Monitoring Oxygen Therapy
Is it Worth the Cost?

In this issue (see page 646) Brougher et al tested the hypothesis that adherence to medical necessity guidelines can reduce oxygen charges and subdivided the guidelines into "physiologic" and "clinical" criteria, the former relying upon arterial blood gas or hemoglobin saturation determinations, and the latter incorporating the clinical judgment of the attending physician. They found that if oxygen were provided to hospitalized patients solely on the basis of physiologic guidelines, charges for oxygen would be substantially reduced. Applying clinical/physiologic criteria resulted in only marginal charge reductions. In most respiratory therapy departments, it is necessary repeatedly to remind respiratory therapists to enforce medical necessity guidelines. When reminders are discontinued, oxygen use increases.

Although this study demonstrates that oxygen charges can be reduced, charge reductions might not be relevant under present prospective payment systems. Brougher et al did not look at the costs of providing oxygen therapy, which might be a more appropriate measurement in a DRG reimbursement setting. We have found that charges for oxygen therapy far exceed direct costs. The greatest cost associated with oxygen therapy is not oxygen or cannulae, but the personnel time required to monitor it (unpublished data). Liquid oxygen sufficient to continuously provide 2L of flow per minute costs less than $1.00 a day in our institution. In most hospitals, therapists initiate therapy, repeatedly evaluate therapy, and must occasionally locate physicians to request an order to continue or stop therapy. Nurses and physicians infrequently document the need for oxygen therapy.

Stopping oxygen therapy rarely results in direct benefits for patients. On the other hand, therapy directed at preventing perioperative pulmonary complications or closely monitoring ventilated patients helps to shorten hospital stay and improves quality of care. These outcomes are desirable from a medical as well as administrative standpoint. To prosper in a prospective payment environment, hospital administrators have been forced to reduce staffing levels. Our respiratory therapy department has 50 percent fewer positions than in 1982, while there has been no reduction in the number of beds or occupancy rate of our hospital. Because of developing staff shortages, it has become necessary for medical directors of respiratory therapy departments to focus the efforts of their therapists on activities that can be demonstrated to improve quality of care. Therapy that has little measurable benefit should be de-emphasized.

Oxygen should never be provided capriciously to patients by the medical staff and it remains the duty of respiratory specialists to improve the level of staff knowledge about indications for oxygen therapy. This should be a goal of respiratory therapy departments. However, while policing low flow oxygen might save liquid oxygen costs, it consumes valuable therapist time. In a cost-containment environment, this time might be better spent in caring for critically ill patients.

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Bronchoscopic Photodynamic Therapy of Early Lung Cancer

Treatment of an endobronchial carcinoma using a chemical photosensitizer activated by laser light is
called bronchoscopic photodynamic therapy. This type of treatment is, in essence, a form of photochemotherapy since the activated photosensitizer mediates cytotoxic intracellular biochemical reactions. Furthermore, extracellular reactions may directly or indirectly kill cancer cells by damaging the cancer’s microcirculation. Therefore, photodynamic laser therapy contrasts with the direct ablative effects of the CO₂ laser and the photocoagulation necrosis of the neodymium YAG laser.

The sensitizer currently in clinical use is hematoporphyrin derivative (HpD). Its cytotoxic effects after light activation have been known for 20 years, but the basic mechanisms leading to cytotoxicity are still under investigation.

In this issue of Chest, Kato and colleagues (see page 768) describe a 59-year-old woman with a roentgenographically occult, bronchoscopically visible, squamous cell carcinoma who responded completely to one session of bronchoscopic photodynamic therapy. There was no local or metastatic recurrence after 62 months of follow-up. This is an important report and provides an impetus for further development of photodynamic therapy as primary treatment of early lung cancer in carefully selected patients.

Roentgenographically occult lung carcinomas are predominantly squamous cell type and are uncommon. In the experience of the Mayo Lung Project, their incidence was approximately 15 percent in high-risk patients who were closely screened by sputum cytology and roentgenography. They seem to be slow growing with the in situ stages lasting approximately one to two years. Between 13 and 35 percent of roentgenographically occult lung cancers have been reported to be in situ at the time of resection. It is estimated that less than one-half of 1 percent of lung cancer cases will be of sufficiently early stage (in situ with or without microvesion) to justify local, topical therapy. This translates to a maximum of approximately 700 new early lung cancers per year which, if identified, would be suitable for local therapy. Cancer multicentricity is a significant problem in occult lung cancer patients. Up to 15 percent have simultaneous roentgenographically occult cancers, while metachronous primary lung cancers develop at a rate of approximately 5 percent per year. Surgical resection is the treatment of choice with excellent results (70-80 percent five-year survival) reported. However, surgical management may reduce pulmonary reserve in patients who are at high risk for both operative mortality and postoperative complications, due to associated lung and heart disease. Pulmonary reserve may be further compromised by, or preclude, surgical management of subsequent primary lung cancers. Therefore, an addition or alternative to surgical therapy is welcome since chemotherapy and external beam radiation therapy are not often recommended for these cancers.

