee Cancer. It is based on the principle of TNM classification and includes seven stage groupings (1).

Table 2-3. TNM descriptions of non-small cell lung carcinoma

Primary tumor (T)

T1 Tumor < 3 cm in diameter without invasion more proximal than lobar bronchus

T2 Tumor > 3 cm in diameter or tumor of any size with any of the following:
- Invades visceral pleura
- Atelectasis of less than entire lung
- Proximal extent at least 2 cm from carina

T3 Tumor of any size with any of the following:
- Invasion of chest wall
- Involvement of diaphragm, mediastinal pleura, or pericardium
- Atelectasis involving entire lung
- Proximal extent within 2 cm of the carina

T4 Tumor of any size with any of the following:
- Invasion of mediastinum
- Invasion of heart or great vessels
- Invasion of trachea or esophagus
- Invasion of vertebral body or carina
- Presence of malignant pleural effusion

Nodal involvement (N)

N0 No regional node involvement

N1 Metastasis to ipsilateral hilar nodes

N2 Metastasis to ipsilateral mediastinal or subcarinal nodes

N3 Metastasis to contralateral mediastinal or hilar nodes, or ipsilateral or contralateral supraclavicular nodes

Metastases (M)

M0 Distant metastases absent

M1 Distant metastases present

Table 2-4. Stage groupings of TNM subsets

Stage IA	T1, N0, M0
Stage IB	T2, N0, M0
Stage IIA	T1, N1, M0
Stage IIB	T2, N1, M0 or T3, N0, M0
Stage IIIA	T3, N1, M0
	T1-T3, N2, M0
Stage IIIB	Any T, N3, M0
	T4, any N, M0
Stage IV	Any T, any N, M1

Source: Based on Mountain CE. Revisions in the international system for staging lung cancer. Chest 1997; 111: 1710-1717, with permission.

The stage is a highly significant determinant of prognosis in lung cancer. The T stage is a highly significant determinant of survival in patients who undergo resection. However, the most important survival determinant is the presence or absence of distant metastases.

Stage I (T1 N0 or T2 N0) disease is local disease without regional node involvement. In stage II (T1 N1 or T2 N1) disease, regional lymph node involvement is limited to nodes within the substance of the lung itself (peribronchial, lobar, hilar nodes). The current standard of therapy for stages I and II NSCLC is surgical resection. Based on the 1997 modification of the ISS, T3 N0 M0 is characterized as stage IIB disease.

Stage III comprises regionally advanced disease and is subdivided into stage IIIA and stage IIIB. Stage IIIA disease is regionally advanced disease that is nonetheless technically respectable foe cure. It comprises T3 N1, T1 N2, and T2 N2 disease. Although stage IIIA NSCLC is technically respectable, the efficacy of surgery is more controversial.

Stage IIIB is regionally advanced and technically unresectable (at least with curative intent) disease (T4 or T3 disease). The treatment for both stage III categories is in evolution, but most investigative strategies have used multimodality approaches consisting of chemotherapy, radiation, and sometimes surgery.

Stage IV is distant metastatic disease (M1). Treatment generally consists of chemotherapy, palliative radiation, or sometimes no treatment at all (1).

In 1973, the British Medical Research Council reported that patients with SCLC had a poor prognosis and that SCLC was considered a distinct clinicopathologic entity. After that report, different treatment options were considered, and surgery alone was found to be an insufficient method of treatment. A better response was obtained with the addition of chemotherapy and irradiation. Because SCLC is considered a systemic disease, the clinical course, prognosis and treatment options are clearly different from those of other lung cancers. Clinically, lung cancers are often categorized into SCLCs and non-SCLCs (NSCLCs).

SCLC is categorized into 2 stages:

- Limited disease: The disease is termed limited when it is confined to an area of the chest that can be encompassed by a single irradiation port; supraclavicular nodes may be included.
- Extensive disease: The disease is called extensive when metastasis outside the thorax is present or when intrathoracic disease cannot be contained in a single irradiation port.

Patients with SCLC are rarely surgical candidates, and they are usually treated with irradiation and/or chemotherapy. On the contrary, patients with NSCLC are usually evaluated for possible surgical excision, and their disease is staged by using the common tumor, nodes, and metastases (TNM) staging system (30).

2.1.5 Methods of Diagnosis

Although many pulmonary diseases are suspected with pulmonary symptoms such as cough, dyspnoea, or chest pain, they may be incidentally detected on the chest radiograph of asymptomatic patients. It is important to look carefully for abnormal findings on the chest radiograph, with the knowledge of normal lung and mediastinal anatomy. Abnormal findings on the radiograph are classified into several categories, including pulmonary nodules and masses, focal and diffuse lung opacities, hilar abnormalities, and obstructive lung disease. Detailed morphological analysis of these lesions is difficult with chest radiographs alone (31). Therefore, doctors use a wide range of diagnostic procedures and test to diagnose lung cancer to make an accurate diagnosis and determine the extent or stage of the disease. For example (32,33):

- The history and physical examination may reveal the presence of symptoms or signs that are suspicious for lung cancer. In addition to asking about symptoms and risk factors for cancer development, doctors may detect signs of breathing difficulties, airway obstruction, or infections in the lungs. Cyanosis, a bluish color of the skin and the mucous membranes due to insufficient oxygen in the blood, suggests compromised function of the lung. Likewise, changes in the tissue of the nail beds, known as clubbing, may also indicate lung disease.
- The plain chest film is the most common first diagnostic step when requested radiological examination. Visualization of the lungs is excellent because of the inherent contrast of the tissues of the thorax. Lateral films should not be undertaken routinely. Comparison of the current film with old films is valuable and should always be undertaken if the old films are available. A current film is mandatory before proceeding to more complex investigations.
- Computed tomography (CT) scan is far superior for staging malignancy, detecting pulmonary metastases, and assessing chest wall and pleural lesions, the lung mass, the hilum and mediastinum. High-resolution CT scanning is to proven value in the diagnosis of diffuse lung disease, particularly in the early stages when the chest radiograph is normal, and for the follow-up.

- Magnetic resonance imaging (MRI) uses magnetism, radio waves, and a computer to produce images of body structures. The image and resolution produced by MRI is quite detailed and can detect tiny changes of structures within the body. MRI can be useful for detecting lung cancer that has spread to the spinal cord or brain.
- Radionuclide scanning use a small amount of radioactive substance is swallowed or injected into a vein. A machine records the level of radioactivity in certain organs to reveal abnormal areas and show whether cancer has spread to these organs.
- Sputum cytology is used to confirm diagnosis of malignant cells under a microscope by a pathologist, even when symptoms and x-ray studies are suspicious for lung cancer.
- Bronchoscopy is used under sedation, a fiberoptic, flexible, lighted tube is placed in the mouth and guided down the throat into the large tubes that carry air to the lungs (bronchi). This test can help find tumors in the center of lung and be used to take lung tissue samples or lung secretion samples.
- Biopsy of pulmonary lesions using a fine needle aspiration has a high diagnostic yield for malignancy, excluding lymphoma, with a low incidence of complications. A cutting needle is associated with a higher complication rate but is more helpful in the diagnosis of lymphoma and benign lung conditions.
- Mediastinoscopy under general anesthesia, a hollow lighted tube is guided through a small incision in the neck to reach behind the chest bone to take tissue samples from the lymph nodes along the windpipe (mediastinal lymph nodes) and the major bronchial tube areas.

2.1.6 Treatment of Lung Cancer

Treatment for lung cancer can involve surgical removal of tumor, chemotherapy, or radiation therapy, as well as combinations of these methods. The decision about which treatments will be appropriate for a given individual must take

into account the localization and extent of the tumor as well as the overall health status of the patient (34).

2.1.6.1 Surgery: Surgical removal of the tumor is generally performed for limited-stage (Stage I or sometimes Stage II) NSCLC and is the treatment of choice for cancer that has not spread beyond the lung. The surgical procedure chosen depends upon the size and location of the tumor. Sometimes lymph nodes in the region of the lungs are also removed. Surgery may not be possible if the cancer is too close to the trachea or if the person has other serious conditions (such as severe heart or lung disease) that would limit their ability to tolerate an operation. Surgery is less often performed with SCLC because these tumors are less likely to be localized to one area that can be removed.

2.1.6.2 Radiation: Radiation therapy may be employed as a treatment for both NSCLC and SCLC by uses high-energy x-rays or other types of radiation to kill dividing cancer cells. Radiation therapy may be given as curative therapy, palliative therapy or as adjuvant therapy to surgery or chemotherapy. It given if a person refuses surgery, if a tumor has spread to areas such as the lymph nodes or trachea making surgical removal impossible, or if a person has other conditions that make them too ill to undergo major surgery. It generally only shrinks a tumor or limits its growth when given as a sole therapy. Combining radiation therapy with chemotherapy can further increase the chances of survival when chemotherapy is administered. Radiation therapy does not carry the risks of major surgery, but it can have unpleasant side effects including tiredness and lack of energy. A reduced white cell count (rendering a person more susceptible to infection) and low blood platelet levels (making blood clotting more difficult) can also occur with radiation therapy. If the digestive organs are in the field exposed to radiation, patients may experience nausea, vomiting, or diarrhea.

2.1.6.3 Chemotherapy: Chemotherapy refers to the administration of drugs that stop the growth of cancer cells by killing them or preventing them from dividing. Chemotherapy may be given alone, as an adjuvant to surgical therapy, or in combination with radiotherapy. While a number of chemotherapeutic drugs have been developed, the platinum-based drugs have been the most effective in treatment

of lung cancers. Chemotherapy is the treatment of choice for most SCLC, since these tumors are generally widespread in the body when they are diagnosed. Chemotherapy alone is not particularly effective in treating NSCLC, but when NSCLC have metastasized; it can prolong survival in many cases. Unfortunately, the drugs used in chemotherapy also kill normally-dividing cells in the body, resulting in unpleasant side effects. Damage to blood cells can result in increased susceptibility to infections and difficulties with blood clotting (bleeding or bruising easily). Other side effects include fatigue, weight loss, hair loss, nausea, vomiting, diarrhea, and mouth sores. The side effects of chemotherapy vary according to the dosage and combination of drugs used and may also vary from individual to individual.

2.1.6.4 The others: For examples, brain prophylactic radiation, treatment of recurrence, experimental therapies.

2.2 Background of Chest X-Ray

Chest radiography is the most important imaging tests used to investigate respiratory disease (35). Usually, done for the evaluation of lungs, heart and chest wall. Traditionally, chest x-rays have been taken prior to employment, prior to surgery or during immigration. These “routine” chest x-rays are being reevaluated because of inadequate evidence for their usefulness, and many insurance companies no longer pay for these “routine” x-rays obtained in absence of specific signs, symptoms, or medical conditions (36).

Chest x-ray is a radiology test that involves exposing the chest briefly to radiation to produce an image of the chest and the internal organs of the chest. An x-ray film is positioned against the body opposite the camera, which sends out a very small dose of a radiation beam. As the radiation penetrates the body, it is absorbed in varying amounts by different body tissues. Due to the differences in their composition (and, therefore, varying degrees of penetration of the x-ray beam), the lungs, heart, aorta, and bones of the chest each can be distinctly visualized. The x-ray film records these differences to produce an image of body tissue structures and used

to define abnormalities of the lungs such as excessive fluid, pneumonia, bronchitis, asthma, cysts, and cancers. Heart abnormalities, including fluid around the heart (pericardial effusion), an enlarged heart, heart failure, or abnormal anatomy of the heart can be revealed on the films. Certain bony structures of the chest, and broken bones or abnormalities of the bones of the spine (vertebrae) in the chest can often be seen. A chest x-ray is a safe procedure which is commonly used both in annual physical exams and evaluations of patients before certain surgical operations (37).

2.2.1 Production of X-Rays

X-rays are a form of energy that has both electrical and magnetic properties, called electromagnetic waves that have high energy and short wavelength. The basic equipment required for the production of x-rays is an evacuated tube containing two electrodes connected to an external high voltage supply. One of the electrodes (cathode) produces free electrons when it is heated by an electric current. When a high voltage is applied across the two electrodes via a high tension transformer, the electrons are then attracted toward the anode at high speeds. X-rays are produced when the stream of electrons are rapidly decelerated as they strike the metal anode target. When electrons traveling at high speeds are made to penetrate the atoms of the target, the resultant transfer of energy from the decelerating electrons to the inner orbital electrons of the target atoms causes internal derangements culminating in the release of x-rays (38).

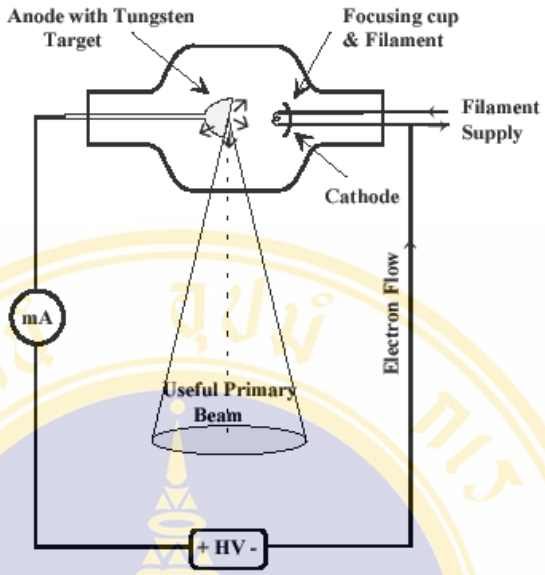


Figure 2-2. Simple x-ray tube and circuit (HV- high voltage supply) (39)

2.2.2 Formation of the X-ray Image

The formation of an x-ray image depends on the intensity of the x-ray beam and the physical properties of the structures through which the beam passes include x-ray tube kilovoltage, duration of exposure, atomic number of the anode target, and beam filtration. In the human body, physical properties contributing to the appearance of the x-ray image include the thickness, density, and atomic number of various component structures, due to differential absorption or attenuation of the transmitted x-rays. The four basic densities are recognized: gas, fat, soft tissue and calcification/bone. Which information in the body is derived from the varying pattern of the transmitted x-ray is known as the primary x-ray image. The primary image cannot be viewed by the human eye and has to be converted into a visual image. Devices that are used to convert the x-ray image to a light image include x-ray film or radiographs, fluorescent screens, and image intensifier-television systems (38).

Table 2-5. Show effective atomic number and specific gravity of tissue/object (40)

Tissue/Object	Effective Atomic Number	Specific Gravity
Gas	1-2	0.001
Fat	6-7	0.9
Soft Tissue/Fluid	7-8	1
Bone	14	1.8
Metal (lead)	82	11.3

2.2.3 Visualization of the X-ray Image

The major recording medium used in radiology is x-ray film although the situation is changing with the introduction of new technologies in recent years (41). Unexposed film consists of a transparent plastic base coated on both sides with emulsion. The emulsion contains silver bromide crystals in gelatin. The diameter of the crystals varies from 0.1 to 1 micrometer, according to the required film speed. Visibility of normal structures and disease processes depends on this differential absorption and the radiographical contrast produced (38,42).

Figure 2-3. A cross-section through a double emulsion film (41)

To increase the sensitivity of radiographic film is usually used in combination with a set of fluorescent screens located within a film cassette, known as intensifying screens. Film by itself can be used to detect x-rays, but it is relatively insensitive and therefore a lot of x-ray energy is required to produce a properly exposed x-ray film. To reduce the radiation dose to the patient, x-ray screens are used in all modern medical diagnostic radiography. Screens are made of a scintillating material, which is also called a phosphor. When x-rays interact in the phosphor, visible or ultraviolet (UV) light is emitted. In this sense, the function of the intensifying screen is to convert the x-rays image into a light image, and giving rise to much greater film blackening. Only about 5% of the blackening film is a result of direct x-ray interaction with the film emulsion. An intensifying screen has four layers: base, reflecting layer (titanium oxide), phosphor layer, and a protective coat (38,42).

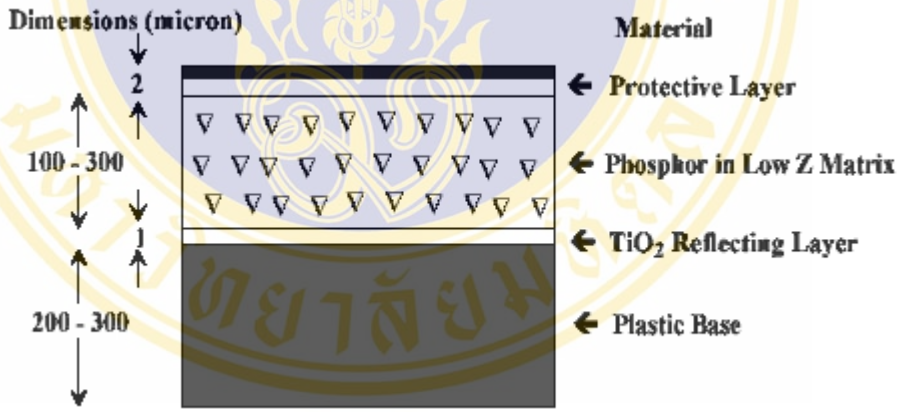


Figure 2-4. A cross-sectional image of an intensifying screen (1 micron = 1 mm) (41)

2.2.4 Technical Factors (43)

2.2.4.1 Kilovoltage (kV): kV should be high enough to result in sufficient contrast to demonstrate the many shades of gray needed to visualize the finer lung markings. Thus in general, chest radiography uses low contrast, described as a long-scale contrast, with more shades of gray. But lower kV, yielding high contrast, will

not provide sufficient penetration to visualize well the fine lung markings in the areas behind the heart and the lung bases. Too high contrast is evident when the heart and mediastinal structures appear underexposed, even though the lung fields are sufficiently penetrated. And a general rule, in chest radiography, the use of high kV (above 100) requires the use of grid. Exceptions to this are some mobile chests taken with equipment that is limited to 80 to 90 kV, for which IRs without grids may be used, but this is not recommended.

2.2.4.2 Exposure Time and Milliamperage (mAs-milliampere seconds): Generally, chest radiography requires the use of high mA and short exposure times to minimize the chance of motion and resultant loss of sharpness. Which, sufficient mAs should be used to provide for optimum density of lungs and mediastinal structures.

2.2.4.3 Placement of Image Markers: Throughout the positioning sections of this text, the correct or best placement of patient ID information and image markers is indicated. The top portion of each positioning page includes a drawing that demonstrates the correct image receptor size and placement (lengthwise or crosswise) and indicates the best location for patient ID blocker and the location and type of image marker used for that specific projection or position.

2.2.4.4 PA 72-inch (180 cm) SID (Source Image Receptor Distance): Chest radiographs taken AP rather than PA at 72 inches (180 cm) will cause increased magnification of the heart shadow, which complicates the diagnosis if possible cardiac enlargement. The reason for this is the anterior location of the heart within the mediastinum, placing it closer to the IR on the PA, thus resulting in less magnification. A longer SID, such as 72 inches, or 180 cm, magnifies less because the x-ray beam has less divergence.

Figure 2-5. Posteor-anterior projection of chest x-ray positioning

2.2.5 Radiographic Views

The standard radiograph is the erect postero-anterior (PA) projection. Accompanying lateral radiographs are not required in routine cases or when chest radiography is used to screen a population. They are, however, desirable as part of the initial radiographic assessment of patients with chest symptoms, though they can often be safely withheld in the follow up of patients with known disease.

Lordotic films are an excellent way of demonstrating a questionable apical opacity otherwise partly obscured by the clavicle. Oblique projections are invaluable for demonstrating pleural plaques and other pleural and chest wall lesions by providing a tangential view of them. An anteroposterior view is sometimes very helpful in deciding whether a small questionable pulmonary opacity on the PA view is genuine, by altering its relationship to the overlying rib. Lateral decubitus views may demonstrate pleural fluid. The differentiation between a subpulmonary effusion and a high diaphragm is readily made by this means. Lateral decubitus views with the affected side dependent provide a sensitive means of detecting small quantities of

pleural fluid (50-100ml). Films exposed in expiration are invaluable in the investigation of air trapping, particularly in pediatric practice for any patient suspected of having inhaled a foreign body. An expiratory film may also enhance the demonstration of a small pneumothorax (35).

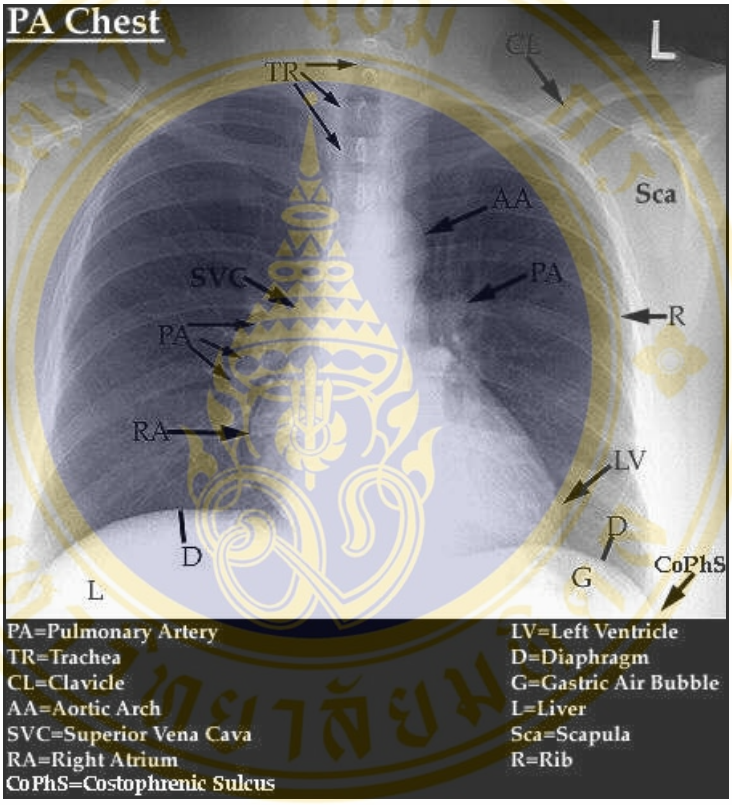


Figure 2-6. Normal PA chest radiography

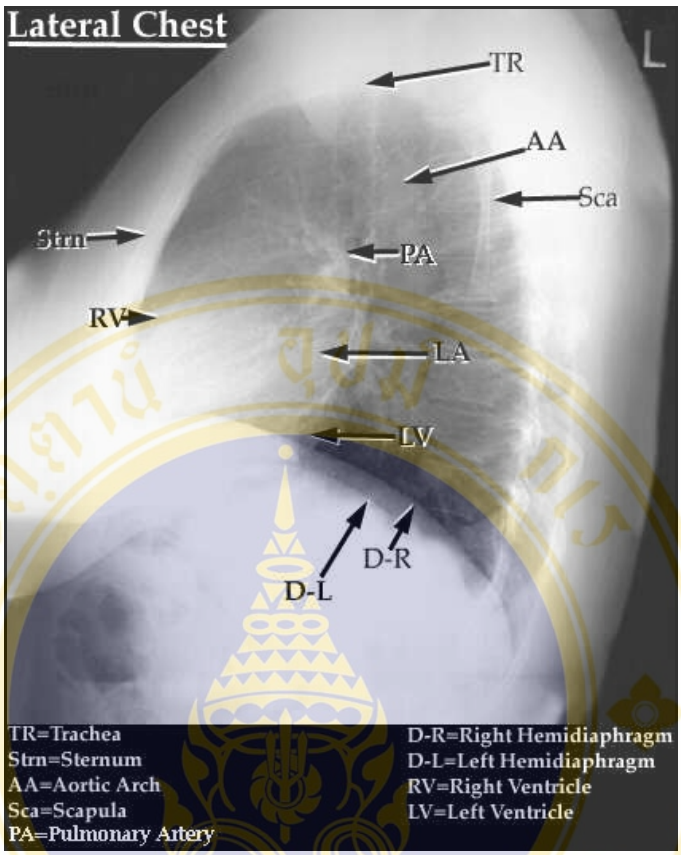


Figure 2-7. Normal lateral chest radiography

2.2.6 Interpreting the chest radiography

Radiographic interpretation is based on the visualization and analysis of opacities on a radiograph. The radiopacity of various objects and tissues results in radiographs showing different radiopacities, and hence they can be differentiated. Radiopaque tissues/objects result in a whiter image; less radiopaque objects result in a blacker image (40).

The interpretation of the chest radiograph is the most common activity of the majority of radiologists and requires more time and consideration than is generally given to it. Radiologists must always remember that they are ultimately to provide

added value for the clinical management of patients (44). The outlines a systematic approach to the final result or the radiology report as outlined below.

