

answers the same purpose as the chloride of zinc solution, while it causes no pain.

*Carbolised cotton wool* is used in some cases of gangrene. It is obtained by soaking pure cotton wool in a 1 per cent. solution of carbolic acid in ether. The cotton is then dried and used immediately.

## CHAPTER IV.

ASEPTIC SURGERY (*continued*).

Example of an aseptic operation: Purification of the skin—Fingers—Instruments: Spray—Precautions—Probable errors, and mode of remedying them: Guard: Ligature of arteries: Drainage of wounds—India-rubber tubes—Catgut drains—Horse hair—Decalcified bone tubes (Neuber's and MacEwen's): Sutures: Button stitches—Stitches of relaxation—Stitches of coaptation—Aseptic strapping—Protective: Deep dressing: Loose gauze: Gauze dressing: Elastic bandage. CHANGING THE DRESSINGS—Time—Method. TREATMENT OF ULCERS: Purification of the sore: Boracic dressing: Boracic and salicylic ointment: Boracic poultice.

HAVING described the materials employed in aseptic surgery, we must now consider how they may best be employed. Take as an example of an operation the removal of a fatty tumour.

The patient having been brought under the influence of chloroform or other anæsthetic, the skin over the tumour, and for some distance in the vicinity, is thoroughly purified from any active dust by washing it well with a solution of carbolic acid 1-20. The surgeon and his assistants also wash their hands in 1-40 carbolic lotion, while the instruments are put to soak in 1-20. A towel is arranged close to the tumour, generally on the part of the table between the operator and the patient, which towel has been well soaked in 1-20 carbolic lotion, and is meant as an antiseptic basis on which instruments may be laid during the course of the operation without any fear of their contamination. This towel is so arranged as to be within the cloud of spray. A spray being now made to play over the part from a convenient distance, the surgeon makes his incisions, removes the tumour, ties the vessels with catgut, introduces a suitable drain, stitches up the wound, and applies a piece of protective but little larger than the wound—the protective being of course dipped in the 1-40 carbolic solution.



Outside this is applied a piece of wet gauze, consisting of several layers of loose gauze which has been soaking for some time in the 1-40 carbolic solution. This wet gauze and protective are called the *deep dressing*. The wet gauze must overlap the protective in all directions. Then any remaining hollow is filled up with loose gauze, and outside the whole a gauze dressing is fixed. This dressing consists of a piece of carbolic gauze of suitable size, folded in eight layers, and having the macintosh placed beneath the outermost layer, with the india-rubber side inwards. The dressing is fixed by means of a bandage, and when this is accomplished the spray may be stopped. Then around the edge of the dressing an elastic bandage is applied so as to keep the edge constantly in contact with the body, and to allow no interval to occur between the dressing and the skin during the movements of the patient. The elastic is carefully fixed to the edge of the dressing by means of safety pins.

In the after progress of the case the dressing is changed according to the amount of discharge, though in no instance is it left longer than eight days.

Such is, very briefly, a sketch of the ordinary method of performing operations aseptically. I shall now consider each step in detail, and point out the most frequent sources of failure in carrying out the method; for it must always be borne in mind that the whole operation, as far as regards the avoidance of putrefaction, requires as much care as if it were an experiment performed in a laboratory on putrescible fluid contained in glass vessels.

The first thing, then, is to purify the skin in the neighbourhood of the seat of operation. This is necessary, because the skin is covered with dust. The natural grease of the skin is not easily removed by simple washing, and it protects the septic particles present beneath it and in the hair or sebaceous follicles. This purification of the skin is carried out by washing it well with 1-20 carbolic lotion, the antiseptic being allowed to act for some little time. It is well, having first washed the neighbourhood thoroughly, to apply over the seat of operation a large rag or towel soaked in 1-20 solution, and to allow this to remain on the part for some minutes. Where the epidermis

is thick, or where there is any putrid matter present, it is best to apply this towel about half-an-hour before the operation. It is not necessary to wash the skin with soap and water, or with alcohol or ether, as is often done in Germany. The carbolic acid has a wonderful power of penetrating grease or epidermis; and if time be given for it to act it is unnecessary to wash off the grease beforehand. If the wound is to be in the neighbourhood of hair, as in the axilla or near the pubis, the part must be shaved, and then well soaked with the carbolic lotion.

