Oleothorax Following Pulmonary Resection*

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Thoracoplasty has been generally accepted as the method of choice for the prevention of mediastinal shift and the resultant disturbances in cardiorespiratory function which may follow pneumonectomy in the adult. While in most patients this additional surgical procedure is well tolerated, either as a concomitant or subsequent operation, there are some patients in whom thoracoplasty is inadvisable because of debility, advanced age, or poor prognosis, while in others it is refused by the patient or temporarily deferred by the surgeon. For these patients, an easily tolerated method of preventing overdistention of the remaining lung and shift of the mediastinum should be considered. Ideally, this procedure should be simple in application, minimally traumatic, and easily discontinued if necessary.

The constant search for an ideal intrapleural space-filling substance, which could be used as a substitute for thoracoplasty in the compression treatment of tuberculosis, and more recently as a method of filling the pleural space after pneumonectomy, indicates that many investigators do not consider thoracoplasty an altogether satisfactory procedure.

Johnson, Kirby, Lazatin and Cocke have used a solitary large hollow metal prosthesis of zirconium, as well as multiple small hollow spheres of methyl methacrylate in the pleural space in dogs. They favor the latter because of minimal pleural reaction. These authors recently have reported upon the use of the spheres in eight patients without apparent complications.

Small, Clagett, and Grindlay used gelatin foam sponges in the pleural space following pneumonectomy in dogs and rats, and found that although the material was absorbed, postoperative shift of the mediastinum was prevented. More recently, Grindlay, Clagett and Rydell reported upon the use in dogs of a heat-sealed Polythene film bag filled with fiber glass and air which was made roughly the size and shape of the pleural cavity. These investiga-

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501
# Table I

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<tr>
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**Remarks:**
- Case 1. Expired, 2/25/50.
- Case 2. Expired, 10/49.
- Case 3. Contralateral spread of carcinoma.
- Case 4. Thoracoplasty, 2/9/50.
- Case 5. Reestablishment of oleothorax, 9/9/49.
- Case 7. Expired, 4/18/50.
- Case 8. Working.
- Case 10. Spread of carcinoma to brain.
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**Remarks:**
- Case 11: Working.
- Case 12: Improved.
- Case 13: Apparently well.
- Case 14: Apparently well.
- Case 15: Apparently well.
- Case 16: Apparently well.
- Case 17: Apparently well.
- Case 18: Apparently well.
- Case 19: Apparently well.
- Case 20: Apparently well.
tors are now studying a hollow molded one-piece prosthesis of methyl methacrylate.

Cournand and Berry, 5 while studying pulmonary function following pneumonectomy, used oleothorax in one case to maintain the mediastinum in the midline and to prevent overdistention of the remaining lung. One year following establishment of the oleothorax, the maximum breathing capacity with one lung was almost identical to that obtained with two lungs prior to surgery.

Overholt and Langer 6 in discussing the problem of overdistention of the remaining lung following pneumonectomy favor the use of thoracoplasty, but state that air and oil have been used and are usually well tolerated by the patient. However, they warn that a foreign body in the pleural space introduces definite hazards such as infection and bronchopleural or pleurocutaneous fistulae.

The use of oil as a prosthesis in the pleural space has definite advantages over solid space-filling devices in that the oil is pliable, conforms easily to any sized cavity, and lacks friction points which might erode vital structures. Although oleothorax fell into disrepute in the compression treatment of tuberculosis because of complicating bronchopleural and pleurocutaneous fistulae, these may have been due to concomitant infection in the pleural space or lung parenchyma.

At the Ohio State University hospitals, during the past six years, a series of 20 cases has been accumulated in which oleothorax has been used following pneumonectomy. The patients selected for this procedure had previously been subjected to pneumonectomy for bronchogenic carcinoma, tuberculosis, bronchial adenoma, or congenital cystic disease of the lung (Table I).

Method

In order to maintain all factors as constant as possible for the analysis of these cases, the following routine measures were agreed upon and followed in the majority of them.