What do we know about photodynamic therapy with HpD? 1) Reports such as Hayata’s are encouraging, though anecdotal. However, the ability to obtain a complete response using photodynamic therapy in early lung cancer has been confirmed by other investigators. At my institution, one patient is beyond 57 months and several others are beyond 40 months with no evidence of local recurrence. 2) For palliative treatment of patients with advanced, endobronchially obstructing lung cancer, photodynamic therapy can be selected in addition to external beam radiation therapy, endobronchial brachytherapy, chemotherapy, and YAG laser therapy. 3) Is it an alternative to surgery for treatment of early lung cancer? Perhaps. To evaluate this question, controlled studies will be required and patients will need to be selected carefully. The Mayo Lung Project data documented N, lymph node involvement in 23 percent of patients with roentgenographically occult and bronchoscopically visible carcinomas. The patient described in the report of Kato et al had a similar cancer. Presently, photodynamic therapy does not reach regional lymph node tissue, and therefore, is inappropriate if nodal involvement is known or suspected. Unfortunately, it is impossible to predict non-surgically the absence of nodal metastasis. CT scans are the best means, but are far from accurate because micrometastases may not enlarge nodes. A new test or examination, such as a radionuclide scan, blood test, or bronchoalveolar lavage, is essential to solve this problem.

Perhaps the answers will come from molecular biological research. Oncogenes express their presence by deregulating normal DNA function, eventually producing transformation of the cell surface. Such cellular transformation can be estimated by measuring specific cell surface antigens, as well as detecting activated T-cells of peripheral blood lymphocytes and tumor-infiltrating lymphocytes with monoclonal antibodies to receptors for interleukin 2. Monoclonal antibodies tagged with radionuclides may prove useful in identifying nodal metastatic disease. While the level of IgA in bronchoalveolar lavage fluid is not specific for cancer, in patients with known cancer it is conceivable that this local immunologic response may correlate with nodal disease, but this has not yet been investigated. Research like this is required to improve our ability to clinically predict nodal involvement thereby enhancing the selection of patients who would benefit from photodynamic therapy.

The Mayo Lung Project experience showed that lymph nodes were not involved in patients with carcinomas which were both roentgenographically and bronchoscopically occult. Although these patients represent an extremely small proportion of patients with
lung cancer, they would be ideal candidates for photodynamic therapy since the cancers were all either *in situ* or microinvasive.

In the future, I look forward to new developments: improved photosensitizers; improved laser and bronchoscopic technology, for both localization and treatment of early carcinoma; new tests to predict nodal involvement; and, most importantly, controlled clinical trials comparing photodynamic therapy to surgical resection for early lung cancer.

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**Obscure Pleural Effusion**

*Look to the Kidney*

A pleural effusion is a sign, except in mesothelioma, of primary disease outside the confines of the pleural space. In 20 to 25 percent of cases an obvious cause of pleural effusion is not discernible after initial evaluation of the hematologic and biochemical characteristics of the pleural fluid. In these perplexing cases, the clinician should consider renal disease as an etiology of the pleural fluid that results from several different mechanisms. Renal-related effusions include: 1) nephrotic syndrome; 2) uremic pleurisy; 3) urinothorax; 4) peritoneal dialysis; 5) perinephric abscess; and 6) acute glomerulonephritis.

Approximately 20 percent of patients with nephrotic syndrome develop pleural effusions, due to decreased oncotic pressure, that tend to be bilateral with a predilection for the subpulmonic space. The diagnosis of a transudate in the proper clinical setting provides a presumptive diagnosis. However, the finding of an exudate or blood in the effusion should raise the possibility of pulmonary embolism, found in 25 percent of patients.¹

Uremic pleurisy is a fibrinous pleuritis producing a sanguineous, exudative effusion that occurs in patients on chronic dialysis therapy.² Patients may present with fever and pleuropericarditis (or be asymptomatic) and unilateral effusion. The major differential diagnoses of unilateral pleural effusion in the setting of chronic dialysis are uremic and tuberculous pleurisy, and pleural biopsy should be done.

Urinothorax is a rare cause of pleural effusion that develops in patients with urinary tract obstruction or interruption.³ It is usually ipsilateral to the affected side and varies in volume. The pleural fluid has the odor of urine and may be either transudate or exudate; it is the only cause of a low pH transudate. Pleural fluid to serum creatinine ratio of greater than one appears diagnostic. Relief of the urinary obstruction results in prompt resolution of the effusion without residual pleural damage.

Patients undergoing peritoneal dialysis may present with acute dyspnea and large, right-sided pleural effusions, usually within hours of initiating dialysis. The dialysate moves from the peritoneal to pleural space via diaphragmatic defects. Thoracentesis reveals fluid with protein and glucose concentration similar to the dialysate; however, the high glucose content may create a polymorphonuclear leukocyte response.

Perinephric abscesses, like other abdominal infections, may manifest pleural effusions. These sterile exudates are usually ipsilateral to the affected kidney. They result from an inflammatory response to subdiaphragmatic infection, rarely become infected and can be observed once the diagnosis is established.

Pleural effusions in acute glomerulonephritis appear to be due to an increase in microvascular hydrostatic pressure and result in transudates.⁴ Edema and cardiomegaly are clinical accompaniments reflecting hypervolemia and salt and water excess.

The astute clinician never focuses on a single abnormal finding but evaluates the total presentation. The kidney should be considered as a cause of an obscure pleural effusion; as with any organ, disease can be manifest in the pleural space.

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