Late Complications of Collapse Therapy for Pulmonary Tuberculosis*

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Study objectives: Collapse therapy for pulmonary tuberculosis involved placement of various materials to occupy space and keep the lung collapsed. Complications are encountered decades later.

Patients and methods: Between 1980 and 1997, we treated 31 patients with a history of pulmonary tuberculosis in whom collapse therapy had been used and who later developed complications related to their treatment. Pyogenic empyema was present in 24 patients, pleural calcifications with bronchopleural fistula was present in 3 patients, pleural calcification with nonresolvable pneumothorax was present in 1 patient, and migration of a foreign body with formation of subcutaneous mass occurred in 3 patients. All patients with empyema were treated with antibiotics and tube drainage of pus. In addition, Lucite balls were extracted in 4 patients, lung decortication was performed in 6 patients, thoracoplasty was performed in 2 patients, and fenestration was performed in 16 patients. Bronchopleural fistulas were closed with sutures and reinforced with intercostal muscle flap in three patients; in one patient with pleural calcification and nonresolvable pneumothorax, tube drainage was attempted. In three patients with subcutaneous mass due to paraffin migration, paraffin was extracted.

Results: Pulmonary decortication (six patients) and thoracoplasty (two patients) resulted in elimination of empyema. Extraction of Lucite balls resulted in lung expansion and elimination of empyema in three of four patients; draining sinus remains in one patient. Fenestration resulted in elimination of empyema in 12 of 16 patients, with 3 patients with residual draining sinuses and 1 patient with remaining empyema. All bronchopleural fistulas closed with intercostal muscle flap remained closed. Following extraction of paraffin blocks, infection developed in one patient. During the follow-up period, three patients died, all of unrelated causes.

Conclusions: Delayed complications of collapse therapy for tuberculosis should be treated without delay. Pressure on adjacent structures or their erosion presents danger and mandates immediate extraction; however, there is no need for routine removal of every residual plombe. Further increase in the number of multiple-drug resistant strains may force the return of collapse therapy.

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Key words: collapse therapy; complications of collapse therapy; tuberculosis

Collapse therapy was used widely in the treatment of pulmonary tuberculosis in the 1930s, 1940s, and 1950s. It involved therapeutic pneumothorax with multiple refills and extrapleural placement of various materials intended to occupy space and prevent expansion of the lung, thus keeping the tuberculous cavity collapsed. With time, presence of these materials and refills of pneumothorax, sometimes under less than sterile conditions, led to complications. During the past 18 years, we treated 31 such patients.

Materials and Methods

Between 1980 and 1997, we admitted 31 patients with a history of pulmonary tuberculosis. These patients had been treated in the 1930s through 1950s with a range of invasive methods, such as artificial pneumothorax and various forms of plombage. Although no effective chemotherapy was available at that time, the disease was arrested in all patients. However, the invasive therapeutic procedures and the materials used for plombage resulted in a variety of complications. There were 21 men and 10 women, ranging in age from 48 to 73 years (mean age, 57 years). The preceding therapeutic procedure was artificial pneumothorax in 22 patients, extrapleural oleothorax in 2 patients (Fig 1), Lucite ball plombage in 4 patients (Fig 2), and paraffin wax...
plombage in 3 patients. Because many more patients were treated with pneumothorax than with plombage, complications of pneumothorax were more common.

All patients with empyema were treated initially with tube drainage of pus and of oleothorax (Fig 3). The organisms cultured were *Staphylococcus aureus* in nine patients, *Klebsiella pneumoniae* in five patients, *Streptococcus pneumoniae* in three patients, and *Haemophilus influenzae* in one patient. In seven of these patients, two organisms were grown: Staphylococcus and Klebsiella in four patients, and Streptococcus and Klebsiella in three patients. In 13 instances, there was no growth. No mycobacterium was found in any of the patients with empyema. Antibiotics were administered according to results of culture and sensitivity studies. Lucite balls numbering from 16 to 36 per

**Figure 1.** Oleothorax in a 61-year-old woman treated for tuberculosis at the age of 18 years. During the 43-year interval, the oil shifted down from its initial position over the apex of the lung. Top: Posteroanterior radiograph. Bottom: Lateral linear tomography.

**Figure 2.** Lucite spheres compressing the apicoposterior and anterior segments of the left upper lobe. Top: Posteroanterior radiograph. Bottom: Lateral linear tomography.
plombage were extracted at muscle-sparing thoracotomy in 4 patients, decortication of the lung was performed in 6 patients (including both patients with oleothorax), seven-rib thoracoplasty was performed in 2 patients, and fenestration of the pleural cavity was performed in 16 patients. In the three patients with pleural calcifications and bronchopleural fistula, there was no pus. Partial decortication was performed, and the fistulae were covered and closed with suture and an intercostal muscle flap. In one patient with pleural calcification and nonresolvable pneumothorax, tube drainage was attempted without success and was discontinued, and no other treatment was given. In three patients with subcutaneous mass due to paraffin migration, all paraffin was extracted.

RESULTS

Pulmonary decortication resulted in complete expansion of the lung and return to normal activity in all six patients. In both patients treated with thoracoplasty, the empyema was eliminated, and they did well. Extraction of Lucite balls resulted in complete lung expansion and elimination of empyema in three of four patients; draining sinus remains in one patient who also underwent fenestration. Fenestration resulted in obliteration of the pleural cavity by granulation tissue and elimination of empyema in 12 of 16 patients. Three patients have residual draining sinuses, including one patient who underwent an earlier extraction of Lucite balls. In one patient, the fenestration failed to eliminate empyema. Suture closure with an intercostal muscle flap in the three patients, who had pleural calcifications and bronchopleural fistula, resulted in permanent obliteration of the fistula in all. Nonresolvable pneumothorax in one patient remained unchanged; however, its size is small, and the patient is asymptomatic. Following extraction of the paraffin blocks, infection developed in one patient and the wound had to be drained. During the follow-up period, three patients died of unrelated causes: two deaths were caused by myocardial infarction and one death resulted from cancer of the colon with metastases.

