Effect of Direct Irradiation on the Course of Pulmonary Tuberculosis (Using Cancerocidal Doses)***

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The primary objective of this study was to determine whether there is any hazard in the use of irradiation to the thorax for neoplastic disease coexistent with pulmonary tuberculosis.

The association of lung cancer and pulmonary tuberculosis has become a problem of much significance. There has been in recent years a striking increase in lung cancer incidence and mortality. Tuberculosis which heretofore had been a disease chiefly of young adults has become a disease of middle age and older persons, predominantly men. Longevity has increased in tuberculosis patients. Lung cancer and pulmonary tuberculosis are therefore prevalent in the same age and sex group, namely, the older man. The expectation is that the frequency of this coexistence will continue to increase. In the predrug era, there were few reports of carcinoma associated with tuberculosis, as many tuberculosis patients died before reaching the cancer age. In recent years, there have been a good number of reports of coexistent pulmonary tuberculosis and primary lung cancer.††† In these, when therapy is discussed, the possibility of surgery for the neoplasm is considered. X-ray therapy for inoperable or unresectable carcinoma in the presence of tuberculosis is not recommended apparently because of the accepted opinion that irradiation of a tuberculous lesion will cause its reactivation. On theoretic consideration, it was our belief that pulmonary tuberculosis under effective control of antituberculosis drugs would not contraindicate the application of radiotherapy. A preliminary study of the effect of irradiation in eight patients with pulmonary tuberculosis under the cover of antimicrobial therapy was carried out in the New York City Municipal Sanatorium at Otisville, New York in 1953 and 1954. This study was stimulated primarily by Dr. Fred Elias, the roentgenologist. In this experience, it was found that with antituberculosis drugs being used, radiotherapy with small and moderate doses (400 r to 2000 r [air] and the mid-lung dose with the factors used averaged 30 per cent of the air dose) could be administered directly to active pulmonary tuberculosis of cavitary nature without danger of deterioration of the tuberculosis. It was, therefore, planned to carry this work a step further and we felt justified in using larger x-ray doses where indicated. In the present study, cases of inoperable lung cancer

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coexistent with pulmonary tuberculosis were irradiated for palliation or possible cure. These patients were irradiated during the period from December, 1956 to November, 1958. These radiation doses were much higher than those previously reported. All of the patients were on antituberculosis drug treatment. It was believed that this would permit the essential radiation treatment to be administered. There were seven patients in this group (all treated in the Bronx Municipal Hospital Center*) and the main findings follow.

**Case 1:** A. B., a 70 year-old white man was admitted on October 23, 1956 with extensive soft and cavitary tuberculosis in the upper and apex of the lower lobe of the right lung (Fig. 1). Under antituberculosis drug therapy (SM, PAS, and INH)** sputum conversion occurred within two months. A dense lesion then appeared in the right upper lobe with retraction of the mediastinum. Bronchoscopic biopsy of a granular lesion at the right upper lobe orifice revealed squamous carcinoma. There was excellent resolution of the tuberculous areas so that in nine months there was only residual fibrosis. The neoplasm developed steadily in the right upper lobe. The sputum was negative for ten months and the antituberculosis drug treatment had been in use for 12 months before radiation therapy was given, prompted by the appearance of a superior vena caval syndrome (Fig. 2). With Cobalt-60 teletherapy to 10 x 15 cm. right upper lobe portals, a tumor dose of 4000 r was given in 32 treatments over a period of three and one-half months (October 2, 1957 to January 14, 1958). At the end of irradiation, there was no roentgenographic change. The patient survived for 14 months and one week after completion of radiation therapy. During this period, many sputum cultures were negative except for a single positive culture three and one-half months before death (almost 11 months after irradiation) and two years after the last previously positive culture. The chest x-ray films were unchanged for ten months after completion of irradiation and then revealed an increase in the diffuse density in the right upper lobe and greater deviation of the trachea and mediastinum. The roentgenograms remained unchanged during the next four months prior to death. He died on March 21, 1959 after several hemoptyses. On necropsy, at the carina and mouth of the right upper lobe bronchus was an ulcerating fungating friable mass.