A) Pneumonectomy:

Silk suture was used throughout the procedure. The bronchus was closed with a single row of interrupted 00 silk. When possible pleura was approximated over the sutured end of this structure.

All patients received penicillin and streptomycin both systemically and by aerosol 48 hours prior to operation. These antibiotic drugs were given systemically during the postoperative period until such time as the temperature had been normal for 24 hours.

B) Oleothorax:

Four to six weeks following pneumonectomy, the patient was hospitalized for three days. Upon admission, an x-ray film was
taken to estimate the size of the pleural space, the amount of pleural fluid and the position of the mediastinum. Thoracentesis was then done utilizing sterile precautions. The pleural fluid which was removed and submitted for bacteriological study was replaced with air and 25 milliliters of sterile olive oil. If there was no evidence of organisms in the pleural fluid by smear, 300 to 400 milliliters of oil was introduced into the hemithorax on the second hospital day. Fluoroscopy was done on the third day to estimate the additional amount of oil needed to fill the pleural space. If necessary, this was introduced and a roentgenogram taken for final evaluation. In order to avoid increased pressure upon the mediastinum and leakage of oil back through the needle tract, the oil was never injected into the pleural cavity against positive pressure.

All patients were instructed to lie on their operated side if they should at any time notice the presence of oil in their sputum. They were instructed to return in one month for x-ray studies to ascertain the position of the mediastinum following absorption of the small apical cushion of air residual from the last thoracentesis. At that time oil could be added or removed as indicated by the position of the mediastinum.

The material used in this study was commercial olive oil which had been sterilized by dry heat for three hours at 160 degrees C. and allowed to cool to room temperature. Bacteriological study of samples of oil so treated showed this time and temperature adequate for sterilization. Immediately prior to introduction into the pleural space, 100,000 units of penicillin in oil was added to each 100 milliliters of olive oil.

**Results**

Although thoracoplasty was considered, particularly early in this study, as the ideal method to obliterate the pleural space which remains following pneumonectomy, 20 patients were selected for oleothorax and have been followed for a period of from six years to one month. The selection was based on: (a) poor prognosis, (b) refusal to accept thoracoplasty, or (c) because thoracoplasty was considered hazardous at the time of pneumonectomy or during the early postoperative period.

These 20 cases have been divided into three groups based upon the primary disease for which pneumonectomy was done.

1) *Bronchogenic Carcinoma*:

Twelve cases included in this group were all males ranging in age from 47 to 67 years. They were selected for oleothorax because of a relatively poor prognosis which was manifested by lymph node
Figure 1. Case 1: Post-operative film showing shift of the heart and mediastinum toward the empty pleural space—Figure 2.
Case 2: Following deobstructive trachea is again in the midline and the heart has returned to a more normal position—Figure 3.
Case 3: Five months following pneumonectomy for bronchogenic carcinoma. Metastatic nodules are present in the right lung field.
metastases in seven instances, lack of differentiation of the carcinoma in three, and tumor thrombus, or invasion of the chest wall in the remaining two cases.

Four patients in this group have expired as the result of extension of their diseases, two, six, seven and 10 months after pneumonectomy. While three of these patients died at home, the fourth was admitted to another hospital by his physician. Postmortem examination was performed but the pathologist was unaware of this study. Two of these four cases are presented.

**Case 1:** G.V., a 66 year old white male was admitted to University Hospital on August 10, 1949, with a tentative diagnosis of bronchogenic carcinoma. Six days later, a left pneumonectomy was done for a poorly differentiated squamous cell carcinoma with regional lymph node involvement. Postoperative course was complicated by congestive heart failure on the third day which responded to digitalization. Four weeks following pneumonectomy he was readmitted to the hospital for oleothorax. An x-ray film of the chest (Figure 1) showed the presence of pleural effusion and pneumothorax with some shift of the mediastinum to the operated side. On the following day, 300 milliliters of serous fluid was removed from the left chest and submitted for bacteriological study. Twenty-five milliliters of sterile olive oil was placed in the pleural space. The smear of the chest fluid contained no bacteria and 425 milliliters of sterile olive oil was introduced into the pleural space on the second hospital day. The next day, following fluoroscopy, an additional 850 milliliters of oil was placed in the hemithorax. X-ray films (Figure 2) taken before discharge showed the left hemithorax to be filled with oil except for a small apical cushion of air. The mediastinum had returned to the midline.

