Farmer's Lung

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INTRODUCTION

Farmer’s lung is one of the many diseases affecting man as a result of the inhalation of vegetable dust.

It was first described in medical literature by Campbell in 1932 in North Lancashire, an area of high rainfall in the northwest of England. The condition has been known, however, for generations among the farmers in Devonshire, and in 1960, I had the pleasure of entertaining Dr. Bjornson from southern Iceland, who was interested in the condition and there the traditional country name for it is “hey-maethie,” which may be translated “hay-breathlessness.”

The disease has now been reported from the U.S.A., Switzerland, Norway, Sweden, Finland and the British Isles, among other countries.

My interest in it was first aroused by Fawcitt's work in 1936. Devonshire proved to be an ideal locality to observe cases and by 1942, when Exeter suffered several air raids, I had collected a number of cases. Unfortunately, all the records were destroyed at that time and it was not until 1945 that time was available for further studies.

Duncan published an excellent paper in 1945, in which he stated that he was doubtful whether Fawcitt's hypothesis of a bronchomycosis was tenable, and in support of this doubt, four of my own cases had swabs of their bronchi taken through a bronchoscope and the only findings were some reddening of the mucosal lining and a Penicillium grown in one case.

Tornell published a paper in 1946 postulating that Candida albicans was the causal factor, but the prevalence of this fungus in a random sample of sputa can be as high as 15.7 per cent (Fuller). It seemed, therefore, that this suggestion was improbable.

The first case in which a lung biopsy was carried out in Devon was 1954. This man was a farmer who had an enlarged intrathoracic thyroid and a fine mottling of his lung fields. The biopsy material was not seen by me until 1956, when I was able to study the history and serial roentgenograms and to examine the patient. It became apparent that this was a typical example of farmer’s lung. This and one other case were published at a symposium in 1958 and later included in a publication “Fungal Diseases and Their Treatment” (Butterworth) 1959. In the same year Frank, Dickie and Rankin, Totten et al., all published papers.

CLINICAL PICTURE

The arbitrary division of farmer's lung into three phases would still seem to be useful.

The first or acute phase occurs after exposure to a massive dose of vegetable dust. This usually happens during threshing a rick of heated grain, which has been harvested in wet weather. The illness appears about six to eight hours after the exposure and is characterized by fever with shivering, headache, a dry irritant cough, occasionally hemoptysis, but more commonly a small amount of mucopurulent sputum, the whole condition clearing up in a few days and bearing a close similarity to an attack of influenza. No x-ray changes in the lungs are apparent at this stage.

The second or subacute phase may follow directly after the initial condition, but more commonly arises after repeated exposure to moldy hay and is more insidious in its onset. The symptoms come on gradually over a period of three to four weeks.

Slight evening temperature is characteristic with some headache, loss of appetite and a cough, but the symptom that drives
the patient to the doctor is increasing dyspnea. This may become severe and is often accompanied by central cyanosis. A dry cough is again present, but sputum is scanty.

Examination of such a patient in the active stage will reveal no impairment of the lung fields, but at both bases, numerous fine crepitations are heard. The breath sounds will be vesicular. In this stage, the characteristic fine mottling of the x-ray film is obvious, especially in the middle and lower zones. Provided that there is no further exposure to the dust, a patient may recover from phase two in three to six months, but after each attack the period of recovery becomes longer until phase three is entered, when there is permanent damage to the lungs with widespread fine fibrosis and a honeycomb type of bronchiectasis.

From this phase there is no recovery and the patient finally becomes a pulmonary cripple with all the attendant disabilities, including right-sided heart failure.

INCIDENCE

As has been said in the introduction, farmer's lung has been described in many countries in the northern hemisphere. The effect of climate on the incidence of the disease is well shown by a survey carried out by Staines and Forman in Great Britain.

In this paper, 191 cases were reported and it was demonstrated that the condition was virtually unknown in the relatively dry eastern counties of England and Scotland and increasingly common in the west, reaching a maximum in Westmorland, Lancashire, West Wales, Devon and Cornwall.

