With 64 lung transplants performed in 2004 – the most of this type ever performed in one year at a single U.S. hospital – The Cleveland Clinic became the nation’s leading lung transplantation center. The Clinic’s cadaveric lung transplantation program is considered the largest and most active in the United States. In 2004, we performed 64 transplants: 28 single-lung, 35 double-lung and one combined lung and heart/lung transplants.

Last year was the Cleveland Clinic Lung and Heart/Lung Transplantation Program’s most successful since its inception over 15 years ago. Our lung transplant recipients now have an 82 percent one-year survival rate, compared with the national average of 72 percent.

In addition, we have one of the shortest waiting times in the country, so patients are likely to receive transplants sooner. This means that sicker patients can be listed faster and have a better chance of survival.

Any patient within a 1,000-mile radius of The Cleveland Clinic can wait at home without having to relocate prior to transplantation until a donor organ is located.

In 2004, 30-day mortality associated with pulmonary transplantation in our program was just 2 percent, despite an increasing complexity of cases. Post-transplant length of stay decreased from a median of 14 days in 2003 to 12 days last year, while ICU stays decreased to seven days.

continued on page 2
DEAR COLLEAGUES:

Welcome to the 4th issue of *Respiratory Exchange*, a publication for physicians with an interest in management of pulmonary and allergic conditions. Whereas the initial issues of *Respiratory Exchange* were produced by the Cleveland Clinic Department of Pulmonary, Allergy and Critical Care Medicine, this 4th issue is co-published with our colleagues in thoracic surgery, pulmonary pathology and thoracic imaging. We believe that patients at our institution benefit from the expertise of a multidisciplinary team, collaborating in the management of complex respiratory disorders.

For additional information about the array of ongoing clinical and research activities in respiratory disorders at The Cleveland Clinic, please visit our department Web sites at clevelandclinic.org/pulmonary (current and previous issues of *Respiratory Exchange* are available here) and clevelandclinic.org/thoracic.

We hope that you – the specialist managing patients with respiratory diseases – find *Respiratory Exchange* to be valuable and informative. Please feel free to contact us at our toll-free number for physicians, 866/CCF-LUNG (223-5864), if you have any questions or if you would like to refer a patient. We welcome the opportunity to work with you.

Sincerely,

Herbert P. Wiedemann, M.D.
Chairman, Department of Pulmonary, Allergy & Critical Care Medicine

Thomas W. Rice, M.D.
Head, Section of General Thoracic Surgery
Department of Thoracic & Cardiovascular Surgery

Carol F. Farver, M.D.
Director, Pulmonary Pathology
Division of Pathology & Laboratory Medicine

Moulay A. Meziane, M.D.
Head, Section of Thoracic Imaging
Division of Radiology

continued from page 1

In 2004, the mean waiting time for lung transplant was 92 days for Cleveland Clinic patients, some of whom were listed for only two to 10 days before receiving organs. The average waiting time has steadily declined, despite an increase in transplant volume, from 360 days in 1999 to 346 days in 2000 and 157 days in 2001 to the current 92 days.

The expertise of our surgeons and pulmonary transplant team allows them to consider and transplant more complex cases that may be declined listing at other centers. We have successfully combined valvular repair and transplantation, coronary bypass grafting and transplantation, transplantation of patients with hepatitis C, and transplantation of cystic fibrosis patients with multi-drug-resistant organisms.

WITH 64 LUNG TRANSPLANTS PERFORMED IN 2004 – THE MOST OF THIS TYPE EVER PERFORMED IN ONE YEAR AT A SINGLE U.S. HOSPITAL – THE CLEVELAND CLINIC BECAME THE NATION’S LEADING LUNG TRANSPLANTATION CENTER

Meanwhile, both before and after lung transplantation, we offer patients and families affordable on-campus residential units in the Transplant Hospitality Center. This allows for rapid pre-transplant evaluation, short lengths of stay and easy access to our outpatient thoracic and pulmonary clinics.

