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Multidisciplinary Evaluation of Patients With Suspected Lung Cancer

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Abstract

Lung cancer diagnosis and treatment has evolved to require the input and expertise of multiple diverse medical and surgical specialties. The approach to lung cancer patients requires the adherence to a few principles that include thorough use of staging modalities to assure the proper treatment for each patient, and an understanding of the limitations and advantages of each of these modalities. Evidence is continuing to emerge that supports the notion that diagnostic workup and treatment of lung cancer patients is best done within the context of a multidisciplinary team devoted to this purpose.

Introduction

Lung cancer is the leading cause of cancer-related mortality worldwide. As management of lung cancer evolves, the majority of patients now receive (at some time in the course of their disease) multiple modes of treatment (e.g. surgery, chemotherapy, radiotherapy, and/or palliative treatment). Consequently, management of patients with known or suspected lung cancer has become increasingly complex. In line with this, evidence-based guidelines from both the American College of Chest Physicians (ACCP) (1), and the National Comprehensive Cancer Network (NCCN) (2) strongly advocate for multidisciplinary care. This push has been supported by the success of multidisciplinary approaches in the care of patients with other types of cancer. For example, multidisciplinary clinics have been shown to increase breast cancer patient satisfaction, shorten the time between diagnosis and treatment, and to meaningfully alter management (3,4). The evidence supporting the benefit of a multidisciplinary lung cancer clinic is also emerging more clearly with time. The goal of multidisciplinary care should be to establish a seamless, efficient, and coordinated approach to diagnosis, staging, and treatment of patients with lung cancer. The approach should assure that patients receive the appropriate treatment based upon their stage at the time of presentation. The roles of the pulmonologist in the multidisciplinary team are many. They include pre-operative pulmonary risk assessment, management of co-morbid illnesses, and helping establish diagnosis and accurately determining the disease stage, particularly in those with medically or surgically unresectable lung cancer. Pulmonologists should also be prepared to manage disease and treatment related complications.

Epidemiology

There will be more than 200,000 new cases of lung cancer in 2009 (5). While the number of new cases is declining in the US, this is not the case in developing countries such as China where the prevalence of cigarette smoking has dramatically increased. About two-thirds of

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adult men in China are smokers (6) while approximately twenty percent of US adults smoke (7). Although lung cancer is not the most commonly diagnosed cancer in men or women, it remains far and away the leading cause of cancer deaths. In fact lung cancer causes more deaths than the combined deaths from colon, breast, and prostate cancer. Over 160,000 people in the U.S. will die of lung cancer in 2009 (5). The overall 5-year survival rate for NSCLC varies greatly by stage. Accurate staging of patients with lung cancer is of paramount importance because of the prognostic importance of disease stage, as well as the fact that treatment of lung cancer varies widely across stages (Table I). The greatest impact of the multidisciplinary approach may be the efforts of multiple specialists to accurately stage the patient's lung cancer in order to provide accurate prognostic information and to guide therapy (8,9).

Evaluation of the patient with a lung nodule or mass

One safe rule of thumb regarding the patient with a lung nodule or mass is to assume that all such findings are lung cancer until proven otherwise. This may sound extreme in light of the fact that the vast majority of lesions discovered are not in fact lung cancer; however, if one recognizes that the urgency of obtaining that proof, and the level of evidence needed to support that proof differs greatly from patient to patient, this is a good place from which to start one's evaluation. The degree of urgency and burden of evidence is informed by estimating the pre-test probability that any given nodule or mass is a lung cancer. Experienced clinicians intuitively estimate this pre-test probability with good accuracy (10), but a quantitative tool was developed for this purpose by Swensen and colleagues (11). The likelihood of malignancy in the Swensen model is based upon three radiologic features of the lesion (location, size, and border character) as well as three clinical characteristics of the patient (tobacco use, age, and history of prior malignancy). A simple calculator that provides his quantitative estimate is available online (http://www.chestx-ray.com/SPN/SPNProb.html). This tool is very useful to both practitioners as well as educators working with trainees in this area. Once a pre-test probability is in mind, most patients will require further evaluation. Only those with very low pre-test probability of cancer (<5%), or those with extenuating circumstances (refusal of more invasive procedures, competing mortality) should be considered for serial radiologic follow up. Serial comparisons for most lesions are best made with CT scans, since small but important changes in size are not easily detected on plain chest radiographs. For most patients with moderate to high risk, the next test to determine the likelihood of malignancy in a lung nodule should be an integrated PET-CT scan. In patients considered to be at risk for lung cancer, lesions that show uptake of ^{18}flouro-deoxyglucose (FDG) should be considered for surgical resection. Where PET scans are not available, dynamic contrast enhanced CT scans have excellent sensitivity (though lesser specificity than PET) for identifying malignant nodules (12).

