THE DISINFECTION OF VITALIZED TISSUES AND THE HEALING OF WOUNDS WITH CHINOSOL AND SALT*

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The objective is to bring positive and convincing proofs of the healing value of chinosol in combination with salt.

Chinosol is pure normal oxyquinoline sulphate. *In vitro,* though a powerful antiseptic, it is very little germicidal. A 2 per cent. solution did not kill staphylococcus aureus in twenty-four hours. Its disinfectant action on vitalized tissues is therefore probably due to the excitement by it of physiological stimuli to bring nature's forces of resistance to the fore.

Salt was combined with chinosol by the writer through the influence of the writings of Col. Sir Almroth E. Wright[1] relating to salt in the treatment of wounds.

Clinical Experience.—Examples of cases treated with chinosol and salt are as follows: Primary union in incised wounds, as, for instance, a case of cut tendons of the wrist; cases of acute suppuration, as one of cellulitis of the leg covering an area about the size of one's hand, due to colon bacillus, with sloughing interior, in which, with the use of a solution of 2 per cent. chinosol and 5 per cent. sodium chloride, the opposing surfaces of the abscess cavity were almost completely united on the ninth day; the healing of a whitlow with bone involvement without destruction of the tendons (function returning) and with union of the soft parts to the area of exposed bone, the latter having taken place by the tenth day, using a solution of 2 per cent. chinosol and 0.85 per cent. sodium chloride; the filling with granulations, in about five weeks' time, of a bone cavity about 7 inches in length in an expanded lower portion of the shaft of a tibia, resulting from an operation for osteomyelitis, the whole medullary portion of the bone having been removed, treatment having been by a daily application of gauze wet with a solution of 2 per cent. chinosol and 0.6 per cent. sodium chloride for two hours; the healing of a pelvic fistula 6 to 8 inches in length, by injections, at first daily for one month with a solution of 2 per cent. chinosol and 5 per cent. sodium chloride, with which treatment the fistula became reduced to 2⅜ inches in length, later having been completely closed with the use of the tincture of chinosol; the cicatrization of a deep wound entirely encompassing the anus, the result of the separation of a slough, with high retraction of the anus above the skin surfaces of the buttocks, so that

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[1] Wright, A. E.: Lancet, 1915, ii, p. 1009; 1916, i, p. 1203; 1918, i, 831.

in three and one-half weeks' time the anus was pulled down and united even with the surrounding skin, treatment having been by the daily application of gauze wet with a solution of 2 per cent. chinosol and 2 per cent. sodium chloride for about one-half hour; the complete removal of a deep slough filling the base of a large carbuncle of the neck, which had been incised, with the adhesion of the undermined skin edges almost everywhere to the surface of the ulcer underlying them, by the fourteenth day, using a solution of 2 per cent. chinosol and 0.85 per cent. sodium chloride.

A chinosol ointment and a tincture of chinosol have important uses. The ointment (℞ chinosol grains vi, sodium chloride grains ii, lanolin and vaseline āā ʒss) rubbed in for four or five minutes once in two or three hours, has proved a pretty reliable agent with which to abort beginning hair-follicle infections. The tincture (℞ chinosol, 2 per cent., and sodium chloride grains iss to the ounce in 80 per cent. alcohol) applied once a day to the skin around a furuncle, after having removed the grease with a fat-solvent, will prevent infection of neighboring hair follicles.

The technic is simple, application of the chinosol-salt aqueous solution in suppurating and granulating wounds which are accessible being made by means of gauze which, when the wounds are discharging, is left in place between daily dressings, but when the wounds begin to granulate healthily with little discharge, should be removed in two or three hours following the dressing, to permit collapse of the wounds. The solutions used in this class of wounds contain 2 per cent. of chinosol with either 0.85 per cent. or 5 per cent. of sodium chloride. The combination of this strength of chinosol with the hypertonic salt probably promotes cicatrization to a greater degree than does that with the iso-tonic salt, while the latter combination probably promotes the growth of granulations more than does the former. These solutions on contact with the wound cause a burning sensation which quickly passes away.

