Battle Creek Health System

physicians Review

New Technology Aids in *Earlier Detection* of Lung Cancer

By: Tammy L. Gleeson, D.O.
Board Certified,
Cardiovascular Thoracic Surgeon

Lung cancer is the leading cause of cancer-related death among men and women and second leading cause of cancer in the United States (US). Worldwide, lung cancer and lung cancer-related deaths have been increasing in epidemic proportions, largely reflecting increased rates of smoking. In 2009 the American Cancer Society predicts that there will be approximately 219,000 new cases of lung cancer diagnosed and approximately 159,000 lung cancer-associated deaths in the US. Worldwide, it is estimated that there were 1 million deaths in the year 2000.

continued on page A2

Also in this issue

Unfortunately, 75 percent of patients with lung cancer present with symptoms due to advanced local or metastatic disease that is not amenable to cure. Despite advances in therapy, five-year survival rates average less than 15 percent for all individuals with lung cancer.

Prevention, rather than screening, is the most effective strategy for reducing the burden of lung cancer. The promotion of smoking cessation is essential, as cigarette smoking is felt to be causal in almost 90 percent of all lung cancer. Progress in smoking cessation is now reflected in declining lung cancer rates and mortality in men in the US. However, the US smoking rate remains high at 24 percent and is increasing in many parts of the world. A high percentage of lung cancer occurs in former smokers, since the risk for lung cancer does not decline for many years following smoking cessation. Second hand smoke exposure is common and also associated with lung cancer.

Potential for Early Detection

Clinical outcome for lung cancer is directly related to stage at the time of diagnosis, ranging from over 60 percent five-year survival for stage I disease, to less than 5 percent for stage IV disease. In addition, within early lung cancers (stage I) there is a relationship between tumor size and survival.

Many characteristics of lung cancer suggest that screening would be effective: high morbidity and mortality; significant prevalence (0.5 to 2.2 percent), identified risk factors allowing targeted screening for high risk, a lengthy preclinical phase, and evidence that therapy is more effective in early stage disease.

These observations have stimulated great interest in lung cancer screening for asymptomatic high-risk individuals. Although the potential of screening to detect early cancers may both increase the overall cure rate and allow more limited surgical resection to achieve cure, whether screening will decrease mortality and morbidity remains uncertain.

Imaging techniques, cytological analysis of sputum and advances in electromagnetic navigation bronchoscopy has been the focus of screening studies and the form of supporting early diagnosis for lung cancer. Systematic screening for lung cancer is not currently recommended by any major medical professional organization.

Advancements in Bronchoscopy

Bronchoscopy is a procedure that enables a chest physician (pulmonologist or thoracic surgeon) to examine the air passages of the lungs through a thin fiber optic scope called a bronchoscope. Often, a bronchoscopic procedure is the first method of diagnosis for lesions in the lungs, due to its low risk. However, traditional bronchoscopy often cannot reach the peripheral areas of the lungs where most lesions are found. Thus, more invasive techniques are required to access peripheral lung lesions to obtain a diagnosis.