Determining whether a given suspicious lesion is surgically resectable requires accurately estimating both the clinical stage of the tumor, as well as the "physiologic" stage of the patient (Figure 1). The approach to non-small cell lung cancer staging is based upon the T, N, and M system, and the staging system will not be covered in detail here. Malignant involvement of mediastinal (ipsilateral N2 or contralateral N3) lymph nodes most often determines if surgical resection is appropriate. This is where the pulmonologist must be closely involved in the initial diagnosis and staging of lung cancer patients, as staging of the mediastinum is one of the more critical contributions the pulmonologist offers to the multidisciplinary team. The current staging system is going to undergo some important changes in mid 2009, and the details of changes to this staging system are reviewed elsewhere (13–17). These changes should be viewed as critically refining the current staging system, rather than constituting a complete overhaul. Non invasive methods of mediastinal staging include CT scanning and PET scanning. Invasive mediastinal staging approaches include mediastinoscopy, transthoracic CT guided needle aspiration, transbronchial needle aspiration, with or without endobronchial ultrasound

(EBUS), esophageal endoscopic ultrasound (EUS), and video-assisted thoracic surgery (VATS). In many centers EBUS is becoming the preferred choice for mediastinal staging, given its high sensitivity, acceptable negative predictive value, and lower costs compared with mediastinoscopy (18,19).

The initial approach for all patients is careful review of the chest CT scan. The chest CT (particularly if done with intravenous contrast) provides anatomic detail of the primary tumor, proximity to surrounding structures, and the presence or absence of mediastinal lymph node enlargement. Mediastinal lymph nodes are considered enlarged by CT scan criteria if they are larger than 1cm in the short-axis. This definition is inherently flawed in that it is neither sensitive nor specific enough to obviate the need for further testing. Many studies have evaluated the sensitivity and specificity of CT scanning for identifying mediastinal lymph node metastasis. In one large systematic review, the overall pooled sensitivity and specificity were 51% and 86% respectively (20). Overall, the accuracy of CT scans in detecting malignant lymph nodes is about 67% (20,21). It is not appropriate to rely upon CT alone to determine if mediastinal lymph node metastases are present. CT scan is best utilized as a guide to determine which invasive procedure to use in establishing a tissue diagnosis and it may also detect lesions suspicious for distant metastases (e.g. liver, adrenal glands, and skeletal metastases).

PET scanning utilizes a radio-labeled glucose analog, ^{18}flouro-deoxyglucose (FDG), to detect the increased cellular uptake and a higher rate of glycolysis, which is a common property of both neoplastic and inflamed tissue. PET scanning was traditionally used to generate images of metabolic activity and had poor anatomic resolution; however newer integrated PET-CT images have much better image quality and allow more precise anatomic localization of abnormal metabolic activity. The lower limit of resolution of tumor or lymph node detectable by PET scanning is 7mm–10mm (22,23). FDG-PET is highly sensitive but less specific (more false positives) when enlarged lymph nodes are present (median sensitivity, 100%; median specificity, 78%) than when lymph nodes are not enlarged (median sensitivity, 82%; median specificity, 93%). PET scanning provides more information about mediastinal lymph node involvement than CT scans, and may reveal clinically unexpected distant metastasis (24). Infection and granulomatous inflammation often demonstrate marked FDG uptake, and result in false positive results. Because of false positives, and the treatment implication of accurate staging, a tissue diagnosis is virtually **always** required confirm such findings. The PET scan must never be used to substitute for tissue confirmation of disease stage. Some well-differentiated low grade malignancies such as bronchoalveolar cell carcinoma and carcinoid tumors have higher rates of false negative findings on PET imaging.

This clinical stage determined by CT scan and PET-CT scan should be used for planning surgical intervention (if the patient appears to have disease restricted to the lung) or for determining whether a biopsy is indicated before pursuing any further therapy (in medically unresectable patients, or those with stage III or IV disease). For patients whose clinical stage is IIIA or worse, the next consideration should be how to most accurately confirm that estimate. Patients who appear to have an early stage resectable lung cancer should then have an estimate of their physiologic ability to tolerate lung resection.

Potentially resectable tumors often occur in persons with abnormal pulmonary function, most commonly chronic obstructive pulmonary disease, a complication of cigarette smoking. Cigarette smoking also increases the risk for other important co-morbid conditions such as coronary artery disease. The peri-operative risks and risk of long term morbidity associated with thoracic surgery must be weighed against the risk of sub-optimally treated lung cancer. Preoperative physiologic risk assessment should be performed for all patients with potentially resectable tumors (25). Patients with risk factors for peri-operative cardiovascular morbidity should undergo a preoperative evaluation for coronary artery disease. Advanced age alone

should not prohibit consideration of surgical resection. Indeed, co-morbid illnesses are often more common in the elderly, however carefully selected patients can tolerate lung cancer resection regardless of age, and there should be no absolute age cutoff for surgical treatment of lung cancer. The determination of suitability for surgery should be based upon an overall assessment of cardiovascular and pulmonary risk, of which age is just a single factor (26,27).