2.2.6.1 Identification of the radiograph: It is essential for the radiologist to follow a protocol of identification during the reporting process.

- Name and patient identification number: It is important for the interpreting radiologist to verify the patient's name and identification number on the chest radiograph.
- Name of referring physician: It is an integral part of the radiological report as is the address on any other form of written communication.
- Type of examination: This should be recorded projection and position of patients for the benefit of the interpretation.
- Date and time of examination: Patient's radiographs may be obtained several times a day and information is therefore of vital importance for the patient's management.

2.2.6.2 History and clinical questions: There should always be sufficient clinical indication to warrant the performance of a radiographic study. It is important that these indications be communicated to the radiologist who is responsible for interpretation. An accurate history will undoubtedly result in a better informed interpretation and increased clinical relevance of the radiological report.

- Reporting the radiological findings: The report should reflect the findings of a careful survey of the images and include precise anatomical descriptions where appropriate. The interpretation of the chest radiograph must occur under ideal external viewing conditions. A radiologist will be able to perform best under quiet conditions with low ambient lightening.
- Radiological signs and terminology specific to chest radiology: There are four basic signs available in the radiological armamentarium for the interpretation of chest radiographs; the displacement of normal structures; the enlargement of structures to greater than normal; the presence of densities in areas where none normally exist; the obliteration of normal structures or borders.

- Alternative forms of communication: Direct communication should be employed if there is a significant discrepancy between a preliminary communication and the final written report. And informal consultation is very useful in the clinical setting where decisions need to be made promptly.

2.2.7 **Radiographic Features** (10)

The initial diagnosis of carcinoma of lung is often suspected from the findings on plain chest radiographs. The radiological features are discussed under three headings: peripheral tumor, central tumor, spread of tumor.

2.2.7.1 The peripheral tumor: Approximately 40% of bronchial carcinomas arise beyond the larger segmental bronchi, and in 30% a peripheral mass is the sole radiographic finding. The great majority of peripheral lung cancers are approximately spherical or oval in shape. Lobulation, a sign that indicates uneven growth rates in different parts of the tumor, is common. Occasionally, a dumb-bell shape is encountered or two nodules are seen next to one another.

- Corona radiata is used to describe numerous fine strands radiating into the lung from a central mass, sometimes with transradiant lung parenchyma between these strands. While not specific, this sign is highly suggestive of bronchial carcinoma. Absolutely spherical, sharply-defined, smooth-edged nodules due to carcinoma of the lung are rare. A peripheral line shadow or ‘tail’ may be seen between a peripherally located mass lesion and the pleural, a phenomenon which occurs in both benign and malignant lesions. When associated with carcinoma of the lung, the ‘tail’ probably represents either plate-like atelectasis secondary to bronchial obstruction beyond the mass or septal oedema due to lymphatic obstruction.
- Cavitation may be identified in tumor of any size and is best demonstrated by CT. Squamous cell carcinoma is much the most likely cell type to show cavitation. The walls of the cavity are of irregular thickness and may contain tumor nodules, but sometimes the wall has smooth inner and outer margins.

- Air bronchograms may on occasions be seen within lung cancers, notably with bronchiolo-alveolar carcinoma and Adenocarcinoma, particularly when high-resolution CT is used.

- Calcification within lung cancers is very rarely demonstrable on conventional radiography, but it is becoming increasingly apparent that CT may demonstrate such calcification. Recent studies have shown recognizable calcification within 6-7% of bronchogenic carcinomas. Some such foci of calcification represent preexisting calcified granulomatous disease engulfed by the tumor, but amorphous or cloud-like punctuate calcification, entirely in keeping with tumor calcification, is now well recognized. In the series reported

- Dilated mucus-filled bronchi are seen distal to a carcinoma obstructing a segment or subsegmental bronchus. The lung beyond the dilated bronchi may be aerated by collateral air drift, in which case the mucocele is seen as a peripheral tubular density which may branch.

- The rate of growth of a suspected lung cancer can be very helpful in marking a diagnosis. It has been calculated that peripheral primary carcinomas of the lung double their volume in between 30 and 490 days (median 120 days, with only the occasional case showing a volume doubling time outside this range. Slower or farter rates of growth than these therefore point to an alternative diagnosis.

2.2.7.2 The central tumor: The cardinal imaging signs of a central tumor are collapse/consolidation of the lung beyond the tumor and the presence of hilar enlargement, signs which may be seen in isolation or in conjunction with one another.

- Collapse/consolidation: Obstruction of a major bronchus often leads to a combination of atelectasis and retention of secretions with consequent pulmonary opacity, but collateral air drift may partially or completely prevent these postobstructive changes. Secondary infection may occur beyond the obstruction.

- Hilar enlargement: is a common presenting feature in patients with bronchial carcinoma. In one large series, 38% of patients had a hilar or perihilar mass, and in 12% a central mass was the only radiographic abnormality. In general, the more lobular the shape, the more likely that metastatic lymphadenopathy is

present. A mass superimposed on the hilum may lead to increased density of the hilum owing to summation of the opacity of the mass and that of the normal hilar shadows. This sign may be the only indication of lung cancer on a frontal chest film; when suspected, it is essential to inspect a lateral film with care.

2.2.7.3 Spread of tumor: The International Staging System for Lung Cancer uses the TNM system to describe the findings and the stage is derived from the TNM description.

2.2.8 Radiation Protection (43)

Patients should be protected from unnecessary radiation for all diagnostic radiographic examinations, especially for chest radiographs because these are the most common of all radiographic examinations.

- Repeat Exposures: Chest radiographic exams are often considered the simplest of all radiographic procedures, which the highest repeats in many radiology departments. Therefore minimize unnecessary radiation exposure from repeat exposures by taking extra care in positioning, central ray (CR) centering, and selecting correct exposure factor if automatic exposure control (AEC) systems are not used. Reduce patient dose as much as possible through the use of correct radiation protection practices by close collimation and gonadal shielding.
- Collimation: Careful collimation is important. Restricting the primary x-ray beam by collimation not only reduces patient dose by reducing the volume of tissue irradiation but also improves image quality by reducing scatter radiation.
- Gonadal Shielding: A leaded gonadal shield should be use for the abdominal area below the lungs. This is especially important for children, pregnant women, and all those of childbearing age. A minimal rule is that gonadal shielding should be used on all patients of reproductive age. Many departments, however, have a general policy of gonadal shielding for all patients in chest radiography.

- Back Scatter Protection: To protect the gonads from scatter and secondary radiation from the cassette or IR holder device and the wall behind it, some references suggest a freestanding shield or a wraparound shield also be placed over the gonads between the patient and the IR.

2.3 Background of Computed Radiography

Conventional radiographic imaging system has provided increasing better diagnostic images for many years. It is made like a shadowgraph: using x-ray beam that forms an image pattern after transmission through the patient. The image receptor, a screen-film combination, is a device that records this transmitted image directly, but it has limitations. It requires processing time that can delay the completion of the examination. When the examination is complete, the images are in the form of hardcopy film that must be cataloged and stored for future review. Another and perhaps more severe limitation is the noise inherent in these images. Radiography use area beams (that is, large rectangular beams of x-rays). The Compton-scattered portion of the remnant x-ray beam increases with increasing field size, which increases the noise of the image and severely degrades contrast resolution.

These limitations can be overcome somewhat by incorporating computer technology into diagnostic x-ray imaging. Computer technology is based on transforming the conventional analog images into digital form, processing the digital data, and displaying the images so that they look like conventional images. Such data conversion and manipulation would be impossible if it were not for advanced computer technology (46).

2.3.1 Principles of computed radiography

Since the days of Wilhelm Conrad Roentgen, radiography has been continuously improved and diversified. Throughout the 1990s and into the new

century, the fluorescent x-ray film-screen combination remains the most widely used radiographic method. However, conventional film-screen radiography limits image manipulation to “hot-lighting” or duplication. Modalities such as computed tomography (CT), ultrasonography, and magnetic resonance imaging (MRI), are digital; they provide cross-sectional images and allow the image to be manipulated. Conventional projection radiography, which accounts for nearly 70% of a radiology department’s volume, remained an analog modality until the past decade.

Analog information is represented in a continuous fashion, whereas digital information represented in discrete units. The advantage of digital information is that the location and nature of each digital level are known and can be adjusted accordingly. In all digital imaging systems, information is acquired by a process called analog-to-digital conversion. After the x-ray beam has passed though the patient, it is still an analog signal. This signal varies smoothly from zero (all the radiation has been absorbed by some part of the patient) to maximum intensity. In a computed radiographic system, the analog-to-digital conversion occurs when the exposed image plate is scanned with a laser. At this point the image reader converts the emitted light pattern to digital information.

The major obstacle to developmental changes in the field of conventional projection radiography has been that one specific medium x-ray film serves three distinct functions in the radiographic process: 1) x-ray film is the “sensor” to acquire the diagnostic information; 2) it is used to display the information; and 3) it is used to store the information (47).

2.3.2 Operational Components

At the 1981 International Congress of Radiology meeting Brussels, Fuji Photo Film Co., Ltd. introduced the concept of computed radiography (CR) employing photostimulable phosphor plate technology. In 1983 the computed radiography was first used clinically in Japan, and by 2003 more than 25,000 systems will be in clinical

use worldwide. The key to development is separation of the functions of sensing, displaying, and storing information however central control of the final image is maintained through computer technology.

2.3.2.1 Image Acquisition Functions

The image acquisition or "sensor" function is served by the photostimulable phosphor imaging plate receives the portion of the x-ray beam that has passed through the patient. This plate looks much like an intensifying screen and is placed in a cassette similar an x-ray film. It contains a layer of europium-doped barium fluorohalide ($BaFx:EU^{2+}$) crystals, which are energized when exposed to x-rays (46). The cassette consists of a frame of either lightweight aluminum or rigid steel; the back is lined with a thin layer of lead to absorb backscatter radiation. And the image reader is another important component of the image acquisition control in computed radiography. It converts the continuous analog information (latent image) on the imaging plate to digital format.

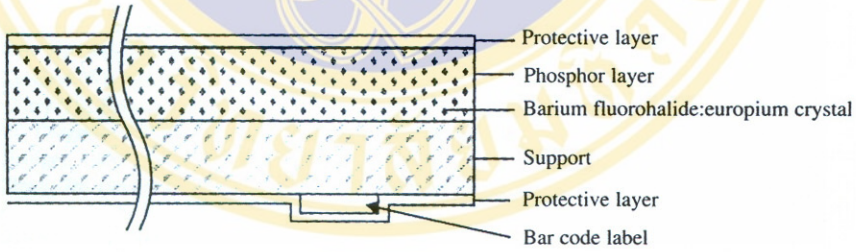


Figure 2-8. Diagram shows the components of digital radiography cassette containing a photostimulable phosphor (38)

Figure 2-9. Example of computed radiography readers

2.3.2.2 Display functions

The display of computed radiography data is basically the results of spatial frequency response and gradation processing. Spatial frequency response controls the contrast of the boundaries between two structures of different densities. Gradation processing controls the range of densities used to display structures on the image. The two different characteristics contrast and density are optimized by the digital image processor for the specific anatomic region being studied. To produce an image for viewing, the computed radiography computer system constructs (format) the image from the raw data set as read from the photostimulable plate. The final image can be displayed on a monitor or produced as a hard-copy image on film or another medium. If the image is displayed on a monitor, the user to examine all features of the image to best advantage can adjust the image characteristics visually. Various workstations with high resolution cathode ray tube (CRT) monitors can be directly interfaced to the computed radiography unit to assist in the display process.

Figure 2-10. Example of computed radiography laser printer

2.3.2.3 Storage Functions

Computed radiography decreases image archive storage space requirements by reducing the size of films stored or by converting bulky film storage to electronic storage. Benefits include tremendous space savings, reduction in image retrieval time, and decreased film loss. The optical electronic storage, digital data do not deteriorate when such data are retrieved at a later date for image review and/or for copying on film. The design of electronic image archive devices must be flexibility and should be expandable. The amount of storage on the electronic image archive should be adequate for the amount of data to be stored. The storage capacity of an electronic image archive depends on several variables, including the size of the basic storage unit, the number of units on-line, and the ratio of data compression that is used. Nowadays, magnetic tape, DVD, and optical disk are currently the storage media of choice for computed radiographic images (47).

2.3.3 Clinical Application

The sequence of events in computed radiographic imaging in clinical environment is shown in Figure 2-10. The radiographer exposes the imaging plate in the same manner as when a conventional film-screen cassette is used. The exposure may be made using a tabletop, mobile, or table/wall Bucky technique. The exposed imaging plate cassette is taken to the control terminal of the computed radiography reader unit. There, the patient demographic and examination information is entered, and the cassette is scanned with the bar code reader. In this way, each specific exposed imaging plate is linked to the correct patient and image data. This step replaces the typical ID camera step in film radiography. The internal functions of a computed radiography system are illustrated in Figure 2-11 (47).

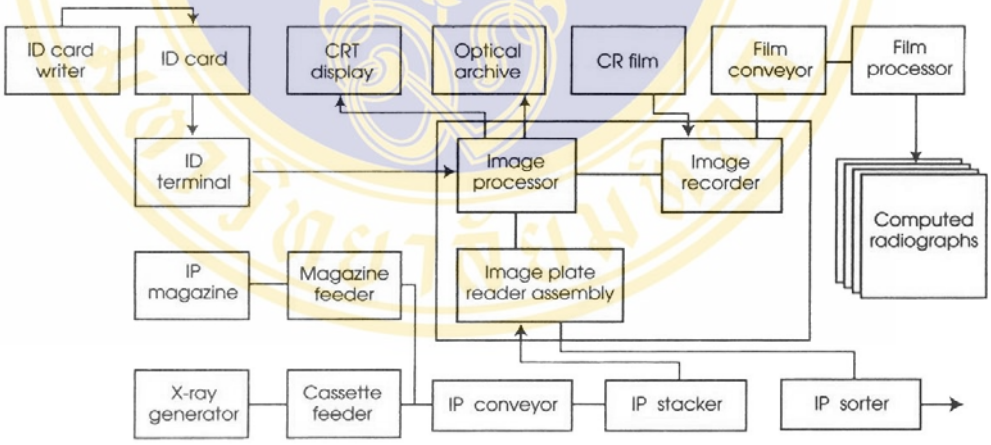


Figure 2-11. Computed radiography sequence flowchart

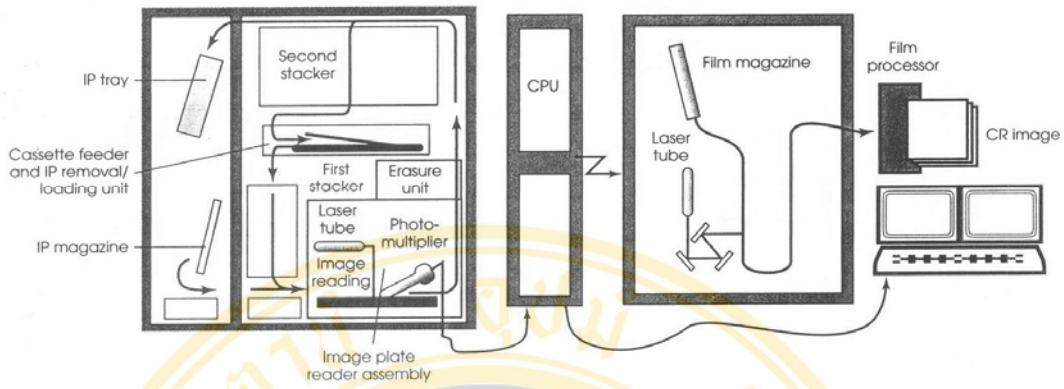


Figure 2-12. Generalized internal functions and components of a computed radiography system

The imaging plate is a completely analog device, but it is read out by analog and digital electronic techniques, as shown in Figure 2-12. The imaging plate is translated along the readout stage in the vertical direction (the y direction), and a scanning laser beam interrogates the plate horizontally (the x direction). The laser is scanned with the use of a rotating multifaceted mirror. As the red laser light (approximately 700 nm) strikes the imaging phosphor at a location (x,y), the trapped energy from the x-ray exposure at that location is released from the imaging plate. A fraction of the emitted light travels the fiberoptic light guide and reaches a photomultiplier tube (PMT). The electronic signal that is produced by the PMT is digitized and stored in memory. Therefore, for every spatial location (x,y), a corresponding gray scale value is determined, and this is how the digital image I (x,y) is produced in a CR reader (48).

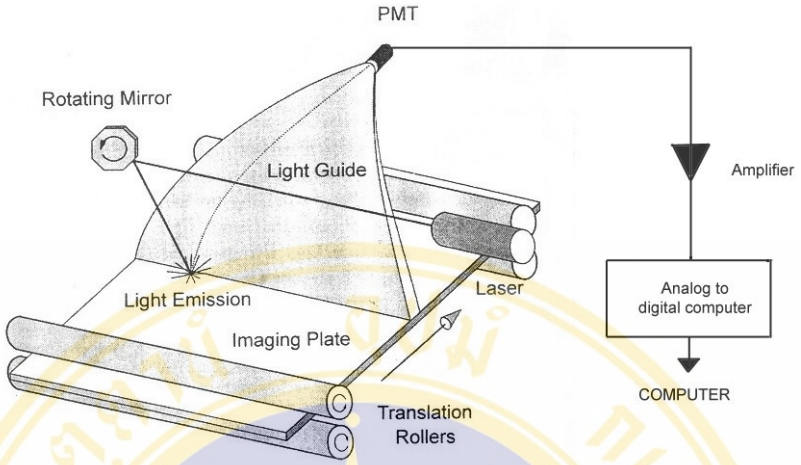


Figure 2-13. Reading of computed radiographic imaging plate and conversion to digital information

The digital image that is generated by the CR reader is stored temporarily on a local hard disk. Many CR systems are joined directly to laser printers that make film hard copies of the digital images. CR systems often serve as entry points into a picture archive and communication system (PACS), and in such cases the digital radiographic image is sent to the PACS system for interpretation by the radiologist and long-term archive. PACS will allow radiology department to finally move to the filmless environment and reduced the cost of purchasing radiographic film but high initial cost.

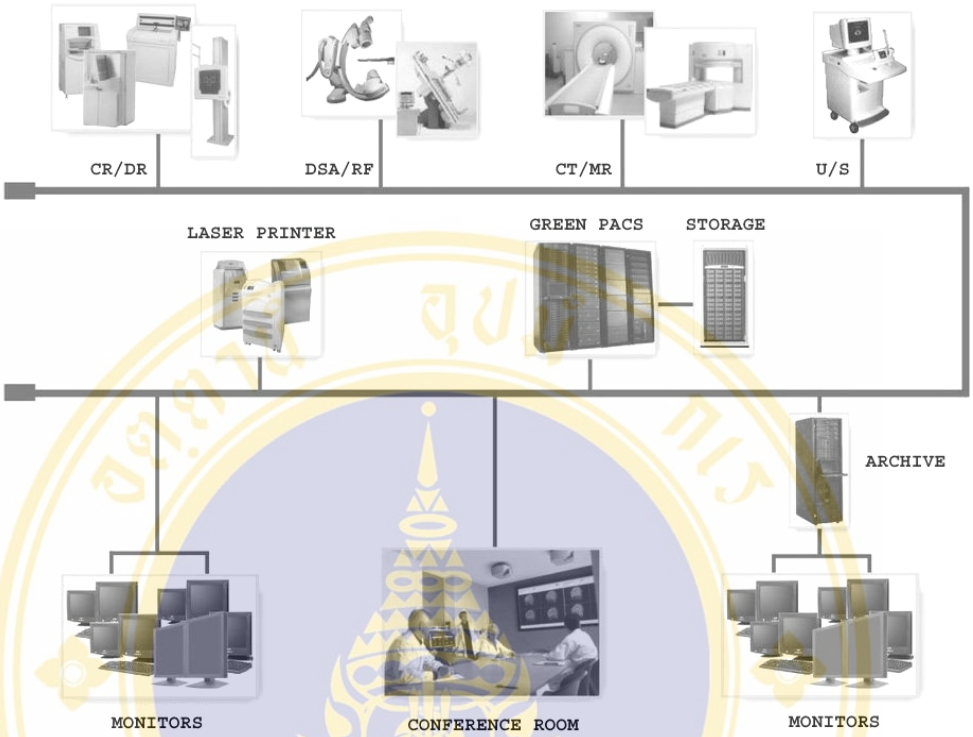


Figure 2-14. PACS network demonstrating the different imaging modalities connected throughout a medical system

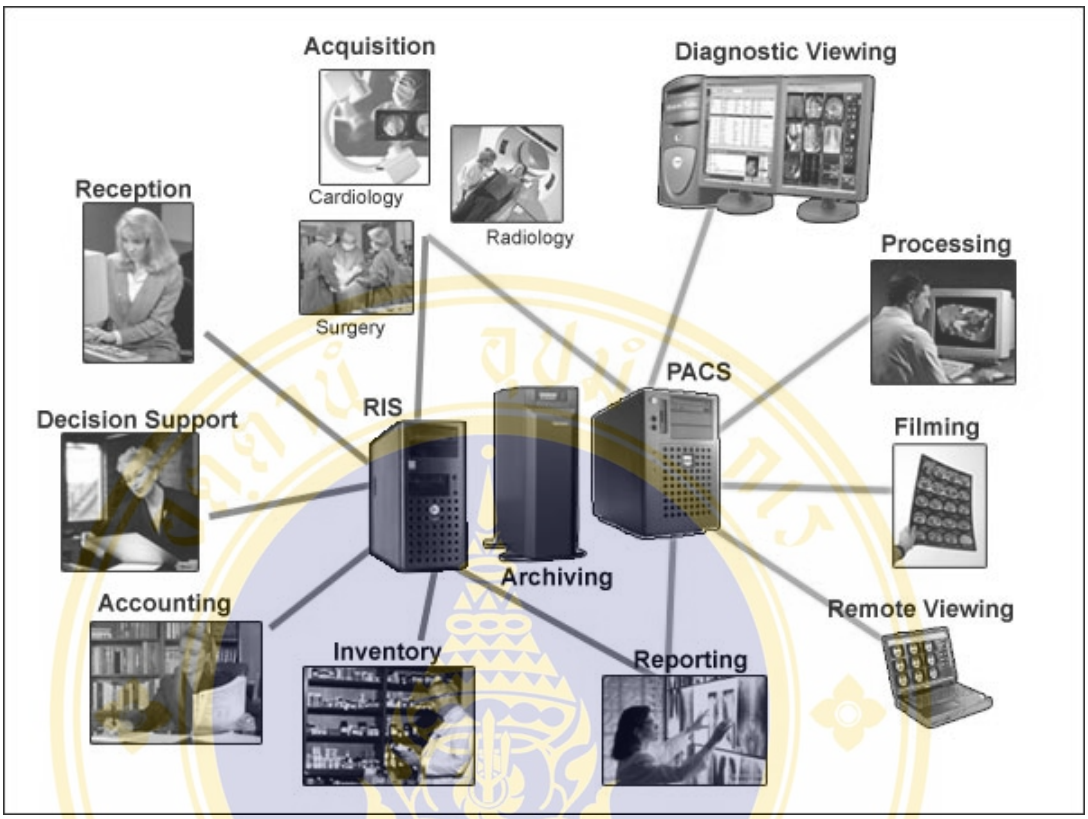


Figure 2-15. PACS in hospital network system

Table 2-6. Analogue versus digital chest radiography (35)

	Advantage	Disadvantage
Analogue technique		
Conventional film/screen combination	Inexpensive Readily available	Optimal exposure for all regions impossible Suboptimal portable radiographs
Asymmetrical film/screen combination	Wider latitude than conventional film/screen combination	Relatively expensive
Scanning equalization radiography	Overcomes unfavorable characteristics of conventional film	Expensive and unreliable Movement and other image artifacts
Digital techniques		
Phosphor plate computed radiography	Wide latitude Post-processing of image Advantages of digital image storage and transmission	Spatial resolution inferior to conventional film radiography Reduce detector efficiency at high kV Relatively high sensitivity to scattered radiation Maintenance costs
Selenium detector radiography	(As for phosphor plate CR, and:) Excellent quantum efficiency Considerable radiation dose reduction possible	High cost Memory image artifact
Large area, thin-film transistor detector radiography	Rapid image acquisition Excellent image quality (no intermediate scanning stage)	Under development

CHAPTER III

MATERIALS AND METHODS

3.1 Materials

This retrospective study was performed to investigate the diagnostic investigation of patients with primary lung cancer diseases by the chest radiographic imaging. The patients in this study were identified through the databases maintained by the Department of Pathology of Siriraj Hospital in between 1998-2004. Patient selection was restricted to case with histologically proven non-small cell lung cancer (NSCLC), which includes the histological subform squamous cell carcinoma, adenocarcinoma, and large cell carcinoma, and small cell lung cancer (SCLC). There were 860 evaluable cases of patient with primary lung cancer in these 4 cell types.

