Medical Aspects of Rehabilitation
in Tuberculosis

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A. Pathological and Immunological Basis for Rehabilitation.

The average patient with tuberculosis takes active treatment for a period of one to two years, and is discharged as apparently arrested several months after his sputum has become negative and he has become symptom free. There are two questions which must confront the physician when this point is reached. The first is what is the actual residual disease in the lung of this patient whose lesion appears by x-ray to have resolved or to have undergone fibrosis. The second is what is the immunological status of the patient with respect to the residual infection in his body.

In answer to the first question it may be said that the course of reinfection tuberculosis is modified by the indeterminable factors, native immunity, degree of allergy, the dose as well as the virulence of invading organisms, and many other factors more difficult to evaluate. There are consequently extreme variations in the rate of progress of the disease as well as in its rate of healing. The careful studies of healing and resolution cited below preclude any assumption that a patient discharged from the sanatorium with the usual criteria of an apparently arrested case can conceivably be cured and out of danger. The studies of Sweaney show that the average rate of encapsulation and resolution in both primary and reinfection tubercles of moderate size (3-12 mm.) is a relatively uniform function of time over a period of ten to twenty years. Amberson summarizing his observations in several thousand cases states as follows:

"Clinical observation suggests that competent encapsulation requires a year or two and sometimes more after resolution has exhausted its role, a point needing strict attention in attempting to guard against relapse."

Cases are presented by Amberson and by Pinner to demonstrate the fact that tracing a fading lesion to the point of invisibility by x-ray films does not prove its actual disappearance. The presence of caseation over many years' duration is demon-

strated by the appearance of calcification after a lapse of five to
ten years during which time the x-ray has been clear. Experi-
mentally similar discrepancies between roentgenological and anat-
omical evidence of disease in rabbits infected with tubercle bacilli
have been demonstrated by Austrian and Willis\(^2\) and by Burke.\(^3\)

The above teachings constitute the basis for the customary
vigilance toward the discharged sanatorium patient. We recog-
nize that describing him as arrested furnishes a clinical picture of his
disease; that anatomical changes are still in progress, and will
continue to be for years to come. The frequent flare ups are
understandable in the light of this knowledge.

Faced with the problem of guiding a patient with residual
infection, the answer to the second question is highly desirable.
What is the immunological status of the patient with respect to
his infection? The problem here is similar to that in the handling
of an acute infection such as lobar pneumonia. In the days before
the advent of chemotherapy a crisis or lysis indicated the estab-
ishment of immunity in the patient, and the disease was known
to be under control from this point on. With the use of antibiotics
remarkable cures were established within a few days. It was a
common experience for those who discontinued the use of drugs
upon the first x-ray evidence that the lung had cleared to find
within two or three days that the disease had returned in the
same or in another lobe. The obvious explanation was that treat-
ment had been discontinued prematurely—before the establish-
ment of adequate immune mechanisms on the part of the body.
Minute areas of residual disease were therefore capable of serving
as centers from which renewed attacks upon a defenseless body
take place.

The immunological mechanisms in tuberculosis are infinitely
more complex than those in lobar pneumonia although they may
be similar in basic pattern. Some insight into this complexity
may be gained from Rich's detailed discussions.\(^9\) It is obvious
from the clinical course of this chronic infectious disease that
the defense mechanisms are developed slowly, and do not attain
their maximum height until several years after the onset of the
infection. Furthermore, marked fluctuations in the level of im-
munity occur constantly under the influence of factors such as
pregnancy, the puerperium, fatigue, emotional strain, and many
others. Under the circumstances it becomes virtually impossible
in any individual patient, discharged as arrested from a sana-
torium, to predict to what degree he will withstand the various
untoward influences upon his immune level. Knowing full well
that viable organisms are probably still present, no matter how
clear the x-ray film, the uncertain immunological state here, as
is the case after two or three days of chemotherapy in lobar pneumonia, demands the continuation of treatment. It is for this reason that we look upon the process of rehabilitation in tuberculosis primarily as the continuation of medical treatment during a period of increased activity when sociological and psychological readjustment can be brought about.

To demonstrate the importance of the immunological status in the course of pulmonary tuberculosis in patients discharged as arrested from sanatoria, two cases are presented below. In each the total area of visible disease was extirpated by surgery, and no roentgenological evidence of residual disease remained.