*Some of these cases were treated under the supervision of Dr. Charles Botstein.

**SM refers to streptomycin, PAS refers to para-aminosalicylic acid, and INH refers to isoniazid.

**FIGURE 1: Admission film. Extensive tuberculosis right lung with coalescent exudative-productive lesions and subapical cavitations. FIGURE 2 (Case 1):** Prior to irradiation (irradiated area outlined). Excellent resolution of tuberculosis. Dense neoplastic lesion in medial part right upper lobe. Slight retraction of trachea, mediastinum.
The remaining lung parenchyma showed marked anthracosis and honeycombed appearance. Section through the right upper lobe showed a squamous cell carcinoma arising in the bronchial mucosa with invasion of the surrounding lung parenchyma. There was marked chronic inflammatory cell infiltration of the bronchus and marked fibrosis and chronic inflammatory cell infiltration in the areas of tumor invasion and some necrosis of the tumor. Most of the adjacent tissue showed fibrosis and increased vascularity. Many collapsed old vessels and many thick-walled blood vessels, some of which had organized thrombi. These changes were interpreted as radiation effect. Beneath the wall were localized masses of hyaline, resembling old healed tuberculosis.

Comment: This patient, with extensive tuberculosis in the right lung, having had 29 months of antituberculosis drug treatment, controlled his tuberculosis and reached an arrested state. The 4000 r given for the carcinoma which developed in the right upper lobe did not, in the 14 months the patient lived after the radiation treatment, cause any exacerbation of the tuberculosis. The chest x-ray film changes in the terminal period were due to the advancing neoplasm. The single positive culture noted three and one-half months before death is apparently not indicative of an unstable, active or relapsing tuberculosis. Rather it can be explained as probably due to an incidental release of a few bacilli from the carcinoma invading an old controlled focus of tuberculosis. The necropsy findings would confirm this as the tuberculosis appeared old, and fibrotic with no active lesion.

Case 2: R. W., a 43 year-old colored man, was admitted June 6, 1956. Chest x-ray film showed extensive soft nodular and conglomerate infiltrations in both lung fields and right pleural effusion. Sputa were positive for acid-fast bacilli and antituberculosis drugs (SM, INH and PAS) were started. There was marked clinical improvement and steady reduction of the pulmonary infiltrations, leaving coalescent apical residuals. The sputum cultures became negative within two months and remained so except for one culture seven months after admission. He was discharged on March 12, 1957, but was re-admitted 13 months later (April 24, 1958) with unchanged apical infiltration, but with a new left hilar mass and infiltration extending into the lingula of the left upper lobe. Left thoracotomy revealed tuberculosis in the left upper lobe and a hard mass at the hilum which, on biopsy, showed a metastatic nonkeratinizing epidermoid carcinoma. Radiation therapy was started five months after readmission with Cobalt-60 teletherapy to the left upper chest through anterior and posterior ports of 10 x 14 cm., with a total tumor dose of 4300 r in 49 days (October 2, 1958 to November 9, 1958). This irradiation was given over an area of tuberculosis. After radiation therapy, the apical tuberculous areas remained unchanged and the left hilar and parahilar involvement decreased in size. He was discharged March 11, 1959, four months after irradiation. The sputum and gastric cultures had remained negative. A month and a half after discharge, the left hilar and parahilar involvement was considerably increased, but the tuberculous areas were unchanged. He died June 7, 1959, seven months after irradiation with a final diagnosis of epidermoid carcinoma of the lung with metastases to the pleura.

Comment: In this case, extensive bilateral pulmonary tuberculosis improved considerably with antituberculosis drugs. Carcinoma developed in the left hilum and lingula. Irradiation was given to the left upper lobe and mediastinum. The patient had been under antituberculosis drug therapy for 26 months and was last positive for tuberculosis 21 months before irradiation was started. During irradiation the residual nodular apical tuberculous infiltration did not change. In a follow-up period of seven months after completion of irradiation, there was temporary regression of the tumor and then a considerable increase with the neoplasia causing death. The tuberculosis roentgenologically showed no change and the sputum and gastric cultures remained negative. The tuberculosis was well controlled by drug treatment. The 4300 r given for the tumor in the left upper lobe did not in the seven months he lived after radiation treatment cause any exacerbation of the tuberculosis.

