AN ADDRESS

ON THE

ANTISEPTIC MANAGEMENT OF WOUNDS.

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(Concluded from page 278.)

AN external antiseptic dressing, to be ideally perfect, should have four essential qualities. It should contain some thoroughly trustworthy antiseptic ingredient; it should have that substance so stored up that it cannot be dissipated to a dangerous degree before the dressing is changed; it should be entirely unirritating; and it should be capable of freely absorbing any blood and serum that may ooze from the wound.

The carbolic gauze which we formerly used did, indeed, contain a very efficient antiseptic; but this, being volatile, was perpetually flying off in spite of our endeavours to fix it, and it was a matter of uncertainty in how many days it might have so far disappeared from the dressing as to leave it untrustworthy. Carbolic acid had also this disadvantage as an element of an external dressing that, acting, as we have seen, with peculiar energy on the epidermis, it interfered seriously with cicatrization, and we were obliged to interpose what we termed a "protective" to shield the healing wound from its action. And this gauze, containing resin for the purpose of fixing the carbolic acid, was not a very good absorber of blood and serum. Carbolic gauze, then, was not an ideally perfect dressing.

Corrosive sublimate had the advantage over carbolic acid of not being volatile. But it was readily washed out of gauze or wool charged with it, and under some circumstances it proved very irritating. The discharge, passing from one part of the dressing to another, took up more and more of the bichloride in its passage, and sometimes became so strong a solution of the salt as to cause vesication. I endeavoured to remedy these defects by combining the bichloride with the albumen of the serum of horse's blood.⁵ But though the sero-sublimate gauze answered its purpose, in so far that it contained the bichloride better stored up and in a less irritating form, it had inconveniences, especially as regards its preparation, which induced me to abandon it.

The agent which we have found the most satisfactory as the antiseptic ingredient of the dressing is the double cyanide of mercury and zinc.⁶ Cyanide of mercury, while it has powerful antiseptic properties, is very soluble and highly irritating; but the combination of cyanide of zinc with it has the same sort of effect, but in a much higher degree, as the albumen of the sero-sublimate gauze had upon the bichloride. The combination with zinc keeps the cyanide of mercury from being dissolved away, and also prevents it from irritating. It is, so to speak, chained down by the cyanide of zinc with which it is combined. The double salt is very little soluble in blood serum, requiring between two and three thousand parts to dissolve it; and thus a small quantity of it will last a long time in spite of a free flow of discharge through it. It thus fulfils the condition of persistent storage. It is at the same time practically unirritating; wounds heal under its immediate contact without the necessity for a protective layer interposed. Then, as to the essential question of its antiseptic virtues. Small as is the quantity which serum dissolves, it proves amply sufficient to prevent bacteric development. Thus in one experiment some serum of horse's blood containing $\frac{1}{1000}$ part of the salt remained clear and odourless for more than a fortnight at the temperature of the body in

spite of inoculation with putrid material, and even $\frac{1}{10000}$ part prevented all growth for ten days. When mixed with serum and corpuscles, it prevents putrefaction in smaller quantity than any other antiseptic with which I am acquainted. The greater the amount of albuminoid substances in any solution, the more severely is the antiseptic tested; and when the red corpuscles are mingled with the serum, as is the case in the first twenty-four hours after the infliction of a wound, a much larger amount of the antiseptic is needed than with serum only. Thus four times as much corrosive sublimate is required to prevent putrefaction in serum and corpuscles than in serum. Now, the double cyanide answers the purpose in half the quantity that is necessary with corrosive sublimate. As an illustration of the practical value of this material, I may mention a single experiment, not hitherto published. I packed a piece of glass tube with gauze charged with 3 per cent. of the double salt, and poured into it serum and corpuscles obtained by whipping pig's blood. I then inoculated one end of the saturated gauze with a drop of septic serum, and kept it at the temperature of the body, with provision for preventing evaporation. After the lapse of five days I found the entire mass of gauze pure in odour and without bacteric development, as tested by microscopic examination of stained cover-glass preparations of the contained blood. Meanwhile a piece of unprepared gauze similarly treated showed bacteric development within twenty-four hours.