Four and one-half months following pneumonectomy he complained of a slight but increasing dyspnea. X-ray film (Figure 3) showed multiple areas of metastatic carcinoma in the right lung field. Two weeks later he was admitted to another hospital, following a cerebral vascular accident. His course was gradually downhill and he expired five weeks after admission. Postmortem examination showed the right lung to contain multiple metastatic carcinomatous nodules. Examination of the left hemithorax showed the lung to be surgically absent and the pleural cavity to be filled with approximately 1,000 milliliters of light yellowish-green oil. The left parietal pleura was somewhat thickened but was smooth and glistening. No statement was made about the condition of the left main bronchus, nor were microscopic sections of the pleura obtained.

**Case 2:** O.M., a 58 year old white male entered University Hospital on March 3, 1949 and 12 days later right pneumonectomy was done for an undifferentiated bronchogenic carcinoma. Four weeks later he was re-admitted because of cough, hemoptysis, and fever of two days duration. Thoracentesis of the right pleural space revealed a thick, greenish, purulent material which upon culture proved to contain streptococcus hemolyticus. Bronchopleural fistula was shown to be present by the introduction of methylene blue into the right chest and the subsequent expectoration of bluish sputum. Daily thoracentesis and both local and systemic penicillin and streptomycin were followed by a rapid clearing
of the empyema. This patient was discharged on his 16th hospital day after refusal of both thoracoplasty and oleothorax.

Three weeks later, he again returned, with evidence of empyema. At thoracentesis, 900 milliliters of greenish purulent material was removed from the pleural space. Daily thoracentesis, as well as local and systemic antibiotic therapy, was followed by rapid clearing of the empyema. Two weeks later, after injecting methylene blue into the right hemithorax without evidence of bronchopleural fistula, 50 milliliters of sterile olive oil was introduced into the pleural space and 500 milliliters of oil was added on the following day. Fluoroscopy and x-ray film showed the hemithorax to be filled and the patient was discharged. He did not return for follow-up as requested. His physician reported that he subsequently developed evidence of local and cerebral recurrence of carcinoma and expired seven months after pneumonectomy. No further empyema occurred.

Eight of the 12 cases in this group are still living two to 22 months following pneumonectomy. Four are apparently well and have returned to light work or to their original jobs. These patients have been followed at monthly intervals and show no evidence of recurrence of carcinoma or difficulty resulting from the presence of the oleothorax. Two of the eight patients have recently shown evidence of spread of the malignancy, one to the brain, and the other to the contralateral lung with complicating hydrothorax. The case report of the latter follows:

Case 3: H.D., a 55 year old white male was admitted July 27, 1949, with a diagnosis of bronchogenic carcinoma of the right lung. Pneumonectomy was done three days following admission. The pathological diagnosis was undifferentiated carcinoma of the bronchus with lymph node metastases. Four weeks following pneumonectomy he was readmitted for

**FIGURE 4**

*Figure 4, Case 4: One year following pneumonectomy for bronchogenic carcinoma, an empyema and pleuro-cutaneous fistula developed.—Figure 5, Case 4: Oleothorax has been established.*
oleothorax. After removal of 250 milliliters of serous fluid, 25 milliliters of sterile olive oil was instilled in the right pleural space. The following day 400 milliliters, and one day later 300 milliliters of sterile olive oil was placed in the hemithorax. X-ray film showed adequate filling and a small apical cushion of air. The mediastinum had returned to the midline. Two and one-half months later, an increased intrapleural pressure was noted on thoracentesis and 300 milliliters of serous fluid was removed from below the oleothorax. Within the next two months a total of 900 milliliters of fluid was removed on three occasions. A specimen of fluid and oil has been studied for evidence of bacteria or malignant cells. None could be found. Currently, 50 to 100 milliliters of fluid is removed from his chest each month. An x-ray film taken nine months following pneumonectomy showed the first evidence of extension of the malignancy to the remaining lung.

