

The usefulness of transesophageal echocardiography in the staging of locally advanced lung cancer

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ABSTRACT: *The usefulness of transesophageal echocardiography in the staging of locally advanced lung cancer. U. Caterino, G. Dialetto, F.E. Covino, G. Mazzarella, E. Grella, M. Massimo.*

Background. The pre-operative staging of locally advanced non-small cell lung cancer (NSCLC) is an important clinical and radiological issue. Computed tomography (CT) scan cannot always provide sufficient information about resectability and some patients may undergo unnecessary thoracotomy. The purpose of this study was to evaluate the utility of transesophageal echocardiography (TEE) in distinguishing T3 from T4 lesions in patients with lung cancer possibly involving cardiovascular structures and to compare its findings with those of computed tomography and, whenever possible, of surgical samples.

Methods. Between January 1998 and December 2001, sixteen patients were referred to our pulmonology unit for evaluation of locally advanced NSCLC possibly involving

the heart or great vessels. All patients underwent mediastinal staging with both contrast enhancement CT scan and TEE.

Results. The mediastinal staging by CT scan classified eleven patients as T4N0M0 and five patients as T3N0M0. TEE suggested mediastinal extension of the tumour in nine out of sixteen patients, who were eventually classified as T4; the remaining seven patients had no mediastinal involvement according to TEE and were therefore classified as T3. The pathologic staging confirmed clinical TEE staging in all of the ten patients who subsequently underwent surgery. The remaining six patients were excluded from surgery either because of major coexistent illnesses or because refused to be operated on.

Conclusion. TEE is a useful diagnostic tool in the staging of patients with locally advanced NSCLC which suspect involvement of heart and/or great vessels.

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Keywords: *Transesophageal echocardiography, endoscopic ultrasonography, lung cancer, computed tomography, mediastinal staging.*

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Introduction

Accurate mediastinal staging plays a crucial role in selecting the appropriate treatment strategy for locally advanced non-small cell lung cancer. In the International Staging System (ISS), locally advanced lung cancer includes patients with T3N0M0 and T4N0M0 stages, both of which are considered potentially resectable [1-2]. In the absence of mediastinal lymph node involvement, careful evaluation of the direct tumour spread to adjacent mediastinal structures is essential in planning the extent of tumor resection. In clinical staging, computed tomography (CT) is widely used to evaluate the mediastinum, although its ability to visualise mediastinum is not fully satisfactory [3-4-5]. As a consequence, some patients may undergo unnecessary thoracotomy due to false negative imaging study on mediastinal structures involvement.

In the last two decades, the usefulness of ultrasound-based techniques in the staging of lung cancer

has been extensively evaluated [1, 2, 6-9, 16, 22, 23] the vast majority of these studies refer to endoscopic ultrasound-guided needle aspiration (EUS-NA), a technique used mainly by gastroenterologists to sample mediastinal lymph nodes (especially those located in the posterior mediastinum) from the esophagus. Another ultrasound-based technique, namely transesophageal echocardiography, has been used in the assessment of locally advanced lung cancer, and has been shown to be superior to CT in differentiating mediastinal neoplastic invasion from simple contact by contiguity or adhesion.

The aim of the present study was to assess the diagnostic value of TEE in the staging of locally advanced lung cancer.

Materials and Methods

We retrospectively analysed the data from sixteen consecutive patients (median age, 60.6 years; twelve males, four females) with NSCLC who un-

derwent TEE between January 1998 and December 2001 at Monaldi Hospital in Naples. Before TEE, all patients had a definite histologic diagnosis of NSCLC by bronchoscopy and had a CT scan mediastinal staging. Patients considered to be operable after CT and TEE mediastinal staging were subsequently submitted to surgery. The following categories of patients were excluded from the study: a) definite CT evidence of unresectable disease; b) mediastinal lymph node involvement; c) metastatic disease; d) serious co-morbid medical illness which rendered them not surgical candidates; e) esophageal stenosis.