The summer rainfall may again cause great variations in the incidence, thus 1958 was exceptionally wet in June, July and August and resulted in a large number of cases in the following winter, whereas 1959 was notable as a dry year with few cases during the following winter.

Seasonal incidence is well demonstrated over the ten-year period of 1950-59. During that time, 53 cases were seen at my clinic. The date of onset of these cases shows a moderate peak in the autumn due to threshing and a major peak in the early months of the year, when the cattle are being fed under cover, not in large airy milking areas, but in small sheds where the hay is stored in lofts above the stalls. This hay is shaken up by the cowman before being thrown down to the stalls and if of bad quality, will produce a cloud of dust so thick that no one can see across the shed.

The sex incidence in my cases shows a large predominance of men over women as might be expected. These figures prove nothing, for it is virtually impossible to determine the relative numbers of men and women at risk. I have known a girl of 16 get a typical attack. My impression is that both sexes are equally susceptible.

HISTOLOGY

The two cases in my series in which biopsy material was obtained are quoted below with acknowledgments to Butterworth.

CASE 1

A young agricultural worker, aged 27 years, had been using moldy hay to feed his cattle for one month prior to hospital admission. He was admitted to Exmouth Hospital on April 11, 1956, with a history of breathlessness and cough. His Mantoux was negative at 1:1,000, and in view of the extensive mottling throughout both lungs, a tentative diagnosis of farmers' lung was made. Lung biopsy was carried out on May 3, 1956, and at operation the surface and substance of the lung showed miliary bodies indistinguishable from miliary tuberculosis. Half the biopsy specimen was examined bacteriologically and half histologically. Mycobacterium tuberculosis was not isolated in culture, nor by animal inoculation, nor was it found in repeated examination of sputum, bronchial washings and gastric residues during the three months following operation. Histologic examination of the biopsy material showed a large number of tuberculoid systems. These contained endothelioid cells, sometimes giant cells at the periphery and a ring of small round cells inside these. Some of these systems showed central necrosis; many of them did not contain giant cells, and simulated a sarcoid reaction. No foreign bodies were seen in the giant cells, nor
was any doubly refractile material or dust present. Lipophages were numerous.

Clinical and radiologic recovery followed and the patient returned to work three months after the biopsy was taken; he has been well since and a roentgenogram taken ten months later was normal.

Case 2

A man aged 55 years had helped to thresh a large amount of moldy corn in a barn during January, 1954. The same evening he developed a "chill" as did two other members of the threshing team to a lesser degree. A month later, the patient was examined and found to be suffering from exertional dyspnea and fatigue. Crepitations and rhonchi were apparent and a roentgenogram showed a broad mediastinal shadow and areas of fine mottling at the lung bases. After bronchoscopy and tomography, surgical exploration of the right chest was carried out and a biopsy of lung taken; a retrosternal and partially calcified thyroid was observed. Histology of the biopsy material showed only an occasional focus of endotheloid cells with a few giant cells. The tissue was, however, infiltrated with masses of small round cells including small numbers of plasma cells. Many scattered giant cells were present, mostly of foreign-body type containing spear-shaped clefts resulting from dissolved foreign-body material, possibly cholesterol. A small amount of brownish dust material was present, not within giant cells, but there were no doubly refractile particles. Lipophages were plentiful. The condition was considered to be a type of chronic pneumonitis around bronchioles which could well be a reaction to dust.

This patient made very slow progress toward resuming his life as an active farmer. Three months after the thoracotomy, he was unable to do more than move slowly about his farm, and during the next three years was subject to respiratory infections. He is able to do a full day's work now, but at a rather slower pace than before his illness.

Dr. Stewart Smith, who reported on these two biopsies, goes on to say: "Here we have two lung biopsies from cases which clinically were examples of farmers' lung. They show lesions which, while not identical with each other, have certain similarities or shall we say, the pictures overlap."

The similarity of these lesions to those described by Zettergren in his experiments on rabbits is of considerable interest.

