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Evaluating multi-detector CT scan findings for patients suffering primary bronchogenic cancer

Babak Shekarchi[1], Samane Fartookzadeh[2]* and Ghazal Lashgari[3]

[1]Assistant Professor, Radiology Department, AJA university of Medical Science, Tehran, Iran
[2]Assistant professor, Cardiac department, AJA University of Medical Science, Tehran, Iran
[3]MD Researcher, Shahid Beheshti University of Medical Science, Tehran, Iran
**Corresponding author*

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A B S T R A C T

Statistics have shown that 80% of the cancer mortality is due to primary bronchogenic cancer. The objective of this study is to show that evaluating the results of MDCT scans is more appropriate for early diagnosis of primary stages of bronchogenic cancer. High resolution 64-MDCT was performed for both groups of study sample; for patients with primary bronchogenic cancer it was done in order to determine or confirm the stage of disease. Any case with positive CT-guided biopsy of peripheral mass or bronchoscopic biopsy of central mass was included in the study. A questionnaire with specific variables was designed at the beginning of study and it was completed for each case during research. Variables were compared between two groups of pathologies (SCLC and NSCLC) using statistical tests. Analysis of variables in two groups of pathologies showed significant statistical difference in direct mediastinal invasion, lymph node involvement, central position, collapse and stage between SCLC and NSCLC ($p < 0.05$). On the other hand age, sex, mass size, border (well-defined or ill-defined), cavitations, speculation, chest wall invasion, calcification, pleurisy, pericardial effusion, location, liver metastasis, spleen metastasis and adrenal metastasis were not significantly different in two groups of primary bronchogenic cancer SCLC and NSCLC ($p > 0.05$). Statistical analysis showed a highly significant relation between direct mediastinal invasion of tumor and pathology result (SCLS or NSCLS). Second great relation was between pathologic results and central position, collapse and lymph node involvement.

Introduction

Primary bronchogenic carcinoma is the leading cause of cancer deaths in both men and women globally .[1] Studies have shown that in most cases, bronchogenic cancer happens between ages of 55-65.[1,2] Unfortunately, high percent of cancer mortality rate is due to primary bronchogenic cancer.[1,2] In recent decades

on-time diagnosis and combined treatment improvements such as surgery, radiation therapy and chemotherapy have caused a longer survival for patients.[1, 2]
Bronchogenic cancer has different clinical symptoms such as: tumor's local growth, metastasis, lymph node involvement, chest wall invasion and etc.[3] There are few cases with no symptoms that their cancer is discovered by chest radiology; it reveales the importance of screening high risk patients.[3,4]

The term "primary bronchogenic cancer" is used for malignant neoplasms arising from epithelium of a bronchus or bronchiole.[1,4] Lung cancers are divided into two categories base on predominant cell type: small sell carcinomas and non-small cell carcinomas.[5,6] Mass patterns of small cell carcinomas are different from those of non-small cell carcinomas shown in radiology. Also different treatment strategiess are preferred for each of them.[6]

Usually, surgery can not cure small cell carcinomas as they are spread, but timely radiation therapy or chemotherapy increases the likelihood of curing.[7] On the other hand, localization of non-small cell carcinomas substantially increases surgery appropriateness and chemotherapy effectiveness.]

64-multi-detector-row CTs are new series of computed tomography that enable accurate and reliable visualization of whole body within few seconds in thin section format.[4,8] Great ability of MDCTs in diagnosis of pulmonary fibrosis and other abnormal pathologic changes of lung tissues has been the subject of many recent studies.[1,3,4]

The available technologies for detecting the primary Bronchogenic cancer include cytologic and molecular evaluation of lung sputum and imaging modalities.[2,4] Sputum cytology was believed to have potential for the early detection of bronchogenic cancer.[5] But one of the main disadvantages of this method is that other diagnostic methods must be applied to identify the location of the cancer.[4,5] Fine needle aspiration (FNA) biopsy is another diagnostic method which has the risks of blood coughing, pain and hemoptysis.[5, 6] Also it has the inability to biopsy right para-tracheal and pre-tracheal nodes due to the air-filled trachea, which blocks the ultrasound signal.[5,6,7] These reasons along with other limitations of current diagnostic methods haveencouraged using MDCT for primary bronchogenic cancer evaluation.[8]

No other research has ever been done in evaluating the MDCT results for patients with primary bronchogenic cancer. The aim of this study is to show that evaluation of MDCT results is more appropriate for primary bronchogenic cancer diagnosis.