While they are wait-listed, transplant candidates can await notification of a donor organ at home, as long as they live within 1,000 miles of The Cleveland Clinic. Once a donor organ is found, patients are transported via private plane to Cleveland within hours.

To refer a patient for consideration for lung transplant or heart-lung transplant, please call a Cleveland Clinic lung/heart-lung transplant coordinator at 216/444-8282, option 3.

At The Cleveland Clinic, COPD is the primary diagnosis for patients undergoing lung transplant and accounts for 34% of cases.
Transplant volume has grown significantly over the past five years. Overall lung transplant volume since the program’s inception in 1990 exceeds 450 cases. In 2004, The Cleveland Clinic became the most active lung transplantation center in the United States.

*Projected total for 2005 in green, based on 42 transplants performed through July 26, 2005.

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*Projected total for 2005 in green, based on 42 transplants performed through July 26, 2005.

**Patient Waiting Time**

1999 – 360 days
2000 – 346 days
2001 – 157 days
2002 – 126 days
2003 – 158 days
2004 – 92 days
2005 YTD* – 60 days

*As of July 26, 2005

**Listed Patients Can Wait at Home**

In addition to a short wait time – 92 days in 2004 – patients living within a 1,000-mile radius of The Cleveland Clinic can wait at home until a donor organ is located. Once a donor organ is found, patients are transported via private plane to Cleveland within hours.
GPS (global positioning system) technology has become commonplace in the automotive industry, and now, similar technology is available for diagnostic bronchoscopy. The Cleveland Clinic is involved in the first North American pilot trial utilizing electromagnetic navigation technology for the diagnosis of peripheral lesions and mediastinal adenopathy.

The superDimension/Bronchus system (Herzliya, Israel) being used by Cleveland Clinic pulmonologists was FDA-approved in November 2004 as an adjunct to diagnostic bronchoscopy. A pilot trial in Germany demonstrated that the system produced definitive diagnoses for 69 percent of peripheral lesions biopsied. The results were published in the *Journal of Bronchology* (*J Bronchol* 2005;12:9-13).

Between November 2004 and June 2005, we recruited more than 50 patients for our single-center trial of electromagnetic navigation bronchoscopy. Results were published in *Lung Cancer*. (Gildea, TR. Electromagnetic navigation bronchoscopy. *Lung Cancer* 2005; 49(suppl 2):S1-S433.)

Prior to the procedure, data from each patient’s chest CT scan is saved in DICOM format (3-mm cuts at 1.5-mm intervals). The data are then transferred to a CD-ROM, loaded onto a laptop computer and configured into a multiplanar (axial, coronal and sagittal) CT scan and virtual bronchoscopy images.

The lesion of interest is identified in the planning program, along with normal anatomic landmarks. The main carina and left and right secondary carina and a few other distal carinae are plotted to provide points of reference. Once computer planning is complete, the physician performs a virtual bronchoscopy to determine the bronchus that leads most directly to the lesion.

The patient is laid on a standard bronchoscopy table, under which an electromagnetic field generator has been installed. Cutaneous leads attached to the patient serve as points of reference inside the electromagnetic field. These leads also help the computer adjust for chest motion with normal breathing.

The bronchoscope is introduced in the usual fashion. A locatable guide serving as the probe is connected to the system and passed through an extended working channel, which is introduced through the working channel of an adult therapeutic bronchoscope.

Registration is performed, allowing the computer to correlate actual anatomic images on the bronchoscope’s video monitor with virtual bronchoscopy images. When registration is complete, the virtual model of the patient runs alongside the actual bronchoscopy image on the monitor.

The locatable guide is then attached to a directional instrument that allows its tip to move in eight different directions. Once the scope is advanced as far as possible, the locatable guide is advanced through the extended working channel. Using directional instruments, the probe is advanced toward the lesion in the actual patient using the “virtual patient” for electromagnetic navigation.