It is our impression that this patient has a hydrothorax as the result of pleural extension of the undifferentiated carcinoma. However, we are at the present time unable to eliminate the possibility that this might be a reaction to the presence of the olive oil. In one case of this group, oleothorax has been discontinued and thoracoplasty performed.

_Case 4:_ O.S., a 47 year old white male was admitted August 10, 1948, with a tentative diagnosis of bronchogenic carcinoma and a right pneumonectomy was performed 15 days later. The pathological diagnosis was squamous cell carcinoma of the bronchus with lymph node metastases. One year following surgery this patient developed a right empyema and a pleurocutaneous fistula (Figure 4). This responded to local aspiration combined with local and systemic antibiotic therapy. Three weeks after the appearance of the empyema the patient was referred to us for

**FIGURE 6**

*Figure 6, Case 4:* Oleothorax complicated by recurrence of empyema and pleurocutaneous fistula. Lipiodol outlines the base of the empyema space.

**FIGURE 7**

*Figure 7, Case 4:* Early postoperative film showing thoracoplasty with satisfactory collapse of the pleural space.
oleothorax. The pleurocutaneous fistula was healed, and his temperature and white blood count had been normal for two weeks. X-ray examination showed the left lung to be slightly hyperaerated, and the heart and trachea to be shifted to the right. One hundred milliliters of clear fluid was removed from the pleural space and 25 milliliters of sterile olive oil introduced. On the following day, 225 milliliters of oil was instilled, and an x-ray film (Figure 5) revealed complete filling of the hemithorax and return of the mediastinum towards the midline.

Four months after establishment of the oleothorax, empyema again developed and there was a spontaneous drainage of oil and purulent material through the site of the healed pleurocutaneous fistula (Figure 6). Culture of the pleural fluid yielded Staphylococcus aureus. The empyema responded to treatment.

Two weeks later thoracoplasty was done with removal of the first to seventh ribs and a satisfactory collapse of the pleural space resulted (Figure 7).

Although this patient is included in this series of cases, it will be noted that the oleothorax was not established until one year after pneumonectomy and following development of empyema. This case does illustrate, however, that oleothorax is reversible and can be discontinued at any time in favor of a thoracoplasty.

In only one of the 20 patients in this series has empyema with bronchopleural fistula developed after the production of oleothorax. Inasmuch as this patient had been subjected to pneumonectomy for bronchogenic carcinoma, his case report is included in this group.

Case 5: H.O., a 58 year old white male entered the hospital April 11, 1949 and left pneumonectomy was done seven days later. Pathological diagnosis was squamous cell carcinoma with metastases to the regional lymph nodes. Two months following operation, he was readmitted com-

![Figure 8](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21211/)

**Figure 8**,

Case 5: X-ray film made two months postoperatively at time of admission with bronchopneumonia.

**Figure 9**,

Case 5: Oleothorax has been established.
plaining of cough, chills, fever, and dyspnea of three days duration. A diagnosis of bronchopneumonia was made (Figure 8) and successfully treated with antibiotics. Inasmuch as bacteriological examination of the pleural fluid showed it to be sterile, oleothorax was instituted, using 400 milliliters of sterile olive oil, after the pneumonia had cleared. An x-ray film (Figure 9) taken at the time of discharge showed the pleural space to be filled except for a small apical cushion of air. The mediastinum had returned toward the midline.

Four weeks after establishment of the oleothorax this patient again noted cough and fever. Shortly thereafter he started producing foul sputum mixed with oil. According to previous instruction, he immediately went to bed and remained on his left side until he was brought to the hospital (Figure 10). Thoracentesis was done shortly after admission and 300 milliliters of purulent material was removed from the left pleural space. Bacteriological study revealed Escherichia Coli. The empyema rapidly cleared with treatment.

