

## EDITORIAL ARTICLES.

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### BAUBY ON THE TREATMENT OF SURGICAL TUBERCULOSIS WITH HOT WATER.<sup>1</sup>

THIS new method of treating suppurative tuberculosis by means of hot water was instituted by Jeannel, of Toulouse, and designated by the term *ébouillamment*. Within the past year he read a paper upon the subject before the Académie de Médecine de Paris. Since that the use of this therapeutic measure has been continued and a large number of cases added to the last statistics.

The modern tendency of surgical therapeutics is in two different directions, but which have in view the same object. One method which belongs to the era of asepsis consists in attacking and extirpating all signs of the disease. This is often bold and hazardous. The other method consists in sacrificing as little tissue as possible, in a limited operative intervention and in preserving intact the function and form of the part.

Formerly, the cases of local tuberculosis were practically left to their fate to recover spontaneously or to die. A cold abscess was allowed to go on suppurating. White swelling was only treated by amputation when that extreme measure became necessary. Now we see tuberculous foci exposed in the most remote places, in the peritoneum, in the articulations, and in the medullary canal. This is the result of aggressive surgery. But when the operator comes down upon the lesion itself, he occupies himself with preserving the important structures.

Under the influence of these general principles early resections

<sup>1</sup> Bauby (Toulouse), Traitement des Tuberculoses chirurgicales par l'Eau bouillante, Archives Provinciales de Chirurgie, T. III, No. 9, 1894.

are taking the place of late amputations. Unfortunately, a skilful and judicious operation does not always crown these early efforts with the desired success. Sometimes recurrence of the disease takes place at the seat of operation; and often suppuration retards the healing process.

In order to avoid these complications and to obtain quick healing, as in other operations, not only the easily-accessible infective tissue must be removed, but also the remoter colonies of bacilli must be attacked. With the ordinary cutting instruments of the surgeon this is almost impossible. An excision of all visible disease, a dissection of the fungosities, or a thorough curetting have to be done to effect a cure.

It has been the endeavor of all time, since the discovery of the bacterial cause of tuberculous inflammations, to find some surgical procedure or some remedy or means by which the whole lesion might be destroyed.

At the present time there are two methods for combating surgical tuberculous disease practised,—the chemical and the physical. The chemical method operates by causing a change in the tissues or by acting directly upon the microbes themselves. The chloride of zinc is an example. It is used in various ways, either in weak solution or in a concentrated form. It is injected into the tuberculous cavities with the view of killing the bacilli and hastening cicatrization, or it is injected into the boundary of sound tissue for the purpose of causing sclerosis after the method of Lannelongue.

The use of iodoform is in high credit. It has been regarded almost as a specific. Used as a powder, in emulsion, or in solution it has certainly given some good results. The mixture of iodoform and ether merits especial notice, because of its value due to its diffusibility.

Naphthol-camphor, tincture of iodine, and other products have been used with various degrees of success in the hands of various practitioners. All of these chemical agents possess incontestable merit, and the author does not purpose to discredit them.

It is wise to have in mind their inadequacy. They all act superficially; or if they do penetrate the diseased tissue, their action does not, as a rule, extend as far as the limit of the disease; and the active element and propagator of the disease continues its action centrifugally from the centre of the nodule or tuberculous abscess. If these peripheral colonies are not exposed, the chemical agents do not reach them.

The agents which act physically are used to obtain the same results. Heat constitutes the most effective means of destroying infective germs. For sterilizing contaminated objects, instruments, and culture media, dry or moist heat is used in some of its various forms in laboratories and in general practice.

From the point of view of the special sterilization of wounds, and particularly tuberculous wounds, dry heat has been used for a long time. The red-hot iron of the ancients, replaced by the thermo-cautery, is much used at the present time, and is frequently employed to destroy fungosities and to affect the disease in pathological tissue. But this method has but a superficial action. Beneath the carbonized layer in which the microbes and animal cells are immediately destroyed, the living tissues are but little changed. The frequent recurrences, the continuous progress of the disease, demonstrate that the tuberculous process is not always checked by cauterization.

