Long-term Physiologic Outcome after Acute Farmer's Lung*

Yvon Cormier, M.D., F.C.C.P.,† and Jacques Bélanger, B.Sc.

We performed a follow-up study of 61 patients who had an acute episode of farmer's lung (54 men and seven women). Twenty-four subjects had ceased all contact with the barn, while 37 had continued farming. Pulmonary function tests for all subjects showed an initial improvement after the acute episode: 92.4 ± 36.9 percent of predicted for carbon monoxide diffusing capacity (Dco) after one year, compared to 61.5 ± 22.5 percent at diagnosis (p<0.01); and 6.01 ± 1.50 L for total lung capacity (TLC) after three years, compared to 5.35 ± 1.42 L (p<0.05). Subsequently, pulmonary function decreased over time. Five years or more after the acute episode, pulmonary function tests in subjects who had continued farm work were not worse than those of subjects who had ceased contact for Dco (65.1 ± 21.4 percent of predicted vs 80.6 ± 27.7 percent, respectively [p>0.1]) and for TLC (5.55 ± 1.31 L vs 5.90 ± 0.84 L [p>0.2]). This study shows that during a long-term follow-up, subjects with farmer's lung who stayed on the farm have subnormal values for pulmonary function but comparable values to those who left their farm.

Extrinsic allergic alveolitis can lead to an irreversible and disabling pulmonary fibrosis;1-3 because of this, it is often recommended, even by recent authors, that farmers with farmer's lung be told to leave their farm and pigeon breeders to sell their birds.4-6 Since these diseases are clearly caused by the inhalation of organic dust (fungi, bacteria, protein),7 avoidance of the offending agent is certainly logical. Cessation of contact may solve the medical problem, but in the case of farmer's lung, may lead to financial and social hardships.

Recent studies have shown that continued contact after an acute attack of farmer's lung may not necessarily lead to progressive respiratory impairment.8,9 To further document the outcome of pulmonary function of patients after an acute attack of farmer's lung, we observed a group of 61 patients with farmer's lung for from 1 to 11 years. On a long-term basis (those who have been followed for five years or more), we found little difference in pulmonary function of subjects who stayed on their farm compared to those who ceased contact. After the acute attack, pulmonary function initially improved and then stabilized at slightly subnormal values.

Materials and Methods

The population under study consisted of 61 proven cases of farmer's lung. There were 54 men and seven women, with a mean age of 39 years (range, 13 to 71 years). Diagnosis was based on a combination of factors, including known exposure, typical clinical presentation, physical examination, chest roentgenograms, pulmonary function tests, serum precipitins, bronchoalveolar lavage, transbronchial lung biopsy, trephine lung biopsy, and, when doubt still persisted, open lung biopsy. Serum analysis for the presence of precipitins was done by Ouchterlony's double-diffusion method.9 We used the American Thoracic Society's criteria for tobacco usage.10

Pulmonary function tests done were as follows: pulmonary volumes by the helium-dilution method (total lung capacity [TLC]; residual volume [RV]); forced expiratory flows (forced vital capacity [FVC] and ratio of forced expired volume in one second to FVC [FEV/FVC]); and carbon monoxide diffusing capacity (Dco).

Four patients were younger than 20 years; since their predicted values changed rapidly over a short period of time due to pulmonary growth, their results on pulmonary function tests were excluded from the statistical analysis. Of the 57 remaining subjects, all had their TLC measured at the acute episode; 56 had TLC and FEV/FVC, and 52 had Dco. All of these subjects were retested at least once, 22 had two retests, and nine subjects had three or more retests.

After the intervals of one and two years since the acute episode, data were pooled in one time interval each for three and four years, five and six years, seven and eight years, and nine years or more. We compared these interval results to the values at the acute episode using Student's paired t-tests; at given intervals, subjects were therefore always compared to themselves. Results are expressed as the mean ± 1 standard deviation (SD), and a p value less than 0.05 is considered to be statistically significant. Fisher's exact test was used for contingency tables due to small values in some cells.