Case 3: B. B., a 44 year-old colored man, was admitted on September 13, 1957, with extensive bilateral upper lobe tuberculosis with nodular mottling and a 2 cm. cavity in the right subapical area. On antituberculosis medication (INH and PAS) there was considerable improvement with residual fibro-nodular areas in the upper lobes, but persistence of the right subapical cavity. The sputum remained frequently positive for acid-fast bacilli. Within eight and one-half months a left parahilar lesion developed. This increased in size and was associated with pain in the dorsal spine, a paraspinal mass and destructive changes in D5 and D6. Biopsy of the mass revealed adenocarcinoma. Streptomycin was added to the drug regimen. The sputum cultures continued to be positive for acid-fast bacilli until two months before irradiation. The nodular upper lobe infiltration and growth with the right subapical cavitation persistent. Radiation treatment was started one year after admission (and 14 months after initiation of antituberculosis drug therapy) with Cobalt-60 teletherapy to the left chest over the tumor mass. Over a 67-day period (September 1, 1958 to November 4, 1958) a total tumor dose of 5300 r to the spine and 5100 r to the chest were delivered through anterior and posterior ports of 14 x 17 cm. He lived seven weeks after completion of irradiation with death on December 28, 1958. The sputum culture was positive for acid-fast bacilli within five
weeks of the beginning of irradiation and then remained negative until death—a period of ten months and 19 days. The chest films after irradiation revealed a slight decrease in the parahiliar density, but no change in the bilateral upper lobe tuberculosis. The necropsy revealed primarily adenocarcinoma in the left upper lobe and apex of left lower lobe with extensive regional and distant metastases and secondarily inactive pulmonary tuberculosis with pulmonary emphysema and fibrosis. Microscopic sections revealed infiltrating, poorly differentiated adenocarcinoma with many areas of necrosis and hemorrhage within the tumor. Sections of lung showed diffuse fibrosis and focal emphysema. In the upper lobe were several caseating granulomata with thick fibrous capsules. Adjacent tissue showed marked fibrosis but typical features of radiation changes were lacking. The diagnosis was that of healed encapsulated fibrocaseous tuberculosis.

Comment: In this case with extensive bilateral upper lobe tuberculosis there was much improvement with antituberculosis drugs. An adenocarcinoma developed in the left lung and irradiation was given through the tuberculosis in the left upper lobe. The sputa were positive until two months before irradiation was started. A single sputum was positive five weeks after irradiation was started and then all sputa were negative until death occurred two and one-half months later. Necropsy revealed fibrosis and well encapsulated fibrocaseous focus and no active tuberculosis. The evidence indicates that with the antituberculous coverage the 5100 r to the lung did not cause any exacerbation of the tuberculosis and the healing was maintained.

Case 4: R. S., a 56 year-old white man, was admitted on November 23, 1956. He was known to have pulmonary tuberculosis at least four and one-half years before a definite diagnosis of right upper lobe epidermoid carcinoma was made by bronchoscopic biopsy. He had been under antituberculosis drug treatment (SM, INH and PAS). There was a fibrocalcific nodular infiltration in the upper halves of both lungs with coalescent soft infiltration and cavitation in the left upper lobe. The carcinoma appeared as a mass in the right paratracheal area, extending toward the apex (Fig. 3). Radiation therapy was started within one month after admission. The sputum had been positive prior to irradiation. Radiotherapy was given with grid technique (250 KVP) to the right upper anterior and posterior chest through 10 x 15 cm. ports with a total tumor dose of 5100 r in 51 days (December 20, 1956 to February 8, 1957). One month after irradiation there was much reduction in the right paratracheal mass, but the cavitory area in the left upper lobe increased. There was no irradiation to the left lung and it is probable that this change was due to the chronic relapsing character of the tuberculous disease in a patient uncontrolled after years of antimicrobial treatment. The sputum continued to be positive for acid-fast bacilli. Ten months after radiation therapy, the cavity in the left upper lobe decreased in size. In vitro resistance to INH and PAS was present. Antituberculosis drug treatment was continued, but the sputum remained positive. Another antituberculosis drug (cyclasorine) was added. Sixteen months after irradiation, the right paratracheal mass began to enlarge again. By this time, there had been much clearing of the lesion in the left upper lobe (Fig. 4). By April, 1958, 26 months after completion of irradiation, there was complete atelectasis of the right lung. The left lung appeared emphysematous with no change in the