Thoracoplasty was refused by this patient and oleothorax was reestablished two months following the empyema (Figure 11). Recently a bacteriological examination of a specimen of oil removed from his hemithorax showed no evidence of bacteria.

II) Tuberculosis:

Oleothorax has been used in six cases following pneumonectomy for tuberculosis. All patients in this group were females, ranging in age from three to 58 years. There have been no deaths.

The indications for oleothorax in this group have been refusal of thoracoplasty in three patients, contralateral disease in two, and age in one.

The three patients who refused thoracoplasty have been fol-
lowed three, eight and 18 months following establishment of the oleothorax. There has been no evidence of complication or difficulty resulting from this procedure.

Age as an indication for oleothorax is illustrated in a child of three years who at operation was found to have tuberculous pneumonia and bronchiectasis, for which pneumonectomy was performed. Because of the presence of disease in the contralateral lung (Figure 12), and the inherent danger of spread in an over-distended lung, oleothorax was considered as a temporary measure in this child. One hundred eighty milliliters of sterile olive oil was introduced into the left hemithorax. There has been regression of the disease in the remaining lung (Figure 13).

Two adult cases in which there was extension of the tuberculosis to the contralateral lung are presented in detail:

Case 14: J.M., a 31 year old white female known to have tuberculosis since 1935 was admitted to a sanatorium on August 8, 1943. Despite pneumothorax, the sputum remained positive. Bronchoscopy and bronchography two years later showed a stenosis of the right main bronchus. Shortly thereafter pneumonectomy was performed and the postoperative course was complicated by tuberculous empyema. Because of this patient's poor general condition and evidence of tuberculous disease in the remaining lung, the empyema was treated by aspiration of the pleural fluid and introduction of olive oil containing 3 per cent Gomenol. Oleothorax has been continued although this patient is no longer under our supervision. In September, 1947, there was recurrence of the disease in the remaining lung which has responded to bed rest and streptomycin.

Figure 12, Case 13: Postoperative film of a three year old child showing a tuberculous lesion in the remaining lung.—Figure 13, Case 13: Following oleothorax, there has been regression of the lesion in the right lung.
therapy. The patient has now returned to limited activity. The oleothorax has been present for six years without complication.

*Case 15*: J.C., a 32 year old white female entered the hospital December 17, 1948. During the preceding seven years, pneumothorax had been maintained for a moderately advanced tuberculous lesion of the left lung. X-ray film taken at the time of admission showed evidence of hydropneumothorax. By bronchoscopy, partial stenosis of the trachea and complete stenosis of the left main bronchus was demonstrated. Following repeated tracheal dilatations, pneumonectomy was performed one month after hospitalization. An x-ray film taken four weeks postoperatively showed mediastinal shift to the left and two nodular lesions in the right hilus which were interpreted as new tuberculous foci. Because of this complication, oleothorax was established by the introduction of 300 milliliters of sterile olive oil into the left pleural space. Roentgenograms (Figure 14) showed the mediastinum to have returned to the midline. One year after establishment of the oleothorax, an x-ray film (Figure 15) showed evidence of fibrous healing of the lesions in the right hilus. The oleothorax has been augmented by small amounts of additional oil when indicated by negative pleural pressure.

III. *Other Lesions Requiring Pneumonectomy:*

Only two patients with lesions other than bronchogenic carcinoma or tuberculosis have been given oleothorax. In both cases, thoracoplasty was refused. One, a 22 year old white female was found to have a bronchial adenoma of the left main bronchus for which the left lung was resected in January, 1949. Oleothorax was established five weeks later. During an 18 months period of

*Figure 14, Case 15:* Oleothorax has been established because of the presence of new tuberculous foci in the remaining lung.—*Figure 15, Case 15:* X-ray film one year following institution of oleothorax, shows improvement of the tuberculous lesions.
observation, neither evidence of recurrence of the adenoma nor difficulty from the oleothorax has occurred. The patient has subsequently completed an uncomplicated pregnancy.

The second patient in this group developed empyema following pneumonectomy. This case is reported in detail.