But here I must remind you of the essential difference, which must always be kept in view in considering antiseptic agents, between germicidal and inhibitory power; that is to say, between the capability of destroying the life of microbes and that of preventing their growth while the agent remains in contact with them. These two properties are by no means similarly proportioned to each other in all antiseptics. Thus, cyanide of mercury is far superior to the bichloride in inhibitory power, but very inferior to it as a germicide. And the double cyanide of mercury and zinc, while admirable as an inhibitor, is very feeble as a germicide; so that we can have no security that materials charged with it may not contain living organisms. Hence if gauze charged with the double cyanide were applied dry to a wound, the time might come when, if the discharge were free, the salt, in spite of its slight solubility, might be all washed out of the deepest parts of the dressing; and as soon as this should be the case, living microbes contained in it would be free to develop towards the wound. In order to guard against this risk, we treat the gauze before using it with a reliable germicide. That which we now use for the purpose is the 1 to 20 solution of carbolic acid, which, besides being thoroughly effective, has the further advantage that it soon flies off from the dressing and leaves nothing in contact with the wound but the unirritating double cyanide and cotton fabric.

And now I wish to correct a mistake I made in a former publication. For the purpose of destroying any microbes that there might be in the gauze I recommended a solution of corrosive sublimate, 1 to 4,000. Now we have seen that the 1 to 4,000 sublimate lotion is not nearly so powerful as a germicide as we then supposed. But it further appears that such power as it possesses is almost entirely lost as soon as the bichloride comes in contact with the cyanide of mercury and zinc, when a curious soluble triple compound⁷ is formed which has extremely slight germicidal action.⁸ The triple salt seems also to be highly irritating; and thus, when we used the bichloride of mercury, we failed almost entirely to obtain the object for which we employed it, and at the same time lost some of the goodness of the double cyanide, part of which was washed out in the process, while the resulting solution might cause troublesome irritation. Soon after I first described this dressing, a surgeon at one of our hospitals came to me and said he had been using it, and found great inconvenience from it. He had applied it to a scalp wound, and the whole of the skin covered by the dressing was excoriated. I found he had applied it soaking wet with bichloride lotion, and we are now able to understand the irritation that resulted.

⁷ See Varet, *Comptes Rendus*, 1888, vol. cvi, p. 1080.⁸ For the determination of this fact I am indebted to my colleague, Professor Crookshank.

⁵ BRITISH MEDICAL JOURNAL, October 25th, 1884.
⁶ This is a double salt of a very peculiar constitution. It has been specially investigated by Professor Dunstan, who concludes that it has the following formula: $4 \text{ Zn Cy}_2, \text{Hg Cy}_2$. See *Trans. Chem. Soc.*, 1892 p. 666. The best way of preparing it was described by Professor Dunstan in the *Pharmaceutical Journal*, Third Series, vol. xx, No. 653.

It is quite unnecessary to have the gauze wet with the 1 to 20 carbolic lotion; mere dampness is sufficient. It may be conveniently moistened as follows: The gauze is commonly sold in pieces of three or six yards, folded lengthwise in eight layers. These are unrolled, and half the number to be moistened are sprinkled roughly with the lotion. The wet and dry pieces are then superposed alternately, and the whole rolled firmly together; and in a few minutes the entire mass will be uniformly damp. This may be done by a nurse, who then folds the gauze up in a piece of mackintosh cloth to prevent evaporation; and if the precaution is taken of turning over the edge of the jaconet so as to prevent the cotton from coming in contact with the gauze, and abstracting moisture by capillary attraction, it will remain damp for weeks together. Used in this way the double cyanide gauze may be absolutely trusted for excluding mischievous microbes; and we have seen that it contains the antiseptic element excellently stored up, and that it does not irritate; and when I add that it is all that can be desired in absorbing power, you will see that it approaches very closely to our ideal. And having now employed it constantly for over four years, both in hospital and in private practice, with thoroughly satisfactory results, I feel entire confidence in recommending it to you.