The healing of blind tracks of soft parts may be facilitated by injecting the tracks once in six or eight hours through tubes having no punctures, introduced to their bottoms, for which purpose the 2 per cent. chinosol solution having the 5 per cent. salt content is probably the preferable solution of the two. The tincture of chinosol (℞ chinosol 2 per cent. and sodium chloride grains iss to the ounce in 80 per cent. alcohol) has seemed particularly advantageous for the healing of blind fistulæ *in ano*, though with a different technic, it being injected into the track two or three times at fifteen to thirty minute intervals each day.

For the control of sepsis in a draining empyema case, the solution of 2 per cent. chinosol with the 5 per cent. sodium chloride content is recommended, one ounce of which may be injected into the cavity daily, to be retained by posture, following preliminary washing with salt solution. In one case the use of a 5 per cent. salt solution for the preliminary washing seemed to avail more toward cicatrization and healing of the wound than had nor-

mal saline. Wright has shown that a preliminary wash of a pus-secreting surface with physiological salt solution to remove the albuminous substances, gives an after-coming antiseptic an opportunity to reach the bacteria. Before dressing a wound, the surrounding skin is first wiped with McDonald's solution (alcohol 60 parts, acetone 40 parts, to which 2 per cent. of pyxol is added).

First-aid treatment is effected either by packing the wound with gauze saturated with a solution of chinosol iv grains to the ounce and 0.85 per cent. sodium chloride, which may be left in place for twenty-four hours before repairing or redressing the wound, when the same solution should be used again, or by simply sponging the wound freely with the solution during the operation for its immediate repair. The above gauze pack, after remaining in a fresh wound for twenty-four hours, often adheres to well-nourished tissues. Hypertonic salt should not be used in a fresh wound which is to be sutured.

In both old and fresh wounds which gape, it is advisable to interpose a piece of rubber tissue between the gauze which brings the chinosol salt solution into contact with the wound and the external dressings, in order to prevent abstraction of the solution into the latter.

Animal experimentation was done to prove the value of chinosol as a first-aid disinfectant. In the animal experiments the wounds were constructed as pockets between the superficial and deep layers of the superficial fascia in a dog's back. These pockets, when made blood-free, would absorb the solution very freely no matter what was the strength of the salt, but when the tissues were infiltrated with blood the absorption of the solution would be slower or sometimes there would be none at all.

The instances in which primary union followed the disinfection of a scientifically infected wound, where the infection preceded the disinfection, were not frequent. One case which gave encouragement to the work was that of a dog infected with staphylococcus aureus, having used as much of a twenty-four hour culture as could be taken up by a piece of gauze about 1 by 1¼ inches square, crumpled up, which was left in the wound for thirty minutes, the wound then being disinfected with a solution of chinosol grains vi to the ounce and 0.6 per cent. sodium chloride, in which primary union took place in the disinfected wound, while from the control wound on the opposite side an extensive cellulitis developed, which resulted in a large area of superficial necrosis with ulceration extending from near the backbone forward to the anterior median line.

In a recent series of experiments consisting of 12 dogs, in which the lymphatics leading from *wound pockets* between the layers of the superficial fascia, *uncontaminated with blood,* were first infiltrated with the disinfectant solution before infecting the wounds for thirty minutes with as much of a virulent twenty-four hour culture of staphylococcus aureus as could be absorbed on a piece of gauze about half an inch square, crumpled up, and the disinfectant solution was applied to the wounds again following the

infection, the wounds having been finally sutured primarily, these same wounds in seven of the animals united by primary union, while the controls all suppurated. The strengths of chinosol used in this series of animals were grains iv and vi to the ounce, and 2 per cent., and of sodium chloride, 0.85 and 0.6 per cent.