A method more efficacious than this must be sought for. Félizet invented the plan of carrying a high temperature into the tissues by means of a blow-pipe flame. This is a very ingenious idea, but its application was rather difficult. To use a homely comparison, it was like broiling a bloody steak, the outside being affected, but the deeper tissues remaining unchanged.

How much more thorough is the action of hot water. With this it is easy to judge when a sufficient degree of heat has been applied, and thus to avoid the accidents of burning. Instead of the carbonization of the tissues, as is caused by dry cauterization, and instead of forming a superficial protecting layer for the subjacent tissues, moist heat ramifies and penetrates the tissues, and the heat is carried

deeply into the seat of the disease. In just this manner foods are cooked and sterilized throughout their entire thickness. When the process of sterilization has gone far enough it can be easily stopped, and thus regulated.

Hitherto the properties of moist heat have not been made use of in therapeutic surgery. Jeannel was the first to think of this plan. He applied his remedy to cold abscesses, which had opened spontaneously or which had been incised, and to infected wounds. The results obtained by the first experiments were eminently satisfactory, and led him and Bauby to continue the practice in a large number of cases.

Before proceeding further, Jeannel wished to make a few experiments upon animals to establish his treatments upon a more scientific basis.

He placed a dog under anæsthesia and exposed the muscles of the buttocks. A thermometer was placed deeply beneath the muscles on one side and the tissues subjected to *ébouillamment* in the same manner and for the same length of time as for a supposed diseased condition. The thermometer rose six degrees,—from 36° C. to 42° C.

The other muscular surface he treated by cauterization with the thermo-cautery at a red or white heat, and much more energetically and for a longer period of time than is practised clinically. The thermometer rose but half of a degree, and a part of the surface of the muscle was absolutely carbonized. The thermometer was placed twenty millimetres from the surface in the first side, whereas in the other side it was but eight millimetres below the carbonized surface.

A repetition of experiments showed that the influence of the thermo-cautery was felt through a muscular thickness of but four millimetres. Other experiments showed that the muscle was affected by *ébouillamment* to a depth of six millimetres, whereas the thickness of muscle roasted by the thermo-cautery was not more than three or four millimetres.

All of these differences speak in favor of the moist heat. It is then, therapeutically, more penetrating than dry heat and gives a

greater variation in the degree of heat. As is known in the laboratories, it takes a much longer time and a higher degree of heat to sterilize by dry heat than by moist heat.

The problem in the sterilization of a tuberculous wound is as follows:

(1) 80° C. of heat are required to destroy and render inert the toxins of the bacteria.

(2) A temperature of 100° or 110° C. of moist heat destroys the germs, and is as effective as 600° or 1600° C. of dry heat, the effect of the former being felt much more deeply and acting more surely.

These, then, are the principles upon which the treatment of surgical tuberculosis by means of boiling water is based.

The application of the method requires some delicacy and prudence, because it is doubly dangerous on account of the energy of the caustic action and the diffusibility of the heat.

It is scarcely necessary to say that anæsthesia should be complete. *Ébouillamment* of the wound would otherwise be very painful. It is conceivable that, under certain circumstances, a small abscess for example, a little cocaine would suffice. In almost all cases general anæsthesia will be necessary.

The tuberculous focus should be evacuated of its pus, the caseous and fungous substances should be thoroughly sponged. Hæmostasis should be perfect. This is indispensable because the heat coagulates the blood over the surface to be affected, and prevents the penetration of the hot water.

This method of treatment may be applied in two very different ways, depending upon whether the hot water is introduced immediately into the pathological cavity or whether the temperature of the water which is introduced is gradually increased. In the first case the boiling water may be rapidly applied to the wound by bringing in immediate contact with it tampons or sponges from the water. This primitive procedure may easily result in a burning of the healthy tissue, and the skin in particular. This accident can, of course, be

prevented by surrounding the area to be treated by compresses saturated with cold water. Or continuous irrigation with cold water may be practised about the wound. The combination of these two methods offers extra security from burning the sound tissue.