Here is a sample of the gauze ready for use. It is, you observe, of mauve colour, whereas the pure cyanide of mercury and zinc is a white impalpable powder. I have fully explained elsewhere the reasons for using a dye,⁹ but I may here shortly recapitulate them. When the pure salt is diffused in water, and a piece of gauze is charged by drawing it through the liquid and dried, it is found that the powder dusts out of the gauze on the slightest touch, and irritates the nostrils extremely. I first remedied this defect by means of starch; and having observed that starch in solution in water becomes attached to the particles of the double salt and completely precipitated with it, it occurred to me that perhaps some colouring matter might behave in the same manner as the starch, and that thus it might be possible to dye the colourless salt, and so have the means of judging, by the tint of the gauze charged with it, whether or not it was uniformly distributed in the fabric. I found on trial that various dyes did indeed behave as I hoped, including colouring matters so different as Prussian blue, logwood, and various aniline dyes. But, what I had not at all anticipated, it turned out that in the case of some of these dyes, when the coloured precipitate was diffused in water and the gauze was drawn through the mixture and dried, without the use of any starch, the objectionable dusting was avoided. The particles of dye, though in extremely small proportion to those of the salt, attached them, as it would appear, to the fabric.

When I last published on the subject,¹⁰ I recommended hæmatoxylin for this purpose. But I have since ascertained that the effect is produced still more satisfactorily by an aniline dye, the hydrochlorate of mauveine, known in commerce by the name of purified rosolane.¹¹ I have here a sample of the mauve-coloured powder, the dyed cyanide, as supplied by Messrs. Morson, of Southampton Row. For charging gauze it is diffused with pestle and mortar in 1 to 20 solution of carbolic acid in the proportion of about 30 grs. to a pint; and the gauze, which must be of thoroughly absorbent quality, is drawn, in a thickness of about eight layers, through the liquid, which is conveniently placed in a trough having a bar near its lower part, beneath which the gauze is made to pass, care being taken that the liquid is kept perpetually stirred to prevent precipitation of the salt. The gauze is then hung up to dry at the temperature of the air. The carbolic lotion is used in preference to water, both because the powder is very much more easily diffused in it and because it is desirable that any dirty material which the gauze may happen to contain may be sterilised. A very

cheap kind of carbolic acid will answer, and the solution that drains from the gauze when it is hung up may be used again for the same purpose. It thus scarcely adds to the expense of the preparation.

This is a very simple process. For a whole year I prepared my own gauze, for use in hospital as well as in private practice, before I had satisfied myself completely as to its value. For hospital use I would advise that the gauze should be prepared in the institution, so as to save the manufacturer's charges. In that case it may be taken down and wrapped in mackintosh when only partly dry, avoiding the trouble to the nurses in moistening it.

Gauze may also be easily charged at a few minutes' notice for emergency in private practice. I have here a 6-yd. piece of unprepared absorbent gauze folded lengthwise in eight layers. I soak this thoroughly with 1 to 20 carbolic lotion, and dust some of the powder roughly over one surface with a pepper-box. I then roll it together, and kneading it for a minute or two with the fingers, produce as you see a sufficiently uniform diffusion of the salt throughout the mass, as indicated by the colour.¹² If this were done by a nurse before the commencement of an operation, and the wet gauze were wrapped in a folded sheet to absorb redundant moisture, it would be ready for use when required. A 6-yd. piece would be an ample dressing for many cases. Now I see by the amount that has gone from the pepper-box that not more than one-fifth of an ounce has been used, and as Messrs. Morson supply the dyed cyanide at 20s. per lb., this implies a cost of only 3d., so that it cannot be regarded as expensive.¹³ If you have no absorbent gauze at your disposal, linen rags, which are excellent in absorbing quality, may be quite well charged in a similar manner. This old towel which has been so prepared, if folded a few times, would make a perfectly satisfactory dressing. Bandages which it is desirable to render efficiently antiseptic, such as one that is to be applied next the skin for keeping down the soft parts in a stump after amputation of the thigh, may be charged on the same principle.

When a free discharge is anticipated we apply a piece of thin mackintosh, sponged with carbolic lotion, over the exterior of the dressing, to prevent the blood and serum from passing directly through it. This arrangement no doubt interferes somewhat with the inspissation of the discharges by evaporation, but this is a matter of indifference when the dressings are efficiently antiseptic.

There is another use to which the dyed cyanide powder may be often advantageously put, namely, treating it with enough of the 1 to 20 carbolic lotion to make a sort of soft mud or cream which may be applied with a camel's hair brush to parts where there is very little space between the wound and some source of septic contamination. I have by this means been repeatedly able to avoid suppuration in the vicinity of the anus, as I otherwise might have failed to do. The store of the antiseptic salt upon the skin prevents the microbes from working their way into the wound under the narrow strip of dressing alone available. There are also situations, such as the pubes, where the cyanide cream applied to the hairs converts them with great advantage into a part of the antiseptic dressing.