Case 1: H.P. was a 31 year old housewife admitted to the sanatorium two months after the onset of symptoms. Her admission film (Fig. 1) shows her disease limited to a shrunken right upper lobe. Her white blood count was normal and sedimentation rate was 2.23 mm. per minute (Rourke method. Upper limit or normal .4). Sputum was positive. Pneumothorax was instituted on the right six weeks after admission. The right upper lobe became completely airless and shrunken (Fig. 2). Bronchoscopy substantiated the impression of intrabronchial disease. The patient gained considerable weight. Her blood smear showed a rise in lymphocytes from 10 to 20 per cent, and the sedimentation rate dropped to 1.42. The sputum, however, remained positive on culture. Therefore, a right upper lobectomy was carried out on July 9, 1942, eleven months after admission. A right temporary phrenic paralysis was also carried out in order to reduce the size of the pleural cavity on this side. The patient was allowed up and about one month after operation, discharged less than three months after her operation as apparently arrested. On discharge no evidence of disease could be seen anywhere in the lung. The patient was under the impression that she was completely cured by her surgical procedure, and she returned to full time activity within a few months after discharge. Two years and seven months after discharge the patient suffered a miscarriage. At that time a slight cough was followed by a small hemoptysis, and an x-ray showed a large new area of infiltration opposite the anterior end of the second rib (Fig. 3).

Case 2: E.T.W. was a twenty-three year old single girl, admitted to the sanatorium on March 9, 1943 with minimal disease in the right upper lobe (Fig. 4). A single gastric lavage was found positive on guinea pig inoculation. Pneumothorax was begun on the right side eight months after admission because of the failure of the lesion to clear on a regime of bed rest. The appearance of the collapsed lung is seen in figure 5 where a solitary nodule can be seen at the level of the mid portion of the second right interspace anteriorly. Because this area remained uninfluenced by the collapse therapy, resection of the right upper lobe was carried out in her fifteenth month. Six months later she was discharged to a program of rehabilitation at the Rutland Training Center. On admission to this institution her x-ray was clear. She was completely symptom free, and her blood was normal with respect to white count, smear, and sedimentation rate. Although placed on a regime of graduated increasing activity, this girl was at all times under the impression
that she had been completely cured by virtue of the fact that her disease had been completely removed. It was found impossible, therefore, to persuade her to adhere to her prescribed program of limited activity. After ten months there was a loss of seven and a half pounds in weight. Her blood showed a white count of 11,000; the smear, a reduction in level of lymphocytes from 48 to 20 per cent. The sedimentation rate rose from .3 to .8 mm. per minute. Nevertheless she was discharged because of the lack of x-ray evidence of disease and the fervent denial of the presence of symptoms. Within four weeks after discharge she became acutely ill, and a film taken at the time showed a large new area of exudation on the right (Fig. 6). Sputum was found positive.

This case, like the first, illustrates the ultimate achievement in the treatment of pulmonary tuberculosis, its apparent total extirpation. In the first case treatment was abandoned prematurely. In the second, a program of rehabilitation, although carried out, was inadequate. In neither case was a level of immunity reached adequate even for the minute residual disease. It is, therefore, our growing experience with cases such as the above that has made it clear to us that the patient, discharged from the sanatorium as apparently arrested, can cope with his two big unknowns, his residual disease and his slowly developing defenses only by a careful program of rehabilitation. This impression is borne out by a comparison between available figures for a five year survival and re-employment rate among patients discharged from sanatoria as apparently arrested without benefit of a rehabilitation program and the distinctly better figures shown after a rehabilitation program at Altro Work Shops.