As the probe approaches the lesion, the virtual target comes into view. The computer displays the distance between the end of the probe and the lesion. When the probe is placed as close as possible to the lesion, the locatable guide is retracted, but the extended working channel is left in place. This allows the introduction of the usual biopsy instruments—brushes, transbronchial biopsy forceps and, if possible, 22-gauge peripheral transbronchial needles.
A case in which this approach proved ideal involved a patient whose listing for lung re-transplant was jeopardized by the emergence of a new, enlarging left upper lobe lesion. Her lung function was too poor to recommend resection; percutaneous biopsy appeared to be too dangerous for similar reasons. Using electromagnetic navigation technology, however, the lesion was successfully biopsied, and aspergillus was identified. The patient was started on Voriconazole and was re-transplanted a few weeks later.

Results from our first 30 patients, with lesions as small as 1 cm in the periphery, showed that we could reach a definitive diagnosis in approximately 70 percent with electromagnetic navigation bronchoscopy. Results of the ongoing study were presented in July 2005, at the 11th World Conference on Lung Cancer in Barcelona, Spain.

Future uses for this technology are being considered for directive therapy. Perhaps in the future, we may be able to place brachytherapy catheters or perform radiofrequency ablation on small lesions using electromagnetic navigation bronchoscopy. We also may be able to apply it to other techniques requiring precise placement of drugs or devices.

Thomas R. Gildea, M.D., and Peter Mazzone, M.D., M.P.H., are members of the Department of Pulmonary, Allergy and Critical Care Medicine, along with Atul Mehta, M.D., who heads the Section of Bronchology.

The Cleveland Clinic was the first medical center in North America to use electromagnetic navigation technology to diagnose peripheral lesions and mediastinal adenopathy.
The Cleveland Clinic’s Section of Thoracic Imaging, with its four full-time chest radiologists, manages over 100,000 non-cardiac thoracic studies in a year in a fully digital environment. Studies ranging from the simple chest X-ray taken at an acutely ill patient’s bedside to highly complex 3-D CT scan images are obtained both locally and remotely and are processed and analyzed at the Thoracic Imaging Center.

To ensure the highest level of patient care, we have integrated cutting-edge image technology into our daily clinical practice. Our multi-slice CT scans allow for a significant improvement in image quality for a faster and more confident diagnosis in a wide range of conditions, including lung cancer, pulmonary embolic disease, emphysema and interstitial lung disease. Hundreds of images offering resolution at the sub-millimeter level can now be obtained in less than 10 seconds with no increase in radiation dose to the patient.

With new technology, characterization of disease, such as distinguishing benign from malignant nodules, is becoming easier and more accurate, which helps to speed diagnosis. Using the latest software, Clinic radiologists can precisely measure nodule volume and evaluate growth in suspected malignancy (figures 1a and 1b). Diffuse lung disease also can be quantified, allowing for measurement of disease burden.

Thanks to improved speed and resolution, virtual bronchoscopy images of unprecedented quality now are available. A pilot study is under way at The Cleveland Clinic to formulate a scoring method for evaluating alveolar proteinosis and its response to treatment (figure 2).

Such studies are being used for transbronchial interventional procedures for the diagnosis of peripheral pulmonary nodules (superDimension project) (figure 3).
The Department of eRadiology began as a natural progression of the Cleveland Clinic’s need to integrate multiple hospitals, family health centers and outpatient imaging centers into one cohesive radiology service model. Over the past five years, this model has grown to include more than 40 separate imaging locations in 12 states, and e-radiologists perform more than 50,000 exams annually.

Modalities include magnetic resonance imaging, computed tomography and nuclear medicine, including PET scans. Each of our client locations is integrated with our radiologists via a high-speed virtual private network that allows Cleveland Clinic radiologists to receive each exam in real time, while conforming to all aspects of HIPAA regulations.

Technologists from our client locations receive training at The Cleveland Clinic in the use of the appropriate modalities as well as in our RIS and PACS systems. We provide exam protocols for every procedure based upon patients’ medical indications and histories. Reports from our radiologists are typically available within 24 hours, with STAT reports available upon request. If unexpected findings surface, our radiologists call the referring physician immediately.