In two similar experiments with *blood-infiltrated wounds,* in which solutions of chinosol grs. vi to the ounce in combination with 0.6 per cent. and 0.85 per cent. sodium chloride respectively, were used, each of the wounds thus treated exhibited an area of dark gray staining of its fatty interior, due to a change produced in the infiltrated corpuscles in the course of from fifteen to thirty minutes by the action of the chinosol, and both of the wounds suppurated, pure staphylococcus aureus having been found in the pus from each, while the control wounds, also infiltrated with blood, both united by primary union. These results led to a study of the action *in vitro* of solutions of chinosol and salt, on washed blood corpuscles. In this connection, it is of interest that two *sterile* blood-infiltrated wound pockets in the subcutaneous tissue of a dog, treated with a solution of 2 per cent. chinosol in combination with salt, with resulting areas of dark gray and gray-black staining, following primary suture, united by primary union. With the use of the first-aid solution (chinosol grs. iv to the ounce and 0.85 per cent. sodium chloride) in experimental wounds into which blood had flowed, a smoky yellow color and occasionally a light grayish tinge have been noted, usually affecting the loose connective tissue joining together the superficial and deep layers of the superficial fascia, which at the same time has become the seat of an œdema resulting from an infiltration of it by the solution. In fresh traumatic wounds, staining of the tissues attendant upon the use of the first-aid solution has, in a limited experience, not been a feature.

These experiments have shown that the production in fresh wound pockets uncontaminated with blood, of immunity to scientific infection with a large number of virulent staphylococci aurei, by the use of chinosol with iso- and slightly hypo-tonic salt and once by the use of 2 per cent. chinosol alone, has been accomplished in a majority of the instances, which furnishes *proof* of the disinfectant action of chinosol on vitalized tissues. The practical application of this knowledge would be to the first-aid treatment of wounds. Thus it would seem that, if fresh traumatic wounds could, within the first few hours of their receipt, at a time when, as Carrel and Dehelly have shown, bacterial growth has hardly begun, have their open lymphatics blocked with a solution of chinosol and iso-tonic salt, comparable to the lymphatic block with the disinfectant solution preceding the scientific infection with a large number of virulent bacteria in the dog's wounds, that immunity of these wounds, at least to the ordinary pus germs, in the presence of a but comparatively trivial amount of in-

fection at this early period, could similarly be expected. The lymphatic block of a fresh traumatic wound with chinosol and salt should be superficial, since in the animal experiments an extensive infiltration of the solution into the lymphatics opening into a wound, following scientific infection of the latter, seemed many times to have been the probable cause of extending the infection to a distance from the site of its implantation. Although blood infiltration associated with the use of the chinosol salt solution as described, might be incompatible with the production of immunity against a severe scientific infection in an experimental wound closed by primary suture, yet this same condition would not necessarily be incompatible with producing a lymphatic block against the invasion of the tissues by bacteria or with arresting bacterial growth, in a traumatic wound treated open by the introduction into it of gauze packing saturated with the disinfectant solution, especially when the latter is introduced early before the bacteria have begun to multiply greatly.

Twenty-four grains of chinosol in solution have been infiltrated into the lymphatics of a sterile, fresh wound in the back of a dog weighing 8 kilos, with primary union and without complication.

Miss W. Carey Noble, of the Research Laboratory of the New York Board of Health, has made very careful bacteriological tests with chinosol, which virtually confirm the tests of the Council on Pharmacy and Chemistry [2] of the American Medical Association.

Dr. Alexander O. Gettler, pathological chemist to Bellevue Hospital and to the City of New York, has done important work on the chemistry of chinosol to incorporate in this report.

Mr. Pro. V. Prewitt, Instructor in Physiology at the New York University and Bellevue Hospital Medical College, has done a valuable piece of work on the action of chinosol alone, and in combination with salt, on blood corpuscles.

The merits of chinosol in combination with salt as a tissue disinfectant can be summarized as follows: Its stability, its ease of application, its applicability to first-aid treatment of wounds, its tendency to dry up pus, its non-irritability when applied in accordance with the technic here advocated, unless possibly after prolonged use; also the facts that it appears not to attack tendons and that it facilitates the separation of sloughs.

[2] Report on Chinosol of Council on Pharmacy and Chemistry, American Medical Association, Journ. A. M. A., 1910, liv, p. 1801; editorial, p. 1790.