B. Medical Problems Encountered in the Course of Rehabilitation.

Medical problems arising during rehabilitation are frequently different from those arising during the earlier part of the patient's treatment. Two reasons for these differences are as follows: First, the increased activity of the rehabilitation period brings to light physical disorders which may be masked while the patient is on markedly restricted activity. Second, the very treatment instituted in the sanatorium to convert the patient from sputum positive to negative occasionally introduces complications which retard or make impossible full physical rehabilitation. It is hoped, by summarizing our experiences, to contribute to a long ranged point of view with regard to the medical management of pulmonary tuberculosis: that the all important efforts during the first part of the patient's illness to save his life and convert him from sputum positive to negative might avoid so far as possible irreversible measures interfering with subsequent rehabilitation. The various problems encountered are readily grouped as follows:

1. Non Tuberculous Complications. These serve only to delay
the course of rehabilitation to some degree. Thus, episodes of acute appendicitis, gall bladder disease, hernias, and other surgical problems are to be expected and are handled with ease. Of greater importance are the pneumonias and other respiratory infections. During these illnesses the question is repeatedly presented as to whether a reactivation of the tuberculosis has taken place. Even minor episodes of acute bronchitis or tracheitis may lead to disturbing hemoptysis necessitating reevaluation of the medical status in each case and significant interruptions of programs. Relatively minor respiratory infections may have serious consequences through operation of heteroallergic reactions or through the Shwartzman phenomenon as elaborated by Rich.\textsuperscript{10} We have adopted the policy, therefore, of administering penicillin freely by inhalation to all patients suffering from respiratory infections of more than forty eight hours duration without significant improvement in an effort to minimize their disturbing influences.

Occasionally metabolic diseases in their incipiency may tax the physician. Hyperthyroidism was encountered several times in young women during rehabilitation. The difficulty in distinguishing symptoms of this disease in its earliest stage from evidence of reactivating tuberculosis is obvious.

Non allergic asthma is a rather common finding, although no figures are available at this time indicating its exact frequency in tuberculosis. We have found very commonly among our trainees the symptom complex of wheeze, cough, and mild to severe paroxysms of dyspnea, occurring throughout the year, aggravated by exposure to dampness and occasionally to cold air, frequently precipitated by exercise and emotional disturbances, associated with the production of mucoid sputum never found positive. Until the exact nature of the symptomatology is clarified in each case frequent interruptions for evaluation of the status of these patients is necessary.

2. Problems Arising from Inadequate Measures During the First Period of Active Treatment. These are common. The restricted regime of the sanatorium frequently gives a false sense of security with respect to a variety of conditions. Outstanding among these are two. One is the patient with a unilateral pneumothorax whose opposite side is not collapsed although a considerable amount of infiltration is present therein. Many breakdowns occur among these patients as their rehabilitation is attempted. Often symptoms are of sufficient magnitude to prevent these patients from passing beyond three to four hours of activity although they may maintain negative sputum.

Another common source of trouble is the patient with a pneu-
mothorax apparently successful during residence in the sanatorium despite the presence of adhesions. These patients find rehabilitation difficult. Loss of weight and strength and other complaints frequently make progress slow or impossible. In a few cases where pneumolysis was carried out after attempts at rehabilitation were found difficult, the prompt increase in appetite and strength which followed appears to have justified our wish that pneumolysis be carried out in every case during the first few weeks of pneumothorax whenever possible regardless of the apparently satisfactory result which may have been achieved without it. This long ranged view of our medical treatment would thus allow these patients to undergo a smoother course of rehabilitation.

Patients with a predilection for bronchial tuberculosis are frequently difficult to manage. We have repeatedly seen patients with negligible disease in the lung, who appear to be satisfactorily controlled while in the sanatorium, but after beginning to undertake a program of increased activity, develop positive sputum referable only to intrabronchial disease. These patients may have transient areas of atelectasis in their lungs. Collapse measures are of no benefit and frequently introduce further complications. Resection is futile because the disease ordinarily is not limited to a single area. Although they undergo frequent remissions, when increased activity is permitted, symptoms and positive sputum commonly reappear. It can only be hoped that chemotherapy may prove of value to these patients in the future.

3. Extrapulmonary Tuberculosis. This complication will commonly manifest itself more readily during periods of increased activity. The most commonly encountered sites of extrapulmonary disease in our experience have been the glands, the kidneys, and the intestinal tract. In most cases symptoms had been present early in the sanatorium period of treatment. It was obvious that the restricted life of the sanatorium had masked the disease which became apparent as activity was allowed to increase. Only involvement of the genitourinary tract was considered sufficient to warrant immediate return to the sanatorium. No case of tuberculous adenitis was returned or held back appreciably in his progress. Cases of tuberculous enteritis were all considered individually. Thus far with adequate dietary management and moderate restriction of activity uninterrupted progress has been maintained in all cases.