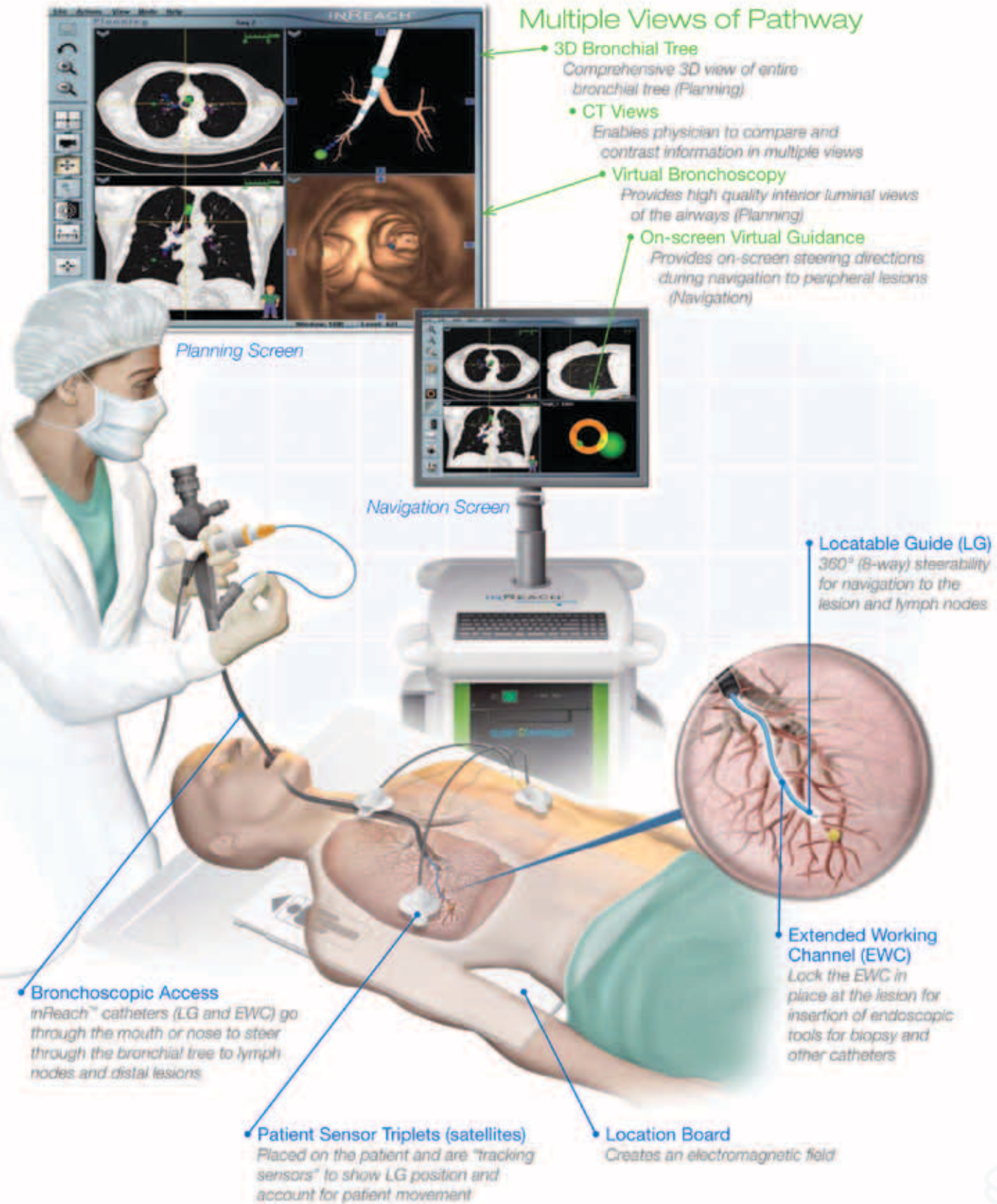
Electromagnetic Navigation Bronchoscopy™, the superDimension i·Logic System extends the reach of the bronchoscope to regions deep in the lung. Through advanced software and electromagnetic technology, the system takes advantage of natural airway access and enables physicians to locate small lung lesions for diagnostic testing and potential treatment. During a planning phase, the inReach planning software utilizes a standard pre-operative CT image of the lungs to create a roadmap to the lesion. This three-dimensional roadmap is transferred to the procedure (or naviga-

Electromagnetic Navigation Bronchoscopy™ the superDimension i·Logic System

Key System Benefits

- Extends beyond the reach of the bronchoscope and guides endoscopic tools and catheters deep into the lung
- Provides more bronchoscopist options for diagnosis and treatment of lung disease
- Enables bronchoscopy to find positive pathology sooner thus enabling treatment earlier and potentially expanding treatment options
- Enabling less invasive procedures (other options are open chest procedures)
- Reduces need for invasive, high risk alternative procedures
- Provides effective alternatives for patients with procedure-restricting conditions
- Facilitates reduction of patient exposure to fluoroscopic radiation

inReach™ access to distal lesions with GPS-like navigation



tion) phase where an electromagnetic localization system tracks the real-time position of a guide catheter with location sensor at its tip to the target lesion area in the lungs. Once arriving at the target the location sensor is removed and the guide catheter provides a channel for diagnostic or therapeutic tools.