The errors in the purification of the part may be that the skin is not purified at all, or that it is washed with water; or, as I have seen, the operator simply allows a carbolic spray to play over it for a minute or two, and is satisfied with this; or he merely rubs the surface with his wet finger. This purification must, however, be done thoroughly, for every hair follicle and gland duct may contain causes of putrefaction. Carbolic oil is used by some instead of the watery solution to purify the skin. This is a great mistake, for oil has a much greater affinity for carbolic acid than water has, and therefore the carbolic acid in the oily solution does not act with the same rapidity as the watery solution. Thus 1-20 or even 1-10 carbolic oil is not nearly so useful for producing an instantaneous effect as 1-20 carbolic lotion.

At the same time the operator and his assistants purify their hands. This must also be done thoroughly, and the folds of skin about the nail more especially must be well cleansed with the lotion. In an important operation, as in an operation on a joint, it is well to use 1-20 carbolic lotion for this purpose, so as to avoid any chance of a lurking particle; but in ordinary operations 1-40 is quite sufficient. This purification of the hands is only too apt to be a sham, no care being taken about the nails and folds of skin. The 1-20 is not used in all cases, because 1-40 is really sufficient, and the stronger solution is apt to benumb the hand.

The instruments are purified by immersion in 1-20 carbolic lotion before the operation. A tin or porcelain trough filled with the 1-20 solution is employed for this purpose, the instruments being placed in it some time before an operation (Fig. 22). The instruments are not merely dipped; they must remain in



the lotion for some time, because the carbolic acid requires a little time to act on the grease or dirt on them. For the same reason the teeth of toothed instruments ought to be cleaned thoroughly, and forceps locking by catches ought to be widely opened, so as to allow the solution to come in contact with all parts. The whole instrument must be immersed, for if only the point be purified it may happen that the impure handle is inadvertently brought into contact with the wound during the course of the operation.

The errors most likely to occur are either that during the course of the operation an instrument not previously in the tray is used without any attempt at purification, or that the instrument is imperfectly purified or only part of it cleansed. I have seen the danger of partial purification more than once exem-

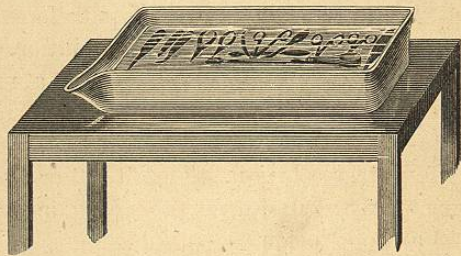


FIG. 22.—PORCELAIN TROUGH CONTAINING INSTRUMENTS SOAKING IN CARBOLIC LOTION.

plified. Thus I have seen the blade of a knife alone purified, and the surgeon in the middle of the operation use the unclean handle to separate the tissues. Other errors in the manipulation of instruments will be referred to presently.

The spray is very important in many cases, for it provides an atmosphere in which instruments, &c., may be kept without danger of contamination. In order to have a wide and large antiseptic area in which to work, the spray ought not to be too near, about six or eight feet or more being a suitable distance for a good spray. Care must be taken that the spray is not blown off the part by draughts or by people moving about. The spray is most necessary in opening abscesses or in stitching up wounds, for, to take the latter case, as the wound is not syringed

out after the stitches are inserted, septic air may be inclosed in the cavity of the wound, and may give rise to putrefaction if

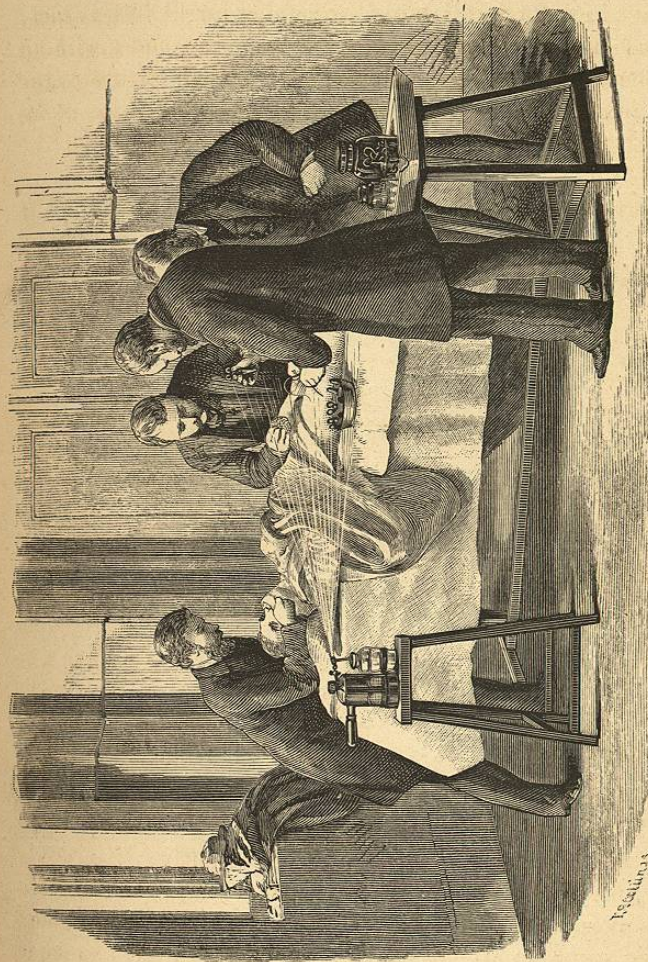


FIG. 23.