FIGURE 3

FIGURE 4

infiltration, but the suggestive cavity in the left upper lobe was smaller than before irradiation. The clinical condition deteriorated and he died from the carcinoma on October 29, 1959 or thirty-two and one-half months after irradiation.

Comment: There was extensive fibrocalcific tuberculous involvement in the upper lobe of the right lung (and fibrocalcification in the upper lobe of the left lung). Fifty-one hundred r was given to the right upper lobe where a carcinoma had developed. He survived for thirty-two and one-half months after irradiation. For six months before death, the tuberculosis in the right upper lobe could not be visualized because of complete right lung atelectasis due to the tumor. During the long period before this atelectasis, there was no roentgenologic change in the tuberculosis in the right upper lung. He had tuberculosis at least four and one-half years before cancer was diagnosed. The spuota remained positive throughout the course of treatment due to a persistent cavitary lesion in the left upper lobe and bacillaemia resistant to antituberculosis drugs. At death, the left lung had shown much resolution and the cavity was smaller compared to the status prior to irradiation. Although an autopsy was not done, there was no clinical indication of deterioration of the tuberculosis due to irradiation.

Case 5: W. M., a 61 year-old white man, was admitted May 21, 1957 after 26 months' hospitalization elsewhere. His first x-ray film had revealed extensive bilateral pulmonary tuberculosis with confluent soft areas and cavities in the upper lobes and soft linear nodular infiltration in the rest of the lungs. The sputum was positive for acid-fast bacilli and remained so for 11 months. He was placed on antituberculosis drug treatment (SM and INH) with marked resolution. After one year, the lower lung fields were clear, but there was residual linear and nodular fibrosis in the apical and subapical areas. However, a mass appeared in the right parahiliar area nine months after the first admission and increased slowly. The sputa and cultures remained negative. On admission to Bronx Municipal Hospital Center, sputum examinations were positive for malignant squamous cells and needle aspiration of the right lung mass revealed malignant cells. Radiation therapy was started two and one-half months after admission. At this time there was a homogeneous density of the right upper lobe. Cobalt–60 irradiation was given to the right upper lung through anterior and posterior portals 14 x 14 cm. for a period of 37 days (August 7, 1957 to September 12, 1957) with a total tumor dose of 5200 r. After completion of therapy there was a slight increase in the right upper lobe retraction. The tuberculous infiltrations in the right upper lobe could not be visualized and the left lung was unchanged. Clinical deterioration continued. Terminally he developed right hemiplegia from metastasis to the brain, became comatose and died on December 24, 1957, three and one-half months after completion of irradiation. There were no roentgenologic changes during this period. The sputum had remained negative for tuberculosis.

Comment: In this patient, extensive bilateral soft and cavitary pulmonary tuberculosis had undergone marked resolution with antituberculosis drugs leaving only residual fibrosis in the upper lobes. The sputum which had been positive for tuberculosis became negative 11 months after start of drug therapy and remained so the rest of his life. Fifty-two hundred r was given for a right upper lobe neoplasm and through an area of tuberculosis. He died three and one-half months after irradiation and the tuberculosis in the left lung field on the right. This case is more difficult to evaluate because the follow-up period was short and there was no necropsy. However, the tuberculosis in the visible lung field appeared well controlled by antimicrobial therapy following irradiation.