4. Problems Arising from Therapeutic Measures Instituted During the Earlier Phase of Active Treatment. These have been the most serious and the most difficult to manage. Chief among these is the unexpandable lung following a period of pneumothorax treatment. Recently summarized by Jacobs, this problem is confronted
sufficiently often to warrant great concern and a definite plan of management. The etiology of this predicament is obviously the combination of the following circumstances: a fixed mediastinum and a fibrotic lung enclosed by a thickened pleura. Bronchial stenosis is probably an early factor predisposing to the pulmonary fibrosis. Progressive negative pressure develops rapidly after introduction of air is abandoned. Fluid accumulates but does not prevent the subsequent discomfort and dyspnea which all these patients complain of. Repeated introduction of air must be continued indefinitely in order to insure an intrapleural pressure compatible with comfort. Occasionally these patients develop empyema, and an additional complication is thereby presented. These patients, then, face the necessity of maintaining an undesirable pneumothorax for the rest of their lives and must ever be fearful of a possible empyema. It is felt that these cases can for the most part be recognized while they are still in the sanatorium, and their future freed of its uncertainty there by a thoracoplasty. To carry out such a procedure on a patient after he has left the sanatorium involves obvious difficulty in obtaining the proper surgical skill for this procedure besides the emotional disturbances which necessarily follow the advice that a thoracoplasty is necessary after the first period of active treatment has been completed and the patient is well along on his way to rehabilitation.

Similar to the problem of the unexpandable lung is the problem of extrapleural pneumothorax. Like the patients with unexpandable lungs collapsed by intrapleural pneumothorax, thoracoplasty presents the only reasonable solution, when the lung fails to re-expand, and for the same reasons these patients are best handled by terminating the extrapleural pneumothorax while they are still being treated in the sanatorium.

Another complication which should be recognized early, because it is best handled while the patient is in the sanatorium, is intermittent bronchial obstruction with bronchiectasis. This is not an unusual complication especially following collapse measures such as pneumothorax and thoracoplasty. We are, therefore, occasionally called upon to rehabilitate patients whose sputum is negative but who have evidence of chronic pulmonary suppuration, which on investigation proves to be due to bronchiectasis. Although mild degrees of bronchiectasis need no treatment, those associated with severe symptoms, especially in conjunction with intermittent bronchial obstruction, can look forward to a normal life only after resection of their disease areas. It is otherwise futile to attempt a program of rehabilitation.

A syndrome pointed out recently, which interferes with the
nutrition of patients undergoing pneumothorax treatment to the left lung, is due to mechanical paralysis of the left hemidiaphragm. By elevation of the left intrapleural pressure, mobility of the left hemidiaphragm is mechanically impaired. This condition, in turn, leads to impaired adjustability of the stomach beneath it to increasing contents, thereby interfering with nutrition. This symptom complex of impaired appetite, loss of strength and weight, wholly unrelated to active disease, has been an occasional stumbling block to many who attempt rehabilitation with this handicap. These patients are frequently helped by reducing the frequency and doses of refills. Occasionally it is necessary to abandon pneumothorax prematurely before rehabilitation can progress.

SUMMARY

Upon discharge from a sanatorium as clinically arrested, the patient with tuberculosis is confronted with two unknowns: the residual disease in his lung and the level of his immunity. The available evidence indicates that anatomical healing of tuberculous disease goes on for years after all clinical evidence of disease has gone, that the defense mechanisms of the body against the tubercle bacillus are elaborated slowly, and for many years the level of immunity fluctuates in response to many influences. These facts constitute the basis for the program of rehabilitation which permits the patient's activity to keep pace with his increasing immunity. Medical problems which are confronted during this period are classified and described. Suggestions for their handling are presented.