A patient who is a candidate for surgery should be questioned about physical activity and exercise tolerance. Most patients who tolerate rigorous physical exercise for example, have a very low risk for operative complications regardless of the level of pulmonary function. Additionally, patients who continue to smoke, regardless of other co-morbidities, are at significantly increased risk of both peri-operative complications, and long term recurrence of lung cancer (28,29). Patients with productive cough are at heightened risk for morbidity and mortality following lung cancer surgery (30). In addition to history and physical examination, spirometry is recommended in all patients considered for lung cancer resection. This is both to estimate the patient's baseline pulmonary function, and to aid in estimating the predicted post-operative (PPO) pulmonary function. Those with FEV_1 and carbon monoxide diffusion capacity (DLCO) of >80% predicted can proceed with resection without additional physiologic evaluation (25). All others and those with history of interstitial lung disease or dyspnea should have calculated estimates of PPO lung function. PPO lung function can be determined from the pre-operative measurements and by estimating how much functional lung would be surgically removed. A formula for PPO lung function that can be used is based upon the fact that each lung segment represents approximately 5% of the patients lung function;

$$\text{PPO value} = \text{preoperative value} \times (1 - S(31)/100),$$

where S represents the number of lung segments to be resected. The same equation can be used to calculate both the PPO FEV_1, and the DLCO. Studies assessing this formula have found a high degree of correlation between predicted and actual values measured post-operatively (32). In fact, where the equations are inaccurate, they tend to underestimate true post-operative pulmonary function (33).

The FEV_1 is well accepted, but imperfect as a predictor of post-operative pulmonary complications. Peri-operative risk increases when the FEV1 is less than 40% PPO. Other studies have found that a PPO DLCO of less than 40% is a risk for morbidity and mortality after lung resection (34,35) as well. DLCO and FEV_1 should not be viewed as mutually exclusive in the preoperative evaluation. Rather, they should be viewed as providing complimentary information. Some studies suggest that the product of the PPO FEV_1 and DLCO (each expressed as a percent of predicted) are a better predictor of morbidity and mortality after lung cancer surgery (36,37), with a value of less than 1650 predicting greater risk of peri-operative mortality and cardiopulmonary complications. Patients with this degree of limited pulmonary reserve should have further testing to determine their ability to tolerate lung resection.

In situations where a mass is centrally located, if there is significant atelectasis, a quantitative ventilation-perfusion (V/Q) scan is helpful to predict the degree of remaining functional lung tissue after resection of the involved lung. Cardiopulmonary exercise testing (CPET) can be performed to measure the maximal oxygen consumption (VO_{2max}). Patients with a VO_{2max} of > 20 ml/kg/min are at very low risk for cardiopulmonary complications and peri-operative mortality, while patients with VO_{2max} less than 10 ml/kg/min have an unacceptably high surgical risk (36,38). Stair climbing is a less expensive and perhaps equally effective means of determining a patient's suitability for lung cancer surgery (39). This can be used if CPET

is not available. If a patient can climb three flights of stairs without difficulty, their risk for complications is acceptably low (39) In the 1990's, coincident with the increased number of surgeons performing lung volume reduction surgery (LVRS), there were several reported series of patients undergoing surgical resection of lung cancer in spite of very advanced emphysema (40–45). A majority of patients in these studies were being considered for LVRS and were found to have lung cancer in the upper lobes. They underwent combined LVRS and lung cancer resection. This strengthens the point that patients with lung cancer should not be denied a potential surgical cure solely on the basis of a low FEV_1. However, one must emphasize the fact that these patients were seen and cared for in a multi-disciplinary setting that included vigorous pre-operative pulmonary rehabilitation, and underwent surgery in centers with significant experience in LVRS, post-operative respiratory care, and aggressive pain management. Patients with severe emphysema being considered for lung cancer surgery should be seen in a center with experience in the management of such patients. It should be emphasized that the final say of whether a patient meets criteria for surgical resection is best made by a surgeon specializing in the treatment of thoracic malignancy.

