THE BOSTON MEDICAL AND SURGICAL JOURNAL.

VOL. XCVII.—THURSDAY, AUGUST 30, 1877.—NO. 9.

PERSONAL OBSERVATIONS OF LISTER'S ANTISEPTIC TREATMENT.

BY ROBERT WHITE, JR., M. D.

THAT the system of treating wounds devised by Joseph Lister, of Edinburgh, is actively engaging the attention of surgeons throughout the world is evidenced by the frequent references to it in medical articles, and by the attempts made to carry it out in numerous hospitals in this country and in Europe. The constant presence at the Edinburgh Infirmary of representative surgeons from all parts of the world, especially from Germany, where Lister's system has been very extensively adopted, points to his wards as the present centre of surgical interest in Europe.

Most extraordinary results have followed this treatment in the hands of those who have faithfully carried out Lister's ideas and who have worked in accordance with the rules on which the method is founded; it is evident that these are but imperfectly understood, many who have written on the subject, or who have attempted to carry on the treatment, betraying such a vague understanding of the true principles governing it that it is not difficult to account for the variety of results arrived at by different surgeons.

A residence of several months in Edinburgh, after my inspection of the attempts made to carry out the antiseptic treatment in the hospitals of England and the Continent, gave me the advantages of Mr. Lister's personal instruction in his methods, and the observation of his experiments and cases under circumstances more favorable for forming a correct opinion in the premises than are possessed by visitors who make a few hasty visits through the wards and come away with but very crude ideas of either the principles or the results of the treatment.

Without a proper comprehension and *acceptance* of the principles on which the antiseptic treatment is founded, any attempts to carry it out will almost certainly be attended with failure; let us, therefore, briefly review these. Pasteur, Tyndall, Lister, and others have proved by extended series of experiments that atmospheric air, in even the most healthy and favorable localities, contains great numbers of minute germs or organisms in a state of great activity, and capable of proliferation with astonishing rapidity. As seen under high powers of the micro-

scope (400) their general form is that of a minute globule, or a chain of two or more of these, many of the single globules not being more than $\frac{1}{1000}$ of an inch in diameter; they are known by the general names of bacteria and vibriones. Numerous other organisms exist in the air, as the penicillum glaucum, the torula cerevisiæ, or yeast plant, and other germs, the introduction of which into liquids produces the various forms of fermentation; but the bacterial species spoken of above has special interest for us as being the recognized source of putrefaction, either directly or by some noxious substance generated by it. This is easily demonstrated by a few simple experiments. Examine microscopically a drop of milk that has been exposed to the air at a moderate temperature for forty-eight hours. Circulating rapidly among the oil-globules, and exceeding them greatly in number, will be seen the bacteria referred to above. If they should not be present in great numbers in the first specimen examined, their rapid proliferation in the course of a few hours will be astonishing to the new observer; the same thing may be seen in urine, meat juice, vegetable infusions, or other readily putrescible fluids. For comparison take any of the same fluids in a fresh condition, boil for some time to destroy any germs that may already have entered the fluid, examine with the microscope, and no bacteria will be found; leave the same liquid exposed to the air for twenty-four hours or more, and it will be found to be swarming with organisms that entered it from the air, or the same result will be produced in it in a few hours by the introduction of a minute drop of the fluid in which putrefaction has already occurred. If the boiled liquid be sealed, or the air having access to it be charged with an agent capable of destroying the germs, on examination weeks or months afterwards it will be found free from organisms, but after twenty-four hours' exposure will teem with them.

In the vast majority of abscesses in which there has been no communication with the air, no organisms are found, while in abscesses or wounds that have been exposed to the air for a few days they are generally found in greater or less quantity, and wounds that have assumed a putrid character fairly teem with them. An extended series of experiments have also shown that these germs may be destroyed and the air containing them rendered innocuous by the action of certain chemical substances (antiseptics), by continued heat, or that it may be quite freed from them by filtration. If a flask which contains milk, blood, urine, or any readily putrescible fluid, be boiled and the mouth of the flask well plugged with a bunch of carbolized wool before removing from the flame, the air which naturally regurgitates into the vessel on cooling must pass through the wool, where the germs are destroyed by the antiseptic, and no elements of putrefaction are introduced. In Mr. Lister's hands I have seen flasks of urine, milk, and blood which had pre-

served all the characteristics of perfectly sweet and fresh fluids for periods varying from one to two years. On being opened they were found quite free from organisms, but twenty-four hours after exposure they swarmed with bacteria, and presented all the other evidences of putrefaction. Experiments of this character may be varied to a great extent, all tending to show, however, the source of putrefaction and the means of preventing it; those above cited have special bearings on antiseptic surgery.