Patients with lesions in the lung are often told to 'wait and see' what happens to the lesion over time (watchful waiting). This option is often considered due to the invasive nature of the biopsy process. Waiting can result in patient anxiety and can potentially allow a malignant lesion to advance.

Since Electromagnetic Navigation Bronchoscopy uses the patient's natural airways to access lung lesions, it is a low risk procedure with few complications. It can be used with a broad group of patients, even those that may not be suitable for other diagnostic techniques due to poor lung function or other medical conditions. In particular, Electromagnetic Navigation Bronchoscopy can reduce the risk of pneumothorax that occurs with external needle biopsy or reduce the morbidity associated with surgical biopsies.

It is also noted that CT and PET scans have limitations in diagnosis – neither method yields the necessary lung tissue for a definitive benign or malignant diagnosis. Since superDimension's inReach System uses the patient's natural airways to access lesions. Outcomes may improve by:

- Enabling earlier diagnosis thus enabling earlier treatment decisions
- Reducing the risk of pneumothorax from transthoracic needle diagnosis procedures
- Reducing the need for an invasive surgical biopsy for patients with benign lesions
- Allowing malignant lesions to be staged in the same procedure as the diagnosis

There are 17 published studies to date which demonstrate clinical efficacy, diagnostic yield, low complication rates and the newer application as mentioned, such as fiducial marker placement, and dye marker placement for follow up video-assisted thoracoscopic surgery and/or da Vinci robotic assisted thoracic surgery.

In addition to the published clinical support, the superDimension inReach system is being used at over 100 leading medical facilities across the United States. Battle Creek Health System is one of the few hospitals that have become an early adopter of this technology in supporting the advancements in the diagnosis of lung cancer.

For more information regarding Electromagnetic Navigation Bronchoscopy and its applications in the diagnosis of lung cancer contact, Dr. Tammy Gleeson at 269-979-6310.

CASE REVIEW:

Use of Electromagnetic Navigation Bronchoscopy (ENB) for Insertion and Fixation of Radiosurgical Markers for the Setup and Tracking of a Lung Tumor During Radiation Therapy

Introduction

With the recent advances in the precision of treatment delivery, radiation therapy has become more accurate, integrating high-resolution real-time imaging with radiation delivery for the treatment of lung cancer. A recent development in this field is Image-Guided Radiation Therapy (IGRT) with real-time tumor tracking, promises to improve efficacy and reduce morbidity. This technique can be enhanced by implanting radio-opaque markers; however the marker insertion technique has not yet been widely established.

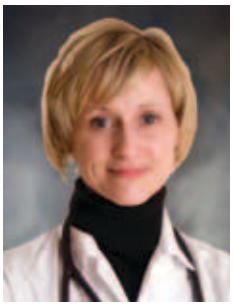
Case Report

A 71-year-old female with severe emphysema was evaluated in our clinic for treatment of recurrent non-small cell lung cancer. She was initially diagnosed with primary adenocarcinoma of the lung by fine needle aspiration of a mass in the right upper lobe, posterior segment. She was deemed inoperable due to her emphysema, and was treated with standard-dose radiotherapy (50 Gray), with reduction in tumor size and FDG uptake. A repeat chest radiograph nine months later, however, revealed an interval increase in the size of the tumor. A PET scan also revealed a return of FDG activity (SUVmax 7.6). She refused chemotherapy, and high-dose stereotactic radiotherapy was planned. To track the changes in tumor position during the treatment, radiosurgical markers were inserted into the tumor using ENB.

Discussion

Total radiation delivered to a tumor is limited by its toxicity to surrounding normal lung tissue. Problems in targeting radiotherapy include changes in tumor position, which can be due to the normal respiratory cycle and unpredictable baseline shifts in respiratory rates and amplitude. Radiosurgical markers inserted into or near the lung tumor are useful both for daily setup as well as real-time tumor tracking of the tumor position. These markers can be inserted into or near the tumor using a transthoracic needle or conventional bronchoscopy. The former is associated with a high frequency of pneumothorax and the latter with marker migration or inaccurate placement.

