

Thoracotomy can at best be but a palliative procedure. By supplying drainage of the cavities, it diverts their secretion from the upper respiratory tract, thus, to some extent, shielding uninvolved portions of the lung from infection. It may produce a distinct improvement in the condition of the patient. A knowledge of the pathology of lung suppuration teaches us, however, that the only hope of complete cure rests in a complete removal of the infiltrated lung. This, no drainage operation can accomplish. Unfortunately, lung resection is an operation fraught with the greatest difficulties; it demands the highest surgical skill, and the operative indications in the individual case are extremely narrow. They may thus be formulated: The patients must be young; the operation in those who have reached the age of 40 has a prohibitive mortality. The case must be uncomplicated, that is, the pleural cavity must be free of dense adhesions so that the lobectomy may be expeditiously performed. Operations which last much over an hour result in a high mortality. The disease must be unilateral. When the operation has been successfully performed, the patient is completely cured; and surgery records no more brilliant or dramatic achievement than the restoration to health of a person afflicted with this most dreadful and hopeless disease. Of the patients in this series, five were cured by lobectomy by Dr. Lilienthal, all of whom remain well to this day.

Of the other surgical procedures, mention should be made of artificial pneumothorax. It is difficult to see how the injection of air into the pleural cavity may be expected to cure these patients. The conditions present bear no similarity to those which obtain in tuberculosis. It is not desirable to stimulate fibrosis, as there is already a tendency to fibrosis. The collapse of a cavity, if this is possible, which is doubtful, will not bring about the removal of a gangrenous focus. Not only is this procedure of no value, but it also may be distinctly harmful. The collapse of the lung may lead to a dissemination of septic material into distant portions of the lung with a rapid extension of the disease. In two of the cases in this series in which artificial pneumothorax was performed, not only was there a marked extension of the disease, to be observed on the roentgenogram, but also both patients died suddenly, shortly after the last insufflation.

It is important to emphasize the value of bronchoscopic examination preliminary to any operative procedure. In children, especially, it is not unusual to find a foreign body in the bronchus as the unsuspected cause of a lung abscess, and unless the disease is of long standing, removal of the foreign body may result in a cure.

#### CONCLUSION

It may be worth while to emphasize a few points in the pathogenesis of suppuration of the lung. There seems to be little doubt, from a study of the cases of postoperative abscess, that the disease is bronchogenic. It is equally probable that the infection is primarily gangrenous and owes its origin to definite forms of anaerobic micro-organisms. The pathogenesis of post-pneumonic abscess is, however, not so clear. In the chronic types there is, undoubtedly, primarily a pneumonic process which is due to the usual bacteria, such as the streptococcus and pneumococcus, which have the power to incite a chronic type of inflammation. There is, however, a group of so-called acute

postpneumonic abscesses or gangrene in which, without any evidence of operation or aspiration, there is, nevertheless, a primary gangrenous inflammation. In these cases, of which there were sixteen, the onset of fetid expectoration occurred on the thirteenth or fourteenth day just as in the cases of aspiration. They resembled the latter also in the frequent involvement of the upper lobes and in the early development of large cavities. The question, therefore, arises whether these are truly cases of pneumonia with subsequent development of gangrene, or whether they are not also due to the aspiration of septic material from the teeth or the tonsils, perhaps in the act of snoring during sleep. That this is not improbable will be evident from a consideration of several of the cases in which aspiration gangrene developed during unconscious states. This occurred in one case after an overdose of morphin, and in another after alcoholic coma. In both these cases, the chronology of the symptoms and the clinical course were identical with those of postoperative cases. It is to be hoped that a clearer insight into the pathogenesis of lung suppuration will be obtained when we succeed in reproducing the disease in animals, and when systematic studies of its anaerobic bacteriology have been made.

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## CONTAMINATION OF THE HANDS AND OTHER OBJECTS IN THE SPREAD OF DIPHTHERIA

OBSERVATIONS ON SECONDARY INFECTIONS IN  
HOSPITALS FOR CONTAGIOUS DISEASES \*

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Crossed infections in hospitals for contagious diseases are always a matter of concern, and the technic followed in modern hospitals for these diseases has been elaborated with the special purpose of preventing such infections. Since the transfer of the infectious material is probably in most cases by direct carriage, it is most important to know just what the carrier is and to take measures to avoid its activity. It is readily imagined that the hands of nurses and others which are often in contact with patients and which frequently become contaminated by discharges from the throat, nose, ears, etc., may readily act as carriers. Our observations were made to learn if the routine followed in the hospital was sufficient to preclude such carriage by hands. Cultures were made to determine whether the hands of nurses and interns were free from the organisms which they had acquired in handling patients after the washing with soap and running warm water which we have depended on for cleaning the hands. The observations were made on a floor of the hospital principally devoted to diphtheria patients. Two forms of bacteria were sought by cultures, namely, the diphtheria bacillus and hemolyzing streptococcus. Neither of these is apt to occur except as it comes from disease secretions. Davis<sup>1</sup> and others have

\* From the Durand Hospital of the John McCormick Institute for Infectious Diseases.  
1. Davis, D. J.: Illinois M. J. 36: 134 (Sept.) 1919.

pointed out that hemolyzing streptococci do not occur on normal clean skin. Since they commonly are present in the secretions in cases of diphtheria, their presence on the hands of those caring for persons with this disease can safely be inferred to be due to contamination with patients' secretions. Similar conditions apply to diphtheria bacilli. Cultures were also made from door knobs leading to the vestibule of patients' rooms, since if they become contaminated they may soil hands that have been properly cleaned. The cultures from hands were taken after routine washing, the person not knowing when they were to be taken. Cultures from door knobs were made after they had been unwashed for several hours.

