nonpurulent bronchitis (NBP, 7); purulent bronchitis (PB, 5); miscellaneous inflammatory (MI, 2); and neoplasia (N, 1). Two patients were assigned to two groups, and one patient was lavaged twice. Their ages ranged from 14 to 70 years, with 18 men and 21 women, 28 nonsmokers and 11 smokers. Twelve patients with progressive DILD underwent open lung biopsy at the time of lavage, and provided lung tissue for correlation with the lavage specimens. For each lung biopsy patient, interstitial mononuclear cell infiltration (IMCI) and fibrosis were each semi-quantitated (0-4+), and differential cell counts of the in situ alveolar space exudate and the lavage effluent obtained and cross-correlated.

**Results**

Total cell yield was greater for smokers ($24.55\pm7.77\times10^6$) than nonsmokers ($11.59\pm2.79\times10^6$, $P<0.001$), but with more variation in this patient series than in previously reported normal volunteer series. Decreased fractions of the instilled volume of saline solution were recovered in patients with spirometric airways obstruction. Age, sex and obstructive airways disease did not affect the concentration of cells (cells/ml) in the lavage effluent. The control group showed ($m\pm SEM$) 0.90±0.37 percent PMN leukocytes, 6.40±0.96 percent lymphocytes, 92.69±1.07 percent macrophages in the lavage differential cell count.

Patients with clinically active DILD showed a striking lymphocytosis ($21.46\pm3.98$ percent), three-fold greater than control levels ($P<0.001$). The lymphocyte count in lavage specimens correlated with the lymphocyte count in the alveolar spaces ($r=0.985$). Lymphocytosis in lavage and alveolar cell counts reflected the degree of IMCI as higher mononuclear cell grades in tissue were correlated with larger numbers of lymphocytes in the alveolar spaces ($r=0.818$) and the lavage ($r=0.698$). PB patients, all of whom produced daily purulent sputum, showed elevated PMN leukocyte counts (39.83±11.02 percent, $P vs C<0.001$), whereas NPB patients were similar to controls.

Migration of lymphocytes from the capillary space, to the interstitial space, and into the alveolar lumen has been observed in animal models and human cases of pneumonitis. While concentration mechanisms are not clear, isotopic activity has been found in the lymphocytes in the alveolar space reflects the exuberance of interstitial inflammation, and that their presence is accurately sampled by pulmonary lavage. This technique may hold potential for relative evaluation of pulmonary function and pulmonary surfactant (?) obtained from the lungs of human smokers and nonsmokers by bronchial lavage. Anal Respir Man 183:497-506, 1969

4 Reynolds HY, Newhall HH: Analysis of proteins and respiratory cells obtained from human lungs by bronchial lavage. J Lab Clin Med 84:559-573, 1974


67 Gallium Citrate Lung Scans in Interstitial Lung Disease*

Albert H. Niden, M.D.; Fred S. Mishkin, M.D.; and Man Mohan Lall Khurana, M.D.

Patients with diffuse interstitial lung disease often require a lung biopsy to determine the diagnosis and proper therapy. However, once the diagnosis is established, clinical evaluation of symptoms, chest roentgenogram and pulmonary function testing are the only noninvasive means currently available to assess activity of the disease process and response to the therapy. Although these measures appear adequate in the presence of acute active disease in which response to therapy results in readily demonstrable changes in the above parameters, they may be insensitive to subtle changes that can occur in minimally active disease with slowly progressive interstitial pulmonary fibrosis over a period of years. A more sensitive noninvasive technique for identifying these cases with a smoldering diffuse interstitial inflammatory process might greatly improve our ability to effectively manage such patients. With this in mind, the value of gallium lung scan was investigated to assess its ability to predict inflammatory activity in such a clinical setting.

Gallium citrate has been shown to concentrate in certain neoplastic and inflammatory disease processes. While concentration mechanisms are not clear, isotopic activity has been found in the lysosomal fraction of macrophages, reticuloendothelial cells, lymphocytes and leukocytes. In the lung, gallium concentration is normally low. Increased accumulation of gallium has been found in pulmonary neoplasm, pneumonia, pneumoconiosis and sarcoidosis, in processes provoking a cellular reaction. Increased concentration of gallium in the lung might, therefore, prove to be a sensitive index of inflammatory activity in diffuse interstitial lung disease. To test this hypothesis, 12 patients with diffuse pulmonary infiltrates on chest roentgenogram were studied by gallium imaging of the lung, clinical evaluation, pulmonary function testing, chest roentgenogram and lung biopsy.