Case 6: T. H., a 51 year-old white man, was admitted January 4, 1957. He had diffuse infiltration throughout the right lung, with linear infiltration and mottling throughout the right upper lobe with suggestive small radiolucent areas. He was on antituberculosis drugs (SM and PAS). Within two and one-half months after admission, bronchoscopy revealed a neoplasm in the right main bronchus with tissue section showing an infiltrating squamous cell carcinoma. The chest film had shown enlargement of the right hilum. The tuberculosis responded to antituberculosis drug therapy, the sputa and gastric washings were negative for acid-fast bacilli, and just prior to irradiation there had been moderate resolution of the linear and nodular infiltration in the right lung. The right parahilar density was larger and there was retraction of the upper lobe. Irradiation was started four and one-half months after admission with Cobalt–60 to the right upper lung field through anterior and posterior portals 14 x 16 cm., with a total tumor dose of 4500 r in 78 days (April 18, 1957 to July 1, 1957). The irradiation was given through an area where the major roentgenologic evidence of tuberculosis had been present. The film at completion of irradiation showed more atelectasis of the right lung and encapsulated right pneumothorax. The roentgenologic changes in the tuberculosis could not be determined and the left lung remained clear. There was a follow-up period of five months after radiation therapy. The irradiation was associated with some temporary symptomatic improvement. The sputum and cultures continued to be negative. He died on November 12, 1957, five months and one week after completion of therapy with terminal kidney failure. Necropsy revealed the right upper main bronchus markedly narrowed by neoplastic tissue which extended into the lung parenchyma. The right lung was quite rigid and
showed a diffuse mesh-like pattern of neoplastic infiltration throughout forming irregular circumscribed nodular honeycombed areas. The lung on section showed not only the keratinizing squamous cell carcinoma but areas of edema and fibrosis. In addition there were scattered fibrocaseous nodules with occasional Langhans' type giant cells. No definite change attributable to radiation was recognized.

**Comment:** The patient had extensive tuberculosis in the right lung, especially the upper half, with moderate resolution under antituberculosis drugs and sputum conversion. A neoplasm developed in the right lung and he received 5400 r to the right upper lung field where tuberculosis had been present. He survived five months after completion of irradiation. The sputa continued negative, the left lung remained clear and there was no roentgenologic evidence of spread of tuberculosis, although the atelectasis obscured details in the right upper lobe. At necropsy the tuberculous foci appeared old and fibrocaseous. There was no evidence of exacerbation of the tuberculosis.

**Case 7:** C. K., a 68 year-old white man, was transferred on May 22, 1957. In the first institution, to which he had been admitted in October, 1956, it was noted that he had tuberculosis in the right upper lobe with small cavities. A coexistent homogeneous right upper lobe density (Fig. 5) was proved due to epidermoid carcinoma of the bronchus by bronchoscopic and scalene node biopsies. The tuberculosis was confirmed by three positive sputum cultures. With antituberculosis drug therapy (SM and INH) sputum conversion occurred. The right upper lobe neoplasm progressed to create a uniform lobar density. Irradiation was given (250 Kv) with a total tumor dose of 2000 r in 30 days (March 18, 1957 to April 17, 1957), less than six weeks after antituber-

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**FIGURE 5**

[Image: Film at onset. Tuberculous infiltrations in right upper lobe and subapical cavities. Homogeneous neoplastic density at base of right upper lobe.]

