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TABLE OF CONTENTS

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THE MASSACHUSETTS MEDICAL SOCIETY.		BOOK REVIEW	
PAPERS AND DISCUSSIONS OF THE ANNUAL MEETING OF THE SOCIETY, JUNE 3, 1919.		Diseases of the Skin. By James H. Sequeira, M.D. 98	
WHAT GENERAL SURGERY HAS GAINED FROM THE WAR. By Hugh Cabot, C.M.G., M.D., F.A.C.S., Boston. 79		EDITORIALS	
EMPHYSEMA. By Homer Gage, M.D., Worcester, Mass. 84		THE PANDEMIC OF 1918. 99	
EMPHYSEMA IN CHILDREN, WITH SPECIAL REFERENCE TO DIAGNOSIS. By Frank Spooner Churchill, M.D., Boston. 87		PHYSICAL EXAMINATION OF THE FIRST MILLION DRAFT RECRUITS. 100	
DISCUSSION OF PAPERS BY DRs. CABOT, GAGE, AND CHURCHILL. 90		RABELAIS, A LITERARY PHYSICIAN. 101	
ORIGINAL ARTICLES		MEDICAL NOTES. 101	
DIPHTHERIA, THE UNCONTROLLED. By Bernard W. Carey, M.D., Boston. 92		CORRESPONDENCE	
BRONCHITIS, THE MOST SIGNIFICANT DISEASE OF THE WAR. By George A. Soper, Ph.D., New York. 95		ARSPHENAMINE AND VASO-DILATORS—A FURTHER EXPLANATION. H. S. Jellison, M.D. 106	
		THE POLITICAL DUTY OF PHYSICIANS. Edwin A. Sanborn, M.D. 106	
		MISCELLANY	
		MEMORIAL RESOLUTIONS FOR DR. SARAH A. BOND FRASIER. 106	

The Massachusetts Medical Society.

PAPERS AND DISCUSSIONS OF THE ANNUAL MEETING OF THE SOCIETY, JUNE 4, 1919.

WHAT GENERAL SURGERY HAS GAINED FROM THE WAR.

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THE contributions which the war will be found to have made to general surgery center almost entirely about the management of contaminated and infected wounds. Other departments of surgery, notably orthopedic surgery, involving the question of the late results of bone injuries, are likely to be importantly affected, largely through the opportunity of working out on a large scale methods of treatment which have heretofore remained somewhat in the realm of the doubtful on account of insufficient experience. Particularly is this true of the application of bone grafts and the treatment of ununited fractures.

My own experience though large in numbers was limited to the care of casualties in the comparatively early stages. None of the Brit-

ish hospitals in France were in a position to keep their patients any longer than was absolutely necessary and it followed that our knowledge of end results where these were long postponed was of necessity much limited. On the other hand, a very large opportunity was given for the study of wounds at periods varying from 24 hours to several days after the occurrence of the casualty, and it is therefore possible to survey the field of acute war surgery with some prospect of accuracy of conclusion.

The great problem of this war was the management of contaminated and potentially infected wounds. The distinction between contaminated and infected is a real one upon which, in fact, turns most of the developments of war surgery. The contaminations were always potential infections and that with a great variety of organisms, some of them pathogenic, others harmless, collected from the various flora of Flanders Field. As time went on it became clear that some period, long or short, must elapse between the receipt of a wound, with its accompanying contamination, and the growth and development of bacteria to an extent properly dignified by the term infection. It is in this interval between the contamination and the development of infection that treatment can most closely approach the ideal, and

upon it attention was increasingly centered as the war went on.