Those patients with pathological proven primary lung cancer in 4 cell types were reviewed to look up chest radiographic imaging from Division of Diagnostic imaging, the Department of Radiology, Siriraj Hospital. Which, the films were collected in analogue (conventional radiography) and digital form (computed radiography). There were 138 evaluable cases of patients with primary lung cancer in these 4 cell types during the study period. Ninety patients (65.22%) were men and forty-eight patients (34.78%) were women. The age of these 138 patients ranged from 19-84 years with a mean age of 62 years (standard deviation = 12 years). The histology was squamous cell carcinoma 35 patients (25.36%), adenocarcinoma 86 patients (62.32%), large cell carcinoma 3 patients (2.17%), and small cell carcinoma 14 patients (10.14%). The characteristics of the patients are listed in Table 3-1 and Chart 3-1.

Table 3-1. Histological frequency

Histological	Amount of patients
Squamous cell carcinoma	35 (25.36%)
Adenocarcinoma	86 (62.32%)
Large cell carcinoma	3 (2.17%)
Small cell carcinoma	14 (10.14%)
Total	138

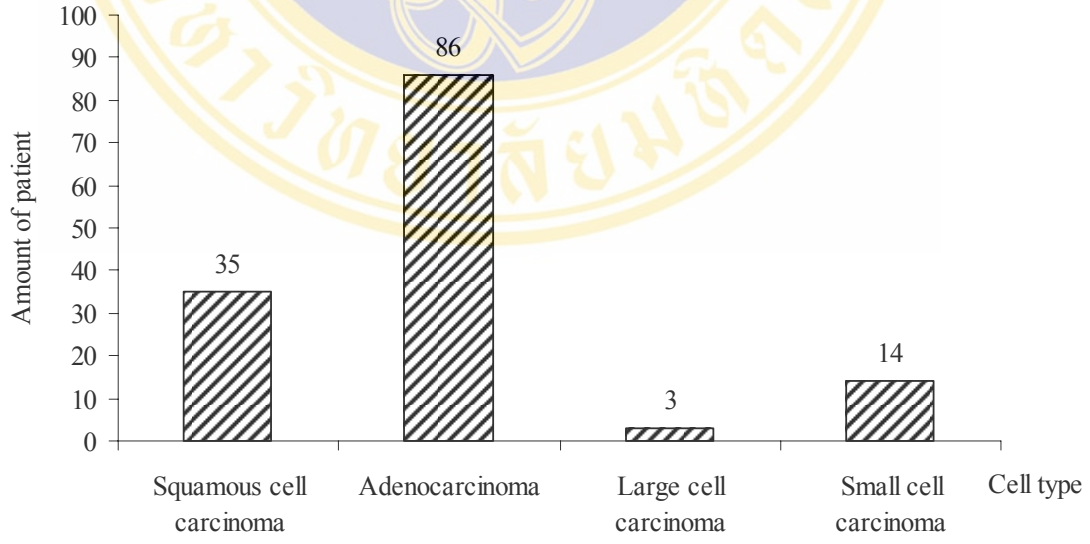


Chart 3-1. Histological frequency

3.2 Methods

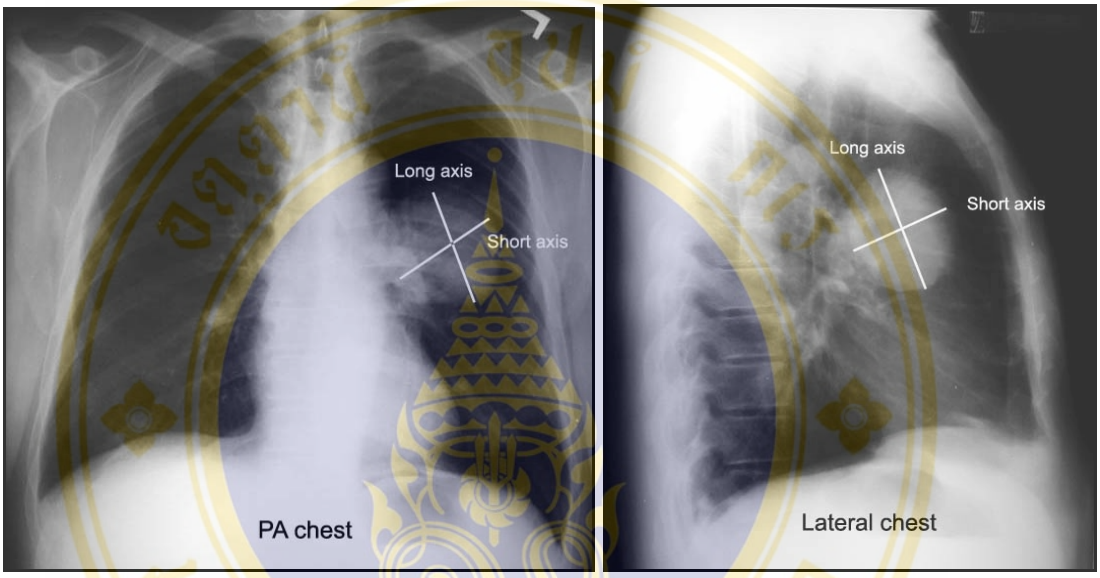
From looked up chest radiographic imaging by databases maintained of Pathology Department, there were 138 cases with chest radiographic imaging during the study period. Each case was arranged film by date. There were two radiologists reviewed film chest radiograph by independently and unaware of the pathologic results. The individual radiologists recorded a characteristic of tumor and chest radiographic findings in location, size, density, lymph node enlargement, destruction, and others follow the criteria. Including used criteria of Table 3-2 to distinguishing in any cell types. After that, the discrepancies of individual interpretation were resolved by consensus.

Table 3-2. Radiographic findings by tumor histologic type (45,49)

Radiologic Symptom	Squamous Cell Carcinoma	Adenocarci-noma	Large Cell Carcinoma	Small Cell Carcinoma
Hilar or perihilar tumor	40%	18%	32%	78%
Peripheral tumor	27%	71%	59%	29%
< 4.0 cm	9%	45%	18%	21%
> 4.0 cm	18%	26%	41%	8%
Apical tumor	3%	1%	4%	2%
Obstruction, pneumonitis, collapse, or constriction	53%	25%	33%	38%
Atelectasis	36%	10%	13%	17%
Mediastinal lymph nodes	1%	2%	10%	13%

3.3 Criteria for Recorded

3.3.1 Size of tumor: the diameter was measured by short axis and long axis diameters.



(a) (b)

Figure 3-1. Measurement of tumor size from chest x-rays (50)
(a) PA chest x-ray film
(b) Lateral chest x-ray film

3.3.2 Location of tumor: described by lobe of lung which the right lung has three lobes and the left lung has two lobe. There were presented in upper, middle, and lower lobe. Another location was presented in central and peripheral region. The tumor located in medial lung or close to the hilum was considered central region. But located beyond the hilum was peripheral region.

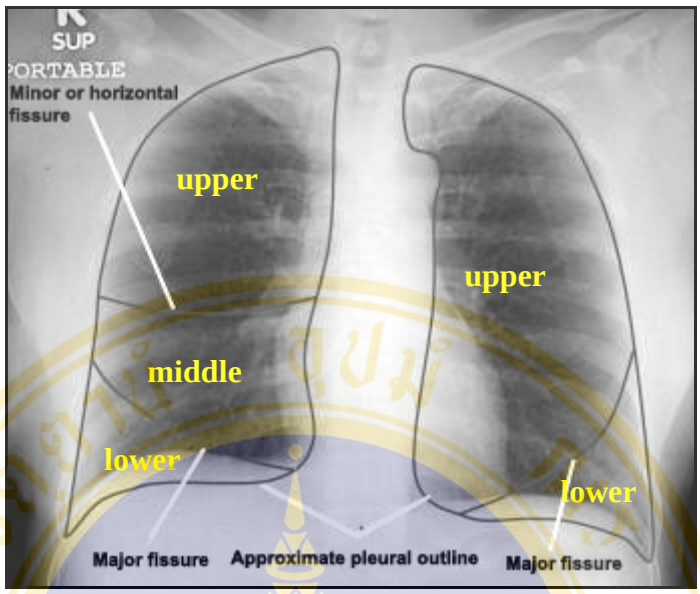
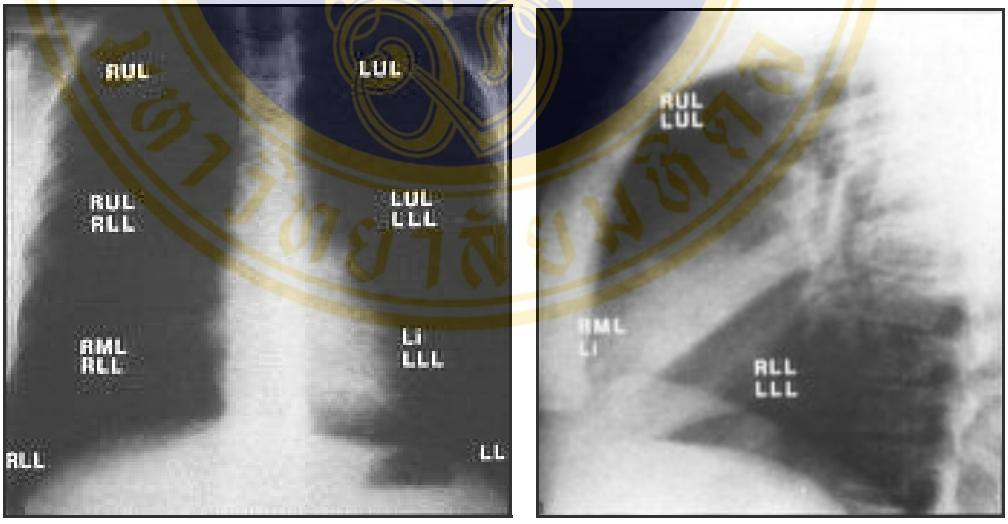


Figure 3-2. Characteristic divide of lung by lobe (upper, middle, lower lobe) (50)

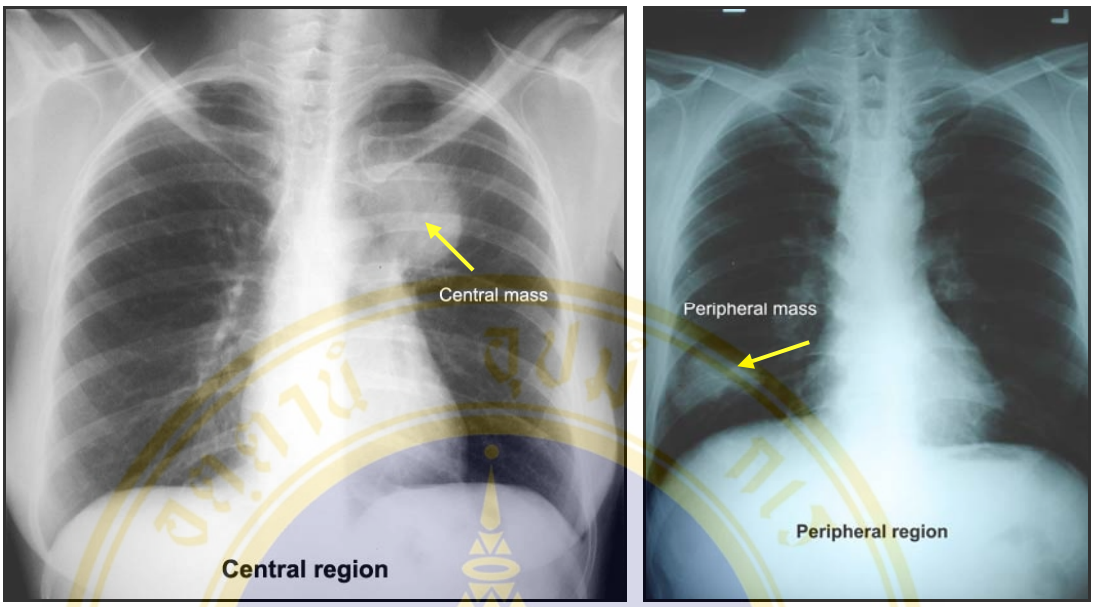


(a) (b)

Figure 3-3. Abbreviation of each lobe location (50)

(a) PA chest x-ray film

(b) Lateral chest x-ray film



(a) (b)

Figure 3-4. Location of lung by region (central & peripheral region) (50)
(a) Tumor was presented in central region
(b) Tumor was presented in peripheral region

3.3.3 Edges: were divided as regular and irregular. Which regular defined that, tumor was sharp and smooth margins, if not were irregular.

3.3.4 Density: was tumor attenuation which presented in homogeneous or inhomogeneous density.

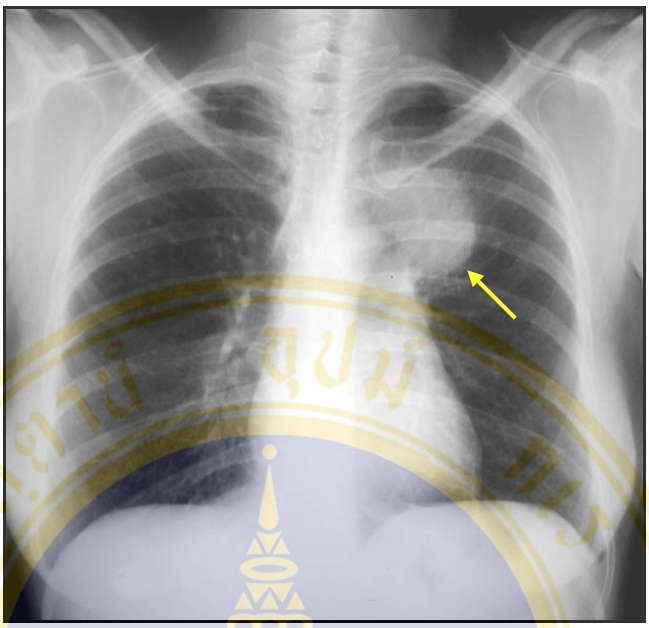


Figure 3-5. Tumor with regular edges (sharp margin) & round homogeneous density (50)

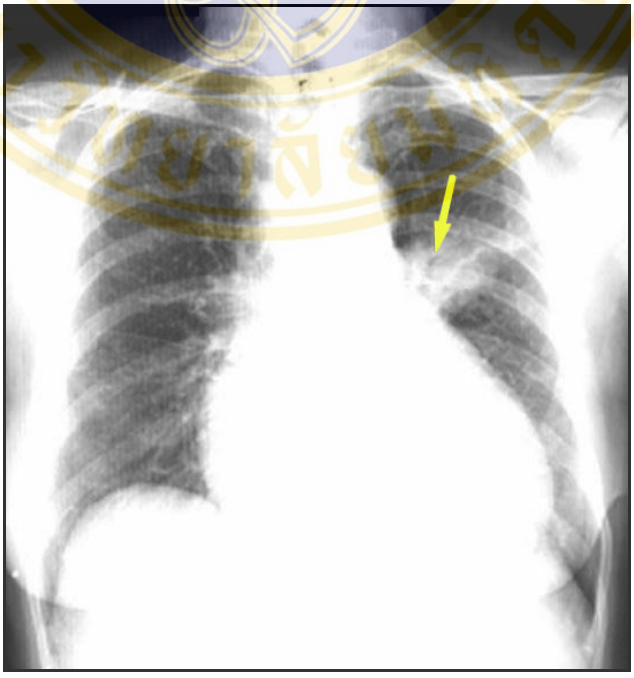


Figure3-6. Tumor with irregular edges (irregular margin) & round inhomogeneous density (50)

3.3.5 Calcification: was presented or absented.

3.3.6 Cavitation: was presented or absented.

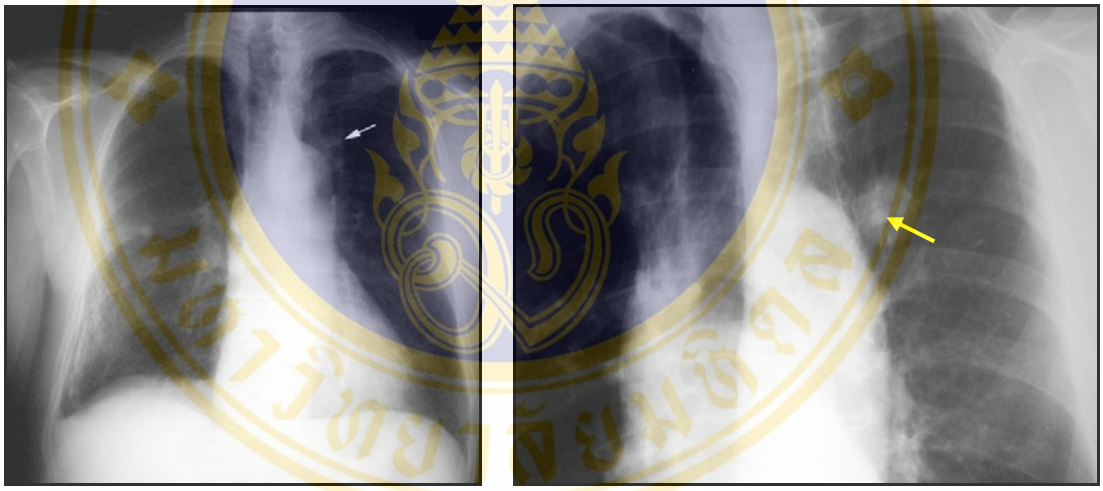
3.3.7 Air fluid level: was presented or absented.

3.3.8 Lymph node enlargement: was presented or absented.

3.3.9 Pleural effusion: was presented or absented.

3.3.10 Infiltration: was presented or absented.

3.3.11 Other radiographic finding: was presented or absented. There were bone and chest wall destruction, atelectasis, obstruction, tuberculosis, pneumonia, lung collapse, and other radiographic sign were presented.



(a) (b)

Figure3-7. Calcification was presented in tumor (50)

(a) Tumor with central calcification

(b) Zoom in tumor with central calcification

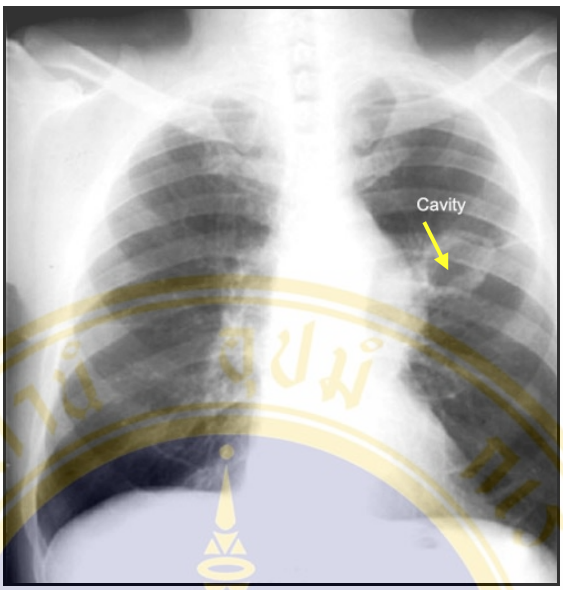
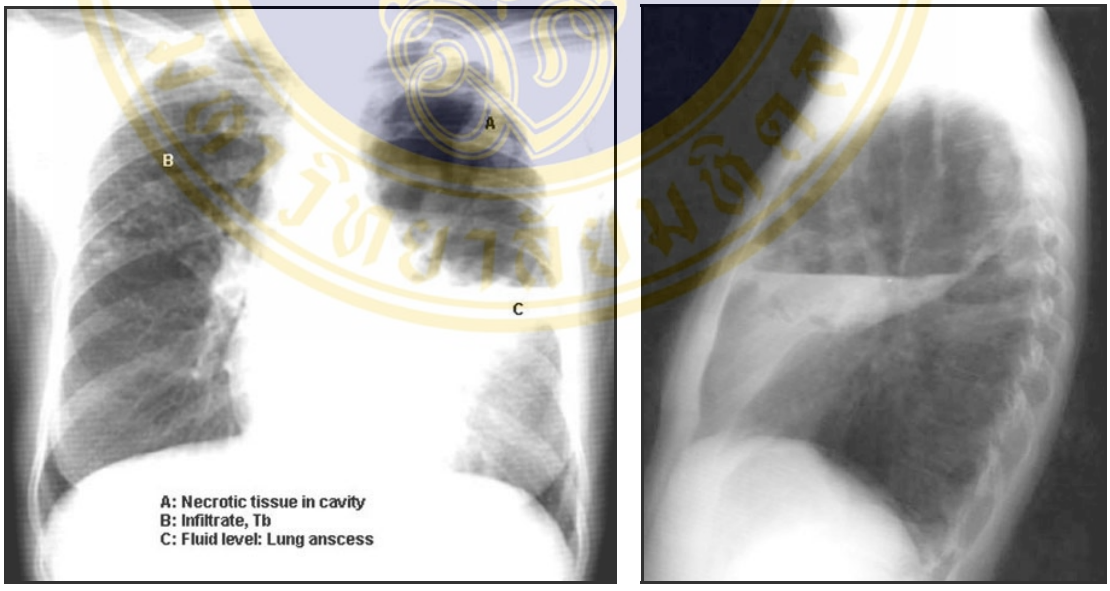


Figure 3-8. Tumor with irregular lumen & thick wall cavity (50)



(a) (b)

Figure 3-9. Show infiltration & fluid level in PA and Lateral films (50)

(a) PA chest x-ray film

(b) Lateral chest x-ray film

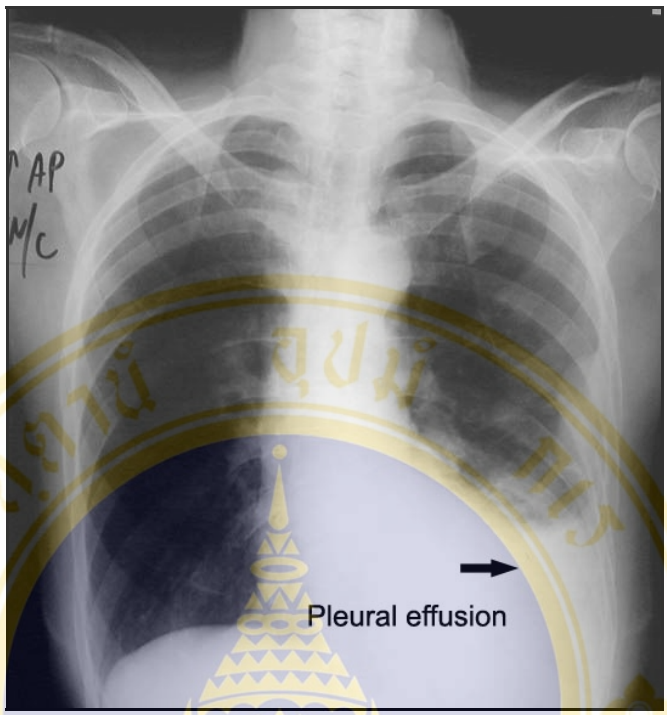


Figure 3-10. Showed pleural effusion at left lower lobe (LLL) (50)

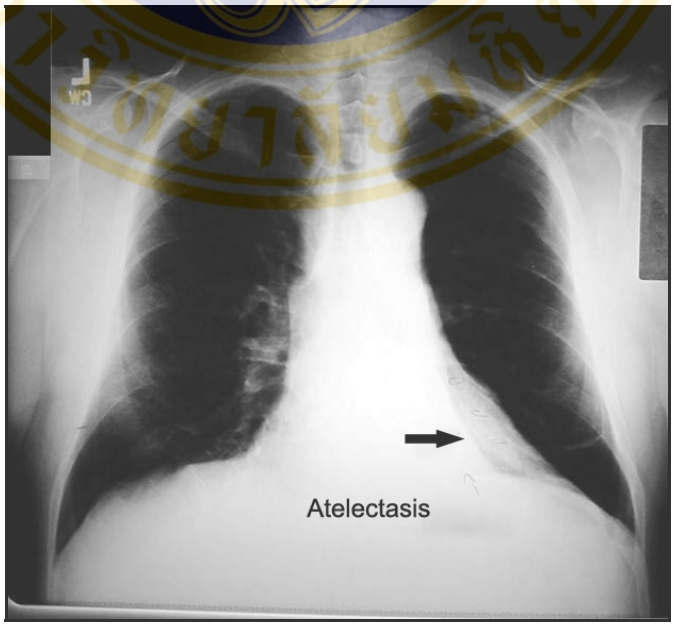


Figure 3-11. Show atelectasis at left lower lobe (LLL) (50)

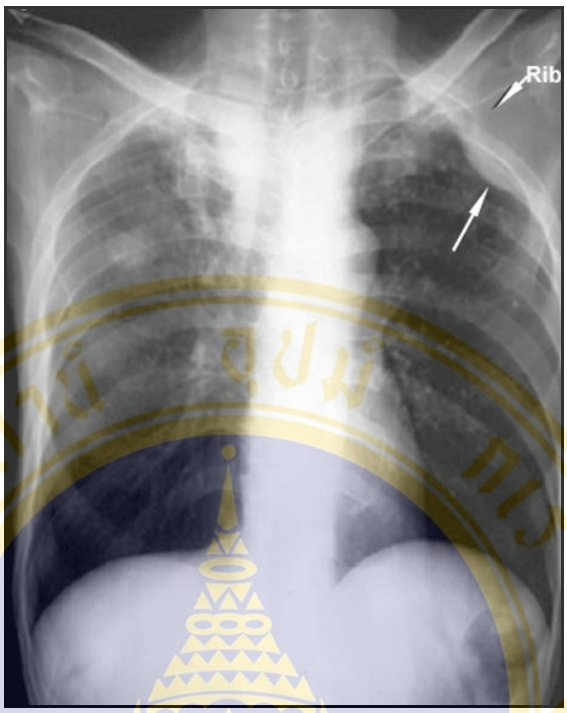


Figure 3-12. Show right rib destruction (50)

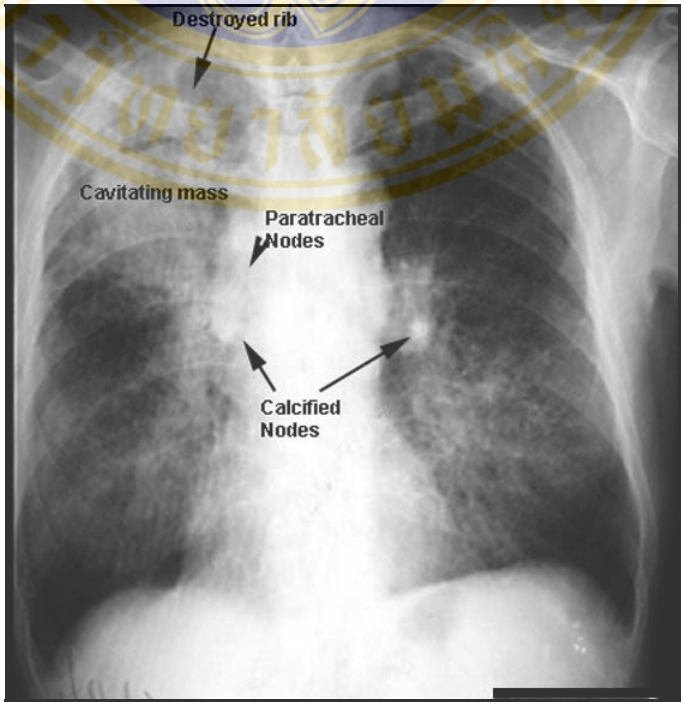


Figure 3-13. Pancoat tumor has many radiological sign (50)

3.4 Classification of Four Cell Types

The individual radiologists were classified all radiographic finding as squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma by used criteria of Table 3-2 to distinguish cell types. The discrepant interpretative cases were resolved by jointly interpret consensus.