In general, patients with masses suspicious for lung cancer who are good surgical candidates should be referred directly to surgery if an initial evaluation suggests that they do not have metastatic or locally advanced disease. In such a situation, obtaining a tissue diagnosis prior to surgery offers absolutely no benefit to the patient or the surgeon. An exception to this is the patient at extremely high risk for surgery, or patients requiring pneumonectomy, in whom a definitive pre-operative diagnosis informs the surgeon's discussion of risk and benefit with the patient. In this case, the discussion of these issues in the multidisciplinary setting facilitates prompt referral and diagnosis using the most appropriate pre-operative means (e.g. CT, or electromagnetic navigation guided biopsy in centers with experience in this procedure).

In many patients with suspected lung cancer, surgical intervention is not feasible, either because of the extent of the mass, the presence of bulky N2 (mediastinal) metastasis, or because of the patient's underlying medical condition. If a staging workup that includes history, physical exam, CT scan and/or PET/CT suggests distant metastasis, biopsy of distant metastatic lesions (liver, bone or adrenal metastases, for example) is preferable. The best rule of thumb is to subject the patient to the least invasive approach that provides BOTH the diagnosis AND the stage in one procedure. An exception to this is the patient with a lung mass and suspected intracerebral metastasis. In these patients, the least invasive approach is usually the most appropriate, but enlarged mediastinal lymph nodes should NOT be assumed to indicate nodal metastasis, since metastasectomy may be appropriate for patients with localized (N0) thoracic disease, and a resectable intracranial metastasis. Bronchoscopy is most useful for centrally located masses, or in patients with bulky mediastinal lymph node involvement, in which transbronchial needle aspiration yields both a cytologic diagnosis and a stage. EBUS has increased the role of the pulmonologist, by rendering even small lymph nodes in the mediastinum accessible to transbronchial needle aspirate (TBNA), particularly when they are detected on a PET/CT scan (Figure 2).

For patients deemed medically unresectable (that is, early stage disease, in whom surgery is prohibitively risky due to co-morbid disease), biopsy of a lung nodule or mass is necessary to allow for consideration of radiotherapy. In the past, CT guided biopsies were considered the gold standard, due to their accuracy for peripheral lesions when compared with bronchoscopy. This is still largely true in most centers, and this has become the standard for medically inoperable patients with suspected lung cancer. The recent development of electromagnetic guidance bronchoscopy (ENB) has resulted in the availability of additional biopsy options for patients with suspected early stage lung cancer who are not surgical candidates. Experience with ENB is gaining wider acceptance, and the lower risk of pneumothorax associated with bronchoscopic biopsy makes this preferable in centers where experienced users are available.

A special note is worthy on the use, and misuse, of the PET/CT scan. The use of the PET/CT, where available, has become an indispensable tool in the care of patients with lung cancer due to its high sensitivity in determining the likelihood of malignancy in a lung nodule, as well as its utility as a staging tool. It is also perhaps the most misused tool in thoracic oncology. It is perhaps best to think of the PET/CT as addressing two questions with a single study. It is an unmatched imaging tool for determining the likelihood of malignancy in a pulmonary nodule, and its sensitivity, specificity, and cost effectiveness in this setting have been examined in a number of reviews (22,24). On the other hand, for patients with suspected lung cancer, it is also an excellent staging tool. It is in this setting, however, that it has been most misused. The PET/CT must never be used as a substitute for a tissue biopsy. In order to avoid pitfalls in staging, physicians caring for patients with suspected lung cancer must remember that while the sensitivity of PET scanning for detecting nodal or distant metastasis is well over 90%, its specificity is closer to 70%. It is safest to recall that a PET/CT scan is not a biopsy, but rather it is a road map to inform the clinician what to biopsy.

Lastly, expertise in pulmonary diseases may be required in the management of disease and treatment related complications. Disease related complications may include post-obstructive pneumonia and hemoptysis. Treatment related complications vary depending on modality of therapy. These include surgical complications, post-operative loss of lung function, radiation pneumonitis, and exacerbation of underlying pulmonary disease. Patients may require management of dyspnea related to underlying disease (COPD), due to treatment, or due to disease progression. Familiarity with palliative care of lung cancer is advised by the ACCP for pulmonologists involved in the care of these patients (46). Oxygen therapy is often required for patients with borderline lung function, and the pulmonologist is in the best position on the team to manage this aspect of patient care.