Results

The number of subjects tested at each time interval varied from 57 at diagnosis to ten at nine or more years after diagnosis. The parameter that showed the greatest change between the acute episode and one year after was Dco (61.5 ± 28.5 percent of predicted vs 92.4 ± 36.9 percent of predicted; n = 11 subjects; p<0.01; Fig 1); Dco was also higher than at diagnosis for the intervals of three to four years and five to six years (p<0.05), but not for the intervals of two years, seven to eight years, and nine years or more (p>0.1). The FEV/FVC did not change with time and always remained within normal values for subjects tested (Fig 2). The TLC was higher than at diagnosis, at the interval of three to four years (5.35 ± 1.42 L vs 6.01 ± 1.50 L; n = 18; p<0.05; Fig 3), and at the interval...
Eleven subjects (18 percent) were smokers at the time of their first acute episode, while 15 were ex-smokers, and 35 had never smoked. At the time of restudy, only six subjects were current smokers; three subjects had ceased tobacco use at the beginning of their first episode, and three had later stopped smoking, while one ex-smoker resumed smoking after his first episode of farmer's lung. At the first acute episode, precipitins were positive in four smokers, negative in six, and not recorded in one (Table 1); overall precipitins were positive in 40 of 61, negative in 18 of 61, and unknown in three; fewer smokers than non-smokers had positive precipitins (p < 0.05). There were two smokers in the group who stayed on their farm and four in the group who quit; one of the four was a subject younger than 20 years old. The difference between the two groups (for subjects who had pulmonary tests

<table>
<thead>
<tr>
<th>FVC (liters)</th>
<th>TIME SINCE ACUTE EPISODE (years)</th>
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<tbody>
<tr>
<td>57</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
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<td>17</td>
<td>2</td>
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<tr>
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<td>20</td>
<td>5-6</td>
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<td>13</td>
<td>7-8</td>
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<tr>
<td>12</td>
<td>9+</td>
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Figure 3. Total lung capacity for same intervals, as in Figure 1.

FEV1 / FVC (%) was higher than at diagnosis until six years after (p < 0.05); FVC was also higher at one year (p < 0.001), two years (p < 0.05), three to four years (p < 0.01), and five to six years (p < 0.05) since diagnosis.

<table>
<thead>
<tr>
<th>DCO (% of predicted)</th>
<th>TIME SINCE ACUTE EPISODE (years)</th>
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<tbody>
<tr>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>3-4</td>
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<tr>
<td>19</td>
<td>5-6</td>
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<td>11</td>
<td>7-8</td>
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<td>10</td>
<td>9+</td>
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Figure 1. Diffusing capacity (mean ± SD) for all subjects at acute episode and at various intervals thereafter. Numbers under bars for SD represent number of subjects studied at each interval.

When TLC and FVC were expressed as percent predicted, results showed similar trends: TLC was

<table>
<thead>
<tr>
<th>TLC (liters)</th>
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<tbody>
<tr>
<td>56</td>
<td>0</td>
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<tr>
<td>13</td>
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<td>22</td>
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<td>13</td>
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<td>11</td>
<td>9+</td>
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</tbody>
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Figure 2. FEV1/FVC for acute episode and at different intervals, as in Figure 1. There is no significant difference between times (using paired data for analysis).

Figure 4. Forced vital capacity for same time intervals since acute episode, as in Figure 1.
Table 1—Precipitins in Smokers and Nonsmokers

<table>
<thead>
<tr>
<th>Group</th>
<th>+</th>
<th>-</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smokers</td>
<td>4*</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Nonsmokers</td>
<td>36*</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>18</td>
<td>58</td>
</tr>
</tbody>
</table>

*p<0.05 by Fisher's exact test.

compared) was not significant (p>0.2).

Of the total number of patients, 37 (61 percent) chose
to stay on their farm, while 24 (39 percent) either sold
their farm or never returned to the barn. Of the 24
quitters, 14 did so less than six months after their first
acute episode; of the ten who left their farm at a later
date, four had one or more recurrence of symptoms
severe enough to seek medical assistance. Of the 37
subjects who stayed on their farm, 12 had one or more
recurrence of farmer's lung; one died 11 years after his
first acute illness, of a cause not related to farmer's lung
(pulmonary embolism secondary to myocardial infarct). The number of recurrences was not significantly
different in the two groups (p>0.2).

Results for Dco (in percent of predicted, Fig 5) and
TLC (in liters, Fig 6) could be calculated for selected
groups of subjects who had evaluations at diagnosis and
at five or more years after their acute phase. Both TLC
and Dco were similar between the two groups at
diagnosis (p>0.2 by nonpaired Student's t-test). There
was a large variability between subjects, but the mean
values for TLC did not change significantly over time
for either group; however, subjects who left their farm
had a significant improvement in their Dco (from
64.2 ± 25.4 at diagnosis to 80.6 ± 27.7 percent of pre-
dicted after five years; n = 12 subjects; p<0.05; Fig 5).

This was not seen for the subjects who stayed on their
farm (57.8 ± 17.5 to 68.1 ± 21.4 percent; n = 20; p>0.1); however, TLC did not significantly improve after five
years for subjects who had left (5.38 ± 0.85 vs 5.90 ± 0.84 L; n = 14; p>0.1; Fig 6). After five years,
values for Dco and TLC between the group of subjects
who continued farming and those who left their farm
were not significantly different (p>0.1).