Patients and Methods

In this descriptive case series study, 42 patients who were either presented with primary stage or suspected to have bronchogenic cancer were selected from patients who came to radiology center. First group were patients whom primary bronchogenic cancer was diagnosed by pathology evaluations. In this group the goal was more evaluation of bronchogenic cancer stage. Second group were patients with suspicious clinical symptoms.

High resolution 64-MDCT was performed for both groups. For second group it had more a diagnostic reason. Patients whom MDCT result showed a pulmonary mass and the pathologic result of their CT guided or bronchoscope biopsies were suggestive

of one of the primary bronchogenic cancers (SCLC or NSCLC) were included in the study. If the pathology showed any other results (metastasis, granuloma, etc.) patient was excluded from the study. A data collection form with twenty different variables such as sex, age, mass size, mass pattern, cavitation, speculation, mass stage, pancreas metastasis, mass pathology, etc. was designed before the study was started. For each case, questionnaires were completed due to their MDCT result.

Data was analyzed using SPSS 16. For quantitative variables mean, median, minimum, maximum and standard deviation were calculated and for quantitative variables frequency tables and graph were conducted.

Result and Discussion

Among all cases, 67% were males and 33% were females, 21% had small-cell carcinoma and other 79% had non-small-cell carcinoma according to pathology results. Mean age were 53 ± 22.4 and 63±13.9 for SCLS and NSCLC, respectively. Frequency distribution of age for both groups is presented in table 1.
Forty two percent of patients with NSCLC had SCC, 39% adenocarcinoma, 9% broncho-alveolar carcinoma and 9% had undifferentiated type of cancer.
Mean mass size for SCLC group and NSCLC group were 61 ± 19.5mm and 52 ± 19.4mm, respectively. Statistical analysis didn't show a significant different for mass size between two groups ($p > .05$).

One of the important variables was direct mediastinal invasion of tumor which had a statistically significant difference between SCLC and NSCLC groups ($p < .01$). A logistic regression for pathologic result on direct mediastinal invasion (DMI) was fitted. As it can be seen in table 2, DMI odds ratio is 44.8. It means that chance of mediastinal invasion for SCLC group is 44.8 times more than its chance for NSCLC group.

Lymph node involvement, mass central position and mass staging were other variables that were significantly different in SCLC and NSCLC groups ($p < .05$) (table 3) (figures 1-3).

In this study the incidence of two types of primary bronchogenic cancer based on pathology was evaluated. Direct mediastinal invasion, lymph node involvement, mass central position and mass staging were variables that differ significantly in SCLC and NSCLC groups. Sex, age, mass pattern, cavitation, speculation, pericardial effusion, liver metastasis and adrenal metastasis on the other hand were not statistically different in two groups. The interesting part was the sex ratio of patients that remained 2 in both groups of SCLC and NSCLC.
We did not find any relationship between cavitation, liver or adrenal metastases, and the tumor type, but some authors have shown that cavitation (which is a result of central necrosis) is suggestive of NSCLC [9, 10].