Multidisciplinary Lung Cancer Care

There is an increasing variety of staging and diagnostic modalities used for lung cancer patients. Additionally, with chemoradiation therapy as the standard of care for stage III lung cancer, and adjuvant chemotherapy now standard for many patients after lung cancer surgery, most patients with lung cancer will receive more than one type of treatment at some point in the course of their disease. Therefore the evolution of lung cancer management has centered on the development of multidisciplinary teams to deliver the right care to the right patients. A multidisciplinary lung cancer team includes physicians from several specialties often sharing a clinical space, staff room, coordinators and ancillary staff. Members may include pulmonologists, thoracic surgeons, medical oncologists, radiation oncologists, pathologists, and radiologists. Other key participants include nursing, psychology, palliative care, social work and pastoral care. To handle community referrals there should be a triage liaison or clinic coordinator who directs new referrals of suspected or known lung cancer to the most appropriate initial specialist. The coordinator also assures expedited appointments. Patients referred to a multidisciplinary clinic might see more than one physician and/or other providers at the same visit. The pulmonologist is an integral member of the multidisciplinary team. The roles of the pulmonologist include establishing a diagnosis, mediastinal staging, pre-operative pulmonary risk assessment, management of co-morbid illnesses, and management of treatment and disease related complications. Of these, accurate mediastinal staging is of paramount importance as treatment and prognosis vary widely with stage.

There are many possible benefits of establishing a multidisciplinary lung cancer clinic. It can provide a streamlined approach to diagnosis, staging and treatment. Delays in lung cancer diagnosis and management can be minimized, and patients and families may achieve a higher level of satisfaction due to expedited care. There are several barriers to establishment and sustainability of multidisciplinary teams. These include physicians' conflicting schedules, lack

of available and suitable shared space, community referral patterns, and economic factors. Availability of several specialist physicians at the same time and location is often a significant hurdle to overcome. There is often a lack of specialists at non-tertiary care centers. Primary care physicians are usually the first to suspect lung cancer, making referral patterns of such physicians important. Finally, economic barriers include resources for support personnel, clinic facilities, and third party payer compensation for multiple physician visits in one day. The multidisciplinary clinic facilitates collegial exchange of professional opinions and serves as a venue for enrolling patients in clinical trials which are desperately needed to identify optimal treatment.

Evidence for Benefits of a Multidisciplinary Approach to Thoracic Malignancy

There have been several studies comparing traditional care to multidisciplinary care in lung cancer patients. These studies have in general been small, with diverse endpoints and interventions, making comparisons difficult at best. However, some general conclusions can be taken that support the impact of multidisciplinary care on important (albeit surrogate) outcomes. These include improvement in waiting times, alterations in management, patient satisfaction, and in some cases survival time. Individuals with suspected cancer as well as their families are often significantly anxious, and for this reason alone, prompt evaluation and diagnosis are important. Delays can occur at several steps including delay from initial symptoms to first general practitioner visit, referral to a specialist, diagnostic testing, and delay of definitive treatment. The British Thoracic Society recommends that a patient with suspected lung cancer be referred by a general practitioner to a lung specialist immediately, that the specialist appointment should be within 1 week, and that the patient should have diagnostic testing within 2 weeks. Lastly, the recommendations suggest that a maximum of 8 weeks should elapse between initial visit with pulmonologist and operation if surgery is an option. (47). However, promptness should not be sought at the expense of accurate staging, and judicious use of invasive procedures.

Few studies have addressed whether the incorporation of a multidisciplinary team decreases these waiting times. Murray et al. (48) randomized 88 patients with suspected lung cancer to either conventional investigation at the local hospital or to evaluation at a centralized location with multidisciplinary team input. They found a significant difference between the two groups in the time from initial presentation to the first treatment. There was a 4 week improvement in the multidisciplinary group (3 weeks versus 7 weeks) compared to the conventional group (48). When comparing average waiting time from diagnosis of NSCLC to initiation of treatment prior to and after the establishment of a multidisciplinary clinic, Seek et al. found a decrease from 29.3 to 18.8 days and 92% of patients initiated treatment within 14 days (49). Overall, establishing a multidisciplinary lung cancer clinic improves waiting times in diagnosis and treatment of patients with lung cancer.

One study of multidisciplinary care sought data from patients on their level of satisfaction with the care they received and compared it to those receiving traditional care. Individuals cared for in the multidisciplinary setting reported improved satisfaction on a questionnaire compared to those in the control arm (48). The individuals treated in the multidisciplinary clinic reported a better care experience and a faster diagnostic process.