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References


4 Reynolds HY, Newhall HH: Analysis of proteins and respiratory cells obtained from human lungs by bronchial lavage. J Lab Clin Med 84:559-573, 1974


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CHEST, 69: 2, FEBRUARY, 1976 SUPPLEMENT
Table 1—Pathologic Diagnoses

<table>
<thead>
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<th>Diagnosis</th>
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<tr>
<td>Sarcoidosis</td>
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<tr>
<td>Interstitial pneumonitis</td>
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<tr>
<td>Siderotic fibrosis</td>
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</tr>
<tr>
<td>Systemic lupus erythematosi</td>
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</tr>
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<td>Miliary tuberculosis</td>
<td>1</td>
</tr>
<tr>
<td>Carcinomatosis</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
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</table>

**METHODS**

Twelve patients, eight women and four men ranging in age from 22 to 48 years and with diffuse pulmonary infiltrates on chest roentgenogram, were studied. One patient had open lung biopsy from multiple sites, while 11 had percutaneous needle biopsy of the lung, two of whom had repeat needle biopsies following treatment. Needle biopsy was performed with the Franklin modification of the Vim-Silverman needle. Adequate tissue specimens were obtained in all cases without significant complications. The pathologic diagnoses are listed in Table 1. Inflammatory activity was graded from 0 to 3+ on the basis of number of granulomata (sarcoidosis) or mononuclear inflammatory cells present in the biopsy specimen.

Pulmonary function studies were obtained in all patients at the time of biopsy and serially following treatment when indicated. The measurements obtained before and after a bronchodilator included vital capacity, total lung capacity, residual volume, forced expiratory volume in one second, forced expiratory volume in three seconds, airway resistance, thoracic gas volume, steady state carbon monoxide, diffusing capacity and closing volume by the oxygen method utilizing standard techniques.

Seventy-two hours after the intravenous injection of 4 mCi $^{67}$Ga citrate, imaging was performed from head to thigh from anterior and posterior aspects using a dual probe 20 cm in diameter crystal rectilinear scanner appropriately collimated with the spectrometer set to accept gamma energies from 150 to 450 KeV. Increased gallium activity was judged to be present in the lung when lung activity was greater than activity in the soft tissues of the shoulders. Gallium concentration in the lung parenchyma was graded as zero (normal), 1+ (increased but less than normal concentration in liver), 2+ (equal to concentration in liver) and 3+ (greater than concentration in liver).

Figure 1A demonstrates an abnormal gallium lung scan in a patient with clinically active sarcoidosis (Fig 1B). Following treatment with adrenocorticosteroids, patient became asymptomatic and her pulmonary function tests, chest roentgenogram and gallium lung scan (Fig 1C) were normal.

There was a close correlation between pathologic activity determined from biopsy specimen and activity as determined from gallium lung scan (Fig 2 and Table 2). In contrast, clinical activity as ascertained by symptoms, stable chest roentgenogram and/or stable pulmonary function studies did not correlate with assessment of activity as determined from gallium lung scan and lung.
biopsy (Table 2).

Of interest, two patients with active pulmonary sarcoidosis became clinically inactive following adrenocorticosteroid therapy. Both had stable residual pulmonary function and chest radiographic abnormalities. Gallium lung scan improved in both cases, but considerable concentration of $^{67}$Ga remained in the lung. Repeat needle biopsy of the lung in both instances revealed persistent significant pathologic activity of the disease process (Fig 3).

**DISCUSSION**

Although the number of cases is small and one must interpret with caution results from needle biopsy of the lung as being representative of overall pulmonary parenchymal changes, the data suggest that the gallium lung scan does correlate with pathologic inflammatory activity in diffuse interstitial lung disease. (Table 2, Fig 2). **Most important, clinical assessment by conventional means appears to be an insensitive index of pathologic activity** (Table 2). Of note, the one patient in this series with a normal gallium scan had little if any evidence of inflammatory activity from open lung biopsy with specimens obtained from multiple sites (Fig 4).

Our study is compatible with the concept that some patients may have pathologically active diffuse inflammatory interstitial lung disease which may not be appreciated by serial evaluations of symptomatology, chest roentgenogram and pulmonary function studies. In contrast, the gallium lung scan is a noninvasive technique which appears to be sensitive to such pathologic activity. The clinical significance of these findings needs further evaluation.

**REFERENCES**


**Table 2—Assessment of Disease Activity**

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>($S_a$, x-ray, Pulm Fn)</td>
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<tr>
<td>$^{67}$Ga scan</td>
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<tr>
<td>Pathology</td>
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