The remarkable criterion:

- For a squamous cell carcinoma and small cell carcinoma are properly located in central region, if not are adenocarcinoma and large cell carcinoma.
- The lymph node enlargement presence jointly with central lesion like to small cell carcinoma.
- The tumor size of peripheral lesion smaller than 4 cm is present in adenocarcinoma, if not is large cell carcinoma.
- Bronchioloalveolar carcinoma is subform of adenocarcinoma properly present as diffuse reticulonodular.

3.5 Statistical Analysis

3.5.1 The measurement of tumor size was calculated by descriptive statistic which presented in mean ± standard deviation.

3.5.2 The correlation between histological cell types and radiographic characteristic pattern was calculated by Pearson's chi square test. A value of $p < 0.05$ was considered statistically significant but $p > 0.05$ was not considered statistically significant.

3.5.3 The interpretation agreement between the radiologists was calculated by the Kappa index to test of concordance. Concordance between radiologists was consider fair ($0.05 < K \leq 0.6$), good ($0.6 < K \leq 0.8$), or excellent ($K > 0.8$).

3.5.4 Accuracy and predictive values with 95% Confidence Interval was used to estimate the evaluation histological cell types of primary lung cancer disease by chest radiographic imaging.

CHAPTER IV

RESULTS

4.1 Population

The patients with primary lung cancer in 4 cell types during the study period on the chest radiography consisted of squamous cell carcinoma 35 cases (29 males and 6 females; mean age ± SD, 66 ± 8 years; age range 47-81 years), adenocarcinoma 86 cases (47 males and 39 females; mean age ± SD, 61 ± 12 years; age range 25-84 years), large cell carcinoma 3 cases (2 males and 1 female; mean age 58 ± 22 years; age range 45-84 years), and small cell carcinoma 14 cases (12 males and 2 female; mean age 61 ± 16 years; age range 19-82 years). The characteristics of the patients are listed in Table 4-1 and Chart 4-1. The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and sex ($p=0.003$) were present by Pearson's chi square test which a value of $p<0.05$ was consider statistically significant. But Pearson's chi square test correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and age ($p=0.397$) showed difference was not statistically significant because a value of $p>0.05$, as shown in table 4-1.

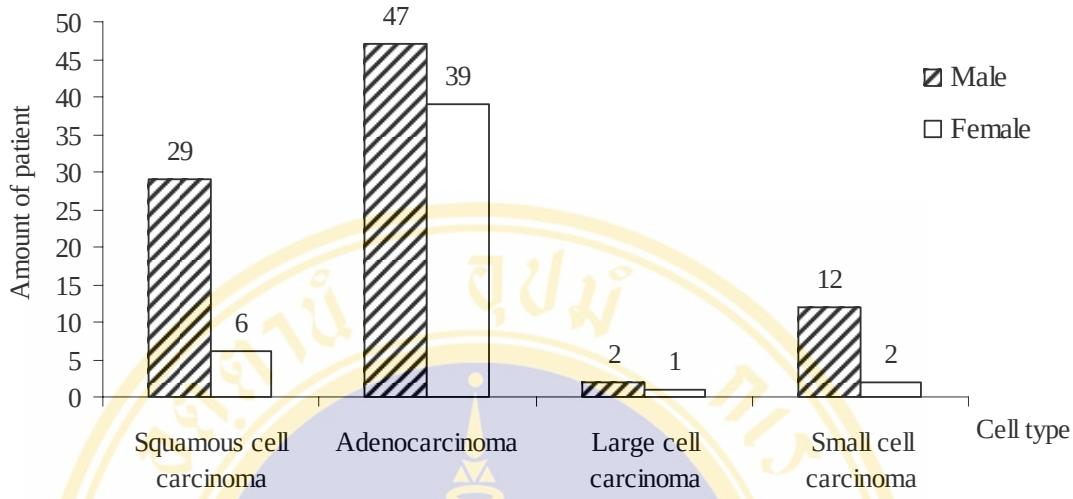


Chart 4-1. The distribution of lung cancer in 4 cell types by sex

4.2 Tumor size

The tumor size of patients with primary lung cancer in all 4 cell types presented with the mean ± standard deviation diameter was 4.6 ± 2.2 cm, minimum and maximum diameters were 1.0 cm and 12.0 cm respectively. Whereas the mean ± standard deviation diameter of squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma were 5.3 ± 2.5 cm (minimum diameter was 1.0 cm and maximum diameter was 12.0 cm), 4.3 ± 2.1 cm (minimum diameter was 1.0 cm and maximum diameter was 10.5 cm), 5.1 ± 2.0 cm (minimum diameter was 2.5 cm and maximum diameter was 8.0 cm), and 4.9 ± 1.5 cm (minimum diameter was 2.6 cm and maximum diameter was 8.0 cm), respectively. The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and tumor size ($p=0.044$) were present by Pearson's chi square test which a value of $p<0.05$ was consider statistically significant (Table 4-1).

Table 4-1. The distribution of lung cancer in 4 cell types by sex, age, and size

	Histology				
	Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcinoma (n=3)	Small cell carcinoma (n=14)	p-value*
Sex					0.003
Male	29 (82.9%)	47 (54.7%)	2 (66.7%)	12 (85.7%)	
Female	6 (17.1%)	39 (45.3%)	1 (33.3%)	2 (14.3%)	
Age (years)					0.397
Mean ± SD	66 ± 8	61 ± 12	58 ± 22	61 ± 16	
Median	68	62	46	64	
Range	47-81	25-84	45-84	19-82	
Size (cm)					0.044
Mean ± SD	5.3 ± 2.5	4.3 ± 2.1	5.1 ± 2.0	4.9 ± 1.5	
Median	5	4	4.5	4.6	
Rank	1.0-12.0	1.0-10.5	2.5-8.0	2.6-8.0	

* P-value in the tables was Pearson's chi square test between the correlation of histology and demographic data or radiographic finding. Which the histology was calculated only 3 histological cell types (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) because other histology (large cell carcinoma) was not enough samples size (there are only 3 cases).

4.3 Location

4.3.1 Location (central, peripheral)

Twenty lesions (57.1%) of squamous cell carcinoma located central region and eight lesions (22.9%) in peripheral region of the lung. Forty-three lesions (50%) of adenocarcinoma located central region and twenty-five lesions (29.1%) in peripheral region. Two lesions (66.7%) of large cell carcinoma located central region and one lesion (33.3%) in peripheral region. And eleven lesions (78.6%) of small cell carcinoma located central region and two lesions (14.3%) in peripheral region. There were twenty-six cases of primary lung cancer in 4 cell types couldn't assess and presented in squamous cell carcinoma 7 cases (20%), adenocarcinoma 18 cases (20.9%), and small cell carcinoma 1 case (7.1%). Because some lesions located in between central and peripheral region, some lesions were small nodule in whole lobe or both lung and another radiological pathology were trouble. So those, the location of 26 cases were present in non assessment which were abbreviate in N/A (Table 4-2 and Chart 4-2). Pearson's chi square test correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and location (central and peripheral) showed difference was not statistically significant ($p>0.05$), as shown in table 4-2.

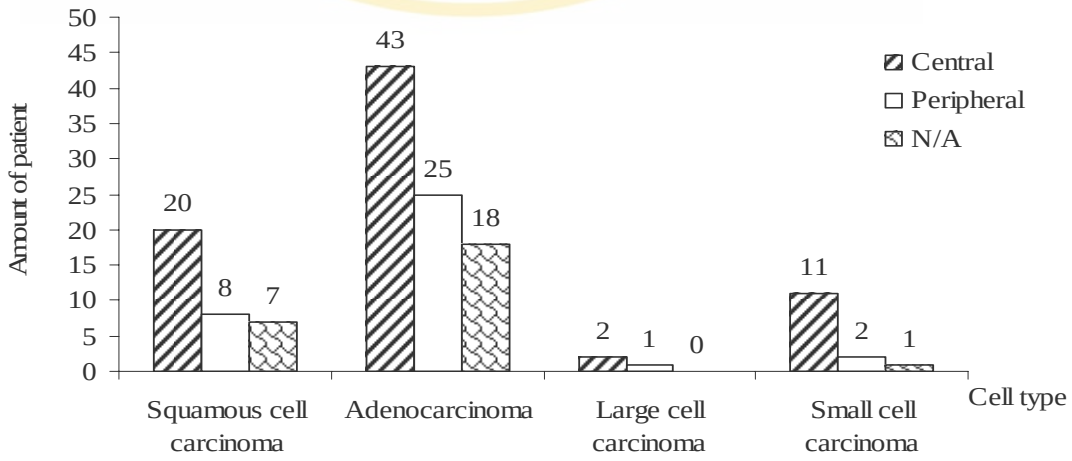


Chart 4-2. The distribution of lung cancer in 4 cell types by location (central, peripheral)

4.3.2 Lobe (right, left)

Twenty-three lesions (65.7%) of squamous cell carcinoma located right lobe and eleven lesions (31.4%) in left lobe. Fifty-three lesions (61.6%) of adenocarcinoma located right lobe and twenty-nine lesions (33.7%) in left lobe. All three lesions (100%) of large cell carcinoma located only right lobe. Seven lesions (50%) of small cell carcinoma located right lobe and six lesions (42.9%) in left lobe. And there were six cases located in both lobes which presented in squamous cell carcinoma 1 case (2.9%), adenocarcinoma 4 cases (4.7%), and small cell carcinoma 1 case (7.1%) (Table 4-2 and Chart 4-3). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lobe (right and left) showed difference was not statistically significant ($p>0.05$) by Pearson's chi square test, as shown in table 4-2.

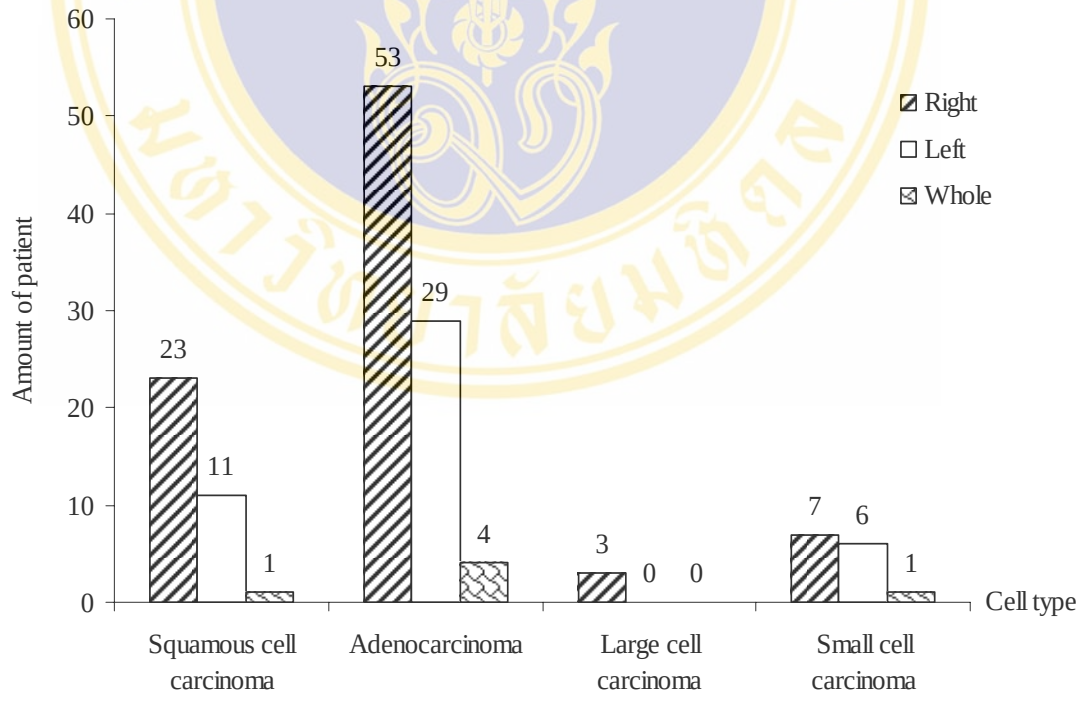


Chart 4-3. The distribution of lung cancer in 4 cell types by lobe (right, left)

4.3.3 Lobe (upper, middle, lower)

The location lobes of squamous cell carcinoma in upper lobe, middle lobe and, lower lobe presented in twenty lesions (57.1%), two lesions (5.7%), and eleven lesions (31.4%) respectively. Adenocarcinoma, the location lobes in upper lobe, middle lobe and, lower lobe presented in forty-one lesions (47.7%), seven lesions (8.1%), and twenty-six lesions (30.2%) respectively. Two lesions (66.7%) of large cell carcinoma located upper lobe and one lesion (33.3%) in lower lobe. Five lesions (35.7%) of small cell carcinoma located upper lobes and five lesions (35.7%) in lower lobe. There were 18 cases of squamous cell carcinoma 2 cases (5.7%), adenocarcinoma 12 cases (14%), and small cell carcinoma 4 cases (28.6%) presented in whole lobe (Table 4-2 and Chart 4-4). Pearson's chi square test showed difference was not statistically significant ($p>0.05$) of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lobe (upper, middle, and lower), as shown in table 4-2.

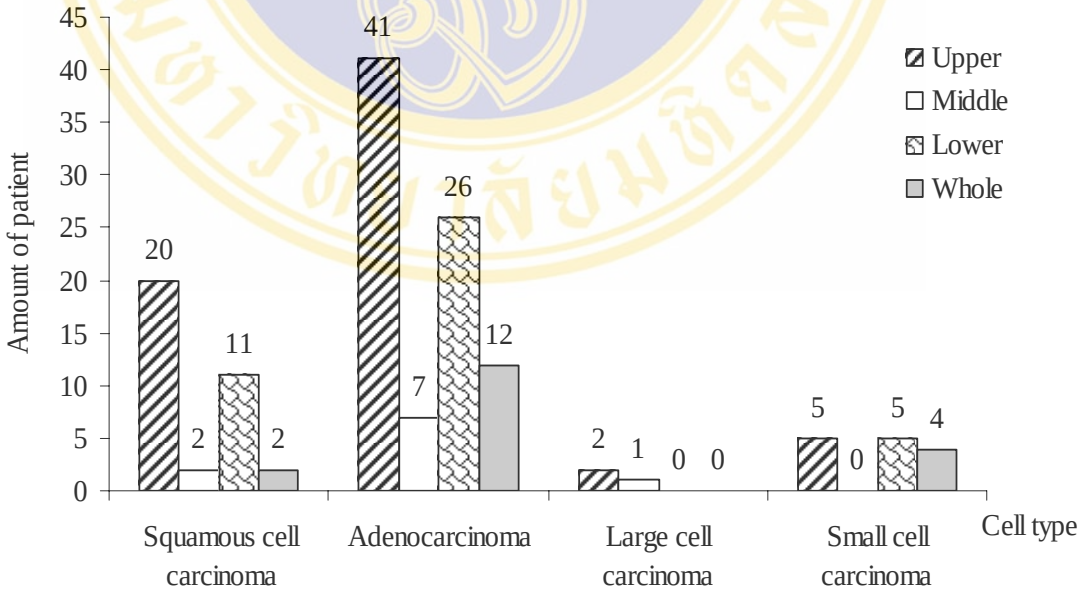


Chart 4-4. The distribution of lung cancer in 4 cell types by lobe (upper, middle, lower)

4.3.4 Lobe (RUL, RML, RLL, LUL, LLL)

Squamous cell carcinomas located in right upper lobe eleven lesions (31.4%), right middle lobe two lesions (5.7%), right lower lobe nine lesions (25.7%), left upper lobe nine lesions (25.7%), left lower lobe two lesions (5.7%), and whole lobe two lesions (5.7%). Adenocarcinoma located in right upper lobe twenty-three lesions (26.7%), right middle lobe seven lesions (8.1%), right lower lobe eighteen lesions (20.9%), left upper lobe eighteen lesions (20.9%), left lower lobe eight lesions (9.3%), and whole lobe twelve lesions (14%). Large cell carcinoma located in right upper lobe 2 lesions (66.7%) and middle lobe one lesion (33.3%). And small cell carcinomas located in right upper lobe five lesion (35.74%), right lower lobe one lesion (7.1%), left lower lobe four lesions (28.6%), and whole lobe four lesions (28.6%). Which the lesions were present in whole lobe of squamous cell carcinoma, adenocarcinoma, and small cell carcinoma were trouble of other radiological sign and pathology (Table 4-2 and Chart 4-5). For the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lobe (RUL, RML RLL, LUL, and LLL) by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-2.

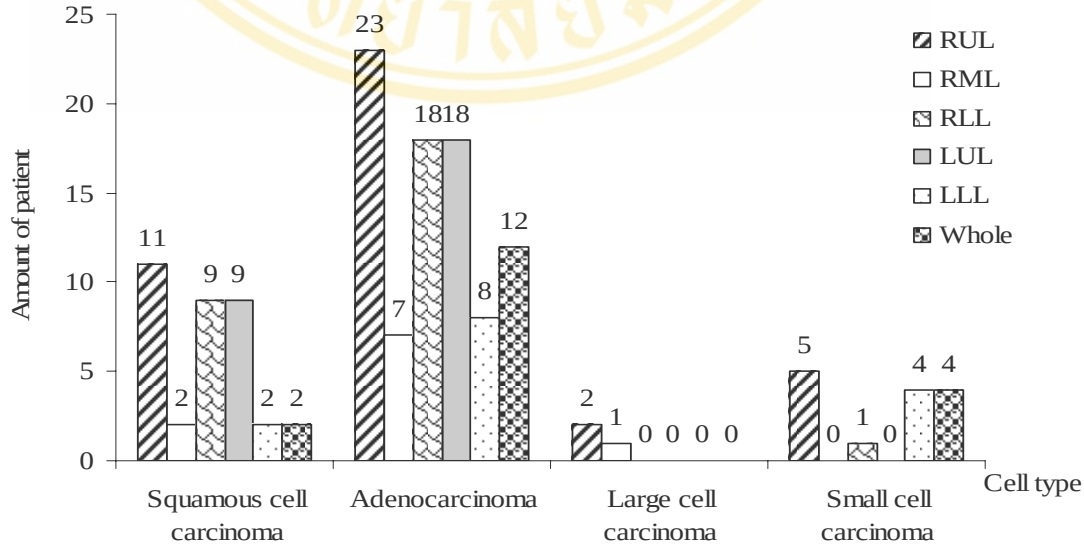


Chart 4-5. The distribution of lung cancer in 4 cell types by lobe (RUL, RML, RLL, LUL, LLL)

Table 4-2. The distribution of lung cancer in 4 cell types by location and lobe

	Histology				
	Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcinoma (n=3)	Small cell carcinoma (n=14)	p-value*
Location					0.376
Central	20 (57.1%)	43 (50%)	2 (66.7%)	11 (78.6%)	
Peripheral	8 (22.9%)	25 (29.1%)	1 (33.3%)	2 (14.3%)	
N/A	7 (20%)	18 (20.9%)	-	1 (7.1%)	
Lobe (right/left)					0.873
Right	23 (65.7%)	53 (61.6%)	3 (100%)	7 (50%)	
Left	11 (31.4%)	29 (33.7%)	-	6 (42.9%)	
Both	1 (2.9%)	4 (4.7%)	-	1 (7.1%)	
Lobe (upper/lower)					0.382
Upper	20 (57.1%)	41 (47.7%)	2 (66.7%)	5 (35.7%)	
Middle	2 (5.7%)	7 (8.1%)	1 (33.3%)	-	
Lower	11 (31.4%)	26 (30.2%)	-	5 (35.7%)	
Whole lobe	2 (5.7%)	12 (14%)	-	4 (28.6%)	
Lobe					0.098
RUL	11 (31.43%)	23 (26.7%)	2 (66.7%)	5 (35.7%)	
RML	2 (5.7%)	7 (8.1%)	1 (33.3%)	-	
RLL	9 (25.71%)	18 (20.9%)	-	1 (7.1%)	
LUL	9 (25.71%)	18 (20.9%)	-	-	
LLL	2 (5.7%)	8 (9.3%)	-	4 (28.6%)	
Whole lobe	2 (5.7%)	12 (14%)	-	4 (28.6%)	

4.4 Edge

Five lesions (14.3%) of squamous cell carcinoma were regular edge and thirty lesions (85.7%) were irregular edge. Fourteen lesions (16.3%) of adenocarcinoma were regular edge and seventy-two lesions (83.7%) were irregular edge. One lesion (33.3%) of large cell carcinoma was regular edge and two lesions (66.7%) were irregular edge. One lesion (7.1%) of small cell carcinoma was regular edge and thirteen lesions (92.9%) were irregular edge (Table 4-3 and Chart 4-6). Pearson's chi square test correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and edge showed difference was not statistically significant ($p>0.05$), as shown in table 4-3.