Multidisciplinary care may also strongly influence practice patterns and patient management. Several studies comparing traditional care to multidisciplinary care support this statement by demonstrating an increase in the number of patients treated with curative intent therapy (radiation or surgery) and chemotherapy (for patients with stage IV disease, now the recommended standard for good performance status patients) in a multidisciplinary clinic (48,50–52). In the randomized trial by Murray et al., 43% of patients in the multidisciplinary

group received curative intent treatment compared to 33% in the control group. This difference was not statistically significant; however there was a significant difference in the number of patients receiving chemotherapy, 66% of patients in the multidisciplinary group and 37% in the control group (48). Multiple before and after studies also found an increase in surgical resection rate and administration of chemotherapy following the institution of a multidisciplinary program. Rates of surgical resection increased significantly just by the addition of a dedicated thoracic surgeon in place of a surgeon who did not specialize in thoracic malignancies. This same study showed a higher rate of sleeve resection replacing pneumonectomy (50), suggesting increased use of more technically difficult, but less morbid approaches to lung resection. Therefore, an important benefit of the multidisciplinary approach is having multiple specialists with diverse expertise in state of the art diagnostic procedures and therapies, in order to properly stage patients and then treat aggressively when possible. As the outcome of lung cancer is dismal without surgical resection, getting more patients to surgery is extremely important and these studies clearly demonstrate that a multidisciplinary clinic accomplishes this goal.

As multidisciplinary care teams increase the number of patients receiving curative intent therapy one would expect an increase in patient survival. The current body of literature is inconclusive, but encouraging in this regard. In a systematic review of the literature, Coory et al. concluded that multidisciplinary teams change patient management in a meaningful way, but there is insufficient evidence to show that they alter survival (53). A prospective trial with a large sample size would be necessary to provide further insight into both clinical and cost benefits of multidisciplinary care, and the feasibility of conducting such a trial would be questionable.

A recent report on the utility of multi-modality staging provides very strong, if indirect, evidence in favor of multidisciplinary care. Farjah and colleagues (8) used data from the Surveillance, Epidemiology, and End Results (SEER)-Medicare data (from 1998 to 2005) to ask two questions: How often was multi-modality approach used in staging lung cancer patients, and did it make a difference? They defined staging in three steps, CT scan of the chest, PET scans, and invasive mediastinal staging (bronchoscopy with transbronchial needle aspiration, or mediastinoscopy). Patients were categorized based upon whether their lung cancer was staged using a single (CT only), bi- (CT and PET, or CT and invasive), or tri-modality (CT, positron emission tomography, and invasive staging) approach. They found the use of single modality staging was the most common approach, but also that single modality staging decreased over time, whereas the use of bi- and tri-modality staging increased. Most importantly, the use of a greater number of staging modalities was associated with a lower risk of death (8). Given the degree to which treatment of lung cancer varies by stage, this suggests that accurate staging not only averts “unnecessary surgery”, but also assures the most appropriate (and effective) treatment for each patient. These same investigators also published a study that showed improved long term survival for patients treated by dedicated thoracic surgeons as compared to those whose lung cancer was treated by a general surgeon or cardiothoracic surgeon, providing further evidence in favor of patients being treated by surgeons who specialize in thoracic malignancies (9). Overall, studies of multidisciplinary care suggest that patients receive more timely assessment, more accurate staging of disease, higher rates of staging procedures to confirm pathologic staging, and increased use of aggressive therapy including curative intent radiation therapy, surgery, and chemotherapy.

Conclusion

Lung cancer continues to be the leading cause of cancer deaths worldwide. Because the treatment and prognosis of individual patients is profoundly affected by the stage of disease, accurate staging is critical. As advances in staging techniques, surgical procedures, radiation

therapy and chemotherapeutic options become available, the care of patients with lung cancer becomes increasingly complex. Therefore, a multidisciplinary approach to lung cancer care that employs the services of multiple specialists with diverse expertise is fundamental in ensuring the right care for the right patient.