**FIGURE 6**

[Image: After first course of irradiation. Extensive homogeneous density right upper lung field. (Area irradiated during second course of irradiation outlined.)]
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culosis drugs were started and only a few weeks after sputum conversion. On admission to the Bronx Municipal Hospital Center, the chest film showed an extensive homogeneous density in the right upper lung field (Fig. 6). INH and SM were continued. Two months after completion of the first course of irradiation, another course of irradiation with Cobalt-60 teletherapy was given. A total tumor dose of 6800 r was given in 52 days (June 20, 1957 to August 9, 1957) to the right upper chest, through anterior and posterior portals of 12 x 15 cm. He had a total tumor dose of 8800 r in five months to the right upper lung field, the area of the pulmonary tuberculosis. After irradiation there was subjective improvement with much reaeration of the right upper lobe (Fig. 7). Sputum smears and cultures prior to irradiation were negative, but there was no sputum report available during or immediately after irradiation. He was discharged to clinic supervision on August 30, 1957, three weeks after completion of irradiation. He never returned to the out patient department. There is a serious question as to whether he continued his antituberculosis drug therapy after discharge. He was re-admitted to another hospital on November 1, 1957, two months after discharge. Based on previous hospitalization for tuberculosis, antituberculosis drugs were started one month after readmission. A sputum smear on November 7, 1957, two months before death, was negative, but the culture was positive for acid-fast bacilli. The last chest x-ray film, two months before death, revealed considerable change, with destruction of the right upper lobe and bilateral diffuse infiltration (Fig. 8). He died on January 9, 1958, five months after irradiation. The cause of death clinically was carcinoma of the lung with inactive, moderately-advanced chronic pulmonary tuberculosis.

Comment: This patient had tuberculosis in the upper lobe of the right lung and carcinoma developed in the same area. Sputum conversion occurred rapidly with antituberculosis drugs. He survived five months after completion of irradiation with 8800 r given to the right upper lung field. Because of atelectasis in the right upper lobe the roentgenologic changes in tuberculosis could not be discerned, but there was much

FIGURE 7

FIGURE 8

FIGURE 7 (Case 7): At completion of second course of irradiation. Much reaeration of right upper lobe. FIGURE 8 (Case 7): Three months after second course of irradiation. Destruction of right upper lobe. Diffuse infiltration in rest of right lung and left lung.
resection of the lobe after irradiation. A film two months before death showed destruction of the right upper lobe with bilateral diffuse pulmonary infiltration. A sputum culture at this time was positive for acid-fast bacilli. The crucial question is whether there was progression of the tuberculosis. It is not certain whether the final chest x-ray film shows necrosis of tumor with progression of malignancy and lymphangitic spread or relapsing tuberculosis. There are several possibilities for the positive culture: (a) was this a true tuberculosis relapse due to discontinuation of the antituberculosis drugs for three months after irradiation?; (b) did the unusually heavy dose of irradiation (8800 r) cause lung necrosis?; (c) did the neoplasm extend into healing areas of tuberculosis and release a few acid-fast bacilli without a true relapse of the tuberculosis? In any case, positive bacteriologic findings are evidence of relapsing tuberculosis by our criteria and a positive culture was found two months before death and three months after irradiation. The issues considered above prevent a definite conclusion that this was due to the radiation therapy although this cannot be excluded. It must be emphasized that the continuation of antituberculosis drugs is a basic requirement to avoid the possibility of any worsening of the tuberculosis from irradiation.

Discussion

The seven patients in this series with lung cancer and pulmonary tuberculosis given radiation therapy were men, aged 43 to 70. The known duration of the tuberculosis varied from four months to four and one-half years. The tuberculin reactions prior to irradiation were positive in one patient as fibrocalcific noduleation, in another as dense infiltration and small cavities, and five had soft mottled infiltrations with cavities. Before irradiation, various degrees of resolution and healing had occurred, leaving residual coalescent or fibrotic linear and nodular lesions. It may be significant that there was no recent large caseous pneumonic area or acute cavity.

At the start of irradiation, the sputum was still positive in two and negative in five patients. In these latter five cases the sputum had been negative for intervals of two to 21 months. The tuberculosis was active in two, arrested in three and inactive in two.

Antituberculosis drugs had been given in each case for varied periods prior to irradiation—from six months to one-half years. These drugs were continued in every patient during the treatment period and in all but one after completion of treatment.

The primary lung cancer was present in the right upper lobe in five patients and in the left upper lobe in two. A histologic diagnosis was made in all patients, epidermoid carcinoma in six and adenocarcinoma in one.

The radiation therapy was given with Cobalt-60 in five, with 250 Ky grid technique in another and one had a first course elsewhere with 250 Ky followed by a second course with Cobalt-60. The mid-lung depth dose varied from 4000 r to 5400 r, and in the patient with two courses, 2000 r was given in the first and 6800 r in the second course. The irradiation was administered to anterior and posterior fields of 150 to 200 square cm. with daily treatments except when interrupted because of the patient's condition. Total treatment varied from 37 to 104 days (but most within two months).