The latest researches made with reference to the ætiology of septicæmia and pyæmia go far towards proving that these diseases are produced by the absorption into the circulation of the putrefactive secretions of wounds. Pyæmia but rarely occurs when the skin is unbroken, and the absorption or even the injection of healthy pus into the circulation is often unattended by any bad effects, or when followed by symptoms they are much less marked than when putrid pus is injected, this causing all the symptoms of pyæmia. It may be asked, admitting this, Is it proved that the putrid pus on the surface of the wound can enter the circulation? It has been experimentally proved that pus corpuscles can reënter the veins through their coats, and the appearance of bacteria on the stumps of amputated limbs is soon followed by their appearance in the blood, in cases of marked infection, in such quantity that they outnumber the red corpuscles in the proportion of two or three to one. We know also the facility with which the white corpuscles penetrate the tissues and the walls of the blood-vessels. Moreover, it is not necessary that the pus corpuscles should actually get into the blood current, the absorption of the noxious products of putrefaction, whatever they may be, being sufficient to produce the dreaded effects. The epidemics of pyæmia, of hospital gangrene, and of erysipelas that occasionally prevail in certain localities are doubtless frequently caused by the air in the vicinity of patients suffering from putrid wounds becoming loaded with the noxious products of putrefaction, and the consequent infection of other patients through their wounds, to which the contagion is introduced by the germ-laden air. It is by the destruction of these germs and the purification of the air that comes in contact with the wounded surfaces, thus removing the causes of putrefaction, that Lister aims at the prevention of pyæmia, as well as the prevention of suppuration and the necrosis of tissues, and at the promotion of rapid healing.

This result is not to be gained by the occlusion of air from the wound, or by simply applying an antiseptic to it. Lister does not attempt the impracticable feat of excluding the air from the wound, but purifies it, and the simple application of an antiseptic to the wound falls far short of the results secured by proper antiseptic treatment. In the first place it is extremely difficult to have the antiseptic penetrate those

parts of deep wounds where putrefaction would most readily occur; secondly, and most important, any agent sufficiently active to insure the destruction of the germs, if applied directly to the wound, will act as an irritant, induce suppuration, and thus interfere with the rapid healing process which it is the aim of proper antiseptic treatment to promote, and during the progress of which the agent does not come in contact with the wound. That the action of a chemical irritant on the surface of a wound will greatly delay its healing is undisputed, and almost as certain is it that the decomposition of the albuminous secretions of a wound is attended with the generation of noxious substances which exercise an influence similar to that of the chemical irritant, with the same consequences of inflammation, suppuration, and slow healing. Under the antiseptic treatment this decomposition is prevented, the local process of repair goes on unchecked by the presence of irritating secretions, and rapid healing ensues. That the tendency of wounds is to heal, and that the time employed in healing is very much shortened, will be apparent to any one who makes more than a transient visit to Lister's wards.

It has happened to some who tried Lister's method that they have failed to obtain the results its advocates have claimed for it, either in the prevention of putrefaction or in the securing of rapid healing. Without doubt, in the majority of such cases the failure is due to ignorance of the principles governing the antiseptic treatment and the omission of some of the details necessary for its success.

Let us follow Mr. Lister through the steps of an operation and dressing, for it is only by the close observation and imitation of his treatment in all its minutiae that we can hope to secure the same results that are attained at his hands.