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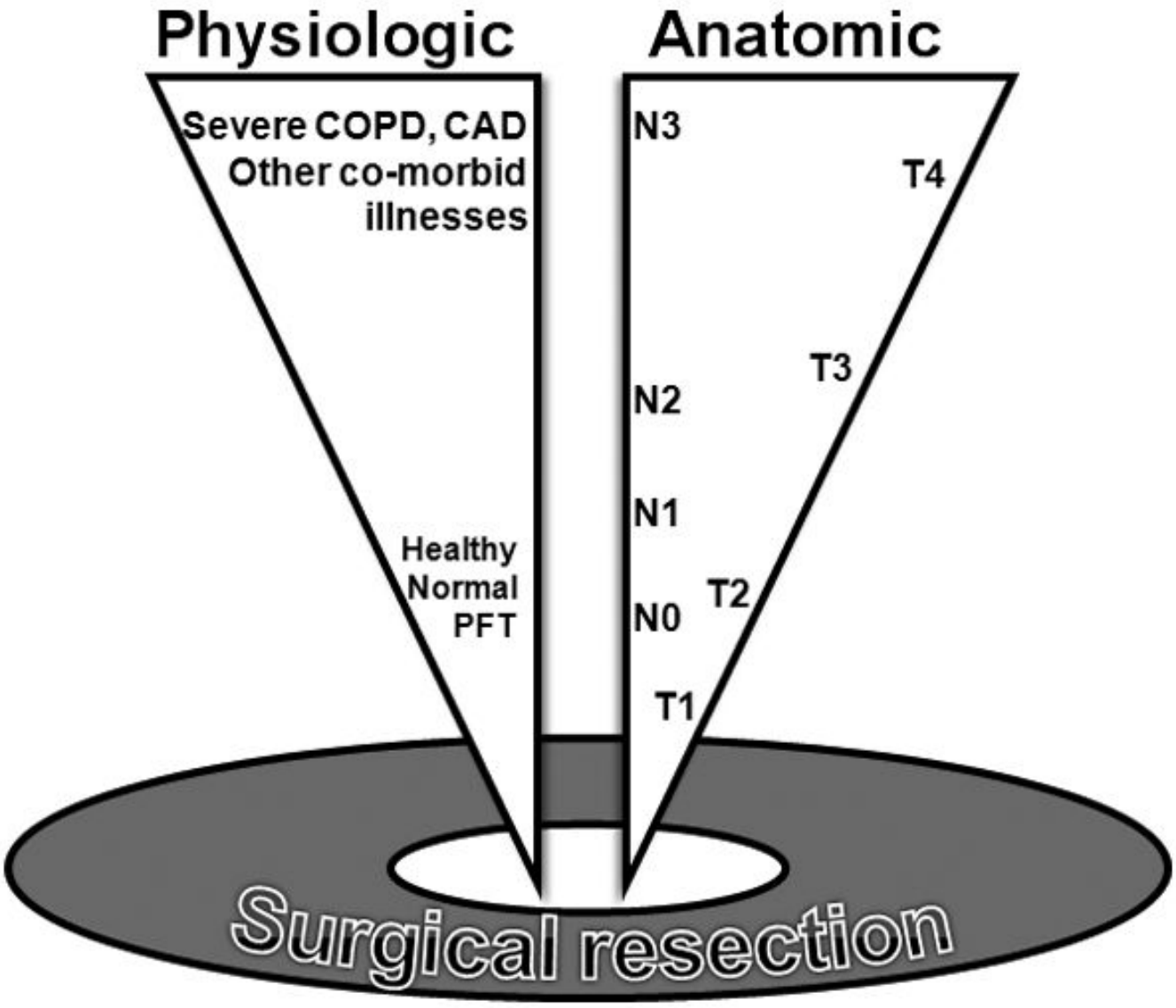

Figure 1.

Patients undergoing lung cancer surgery bring with them to the OR a certain burden that can be measured in both anatomic (tumor) and physiologic (co-morbid) terms. Only so much of each can be sustained for a patient to successfully withstand lobectomy or greater operations (chest wall resection, pneumonectomy). Considering patients for surgery requires an accurate knowledge of not just the tumor stage (as determined by parameters of tumor "T", nodal "N", and metastatic "M" extent), but also of the patients "physiologic stage". Patients with more extensive disease can undergo surgery if they are otherwise in good physiologic condition. Likewise, patients with more co-morbidity can withstand more limited operations, but (for example) not pneumonectomy or chest wall resection.