Immunologic and Chemical Changes

Tornell first noted the reversal of the tuberculin reaction in 1946, during the active phase of the disease. In 1959, one of the peak years in Devon, when 23 cases were seen in my clinic, 20 were Mantoux-negative, two positive and one not tested. In other words, 87 per cent were negative; considerably more than double that in a normal agricultural community, which is 36.1 per cent, quoting from the Public Health Authority Reports of the Devon County Council.

I would go so far as to say that a positive Mantoux reaction during the active phase of a supposed case of farmer's lung, makes the diagnosis dubious. On several occasions I have seen patients with undoubted calcified primary tuberculosis complexes who were Mantoux-negative in the active phase.

In a small number of cases, electrophoresis was carried out at intervals over a period of several months. This shows a significant increase in the gamma globulin in the active phase.

Pepys working at the Brompton Hospital reported the presence of specific precipitins in the sera of patients suffering from farmer's lung.

He used sera from ten patients attending my clinic at Exeter and ten other cases not suffering from farmer's lung from the same area, together with other elaborate controls. Agar-gel tests were performed by the Ouchterlony method. The sera from the ten cases of farmer's lung all gave precipitin reactions with moldy hay extracts, but those from the ten normal subjects gave none.

Physiologic Changes

In 1959, Trobridge, working in collaboration with me at Hawkmoor Chest Hospital near Exeter, investigated 17 cases of farmer's lung who were in their first attack, carrying out detailed physiologic studies. These patients all showed a low arterial carbon dioxide and low oxygen saturation, which became accentuated on exercise. Other causes having been excluded, it was concluded that the change was due to a low alveolar-capillary diffusion rate. Eight of these 17 cases have had lung function tests repeated two years after their
original attack and it is significant that only 50 per cent have returned to normal and that the other 50 per cent show signs of permanent lung damage, with early fibrosis. While these investigations were being carried out on patients in Devonshire, a group of workers at the Brompton Hospital, London, were becoming interested in the problem and a number of the patients from my clinic agreed to go to London. There lung function tests were repeated confirming our results. Williams' however, was able to reproduce the typical symptoms of farmers' lung, namely the malaise, fatigue, anorexia, temperature, headache and breathlessness, by administering extracts of hay through a Wright's nebulizer under a pressure of 20 lb. to the square inch.

The symptoms came on three to eight hours after administration and lasted up to 21 hours. There was a marked fall in the static compliance during the reaction, a mild fall in the F.E.V. and F.V.C. which could not be reversed by inhalation of an isoprenaline aerosol.

These extracts were prepared from moldy hays known to have produced farmers' lung, by defatting with acetone and extracting with phenol saline solution for five days. The extract was then filtered and the filtrate dialyzed against running tap water for 24 hours to remove the phenol. It was then Seitz filtered to remove bacteria, fungi and spores and other particulate matter.

Extracts of 11 different moldy hays were made in this way, also clean hay, clean hay sterilized by heat and then inoculated with Aspergillus and Mucor and lastly fungi isolated from moldy hay and cultured on Sabouraud's medium. Nine of the 12 farmers' lung patients reacted to the moldy hay extracts, but none of 20 controls. Further the extracts from clean hay, whether contaminated with mold or not, and those made from the pure cultures of Aspergillus, Penicillium, Alternaria, Cladosporium, Mucor and Candida albicans produced no reactions in the farmers' lung patients or the controls.

Help was then sought from the Rothamsted Experimental Station where Gregory had for several years been investigating the processes involved in the maturing of hay. He made use of a small wind-tunnel 14 feet long in the following way. A certain quantity of hay is put in a perforated drum which rotates at one end of the tunnel and air is drawn through this at four meters per second by a suction fan at the other. The air can be sampled (a) to give a visual count microscopically, and (b) to give a count of organisms growing on culture. The hay dust was split into four fractions.