Our services are truly integrated with the physician practice. The radiologists associated with the Department of eRadiology provide services full time to our client locations; the radiologists are available throughout the day for consultations and follow-up with the referring physician.

By integrating subspecialty radiology interpretations to local imaging centers and physician practices, we are able to provide the best in patient care. All in all, it is better medicine.

For more information about eRadiology consults, contact Dr. Michael Recht, Chairman of the Department of eRadiology, at 216/444-2285 or 800/553-5056, ext. 42285, or via e-mail at rechtm@ccf.org.
At The Cleveland Clinic, a team of pulmonologists and oncologists is utilizing several gaseous chemical sensing and identification devices designed to study the exhaled gases of lung cancer patients. The new devices are able to detect a single (or patterns of) odorant molecule(s) such as volatile organic compounds (e.g., alkanes and methylated alkanes) in breath. Volatile organic compounds (VOCs), which result from lipid peroxidation of polyunsaturated fatty acids in cell membranes, are felt to be markers of oxidative stress. There is evidence that the production and processing of reactive oxygen species differs in individuals who have lung cancer, suggesting that the breath VOCs of lung cancer patients may be distinct. In addition, studies using gas chromatography and mass spectroscopy (GC-MS) have confirmed that distinct patterns of breath VOCs exist in lung cancer patients. Unfortunately, GC-MS is not readily available at most centers and is not a tool that is easy to apply as a point-of-care test.

**ANALYZING SMELLPRINTS**

Gaseous chemical sensing and identification devices have employed a variety of sensor arrays, including conductive polymers, non-conductive polymer/carbon black composites, metal oxide semiconductors, fluorescent dye/polymer systems, quartz microbalance sensors coated with metalloporphyrins and polymer coated surface acoustic wave devices. The premise with most of the devices is that absorption of gases onto the sensor system causes a change in the conductivity, mass or vibration of the sensor, altering its output. The systems generally employ an array of sensors that can be tuned to their task. The composite output of the array requires complex multivariate statistical techniques to analyze the patterns, or “smellprints,” of output produced, thus aiding in decision making.

The Cyranose system contains 32 sensors, each a composite of a nonconducting polymer and conductive carbon black particles. The sensor swells as it absorbs vapor analytes (based on specific stereochemical characteristics of the odorant molecules), breaking pathways in the conducting film and altering the resistance of the sensor. Because each sensor contains a unique and adjustable polymer composite, each responds differently to a given vapor analyte. The combined output of the sensors is analyzed to develop a smellprint of the gases that were sampled. Once a smellprint has been established for a particular substance or condition, subsequent samples can be tested to see how closely the patterns match.

We hypothesized that this device could detect lung cancer on the basis of the complex smellprints of VOCs in exhaled breath. Smellprints were obtained on the exhaled breath of 14 individuals with bronchogenic carcinoma, 19 with alpha1-antitrypsin deficiency (α1-ATD), six with chronic beryllium disease (CBD), and 20 healthy controls. Unlike α1-ATD and CBD, exhaled breath of lung cancer patients clustered distinctly from controls. These data indicated that the exhaled breath of lung cancer patients has distinct characteristics that can be identified with a carbon polymer sensor system. Subsequently, a cancer prediction model was prospectively evaluated in a group of 52 individuals, 12 with and 40 without cancer. In the prospective study, exhaled breath analyses by the electronic nose had 83.3 percent sensitivity (95 percent CI: 51.5 to 97.9 percent) and 87.5 percent specificity (95 percent CI: 73.2 to 95.8 percent) for the diagnosis of lung cancer (see figure below).