Case 20: V.J., a 31 year old white female had a pneumonectomy for an infected congenital cystic disease of the left lung on November 6, 1948. Three weeks following surgery she noted the onset of cough and fever, and began producing foul brownish sputum. After admission to the hospital, 1,100 milliliters of green, purulent material was obtained by thoracentesis, which upon culture showed Streptococcus hemolyticus. By the intrapleural injection of methylene blue, the presence of a bronchopleural fistula was demonstrated. Treatment consisted of daily thoracentesis combined with local and systemic antibiotic therapy. After 10 days, and improvement in the clinical condition of the patient, one milliliter of methylene blue and 25 milliliters of sterile olive oil were introduced into the left pleural space. Inasmuch as no methylene blue appeared in the sputum and examination of the pleural fluid by smear showed no bacteria, 800 milliliters of sterile olive oil was placed in the hemithorax during the next two days. During the succeeding 18 months, no evidence of empyema or bronchopleural fistula have occurred. A recent suggestion that the oleothorax be replaced by thoracoplasty has been refused because of the patient's desire to remarry and the fear that such an operation might interfere with this objective.

Bacteriological Investigation

Since infection with resultant empyema, bronchopleural or pleurocutaneous fistulae is a hazard either before or after oleothorax, the patients included in this study were requested to return in February and March, 1950, so that a bacteriological study could be made of samples of oil removed from the pleural space. After an x-ray inspection of the chest, 50 cc. of oil was removed from the hemithorax. Eleven of the 16 patients still alive were able to return.

Because of the difficulties of separation and culture of organisms from oil, a modification of the method of extraction of microorganisms from this material reported by Stevens was used for this study. An extracting fluid was prepared by adding 0.05 percent Tween "80" (polyoxyethylene sorbitan monooleate) to physiological saline which had been buffered to pH 7.4 with KH₂PO₄ and Na₂HPO₄. Thirty milliliters of the extracting fluid was placed in an eight ounce prescription bottle, plugged with cotton and sterilized at 121 degrees C. under 15 pounds pressure for 20 minutes. To this was added 10 milliliters of the oil which had been removed from the pleural space. The cotton plug was replaced with a sterile serum bottle cap and the bottle shaken at 25 degrees C. on a mechanical shaker for 30 minutes. The bottle was then inverted and allowed to stand for four hours at 4 degrees C. By means of
sterile needle and syringe, one milliliter of the aqueous layer was withdrawn and inoculated into thioglycollate tubes. Any sample showing growth in five days was streaked on either aerobic or anaerobic blood agar plates, depending upon the area of growth in the thioglycollate media. Isolated colonies were then used for identification.

Prior to the use of this method of extraction upon the clinical material, it was tested upon two representative organisms, Bacillus subtilis and Streptococcus hemolyticus. Although there was evidence of some attenuation of the growth of these bacteria after being placed in sterile oil, recovery of the organisms could be satisfactorily demonstrated upon the thioglycollate media.

Moreover, since penicillin in oil was added to the olive oil prior to instillation in the pleural cavity, a penicillin assay was done on the sample of oil removed from the hemithorax. Since penicillin is much more soluble in water than in olive oil, five milliliters of oil was shaken for 15 minutes with an equal amount of sterile physiological saline. The filter paper disc method of penicillin assay described by Epstein, Foley, Perrine and Lee was used. The concentration of penicillin in the sample was calculated from the size of the zone of inhibition of the test organism against previously prepared standards with known concentrations of a water solution of penicillin. The following factors, together with volume of dose and size of disc, were held as constant as possible:

Organism—Staphylococcus aureus (209-FDA). Plates were seeded with 1 cc. of a 1:1000 dilution of an 18 hour tryptose broth culture of the test organism.

Media—14 cc. blood agar base (Difco).

Incubation—Time and temperature, 18 hours at 37 degrees C.

Control—Water solution of penicillin “G”.

Seven cases of Group I (bronchogenic carcinoma) are included in the bacteriological study. Five of these seven cases showed no bacteria in the specimen of oil removed for study. Included is Case 5 (H.G.) who has received a second oleothorax after developing an empyema and bronchopleural fistula as a complication of his first oleothorax.