RESUMEN

Cuando se le da de alta del sanatorio como caso clínicamente estacionado, el tuberculoso pulmonar hace frente a dos incógnitas: la enfermedad residual en su pulmón y el nivel de su inmunidad. Los datos a nuestra disposición indican que la cicatrización anatomica de la tuberculosis continúa años después de que hayan desaparecido todos los signos clínicos de la enfermedad, que los mecanismos defensivos del cuerpo contra el bacilo tuberculoso se elaboran muy despacio y que el nivel de la inmunidad fluctúa por muchos años como resultado de muchas influencias. Estos hechos constituyen la base del programa de rehabilitación que permite que la actividad del paciente vaya mano a mano con su creciente inmunidad. Se clasifican y describen los problemas médicos a los que se hace frente durante este periodo y se indican algunas formas de solucionarlos.
REFERENCES
8 Pinner, Max: "Pulmonary Tuberculosis in the Adult" (page 239), Charles C. Thomas, Springfield, Illinois, 1945.
10 Ibid., Chapter XI: "The Mechanism of Hypersensitivity."

Discussion
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I am very glad that Dr. Feinsilver has emphasized the fact that rehabilitation is an essential part of treatment. This is a statement that merits frequent repetition. Our object in caring for the tuberculous is to get the patient well and keep him so. This means that there must be no instability of the lesion, or clinical activity, while the patient has a specified work tolerance. Rehabilitation helps to meet these qualifications for the procurement and maintenance of the arrest of the tuberculous process.

Let us see how this works out in actual practice. In our sanatorium the minimum criteria for patients' assignments to rehabilitation are as follows: No symptoms; sputa, gastrics and cultures negative for at least three consecutive months; roentgenograms stable for the same period; no contraindicating complications; an ambulatory status for at least one month; collapse therapy effective, with a minimum of three months after initiation of pneumothorax and six months after thoracoplasty.

The initial rehabilitation assignment is for one hour a day, with
an increase of one hour each month. Our patients spend an average of three and one-half months in the program. These patients, therefore, at time of discharge, are really eligible for classification as arrested (they have stable roentgenograms for at least six months, negative bacteriology for the same period, and a daily work tolerance of three to four hours). In this manner the use of strict medical criteria for rehabilitation placement is a serviceable guide in treatment and helps to procure a status of arrest.

Rehabilitation strengthens and hardens the patient and improves his physical condition. Thus work tolerance can be developed with healing of the tuberculosis. Recovery is thereby aided and patients are prepared for their post-sanatorium responsibilities.

Patients should be discharged from institutions with a developed and known work tolerance. Without this the outside physicians will find it difficult to regulate the work allowance and patients will not be prepared for and will not know how much physical activity they can engage in.

It has been our experience that with constant medical supervision and control of the patients’ progress, and rigid criteria for the placement of patients in the program, rehabilitation is a safe form of therapy. This pertains to all patients with good prognosis irrespective of stage of disease or type of therapy.

Many patients need complete vocational rehabilitation training to provide them with a new, suitable skill. It would be hazardous for this entire group to return to their former occupations. Sanatorium rehabilitation provides necessary and satisfactory skills, and when combined with a good post-sanatorium plan, can help the individual to become self-supporting in skilled employment and contribute to the attainment of adequate economic conditions. Thus rehabilitation attempts to control the higher tuberculosis morbidity and mortality among the unskilled and the poor.

I can only mention briefly the important mental or psychological benefits of rehabilitation. A good program can improve patients’ morale, relieve their monotony, and develop optimism, confidence, hope and self-respect.

The period after sanatorium discharge is, in many respects, not the end but the beginning of treatment. The outcome in a case of tuberculosis depends on much more than the status of the patient at time of departure from the institution. Good rehabilitation, education, and a satisfactory follow-up plan are required. This means provision for close medical supervision, elimination of economic and environmental deficiencies, solution for the financial, health and social difficulties of patient and family, continuation of health education, adjustment of personality and emotional problems, regulation of the patients’ work
tolerance and arrangement for vocational training and safe employment. This type of service is necessary for years after discharge. Then and only then it will be possible to maintain the benefits of sanatorium care and prevent breakdowns.

No sanatorium medical and rehabilitation program, no matter how good, can stand by itself. It requires contributions from nursing, social service, medical, neuropsychiatric, welfare, vocational and educational groups. These sanatorium and community resources must be provided and integrated for the patient and family during the entire process of treatment from the time of diagnosis until complete adjustment of the patient and cure has been obtained. Under such circumstances, it will be possible to restore patients to the "fullest physical, mental, social, vocational and economic usefulness of which they are capable."