You will all of you remember the more or less burning controversies of the earlier days between the various methods or schools of wound treatment, all of which turned upon the use of one antiseptic or another or one method or another of applying them. Here belong the very interesting experiments in the use of varying strengths of salt solution to which so much time and intelligence was devoted by Sir A. E. Wright. Dakin's solution, particularly in its relation to the so-called Carrel-Dakin method, has occupied a large place in the literature of the time. Then came "B. I. P." and flavine, active competitors in an already crowded field; but, like their predecessors, all of them addressed to dealing with wounds at a time when contamination had developed into infection, and all of them handicapped by the everlasting handicap which weighs down the use of all antiseptics. From time immemorial the wise and the foolish alike have sought for some substance which, brought in contact with an infected wound, shall have the power of penetrating the tissue and destroying the organisms without unfavorably affecting the tissue itself. No such substance has been obtained, and though we have learned that many antiseptics of great bactericidal power are worthless or even harmful because of the damage which they do to the tissue, we have always returned to the basic fact that the only satisfactory method of treating an infection is by preventing it. Undoubtedly "B. I. P." and flavine served a valuable purpose in this war, and it is doubtful whether under conditions of active fighting it will ever be possible to dispense with antiseptics. The great advantage which the introduction of these two antiseptics brought to the surgery of war was that it rendered transportation from forward areas to lines of communication, and ultimately to the bases, possible by checking the spread of infection and minimizing the amount of dressing necessary during this period, which may extend to several days. None of us who lived through it will forget the relief which these two antiseptics brought over the previous methods of wet dressings, frequently changed, which, during 1916 and early 1917, were commonly miscalled Carrel's method. The frequently changed wet dressing was a practical impossibility and therefore a tragic absurdity

during days of active fighting; and the attempt at its execution was often followed by a dreadful mortality whether of life or limb. The introduction of "B. I. P." and flavine enabled wounds to be dressed only at relatively long intervals varying from a few days up to a week and yet to remain in satisfactory condition. But this lengthening of the interval between dressing came about, at least in part, because of a wider acceptance of the axiom of the surgery of this war that all penetrating or so-called lodging wounds in which projectiles and contaminated clothing are retained must be widely opened and at least roughly cleaned, with the removal of foreign material, at the earliest possible moment. Upon the acceptance of this axiom turned practically the whole development of the surgery of the last year and a half of the war. Much credit should be given to Carrel for his early enunciation and persistent advocacy of the doctrine of free incision and careful mechanical cleaning. I think that on the whole the French medical service grasped this truth earlier than the British, though my contact with their work was not sufficient to enable me to express an opinion as to their practicability to carry it out.

PRIMARY AND DELAYED PRIMARY SUTURE.

The development of war surgery centered around what is now known as primary and delayed primary suture. I will not take your time by discussing the details of technic but the principles are as follows: Primary suture may be applied to any battle wound, lodging or otherwise, in which contamination has not as yet developed into full blown infection. It depends obviously upon the possibility of thoroughly exposing all portions of the wound to sight, of removing foreign bodies and foreign material and with it damaged or partly damaged tissue. It is further necessary that the space thus left should be such that it can be closed without leaving dead spaces which, where they occur, are practically certain to vitiate the result in a greater or less degree. Much discussion has centered about the length of time after wounding at which such sutures can be carried out; but as our experience increased, it became evident that elapsed hours were only relatively important and that in a proportion of cases, decreasing as time went on, such sutures could be carried out up to a period of

even two or three days. This was far more true of superficial than of deep wounds, and also of wounds in which projectiles did not remain, such as through and through wounds, grazing wounds, and wounds caused by relatively large shell fragments of low velocity.

The term delayed primary suture was given to those cases in which, partly from doubt as to the success of the cleaning process and partly from lack of time on account of pressure of work, it was not deemed safe or possible to complete the operation. Under these circumstances the wound was packed, with or without the use of some antiseptic, and the patient evacuated to lines of communication where the wound would be closed after an interval of from 24 to 72 hours.

In the early days of this work on primary suture, considerable stress was laid upon the importance of taking cultures from varying parts of the wound in the hope that it would importantly affect the treatment. In the long run I do not believe that this was the case, partly because the results of such cultures implied a large element of uncertainty and accident according to the thoroughness with which cultures were taken and the care with which their results were worked out. In war surgery, at least, all this work must be done under pressure and deals with relatively large numbers, large enough at least to swamp the bacteriological establishment of almost any field hospital under the pressure of heavy fighting. It was undoubtedly true that the inclusion in the wound of the hemolytic streptococcus was likely to be followed by a bad result, but my experience leads me to believe that the inclusion of considerable numbers of the gas bacillus group was commonly not followed by any such result. In practice, I doubt if reliance was in fact placed upon laboratory findings in the majority of cases, and in our own work we early discarded them and depended entirely upon the expert judgment of men trained in war surgery for one or two years.