We used an Acuson Sequoia multiplane probe (7 and 3.5 MHz, Mountain View; CA, U.S.A.) with Hewlett-Pechard Ultrasound 2000 biplane probe [Andover; Mass,U.S.A.] equipped with doppler colour flow imaging to examine the lung cancer and its surroundings. The procedure was performed after local pharyngeal anesthesia using 2% lidocaine spray, the patients were positioned in the left lateral decubitus position. The basal short axis, the four chambers, the left ventricular short axis, great mediastinal vessels and the lung tumour itself were inspected during TEE.

The following TEE criteria were considered to be evidence of mediastinal involvement: 1) ultrasonographic finding showed the tumour extending into cardiovascular structures; 2) lack of synchronous movement of mediastinal pleura and cardiovascular wall during respiratory and cardiac motion; 3) absence or reduction of vascular flow for great vessels [1-13].

All TEE data was compared with CT results and with subsequent operative findings if the tumour was resected.

Results

Between January 1998 and December 2001, sixteen patients (twelve male and four female) underwent CT and TEE for locally advanced non small cell lung cancer staging.

By CT scan and TEE, four of sixteen patients showed typical signs of invasion of the cardiovascular structures; two of sixteen patients judged resectable by CT and TEE were inoperable for severely medical complications; 10 of 16 patients underwent surgery.

The CT and TEE pre-surgical staging were compared with pathologic staging. The pathologic stage confirmed CT scan results in eight of the ten patients. In comparison TEE and Pathologic stages were overlapped in all 10 patients (table 1).

Transesophageal echocardiography allowed us to change the planned surgical intervention in three out of ten patients.

In fact, the two patients considered unresectable by CT scan, the first for invasion of the descending aorta and the second for invasion of left pericardium and the left main pulmonary artery, both underwent pneumonectomy after that the TEE showed operable criteria (fig. 1 A-B).

For the third patient, known to be allergic to iodine contrast media, CT scan suggested that the tumour extended into the right pulmonary artery, and involved the superior vena cava. In the same patient TEE doppler colour showed superior vena cava sliding on intact mediastinal pleura with preserved blood-flow.

Discussion

Patients with locally advanced non-small cell lung cancer represent a subset potentially suitable for surgery [5-24]. Recent advances in lung cancer clinical staging, such as the use of Positron Emission Tomography (PET), has improved the assessment of nodal (N) and metastatic (M) disease [12]. Assessment of local invasion of the cancer for T3 and T4 lesions is still largely dependent on CT, which shows a low accuracy although considered the "gold standard" in the preoperative staging of lung cancer [2-3-4-5]. In fact, a tumour with contact >3 cm or with an absent mediastinal fat plane can not always be considered unresectable [3]. The limitations of CT in assessing the tumour invasion are biological and technical [1].

The biological limitations depends pleural thickness that being thin can not be visualised if there is not enough mediastinal fat and (or) the partial volume averaging of the cardiovascular structures which disturbs the CT-imaging [1-21]. Technical limitation is caused by low capacity of computer to distinguish adjacent tissues through their own different grade of radiation absorption.

These limitations may result in an overestimation or understimation of the range of resection, leading to unnecessary thoracotomy.

Table1. - Comparison of Pathologic Stage with Transesophageal ecocardiography and CT

Patient	CT Staging	TEE Staging	Pathologic Staging	Surgery
1	T4N0M0	T3N0M0	T3N0M0	Pneumonectomy
2	T4N0M0	T3N0M0	T3N0M0	Lobectomy
3	T4N0M0	T4N0M0	T4N0M0	Pneumonectomy
4	T3N0M0	T3N0M0	T3N0M0	Lobectomy
5	T4N0M0	T4N0M0	T4N0M0	Pneumonectomy
6	T3N0M0	T3N0M0	T3N0M0	Lobectomy
7	T3N0M0	T3N0M0	T3N0M0	Lobectomy
8	T3N0M0	T3N0M0	T3N0M0	Lobectomy
9	T3N0M0	T3N0M0	T3N0M0	Lobectomy
10	T4N0M0	T4N0M0	T4N0M0	Pneumonectomy