To minimize complication and enhance accurate placement, the inReach™ System can be utilized. It allows for real-time accurate and minimally invasive navigation to be placed anywhere within the lungs using combined

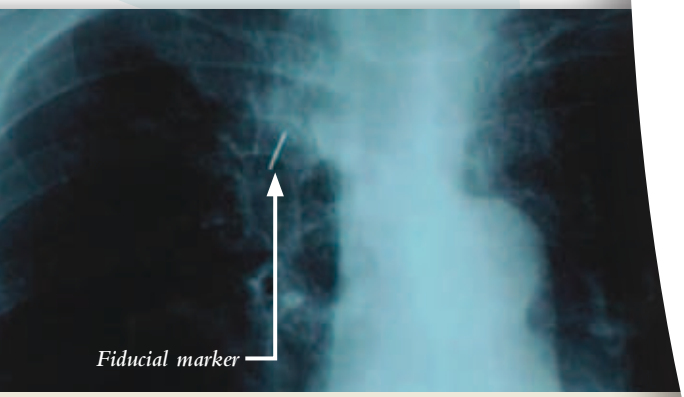


About the author

Tammy L. Gleeson, DO
Board Certified,
fellowship trained in
Cardiovascular Thoracic Surgery

Dr. Gleeson is a graduate of the University of Michigan and the Kirksville College of Osteopathic Medicine. She completed her internship at Bi-County Community Hospital in Warren, Michigan and her residency in general surgery at St. John-Detroit Riverview Hospital. Dr. Gleeson then completed a fellowship in thoracic cardiovascular surgery at Bi-County Community Hospital, which is affiliated with St. John – Oakland Hospital, Henry Ford Health System and Mount Clemens General Hospital.

Dr. Gleeson is a member of the Battle Creek Health System medical staff and has served as the chair of the Department of Perioperative Services and Trauma Committee. She is affiliated with the Vascular Health Center in Battle Creek.



Implanted radio-opaque marker for IGRT.

CT-image and electromagnetic guidance. Using this modality, a working channel can be guided bronchoscopically to a lung tumor; through this channel, radiosurgical markers can be placed using a TBNA needle. Once the radiosurgical markers are placed, real-time tumor tracking can be achieved during radiotherapy planning and delivery.

Radiotherapy planning is done using a three-dimensional CT-based planning system. At the time of radiotherapy,

continued on page A6

BCHS the Only Hospital in Southwest Michigan Offering inReach™ System Electromagnetic Navigation Bronchoscopy

Physicians involved with program development of Electromagnetic Navigation Bronchoscopy Technology:

Maddur Badarinath, MD
Critical Care Pulmonary Medicine

Tammy Gleeson, DO
Cardiovascular Thoracic Surgeon

Gregory Harrington, DO
Pulmonologist-Infectious Disease

Randy Mudge, MD
Radiation Oncologist

Nadine Potempa, MD
Pulmonologist

Reza Tehrani, MD
Critical Care
Pulmonary Medicine

continued from page A6

this radiosurgical marker is used to position the patient accurately within the radiation field by superimposing the planning CT on a real-time fluoroscopic image generated by the system. In addition, utilizing respiratory gaiting software, the marker is also used to assess the effect of respiratory motion, allowing radiation to be delivered during one phase of ventilation. With this confirmation of accuracy, higher doses of radiation can be delivered to target sites by reducing the margins of delivery around the tumor. This serves to avoid damage to the healthy adjacent tissue, allowing for increased total doses of radiation to be delivered to the tumor.

Conclusion

It is important to balance the safety of the implantation and the benefits to be derived from the radiosurgical markers with respect to localization. With the use of advanced radiotherapy systems, this balance favors the use of a marker, provided the invasiveness of implantation is acceptable. In our experience, the inReach™ System greatly improves the safety and accuracy for insertion of these markers.

CASE REVIEW:

Dye Marking Helps Surgeons to Pursue Lung Nodules As Small As 2 mm

Introduction

The inReach™ System navigates to peripheral lung lesions outside the reach of a bronchoscope. This technology provides physicians of multiple specialties the ability to diagnose, stage and prepare to treat distal lung disease. This case report describes a technique of transbronchial injection of dye markers to provide enhanced visual localization of the tumor to guide the minimally invasive video-assisted thoracoscopic surgery (VATS).

