

ods—no general anesthetic, no rib resection, because if you can get your finger in, you can put a tube in; enlarge your wound when necessary according to Lilienthal and put in such drainage as you may see fit. The cosmetic method mentioned by Dr. Newell is interesting. The only pus that gives odor is outside and that is not hurting the patient. If we can perfume these cases it is all right.

*Dr. M. W. Seagars, St. Augustine, Fla.*—A subject that interests me from the railroad standpoint in the after-treatment of empyema, speaking from the employees' standpoint, is the adhesion area. That area comes irrespective of the line of treatment that has been instituted. On the East Coast Railway of Florida we instituted a series of calisthenics for the post-operative treatment of all cases of empyema. These cases were not selected. Treatment was started oftentimes a week after the drainage operation. Naturally the calisthenic exercises were devoted entirely to the lung and the pleura. From the vocational standpoint we all know that the musculature of employees is more or less greatly developed by swinging in and out of platforms. The respiratory muscles and shoulder muscles of that class of cases are greatly developed in comparison with the ordinary civil individual, and it was a most gratifying experience that we had in the post-operative care, of getting better lung expansion, more rapid elimination of adhesions, and a general betterment of the post-treatment which to us and all our minds is the important thing from the patient's standpoint. A crippled condition of the lung, a crippled condition of the pleura, is the aftermath of all these cases irrespective of surgical work. Is the case going on with a normal expansion? Is he going to be crippled with conditions of adhesions from his vocational standpoint and rendered less efficient?

All of these exercises were carried out with the ordinary Whiteley exerciser or by a method installed in bed cases at the foot of the bed. No case was treated in this way until two hours after irrigation in order that the circulatory condition might be allowed to regain a normal condition. The question might be asked, do we use this method in those cases where the exacerbation of temperature curve is greater or less? We found that on a series of cases it made no particular difference on the standpoint of the cardia and we hastened—at least we feel that we hastened—a great number of cases toward a more rapid convalescence. Briefly, the question is whether or not we are going to irrigate the cavity with the numerous and kindred solutions that we have heard discussed this morning. Most of the surgeons agree it is almost impossible in railway hospitals to utilize a technic that is exact in the Carrel-Dakin irrigation method. To my mind the whole thing is in your team work plus your ability to carry out your irrigation in what is known as a precise technic. The ordinary surgeon can not do this. There is only one possible way to my mind for one man to know the exact status of his solution. He must go to the Rockefeller Institute or somewhere where he can study it carefully. If we

have the normal solution of its own normal chemical activity, then we see the wonderful results obtained from the Carrel-Dakin solution in all post-operative conditions. We use the Carrel-Dakin solution exclusively in all our hospitals connected with the railway and I have seen that each and every man had the technic from simply going and knowing how to use it.

*Dr. Eve (closing).*—Dr. Royster sounded a very timely suggestion when he stated there was no need at all of employing irrigating solutions. There is little or no use of antiseptics, for we have learned very little from the military surgeons in the great war, and have to return, in all probability, to the pre-war condition of the treatment of empyema which means simple rib resection and the introduction of a drainage tube.

It is not our purpose to underrate Dakin's solution, for we know too well its great advantages in the treatment of open wounds, but from our experience and that of many other observers it is not indicated in empyema for reasons cited in our paper.

## THE SURGICAL TREATMENT OF EMPYEMA\*

BY W. W. GRANT, M.D.,  
Denver, Colorado.

Excepting the variety and unusual character of wounds treated in the war zone, probably no diseased condition during this period has excited so much interest and consideration as empyema and associated diseases.

The numerous pathogenic bacteria involved have been quite fully investigated and results published, yet in this connection we know only that the one most important mortal factor was the hemolytic streptococcus. The focus of infection is in the lung—infection of the pleura being secondary.

At this time I will confine my remarks to my personal experience based upon the two epidemics in the winter and spring of 1917-18 and 1918-19, at the recruiting depot, Fort Logan, Colo. In view of the diverse opinions expressed and published as to the treatment, I think it important to give, in some detail, chief expression to this phase of the subject. It is of considerable interest to note that the influ-

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enza epidemic of 1917 and spring of 1918 was attended with an epidemic of measles and scarlet fever, while during the last epidemic there were not more than half a dozen cases, and yet proportionately the mortality from pneumonia was decidedly greater in the latter epidemic. This was in a measure surprising, for it had been the universal experience of past years that the prevalence of measles was dreaded as the most dangerous and fatal complication of camp life, with the possible exception of typhoid fever.

In the epidemic of 1917 and spring of 1918, I operated upon 28 cases of empyema with a mortality of 6 cases, and in the winter of 1918-19 I operated upon 3 cases only, with no mortality. Yet, there were three to four hundred cases of influenza and as many cases of pneumonia as in the former epidemic. It was much more fatal and fewer cases reached the surgeon for operation. A detailed report of 28 cases was made to the Surgeon-General's Office.