The material for cultures was secured by drawing sterile cotton swabs, moistened with sterile water, beneath the nail of the right index finger, over the palmar surface of the same finger, and over the surface of a door knob. The swabs were rubbed over slants of Loeffler's solidified blood serum, and then washed off in sterile broth from which 5 to 10 drops were used in preparing blood agar plates. When organisms resembling diphtheria bacilli were seen in preparations from the culture on Loeffler's serum, pure cultures were isolated. Only those were finally recognized as diphtheria bacilli which produced typical lesions in guinea-pigs and were protected against by diphtheria antitoxin. In the blood agar plates, minute hemolyzing colonies were transferred to broth, and those strains which grew in chains and which produced a wide zone of hemolysis on a blood agar streak were listed as hemolyzing streptococci. The observations were carried out over a period of five months. The results may be thus summarized:

#### RESULTS OF EXAMINATIONS

A total of 268 examinations were made on forty-five pupil nurses, from one to fifteen examinations being made on the same individual. Of the 268 cultures from beneath the nail and from the palmar surface of the right index finger, twenty-five, or 9.3 per cent., contained hemolyzing streptococci and eight, or 3.0 per cent., diphtheria bacilli. Of the forty-five nurses, sixteen, or 35.6 per cent., yielded hemolyzing streptococci, twelve from beneath the nail, two from the palmar surface of the finger, and two from both locations. Of the same nurses, six, or 13.3 per cent., yielded diphtheria bacilli, three from beneath the nail, two from the palmar surface of the finger, and one from both locations. No individual who had ten or more cultures failed to show hemolyzing streptococci.

Similar examinations were made of four graduate nurses who had been specially trained in the care of contagious diseases, from five to twenty cultures being made on single individuals. In fifty-one cultures, hemolyzing streptococci were found but once, that is, in about 2 per cent. Diphtheria bacilli were never found. These nurses work with the sickest patients, and their hands are especially liable to contamination. The contrast between the results in highly trained and pupil nurses is striking.

From the hands of three interns, forty-five cultures were made, seven of which, or 15.6 per cent., yielded hemolyzing streptococci, and three, or 6.7 per cent., diphtheria bacilli. Each of the three interns yielded diphtheria bacilli from beneath the nail on one occasion. In two of these the cultures were taken immediately after scrubbing the hands following the making of a necropsy in a case of diphtheria during which no

rubber gloves were worn. All of their hemolyzing streptococci were from beneath the nail.

Cultures were taken from the hands of four diet maids. Out of sixty-four cultures, hemolyzing streptococci were found beneath the nail twice, or in 3.1 per cent. No diphtheria bacilli were found.

An orderly who handled the laundry bags and waste materials yielded hemolyzing streptococci from beneath the nail four times out of eighteen cultures, but never diphtheria bacilli. Cultures from persons in the hospital office and laundry were uniformly negative.

Cultures were made from door knobs 137 times, eight, or 5.8 per cent., yielding hemolyzing streptococci, and six, or 4.4 per cent., diphtheria bacilli.

#### METHODS OF AVOIDING CROSS INFECTIONS

The significance of these findings is evident. While the streptococci may not always have come direct from patients, this can hardly be the case with diphtheria bacilli. It is evident that washing with soap and warm running water as carried out by most individuals does not entirely rid the hands of pathogenic bacteria. That it can be done, however, is indicated by the result of cultures from the hands of the specially trained nurse. The soiling of door knobs, etc., by unclean hands furnishes a means for contamination of clean hands, and so one careless person may annul the efforts of others. It would seem necessary to give special detailed instruction in the care and cleansing of the hands, especially of the nails, to all pupil nurses and interns when they begin work in a hospital for contagious diseases. They should be taught to avoid needless soiling of the hands as well as proper cleansing. They should be impressed by the great danger of the hands acting as carriers of infection to patients and to themselves.

In caring for patients when gross contamination of the hands cannot be avoided, and when performing necropsies, the difficulty of complete cleansing would suggest the use of some mechanical protection, such as rubber gloves. The routine making of cultures such as we have indicated, and which we propose to continue, might well be of value as a check on the technic of persons working about contagious diseases. Doors so constructed that knobs are eliminated would remove one means of hand contamination.

Even with the most perfect mechanical conditions, instances of cross infection can be eliminated only by intelligent, conscientious care by every person who has to do with the patients. Those who are careless should not be tolerated about hospitals for contagious diseases.

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**Fight Against Hookworm.**—The annual report of the International Health Record of the Rockefeller Foundation states that Brazil, Central America, the West Indies, and Far East, and twelve states in the United States are enlisted in cooperative work in the campaign against hookworm. Requests for aid in combating the disease were received from Colombia, the Barbados, Curaçao, and Santo Domingo, West Indies, the Madras Presidency, India, Kelantan, and the Federated Malay States, and Mauritius. In the United States, Alabama, Arkansas, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Texas and Virginia were added to the states actively engaged against the disease. In the West Indies, Guiana, St. Lucia, St. Vincent and Trinidad; in Central America, Costa Rica, Guatemala, Nicaragua, Panama and Salvador; in the Far East, Ceylon, China, Fiji, Seychelles, Siam and Queensland, Australia and in Brazil, the federal district of São Paulo, and Rio de Janeiro.