Four to Fifteen Years Follow-up Study on
387 Cases of Pulmonary Tuberculosis
Discharged in 1942 through 1953*

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Introduction

Since the introduction of specific drugs great advances in the treatment
of pulmonary tuberculosis have been made, and some of the older methods
of treatment have been almost abandoned. These advances can be mea-
ured most effectively by comparing the long-term follow-up status of pa-
tients treated in different ways. It is also felt that an analysis of the
late results obtained in patients followed for many years might reveal
much information of value in guiding the future handling of this disease.

The purpose of this paper is to present and analyze the results of four
to 15 years follow-up study on 387 cases of pulmonary tuberculosis dis-
charged from Piedmont Sanatorium in 1942 to 1953. This was accom-
plished with the cooperation of the local health departments serving the
counties and cities of Virginia.

Materials and Methods

The present study is concerned with an arbitrarily selected group of
patients with a diagnosis of pulmonary tuberculosis among 2,432 con-
secutive discharges from Piedmont Sanatorium, beginning January 1, 1942,
through December 31, 1953. All patients are American Negroes, varying
in age from 15 to 55 years at the time of discharge. Those over 55 years
are not included because many of the older age group become incapacitated
by other chronic diseases. Children are not included because in a large
percentage of this group the lesions were primary.

An attempt was made to choose at random a comparable number of pa-
tients who were treated by the various methods as shown in the tables.

Follow-up letters were sent to each patient's local health department,
where the patients have been followed with the assistance of the family
physician since discharge. The following information was requested: pre-

csent state of health; ability to work; additional treatments after dis-
charge, if any; the results of bacteriologic and roentgenographic exa-
ninations; whether relapse occurred and, if so, at what time; date of death
and cause, if death occurred. The authorized doctors and public health
nurses in each clinic completed the above questionnaires from their records
and interview with each patient.

Of the 630 follow-up letters, it was possible to obtain information which
is available for analysis on 387 (61 per cent) patients. No information was
available concerning the remainder, because they had moved to another
locality and could not be traced.

The 387 have been classified according to sex, age at the time of dis-
charge, types of treatment during hospitalization and duration of follow-up

*From the Commonwealth of Virginia, Piedmont Sanatorium.
### TABLE I

**STATUS BY SEX, AGE AND STAGE OF DISEASE ON ADMISSION**

<table>
<thead>
<tr>
<th>Sex and Age</th>
<th>All Stages</th>
<th>Min.</th>
<th>M. A.</th>
<th>F. A.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Cases</td>
<td>F</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-25</td>
<td>56</td>
<td>30</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>26-35</td>
<td>58</td>
<td>28</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>36-45</td>
<td>51</td>
<td>19</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>46-55</td>
<td>29</td>
<td>8</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td>85</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-25</td>
<td>76</td>
<td>27</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>26-35</td>
<td>79</td>
<td>38</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>36-45</td>
<td>27</td>
<td>12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>46-55</td>
<td>11</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>193</td>
<td>79</td>
<td>48</td>
<td>7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>387</td>
<td>164</td>
<td>75</td>
<td>26</td>
</tr>
</tbody>
</table>

*Min. — Minimal
M. A. — Moderately Advanced
F. A. — Far Advanced
F — Full time work
P — Part time work
S — Sick
D — Dead
period in Table I. The group consists of 194 men and 198 women. The age distribution is mostly in the group of 15 to 35 years. The duration of follow-up of the bed rest alone and pneumothorax groups are mostly for over 10 years, while that of lobectomy and pneumonectomy groups are limited to eight years. Of the 387 patients, 43 were classified on admission as minimal, 106 as moderately advanced and 238 as far advanced disease.

The results are classified into four groups: full time work; part time work; sick and dead. Full time work indicates that the disease is inactive and that the individual is working eight hours or more daily. Part time work indicates that the disease is inactive and the working time is limited to four to six hours daily. "Sick" indicates that the patient is under treatment for active tuberculosis or complications. Deaths are included for both tuberculous and non-tuberculous causes.

**Results**

The results of the entire series of 387 cases are shown in Table I. One hundred twenty-two (31 per cent) were dead [14 (3.6 per cent) from non-tuberculous causes]; 26 (per cent) were sick and the remaining 239 (62 per cent) were working full or part time. These results are analyzed by the various clinical factors and types of treatment.