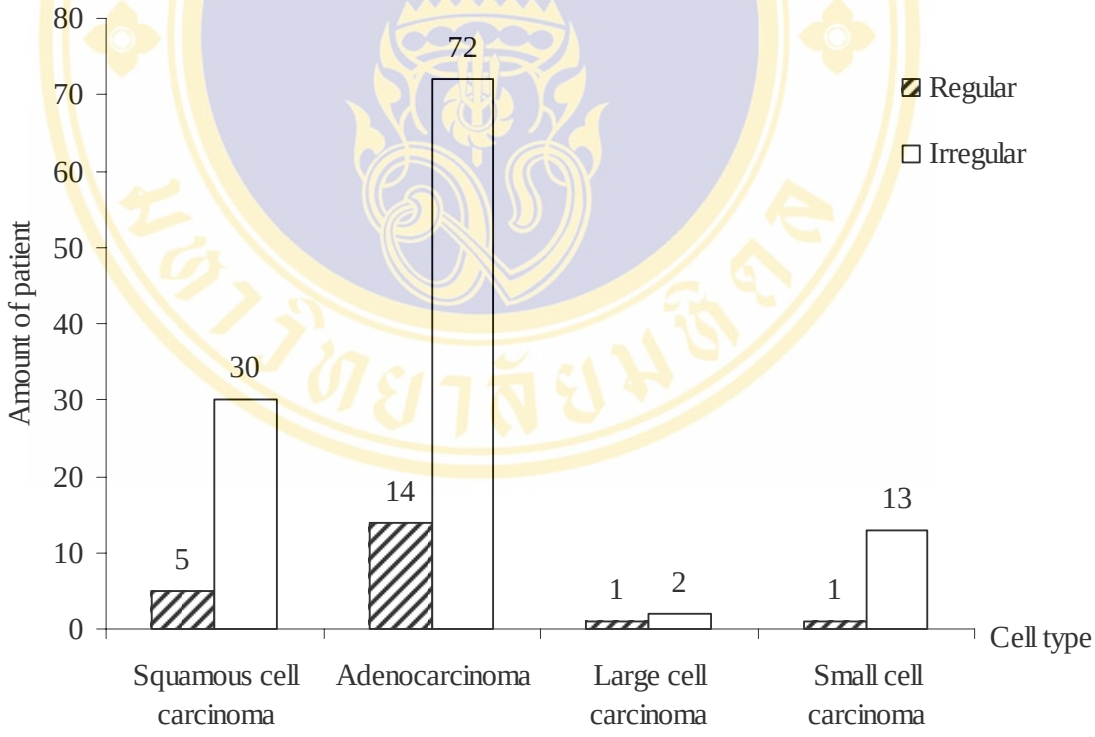


Chart 4-6. The distribution of lung cancer in 4 cell types by edge

4.5 Infiltration

Twenty-eight lesions (80%) of squamous cell carcinoma were present infiltration and seven lesions (20%) were absent infiltration. Sixty-three lesions (73.3%) of adenocarcinoma were present infiltration and twenty-three lesions (26.7%) were absent infiltration. Two lesions (66.7%) of large cell carcinoma were present infiltration and one lesion (33.3%) was absent infiltration. Ten lesions (71.4%) of small cell carcinoma were present infiltration and four lesions (28.6%) were absent infiltration (Table 4-3 and Chart 4-7). For the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and infiltration by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-3.

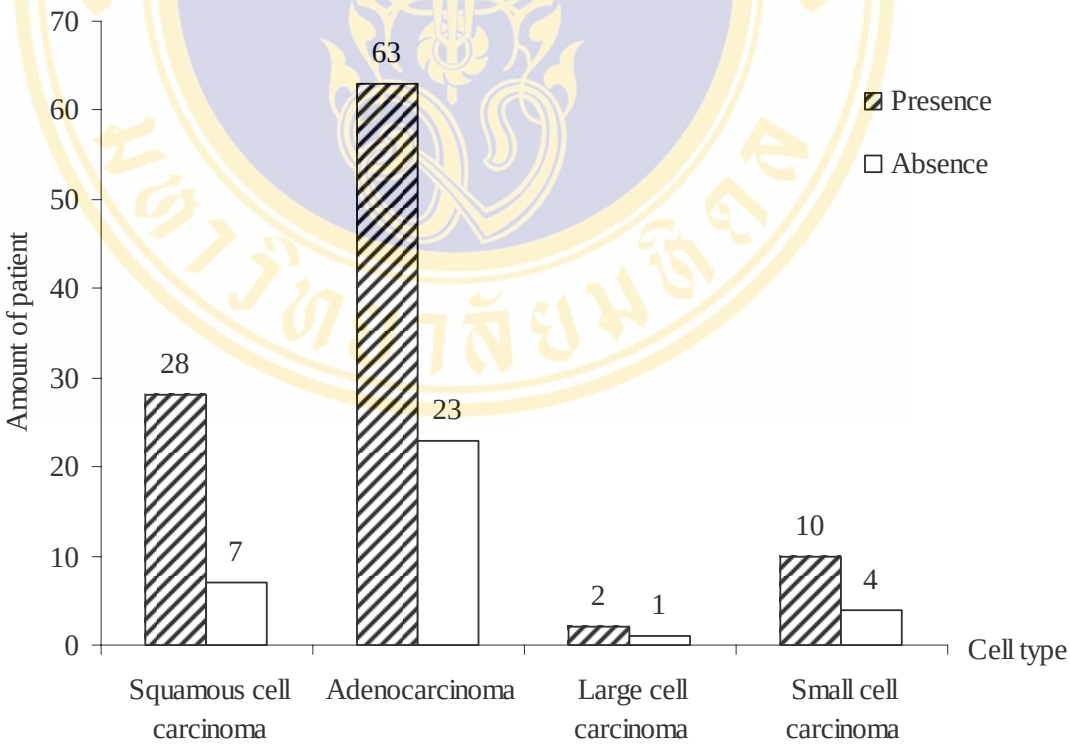


Chart 4-7. The distribution of lung cancer in 4 cell types by infiltration

4.6 Pleural effusion

Ten cases (28.6%) of squamous cell carcinoma were present pleural effusion and twenty-five cases (71.4%) were absent. Thirty-two cases (37.2%) of adenocarcinoma were present pleural effusion and fifty-four cases (62.8%) were absent. All three cases (100%) of large cell carcinoma were present pleural effusion. For small cell carcinoma presented or absented pleural effusion were seven cases (50%) likewise (Table 4-3 and Chart 4-8). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and pleural effusion by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-3.

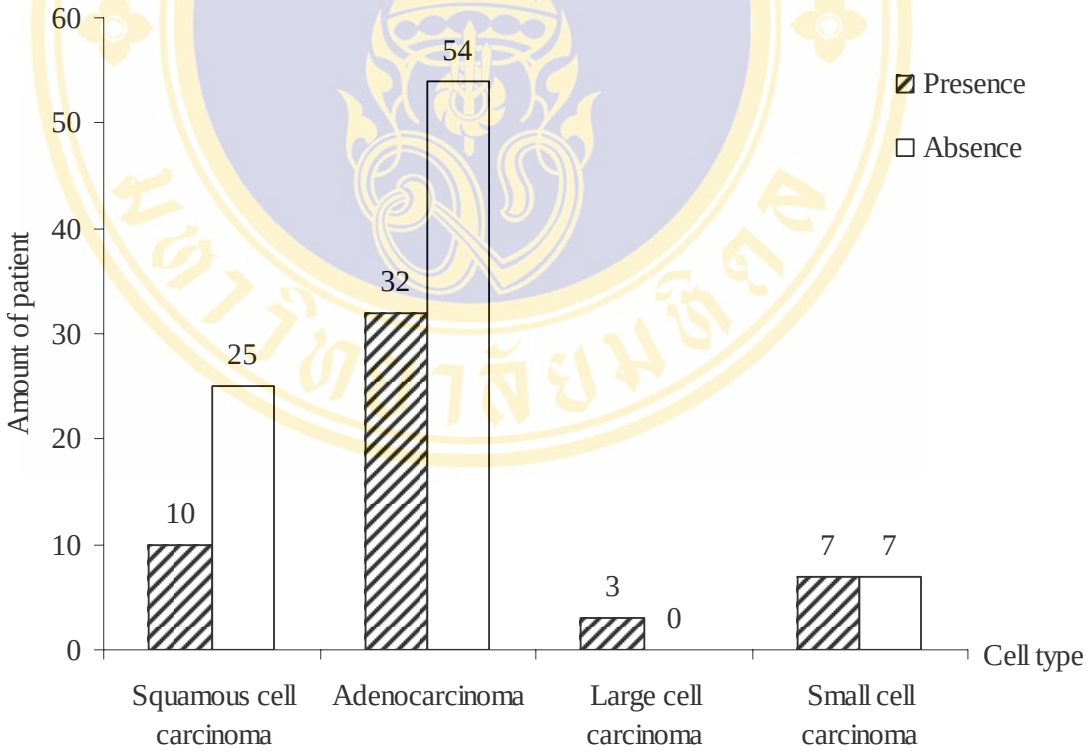


Chart 4-8. The distribution of lung cancer in 4 cell types by pleural effusion

4.7 Bone destruction

Two cases (5.7%) of squamous cell carcinoma were present bone destruction and thirty-three cases (94.3%) were absent. One case (1.2%) of adenocarcinoma was present bone destruction and eighty-five cases (98.8%) were absent. For large cell carcinoma and small cell carcinoma were absent bone destruction (Table 4-3 and Chart 4-9). Pearson's chi square test correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and bone destruction showed difference was not statistically significant ($p>0.05$), as shown in table 4-3.

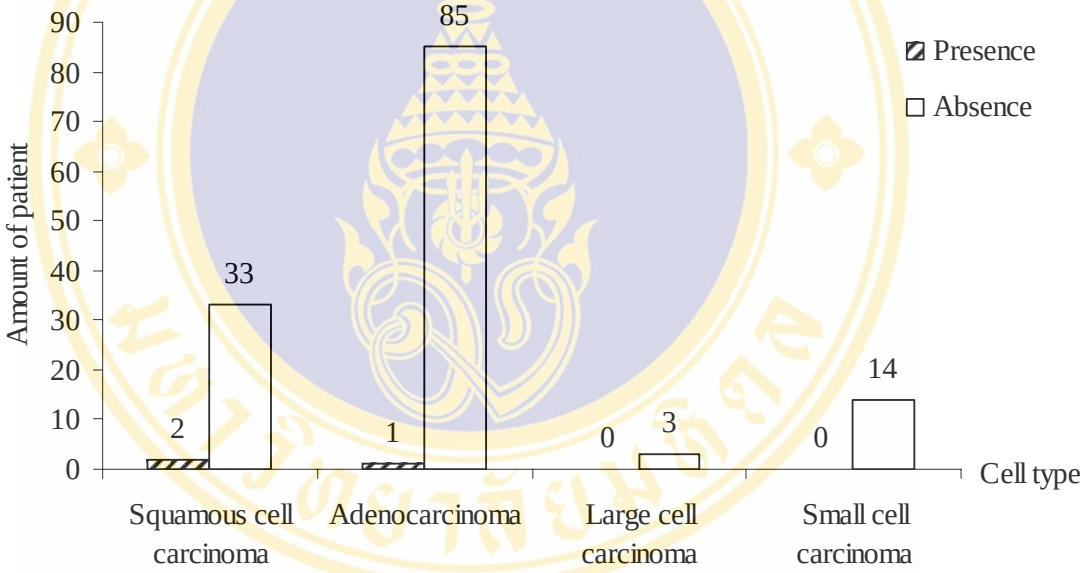


Chart 4-9. The distribution of lung cancer in 4 cell types by bone destruction

4.8 Chest wall destruction

The chest wall destruction of lung cancer in 4 cell types in during the study period was absent. So the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and chest wall destruction by Pearson's chi square test was not calculated (Table 4-3).

Table 4-3. The distribution of lung cancer in 4 cell types by edge, infiltration, pleural effusion, bone destruction, and chest wall destruction

	Histology				
	Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcinoma (n=3)	Small cell carcinoma (n=14)	p-value*
Edge					0.668
Regular	5 (14.3%)	14 (16.3%)	1 (33.3%)	1 (7.1%)	
Irregular	30 (85.7%)	72 (83.7%)	2 (66.7%)	13 (92.9%)	
Infiltration					0.706
Present	28 (80%)	63 (73.3%)	2 (66.7%)	10 (71.4%)	
Absent	7 (20%)	24 (26.7%)	1 (33.3%)	4 (28.6%)	
Pleural effusion					0.355
Present	10 (28.6%)	32 (37.2%)	3 (100%)	7 (50%)	
Absent	25 (71.4%)	54 (62.8%)	-	7 (50%)	
Bone destruction					0.256
Present	2 (5.7%)	1 (1.2%)	-	-	
Absent	33 (94.3%)	85 (98.8%)	3 (100%)	14 (100%)	
Chest wall destruction					-
Present	-	-	-	-	
Absent	35 (100%)	86 (100%)	3 (100%)	14 (100%)	

4.9 Lymph node enlargement

Thirteen cases (37.1%) of squamous cell carcinoma were present lymph node enlargement and twenty-two cases (62.9%) were absent. Twenty-seven cases (31.4%) of adenocarcinoma were present lymph node enlargement and fifty-nine cases (68.6%) were absent. One case (33.3%) of large cell carcinoma was present lymph node enlargement and two cases (66.7%) were absent. Six cases (42.9%) of small cell carcinoma were present lymph node enlargement and eight cases (57.1%) were absent (Table 4-4 and Chart 4-10). For the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lymph node enlargement by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-4.

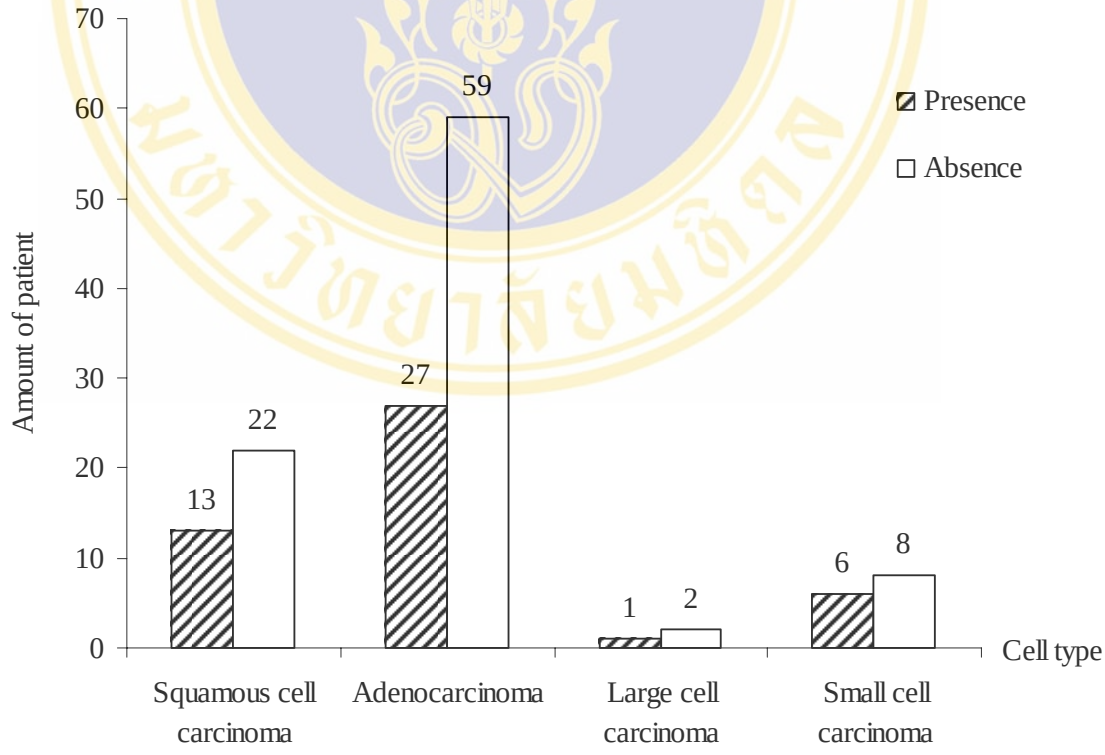


Chart 4-10. The distribution of lung cancer in 4 cell types by lymph node enlargement

4.10 Internal characteristics of tumors

4.10.1 Density

The density of squamous cell carcinoma was homogeneous thirty-two lesions (91.4%) and inhomogeneous one lesion (2.9%). Seventy-eight lesions (90.7%) of adenocarcinoma were homogeneous density and four lesions (4.7%) were inhomogeneous density. Two lesions (66.7%) of large cell carcinoma were homogeneous density and one lesion (33.3%) was inhomogeneous density. Thirteen lesions (92.9%) of small cell carcinoma were homogeneous density. But there were seven lesions couldn't assess density and presented in squamous cell carcinoma 2 lesions (5.7%), adenocarcinoma 4 lesions (4.7%), and small cell carcinoma 1 case (7.1%) because of some cases have other radiological pathology full-filled lung and/or shut out the tumor which was trouble. So, the resolve of 7 cases was presented in non assessment which was abbreviated in N/A (Table 4-4 and Chart 4-11). Pearson's chi square test of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and density showed difference was not statistically significant ($p>0.05$), as shown in table 4-4.

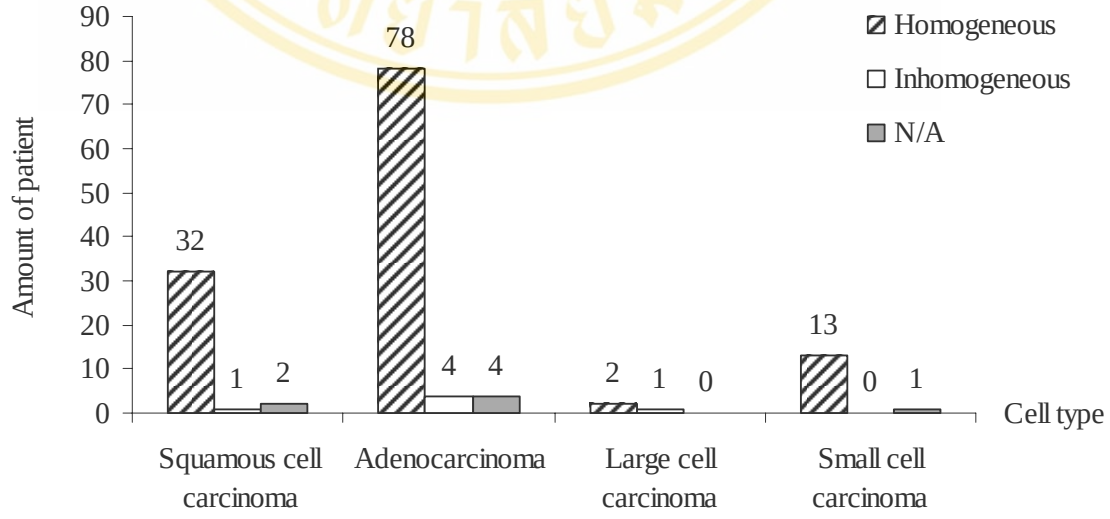


Chart 4-11. The distribution of lung cancer in 4 cell types by density

4.10.2 Cavitation

One lesion (2.9%) of squamous cell carcinoma was present cavitation and thirty-four lesions (97.1%) were absent. Two lesions (2.3%) were present cavitation and eighty-four lesions (97.7%) were absent. But not found cavitation in large cell carcinoma and small cell carcinoma (Table 4-4 and Chart 4-12). For the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and cavitation were present by Pearson's chi square test showed difference not statistically significant ($p>0.05$), as shown in table 4-4.

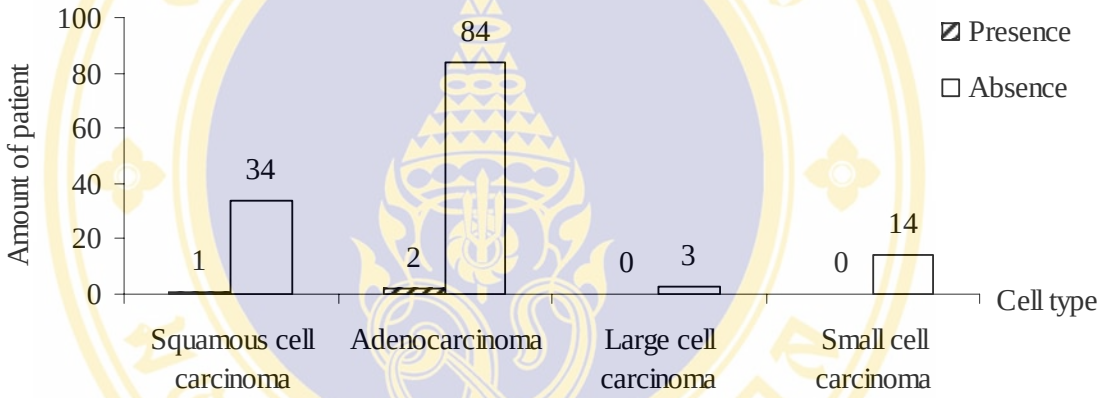


Chart 4-12. The distribution of lung cancer in 4 cell types by cavitation

4.10.3 Calcification

The observation calcification of tumor was not found in any cell types. So Pearson's chi square test was not calculated (Table 4-4).

4.10.4 Air fluid level

The observation air fluid level of tumor was not found in any cell types. So Pearson's chi square test was not calculated (Table 4-4).

Table 4-4. The distribution of lung cancer in 4 cell types by lymph node enlargement, density, cavitation, calcification, and air fluid level

	Histology				
	Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcinoma (n=3)	Small cell carcinoma (n=14)	p-value*
Lymph node enlargement					0.637
Present	13 (37.1%)	27 (31.4%)	1 (33.3%)	6 (42.9%)	
Absent	22 (62.9%)	59 (68.6%)	2 (66.7%)	8 (57.1%)	
Density					0.914
Homogeneous	32 (91.4%)	78 (90.7%)	2 (66.7%)	13 (92.9%)	
Inhomogeneous	1 (2.9%)	4 (4.7%)	1 (33.3%)	-	
N/A	2 (5.7%)	4 (4.7%)	-	1 (7.1%)	
Cavitation					0.824
Present	1 (2.9%)	2 (2.3%)	-	-	
Absent	34 (97.1%)	84 (97.7%)	3 (100%)	14 (100%)	
Calcification					-
Present	-	-	-	-	
Absent	35 (100%)	86 (100%)	3 (100%)	14 (100%)	
Air fluid					-
Present	-	-	-	-	
Absent	35 (100%)	86 (100%)	3 (100%)	14 (100%)	

4.11 Other radiographic pathology

4.11.1 Atelectasis

Four lesions (11.4%) of squamous cell carcinoma were present atelectasis and thirty-one lesions (88.6%) were absent. Ten lesions (11.6%) of adenocarcinoma were present atelectasis and seventy-six lesions (88.4%) were absent. One lesion (7.1%) of small cell carcinoma was present atelectasis and thirteen lesions (92.9%) were absent. In part of large cell carcinoma 3 lesions (100%) were only absent (Table 4-5 and Chart 4-13). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and atelectasis were showed difference was not statistically significant ($p>0.05$) with Pearson's chi square test, as shown in table 4-5.

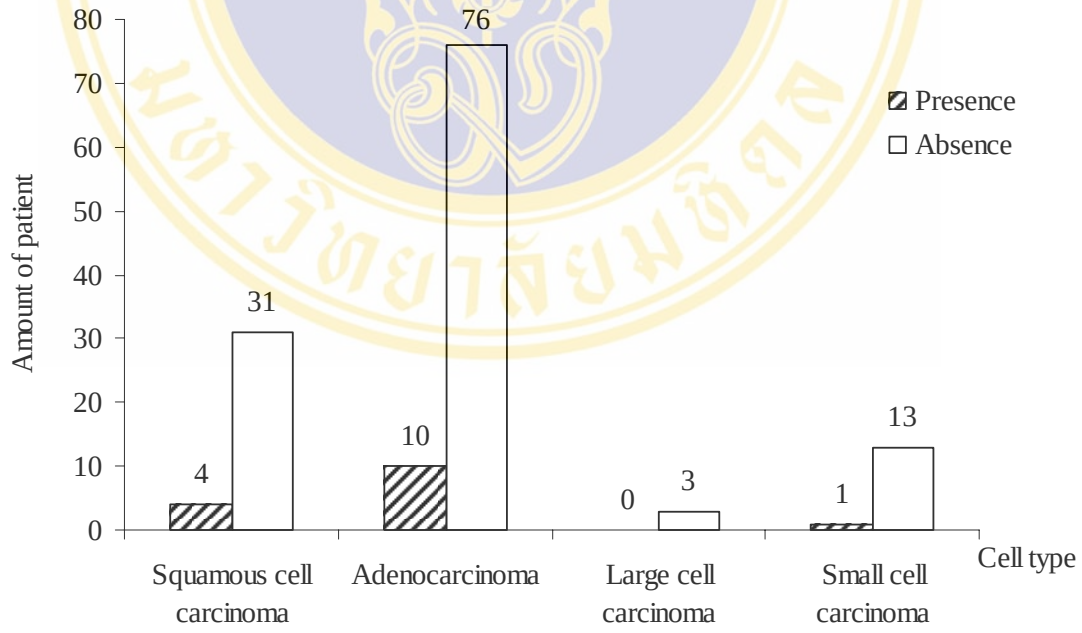


Chart 4-13. The distribution of lung cancer in 4 cell types by atelectasis

4.11.2 Lung collapse

Two lesions (5.7%) of squamous cell carcinoma were present lung collapse and thirty-three lesions (94.3%) were absent. Five lesions (5.8%) of adenocarcinoma were present lung collapse and eighty-one lesions (94.2%) were absent. But large cell carcinoma and small cell carcinoma were show only absent lung collapse (Table 4-5 and Chart 4-14). Pearson's chi square test showed difference was not statistically significant ($p>0.05$) of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lung collapse, as shown in table 4-5.