![Prospective analysis of exhaled breath from individuals with and without lung cancer. Positive deflections are predictions of cancer, and negatives are predictions of no cancer. Overall sensitivity was 83.3 percent, and specificity was 87.5 percent.](image-url)
EVALUATING COLOR FINGERPRINTS

We are continuing to study the use of gaseous chemical sensing devices for the diagnosis of lung cancer. In addition to the Cyranose system, we are evaluating a colorimetric sensor array system. Using a novel optical chemical sensor, the colorimetric sensor array system takes advantage of the color changes that occur in an array of chemoresponsive dyes upon the binding of ligands (e.g., breath VOCs) to identify the composition of a compound or a pattern of many compounds. Color changes are viewed through a scanner that sends signals to a computing device for analysis. The color fingerprint from a given exposure is the difference between the pre- and post-exposure images as processed by dedicated software (see images above). Further study will clarify the test characteristics of these sensor systems for the diagnosis of lung cancer and small pulmonary nodules.

Lung cancer accounts for approximately 29 percent of all cancer deaths. Efforts at early detection and treatment have been frustrating to date, and the overall prognosis remains poor, with roughly one in eight lung cancer patients surviving five years after diagnosis. Unlike current diagnostic techniques, the testing of exhaled breath using these new sensor systems is non-invasive, free of complications and inexpensive. Assuming the new sensors provide necessary accuracy, they will be a welcome addition to diagnostic and screening programs for lung cancer.

Publication


EXPANDED SERVICES FOR LUNG CANCER PATIENTS

Lung cancer patients can take advantage of expanded services at the Cleveland Clinic’s new multidisciplinary Lung Cancer Clinic. The goal of clinic professionals is to provide comprehensive assessment and management recommendations for patients with lung cancer. A host of supportive care services, including pain management, pulmonary rehabilitation and nutrition, also are available to patients to help them better cope with treatment demands. Consultations, including second opinions, are based on a team approach, with same-day assessment provided by physicians from a range of medical and surgical disciplines. Patients may call the Cleveland Clinic Taussig Cancer Center’s Cancer Answer Line at 866/CCF-8100 for appointments.
Aspirin Sensitivity and Aspirin Desensitization

David M. Lang, M.D.

Patients claiming an “aspirin allergy” due to respiratory, cutaneous or other adverse reactions are being encountered with increasing frequency. At the same time, indications for aspirin are expanding.

Aspirin-exacerbated respiratory disease (AERD) is a syndrome affecting an estimated 4 to 10 percent of adult asthmatics that may appear only after years of progression of rhinosinusitis and asthma. Marked by aggressive upper and lower airway inflammation, AERD is provoked by ingestion of aspirin and other non-steroidal anti-inflammatory drugs. Despite avoidance of aspirin and cross-reacting drugs, patients with AERD typically experience refractory rhinosinusitis and asthma, are steroid-dependent and require repeated sinus surgery. Once AERD develops, it is present for life.

The term “desensitization” has traditionally described a procedure involving the modification of IgE-mediated (allergic/anaphylactic) potential to a substance – usually a drug such as penicillin – through repeated re-exposure in a graded-dose fashion. Desensitization can permit patients with AERD to receive aspirin for cardiovascular or rheumatologic conditions and may also have a salutary effect on the course of rhinosinusitis and asthma. The Cleveland Clinic is one of only a few centers in the United States offering oral aspirin desensitization.

The aspirin desensitization procedure, which induces and maintains a state of “tolerance” to aspirin and aspirin-like drugs, entails administration of incremental oral doses of aspirin over the course of several days, until 650 mg (two tablets) can be taken without adverse reaction. Because serious bronchospasm may occur at any time during aspirin desensitization, the procedure is performed in a monitored setting.

At The Cleveland Clinic, we desensitize patients in a short-procedure unit, where reactions can be promptly treated, a 1:1 physician- or nurse-to-patient ratio can be maintained throughout, and emergency-resuscitative equipment and trained personnel are readily available. We also stipulate that AERD patients undergo this procedure when their asthma is well-controlled. In order to proceed, FEV1 should be > 70 percent predicted (or prior best measurement).