1. Fine. Mainly consisting of bacteria and actinomycetes.


3. Coarse. Mainly consisting of other mold spores, pollen and plant fragments.

4. Extra coarse. Mainly consisting of hay fiber and components of grass.

These four fractions were now extracted by Williams as previously explained with the result that the fine and medium fractions produced no reaction in patients suffering from farmers' lung, whereas the coarse and extra coarse did.

**SUMMARY**

There is no final proof of the mechanism of how farmer's lung is caused.

Clinical observation of patients leaves no doubt that it is an entity. The mode of onset is typical, the symptoms show a remarkable uniformity and the x-ray appearances are characteristic. The histology of all the cases published shows a close uniformity. The relatively slow appearance of this granulomatous change accounts for the fact that x-ray changes are not apparent in the first three to four weeks of the condition.

After hay dust has been fractionated it is only the coarser particles which appear to contain the causative factor.

Thus, farmer's lung may be regarded as a granulomatous infiltration of the lungs,
which occurs in agricultural and other workers, who have become sensitized to hay or threshing dust. The condition can, if recurrent, cause permanent damage to the lungs in the form of fibrosis and bronchiectasis. It bears no relationship to asthma.

The treatment is first and foremost the avoidance of the cause. A number of patients in the group which occurred in Devon have been able to continue their farm work provided they wear efficient masks. Others have been forced to change their occupation. Prednisone has been used for short periods in a few cases with apparent success.

Résumé

No hay prueba definitiva de la patogenia de la "enfermedad pulmonar de los granjeros". No hay duda, clínicamente, de la existencia de tal enfermedad. El principio es típico, los síntomas muestran notable uniformidad y los aspectos a los rayos X son característicos. La histología es uniforme. La relativa lentitud con que aparecen estos cambios granulomatosos se debe a que a los rayos X no son aparentes en las primeras tres a cuatro semanas de la enfermedad.

Después de hacer el fraccionamiento del polvo de heno, parece que solo las partículas gruesas contienen el factor causal.

La Enfermedad de los Granjeros puede considerarse como una infiltración granulomatosa de los pulmones que se observa en los agricultores y en otros trabajadores que se han sensibilizado al heno al manzarlo.

Si la enfermedad es recurrente puede causar un daño definitivo a los pulmones en forma de fibrosis y bronquiectasia. No tiene relación con el asma.

El tratamiento es, primero y sobre todo, evitando la causa. Ciertos enfermos del grupo que se observó en Devon han sido capaces de continuar su trabajo de granja si usan mascaras efectivas. Otros se han visto obligados a cambiar de ocupación. La prednisona se ha usado por periodos cortos en algunos casos con aparente buen resultado.

Resumen

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Resumen

Il n'y a aucune preuve décisive concernant le mécanisme du "poumon de fermier". Les observations cliniques des malades permettent d'affirmer qu'il s'agit d'une affection définie. Le mode d'apparition est typique, les symptômes montrent une remarquable uniformité et les images radiologiques sont caractéristiques. L'histologie de tous les cas publiés montre une étroite uniformité. L'apparition relativement lente de cette altération granulomateuse est à mettre sur le compte du fait que les altérations radiologiques ne sont pas apparentes dans les trois ou quatre premières semaines de la condition.

Après fractionnement de la poussière de foin, c'est seulement les particules les plus grossières qui semblent contenir le facteur causal.

C'est pourquoi le "poumon de fermier" peut être regardé comme une infiltration granulomateuse des poumons, qui survient chez les travailleurs agricoles et autres, qui sont sensibilisés à la poussière de foin ou de céréales. Cette condition si elle est récidivante, peut provoquer des troubles permanents des poumons sous forme de fibrose et de bronchiectase. Elle ne comporte aucune relation avec l'asthme.

Le traitement est d'abord et avant tout d'éviter le facteur causal. Un nombre de malades dans le groupe qui a arriva à Devon fut capable de continuer leur travail agricole à condition de porter des masques efficaces. D'autres ont été forcés de changer leur profession. La prednisona a été utilisée pendant de courtes périodes dans quelques cas sans succès apparent.

Références