The neoplasm in all seven patients developed in an area of lung where tuberculous lesions were present. Consequently, the stated tumor dose was given to areas of tuberculosis.

The duration of the follow-up after completion of irradiation, with all cases observed until death, varied from seven weeks to thirty-two and one-half months.

The progression of tuberculosis that could be related to the radiation therapy were reviewed from the clinical, bacteriologic and roentgenologic aspects. Such changes were divided into three periods: first, during the actual time of radiation treatment; second, the six months immediately following irradiation (or until death if it occurred within six months of the radiotherapy) and third, the remaining period of observation.

During the treatment interval, there was no clinical finding of tuberculosis relapse or roentgenologic worsening in any case. One patient (Case 3) had a positive sputum culture five weeks after start of treatment and was then negative until death two and one-half months later. After irradiation, there was no change in the upper lobe tuberculosis. At necropsy, the lung revealed diffuse fibrosis with several caseous granulomata with thick fibrous capsules. There was no exacerbation of disease.

In the six-month period following completion of irradiation, there were three other patients, one at three and one-half months (Case 5), and in two at five months (Case 6, Case 7). Clinically, there was general deterioration from progressive carcinomas in all three. In Case 5, the sputum remained negative and the tuberculosis in the visible lung field appeared well controlled after irradiation. The sputum continued negative. In Case 6, there was no roentgenologic evidence of spread of tuberculosis although atelectasis obscured details. At necropsy, the tuberculous foci appeared old and fibrocaseous with no evidence of exacerbation. The sputum was positive in only one (Case 7). In this case, a positive culture was reported three months after completion of irradiation (and two weeks before death). There were, at this time, roentgenographic changes of lung destruction and diffuse bilateral infiltration. There is a possibility of progression of tuberculosis, but the changes could be due to the
unusually heavy dose of irradiation (8800 r) and radiation necrosis. An additional factor was that the antituberculosis drugs had been discontinued. The final opinion is, therefore, equivocal.

In evaluating the changes in tuberculosis over six months after irradiation, there are three patients to be considered. The clinical changes in these cases were terminal manifestations of carcinoma and death occurred at intervals of seven months (Case 3), 14 months and one-half months (Case 1), and thirty-two and one-half months (Case 4). In Case 2, the sputum remained negative and the tuberculosis roentgenographically showed no change. A single positive culture was reported three and one-half months before death (11 months after irradiation) in Case 1. There had been no x-ray film change in the tuberculosis. At necropsy, the tuberculosis appeared old, fibrotic and healed, with no active lesion. In Case 4, there had been no roentgenologic change in the tuberculosis in the irradiated right upper lung for over 26 months after irradiation when terminal atelectasis from cancer developed. The sputa had been positive throughout treatment due to a persistent tuberculous cavitary lesion in the non-irradiated left upper lobe and bacterial resistance to antituberculosis drugs.

At the final observation of the patients the tuberculosis was considered inactive or arrested in all but two cases. Of the latter, one was definitely active (Case 4 with contralateral tuberculous cavitation), one was of questionable arrest (Case 7 with roentgenologic change and one positive culture and questionable relapse of tuberculosis).

SUMMARY
1. In this study, cases of inoperable lung cancer coexistent with pulmonary tuberculosis were irradiated with cancerocidal doses.
2. Seven patients in whom neoplasm developed in an area of tuberculosis were treated. The dose of irradiation at the central lung varied from 4000 r to 6800 r given in 37 to 104 days.
3. All patients received antituberculosis drugs.
4. The total period of observation after irradiation varied from seven weeks to thirty-two and one-half months.
5. In only one of the seven patients was there x-ray film evidence of change that could possibly be due to relapse of tuberculosis. In this patient (Case 7) the changes might be due to radiation necrosis (8800 r). This patient, moreover, had discontinued antituberculosis drug treatment after irradiation.
6. The experience in this small series of patients would indicate that irradiation of pulmonary neoplasms coexistent with pulmonary tuberculosis with cancerocidal doses can be accomplished without danger of deterioration of the tuberculosis if proper antituberculosis drug coverage is provided. In the presence of considerable drug resistance it would be desirable to add another antituberculosis drug to which the microorganism is sensitive to avoid any possible hazard of irradiation.