This figure represents the general arrangement of surgeon, assistants, towels, spray, &c., in an operation performed with complete aseptic precautions. The distance of the spray from the wound, the arrangement of the wet towels, the position of the trough containing the instruments, the position of the small dish with the lotion, the position of the house surgeon and dresser, so that the former always has his hands in the cloud of the spray, and the latter hands the instruments into the spray and various other points, are shown.

the spray has not been playing over the wound while the stitches were being introduced.

During the course of an operation any instrument which has been once purified, if kept in the spray, even though covered with blood, remains pure, and may be introduced into the



wound without hesitation. The same is the case with the hands of the operator or assistants; and therefore the dresser, in handing instruments to the surgeon, *must hand them into the spray* (Fig. 23). If in the course of the operation the surgeon reaches his hand or an instrument out of the spray for any reason whatever, it must be repurified before being put into the wound. For this purpose there is generally a

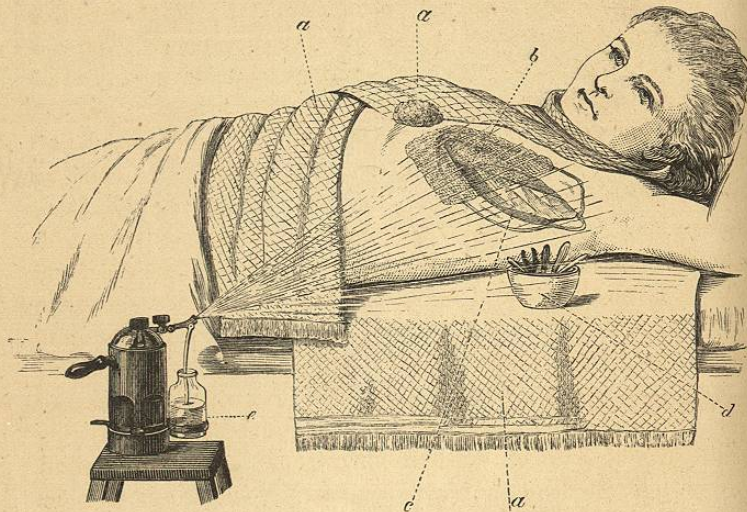


FIG. 24.—TO SHOW THE ARRANGEMENT OF TOWELS, ETC., IN A LARGE OPERATION.

*a a a* Are three towels which have been soaked in 1-20 carbolic lotion, so that instruments, &c. may be placed on them without fear of contamination. Thus a small sponge will be seen on the upper one. *d* is the dish containing 1-40 carbolic lotion which always stands before the operator, and in the line of the spray. In this he places the instruments which are not being used, and in it he repurifies his hands or instruments if they have been removed from the cloud of spray. In this particular instance we have a large wound to deal with—one so large that a single spray, unless of large volume, may not cover it completely. Hence a piece of *guard* soaked in carbolic lotion is thrown over the front of the wound while the surgeon is attending to the axillary part, or *vice versa*.

basin of 1-40 carbolic lotion placed close to the operator in the line of the spray, in which fingers, instruments, &c., may be re-purified by momentary dipping. When instruments are laid down out of the spray, or, in the spray, on a blanket, they must be repurified before being used again. To provide a basis on which instruments may be laid, the carbolised towel is arranged before the operator as formerly described, and the blankets in the neighbourhood are generally also covered up

with wet towels, so as to avoid the chance of the instruments being laid on the blankets (see Fig. 24). Should the operator, during the course of an operation, wipe his hands in a dry towel, or touch any unpurified substance, he must remember to wash his hands in 1-40 carbolic lotion before re-introducing them into the wound.