**Clinical Factors**

Sex and Age: There was no significant difference in mortality between men (31.9 per cent) and women (30.6 per cent). However, the mortality for women with minimal lesions was three times higher than that of the men (men, 3.8 per cent, women, 11.8 per cent—Table I). There was marked difference by age. In the men the mortality increased with the age and the mortality of the oldest group (45-55) was approximately twice as high as the youngest group (15 to 25). In the women this trend was reversed and the mortality of the youngest group was approximately twice as high as the oldest group. Several studies have been reported with different opinions.6, 7, 21

Extent of disease: The close relationship between the extent of disease in the lungs and mortality is so well known as to need no comment. As shown in Table II, the mortality was greater with far advanced (40.8 per cent) than with moderately advanced (20.5 per cent) and approximately six times higher than minimal (6.9 per cent). These relationships were true regardless of sex, age, and types of treatment.

Cavity size and location: There was a definite correlation between the absence or presence of cavitary lesions, as well as their size and location, concerning the mortality rates. One hundred and fifty-nine patients with no cavity showed a mortality of 11.9 per cent, while 228 with cavities showed a mortality of 45.2 per cent. The size of cavity (total diameter of all cavities) plays an important role and the larger the cavity, the higher the mortality rate. This is in accord with the widely accepted point of view which considers cavitation to be an unfavorable prognostic factor. Some observers, however, do not agree with this point of view.7-9

There was no demonstrable relationship between the unilateral location of the cavity and the results attained. There was a minor difference between the cavities in the right lung (44.2 per cent) and the left (38.4 per
<table>
<thead>
<tr>
<th>Treatment</th>
<th>All Stages</th>
<th>Min.</th>
<th>M. A.</th>
<th>F. A.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Cases</td>
<td>F</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>Bed Rest</td>
<td>89</td>
<td>34</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>PNX (18.6 per cent</td>
<td>75</td>
<td>23</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>with chemo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNM (80 per cent</td>
<td>50</td>
<td>15</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>with chemo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THOR (66.6 per cent</td>
<td>50</td>
<td>20</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>with chemo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemo</td>
<td>65</td>
<td>35</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Lobect. and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seg. Resect.</td>
<td>48</td>
<td>35</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Pnect</td>
<td>10</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>387</td>
<td>164</td>
<td>75</td>
<td>26</td>
</tr>
</tbody>
</table>

Min. — Minimal
M. A. — Moderately Advanced
F. A. — Far Advanced
F — Full time work
P — Part time work
S — Sick
D — Dead

PNX — Pneumothorax
PNM — Pneumoperitoneum
THOR — Thoracoplasty
Chemo — Chemotherapy
Lobect. and Seg. Resect. — Lobectomy and Segmental Resection
Pnect — Pneunonecctomy
* — Non-tuberculous
cent). However, the presence of bilateral cavitation raised the mortality rate from 41 to 68 per cent.

Bacteriologic findings: Acid-fast bacilli were demonstrated microscopically in the sputum or gastric contents of all cases on admission except for a few with minimal pathology. Analysis of cases by the bacteriologic findings on admission was therefore considered noncontributory.

The bacteriologic status on discharge definitely related to mortality. Eighty-two patients with positive findings on discharge showed a 75.6 per cent mortality, while in 305 with negative findings the mortality rate was only 19.7 per cent. The high mortality of the positive group could be seen throughout all types of treatment. Most of those in this positive group were discharged against medical advice. A few had received maximum hospital benefit and suitable home care was available.

Types of Treatment

Bed Rest Alone: Eighty-nine patients were treated with bed rest alone and 90 per cent of them were followed for nine to 15 years. Of the 89 of this series, 34 were doing full time work; five part time work; two were sick, and 48 (52.8 per cent) were dead (Table II). Among the 48 deaths, four were from non-tuberculous causes.

Among all treatment groups, as a whole, most of the deaths occurred during the first four years after discharge, following which the proportion of annual deaths occurred at a much lower rate. At the end of four years after discharge 76 per cent of deaths had occurred; the remaining 20 per cent from five to 15 years after discharge (Figure 1).

Pneumothorax: Seventy-five patients were treated with pneumothorax and their refills were continued for an average of two years. Forty had right sided pneumothorax, 28 left sided and seven bilateral. Fourteen (18.6 per cent) had chemotherapy (streptomycin-PAS for three to six months). The observation period of this group ranges from six to 15 years.