It was not possible to keep accurate figures of this work over long periods of time, but I have here a few which probably represent a fair average of the development during the latter part of 1918. During a period of five days in August, 1918, four hospitals in the Camiers district received 2,008 wounded and operated

upon 749, which is 37%. This figure is probably below the average which was being done at that time as I find that during the same days at No. 22 General Hospital we did 505 operations, probably about 50% of the wounded received. During a period of six weeks from the first of August to the middle of September, No. 22 General Hospital received 5,539 wounded and operated upon 2,047, 36%. This appears to show that during conditions of active fighting, even under the most severe pressure, about 35% of the wounded casualties that arrived at the evacuation hospitals on lines of communication are thought to require operation. During this same period of six weeks, 933 cases were thought appropriate for suture, primary or delayed, and of these 741 were primarily sutured. A much larger per cent. would have been treated by delayed primary suture had it not been for the impossibility of retaining them in hospital for the week or ten days which such cases require, and this does not therefore represent a satisfactory figure upon the relative frequency with which delayed primary sutures would be carried out under satisfactory conditions.

The literature of this subject has now become very voluminous, but until we get a little further away from the heat of battle and the stress of controversy no one opinion can be accepted as authoritative. Thus it has been widely held that primary suture of wounds was relatively unlikely to be successful unless undertaken within the first 24 hours. If this had proved to be true only a comparatively small number of casualties could have been thus treated as this method involves delay in evacuation from forward areas and is quite incompatible with active fighting conditions. Early in August a group of hospitals in the Camiers district demonstrated satisfactorily that cases, the majority of which were from 24 to 48 hours old, could be treated by primary suture carried out by a great variety of surgeons with at least 84% of complete successes and 91% of partial and complete successes. A further continuation of this experiment at No. 22 General Hospital showed that this was true in a series of over 700 cases, many of which were more than 48 hours old. I am therefore inclined to advise that the decision be made upon clinical evidence tending to show whether or not contamination has in fact resulted in in-

fection which has penetrated deeply into the tissue. I am certainly not prepared to accept the widely expressed view that the mere lapse of 24 hours, even in lodging wounds involving fractures, is a contra-indication to primary suture.

In order to discuss this question more intelligently, the cases should be divided into (1) cases involving only the soft parts; (2) cases involving bones but not joints; (3) cases involving joints.

(1) Obviously cases involving only soft parts are, other things being equal, more readily dealt with and likely to give better results. On this point I am able to report 479 cases with 410 (86%) complete successes, 16 (3%) partial successes (by which phrase is meant the removal of an occasional suture on account of stitch abscess, without affecting the integrity of the wound), and 53 (11%) failures. The results will, of course, vary with the depth to which the wound penetrates, and in general penetrating wounds of the buttock were best treated by the open method, as were the deeply penetrating wounds of the thigh. Complications, such as damage to the arterial supply, as in the case of the posterior tibial in the calf, would militate against the best results.

(2) It was commonly believed that compound fractures as a complication of lodging wounds could not be submitted to primary suture except in their earliest stages. That this is not invariably true, and that time ought not to be accepted as a positive contra-indication to operation, may be judged from a group of 184 cases done during August and September, with 146 (79%) successes, 11 (6%) partial successes, and 27 (15%) failures. It may properly be admitted that these cases require more skill and judgment than do the wounds of the soft parts, but it is probably not true that failure will have to be paid for at a very much higher price. The osteomyelitis, which is the most serious result of failure, does not appear to me to be importantly worse than that which almost invariably follows upon the open treatment of these wounds. The decision of this point must of course be left until the final results of these never ending cases of osteomyelitis are better known, but at the present time I think there is no evidence to show that serious acute osteomyelitis is importantly more common after failure of primary suture than after open treatment.