These precautions seem on the one hand self-evident, while on the other they seem so burdensome to remember that they are often neglected by self-sufficient surgeons. And yet it is by the neglect of these, rather than by error in any other part of the Listerian method, that mistakes arise and failures occur. Many people think that the spray is the essential part of the treatment, and neglect the precautions as to constant purification of instruments, &c., and when their cases go wrong they say that the principle is incorrect. And yet one thoroughly acquainted with the Listerian method will readily detect the loopholes, and the general loophole is the omission of some of the precautions with regard to purification of fingers, instruments, &c. Thus I have seen a surgeon with considerable experience in aseptic treatment, during the course of a difficult operation wipe his hands with a dry towel and immediately introduce them, covered with the dust from the towel, into the wound. The patient died of septic poisoning. Now many surgeons might have said, 'I used the spray; I used all precautions; my instruments were soaking; my hands were purified;' forgetting this one little incident. When the point was mentioned, however, the mistake was at once seen. People are too apt to trust to the spray as sufficient, and to speak of aseptic or Listerian surgery as treatment by the spray. This is a great and often fatal mistake. Of all the precautions required by Mr. Lister, that of purifying the air by means of a carbolic acid spray is the least necessary, for there are but few septic particles present in the atmosphere, and even though some of them fall on to a wound they may be rendered inert by washing the wound with carbolic lotion. It must always be remembered that Mr. Lister carried out aseptic treatment for years with great success without any spray; and if at the present time he were compelled for any reason to give up some one precaution, he would at once throw aside the spray, as that one which is least



necessary, and which could be the most readily dispensed with. At the same time, the spray is an immense convenience in many cases, more especially in abscesses, empyemata, in stitching up wounds, &c.; and it saves the necessity of applying a great deal of carbolic acid to wounds by irrigating them, with the consequent irritation and risk of carbolic acid poisoning.

To return to the errors which may arise in this part of the treatment. It may be that the spray is too near, and that thus the cloud is so narrow that the surgeon is constantly getting his hands or his instruments out of it, and forgetting to re-purify them. There are other disadvantages when the spray is too near. Thus it is very wetting, and the hands of the surgeon and the wound are unnecessarily irritated by the carbolic acid. If too near, the opaque spray also obscures the field of vision. On the other hand, where the spray is visible, it may be sufficiently trusted. Other sources of error are that instruments may be used which have never been purified, which have been only imperfectly purified, which have after their use lain about outside the spray or on blankets, &c.; or it may be that the carbolic acid gets exhausted in the spray bottle, or that for some other reason the spray does not act properly.

What is to be done should any of these accidents occur? Suppose that an impure instrument or finger be introduced into the wound, that wound must be at once thoroughly washed out with 1-40 carbolic lotion. This is a bad thing for the wound, because it irritates it, and may prevent healing by first intention; or it may, by causing a much larger quantity of discharge than usual, so saturate the gauze dressing as to render it unable to prevent the spread of putrefaction inwards. Therefore it is better to use the spray, and to take all the precautions before mentioned. Should the spray stop, the wound must be washed out just as in the former case, and then, till the spray can be set agoing again, the wound is covered with a piece of rag soaked in carbolic lotion.

This piece of rag, called the guard, ought to be always present in the basin by the side of the surgeon, and when there is any indication that the spray is failing, or should it be advisable to stop the spray for any reason, this is thrown over the wound for the time being. Should any time elapse before the

spray is again ready for use, this guard must be repeatedly moistened with carbolic acid lotion 1-40.

Where the wound is very large it may be protected during the operation either by having two sprays, or by covering up the part of the wound which is not being operated upon by a guard (see Fig. 24).

The arteries are ligatured with catgut. This catgut is generally employed of three different sizes. The largest is used only for large vessels or for stitches; the medium for medium-sized vessels, or for vessels in inflamed or dense tissues where considerable force is required to constrict the vessel, or for stitches; the small or fine catgut is that ordinarily employed

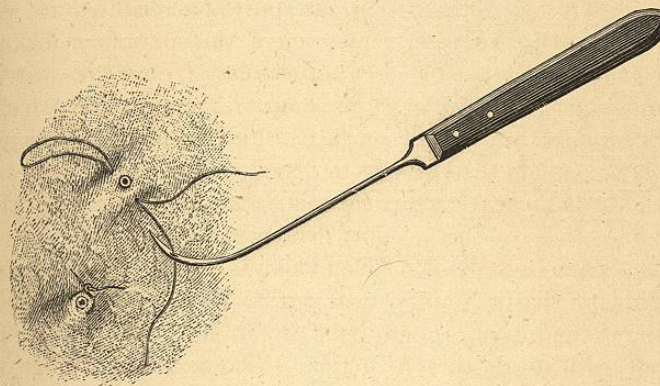


FIG. 25a.—METHOD OF TYING VESSELS IN DENSE TISSUES.  
(After MacCormac.)