Staphylococcus aureus was found in one patient (Case 6, J.H.) who has had no clinical evidence of infection at any time following pneumonectomy.

Staphylococcus aureus was found also in Case 4 (O.S.). This patient, who has been reported in detail above, had a Staphylococcus empyema with pleurocutaneous fistula one year following pneumonectomy and again after establishment of the oleothorax. The specimen submitted for study was obtained on the third day of treatment for the second empyema. In this specimen only could
the presence of penicillin be detected. Twenty units per milliliter of pleural fluid was the calculated concentration.

Two patients of Group II (tuberculosis) returned for this study. Both specimens were negative for pyogenic and acid fast bacteria. Penicillin could not be demonstrated in the oil removed.

Both patients of Group III returned. Case 20 (V.J.), who had empyema prior to her oleothorax, showed no evidence of bacteria in the oil removed. Corynebacterium diphtheria was isolated from the oil of Case 19 (J.G.) who had bronchial adenoma. However, these organisms were considered avirulent after study by the Frazier test.

Discussion

Following pneumonectomy, thoracoplasty is probably the best method for collapse of the remaining pleural space. In some cases, however, a method of obliterating the empty hemithorax which is less traumatic than thoracoplasty should be considered. In our hands, oleothorax with sterile olive oil containing penicillin in oil has proved useful for this purpose.

Olive oil has been chosen because of our familiarity with this agent in the past. Other agents such as mineral oil which are not as readily absorbed could easily be substituted. Oil as a pleural prosthesis has definite advantages over solid agents in that it is readily available and easily sterilized. By virtue of its fluidity it is easily introduced into the thorax and can conform to the size and shape of any cavity.

Oleothorax should be deferred for four to six weeks following pneumonectomy, because in our experience empyema and bronchopleural fistula will have developed in most instances within that time.

Oleothorax following pneumonectomy has its greatest application in cases of bronchogenic carcinoma. In those cases in which a palliative pneumonectomy has been done, oleothorax is easily instituted with little distress to the patient. Patients who refuse thoracoplasty will usually accept oleothorax as a substitute.

Since children tolerate pneumonectomy well, oleothorax is rarely indicated. However, if tuberculosis is present in the remaining lung, this procedure may be used as a temporary measure during the period of growth.

In the adult with tuberculosis, this procedure is most applicable in those patients in whom thoracoplasty might prove fatal. It might also be considered in cases of tuberculous empyema following pneumonectomy as a temporary measure while the patient is being prepared for thoracoplasty as well as in those cases who refuse additional surgery.
The use of oleothorax has been avoided by many because of the possible occurrence of empyema, bronchopleural and pleurocutaneous fistulae. Of the 20 cases of this series, four had empyema prior to the establishment of the oleothorax. In two cases this was due to staphylococci, in one to tuberculosis, and in one to streptococci. In only one case did the empyema recur following the establishment of oleothorax. In this man (Case 4) a pleurocutaneous fistula had been present at the time of the original empyema and might have been the source of the reinfection. Moreover, this oleothorax was started over one year following pneumonectomy.

In only one case did empyema with bronchopleural fistula develop after oleothorax. Analysis of this case reveals that he had been treated for bronchopneumonia only a few days prior to the establishment of oleothorax. In retrospect, although the pleural fluid was sterile at the time of starting the oleothorax, it would have been wiser to have delayed this procedure.

SUMMARY

1) Oleothorax with sterile olive oil containing penicillin in oil has been used in 20 selected cases.

2) Empyema developed in two cases following oleothorax and was associated in one with bronchopleural fistula and in the other with pleurocutaneous fistula.

3) Oleothorax is reversible and thoracoplasty can be substituted at any time.

4) Hydrothorax occurred in one case as a complication to oleothorax in a patient suspected to have pleural recurrence of bronchogenic carcinoma.

5) Empyema present after pneumonectomy does not contraindicate oleothorax if the empyema cavity is adequately sterilized.