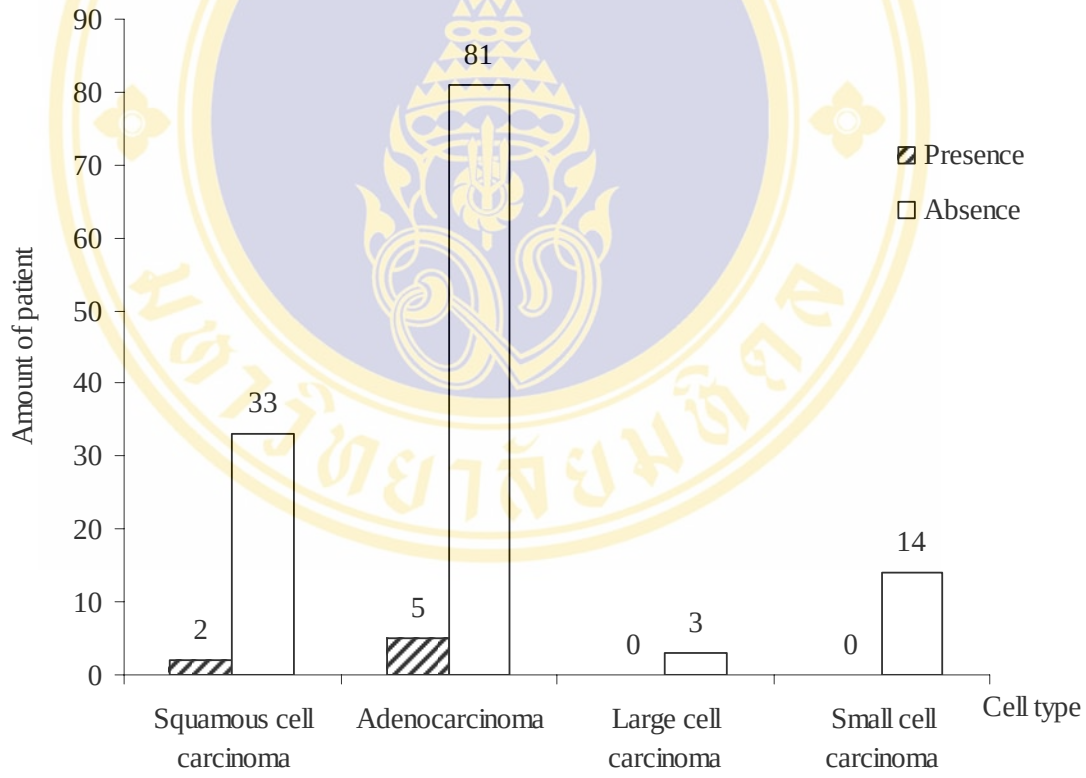


Chart 4-14. The distribution of lung cancer in 4 cell types by lung collapse

4.11.3 Obstruction

Two lesions (5.7%) of squamous cell carcinoma were present obstruction in lung and thirty-three lesions (94.3%) were absent. Two lesions (2.3%) of adenocarcinoma were present obstruction and eighty-four lesions (97.7%) were absent. Large cell carcinoma was show only absent obstruction. Small cell carcinoma shows one lesion (7.1%) was obstruction and thirteen lesions were absent (Table 4-5 and Chart 4-15). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and obstruction showed difference was not statistically significant ($p>0.05$) with Pearson's chi square test, as shown in table 4-5.

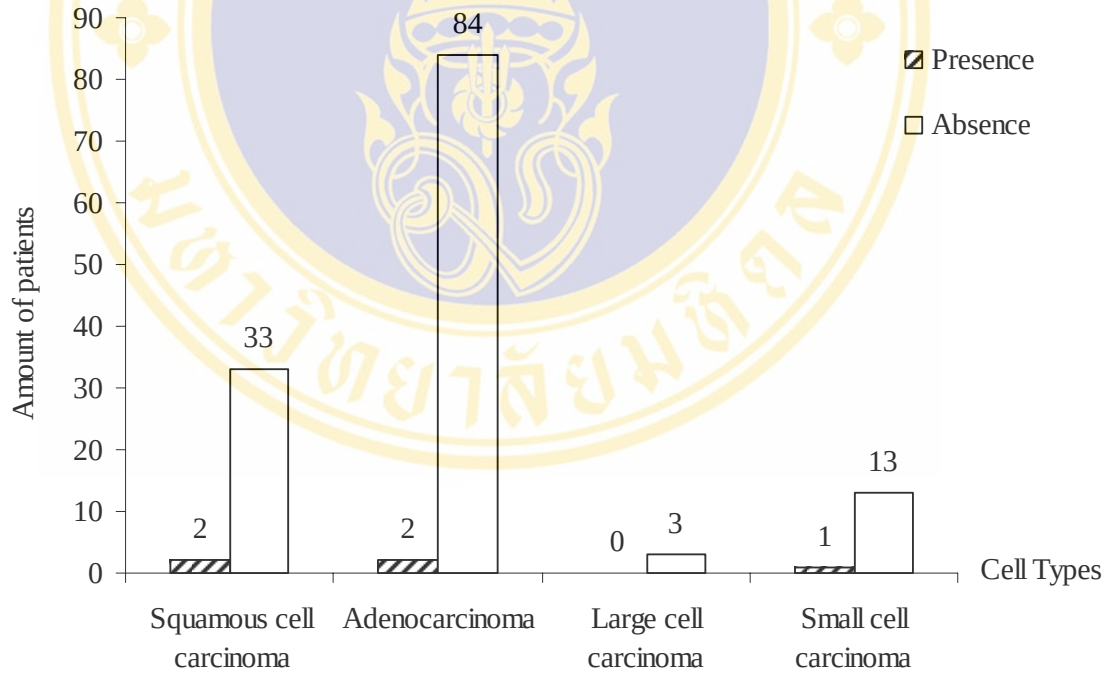


Chart 4-15. The distribution of lung cancer in 4 cell types by obstruction

4.11.4 Fibrotic

One lesion (2.9%) of squamous cell carcinoma presented fibrotic and thirty-four lesions (97.1%) were absent. Three lesions (3.5%) of adenocarcinoma presented fibrotic and eighty-three lesions (96.5%) were absent. Large cell carcinoma and small cell carcinoma were show only absent fibrotic likewise (Table 4-5 and Chart 4-16). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and fibrotic by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-5.

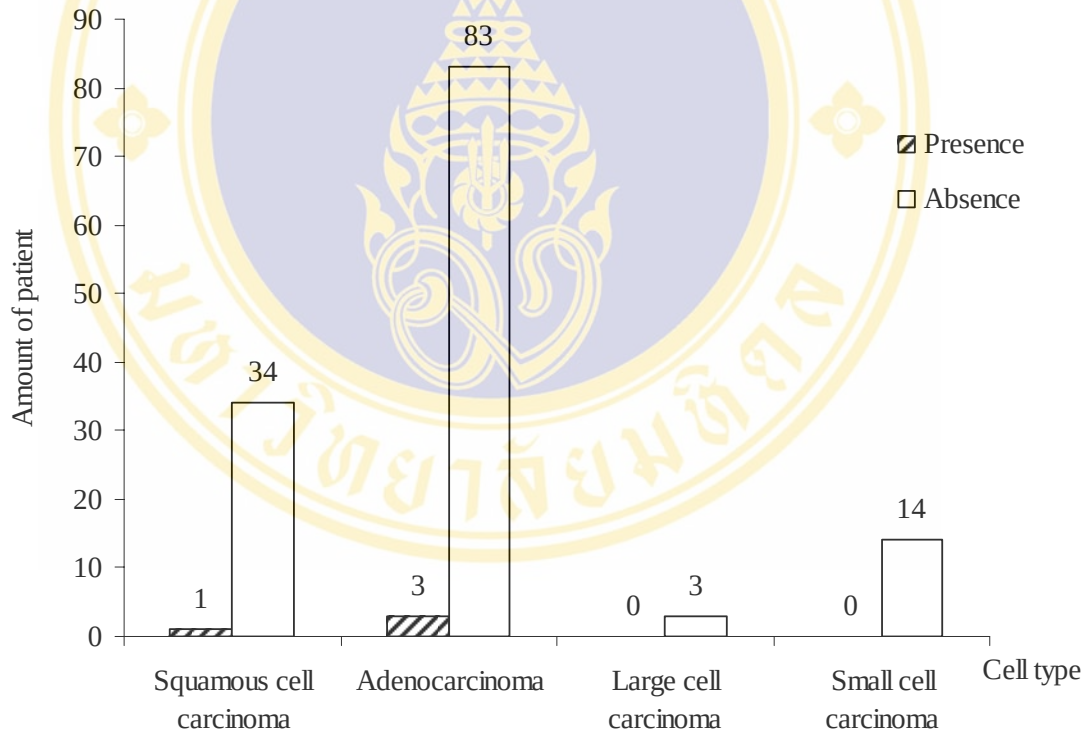


Chart 4-16. The distribution of lung cancer in 4 cell types by fibrotic

4.11.5 Reticulonodular

One lesion (2.9%) of squamous cell carcinoma was present reticulonodular and thirty-four lesions (97.1%) were absent. Four lesions (4.7%) of adenocarcinoma were present reticulonodular and eighty-two lesions (95.3%) were absent. Large cell carcinoma and small cell carcinoma was show only absent fibrotic likewise (Table 4-5 and Chart 4-17). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and fibrotic by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-5.

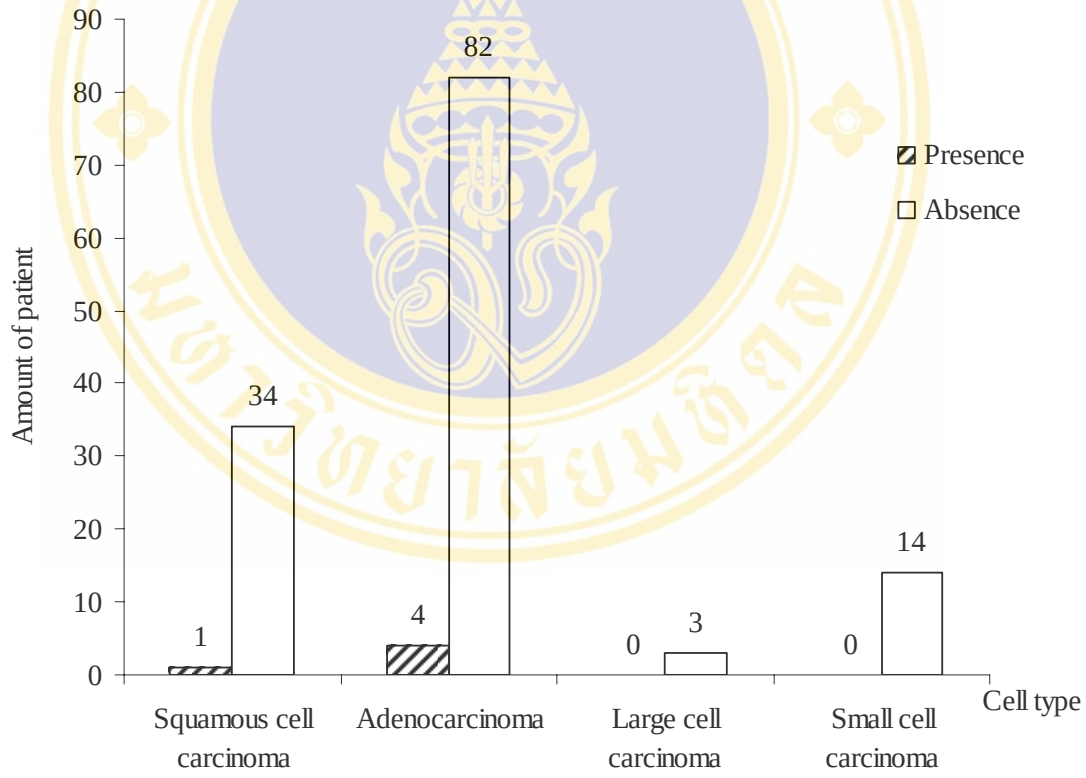


Chart 4-17. The distribution of lung cancer in 4 cell types by reticulonodular

Table 4-5. The distribution of lung cancer in 4 cell types by atelectasis, collapse, obstruction, fibrotic, and reticulonodular

	Histology				
	Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcinoma (n=3)	Small cell carcinoma (n=14)	p-value*
Atelectasis					0.882
Present	4 (11.4%)	10 (11.6%)	-	1 (7.1%)	
Absent	31 (88.6%)	76 (88.4%)	3 (100%)	13 (92.9)	
Collapse					0.652
Present	2 (5.7%)	5 (5.8%)	-	-	
Absent	33 (94.3%)	81 (94.2%)	3 (100%)	14 (100%)	
Obstruction					0.517
Present	2 (5.7%)	2 (2.3%)	-	1 (7.1%)	
Absent	33 (94.3%)	84 (97.7%)	3 (100%)	13 (92.9%)	
Fibrotic					0.774
Present	1 (2.9%)	3 (3.5%)	-	-	
Absent	34 (97.1%)	83 (96.5%)	3 (100%)	14 (100%)	
Reticulonodular					0.662
Present	1 (2.9%)	4 (4.7%)	-	-	
Absent	34 (97.1%)	82 (95.3%)	3 (100%)	14 (100%)	

4.12 Radiographic pathology overlap

The radiographic pathology from reviewed film chest x-rays had many sign to participate with lung cancer tumor therefore compiled the interested radiographic finding overlap together.

4.12.1 Location / Cavity

There were twenty lesions (57.1%) of squamous cell carcinoma located in central with absent cavity, seven lesions (20%) located in peripheral with absent cavity, and one lesion (2.9%) located in peripheral with present cavity. Forty-two lesions (48.8%) of adenocarcinoma located in central with absent cavity, one lesion (1.2%) located in central with present cavity, and twenty-five lesions (29.1%) located in peripheral with absent cavity. Two lesions (66.7%) of large cell carcinoma located in central with absent cavity, and one lesion (33.3%) located in peripheral with absent cavity. Eleven lesions (78.6%) of small cell carcinoma located in central with absent cavity, and two lesions (14.3%) located in peripheral with absent cavity (Table 4-6 and Chart 4-18). The Pearson's chi square test correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and location (specific central and peripheral region) with cavity showed difference was not statistically significant ($p>0.05$), as shown in Table 4-6.

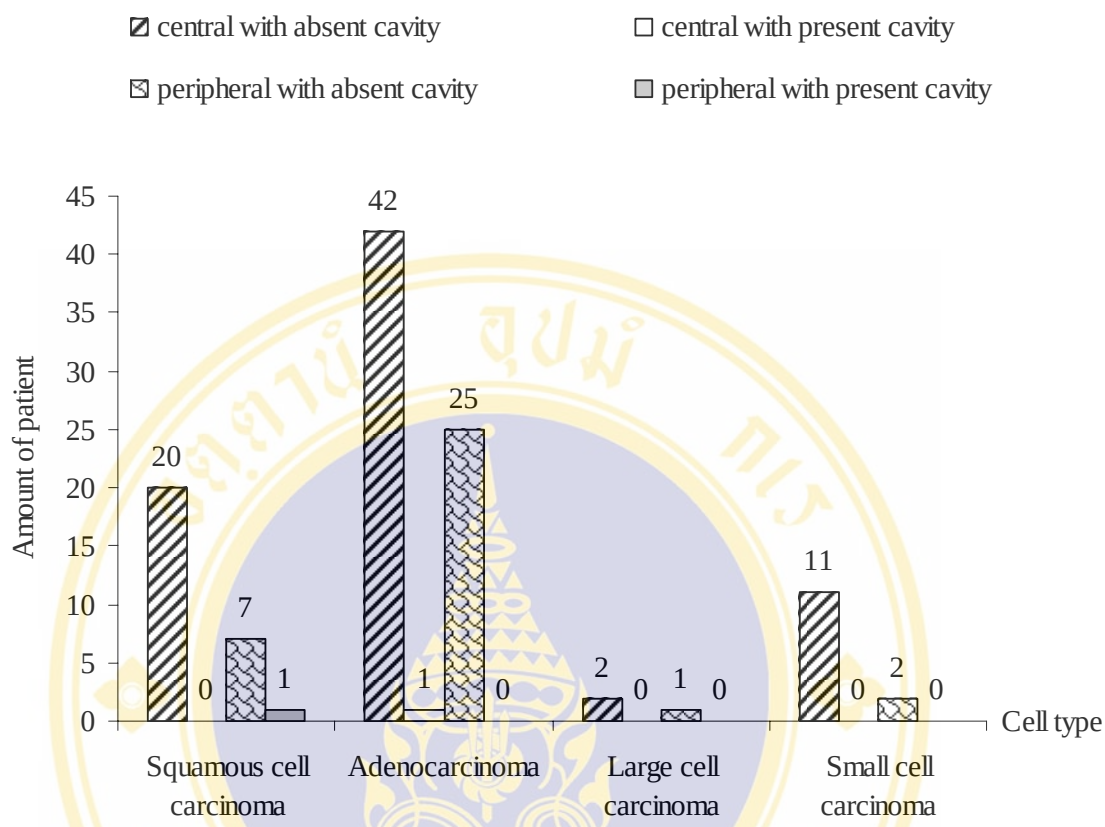


Chart 4-18. The distribution of lung cancer in 4 cell types by location (central and peripheral) with cavity

4.12.2 Infiltration / Edge

Five lesions (14.3%) of squamous cell carcinoma were absent infiltration with irregular edge, two lesions (5.7%) were absent infiltration with regular edge, twenty-five lesions (71.4%) were present infiltration with irregular edge, and three lesions (8.6%) were present infiltration with regular edge. Seventeen lesions (19.8%) of adenocarcinoma were absent infiltration with irregular edge, six lesions (7%) were absent infiltration with regular edge, fifty-five lesions (64%) were present infiltration with irregular edge, and eight lesions (9.3%) were present infiltration with regular edge. One lesion (33.3%) of large cell carcinoma was absent infiltration with regular edge and two lesions (66.7%) were present infiltration with irregular edge. Non lesion was

absent infiltration with irregular edge and present infiltration with regular edge. Three lesions (21.4%) of small cell carcinoma were absent infiltration with irregular edge, one lesion (7.1%) were absent infiltration with regular edge, ten lesions (71.4%) were present infiltration with irregular edge, and non lesion was present infiltration with regular edge (Table 4-6 and Chart 4-19). For the correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and infiltration / edge by Pearson's chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-6.

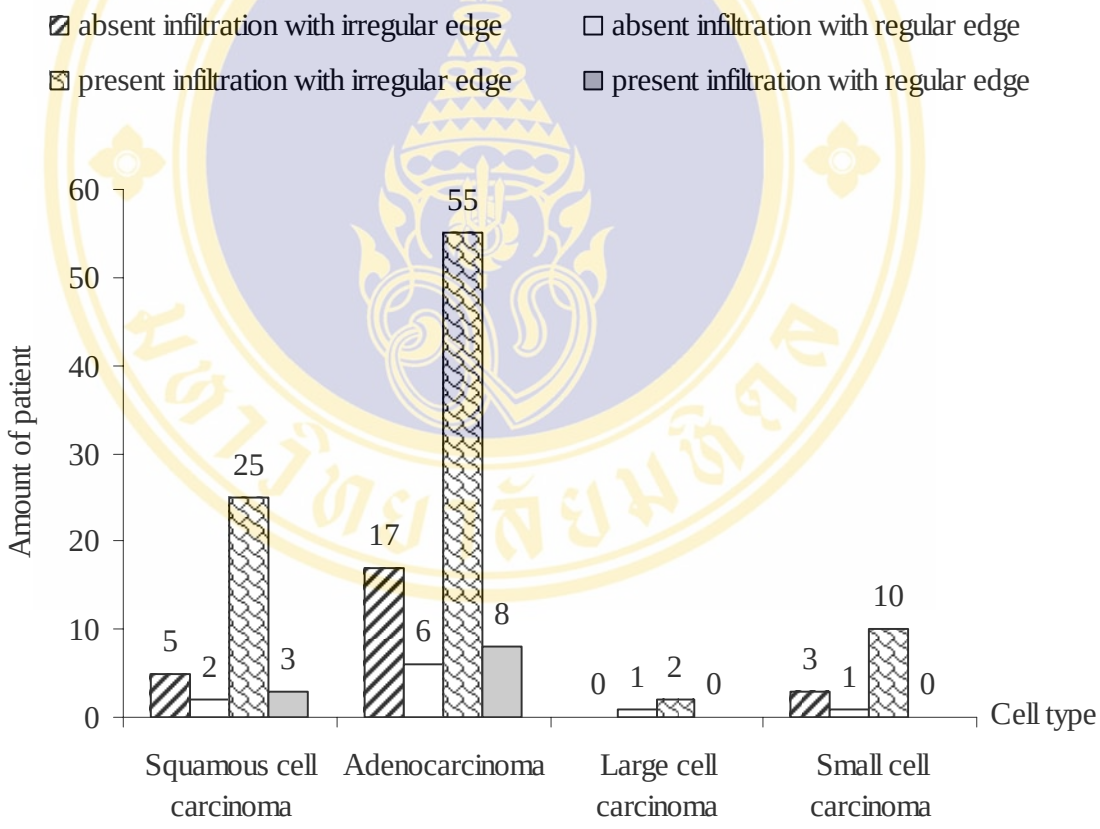


Chart 4-19. The distribution of lung cancer in 4 cell types by infiltration with edge

Table 4-6. The distribution of lung cancer in 4 cell types by location with cavity, and infiltration with edge

		Histology				
		Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcionoma (n=3)	Small cell carcinoma (n=14)	p-value*
Location @	Cavity					0.367
Central	-	20(57.1%)	42(48.8%)	2(66.7%)	11(78.6%)	
Central	+	-	1(1.2%)	-	-	
Peripheral	-	7(20%)	25(29.1%)	1(33.3%)	2(14.3%)	
Peripheral	+	1(2.9%)	-	-	-	
Infiltration	Edge					0.911
-	-	5(14.3%)	17(19.8%)	-	3(21.4%)	
-	+	2(5.7%)	6(7%)	1(33.3%)	1(7.1%)	
+	-	25(71.4%)	55(64%)	2(66.7%)	10(71.4%)	
+	+	3(8.6%)	8(9.3%)	-	-	

@ The location was showed in particular tumor presented in central and peripheral which not include tumor presented in N/A, then complied with cavity to calculated the correlation next.

4.12.3 Lymph node enlargement / Pleural effusion

Sixteen lesions (45.7%) of squamous cell carcinoma were absent lymph node enlargement with pleural effusion, six lesions (17.1%) absented lymph node enlargement but presented pleural effusion, nine lesions (25.7%) presented lymph node enlargement but absented pleural effusion, and four lesions (11.4%) presented lymph node enlargement with pleural effusion. Forty-one lesions (47.7%) of adenocarcinoma were absent lymph node enlargement with pleural effusion, eighteen lesions (20.9%) were absent lymph node enlargement but presented pleural effusion, thirteen lesions (15.1%) were present lymph node enlargement but absented pleural effusion, and fourteen lesions (16.3%) were present lymph node enlargement with pleural effusion. Two lesions (66.7%) of large cell carcinoma were absent lymph node enlargement but presented pleural effusion, and one lesion (33.3%) presented lymph node enlargement with pleural effusion. Four lesions (28.6%) of small cell carcinoma were absent lymph node enlargement with pleural effusion, four lesions (28.6%) absented lymph node enlargement but presented pleural effusion, three lesions (21.4%) presented lymph node enlargement but absented pleural effusion, and three lesions (21.4%) presented lymph node enlargement with pleural effusion (Table 4-7 and Chart 4-20). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lymph node enlargement with pleural effusion by Pearson’s chi square test showed difference was not statistically significant ($p>0.05$), as shown in table 4-7.