for the smaller vessels. The vessel having been securely tied, the catgut is cut short and gives no more trouble. It is well to tie all the visible bleeding points, because a little oozing of blood may give trouble afterwards from tension. If the vessel be situated in dense tissue, so that a ligature cannot be applied around it, a needle carrying a double catgut thread should be passed through the tissue and tied on each side of the vessel (see Figs. 25a and 25b). The catgut should be taken direct from the trough containing carbolic oil, and should not be wetted in the lotion. Where the bleeding is from a tear in a large vein, and where it would be dangerous to ligature the



vessel, I have seen the following method adopted by Mr. Lister:—In removing some cancerous glands from the axilla, a small vein was torn away from the axillary vein at their junction, making practically a longitudinal rent in the axillary vein. Taking a fine curved needle and the finest catgut, he stitched up the rent by the glover's suture. The patient recovered without the slightest bad symptom. There was no pain in the wound, nor swelling of the arm, &c. In another case, where the longitudinal sinus was injured in trephining the skull, the wound was plugged with catgut, and the patient recovered without any untoward symptom.

The drainage of an aseptic wound is the point next in importance to keeping the wound aseptic. For if the blood and

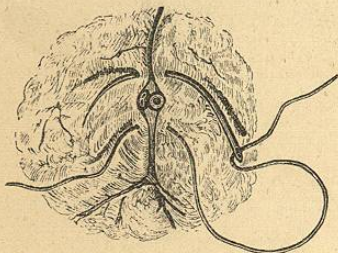


FIG. 25*b*.—ANOTHER METHOD OF TYING VESSELS IN DENSE TISSUES. (From Esmarch.)

serum which collect in the interior of the wound within the first twenty-four or forty-eight hours do not get free exit, they give rise to tension, and tension gives rise to inflammation, and the latter, if allowed to go on long enough, to suppuration; and thus the rapid healing of the wound is prevented, though the patient is not as a rule subjected to any danger to life. To avoid these consequences Mr. Lister has paid very special attention to the drainage of wounds. There are two main ways in which this may be done—drainage through tubes, or drainage by capillarity. The former is the most universally applicable and the most certainly successful.

Drainage by means of tubes is that first used by Mr. Lister, and, as just stated, is the form of drainage which is most universally applicable. The tubes generally employed are the india-rubber tubes introduced by Chassaignac, though of late the kind of rubber has been altered, that now used being red rubber, which contains no free sulphur. By the use of these red rubber tubes disagreeable smells and blackening of the protective, which often occurred when the black tubes containing free sulphur were employed, are avoided. These tubes have round holes cut in them at short intervals, the diameter of each

hole being about one-third of the circumference of the tube. At the outer end the tubes are cut flush with the surface of the skin—straight across if the tube goes directly downwards, or with varying degrees of obliquity according to the direction

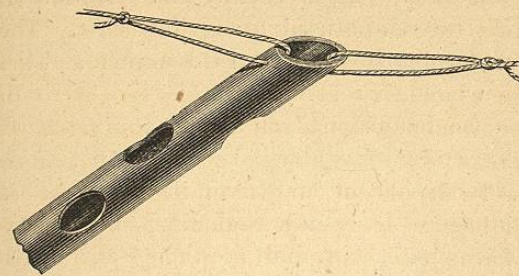


FIG. 26.—ORDINARY OBLIQUE-ENDED DRAINAGE-TUBE READY FOR USE.

which the tube takes (Fig. 26). The tube must not project beyond the surface, for if it does, its orifice gets compressed by the dressing, and the exit of fluid is prevented. To keep the drainage tube from slipping in, two threads of carbolised silk are

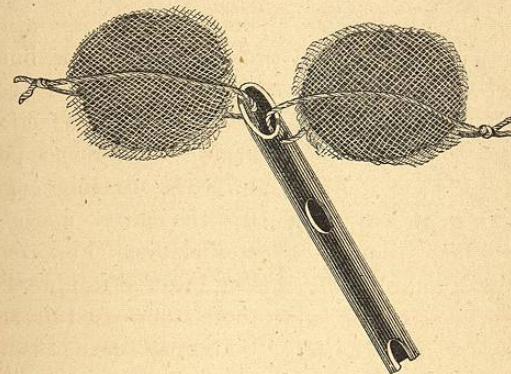


FIG. 27.—DRAINAGE-TUBE WITH MASSES OF GAUZE IN THE LOOPS OF THREAD.

fastened into it at its orifice, and tied in a knot. This knot, held between the dressing and the skin, retains the tube in position. In some cases, however—as for example, in empyema—the tube might slip in in spite of these threads, and therefore it is well to fill up the loops with strips of gauze soaked in the

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FAC. MED. UANL