My surgical assistant visited the medical wards daily with the attending physician in order to detect as soon as possible the need of surgical intervention in any case. Aspiration was freely employed as a diagnostic measure to determine the presence and the nature of the effusion and to relieve embarrassed respiration. This procedure also resulted in the cure of a few cases in the absence of empyema.

The first three cases were operated upon under general ether anesthesia—one of these died shortly after. All other cases were operated upon under local anesthesia of novocain—2 c. c. of a two per cent. solution being injected above and below the rib to be resected, aiming to block the intercostal nerves, and then 5 c. c. of a half of one per cent. solution was injected into the surrounding tissues to be dissected. Two or three minims of adrenalin (1 to 1,000) were added to the solution, and I waited eight to ten minutes for the full effect of the anesthetic, when a few seconds' application of ethylchlorid along the line of a crescentic incision made the incision painless and the resection of the rib with the shears practically painless.

In most of the cases there was no perceptible shock an hour later. In some, who were very weak, moderate lowering

of the blood pressure was noted, but the condition responded soon to salt solution, the rectal drip and hot milk by stomach.

In all cases, about twenty minutes before the operation, an ounce or two of whiskey was administered and a hypodermic injection of 1/6 grain of morphine with 1/200 grain of atropin and 1/2 grain of spartein. One to one and one-half inches of rib were resected: on the right side the eighth rib and on the left the ninth or tenth, usually in the posterior axillary line—the aim being to secure the most dependent drainage. A rubber drainage tube, sometimes double, was immediately introduced and the tissues sutured snugly around it—the tube fixed primarily with a stitch and a safety pin and the long outer tube dropped into a bottle of water beneath the bed as in certain cases of gall-bladder drainage. The quantity of pus varied from two to four quarts. The discharge diminished rapidly and on the second or third day the patients were taken to the dressing room at least twice daily and the cavity irrigated with a five per cent. bicarbonate of soda solution, adding boric acid, and immediately followed by a seven per cent. solution of iodine one ounce to four quarts of warm water of gradually increasing strength. The drainage tube was later cut off close to the skin and the wound protected with a pad of sterile gauze held in place by strips of adhesive plaster and a larger pad over this, fixed by a roller chest bandage until the discharge was greatly reduced and the drainage tube no longer required.

Under this treatment the patients breathed comfortably and the lungs expanded rapidly. In about half the cases—notably those not operated upon before the end of the second or in the third week—the pus was in a partly organized or coherent mass of fibrin in which it was necessary to use the forceps for the removal of the floating mass of exudate at the time of the operation. The play of the diaphragm was easily observed and with long ring forceps and sterile gauze pads these lymph masses were wiped off the diaphragm and pulmonary and costal pleura, the drainage tube being inserted as soon as this procedure, lasting a few minutes, was over.

For irrigation of the pleural or pus cavity, I alternated in some cases the iodine solution with a one-half of one per cent. formalin solution. I made but little use of the Carrel-Dakin solution, because it required exceptional skill and absolute purity of material in its preparation, was difficult to keep, often painful in use, and required almost the constant attendance of a nurse for its most efficient administration. Furthermore, it was my conviction that the mechanical cleansing of the cavity was perhaps as important as the chemical action of drugs used as antiseptics. The Carrel-Dakin can not be effectively applied to the large pleural pus cavity through the small catheter tubes commonly in use, but it may be applied by irrigation like other antiseptic solutions.

When the cavity was so nearly closed as to hold only two or three ounces, the drainage tube was removed and bismuth paste with the addition of iodoform and balsam of peru were injected and a pad placed over the wound and fixed by adhesive plaster. It was necessary in a few cases to reopen the wound much later at the old site on account of a reaccumulation of pus, which showed that the cavity was not sterile and the tube was removed too soon.

The shortest period in which any patient returned to duty after operation was seventeen days, while the convalescent period, with most, was from two to three months. Two of the recovered were discharged (s. c. d.) six months after operation on account of tuberculosis, and one six weeks after complete recovery on account of exophthalmic goitre which was not observed before the present illness.

It was my conviction and that of the attending physicians, based upon observation and experience, that the patients operated upon seven to ten days after beginning of illness, or immediately after the formation of pus, did not progress as satisfactorily as those operated upon at a later date—from the fourteenth to twenty-fourth day from the beginning of the attack of influenza or pneumonia. Some of these cases followed lobar pneumonia, but the most dangerous and fatal were the broncho-pneumonias from hemolytic streptococcic infection. A few facts

concerning the six fatal cases are interesting if not illuminating:

T. C., aged 27 years, was admitted to the hospital on December 27, 1917, with broncho-pneumonia; operation by rib resection under general ether anesthesia January 4, 1917; death, January 5.

H. L., aged 24 years, was admitted to the hospital January 2, 1918; sick two or three days before admission to hospital; operation, January 5; death, January 22 from general sepsis with phlebitis.