Because an aspirin-provoked reaction may be delayed, the minimum interval between doses is three hours; for this reason, the challenge may span three to four days. After doses are given at 8 a.m., 11 a.m., and 2 p.m., the aspirin challenge is suspended until the following day. Patients undergoing this procedure are admitted for observation, leaving the hospital three hours after the final dose of aspirin and returning the following morning.

In select patients who have avoided aspirin because of “aspirin allergy” but now need it for an indication with no effective alternative, a cautious challenge by an allergist/immunologist may be advisable.

Aspirin desensitization entails provoking respiratory reaction to aspirin, then administering the same dose, such that an individual may have repeated reactions. When there is no reaction, the aspirin dosage can be increased as specified in the protocol, until 650 mg is taken without untoward reaction. Note that aspirin-provoked reaction, resulting in significant bronchospasm, is usually observed at a dosage of 60 mg, less than one-fifth of an aspirin tablet (325 mg).

When desensitization is complete, patients are instructed to continue aspirin on a daily basis. In this fashion, desensitization can be perpetuated indefinitely. Studies in which patients take an optimal daily dose of aspirin (650 mg b.i.d.) have consistently shown statistically significant improvement in the course of AERD, including a lower level of symptoms and reduced medication reliance. The economic savings associated with aspirin desensitization treatment accrue from reduced rates of hospitalization and sinus surgery procedures. This intervention has substantial potential for improving health care outcomes and quality of life for patients with AERD.
Serial FEV1 measurements are displayed for GR, a 54-year-old man who underwent successful aspirin desensitization and, in the course of this procedure, experienced two bronchospastic responses to graded-dose aspirin challenge. On day 1 (shown in brown), 60-mg aspirin challenge dose was associated with a 26 percent decline in FEV1, which responded to administration of beta-agonist bronchodilator. Lung function improved over several hours. On day 2 (shown in blue), 100-mg dose provoked a 29 percent decline in FEV1. Protracted bronchospasm continued for several hours despite administration of nebulized bronchodilator; 100-mg aspirin dose then was tolerated without reaction. On day 3, 150-mg, 325-mg, and 650-mg aspirin doses were tolerated without upper or lower airway reaction.

AERD patients who require aspirin (e.g., for cardioprotection) may also be candidates for desensitization. For patients who claim “aspirin allergy” – based on cutaneous or other adverse reaction—a role for desensitization has not clearly been established. However, for properly selected patients who claim “aspirin allergy” and who have avoided aspirin and aspirin-like drugs for many years but now require aspirin for an indication for which there is no equally effective alternative, cautious challenge performed by a board-certified allergy/immunology physician may be advisable.

WHEN TO CONSIDER ASPIRIN DESENSITIZATION

- When reliance on medication (e.g., systemic corticosteroids) for control of asthma and/or rhinosinusitis is unacceptably high
- When moderate or severe persistent asthma is poorly controlled
- When refractory rhinosinusitis mandates repeated polypectomies and sinus surgeries
- When aspirin is required for treatment of cardiovascular, cerebrovascular, rheumatologic or other conditions
The new field of molecular biology has brought about significant advances in the field of genomics, including a first draft of the human genome. With this new genetic information, scientists have begun to define a number of potential tumor markers that may have diagnostic, prognostic and therapeutic significance for lung cancer patients. However, taking a new gene from discovery to clinical use is an extremely laborious process, requiring significant time and resources. A new technique used by pathologists at The Cleveland Clinic allows the study of hundreds of newly discovered genes and reduces both the time and cost of this validation phase.

Using tissue microarrays, multiple cylindrical tissue biopsy cores are built into a recipient block with defined array coordinates (figure 1). These tissue biopsy cores are taken from individual paraffin-embedded tissue blocks from well-characterized, archival cancer specimens. The cores of tissue range from 0.6 mm to 2.0 mm in diameter and are placed using a precision instrument for optimal tissue block assembly. Depending upon the biopsy density, the recipient block may contain up to 1,000 tissue samples (figure 2). From this block, up to 400 sections can be cut to place on glass slides for use in immunohistochemical studies of tumor markers (figure 1). In this way, these tissue microarrays allow for a number of different pathologies and tissue types to be studied at one time, using a minimal amount of reagents.