RESUMEN

1) En 20 casos seleccionados se ha empleado el oleotórax con aceite de oliva estéril que contiene penicilina en aceite.

2) Apareció empiema en dos casos después del oleotórax y estuvo asociado en uno con fistula broncopleural y en el otro con fistula pleurocutánea.

3) El oleotórax es reversible y puede substituirse una toracoplastia en cualquier tiempo.

4) Ocurrió hidrotórax como complicación del oleotórax en un paciente que se sospechaba tener una recidiva pleural de carcinoma broncogénico.

5) El empiema subsiguiente a una neumonectomía no contraindica el oleotórax si se esteriliza adecuadamente la cavidad del empiema.
RESUME

1) Les auteurs ont utilisé dans 20 cas choisis l'oléothorax avec une huile stérile mélangée à de la pénicilline.

2) Dans deux cas, à la suite de l'oléothorax, survint une pleurésie purulente; une fois, elle s'accompagnait d'une fistule broncho-pleurale, et une autre fois d'une fistule pleuro-cutanée.

3) L'oléothorax peut être cessé, on peut lui substituer quand on veut une thoracoplastie.

4) Dans un cas l'oléothorax se compliqua d'un hydrothorax. Il s'agissait d'un malade qui paraissait avoir une métastase pleurale d'un cancer bronchique.

5) Une pleurésie purulente survenant après pneumonectomie ne contre-indique pas l'oléothorax, si la cavité pleurale est convenablement stérilisée.

REFERENCES


Discussion

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As stated by Dr. Andrews, thoracoplasty is still the method of choice for the prevention of mediastinal shift, over distension of the remaining lung and the resultant disturbances in cardiorespiratory function which may follow pneumonectomy in the adult. It is a simple, permanent procedure which carries a low risk and has the advantage of obliterating the pleural cavity.

It is my opinion that thoracoplasty should be done following most pneumonectomies for inflammatory disease particularly in
the younger age groups of adult patients. This is especially true in patients having a pneumonectomy for tuberculosis, where the obliteration of the pleural space and the protection of the remaining lung are so important. In patients having a pneumonectomy for other lesions as neoplasm, who are in the younger age group, and who are considered to have a good prognosis, I believe thoracoplasty to be advisable.

There, of course, is a natural reluctance on the part of both the patient and the surgeon to submit to or perform a second major operation soon after a pneumonectomy. That is only a natural human reaction. However, if the surgeon evaluates the situation carefully preoperatively, and if in his best judgment he considers a thoracoplasty advisable, he should inform the patient of this fact as part of the surgical attack on his disease. If the patient is prepared for a thoracoplasty from the outset, as a necessary part of his treatment, it has been my experience that he is much less likely to refuse it. In certain instances a partial thoracoplasty may be done at the time of the pneumonectomy.

There remains a group of patients in whom a postpneumonectomy thoracoplasty is inadvisable because of age or debility, poor pulmonary function, or poor prognosis in which a simpler method of controlling the intrathoracic pressures and mediastinal position is desirable. It is in this group that some means of space filling prosthesis is particularly desirable. Ideally, some form of prosthesis is needed which could be utilized at the time of pneumonectomy, which is non-irritating, which is malleable and can be easily shaped to conform with size, volume and shape, and which can be easily removed if necessary. However, most of us are reluctant to use foreign bodies in the chest because of the hazards of infection, pressure on vital structures and bronchial fistulae. It would seem to me that this paper presented here today gives us the closest approach to our ideal which we have today. I have had no experience with the use of oleothorax following pneumonectomy but do recall several patients in whom it might have been applied. Oil does meet the requirements of a pleural prosthesis in that it is pliable, conforms easily to size and shape, cannot compress vital structures and can be easily evacuated if the necessity arises. Its introduction four to six weeks after the pneumonectomy would seem safe in most instances from the standpoint of the possibility of a bronchial fistula. However, following pneumonectomies for tuberculosis, the bronchus may open at a still later date, secondary to pleural infection. Because of this possibility, it would seem wise to do a postpneumonectomy thoracoplasty soon in this group, rather than use oleothorax.