Results were similar when subjects with recurrences
were excluded from these comparisons. In the group of
farmers who had stayed on their farm, values after five
years were not different between those who had no
recurrence of illness and subjects who had at least one
recurrence, for all tests of pulmonary function (for
example, for Dco, 75.4 ± 20.1 percent vs 57.1 ± 19.3
percent for subjects with recurrence; p>0.05).

Discussion

Our data show that after an episode of acute farmer's
lung, most farmers do not progress to disabling pulmo-

dary fibrosis even if they stay on their farm. Eventual
loss of pulmonary function seems to result more from
the initial attack than from continued exposure. Only
the outcome of Dco was related to continuous contact
with the offending allergen. These results agree with
previously reported studies. Since all subjects were
not restudied at each time interval, results shown in
Figures 1 to 4 compare different subjects at each time
interval; Dco given in percent of predicted somewhat
corrects this difficulty; its values parallel those ob-
tained with pulmonary volumes. In Figures 5 and 6,
we compare the same individuals at two different
times. These results agree with the pooled data; values
show a small improvement after the acute phase, but this was significant only for Dco for subjects who left their farm; however, it does show that pulmonary function does not progressively decrease even in the presence of continued contact.

Pulmonary function test results tended to be better after five years, one has to realize that at the time of the initial study, subjects were in the acute phase of farmer's lung. Mean Dco was only 58 percent of predicted in the group who eventually stayed on the farm and 64 percent of predicted for the quitters. After five years the mean Dco was still subnormal. Four subjects who stayed on their farm and one who left did show a marked decrease in Dco over time. Two of these who were still on their farm had, respectively, two and four clinical recurrences. Sixteen (34 percent) of the 47 patients who stayed on their farm for more than six months after their first acute episode had at least one recurrence severe enough to seek treatment. Others may have experienced less severe symptoms. For subjects who stayed on the farm after their first acute episode, recurrences were not a major factor in the decision to quit; there was no difference between the two groups in the proportion of recurrences.

There were fewer subjects with positive serologic findings in smokers than in nonsmokers. This fact corroborates previous studies;[10,11] the reason why smokers have fewer precipitins is not known. Previous studies have reported that farmer's lung was less common in smokers than nonsmokers;[14] however, this could not be verified in our study. Eighteen percent of our patients with farmer's lung were smokers; in our epidemiologic sample of 888 dairy farmers, 22 percent were smokers[8] (no statistical difference; from the test on the difference of two proportions, p>0.2). The proportion of smokers in cases of acute farmer's lung was not different from that of our population of dairy farmers. The fact that there are fewer seropositive subjects in smokers supports the hypothesis that precipitins do not predict individuals at risk for developing acute farmer's lung and that precipitins may not have a role in the disease itself.[10,17]

We do not know to what extent preventive measures were useful in slowing the progression of pulmonary disease in farmers who stayed on the farm. All subjects were told the cause of their disease, and we discussed with them preventive measures including quality of hay, use of hay conditioners and dryers, feeding schedules, silo decapping, and avoiding the manipulation of stored hay and straw.

Prior to 1975, we urged most farmers with acute farmer's lung to sell their farm and find another line of work; our current policy is to recommend continued farming, take all possible preventive measures, have regular evaluations of pulmonary function, and consult at the slightest suspicion of recurrence. Most of our patients are given oral therapy with corticosteroids at the time of acute attacks. Average doses range between 30 and 40 mg of prednisone initially, with gradual tapering to none in six weeks. We do not know if this changes eventual functional outcome. No studies have proven or disproven this possibility, but since it does accelerate initial recovery, we believe that we are justified in using such treatment. Only subjects with documented progressive irreversible pulmonary impairment need be told to cease all contact. Even patients with two or three recurrences have pulmonary function comparable to patients who have left the farm. Obviously, if removal from the farm does not cause major inconveniences, then the person affected with farmer's lung should seriously consider that option.

In conclusion, we believe that although some farmers may eventually progress to significant functional impairment after acute farmer's lung, most do not. Progressive impairment may be seen even in subjects who leave their farm. The large majority of farmers can stay on their farm without ever developing severe impairment and should be permitted to do so. Further studies are needed to identify subjects who have less favorable prognosis and to see if the reduced Dco sometimes seen is a transient or permanent phenomenon.

REFERENCES
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11 Ferris BG. Epidemiologic standardization project (July 1976). Am Rev Respir Dis 1976; 114(suppl.):1-120
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