Squamous cell carcinoma has decreased in frequency and now comprises 25% of lung cancers[11]. These are usually slow growing, with late metastasis predominately to the liver, adrenal glands, kidneys, and bones.[12,13] Tumors usually range in size from 1 to 10 cm. They are typically found in the central bronchi, although one third occur beyond the segmental bronchi. [12,14,15] Endobronchial neoplasm may result in postobstructive pneumonia and/or atelectasis in up to 50% of cases,[12,15,16] and the underlying mass may be observed.[12,16]

Table.1 Frequency distribution of age and pathology results

		pathology		
		SCLC	NSCLC	Total
Age	25-34	2	1	3
	35-44	3	2	5
	45-54	0	6	6
	55-64	0	5	5
	65-74	1	9	10
	75-84	3	10	13
Total		9	33	42

Table.2 Logistic regression for pathologic result on DMI (Direct Mediastial Invasion)

	B	S.E.	Wald	df	Sig.	Exp(B)
DMI	3.802	1.166	10.624	1	.001	44.800
Constant	-4.272	1.528	7.814	1	.005	.014

Table.3 Lymph node involvement frequency

			pathology		
			SCLC	NSCLC	Total
Lymph Node Involvement		Yes	7 77.8%	11 33.3%	18 42.9%
		No	2 22.2%	22 66.7%	24 57.1%
Total			9	33	42

Mean mass size for SCLC group and NSCLC group were 61 ± 19.5mm and 52 ± 19.4mm, respectively. Statistical analysis didn't show a significant different for mass size between two groups ($p > .05$).

Figure.1 Direct mediastinal involvement in a small cell lung cancer.

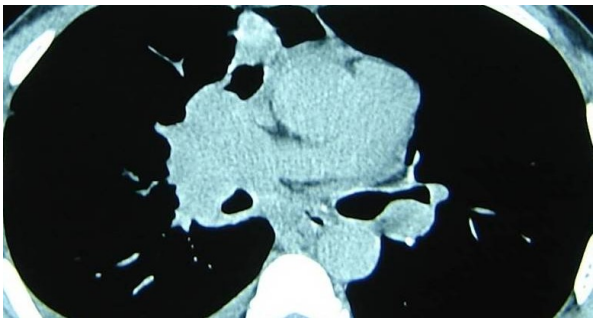


Figure.2a A central lung cancer

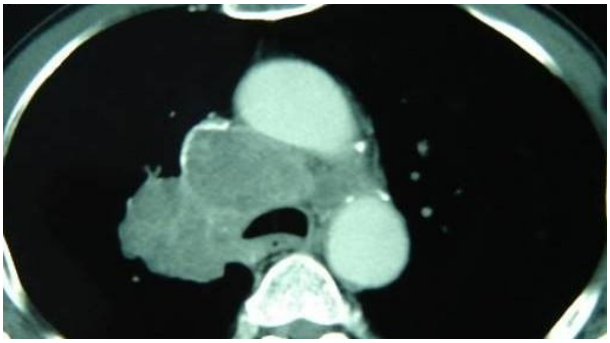


Figure.2b A peripheral lung cancer

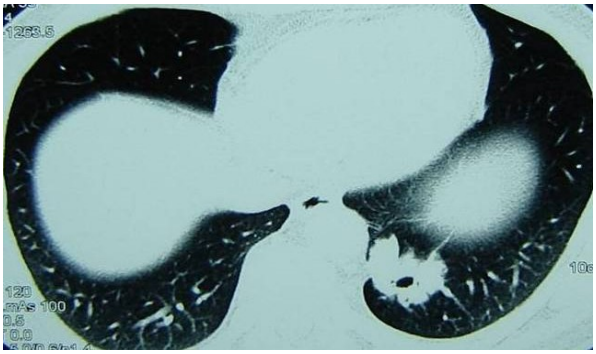
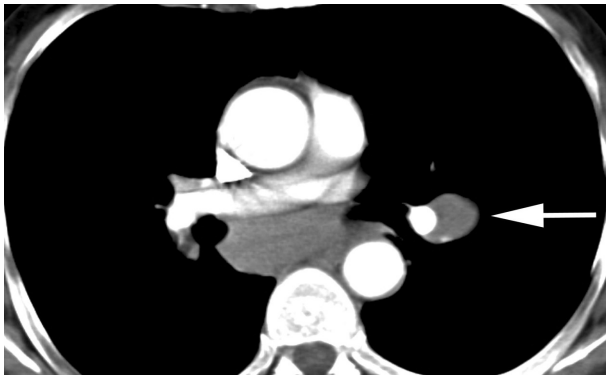