Of the 75 with pneumothorax, 23 were doing full time work, 12 part time work, 2 were sick and 38 (50.7 per cent) were dead (Table II). Among the 38 deaths, four were from non-tuberculous causes. As tabulated in Table II, surprisingly, the group treated with bed rest alone showed better results for moderately advanced patients, while the better results in far advanced disease were obtained with pneumothorax.

Pleural effusion was the most feared complication. A small transitory collection of fluid in the costophrenic sinus insufficient to cover the hemidiaphragm was not classified as a complication. Of the 75 patients, 24 (32 per cent) were complicated with pleural effusion, most of them constituting empyema. Of the 14 who had chemotherapy, no one developed pleural effusion.

Those in whom effusion developed had a strikingly higher mortality rate (79.2 per cent) than those who did not (37.3 per cent).

The degree of collapse was considered and it was found that the majority of patients who died had been maintained with a collapse of 50 or more per cent. Similar observations were reported by others.7, 8, 17, 20

Pneumoperitoneum: Fifty patients were treated with pneumoperitoneum and were followed up for five to 12 years. The refills were continued for an average of two years. Forty (80 per cent) had streptomycin-PAS for
three to six months and the remaining 10 were treated with pneumoperitoneum alone. The majority were far advanced, none was minimal. Peritoneal effusion was not observed.

Of the 50 in the pneumoperitoneum group, 15 were doing full time work; 11 part time work; 9 were sick and 15 (30 per cent) were dead (Table II). One death was from nontuberculous cause.

There were better results in the pneumoperitoneum group, both in moderately advanced and in far advanced disease, than bed rest alone and pneumothorax group. These better results were apparently due to the fact that the majority of the patients in this group received chemotherapy. The mortality of the pneumoperitoneum group, receiving no chemotherapy was 60 per cent although the number of cases was small. Various results are presented by others.4,5

Thoracoplasty:* Fifty patients received thoracoplasty primarily or following unsuccessful pneumothorax (17 patients), pneumoperitoneum or phrenic nerve interruption (five patients). Only 17 of the 50 had no chemotherapy. The majority of these had far advanced disease and were followed from five to 12 years. Twenty-six had right side thoracoplasty and 42 of the 50 had cavitary lesions.

* Surgery was performed at the Division of Thoracic Surgery, University of Virginia Hospital, Charlottesville, Virginia. Surgeons: Dr. E. C. Drash, Dr. G. R. Minor, and their staff.

FIGURE 1: Comparative death rates, during first four years after discharge, by groups of treatment and stage of disease on admission.
OF PULMONARY TUBERCULOSIS

Of the 50 operative cases, 20 were doing full time work; 16 part time work; three were sick, and 11 (22 per cent) were dead. Eight of the 11 deaths were among those who received no chemotherapy. Two deaths were from non-tuberculous causes. This approximates the results of others.\textsuperscript{15, 16} The post-operative hospitalization was longer than six months in all of these cases.

The extent of disease of the contralateral lung at operation was significant from a prognostic standpoint. Fourteen who had no involvement of the contralateral side at operation had a mortality of 7.1 per cent, as compared to 17.2 per cent with minimal and 71.4 per cent with moderately advanced involvement of the contralateral lung.

In the collapse therapy group, there was a marked difference in mortality between the cavitary and noncavitary group. However, there were minor differences in the thoracoplasty group (cavitary group, 25.0 per cent; noncavitary group, 21.4 per cent).

Chemotherapy: Sixty-five patients were treated with chemotherapy alone and most of them were followed up from four to 12 years. Only 30 per cent of this group had cavitary lesions on admission.

Thirty-five were doing full time work; 18 part time work; five were sick, and seven (10.8 per cent) were dead. However, among those with cavitary lesions the mortality was 31.6 per cent. The seven deaths were caused by tuberculosis. No death occurred in the minimal group (Table II).

The analysis suggested that the triple combined regimen (streptomycin, isoniazid, PAS) and isoniazid with PAS were apparently superior to other various regimens. However, definite conclusion can not be drawn from the present materials because of the small number. An important difference was revealed, however, when the duration of chemotherapy was analyzed. None died who received chemotherapy for more than one year but 45 per cent died in the group which received chemotherapy for less than six months and among those treated six to 12 months 9.5 per cent died.