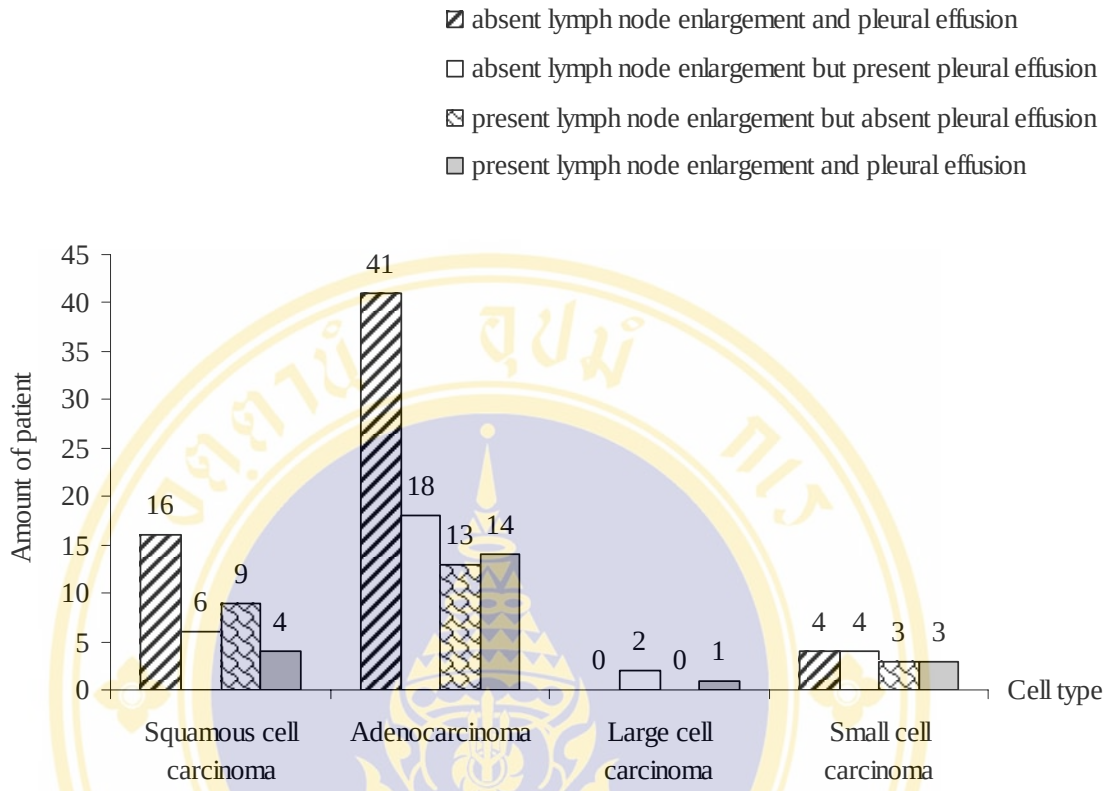


Chart 4-20. The distribution of lung cancer in 4 cell types by lymph node enlargement with pleural effusion

4.12.4 Lymph node enlargement / Atelectasis

Twenty-one lesions (60%) of squamous cell carcinoma were absent lymph node enlargement with atelectasis, one lesion (2.9%) absented lymph node enlargement but presented atelectasis, ten lesions (28.6%) presented lymph node enlargement but absented atelectasis, and three lesions (8.6%) presented lymph node enlargement with atelectasis. Fifty lesions (58.1%) of adenocarcinoma were absent lymph node enlargement with atelectasis, nine lesions (10.5%) were absent lymph node enlargement but presented atelectasis, twenty-six lesions (30.2%) were present lymph node enlargement but absented atelectasis, and one lesion (1.2%) were present lymph node enlargement with atelectasis. Two lesions (66.7%) of large cell carcinoma were absent

lymph node enlargement with atelectasis, and one lesion (33.3%) presented lymph node enlargement but absented atelectasis. Seven lesions (50%) of small cell carcinoma were absent lymph node enlargement with atelectasis, one lesions (7.1%) absented lymph node enlargement but presented atelectasis, and six lesions (42.9%) presented lymph node enlargement but absented atelectasis (Table 4-7 and Chart 4-21). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and lymph node enlargement with atelectasis by Pearson's chi square test was no statistically difference ($p>0.05$), as shown in table 4-7.

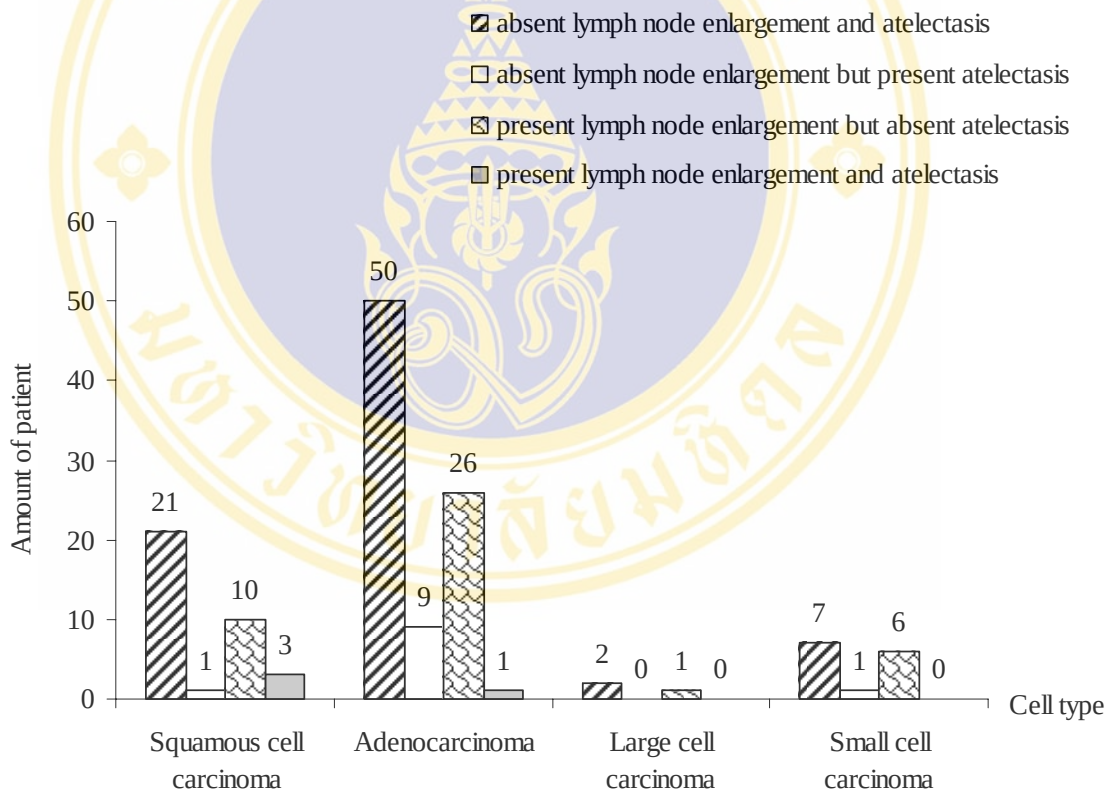


Chart 4-21. The distribution of lung cancer in 4 cell types by lymph node enlargement with atelectasis

Table 4-7. The distribution of lung cancer in 4 cell types by lymph node enlargement with pleural effusion, and lymph node enlargement with atelectasis

		Histology				
		Squamous cell carcinoma	Adenocar-cinoma	Large cell carcionoma	Small cell carcinoma	
		(n=35)	(n=86)	(n=3)	(n=14)	p-value*
Lymph node enlargement	Pleural effusion					0.689
-	-	16(45.7%)	41(47.7%)	-	4(28.6%)	
-	+	6(17.1%)	18(20.9%)	2(66.7%)	4(28.6%)	
+	-	9(25.7%)	13(15.1%)	-	3(21.4%)	
+	+	4(11.4%)	14(16.3%)	1(33.3%)	3(21.4%)	
Lymph node enlargement	Atelectasis					0.257
-	-	21(60%)	50(58.1%)	2(66.7%)	7(50%)	
-	+	1(2.9%)	9(10.5%)	-	1(7.1%)	
+	-	10(28.6%)	26(30.2%)	1(33.3%)	6(42.9%)	
+	+	3(8.6%)	1(1.2%)	-	-	

4.12.5 Pleural effusion / Infiltration

Seven lesions (20%) of squamous cell carcinoma were absent pleural effusion with infiltration, eighteen lesions (51.4%) were absent pleural effusion but presented infiltration, and ten lesions (28.6%) were present pleural effusion with infiltration. Twenty lesions (23.3%) of adenocarcinoma were absent pleural effusion with infiltration, thirty-four lesions (39.5%) were absent pleural effusion but presented infiltration, three lesions (3.5%) were present pleural effusion but absented infiltration, and twenty-nine lesions (33.7%) were present pleural effusion with infiltration. One lesion (33.3%) of large cell carcinoma was present pleural effusion but absented infiltration and two lesions (66.7%) were present pleural effusion with infiltration. One lesion (7.1%) of small cell carcinoma were absent pleural effusion with infiltration, six lesions (42.9%) were absent pleural effusion but presented infiltration, three lesions (21.4%) were present pleural effusion but absented infiltration, and four lesions (28.6%) were present pleural effusion with infiltration (Table 4-8 and Chart 4-22). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and pleural effusion with infiltration by Pearson's chi square test showed difference was statistically difference ($p<0.05$), as shown in table 4-8.

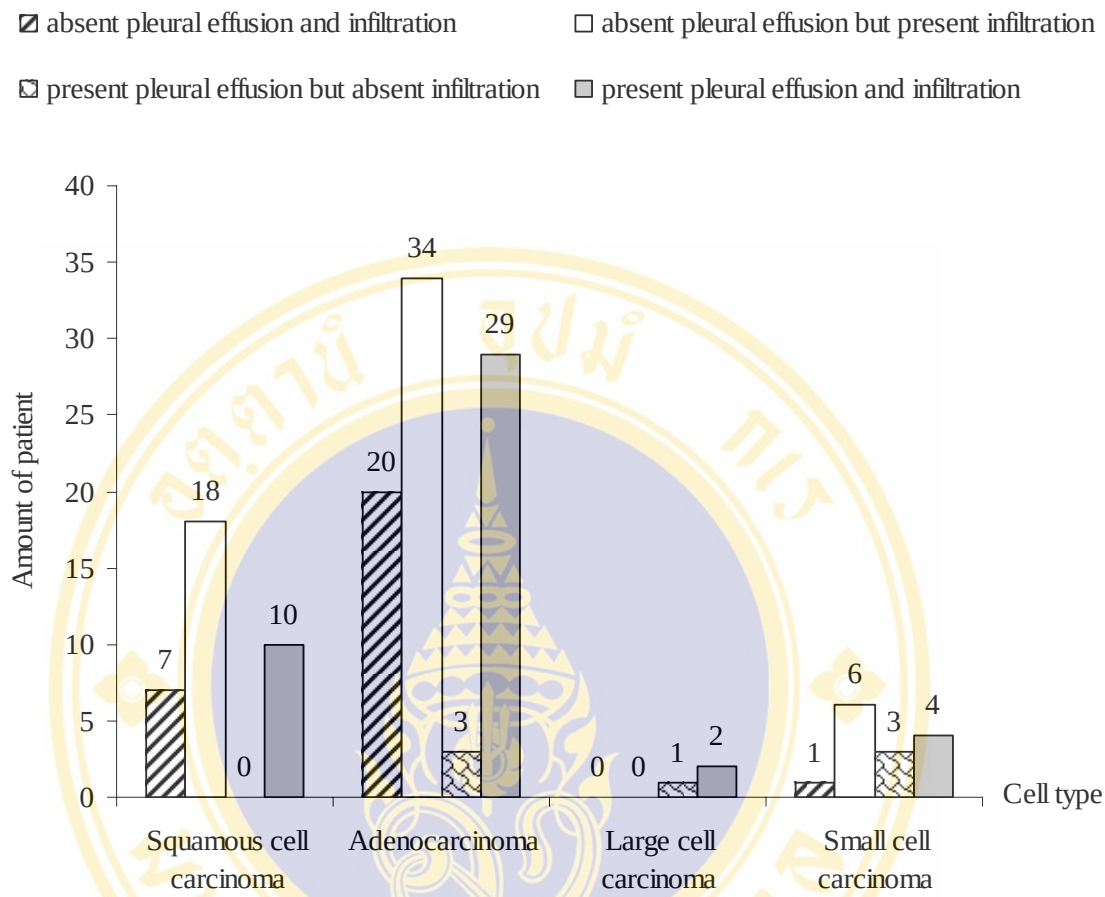


Chart 4-22. The distribution of lung cancer in 4 cell types by pleural effusion with infiltration

4.12.6 Collapse / Obstruction

Thirty-two lesions (91.4%) of squamous cell carcinoma were absent collapse with obstruction, one lesion (2.9%) was absent collapse but presented obstruction, one lesion (2.9%) was present collapse but absented obstruction, and one lesion (2.9%) was present collapse with obstruction. Seventy-nine lesions (91.9%) of adenocarcinoma were absent collapse with obstruction, two lesions (2.3%) were absent collapse but presented obstruction, and five lesions (5.8%) were present collapse but absented obstruction. Three lesions (100%) of large cell carcinoma were absent collapse with obstruction. Thirteen lesions (92.9%) of small cell carcinoma were absent collapse

with obstruction, and one lesion (7.1%) was absent collapse but presented obstruction (Table 4-8 and Chart 4-23). The correlation of histology (squamous cell carcinoma, adenocarcinoma, and small cell carcinoma) and collapse with obstruction by Pearson's chi square test showed difference was not statistically difference ($p>0.05$), as shown in table 4-8.

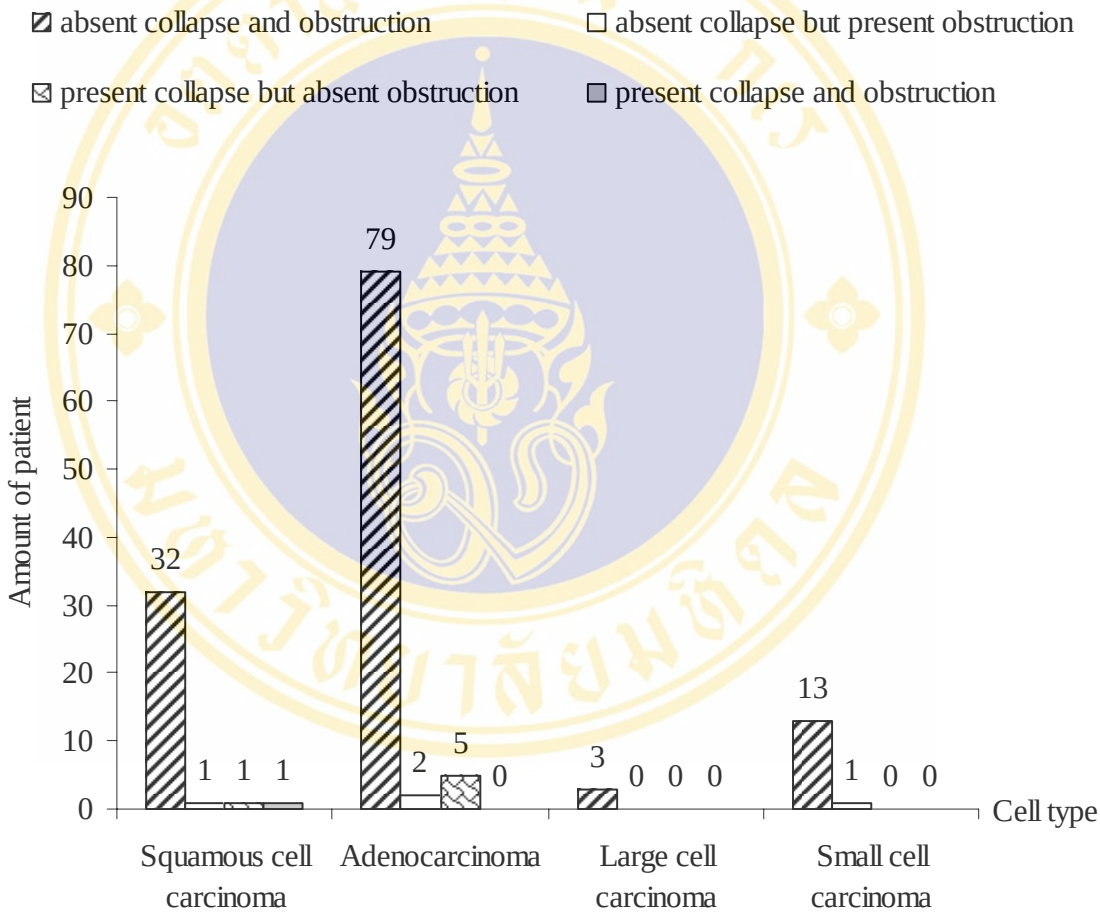


Chart 4-23. The distribution of lung cancer in 4 cell types by collapse with obstruction

Table 4-8. The distribution of lung cancer in 4 cell types by pleural effusion with infiltration, and collapse with obstruction

		Histology				
		Squamous cell carcinoma (n=35)	Adenocar-cinoma (n=86)	Large cell carcionoma (n=3)	Small cell carcinoma (n=14)	p-value*
Pleural effusion	Infiltration					0.037
-	-	7(20%)	20(23.3%)	-	1(7.1%)	
-	+	18(51.4%)	34(39.5%)	1(33.3%)	6(42.9%)	
+	-	-	3(3.5%)	-	3(21.4%)	
+	+	10(28.6%)	29(33.7%)	2(66.7%)	4(28.6%)	
Collapse	Obstruction					0.545
-	-	32(91.4%)	79(91.9%)	3(100%)	13(92.9%)	
-	+	1(2.9%)	2(2.3%)	-	1(7.1%)	
+	-	1(2.9%)	5(5.8%)	-	-	
+	+	1(2.9%)	-	-	-	

4.13 Interpretation agreement

4.13.1 Reviewers agreement

The interpretation agreement with chest x-ray film of the two radiologists was calculated by the Kappa index test concordance. Which the Kappa index of the chest x-ray film interpretation between radiologists or observers was considered fair (K=0.333). The characteristic of interpretation agreement between the radiologists are listed in Table 4-9.

Table 4-9. The interpretation agreement between the radiologists

	Radiologist 1				
Radiologist 2	Squamous cell carcinoma	Adenocar-cinoma	Large cell carcinoma	Small cell carcinoma	Total
Squamous cell carcinoma	37	4	1	22	64
Adenocarcinoma	11	23	6	6	46
Large cell carcinoma	1	0	1	0	2
Small cell carcinoma	2	3	2	9	16
Total	51	30	10	37	128

4.13.2 Reviewers consensus

From the two interpretation radiologists, the discrepant interpretation agreement between radiologists was resolved by consensus which presented as interpretation x-ray compared the histology. The characteristic of interpretation agreement between the interpretation x-ray and histology are listed in Table 4-10.

Table 4-10. The interpretation agreement of the interpretation x-ray and histology

	Histology				
Interpretation x-ray	Squamous cell carcinoma	Adenocar-cinoma	Large cell carcinoma	Small cell carcinoma	Total
Squamous cell carcinoma	24	25	1	4	54
Adenocarcinoma	8	47	2	3	60
Large cell carcinoma	1	2	0	0	3
Small cell carcinoma	2	12	0	7	21
Total	35	86	3	14	138

4.13.3 Accuracy and predictive value

The accuracy of chest x-ray for the diagnosis squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma were 69%, 55%, 0%, and 50% respectively. The positive predictive value of chest x-ray for squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma were 44%, 78%, 0%, and 33% respectively (Table 4-11 and Chart 4-24).

Table 4-11. The accuracy and predictive value

Test	Cell type	Value	95% Confident Interval
Accuracy	Squamous cell carcinoma	69%	95%CI = 54-84
	Adenocarcinoma	55%	95%CI = 44-66
	Large cell carcinoma	0%	
	Small cell carcinoma	50%	95%CI = 24-76
Predictive value	Squamous cell carcinoma	44%	95%CI = 28-60
	Adenocarcinoma	78%	95%CI = 69-87
	Large cell carcinoma	0%	
	Small cell carcinoma	33%	95%CI = 8-58

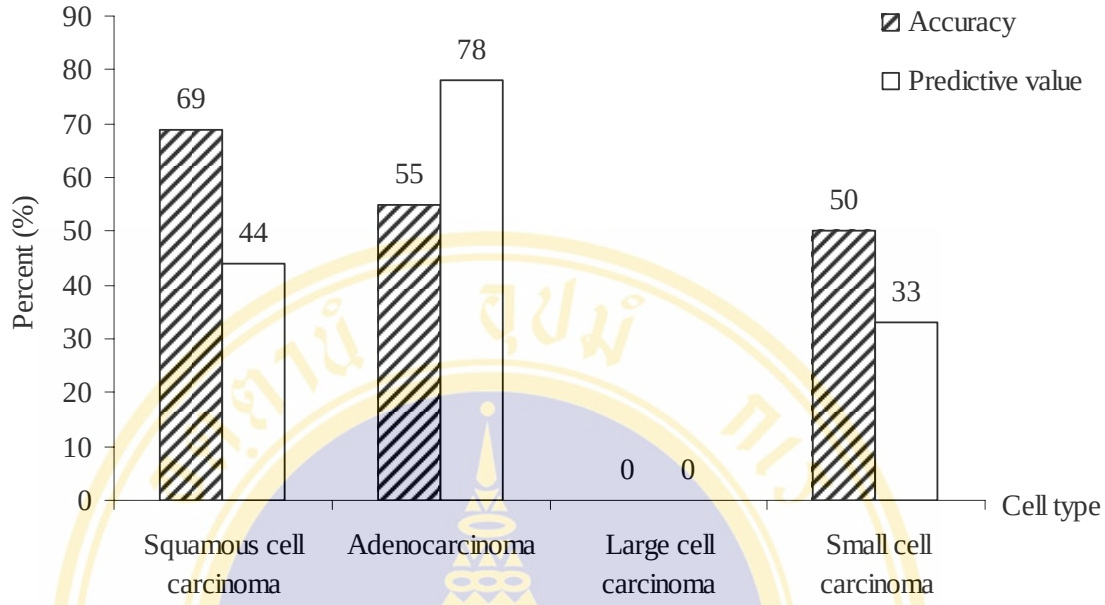


Chart 4-24. The accuracy and predictive value of interpretation from chest x-ray

CHAPTER V

DISCUSSION

Lung cancer is the most common cancer worldwide and the most common cause of cancer death. In Thailand, data on the period 1995-1997 showed cancer incidence difference from region to region and lung cancer was the most important cancer in both sexes (16). None screening technique has been able to demonstrate an impact on lung cancer mortality despite the higher sensitivity to detect smaller lung tumors. Due to the late stage of most lung cancer at the time of diagnosis and curative treatment by surgery is possible only for localized disease. Therefore in 2006, screening for lung cancer can not be recommended (20).

This study was presented in the radiological pathology of lung cancer from reviewed chest x-ray films in 138 lung cancer cases of Siriraj Hospital to consisted of squamous cell carcinoma, adenocarcinoma, large cell carcinoma and small cell carcinoma were 35 (25.36%), 86 (62.32%), 3 (2.17%), and 14 (10.14%) cases respectively like the previous reports in recent years, the predominant histologic type of lung cancer has shifted from squamous cell carcinoma to adenocarcinoma (52). In this study cases were 90 males and 48 females which small cell carcinoma (85.7%) and squamous cell carcinoma (82.9%) were most frequency in males and adenocarcinoma (45.3%) were most frequency in females at the significant difference ($p=0.003$) in sexes of squamous cell carcinoma, adenocarcinoma, and small cell carcinoma. But the group of patient with adenocarcinoma were male (54.7%) more than female (45.3%). In young patients (<45 years) were adenocarcinoma (minimum 25 years) and small cell carcinoma (minimum 19 years) but squamous cell carcinoma (minimum 47 years) and large cell carcinoma (minimum 45 years) were opposite (>45 years).

The tumor size were approximately in any cell type of lung cancer at significant difference (p=0.044) in tumor size of squamous cell carcinoma, adenocarcinoma, and small cell carcinoma which squamous cell carcinoma and adenocarcinoma had the smallest tumor size 1 cm but the largest tumor size was only squamous cell carcinoma 12 cm. After that, the tumor size was calculated by Mode was equal to 4 cm. To result in separate patients were 2 groups that the tumor size more than and less than 4 cm. The most percentage of large cell carcinoma (80%), squamous cell carcinoma (65%), and small cell carcinoma (61.5%) were size more than 4 cm. and the most percentage of adenocarcinoma (48.1%) was size less than 4 cm.