DISCUSSION

Before the discovery of antimicrobial drugs and development of techniques of pulmonary resection, collapse therapy was the mainstream of treatment for pulmonary tuberculosis. It evolved from the idea that collapse of the lung would put the lung at rest and thus promote the healing process. Also, it would limit the spread of tuberculous infection by collapsing the diseased portion of the lung and so prevent spread of tuberculous material to other, uninvolved parts of both lungs. A successful treatment resulted in formation of fibrosis with encapsulation of the diseased portion and containment of infection. Methods to achieve and to maintain the collapse were many and included artificial pneumothorax with air refills, phrenic nerve crush, thoracoplasty, and extrapleural plombage. The method of plombage involved creation of extrapleural space by dissecting periosteum and intercostal muscles off the ribs and filling the space with one of many available materials, such as fat (omentum, fresh lipoma), paraffin wax, bone, gauze sponge, silk, gelatin, rubber balloons, methyl-methacrylate (Lucite) balls, and oil. Both vegetable and mineral oil were used to produce oleothorax and were frequently rendered aseptic by the addition of gomenol, a volatile product of distillation of the leaves of the myrtle tree. The advantages of plombage over thoracoplasty included selective collapse of the diseased part of the lung with less derangement of pulmonary function; also, it could be carried out in one stage and was cosmetically more acceptable. However, the presence of a foreign body for a prolonged period of time resulted in complications, such as malignant tumors, erosion of major vessels with bleeding, and most commonly, infection and migration. In the survey conducted by Shepherd involving 119 patients, there were 16 infections, to which she added 3 of her own. Three of the infections were caused by Mycobacterium tuberculosis; all others were pyogenic. Massard and associates, in their series of 14 pa-

Figure 3. Bronchogram of the same patient as in Figure 1, following drainage of oil and pus. Note the presence of the contrast medium (lipiodol) in the left bronchial tree.
tients, reported on eight instances of empyema: four were pyogenic and four were tuberculous. They theorized that tuberculous empyema can be expected in those patients treated previously without any major antituberculous chemotherapy. These findings contrast with our series, in which all infections were pyogenic; no mycobacterium was ever isolated. This can be explained by the follow-up conducted in our group. After their initial treatment for tuberculosis in the 1940s and 1950s, most of our patients remained under long-term observation and often received antimicrobial therapy that included isoniazid, para-amine salicylic acid, and some other agent. Three successive negative culture findings of mycobacterium were obtained before cessation of treatment.

Compared with other series, ours is characterized by a relatively large number of fenestrations (n = 16), and only six instances of decortication. This finding is not coincidental. It has been influenced by our policy to avoid major surgery in these usually severely ill and debilitated patients. Decortication can be very tedious and time-consuming. As pointed out by Shepherd,1 it would be particularly difficult in severely ill and debilitated patients. Decortication should be extracted in order to prevent further deterioration. However, we cannot concur with Mas- sard and colleagues,9 who recommend routine abla-
tion of any residual plombage material whenever operative risk is acceptable, nor do we accept their recommendation of routine thoracoplasty. As these patients were treated several decades ago in various countries, it is impossible to determine what proportion of the total these complications represent. However, there are many such patients who remain asymptomatic while carrying residual "plombe." The addition of a major operative risk would be of no obvious benefit to them, and thoracoplasty would further add to respiratory embarrassment.13

As the number of living patients treated by plom-bage is attenuating rapidly, fewer and fewer will be seen in the future, and no one is likely to accumulate considerable experience with this problem. Careful approach to these patients is, therefore, essential.

The discovery of drugs effective against M tuberculosis and development of techniques of pulmonary resection in the 1940s and 1950s brought about a great decline in the prevalence and severity of tuberculosis. With the emergence of ethambutol in 1961 and rifampin in 1963, the disease seemed to have been conquered.12,13 Collapse therapy appeared to have passed into history, leaving behind only a diminishing residue of complications. How-
ever, over the past 15 years, a reverse trend has occurred. A significant and steady worldwide increase in prevalence of tuberculosis has been noted, including multiple-drug resistant organisms of M tuberculosis and atypical strains. The reasons for this change are many and are not likely to disappear anytime soon. One might assume that both the incidence of tuberculosis and the number of multiple-drug resistant strains will continue to increase. How will these patients be treated? In absence of adequate therapeutic agents, is it not possible that collapse therapy will return? There are already many patients for whom no combination of agents is of any use. A review of results before the era of modern therapy brings up some interesting data. According to Strieder and associates,14 of > 300 patients at Boston City Hospital treated with plombage and thoracoplasty, at the 5-year follow-up, the disease was inactive in 67%, while among the patients who had no contralateral disease, 75% of patients were reported as having inactive disease. This was consider-
erably better than the present situation. For lack of better means, the return to the old methods may become justified. Should this happen, what materials could be used for plombage? Of those available in the past, Lucite spheres wrapped in a plastic bag were probably the best. On the other hand, Silastic prostheses filled with saline solution, such as those used for breast implantation and in the treatment of postneumonectomy syndrome, would serve the purpose equally well and with less danger of comp-
lications.15–17
REFERENCES


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