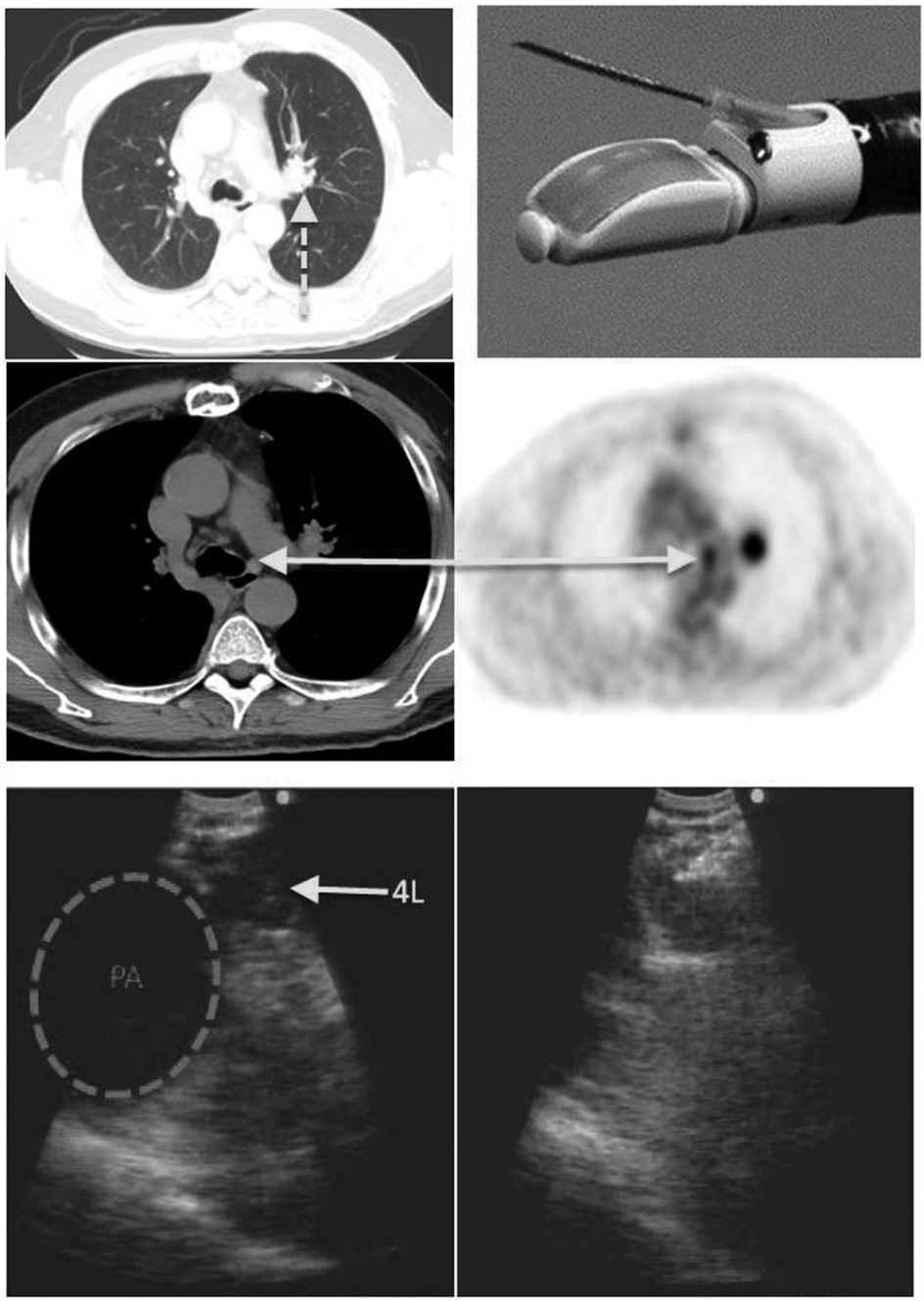

Figure 2.

CT scan showing the presence of a left hilar nodule (Dashed arrow, top left). Combined CT-PET scan shows uptake in the left hilar mass, as well as a small left paratracheal lymph node (Station 4L. Middle row arrow). Endobronchial ultrasound (EBUS) shows the 4L node adjacent to the pulmonary artery (bottom left). Color doppler allows the bronchoscopist to confirm the presence of vessels. EBUS guided needle aspiration of the 4L node demonstrated malignant involvement of the N2 nodes, providing a stage and a diagnosis in one procedure (Bottom right panel shows the needle in the plane of the ultrasound, entering the node). The top right panel shows the linear array ultrasound at the end of the bronchoscope with the needle protruding from the working channel.

Table I

The paramount importance of accurate staging can be appreciated best by understanding how stage (both physiologic *and* anatomic, i.e. TNM stage) affects treatment and prognosis. Shaded boxes indicate that the treatment goal is curative.

Anatomic Stage (Avg. 5 year survival)	**Acceptable physiologic reserve**	**Poor physiologic reserve**
I (50–70%)	Surgery (certain patients with stage IB *may* be candidates for adjuvant chemotherapy)	* Biopsy • EBRT • SBRT • RFA Other (Cryotherapy, wedge resection or brachytherapy)
II (40–50%)	Surgery Adjuvant chemotherapy	
	Performance status** 0 to ~2	Performance status** 3 to 4
III (15%)	* Biopsy Definitive chemo-RT Surgery*** Adjuvant chemotherapy	* Biopsy Palliative RT Chemotherapy if feasible
IV (<5%)	* Biopsy Palliative chemotherapy CNS/skeletal RT	* Biopsy Palliative/Targeted… • Chemotherapy • Radiation

Abbreviations: EBRT – external beam radiotherapy. SBRT – stereotactic body radiotherapy. RFA – radiofrequency ablation. CNS –central nervous system. RT –radiotherapy.

* Biopsy indicates situations where pre-treatment biopsy is indicated. Note the *absence* of a role for routine biopsy of patients with suspected lung cancer who are good surgical candidates.

** Eastern cooperative Oncology Group (ECOG) performance status scale (54)

*** Surgery for clinical stage IIIa (bulky or multiple station mediastinal lymph nodes) is currently not indicated, but stage IIIa disease discovered at the time of surgical resection (pathologic stage IIIa) should be followed by adjuvant chemotherapy.