In addition to the ordinary requirements for an operation there are needed a plentiful supply of carbolic lotion (1 to 20 and 1 to 40), carbolic oil (1 to 10) for instruments, the "protective," the prepared dressing of carbolized gauze and waterproof or "mackintosh" cloth, and a large spray producer containing 1 to 40 carbolic solution. The skin in the vicinity of the part to be operated on is purified by washing with the 1 to 20 solution, the hands of the surgeon and of all the assistants who touch the wound, and all instruments or other objects that touch the wound are dipped in the same solution, the spray is thrown on the part, and the operation is commenced. The sponges lie in a basin of the 1 to 40 solution, and are rinsed in the same. The object of the spray is the purification of the air passing into the wound, which must be kept covered with it during the whole time of operation. If for any reason it becomes desirable to suspend the spray during an operation or dressing, the wound may be effectively protected for a considerable time by a "guard," a piece of cloth large enough to cover the

wound, being wet with the carbolic lotion and laid over it. If saw or gouge is used, it should be coated with the carbolic acid. Vessels too large to be secured by torsion should be tied with catgut ligatures. Into all wounds deep enough to admit one a carbolized drainage tube should be introduced, to facilitate the escape of the secretions. Where sutures are needed, those of carbolized catgut or wire should be used; the parts about the wound being well cleansed with carbolic lotion, the protective is cut large enough to extend a little beyond the edges of the wound and adapted. Much confusion of opinion exists as to the object of the protective. It is not a protection against putrefaction, but against the irritative action on the edges of the wound of the carbolic acid in the gauze dressing which is placed over it. The dressing is usually applied in folds of eight thicknesses, and between the two outer folds is placed a piece of mackintosh cloth with its waterproof side toward the wound; the object of this is to arrest any discharge that may penetrate through the layers of gauze between the mackintosh and the wound, and which but for its interposition would pass through the last layer of the gauze, and, having exhausted the antiseptic in it, would soon putrefy; when arranged in the manner described, the discharge is compelled to traverse the extent of the mackintosh between the central point, where it first impinges on it, and its edge, where the discharge can first come in contact with the elements of putrefaction. Before it reaches that point the dressing should of course be changed; the frequency with which this should be done is determined by the amount of discharge. Immediately after operations, or when a profuse discharge exists from any cause, it should be changed every twenty-four hours, and the intervals should be gradually extended to two, four, six, or even eight days as the discharge diminishes. The gauze dressing with its mackintosh should always extend several inches around the wound; in amputations it should envelop the stump, be folded over it, and secured with bandages of the same carbolized material.

It may be asked, Why the carbolized gauze particularly? Why is not a dressing well saturated with carbolized oil or carbolized glycerine equally effective? In a slight case, with little or no discharge and with frequent dressings, this might answer; but if the discharge be at all considerable, the volatile antiseptic is soon absorbed or dissipated, and the discharge putrefies; the resin with which the gauze is prepared holds the carbolic acid for a long time and gives it off slowly; but without the mackintosh to prevent the discharge penetrating directly through the dressing, the gauze would be little better than any other carbolized dressing.

At each changing of the dressings the spray should be directed on the edge of the gauze as soon as it is exposed by the cutting of the bandages, and on the wound as the gauze is raised from it; the protective is

removed, the wound washed in carbolic solution 1 to 40, drainage tubes, if there are any, taken out and washed in the same solution, replaced, new protective applied, and then a fresh gauze dressing. In all cases in which the gauze dressing has been made up for a long time beforehand, it is a wise precaution to place over the protective a fold or two of gauze wet in the carbolic lotion, for the dry gauze gives off the carbolic acid too slowly to destroy immediately any germs that may have fallen on it; the wetting of the inner layer of the gauze with the spray or lotion answers the same purpose.

At first glance Lister's system, with its necessary spray, gauze, mackintosh, and protective, may appear troublesome and expensive, but to one who continues to observe a large number of cases for a length of time it soon becomes evident that with the exception of the spray, which requires the aid of another assistant, for which duty the nurse or frequently even the patient will answer, there is but little more time or trouble required than for water dressings. As shown by the reports of the cases, the interval between the dressings is much longer, so that taking the whole duration of a case there is actually a saving of time, and the same rule will apply to the cost of the dressings.