This was the original method of Jeannel and Bauby. They found that for general purposes this simple apparatus sufficed, and it contributed to many of their cures. Yet they have now almost entirely abandoned it.

The tampons offered many inconveniences. The water with which they are impregnated becomes rapidly cooled. It loses much of its heat simply in the transportation from the kettle to the wound. One is not able to estimate exactly the quantity used nor the degree of its penetration. It may burn the surrounding skin in spite of the precautions above referred to. The authors were, therefore, compelled to devise some other plan.

They now turn the water directly into the wound, the edges being held open by forceps. The water is conducted from a special vessel by means of a tube. In general practice it is easy to procure for this purpose a tea-kettle with a long spout, which answers very well for this purpose. The modern samovar answers most admirably for this purpose; by means of the stopcock at its lower part it permits of exact regulation of the flow of water. This is an apparatus analogous to that which they employ in their hospital work. They use a sort of copper coffee-pot, having at its base a stopcock, to which a rubber tube is attached. At the other end of this tube is attached another small stopcock. To this is attached an isolated handle for holding the tube without burning the hand. This coffee-pot is filled with salt water, and is placed over a gas or alcohol fire.

After having allowed the first water to flow out of the tube so that it may become warmed, the stream is directed into the wound in the exact quantity desired.

This is a douche of hot water which can be controlled and regulated at pleasure. When the cavity is filled, the water is sponged out; and the process can be repeated until a sufficient action has

been obtained. A characteristic gray coloration of the tissues is observed at once as a result of the heat. This is the first kind of *ébouillamment*.

The second method is quite different. It consists in heating in the wound itself water which is introduced in a cold or tepid state. This is accomplished by plunging into the water the point of the thermo-cautery, kept constantly at a red heat. The time required for heating the water to the boiling-point depends upon the size of the cavity filled; but it is always very quickly accomplished. For an abscess cavity, for example, the size of a pigeon's egg, one minute abundantly suffices. The water begins to boil, takes on a greenish-gray color, becomes covered with froth, and rapidly evaporates, leaving the cavity almost entirely empty.

The walls present the same greenish-gray appearance, and are apparently cooked. It is well to repeat this operation four or five times to obtain a good result.

It is very evident that this is the best method of proceeding, inasmuch as one part is certain to reach a temperature of  $100^{\circ}$  C., and the other part is not in danger of being burned.

This method cannot be used under all circumstances. The wound cavity may be too deep and tortuous, or there may be counter-openings so that the cavity will not hold water.

The authors have under consideration the therapeutic properties of moist heat in the form of superheated steam. They have attempted its use in practice, but unfortunately this vapor, such as is generated in the autoclave, for example, cools down so very rapidly in the air as to render its use thus far impracticable.

Salt water at a temperature of  $105^{\circ}$  C. they find to be the best for the purpose. It is easily prepared, and its infiltration into the tissues is very active, but it cools very quickly. This inconvenience can be avoided by using in place of water some fluid which has a high boiling-point, evaporates very slowly, and which retains its heat for a long time. Such fluids are oil and glycerin. Phocas, of Lille, has used boiling oil in this way with great success. The use of oil has

seemed rational to the author, but because of its disagreeable odor he has not employed it. It is also objected to because it penetrates the tissues very slowly.

Once Bauby employed glycerin in a small tuberculous abscess of bony origin. Though the case recovered, the success was not an encouraging one. He observed that the boiling-point of the liquid was very high, and that the absorption of the fluid by the tissues was very much inferior to that of salt water.