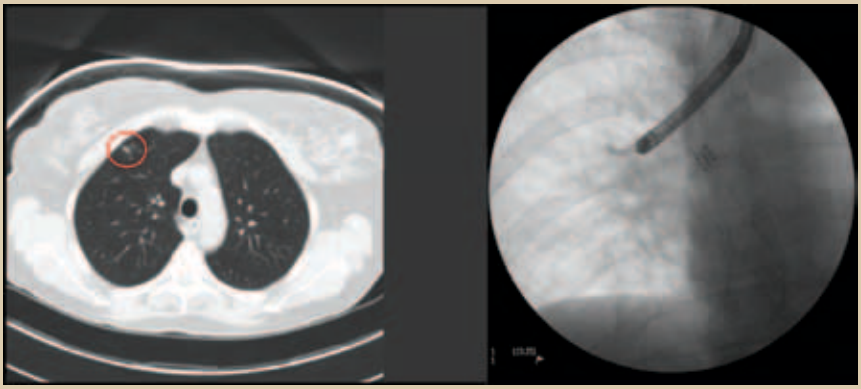
Case Report

A 54 year-old female, previous smoker who developed a persistent cough in recent months, which would not resolve.

The patient had a CT scan, which showed a very small, 2 mm posterior right upper lobe (RUL) lesion very near the pleura. The original recommendation by her doctor was to "watch and wait." However, she refused to do so and sought out care at a facility that offered the inReach System Electromagnetic Navigation Bronchoscopy.

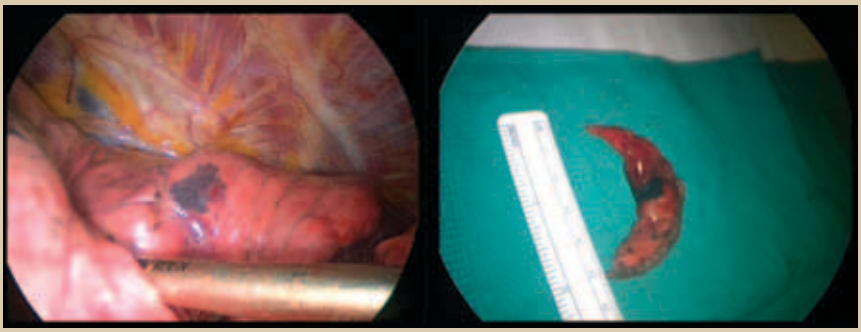
An inReach™ procedure (electromagnetic navigation bronchoscopy) was done prior to VATS to dye mark the lesion. After navigation to the lesion, the inReach™ Steerable Guide Catheter was locked in place and a 25G needle was inserted through the guide to inject approximately .5 – 1 cc of indigo carmine dye to the lesion and the adjacent pleura for easier location during the VATS procedure. (In this case, there was no attempt to biopsy the lesion during the procedure as the agreement with the patient beforehand was to remove it surgically.)

A VATS procedure was performed the day following the dye markers placement. As expected, the dye was visible and on top of this 2mm lesion, allowing localization and removal of this small lesion while preserving as much healthy lung tissue as possible. The lesion was excised in approximately 10 minutes. The excised tissue was sent to pathology and was diagnosed as an adenocarcinoma. A lobextomy was performed removing the patient's RUL.



CT scan-2mm posterior RUL lesion.

InReach™ procedure to dye mark lesion.



VATS procedure performed targeting dye marker.

Dye visible at 2mm lesion.

Discussion

Lung lesions that are small and not readily visible on the surface of the lung are very often difficult if not impossible to localize and remove with standard thoracoscopy. The inReach system allows the surgeon to bronchoscopically mark the pleural surface directly adjacent to small and otherwise unidentifiable lung lesions. A thoracoscopic wedge excision of this area of tissue results in removal of the lesion in question.

While in the case the inReach dye localization procedure was done on the day before thoracoscopic removal, it is also possible for the two procedures to be done at a single setting under general anesthesia. The procedure has direct applicability to lung lesions that require definitive diagnosis such as suspected small lung cancers, suspected metastitic lung lesions, and infectious processes where excision is necessary.