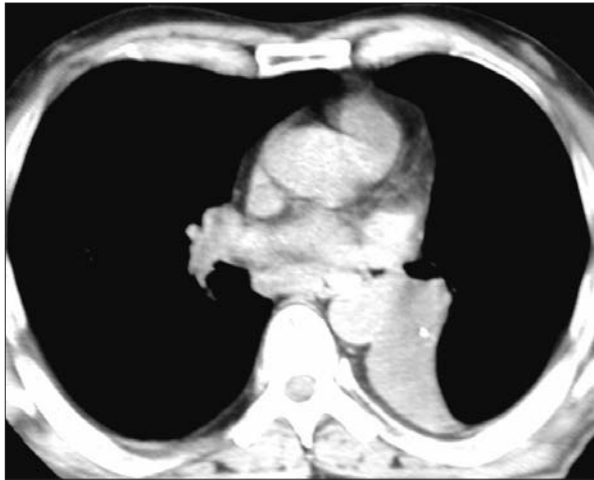


Fig. 1A. - Chest CT with central mass abutting the descending aorta. This mass was classified as infiltrating the vessel; as no plane could be identified between tumor and descending aorta.

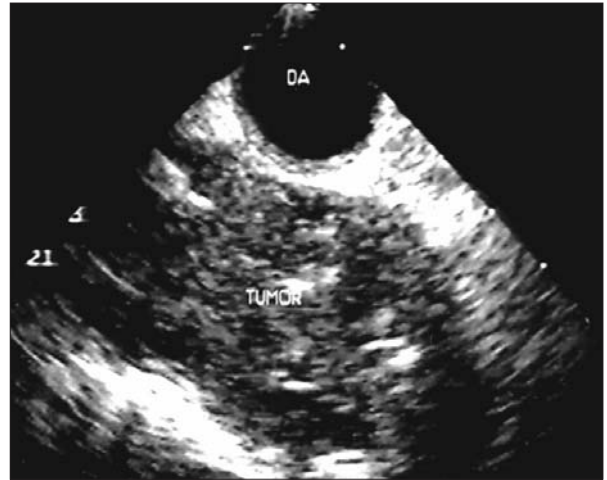


Fig. 1B. - The corresponding TEE examination demonstrates an intact aorta wall with free pulse movement. The TEE findings was confirmed at time of surgery.

In the last two decades, the usefulness of ultrasound-based techniques in the staging of lung cancer has been extensively evaluated [1-2-6-7-8-9-16-22-23]. The vast majority of these studies refer to EUS-NA, a technique used mainly by gastroenterologists to sample mediastinal lymph nodes from the esophagus. TEE, another ultrasound-based technique, has been used in the assessment of locally advanced lung cancer. TEE is a semi-invasive procedure that in this last decade has become complementary to conventional transthoracic echocardiography into evaluation of cardiac structures and great vessels. The advantage of investigating cardiac regions which are difficult to detect by precordial ultrasound, has increased the use of TEE into evaluation of mediastinal neoplastic masses. Secondary cardiovascular involvement by locally advanced lung cancer has been an emerging field of interest by TEE when chest CT scan shows suspicious of local invasion.

Real-time observation of the motion physiologic of cardiovascular structures, represents a essential finding of TEE evaluation. In fact the absence of normal cardiovascular wall motion with respiratory and cardiac cycles, or alteration (absence or reduction) of vascular flow are considered criteria of tumour invasion [13-14-15]. Another advantage of TEE study is the capability of distinguishing invasion from postinflammatory scarring [1]. Preserved echogenicity showing the intact layers of the mediastinal structures rule out invasion.

Several studies compared TEE, CT and MR in the evaluation of T3-T4 staging, and showed TEE to be superior to CT scan and MR, with sensitivity of 68-87.5% and specificity of 81.3-100% [13-17-18-19-20-21].

Our study shows that the combined use of CT and TEE improves the staging accuracy of T3 and T4 lesions, allowing a correct surgical resection in 10 patients with locally advanced lung cancer. Besides patients with hypersensitivity to iodine contrast media, TEE represents an essential diagnostic tool to evaluate the borderlines of resectability between anatomic structures also on the basis of a

different sound conduction of the cardiovascular structures [1].

The anterior mediastinum represents a “blind zone” for TEE due to the presence of air-filled structures [7-8-15-23]. This limitation of TEE calls for complementary use of TEE in conjunction with CT in the preoperative staging of locally advanced lung cancer.

In conclusion, our study suggests that TEE can be useful in selected cases in which there is a suspect of invasion of cardiovascular structures.

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