A. G. W., aged 21 years, was admitted to the hospital April 3, 1918, with scarlet fever and broncho-pneumonia; operation, April 10; death, April 18 with cerebral meningitis of suspected tubercular origin.

H. G., aged 16 years, was admitted to the hospital April 9 with broncho-pneumonia; operation, April 19; death, April 30—nerve type.

H. S. J., aged 19 years, was admitted to the hospital April 11 with broncho-pneumonia; operation, April 18; death, April 20.

This and the preceding case were of a class with distressing nervous symptoms; restlessness, sleeplessness and mildly delirious with spells of stupor, but generally answered questions intelligently and took nourishment willing and plentifully.

D. B., aged 20 years, was admitted to the hospital April 19 with pneumonia; operation, May 13; recovered from empyema, but late in convalescence developed mastoiditis and died from septic basilar meningitis June 22—nearly six weeks after operation for empyema; death clearly not due to pneumonia or operation.

Cases 3 and 4, especially, I believe would have stood a better chance of recovery had the operation been deferred a week, but this is purely speculative.

General anesthesia endangers the prognosis in these acute conditions and is in fact unnecessary, as the operation can be done so quickly, so safely, and so thoroughly under local anesthesia. The safest general anesthetic is undoubtedly nitrous oxid and oxygen.

The patients who had the capacity to resist successfully the acute stage of the disease in question seemed to acquire a certain degree of immunity to the infection which enabled them to resist the local empyema or suppurative pleurisy and operation better, and the mortality was less.

Nothing, in my opinion, is to be gained from operating upon these cases until the acute influenzal and lung conditions have well passed the critical stage. The opposite course will increase the mortality.

I believe a single rib resection and a

flexible drainage tube is the best, most effective and satisfactory method of treatment. There are no medical specifics for this condition.

I have had no experience with the vacuum suction method of draining the pleural cavity of pus. In no case was it necessary to do a multiple costectomy. The lung seemed easily inflated and commenced to expand as soon as the compression was relieved by evacuating the fluid. This process was encouraged and accentuated by forced inspiratory efforts. In all cases aspiration should be used to relieve the compression of the lung and the embarrassed breathing due to the serous or pus accumulation until a more auspicious time for a radical operation. The more virulent the infection due to the hemolytic streptococcus, the greater the mortality with or without operation.

In the *Journal of the American Medical Association*, September 13, 1919, is an interesting editorial commenting on the treatment of empyema, which states that "the objections to simple thoracotomy were that it permitted collapse of the lung through the equalization of the air pressure within and without the pleural cavity, which collapse occasionally became permanent, necessitating secondary operations of doubtful prognosis for the relief of the condition." This statement is not in accord with the facts. The lung is in a state of collapse from compression by the effused serum, or pus, some time before the patient reaches the operating table. The operation, therefore, by the admission of air does not cause the collapse; in nearly every case the empyema was diffuse. No secondary operation is usually required if the primary operation is well done and not delayed so long as to permit permanent adhesions.

The Thiersch method of drainage with a soft rubber catheter inserted between the ribs, through a trocar and working automatically, does not appeal to me as an effective surgical procedure. Furthermore, no small tube would drain the floating exudate or inspissated pus. In my opinion, resection of a rib in the most dependent part and drainage with a rubber tube the size of the finger is the only method so far produced that is worthy of a permanent place in the surgical treatment of the disease.

The admission of air to the pleural cavity during operation is not a serious matter as the lung is already, in diffuse empyema, in a state of collapse; neither have I observed any distress during subsequent irrigation of the cavity. In two cases with bronchial fistulae it was advisable to raise the head and shoulders during the irrigation to prevent the liquid entering the bronchial tubes. These two cases recovered perfectly.

The outer wound heals much faster than the infected cavity behind it and it is necessary to retain the drainage tube until the cavity is sterile and lung expansion has practically or nearly closed it. No secondary operation is needed to close the wound of entrance, as it heals in a short time after removal of the tube. If the cavity is sterile, the small quantity of air inclosed will be absorbed. The Schede, Estlander or DeLorme operation will seldom be required. If the primary operation is not too long delayed, the expansion of the lung will obliterate the cavity.

Empyema is not cured by aspiration nor by the immediate closure of the wound after operation. It is recognized that in the influenzal and pneumonia epidemics the virulence of the infection is more intense and varied and the mortality, in consequence, greater under any treatment than we have been accustomed to experience in sporadic cases under ordinary conditions of civil life.

325 Mack Bldg.

#### EMPYEMA: RECENT EXPERIENCES\*

BY FRANK K. BOLAND, M.D.,  
Atlanta, Ga.

Few subjects in surgery have occupied more space in the literature during the past two years than the discussion of empyema. Before this time it almost seemed that the last word had been said. It is unnecessary to state that the revival of interest in the subject is attributable to the remarkable epidemics encountered in our cantonments during the mobilization of the Army. The type of empyema

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