The same piece of mackintosh may be used for many dressings if sponged over with carbolic lotion before being reapplied. It is well to provide two pieces for each case, so that the dressings may be prepared beforehand; it should not be forgotten that its action is not antiseptic in itself, but simply mechanical. The dressing should always be changed on the day following the operation, as the irritant action of the carbolic spray and lotion on the wound during the operation is followed by a free serous exudation, so that twenty-four hours after an operation performed under the antiseptic method the sanious discharge on the dressings will be much greater than under the ordinary method; but after the first day this rapidly diminishes, so that at the end of a week in favorable cases the dressings are hardly stained, and a stump or other extensive wound may heal without the formation of a single drop of pus. A few cases to illustrate these points will serve as well as a large number.

W. N. Adult. Amputation of fore-arm for caries of wrist. Patient phthisical and a bad subject generally, but he began to improve after the operation on February 11th. The dressings were changed February 12th, 15th, and 22d, and removed February 29th; the wound was really healed February 22d.

J. B. Adult man. Received severe injury necessitating Syme's amputation February 9th. Dressings changed February 10th, 12th, 15th, 20th, 27th, and March 6th, and 15th.

These wounds healed without the formation of a drop of pus or disturbance of any kind; they are not selected cases, but with another

similar one comprised all the capital amputations in Lister's wards at the time referred to.

The treatment of abscesses by the antiseptic method gives very satisfactory results. Mr. Lister and others believe that the suppuration in an abscess before it is opened is maintained by the stimulation of the pyogenic membrane by the pent-up pus, of which a good evidence is the force with which the pus escapes when the abscess is opened, and afterwards by the admission of septic germs into the cavity, causing putrefaction of the remaining pus and stimulation of the pyogenic membrane to increased secretion, which is continued for a long time under the ordinary treatment by poultices, water dressings, etc. In large abscesses this constant formation of pus gives rise to serious constitutional symptoms, which are avoided if the abscess be opened antiseptically, and if all the pus be pressed out at the time of incision, none will be found at the next dressing; as a matter of fact, however, a few drops of pus that have remained in the abscess will be found on the next dressings, which will be succeeded by a thin serous discharge that steadily diminishes, the abscess healing fast. It is not only in so-called cold abscesses that this favorable progress is witnessed; it is still more strikingly seen in abscesses connected with bone caries. Late researches tend to establish the theory that caries is the result rather than the cause of suppuration, and that if the accumulated pus be removed, without the supervention of the irritant action set up by putrefaction, the diseased bone is placed under the most favorable conditions possible for repair. The rapidity with which large psoas and spinal abscesses will heal when treated antiseptically could hardly be realized by any one who has not seen such cases.

The severe constitutional symptoms that attend putrefactive suppuration of the joints are almost wholly avoided by this treatment. It was very instructive to witness the difference in progress between two cases of acute abscess of the hip-joint in women with histories as much alike in all respects as two cases could be up to the time of their admission to the hospital, just previous to which the abscess of one had been opened without antiseptic precautions, the other antiseptically. In the former case there was free suppuration with putrefaction, caries, necrosis, and great constitutional disturbance. Excision of the head of the femur became necessary, and slow and imperfect recovery followed, with ankylosis, shortening, and a very imperfect limb. In the case treated antiseptically little or no pus was formed after the first evacuation, there was but slight inflammation, and no constitutional disturbance; the wound gradually filled with healthy granulations, and the patient was discharged with a freely movable joint.

When abscesses or bursæ connected with joints are opened and treated antiseptically, their rapid progress towards cure is very gratify-

ing, and the same favorable conditions attend the antiseptic treatment of chronic diseases of the joints. In gelatinous degeneration of the knee-joint and kindred affections, Mr. Lister does not hesitate to make free incisions into the joints, and the contained pus being evacuated no more is formed. It is a very striking thing to see joints into which extensive incisions have been made, and in which the space usually occupied by sloughing, putrid material is filled with a clean, healthy growth. I had an opportunity of seeing three such cases at one time in Mr. Lister's wards, and the absence of constitutional symptoms and the clean appearance of the wounds were very marked. A special point in the treatment of abscesses and affections in which cavities exist is that they are not to be syringed out except for special reasons, for the violent introduction of the irritant antiseptic into the cavity acts as an abnormal stimulant, and is wholly unnecessary, as the spray and dressings over the abscess purify the air that passes through them to its interior. The free evacuation of the pus from the abscess at once is a great improvement on the trocar, and in most cases on the aspirator, for the latter frequently does not prevent putrefaction with all its attendant evils, because if the smallest quantity of pus remains in the cavity it is very apt to decompose.