This new technique is now being used in the Molecular Morphology Laboratory in the Division of Pathology and Laboratory Medicine at The Cleveland Clinic to study large cohorts of lung cancer patients with the hope of finding new ways to improve patient therapy and survival.

Dr. Carol Farver can be reached at 216/445-7695 or at farverc@ccf.org.

Figure 1. Preparing glass slides from tissue microarrays.

Figure 2. Immunohistochemical studies of tumor markers from tissue microarrays.

To arrange for pulmonary pathology consultation services, please send pathology slides and reports to:

Carol Farver, M.D.
Department of Anatomic Pathology/L-25
The Cleveland Clinic
9500 Euclid Avenue
Cleveland, Ohio 44195
Raed A. Dweik, M.D., is the new director of the Pulmonary Vascular Program at The Cleveland Clinic. He maintains an active practice in pulmonary and critical care medicine with special interest in pulmonary hypertension. As Director of the Pulmonary Vascular Program, Dr. Dweik leads a team of five physicians, two advanced practice nurses, two research fellows and two research nurse coordinators, all with special expertise and interest in the various forms of pulmonary hypertension. He also coordinates interaction and collaboration with cardiology, cardiothoracic surgery, lung transplantation, hepatology, liver transplantation, sleep medicine and rheumatology.

Dr. Dweik has been involved in pulmonary hypertension research for more than eight years. His research contributed to the findings of low nitric oxide (NO) in pulmonary hypertension and identified the hypoxic regulation of NO in the lungs. His current NIH-funded work is focused on the role of NO in normal lung physiology and in the pathophysiology of pulmonary hypertension.
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  Specialty Interests: cytopathology, gynecologic pathology

**DEPARTMENT OF eRadiology**

- **Michael Recht, M.D.**
  Chairman
  Office: 216/444-2285
  Specialty Interests: musculoskeletal radiology, magnetic resonance imaging, e-radiology
Cleveland Clinic Pulmonary, Allergy and Critical Care CME Calendar

Physicians are welcome to attend the following upcoming symposia:

**HANDS-ON APPROACH TO DIAGNOSTIC PATHOLOGY**
Sept. 24-25
InterContinental Hotel & MBNA Conference Center, Cleveland, OH

**AIRWAY MANAGEMENT**
Nov. 12-13
InterContinental Hotel & MBNA Conference Center, Cleveland, OH

**THE SECOND ANNUAL SYMPOSIUM ON PULMONARY ARTERIAL HYPERTENSION: PATIENTS FIRST**
Nov. 19
InterContinental Hotel & MBNA Conference Center, Cleveland, OH

**2ND ANNUAL LUNG SUMMIT**
April 20-22, 2006
InterContinental Hotel & MBNA Conference Center, Cleveland, OH

Unless otherwise noted, for more information about the above events, call the Cleveland Clinic Department of Continuing Education at 216/444-5696 or 800/762-8173, or visit www.clevelandclinicmeded.com.
Cleveland Clinic plans
Lung Summit 2006: Focus is Innovation

The Cleveland Clinic Department of Pulmonary, Allergy and Critical Care Medicine will hold its second annual Lung Summit April 20-22, 2006, at the InterContinental Hotel & MBNA Conference Center in Cleveland. The summit will focus on the interfaces among innovative technology, research and clinical care.

Topics from last year’s Lung Summit included frontiers in a variety of pulmonary and critical care areas, including electromagnetic navigation in bronchoscopy, electronic nose technology, carbon monoxide in lung disease, newer modes of mechanical ventilation and artificial lung technology, to name but a few.

Twenty-four visiting speakers including academicians and industry representatives from Germany, Sweden, Canada and Japan joined Cleveland Clinic faculty and other experts from around the country for last year’s two-day summit in Cleveland.

For more information about Lung Summit 2006, call 216/444-5696 or 800/762-8173, or visit www.clevelandclinicmeded.com.