Figure.3 Lymphadenopathy



Mucoid impaction, bronchiectasis, and hyperinflation are additional findings of a central obstructing neoplasm. [12,14,17,18] Extension into the chest wall or mediastinum with bone destruction, superior vena cava syndrome, and phrenic or recurrent laryngeal nerve paralysis have been reported.[12,19,20] Squamous cell carcinoma cavitates in 10 to 20% of cases,[12,15] particularly in large peripheral lesions (30%).[14,21] Cavity walls are usually thick and irregular, ranging in size from 0.5 to 3 cm. Rarely, extensive necrosis may result in a thin-walled cavity.[12] Squamous cell carcinoma is the most common type to prove Pancoast or superior sulcus tumors.[12] Asymmetry of > 8 mm in apical pleural thickening may be an important finding, especially when associated with chest wall pain, brachial or laryngeal nerve paralysis, or bone destruction. [12]

Twenty to 25% of all lung cancers are small cell lung carcinoma (SCLC).[22,23,24] They probably arise from neuroendocrine cells and contain neurosecretory granules and may produce peptide hormones.[19,20] The tumors are usually located centrally (75 to 90% of cases),[22,24] and mediastinal extension is common and often extensive with encasement of mediastinal structures and tracheobronchial compression.[25,26] The less-commonly described peripheral SCLC is often associated with hilar adenopathy,[12,15,20,22] and atelectasis secondary to main stem bronchus compression.[14,22]

Pleural effusions are reported in 5 to 50% of cases.[12,25,26,27] The primary lesion may be small or not even visible on radiograph studies, but early extrathoracic metastases are common and even present prior to the development of pulmonary symptoms. Liver, bone marrow, adrenal glands, and brain are frequent sites of metastatic disease.[22,24,28]

Isolated adrenal metastases rarely occur in patients with lung cancer; 98% of patients with lung cancer who have metastasis to the adrenal glands have disease elsewhere. Approximately 50% of adrenal masses that are radiologically detected are, in fact, benign (eg, adenomas, cysts)[29]. Nevertheless, isolated adrenal metastases have been reported in 2.4% of patients with NSCLC (most have other metastases). When the adrenal glands are a site of involvement, they are easily visualized on chest CT, because metastases usually cause the gland to enlarge. In practice, most thoracic CTs include the adrenals in a person suspected of having lung cancer. Adrenal evaluation allows detection of the 2 to 9% of the adult population with adrenal adenomas. Yet the size, shape, homogeneity, and heterogeneity of the adrenal gland are of little help in distinguishing between benign and malignant disease. Patients never report adrenal dysfunction. Magnetic resonance imaging is of questionable help.[30] Biopsy specimens may be diagnostic if the pathologists who review the biopsy specimens are experienced in differentiating adenoma from metastatic adenocarcinoma.[31]

As with the adrenal gland, a portion of the liver is included in chest CT imaging. For radiologists who do not routinely use contrast media (as in our institution), hepatic lesions are not frequently detected or clarified. Isolated hepatic metastases are very uncommon in patients with NSCLC. When lesions are solitary and no other metastases are evident, such abnormalities usually represent a benign process. Because visualization of the liver cannot be avoided during chest CT scanning, we recommend that radiologists either undertake full-fledged studies or establish a prior agreement with referring clinicians

regarding attention to hepatic lesions. Again, isolated hepatic metastases in patients with NSCLC are uncommon.[31] Although some radiological manifestations may suggest the tumor type, but definitive diagnosis is based on histopathology.

Conclusion

In this study the efficiency of MDCT for detailed evaluation of bronchogenic cancer was showed. But despite all the advantages of MDCT technique for imaging chest, its role for bronchogenic carcinoma staging remains limited. New display techniques of three dimensional data sets include volume rendering and virtual bronchoscopy. These techniques represent new tools for the evaluation and demonstration of pathology within the central tracheo-bronchial tree. Their most important application is the guidance of bronchoscopic biopsies.

In future researches combination of MDCT and bronchoscopy can be used in order to prevent the unnecessary treatments (such as several surgeries).

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