The dangers of all operations involving the joints seem to disappear in a great measure before the antiseptic treatment, and thus possibilities of conservative surgery are opened up to the surgeon that would otherwise be denied to him. A case in illustration of this was that of a man who lost the use of his arm from the impaired motion of the elbow, apparently from the growth of an exostosis into the joint; the latter was freely opened, and some two hundred pieces of loose cartilage were removed from between the bones forming the articulation; the dressing was changed daily for the first three days, on account of the free sanious discharge, and then at intervals of three, four, five, and six days. The patient was discharged at the end of three weeks, with the wound healed and perfect motion in the joint. The same favorable results attend the treatment of compound fractures, even where joints are implicated, as well as all operations on bones, Mr. Lister having had some very striking and happy results in both classes of cases. In nearly all cases of compound fracture from accident, and indeed in nearly all accidental wounds, there is ample opportunity between the time of infliction of the injury and the time of the patient's coming into the hands of the surgeon for the introduction of septic elements into the wound, and these, if not destroyed, will render all subsequent antiseptic treatment futile. Such cases are treated by syringing the cavity of the wound and thoroughly washing its surface with 1 to 40 carbolic solution. In deep, irregular, and sinuous wounds the syringing is best done by introducing a catheter into the recesses and sinuses, forcing the solution through it, and afterwards dressing under the spray as usual.

The inquiry may arise here, Why not dress all cases in the same way after an operation is concluded? Why will not the thorough washing of the wound with carbolic solution just before the application of the dressings be effectual, thus dispensing with the inconvenience of the spray? For two very good reasons: first, because such washing and syringing is not always effectual in preventing putrefaction, since, however thoroughly it may be done, cases may occur in which the deepest recesses of the wound into which the septic elements would readily find their way may not be reached by the antiseptic, and because during the time that elapsed between the infliction of the injury and the application of the antiseptic the elements of putrefaction may be taken up by the absorbents or otherwise introduced into the tissues beyond the reach of the agent, so that occasionally cases so treated do become putrid; secondly, because the violent syringing and washing with a strong solution introduces the element of irritation to a much greater degree than when the spray is used, and the avoidance of irritation is an essential point in the healing of wounds.

Expecting the antiseptic treatment to do too much is a source of disappointment to those who have not properly studied its principles: for example, using it in cases where the wound is already putrid, as in chronic abscesses, diseases of the joints with putrid sinuses communicating with the air, etc. So long as such cases remain septic they cannot derive any benefit from the antiseptic treatment, which *prevents* putrefaction in *aseptic* or non-putrefying wounds, but cannot change a putrid wound into an aseptic one, any more than a flask of milk, meat juice, or urine that had putrefied would be restored to the same condition as when fresh by the addition of an antiseptic atmosphere; but in the case of both the wound and the contents of the flask the protection of the same atmosphere from the first would have prevented putrefaction. On account of the vital processes going on in a wound, a septic wound may, however, occasionally be changed to an aseptic one by freely applying a solution of chloride of zinc (forty grains to one ounce) by syringe and catheter to the sinuses and deep recesses of the wound, as well as to the more superficial parts; this destroys the putrescent elements in the wound, they are thrown off, and it may thenceforward be treated antiseptically. Even when the chloride of zinc fails to render the wound aseptic, it is of great value in preventing suppuration and absorption of putrefactive products for some days, or until granulation becomes established; this is in accordance with a generally recognized surgical principle, that a healthy granulating surface presents the best known obstacle to the absorption of the noxious products of a putrefying wound; thus in extensive operations, especially about the joints, the use of the chloride of zinc saves much constitutional trouble at a critical time.