To appreciate the exact value of the observations which are presented in the following paragraphs, it is well to know that the treatment by *ébouillamment* was accompanied with dressings of the wounds with aseptic materials sterilized in the autoclave of Sorel and not with antiseptics. This precaution was necessary in order to judge the good effects of the method, for had the wounds been dressed with iodoform, sublimate, or carbolic, it would have been difficult to decide to which the cure was due.

The wound treated by hot water gives rise to an abundant serous secretion which impregnates the dressings and necessitates their frequent renewal. The notable peculiarities in their appearance is always very evident. After a few days there is manifest an active growth of new tissue. The cheesy centres take on the character of a perfectly healthy, clean wound. Suppuration is but very slight; and the repair is rapid. In certain cases immediate union has been obtained.

Bauby and Jeannel have reported a large number of cases treated by this method. They classify their cases into four groups, tuberculosis of the soft parts, tuberculosis of bone, tuberculosis of articulations, and visceral tuberculosis.

Their work may, perhaps, be said to lack scientific accuracy. They are open to the reproach of not having established, upon the basis of rigorous bacteriological examinations, the nature of the lesions which they treated. They did not affirm the presence of the tubercle bacillus before the operation nor its disappearance afterwards. In a word, they neglected the *contrôle du laboratoire*. Such objec-



tions are perfectly just. Their work has, however, been eminently practical, and their efforts have always tended more towards the perfecting of the technique than to theoretical demonstrations. Yet it is true that the discovery of the microbe of Koch is not absolutely necessary in order to diagnose tuberculosis. Their experiments show that the hot water simply destroys all of the infectious germs, and among these is the bacillus of tuberculosis.

Most all of the cases reported by them are cases of pretty grave local lesions. Most of the cases would have been regarded by surgeons as subjects for radical operation, and not for such conservative treatment as they received. The results were eminently satisfactory in the cases which they have reported.

The seven cases of tuberculous abscess of the soft parts healed perfectly. The process of cicatrization was very rapid, and the resulting scar but slight. It is true that when a cold abscess is opened and curetted it usually heals, if the conditions are favorable. Jeannel and Bauby have not only always secured healing without recurrence, but they have on occasions secured primary union.

They treated four cases of osteitis with four cures. Here also, as in the simple abscesses, the results were very happy ones. The osseous cavities filled up without suppuration. It may be very properly asked whether the osteogenetic power of the periosteum is not impaired by the penetrating heat of the water. This can be answered in the negative, for an opportunity was offered in one of their cases of making a dissection of the parts, and it was found that a firm and solid osseous growth had filled the defect.

Tuberculosis of articulations is represented by nine cases, in which the results were very much the same. Aside from the results which were good,—which were, indeed, remarkably good,—there were a few less satisfactory cases. These failures were of two sorts. One was in a resected hip-joint. The treatment by *l'ébouillement* was not thorough and complete, because it did not reach the deeper part of the suppuration which was in the iliac bone. The intervention was intentionally palliative, and it gave as good a result as could have been expected.

The other case was quite different. They operated with the view of obtaining a perfect cure, but through a fault in the technique the very opposite result was brought about. In two cases there was an osteo-arthritis of the tibio-tarsal joint which most surgeons would probably have treated by amputation. Resection was done with the accessory treatment by *ébouillement*, and gangrene of the foot resulted. The accident was unquestionably due to the hot application. This inopportune heating of the posterior tibial nerves and vessels, poorly protected as they were, caused a coagulation of blood in the vessels and a profound disturbance of the trophic function of the nerves. One of these cases terminated in death and the other in secondary amputation. These are accidents which by proper precautions can be easily avoided.

*En résumé, l'ébouillement* offers, in the opinion of Bauby, a method superior to all others for the sterilization of tuberculous foci. Its action is energetic and far-reaching. It penetrates and traverses the tissues containing the bacilli, and greatly modifies the condition of the vitality of the parts. In circumscribed abscesses in bone, connective tissue or gland, its efficacy is a demonstrated fact. In the more extensive, complex, and irregular lesions the results are most encouraging.

JAMES P. WARBASSE.