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RESUMEN
1. Este estudio presenta los resultados de casos de cancer pulmonar inoperable con tuberculosis pulmonar coexistente que se irradiaron con dosis cancericidas.
2. Se trataron siete enfermos en los que el cancer se desarrolló en el área en que la tuberculosis se trataba. La dosis de irradiación en el centro pulmonar varió de 4,000 r a 6,800 r dada de 37 a 104 días.
3. Todos los enfermos recibieron drogas antituberculosas.
4. El período de observación total después de la radiación varió de 7 semanas a 32½ meses.
5. Solo en uno de los siete enfermos había evidencia radiológica de cambio que pudiera atribuirse a recala de tuberculosis. En este enfermo (caso 7), los cambios podrían deberse a necrosis de radiación (8,000 r). Este enfermo además, había interrumpido el uso de la droga antituberculosa después de la radiación.
6. La experiencia con esta pequeña serie indicaría que la radiación en neoplasmas coexistentes con tuberculosis, con dosis cancericidas, puede realizarse sin peligro de deterioro en la tuberculosis si se protegen los enfermos con las drogas antituberculosas. En presencia de considerable drogarresistencia sería deseable agregar otra droga antituberculosa a la que la enfermedad sea sensible a fin de evitar cualquier complicación a la radiación.

RESUMÉ
1. Dans cette étude, des cas de cancer inopérable coexistant avec une tuberculose pulmonaire furent irradiés avec des doses destructives pour le cancer.
2. Sept malades chez lesquels une néoplasie se développait dans une zone de tuberculose furent irradiés. La dose d'irradiation à la partie centrale du poumon variait de 4,000 r à 6,800 r donnés en 37 à 104 jours.
3. Tous les malades reçurent des produits antituberculeux.
4. La période totale d’observation après irradiation s’étendit de 7 semaines à 32 mois et demi.
5. Chez un seul des 7 malades, il y eut des manifestations radiologiques qui pouvaient être imputables à une rechute de tuberculose. Chez ce malade (observation 7) les lésions pouvaient être dues à une nécrose radiothérapeutique (8,800 r). De plus ce malade avait cessé le traitement antituberculeux après l’irradiation.
6. Cette expérience faite sur un petit groupe de malades semblerait indiquer que l’irradiation des néoplasies pulmonaires coexistant avec une tuberculose pulmonaire peut être pratiquée avec des doses efficaces contre le cancer, sans danger de faire évoluer la tuberculose si un traitement antituberculeux bien fait est associé. En présence d’une résistance élevée au médicament, il est souhaitable d’ajouter un autre produit antituberculeux auquel le germe est sensible, pour éviter toute possibilité de danger imputable à l’irradiation.

ZUSAMMENFASSUNG
2. 7 Kranken, deren Neoplasmen sich im Bereich einer Tuberkulose entwickelt hatten, wurden auf diese Weise behandelt. Die Strahlenmenge im zentralen Lungengebiet schwankte zwischen 4000 r bis 8800 r, die in einer Zeiterspanne zwischen 37 und 104 Tagen verabfolgt wurden.
3. Alle Kranken erhielten antituberkulöse Mittel.
5. Nur in einem Fall von 7 Fällen bestand auf der Thorax-Röntgenaufnahme ein Anhaltspunkt für Veränderungen, die möglicherweise einem Rückfall der Tuberkulose zugeschrieben werden konnten. Bei diesem Patienten (Fall 7) waren die Veränderungen möglicherweise die Folgen der durch die Bestrahlung bewirkten Nekrose (8800 r). Dieser Kranke hatte aber außerdem nach der Bestrahlung mit der antituberkulösen Medikation aufgehört.

REFERENCES