The use of the catgut ligature is an essential feature of the antiseptic treatment. Of the advantages of a ligature that can be cut short in the wound without exciting suppuration it is hardly necessary to speak. In the ordinary process of tying an artery the inner and middle coats are ruptured to a greater or less extent, and the remaining substance of the artery is so pinched up that much of it becomes practically dead tissue, which after a time breaks down into pus and allows the ligature to come away. If the artery in the vicinity of the ligature is plugged with a firm coagulum before this occurs there is no hæmorrhage; but if from any cause, as, for example, the starting of a large branch from near the point of tying, so that the constant current prevents coagulation, or the existence of degeneration in the wall of the vessel, the formation and attachment of a healthy thrombus is prevented, hæmorrhage will occur, and this is what happens too often with the silk ligature; the elements of putrefaction are carried in the interstices of its fibres to the dead tissue of the constricted artery, which is contaminated by them, putrefaction and suppuration are set up and maintained by the irritation of the septic ligature, and the vessel in its vicinity becomes an imperfect structure incapable of withstanding the cardiac impulse; besides this the existence of an external wound during the time necessary for the separation of the ligature delays the cure, and is an element of danger to the patient in exposing him to erysipelas, hospital gangrene, and pyæmia.

Even if the silk be carbolyzed and cut short in the wound, and the possibility of the introduction of septic germs be prevented by the antiseptic treatment, yet the remains of the silk, which are but imperfectly absorbed, may excite suppuration and all its attendant evils. The use of the catgut ligature has been sufficiently extensive to justify the most favorable opinions of it, and also to teach us its *modus operandi*. If any artery that has been tied with catgut under the antiseptic treatment be dissected out with the neighboring parts a month after the operation, it will be found that the ligature has become almost an integral part of the tissues, having become infiltrated with fibro-plastic elements organized and incorporated with the *adventitia* of the vessel, so that instead of acting as an irritant foreign body and an element of weakness it is a source of support to the weakened vessel by surrounding it with a band of living tissue, the change occurring here being similar to what takes place frequently in wounds treated under the antiseptic system, where the original blood clot formed in the wound, instead of breaking down into pus as usual, is actually transformed into organized vascular tissue, furnishing strong evidence of the superior reparative powers displayed by wounds treated in this way.

The advantages claimed for the antiseptic treatment of wounds by Lister's system may be briefly reviewed as follows:—

(1.) The individual wounds so treated are placed in the most favorable condition possible for rapid healing by the exclusion of the elements of putrefaction, with the consequent irritation and suppuration ; and the chances of the infection of the patient with erysipelas, hospital gangrene, pyæmia, and septicæmia from his wound are infinitely lessened.

(2.) Its influence in preventing the occurrence of the above-named hospital diseases where patients are congregated together, as in a ward, by checking the development of the *contagium* of these diseases in wounds which would surely be putrefactive under other treatment, and the infection by it of other wounds in the vicinity.

It must be borne in mind that the simple application of an antiseptic to the wound does not secure this result. On the contrary it may act injuriously by delaying the healing, but a treatment is required which will prevent putrefaction without the contact of an irritant agent to the injured tissues ; and there is little doubt that those who use Lister's system understandingly, and with a proper attention to necessary but not difficult details, will find that the results will exceed their anticipations.

OVARIOTOMY.

BY DAVID W. CHEEVER, M. D.

CASE XIII. Mrs. —, fifty-one years of age, and the mother of four children, was of spare habit and nervous temperament. She had long been a sufferer from dyspepsia and from hæmorrhoids, with frequent losses of blood. For four years she had been conscious of some abdominal trouble. In June, 1876, when I saw her, she was quite oppressed by a swelling which was oval, smooth, and fluctuating, and filled the abdomen. The swelling was evidently cystic, and could be moved from side to side. The uterus was natural, and free from adhesions. The breathing and digestion were seriously interfered with, the facial veins distended, locomotion quickly exhausting her. The diagnosis of a unilocular ovarian cyst, non-adherent, was made, and an operation to remove it was advised. For three months previous the patient had been taking a saturated solution of chlorate of potash, under a physician's care. The tumor had not been reduced. The patient was so feeble and the weather so warm that a preliminary tapping was recommended, as in Case XII., last reported.

It was hoped that this might afford her a respite through the summer, and give her time and digestive power to regain strength. She was accordingly tapped, and sixteen pints of ropy fluid were withdrawn. The tumor wholly disappeared. She was prevented from getting out of bed for a week. Soon afterwards she went to the sea-side, and was especially cautioned against riding, jolting, traveling, or using in any