The common location of lung cancer was central region more than peripheral region by small cell carcinoma and squamous cell carcinoma were often found in central region but adenocarcinoma was often found in peripheral region. In addition to this study found that all cases of adenocarcinoma was in central region more than peripheral region but the percentage of adenocarcinoma cases in central region (50%) less than small cell carcinoma (78.6%) and squamous cell carcinoma (57%). All histological cell types of lung cancer were found in right lobe (62.3%) more than left lobe (33.3%) by squamous cell carcinoma was the first but small cell carcinoma was the first in left lobe. Then the common site of lung cancer was right upper lobe (29.71%) but small cell carcinoma were not found in middle lobe. The tumors had mostly homogeneous density and irregular edge. The infiltration was common found in about two-third of patients (74.6%) which squamous cell carcinoma and adenocarcinoma was 80% and 73.3% respectively. In part of pleural effusion was found in about one-third of patients (37.68%) and all calcification found 2.17% in only squamous cell carcinoma and adenocarcinoma. The lymph node enlargement was found 34% of all histological cell types by most frequency in small cell carcinoma (42.9%). Few cases in squamous cell carcinoma and adenocarcinoma found bone destruction but was not found in small cell carcinoma and large cell carcinoma. The pattern of calcification, air fluid, and chest wall destruction was not found in all cases.

The other radiological pathology in this study was rarely found in patients such as obstruction (3.62%). The atelectasis was firstly found in squamous cell carcinoma equal adenocarcinoma like as the collapse. In this study was not found small cell carcinoma presented collapse, fibrotic, and reticulonodular.

The compilation of the interested radiographic finding overlap together were found that the pleural effusion overlap the infiltration was significant (p=0.037) by non squamous cell carcinoma was found in cases of present plural effusion with absented infiltration while adenocarcinoma and small cell carcinoma found it. Most patients of all histological cell type were found in cases of absent pleural effusion with present infiltration at 42.75%. The location overlap the cavity was present central region with absent cavity at 54.35% and was present peripheral region with absent cavity at 25.36%. The infiltration was present with regular edge in all the histological cell type at the first (66.67%) but present infiltration with irregular edge was found in only squamous cell carcinoma and adenocarcinoma. In part of presented lymph node enlargement with atelectasis was not found in small cell carcinoma and large cell carcinoma while squamous cell carcinoma was firstly.

The interpretation agreement with chest x-ray film of the two radiologists was considered fair (Kappa index = 0.333) by consensus. Then, the accuracy and predictive value of chest x-ray were calculated in 95% confidence interval. The sequences from high to low of accuracy are squamous cell carcinoma (69%), adenocarcinoma (55%), small cell carcinoma (50%), and large cell carcinoma (0%). The part of predictive value have the sequences from high to low are adenocarcinoma (78%), squamous cell carcinoma (44%), small cell carcinoma (33%), and large cell carcinoma (0%).

The result of this present study was calculated in descriptive statistics to search scientifically statistic by Pearson Chi-Square test at a value of $p<0.05$ was considered statistically significant. In cases the correlation between the dependent variable with the independent variable was statistically significant such as sex, tumor size, and overlap of pleural effusion with infiltration brought to regression analysis for predict dependent variable. The coefficient of multiple determinations (R square) was 0.105

or the factor of histological cell types could be predicted at 10% by sex, tumor size, and overlap of pleural effusion with infiltration.

CHAPTER VI

CONCLUSION

Chest x-rays are commonly performed for diagnostic and other purposes. In fact, some abnormalities on chest radiograph are associated with an increased risk for lung cancer incidence and/or overall mortality (53). And then this retrospective descriptive research showed the characteristic patterns of histological lung cancer in any cell types. The radiological finding can help the radiologist to predict the histological cell type of lung cancer but can not to specifiable histological cell types.

The interested histological lung cancer in this study consists of squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and small cell carcinoma which amount patients was difference.

As stated, the film chest x-ray was demonstrated pathological characteristic of lung cancer such as location of tumor to show all histological cell types of lung cancer were found in right lobe more than left lobe especially right upper lobe by squamous cell carcinoma was the most frequency in right lobe but small cell carcinoma was the most frequency in left lobe. The tumor size could used the Mode calculation was equal to 4 cm. in separate patients were 2 groups. The most frequency of the tumor size more than 4 cm. was large cell carcinoma, squamous cell carcinoma, and small cell carcinoma and less than 4 cm. was adenocarcinoma. The present of lymph node enlargement and pleural effusion were most frequency in small cell carcinoma than squamous cell carcinoma but infiltration of squamous cell carcinoma more than small cell carcinoma which other radiological finding likewise. In term of radiological finding overlap, the association of pleural effusion with infiltration was interesting. None squamous cell carcinoma found in cases of the pleural effusion presented with absented infiltration.

The other characteristic of patients can help the radiologist to predict the histological cell type of lung cancer such as sexes and ages. The most frequency of males was small cell carcinoma and squamous cell carcinoma but the most frequency of females was adenocarcinoma. The young patients were found in small cell carcinoma and adenocarcinoma which squamous cell carcinoma and large cell carcinoma were found in older.

The characteristic of 138 patients with primary lung cancer disease were reported. To seem that, the sample size of individual histological lung cancer was difference such as large cell carcinoma was found 3 cases which less to calculate correlation by Pearson Chi-Square test and the film chest x-ray has problem into follow. So the recommendation of the prospective study should have more individual histological sample size in the vicinity. The film chest x-ray maybe looks up from the computed radiography (CR) databases which convenient in present.

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APPENDIX

This appendix showed the data collection table of patients with primary lung cancer from the characteristic of individual patient and radiological finding. Furthermore the pathologic result from databases maintenance of the Pathology Department and the histological result from the radiologist consulted were showed in this table too.

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
1	S 1	70	ชาย	1	6.5x5.4	LUL	C	+	+	-	-	-	-	-	+	-	-		Squamous	Squamous
2	S 2	65	หญิง	1	2.7x5.5	RLL	C	+	-	-	-	-	-	-	+	-	-		Squamous	Squamous
3	S 3	70	ชาย	1	8x2.6	RLL	C	+	-	-	-	-	-	-	+	-	-	Collapse & Pleural thickening	Squamous	Squamous
4	S 4	72	ชาย	1	9.2x8.1	LUL	C	+	-	-	-	-	-	-	+	+	-		Squamous	Squamous
5	S 5	55	ชาย	1	4.2x4.9	RUL	C	+	-	-	-	-	-	-	-	-	-		Squamous	Squamous
6	S 6	64	ชาย	1	4.8x3.1	RUL	N/A	+	-	-	-	-	-	-	+	-	-	Mass between central & peripheral	Squamous	Squamous
7	S 7	72	ชาย	1	3.1x3.5	RUL	C	+	-	-	-	-	+	-	-	-	-	Fibrotic & RUL Atelectasis	Squamous	Squamous
8	S 8	61	ชาย	1	4.5x6.1	RUL	C	+	+	-	-	-	+	+	+	-	-	Atelectasis	Squamous	Squamous
9	S 9	50	หญิง	1	3x3	LLL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Squamous
10	S 10	73	ชาย	1	6x6	RUL	C	+	-	-	-	-	+	+	+	-	-		Squamous	Squamous
11	S 11	71	หญิง	1	1.8x2	LUL	P	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Squamous
12	S 12	50	ชาย	1	12x11	LUL	C	+	-	-	-	-	+	-	+	-	-		Squamous	Squamous
13	S 13	73	ชาย	1	4x3	RML	C	+	-	-	-	-	-	-	+	-	-	RML Atelectasis	Squamous	Squamous
14	S 14	70	ชาย	1	8.2x10	RUL	C	+	-	-	-	-	+	-	+	+	-	3nd Rib destruction & Pancoast tumor	squamous	Squamous
15	S 15	74	ชาย	1	5x6	RLL	C	+	-	-	-	-	-	+	+	-	-		Squamous	Squamous
16	S 16	55	ชาย	1	8x8	RUL	P	+	-	-	-	+	+	+	+	-	-		Squamous	Squamous
17	S 17	70	ชาย	N/A	N/A	Rt.	C	N/A	-	-	-	-	-	+	+	-	-	Collapse & Obsrtuctive neumonia of Rt.lung	Squamous	Squamous
18	S 18	47	ชาย	1	2x1.5	RLL	P	+	-	-	-	-	+	-	-	-	-		Small cell	Squamous
19	S 19	65	ชาย	1	7x4.5	RUL	P	+	-	-	-	-	-	-	+	-	-		Squamous	Squamous
20	S 20	59	ชาย	N/A	N/A	Both	N/A	N/A	-	-	-	-	-	+	+	-	-	Diffuse reticulonodular & infiltration	Adenocarcinoma	Squamous

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
21	S 21	65	หญิง	1	6x4	RLL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Squamous
22	S 22	68	ชาย	1	10x9	LUL	N/A	+	-	-	-	-	-	-	+	-	-		Large cell	Squamous
23	S 23	73	ชาย	1	4x4	RLL	C	+	+	-	-	-	-	-	-	-	-		Squamous	Squamous
24	S 24	65	ชาย	1	4x6	RLL	C	+	-	-	-	-	+	-	+	-	-		Small cell	Squamous
25	S 25	81	ชาย	1	5.5x4.5	RUL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Squamous
26	S 26	63	ชาย	1	10x8	LUL	C	+	-	-	-	-	+	-	+	-	-	Atelectasis	Squamous	Squamous
27	S 27	71	ชาย	1	6x6	RLL	C	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Squamous
28	S 28	68	ชาย	1	6.5x6.5	LUL	P	+	+	-	-	-	+	+	+	-	-		Adenocarcinoma	Squamous
29	S 29	68	หญิง	1	2.2x2.4	RUL	C	+	+	-	-	-	-	-	-	-	-		Squamous	Squamous
30	S 30	65	ชาย	1	4x4	LUL	N/A	+	-	-	-	-	+	-	+	-	-		Squamous	Squamous
31	S 31	59	ชาย	1	3x7	RML	C	+	-	-	-	-	+	-	+	-	-		Squamous	Squamous
32	S 32	59	หญิง	1	6x7	LLL	C	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Squamous
33	S 33	77	ชาย	1	2x1	LUL	N/A	+	-	-	-	-	-	-	+	-	-		Squamous	Squamous
34	S 34	75	ชาย	1	4x4	RUL	N/A	+	-	-	-	-	+	-	+	-	-		Squamous	Squamous
35	S 35	78	ชาย	1	7x4	RLL	N/A	-	-	-	-	-	-	-	+	-	-	Obstructive pneumonia	Squamous	Squamous
36	A 1	60	หญิง	1	4.6x3.2	RLL	C	+	-	-	-	-	-	+	+	-	-	Posterior mass	Adenocarcinoma	Adenocarcinoma
37	A 2	64	ชาย	1	2.5x2.2	RUL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
38	A 3	71	ชาย	1	3.7x1.6	RUL	C	+	-	-	-	-	-	-	-	-	-	Hilar node	Squamous	Adenocarcinoma
39	A 4	54	หญิง	1	2.9x1.9	RUL	N/A	+	-	-	-	+	-	-	+	-	-	Plate atelectasis	Adenocarcinoma	Adenocarcinoma
40	A 5	62	หญิง	1	3x2.5	RUL	C	+	+	-	-	-	-	-	+	-	-	RUL Atelectasis & RUL collapse	Squamous	Adenocarcinoma

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
41	A 6	69	ชาย	1	8x9.9	LUL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
42	A 7	61	หญิง	1	7x4.5	RUL	C	+	-	-	-	-	+	-	-	-	-	Lung collapse & RUL Atelectasis	Squamous	Adenocarcinoma
43	A 8	35	หญิง	N/A	N/A	Both	N/A	+	-	-	-	-	+	+	+	-	-	Reticulonodular & pulmonary infiltration	Adenocarcinoma	Adenocarcinoma
44	A 9	67	ชาย	1	6.1x6.7	RUL	C	+	+	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma
45	A 10	63	หญิง	1	3.8x4.1	Rt.	C	+	+	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma
46	A 11	67	หญิง	N/A	N/A	Both	N/A	+	-	-	-	-	-	-	+	-	-	RLL collapse & Bilateral reticulonodular	Squamous	Adenocarcinoma
47	A 12	75	หญิง	1	7.8x4.7	RUL	C	+	-	-	-	-	-	-	+	-	-	RUL Atelectasis	Squamous	Adenocarcinoma
48	A 13	54	หญิง	1	3.3x2.7	LLL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma
49	A 14	76	ชาย	1	1.5x2.2	RLL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
50	A 15	41	ชาย	1	3.3x2.1	RUL	P	+	-	-	-	-	-	-	+	-	-	Fibrotic	Adenocarcinoma	Adenocarcinoma
51	A 16	58	ชาย	1	2x1.9	RLL	C	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
52	A 17	54	ชาย	1	2.9x2.4	LUL	P	+	-	-	-	-	-	+	+	-	-	Lt. effusion	Adenocarcinoma	Adenocarcinoma
53	A 18	50	ชาย	1	7.1x4.5	Rt.	C	+	-	-	-	-	-	-	+	-	-		Small cell	Adenocarcinoma
54	A 19	51	หญิง	1	4.6x5	RLL	C	+	-	-	-	-	-	+	+	-	-	Plate atelectasis	Squamous	Adenocarcinoma
55	A 20	39	ชาย	1	4x6	RLL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma
56	A 21	44	หญิง	1	5.4x3.7	LLL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma
57	A 22	51	ชาย	1	4.4x4.1	RUL	N/A	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
58	A 23	72	หญิง	1	5.2x6.5	RUL	C	+	+	-	-	-	-	-	-	-	-	Fibrotic atelectasis	Squamous	Adenocarcinoma
59	A 24	73	หญิง	1	3.8x2.9	LUL	N/A	+	-	-	-	-	-	-	+	-	-	Nodule between central & peripheral	Squamous	Adenocarcinoma
60	A 25	79	ชาย	1	7.4x4.4	RLL	C	+	+	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
61	A 26	42	หญิง	N/A	N/A	Both	N/A	N/A	-	-	-	-	-	-	+	-	-	Lymphangiitis atelectasis	Adenocarcinoma	Adenocarcinoma
62	A 27	55	ชาย	1	7x4	Rt.	C	+	-	-	-	-	-	+	+	-	-		Small cell	Adenocarcinoma
63	A 28	68	หญิง	1	2.9x2.9	RLL	P	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
64	A 29	72	ชาย	1	7.8x7.5	RLL	N/A	+	+	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
65	A 30	55	หญิง	1	6.7x6.2	RML	C	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
66	A 31	42	ชาย	1	6x6.5	Lt.	C	+	-	-	-	-	-	+	+	-	-	Lymphangiitis spread	Small cell	Adenocarcinoma
67	A 32	70	ชาย	1	9.7x8	RLL	C	+	-	-	-	-	-	+	+	-	-	Lymphangiitis spread & Atelectasis	Squamous	Adenocarcinoma
68	A 33	84	หญิง	1	4x2.5	LUL	C	+	-	-	-	-	-	-	+	-	-	Fibrotic	Squamous	Adenocarcinoma
69	A 34	25	ชาย	N/A	N/A	Lt.	N/A	N/A	-	-	-	-	-	+	-	-	-	Lt. atelectasis	Squamous	Adenocarcinoma
70	A 35	57	ชาย	1	4x5	LUL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma
71	A 36	61	หญิง	1	2.5x2.3	RML	C	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
72	A 37	72	ชาย	1	1.8x1.2	LLL	P	+	+	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
73	A 38	62	ชาย	1	5x5	LUL	C	+	-	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
74	A 39	69	ชาย	1	8x5	RUL	C	+	-	-	-	-	-	-	+	+	-	Pancoast	Squamous	Adenocarcinoma
75	A 40	65	หญิง	1	6.5x7	RLL	P	+	-	-	-	-	+	+	-	-	-	Pneumonia	Adenocarcinoma	Adenocarcinoma
76	A 41	70	ชาย	1	7x2	LLL	P	+	-	-	-	-	+	+	+	-	-		Large cell	Adenocarcinoma
77	A 42	38	หญิง	1	6.5x3	LUL	C	+	-	-	-	-	+	-	+	-	-		Small cell	Adenocarcinoma
78	A 43	39	หญิง	1	5x5	LUL	P	+	-	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
79	A 44	57	หญิง	1	2x1	LUL	P	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
80	A 45	72	ชาย	1	4x6	RUL	C	+	-	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
81	A 46	65	หญิง	1	3.2x2.3	RUL	C	+	-	-	-	-	+	+	+	-	-		Small cell	Adenocarcinoma
82	A 47	71	ชาย	1	3.8x3.1	RLL	C	+	+	-	-	+	-	+	+	-	-	RUL Atelectasis	Squamous	Adenocarcinoma
83	A 48	59	หญิง	1	3.7x3.2	RUL	P	+	-	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
84	A 49	55	ชาย	1	2x1	RUL	C	-	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
85	A 50	52	ชาย	1	5x3.5	RLL	P	+	+	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
86	A 51	73	ชาย	1	4x6	RUL	C	+	-	-	-	-	+	+	+	-	-		Small cell	Adenocarcinoma
87	A 52	70	หญิง	1	3x3	Rt.	C	+	-	-	-	-	+	+	+	-	-		Squamous	Adenocarcinoma
88	A 53	74	ชาย	1	1.5x1	LUL	C	+	-	-	-	-	-	-	-	-	-		Squamous	Adenocarcinoma
89	A 54	61	ชาย	1	5x5	RLL	C	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
90	A 55	50	หญิง	1	4x3.5	LUL	C	+	-	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma
91	A 56	29	ชาย	1	4x4	LUL	C	+	-	-	-	-	-	-	+	-	-		Small cell	Adenocarcinoma
92	A 57	75	หญิง	1	2x2	LUL	C	+	-	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma
93	A 58	55	ชาย	N/A	N/A	Both	N/A	N/A	-	-	-	-	-	+	+	-	-	Diffuse reticulonodular & infiltration	Adenocarcinoma	Adenocarcinoma
94	A 59	63	ชาย	1	10.5x3	LLL	C	+	-	-	-	-	-	+	+	-	-		Large cell	Adenocarcinoma
95	A 60	63	หญิง	1	3.5x2.5	LUL	N/A	N/A	-	-	-	-	+	+	+	-	-	Diffuse reticulonodular	Adenocarcinoma	Adenocarcinoma
96	A 61	59	หญิง	1	3x2.8	RUL	C	+	+	-	-	-	+	-	-	-	-		Small cell	Adenocarcinoma
97	A 62	69	ชาย	1	5x4.5	RLL	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma
98	A 63	68	ชาย	1	4.7x5	RUL	C	+	+	-	-	-	+	-	+	-	-		Small cell	Adenocarcinoma
99	A 64	62	ชาย	1	7x6	RLL	C	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
100	A 65	77	หญิง	1	2.5x3	LLL	N/A	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Adenocarcinoma

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
101	A 66	62	ชาย	1	3x2	RLL	P	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
102	A 67	72	ชาย	1	7x5	RUL	N/A	+	-	-	-	-	-	-	+	-	-		Squamous	Adenocarcinoma
103	A 68	72	ชาย	1	7x4	RLL	C	+	-	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
104	A 69	73	ชาย	1	6x4	LLL	C	+	-	-	-	-	+	-	+	-	-		Squamous	Adenocarcinoma
105	A 70	56	หญิง	1	4.5x4.5	RUL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
106	A 71	60	ชาย	1	7x3	RUL	P	+	-	-	-	-	+	-	+	-	-		Adenocarcinoma	Adenocarcinoma
107	A 72	67	หญิง	1	3x2.2	RML	N/A	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
108	A 73	80	ชาย	1	7x7	RUL	N/A	+	-	-	-	-	-	+	+	-	-	Obstructive pneumonia & Hilar node	Squamous	Adenocarcinoma
109	A 74	55	ชาย	1	9.5x7.5	RUL	P	+	+	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
110	A 75	64	ชาย	1	1.5x2	LUL	P	+	-	-	-	-	-	-	-	-	-	Old TB at RUL	Adenocarcinoma	Adenocarcinoma
111	A 76	69	หญิง	1	3x2.5	LLL	N/A	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
112	A 77	49	หญิง	1	4x4	RML	C	-	-	-	-	-	+	-	+	-	-	Small mass	Small cell	Adenocarcinoma
113	A 78	58	หญิง	1	6x4.5	RML	P	+	+	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
114	A 79	51	ชาย	1	1.5x1	RML	N/A	+	-	-	-	-	-	-	-	-	-		Squamous	Adenocarcinoma
115	A 80	47	หญิง	1	2x2	RLL	N/A	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
116	A 81	61	ชาย	1	2x3	Rt.	C	-	-	-	-	-	+	+	+	-	-		Small cell	Adenocarcinoma
117	A 82	65	หญิง	1	5x4	LUL	C	+	-	-	-	-	+	+	+	-	-		Adenocarcinoma	Adenocarcinoma
118	A 83	75	ชาย	1	7x6.5	LUL	P	+	+	-	-	-	-	-	+	-	-		Adenocarcinoma	Adenocarcinoma
119	A 84	68	หญิง	1	6x9	Lt.	C	+	-	-	-	-	-	+	-	-	-	Lung collapse & Full Lt. effusion	Small cell	Adenocarcinoma
120	A 85	45	หญิง	1	2x2.5	LUL	N/A	-	-	-	-	-	+	-	-	-	-	Lung collapse	Squamous	Adenocarcinoma

(conc.)

NO.	Name	Age	Sex	Quantity (mass or nodule)	Size (cm.)	Location	Central (C) or Peripheral (P)	Density (homogeneous +)	Edge (regular +)	Calcification (present +)	Air fluid (present +)	Cavity (present +)	Lymph node (enlargement +)	Pleural effusion (present +)	Infiltration (present +)	Bone destruction (present +)	Chest wall destruction (present +)	Other radiographic pathology	Result	Pathology
121	A 86	51	ชาย	1	1.5x1.3	RML	C	+	-	-	-	-	-	-	-	-	-		Adenocarcinoma	Adenocarcinoma
122	L 1	84	ชาย	1	4x2.5	RML	P	+	-	-	-	-	-	+	+	-	-		Adenocarcinoma	Large cell
123	L 2	46	ชาย	1	8x7	RUL	C	+	+	-	-	-	-	+	-	-	-		Squamous	Large cell
124	L 3	45	หญิง	1	4.5x4.5	RUL	C	-	-	-	-	-	+	+	+	-	-	Full infiltration	Adenocarcinoma	Large cell
125	M 1	45	หญิง	1	5.2x2.6	RUL	C	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Small cell
126	M 2	77	ชาย	1	7.7x5.2	RLL	C	+	-	-	-	-	-	+	+	-	-		Squamous	Small cell
127	M 3	51	หญิง	1	7x4.5	RUL	C	+	-	-	-	-	+	+	-	-	-		Small cell	Small cell
128	M 4	70	ชาย	N/A	Small	Both	C	+	-	-	-	-	-	-	+	-	-		Small cell	Small cell
129	M 5	56	ชาย	1	4.7x5	Rt.	C	+	-	-	-	-	+	-	+	-	-	Node obstruction	Small cell	Small cell
130	M 6	58	ชาย	N/A	N/A	Lt.	N/A	N/A	-	-	-	-	+	-	-	-	-		Small cell	Small cell
131	M 7	19	ชาย	1	5x4.5	LLL	P	+	-	-	-	-	-	-	+	-	-		Adenocarcinoma	Small cell
132	M 8	68	ชาย	1	6.4x4.5	Lt.	C	+	-	-	-	-	-	+	-	-	-		Small cell	Small cell
133	M 9	58	ชาย	1	3x3.5	RUL	C	+	-	-	-	-	+	+	+	-	-	Golden S sign	Squamous	Small cell
134	M 10	72	ชาย	1	8x5	RUL	C	+	-	-	-	-	+	+	+	-	-		Small cell	Small cell
135	M 11	73	ชาย	1	4x3	RUL	C	+	-	-	-	-	-	-	+	-	-		Squamous	Small cell
136	M 12	62	ชาย	1	4.5x4	LLL	C	+	-	-	-	-	+	-	+	-	-		Small cell	Small cell
137	M 13	66	ชาย	1	3.5x3.5	LLL	P	+	+	-	-	-	-	+	-	-	-	Atelectasis	Adenocarcinoma	Small cell
138	M 14	82	ชาย	1	6x7	LLL	C	+	-	-	-	-	-	+	+	-	-		Squamous	Small cell

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