I may be asked how it was that I obtained uniformly good results when I used corrosive sublimate solution for the purpose of producing a germicidal effect upon the gauze; for I do not exaggerate when I say that during nearly two years in which I followed this practice I did not meet with a septic failure when I had an unbroken skin to deal with and a fair field around for the dressing. This success was no doubt partly due to the slight solubility of the double salt preventing it from being washed out of the deeper parts of the gauze. But I attribute it also to another circumstance. I invariably washed a substantial mass of the gauze which was to be applied next the wound in 1 to 20 carbolic lotion, in order to get rid of the irritating bichloride which it contained. I thus—though unintentionally—effectually sterilised, not only this portion of the gauze, but also neighbouring parts into which the redundant carbolic liquid

⁹ BRITISH MEDICAL JOURNAL, January 4th, 1890. ¹⁰ *Vide loc. cit.*

¹¹ This dye may be obtained from Messrs. Meister, Luctus, and Brünig, of Höchst-on-Main. I may here publicly express my thanks to Mr. Perkin, to whom the world is indebted for the aniline dyes, for his kindness in ascertaining for me the chemical composition of rosolane. It is used in quantity equal to 1 per cent. of the weight of the double cyanide, and is applied in watery solution, in which the salt, after being freed from excess of cyanide of mercury by repeated washing, but before it has been dried, is thoroughly diffused by stirring. The salt as it precipitates carries the dye down with it, and is afterwards dried at a moderate temperature.

¹² A pair of leather gloves may be worn to avoid staining of the hands, or the dye may be washed from the fingers with spirit of wine.

¹³ I found on weighing this piece of gauze when it was dry that it was needlessly heavily charged, containing 7 per cent. of the salt instead of 3 per cent., which is that ordinarily used. Thus the salt required for such a dressing does not really cost 1½d.

soaked. And this mode of procedure, though not so perfect as the systematic moistening of the entire mass, is a rough-and-ready way of attaining much the same result.

In changing the dressings we make it an invariable rule to cover the wound with something reliably antiseptic before we wash surrounding impure parts, so as to avoid the chance of defiling the wound with them. For these washings we use the 1 to 40 carbolic lotion. As to the times for changing the dressings, it is no doubt true that that which is applied immediately after the operation might in most cases be left untouched for several days. Nevertheless when discharge is free, I prefer, as a rule, to remove the first dressing when the first twenty-four hours have passed. We thus get rid of the serum and corpuscles, which, while they constitute the largest amount of discharge which occurs in the case, test, as we have seen, our antiseptic dressings the most severely. The discharge being still moist near the wound at this period, the gauze is lifted from it without disturbing it in the slightest degree; and I never knew a patient fail to express himself as feeling more comfortable when the first dressing had been changed. There are, however, special cases, like a stump after amputation of the thigh, where an exception may be made on account of the disturbance of the wound that the changing of the dressing would involve.

In conclusion, I may remark that it pleases me, as the years pass, to see the hope which I expressed at the International Congress in London eleven years ago in course of fulfilment, namely, that the use of the antiseptic system would gradually spread by leavening action throughout the world. At the same time I am sorry sometimes to observe that unnecessary trouble is often taken in some directions while essential points are disregarded in others; so that, with the best intentions, the best results are not always obtained. I venture to hope that this address may be of some use to you in directing your attention to the essential conditions of success.

THE TREATMENT OF SEVERE CLUB-FOOT.¹

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At the outset I wish it to be understood that I do not admit anyone can hold more strongly than myself that all ordinary cases of club-foot (and, indeed, as a rule even severe degrees of the affection in the infant) can be and should be satisfactorily and effectually cured by gentle means, aided, if need be, by the simple procedure of division of tendons and tense fascial bands. But I have come to an equally strong opinion from what I venture to think has been a large experience of these deformities during my charge of the orthopædic department at St. Bartholomew's Hospital for the last ten years, that there are in older children many cases that cannot be so cured, and that even in infants cases, exceptional I admit, are at times met with in which we can venture to affirm from the first that without some bone operation a satisfactory condition will not be obtained. To the former part of this proposition—that for relapsed or untreated cases in older children—something more than mere tenotomies or the division of fasciæ with apparatus and orthopædic means may be required, I think all will agree. But to the latter part, that there are cases of club-foot in the infant that cannot be cured without sooner or later some bone operation, I imagine objections may be taken. The subject naturally divides itself into the treatment of severe cases of club-foot in the infant, and the treatment of uncured, the so-called relapsed, cases in older children.