Frequently Asked Questions

Why Would a Patient Need an i·Logic™ Electromagnetic Navigation Bronchoscopy™ (ENB)?

An abnormal finding or lesion in the distant part of the lung has been found on an X-ray, CT-Scan or PET-CT Scan that may be caused by infection, inflammation or cancer. Small lesions in the outer area of the lung are difficult to reach for diagnosis and treatment. Traditional bronchoscopy frequently fails to reach the outer areas of the lungs often leaving only more invasive surgical options for diagnosis. An i·Logic™ ENB procedure will allow a physician to locate, test, diagnose and potentially treat the lung lesion even in the outer areas of the lungs.

How Does Electromagnetic Navigation Bronchoscopy™ Differ From Traditional Bronchoscopy?

ENB transforms traditional bronchoscopy into a high-tech outpatient procedure. ENB uses Global Positioning System (GPS) like technology to navigate a unique set of catheters to a lesion deep in the lungs. The electromagnetic system guides and steers the unique catheters through complex airways beyond the reach of a traditional bronchoscope. ENB minimizes the need for more invasive surgical procedures to be used to access the lung lesion, which often require an inpatient hospital stay and greater potential for complications such as pneumothorax (collapsed lung).

How Many Patients Have Had an i·Logic™ Electromagnetic Navigation Bronchoscopy™?

As of July 2009, more than 7,500 patients have had the procedure at over 100 leading medical facilities across the United States.

What are the Risks to having an i·Logic™ Electromagnetic Navigation Bronchoscopy™?

There are no additional risks beyond those associated with traditional bronchoscopic procedures, which is generally a safe procedure. Also, because ENB is a minimally invasive procedure and uses the patient's natural airways, there is a reduced potential for complications that are often caused during more invasive surgical procedures.

Who Performs the Procedure?

Electromagnetic navigation bronchoscopies are typically performed by a Pulmonologist or Thoracic Surgeon.

Is this Procedure Done in a Hospital?

Electromagnetic navigation bronchoscopy is usually performed in an outpatient center. Nearly all people will go home the day of the procedure, without requiring an overnight hospital stay.

How Long Does the Procedure Take?

The procedure may last between 30 minutes to two hours.

Lung Cancer Diagnosis

Survival Statistics and the Large Unmet Medical Need

- Lung Cancer occurs in more patients than breast, prostate, colon and pancreatic cancers combined.
- More than 74% of new lung cancer cases have late stage cancer and the 5-year survival rate is only 15%.
- National Legislation was introduced in 2007 declaring lung cancer a public health priority with the goal to reduce the mortality rate of lung cancer by 50% by 2015.
- As many as 219,000 men and women in the U.S. will be diagnosed and 159,000 will die of cancer of the lung and bronchus in 2009.
- The present five-year survival rate in the United States for lung cancer is only 15 percent.
- Thirty percent of all cancer deaths, including 87 percent of lung cancer deaths, can be attributed to tobacco.
- In recent years, an increasing number of lung cancers are found in the periphery of the lungs, a shift that has largely been attributed to increased use of filtered cigarettes: smokers must inhale more deeply to achieve the same amount of nicotine, sending the smoke into the far reaches of the lungs.
- Radon is the No. 1 cause of lung cancer among non-smokers. Radon is responsible for about 21,000 lung cancer deaths every year (about 13.1 percent who have never smoked).
- Secondhand smoke is the third-leading cause of lung cancer deaths, claiming 3,000 lives each year.
- More than 75 percent of new lung cancer cases present with late-stage cancer (Stage III or IV).
- In a recent study published in the NEJM, lung cancer diagnosed at Stage I resulted in a survival rate of 88 percent at 10 years.

Smoking Statistics

- There are more than 43 million current smokers and 47 million former smokers in the United States, many of who are at risk for lung cancer.
- In 2006, the 47 million smokers represented an estimated 20.8 percent of the population.
- There is over 15 billion cigarettes smoked worldwide everyday. Smoking related diseases cost the U.S. more than $193 billion a year.