(3) Perhaps the most brilliant successes of primary suture are the cases involving important joints, and this has perhaps more application to the conditions of civil practice than any other of these groups. In the early part of the war, the knee joints infected by gun shot wounds were treated by incision, irrigation, and drainage, and even by laying them wide open by transverse division of the ligamentum patellae, flexing the joint to a right angle and allowing the infection to subside when an attempt was made to restore the integrity of the joint. All methods of drainage proved in the majority of cases to be more or less disastrous failures, and it was to this group of cases that primary suture was applied earlier perhaps than to any other group. It soon became an accepted doctrine that excision of the wound with removal of the foreign body, careful irrigation of the joint, and complete closure at least of the capsule was commonly followed by brilliant success. Extensive damage to the bone involving the joint or extensive damage to the cartilage always gave less satisfactory results and, even in the earliest stages and with the best technic, cases of extensive damage to the joint surfaces frequently ended in failure. Shattering injuries, whether of the condyles of the femur or the head of the tibia, came to be generally regarded as requiring either excision or amputation. On the whole, the enormous number of knee joint injuries, even after the lapse of 24 hours, gave excellent functional results if the indications for cleaning and irrigation were carefully carried out and the joint accurately closed, even though complete suture of the overlying soft parts was not done. In probably the majority of cases it was possible to completely suture the whole wound and get primary union and full motion.

Injuries to the wrist joint, which is ordinarily regarded as a difficult joint to deal with, do well under this method by the removal of all bones damaged to any appreciable extent. This might involve the removal of a portion or the whole of the carpus and might even involve the removal of the proximal end of one or more metacarpals, yet the result at the end of two or three weeks was a joint with a reasonable amount of motion and free use of the tendons. This latter was most difficult to obtain in the earlier methods of open treatment and varying degrees of claw hand commonly resulted. Per-

haps the most brilliant group of these hand injuries was the very common through and through machine-gun bullet wound of the palm, involving one or more metacarpals, commonly breaking through into the wrist joint with a varying amount of damage to tendons. Scrupulously careful cleaning of these wounds with suture of the tendons, occasionally of the nerves, and removal of bone fragments, commonly gave thoroughly useful hands, a result which could not have been obtained by open methods.

Much less satisfactory results were obtained in wounds involving the elbow, shoulder, hip, and ankle joints. This was probably due to the anatomical difficulties of thorough cleaning; and particularly in the shoulder and hip joints, really satisfactory irrigation of the joint is hardly possible. Our experience led us to expect infection of these joints with greater frequency and in the cases of the elbow, shoulder, and hip to resort to excision in a larger proportion of the doubtful cases.

CHEST SURGERY.

Undoubtedly the experiences of the war have added considerably to our knowledge of the surgery of injuries of the chest. Much greater boldness of treatment developed as time went on, and was justified by the results. In the earlier years of the war it was the general custom not to interfere with large hemothorax due to through and through wounds, on the ground that removal of the fluid was likely to be followed by fresh bleeding. Several observers have pointed out that if it was desired to avoid expansion of the lung this could be done by replacing the fluid removed, by sterilized air or oxygen, much upon the same principle as that used in the production of artificial pneumothorax for tuberculosis. In this way further bleeding could be certainly controlled, but the number of cases to which this procedure was applied probably diminished rather than increased during the latter part of the war, as evidence accumulated to show that large hemothorax, whether or not treated by aspiration, tended to result in crippling of the lung, and that opening of the chest with removal not only of the fluid but the clotted portion of the blood, gave a better late result. Suture of the lung, if bleeding appeared, and particularly the removal of indriven bone, was commonly followed

by much more complete expansion of the lung and not commonly by an amount of infection and empyema that was serious. During 1918 many surgeons of all the Allied group came to believe that in penetrating wounds of the chest with retained foreign bodies these should generally be removed by free incision, cleaning of the track in the lung, removing of bone fragments, drying out of the cavity, and suture of the wound. This procedure was commonly followed by expansion of the lung to a considerable extent and also commonly by the formation of a small encapsulated empyema which could either be treated by repeated aspiration, which was more successful than would be ordinarily expected, or by reopening of the wound. These small encapsulated empyemas commonly did well, particularly with drainage, and the amount of ultimate crippling of the lung with retraction of the chest wall was much less than in those cases in which infection of the hemothorax was allowed to develop, and tying up of the lung became a serious factor in producing a large stiff-walled cavity much more comparable to the post-pneumonic empyemas of civil practice. I have had the feeling that the development of these rather radical measures in chest surgery was still in its infancy and that had the war lasted longer the number of officers who were well equipped as regards technic and experience would have increased to such an extent that the already good results would have become even better.