Excisional surgery:* Forty-eight patients received lobectomy (included four segmental resections only) and 10 received pneumonectomy. Twenty-three had right sided lobectomy and six had right pneumonectomy. Of the lobectomy group 56 per cent, and pneumonectomy group 70 per cent had cavitary lesions. Thirty-nine were women and 19 were men. They were followed up from four to eight years.

All had long-term chemotherapy in various combinations and their post-operative hospitalization after excisional surgery was more than six months.

There were two deaths in the lobectomy group. One died of a gun shot wound one year after discharge, and the other died of uremia during pregnancy, two years after discharge. There was only one death in the pneumonectomy group. This patient died of renal disease a year after discharge. Similar results are published by others.\textsuperscript{14, 17, 18}

The relations between mortality and the involvement of the contralateral side were not informative due to the small number of patients.

Type of treatment: The relationship between the various therapeutic regimens and the death rates during the first four years after discharge were illustrated in Figure 1.
Although the results of the various therapeutic regimens were not comparable with each other in the minimal cases, the long-term chemotherapeutic regimen appeared to be the superior method. For the moderately and far advanced groups, excisional surgery with chemotherapy was more effective than chemotherapy alone. Collapse, with or without chemotherapy, was inferior to chemotherapy alone. However, the small percentage of cavitary lesions in the chemotherapy group must be considered. Among the collapse therapy group, the best results in far advanced disease were obtained with thoracoplasty, although it was closely paralleled by chemotherapy. Pneumoperitoneum was more effective than pneumothorax in both moderately advanced and far advanced groups, but the additional effect of chemotherapy must be considered. In the moderately advanced disease, unexpectedly, the pneumothorax was less effective than bed rest alone, while more effective in the far advanced group. Similar results were found in the previous paper.10

DISCUSSION

Analysis of the present study revealed that the mortality for pulmonary tuberculosis in the younger age group of women, 15 to 25, was definitely high. The probable explanation is the fact that this is the most productive child bearing period of their lives. The higher mortality of the pneumothorax patients with moderately advanced disease compared with bed rest alone was, also, surprising. However, it must be considered that there were eight with cavitary lesions and seven complicated with pleural effusion, out of the 24 who received pneumothorax. While there were only two with cavitary lesions out of the 23 with moderately advanced disease who received bed rest only (Table II).

The type of treatment appeared to influence significantly the results. It was evident through this study that prolonged chemotherapy for at least one year or more was markedly effective. But, in view of the presence of cavitary lesions, the combination of chemotherapy and excisional surgery seems to produce the best results.

SUMMARY

Three hundred and eighty-seven arbitrarily selected Negro patients with pulmonary tuberculosis who were discharged from Piedmont Sanatorium from January 1, 1942, through December 31, 1953, were followed up from four to 15 years.

The mortality from pulmonary tuberculosis was significantly related to the increasing age in men, the younger ages in women, the extent of disease, the presence or absence of cavity, the size and bilateral distribution of cavities, the bacteriologic findings, the length of chemotherapy and the type of treatment.

The majority of deaths occurred during the first four years after discharge.

RESUMEN

Se observaron durante 4 a 15 años, trescientos ochenta y cuatro enfermos negros arbitrariamente escogidos, los que fueron dados de alta del Sanatorio Piedmont, desde Enero 1 de 1942 hasta Diciembre 31 de 1953.

La mortalidad por tuberculosis guardó relación con la edad más avanzada en los hombres y con la menor edad en las mujeres, así como con la extensión de la enfermedad, la presencia o no de cavidad, el tamaño y la bilateralidad de las cavidades, los hallazgos bacteriológicos, el tiempo de tratamiento y la forma de éste.

La mayoríá de las muertes ocurrieron durante los primeros 4 años después de su salida.

RESUME

387 malades de race noire, choisis arbitrairement, atteints de tuberculose pulmonaire, qui quitterent le Sanatorium Piedmont du 1er janvier 1942 au 31 décembre 1953 furent suivis pendant une période allant de 4 à 15 ans.

La mortalité par tuberculose pulmonaire fut en rapport d’une manière significative avec l’âge élevé chez les hommes, la jeunesse au contraire chez les femmes, avec l’extension de la maladie, la présence ou l’absence de cavité, la distribution uni- ou bilatérale des cavités, les constatations bactériologiques, la durée du traitement chimothérapique et le type de traitement.

La majorité des décès survint pendant les quatre premières années après la sortie de l’hôpital.
ZUSAMMENFASSUNG


REFERENCES