I.—THE TREATMENT OF SEVERE CASES OF CLUB-FOOT IN THE INFANT.

The title of the discussion precludes mention of the treatment of ordinary and slight cases. It seems that almost any method, if perseveringly and properly carried out, will suffice in these for the perfect and absolute rectification of the foot.

¹ Read in the Section of Diseases of Children at the Annual Meeting of the British Medical Association held at Nottingham, July, 1892.

For severe cases almost every form of treatment and apparatus with which I am acquainted has been honestly tried in the orthopædic department, and I have come to the conclusion that on the whole there is nothing better than the plaster-of-paris method. The practice in the department has been to begin the treatment immediately after birth, and to endeavour, with as little delay as possible, to overcome the varus position and bring the foot in line with the leg, and then to divide the tendo Achillis, and to restore the foot at once, if practicable, to the normal position by what is known as the immediate method of rectification.

I rarely divide the tibial tendons, and agree with those who think that they have very little influence in the production of the deformity. I hold that, as of the peronei in flat-foot, the tenseness of these tendons, when present, is due to passive shortening following on the approximation of their ends consequent on the malposition and altered shape of the bones, and not upon active spasmodic contraction depending upon some fault of the central nervous system. Where, however, the tibials have been felt tense and resisting they have been unhesitatingly tenotomised. But as a rule they have been found to elongate readily as the bone deformity is overcome.

Although for the straightening of the foot I think plaster-of-paris is, on the whole, preferable, I am quite ready to admit that other methods—such as the application of the varus splint, elastic tension, etc.—will answer equally well. The advantages of plaster in out-patient practice are manifold. Thus, if the plaster bandage is properly applied, we can ensure it keeping on for at least a week. Pressure is uniform and continuously kept up, there are no straps or bandages to become loose, and if a thick layer of cotton-wool is carefully placed below the plaster there need be absolutely no risk of sores or chafing. It gives less trouble to the parents, and above all it is cheap. At least once a week, better twice a week, the plaster should be removed, and before it is re-applied systematic passive movements of the joints and massage of the muscles should be employed. In using the plaster-of-paris there are as many details to attend to as there are in the use of Scarpa's shoe or other apparatus. Some little experience is required to know how tight or how loose to apply the bandage, so as not, on the one hand, to cause injurious constriction, nor, on the other, to allow the child to kick it off. Moreover, the foot at each application must be held in the corrected position as far as it will go until the plaster is firmly set.

Whatever method is used the varus position should not be too quickly overcome. We are not dealing in these severe cases merely with contractions of tendons, fasciæ, and ligaments, but with malposition and altered shape of the bones. The neck of the astragalus in severe cases is generally so bent and deflected that the articular surface of the head looks abnormally inwards, and often at the same time almost directly downwards, and the facets both on its head and on its trochlear and lower surfaces are considerably altered in position, direction, and shape. The anterior end of the os calcis is often bent inwards so that its facet for the cuboid looks forwards and inwards, instead of forwards; or there may be a distinct overgrowth of bone on the outer side of its anterior end, immediately behind its cuboidal facet. The remaining tarsal bones, though not much altered in shape, are certainly in severe cases, somewhat compressed on their tibial side, so as to be rendered, as it were, more or less wedge shaped, with the base of the wedge looking outwards. Rapid overcoming of the varus position can only be accomplished by stretching or dividing the soft tissues, leaving the deformities of the bone untouched. By the division of tendons, muscles, and ligaments on the inner side of the sole, the bones in front of Chopart's joint with the os calcis can no doubt be wheeled round on the head and under surface of the astragalus, at the so-called subastragaloid joint, so as to bring the foot more or less in line with the leg; but the articular surfaces are no longer in contact; the neck of the astragalus still keeps its faulty direction, the anterior end of the os calcis remains bent, and the other bones retain their more or less wedge-like shape. After the tendo Achillis has been divided, the scaphoid with the os calcis and the bones in front of them are only too likely to roll inwards again as the divided tissues on the inner side of the foot slowly cicatrise and contract. I have come to regard the neglect to correct the deformity