APPLICATION OF THESE PRINCIPLES TO CIVIL SURGERY.

It is clear that the surgery of war, at least as concerns infected wounds, can have but a limited application to the accidents of every-day life. On the other hand there are, particularly in large industrial or railroad centers, a very considerable group of cases in which the injuries do not importantly differ from the wounds of war. Thus the compound fractures with indriven bone and foreign material roughly resemble the lacerated injuries produced by high explosive shells. These can certainly be treated during the early hours after injury by the principles of thorough cleansing through free incision, with the removal of all foreign material and damaged tissue, the rectification of the bone fragments, and suture of the wound. Many damaged hands which ultimately give un-

satisfactory results will do better than in the past if these principles are applied. The penetrating wounds of the knee joint which we tended before the war to approach with fear and trembling can now certainly be dealt with boldly and with greater certainty of complete success. Crushing injuries of the chest or the less common stab wounds with division of intercostal arteries will do well when treated more radically than in the past has been the custom. There need be no hesitation about freely opening a chest full of blood in order to suture a bleeding wound of the lung or to tie a divided intercostal under a good exposure. Such cases should do even better than wounds of war since the probability of infection from without is greatly less and the surgeon may confidently rely upon his ability to drain a small empyema, should it occur, with the knowledge that the lung has expanded freely and that the final result will be a great improvement over that which will occur if large accumulations are allowed to look after themselves.

It is perhaps proper to utter a word of caution in accepting the figures which we put out from these hospitals near the fighting line. It is probably true that, even though these men are fatigued and even war-worn, they are still in better physical condition than the average civilian of the modern world; that they show a higher degree of resistance, whether to infection or to the physical insults of operative surgery. It is quite impressive to observe the extent to which these fighting youngsters can be literally smashed to pieces without destroying either their courage or their ability to resist infection. On the other hand, it should be possible to surround the problems in civil life which approach those of war with greater niceties of aseptic technic than was for us possible, and it may be that these two factors will so nearly balance each other as to give substantially symmetrical results.

EMPYEMA.

BY HOMER GAGE, M.D., WORCESTER, MASS.

The army camps have during the past two years afforded a most unusual opportunity for the observation and study of empyema, and when the experience of them all has been tabulated and carefully analyzed, as it will be, we shall have a contribution to the literature of

the subject of unusual value. Even if it fails to settle some of the problems which we should like to see settled, it will furnish the largest amount of statistical material on empyema gathered under identical conditions during the same period by a large number of different observers, than has ever been made available to the profession.

There were during the mobilization two distinct groups of empyema, common to all the camps. One during the winter of 1917-18, following the epidemic of measles, and characterized by the presence of the hemolytic streptococcus; the second, in the autumn of 1918, following the epidemic of influenza, characterized by the presence of pneumococcus or streptococcus, or both. Both groups gave the impression to those who had them in charge of being quite different from the empyema which they had been in the habit of seeing in civil practice.

It is not easy to define this difference exactly, but it seemed to me that from the surgical standpoint the most striking difference was the opportunity to see the cases very early after the onset. I think in most of our metropolitan hospitals we see cases much later, when the other serious complications have been outlived and more or less resistance to the infection has been acquired. They are more like what we used to call thoroughly ripe abscesses than like acute spreading infections, and the problem as well as the prognosis is quite different. Then, too, the chronic empyemas of tubercular origin were not met with in the army hospitals.

The experience of the last four years in France and Belgium has added very much to our knowledge of chest injuries, widened very much the field of operative interference, and simplified its technique. From this experience we look forward confidently to a decided improvement in the treatment and results of thoracic injuries. It can hardly be said that our experience with empyema has given us equal confidence. There is nearly as much diversity of opinion as to the proper treatment as ever there was, and this diversity of opinion as expressed in the reports from the different camps is the strongest possible evidence that we have not yet evolved a perfectly satisfactory technique.

In a discussion of this subject before the Society at its annual meeting last year, after confessing my dissatisfaction with our results at