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THE MODERN ANTI-BACILLARY TREATMENT OF TUBERCULAR JOINT-DISEASE.

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The addresses before the various sections of this Society must of necessity, while dealing more especially with the surgical, medical, or special aspects of their subjects, yet be of such a character as shall interest in some measure the general practitioner, as well as those who devote their attention almost exclusively to one branch of our art.

Casting about in my mind for a theme which should fulfil these conditions, the subject of the modern anti-bacillary treatment of tubercular diseases of the joints has appeared to me one about which special interest clings, quite as much for the family attendant as for the surgeon, because it is the former who is first consulted; it is the general practitioner who usually determines, by the initial treatment adopted, whether conservatism or destructive operative treatment must prevail; whether life, with a more or less useful limb, or life after mutilation shall perchance be secured, although too often the prolonged sufferings end only in death despite the attempt at conservative mutilation by erasion, excision, or amputation of the diseased member. I am confident that a wider appreciation of the possibilities and ease of application of modern conservative treatment by the family attendant is gradually diminishing the frequency with which the knife is now resorted to, and it is my hope that what I shall present for your consideration may in some wise further the same end.

The time at my disposal will admit of my doing little more than contending for the applicability of certain general principles of treatment to all cases, with the modifications requisite to

meet the indications for special exceptional ones. An indispensable preliminary, however, is a brief consideration of the pathology of tubercular joint-disease to ascertain how nature effects cures—for this she often does unaided, nay, in the teeth of so-called art.

It is only requisite to state the well-known fact, that while tubercular joint-disease may originate primarily in the constituent bones or the synovial membrane of a joint, in advanced cases all the articular structures become involved, to demonstrate that therapeutic measures adapted to one class of cases or the earlier stages of the disease are not of equal value in all varieties, or the later stages.

Study with me the natural history of tubercle wherever situated. Whether caused by the growth of the tubercle bacillus itself, or the ptomaines produced by the development of these micro-organisms, a more or less modified granulation-tissue results, which, from its lack of proper blood supply, or the effects of the ptomaines, undergoes coagulation-necrosis, in whole or in part.

What further changes are possible? And can we take a hint from them to guide us in our therapeutic measures? Under favorable circumstances, the bacilli being few in number or dying out early from increased resistance of the tissues, however induced, the caseated mass is removed by absorption for the most part, leaving behind only the inorganic portions, perhaps increased by some infiltration of lime salts, nothing but a cretaceous mass remaining encapsuled by connective tissue and of no further pathological moment. Under a still more favorable environment, with the cessation of the cause, the granulation-tissue, in whole or in part, carries out what may be termed its normal function, being converted into scar-tissue, a healthy cicatrix taking the place of the tubercular tissue. The therapeutic lesson to be learned will be specifically mentioned later on, but must be apparent to you without special explanation.

If, however, the resistance of the surrounding tissues to the germs is not sufficient to destroy them, or the exhaustion of nutritive materials for their growth does not occur, the coagulation-necrosis is followed by a caseation which, instead of

becoming encapsulated by an environing growth of connective tissue, goes on to liquefaction, forming a so-called "cold abscess" —yet not containing one drop of pus unless secondary infection has taken place—its walls, however, consisting of a layer of more or less active tubercular tissue. Let secondary infection with the microbes of suppuration now ensue and this "cold abscess" will open, the tubercular matter will be evacuated, a sinus usually remaining lined with tubercular granulations; this is nature's eliminative treatment. In certain favorable cases the intensity of the inflammatory process is such that all the infected tissues are destroyed and evacuated; this is another method by which nature cures by the destruction of tubercular tissue, not by its organization into harmless, permanent tissue.

It is important to recognize the fact that a tubercular infection of a joint must, in the nature of the event, practically always be secondary to tuberculosis elsewhere; the primary point of infection may be some trivial lesion through which the germs have gained access, the lesion itself remaining unaffected, but the germ-charged blood current too often deposits the morbific cause in the epiphyseal regions of the young bones, where the normal conditions incident to their growth are peculiarly favorable for the lodgment and multiplication of microbes, even in the absence of what is so common, viz., some trivial injury, which, by interfering with the proper rate of the circulation through the injured part, tends to promote the dropping out and accumulation of germs of all kinds. A second fact to keep clearly in mind is, that before puberty, in a large majority of cases, both epiphyses entering into the construction of the diseased joint are involved; the process is often recognizable as an embolic one, a minute mass of germ-laden granulation-tissue being found plugging the vessel, or by the mural implantation of a few germs a thrombus has formed blocking the lumen of an arteriole, producing those wedge-shaped sequestra so often found. Conversely, in the adult, tubercular joint trouble is primarily of the synovial form, the bones becoming secondarily involved.

The most superficial clinical study of surgical tuberculosis demonstrates the truth of the deductions drawn from our brief

pathological investigation of the subject, viz., that not only is tuberculosis a curable disease but that it is curable in more than one way. The surgical mind has arrived at the acceptance of this view only by the adoption of a series of tentative procedures: First, the limb formerly amputated for white-swelling, was treated by a resection of the articulation; then the lesser joint troubles for which resection had been unhesitatingly employed —with its destruction of all mobility, its frequent total arrest of growth from the removal of the only partially diseased epiphyses —began to be cured by atypical resections, then by erasion, and now, finally, the wisdom of a resort in all cases to the removal of the disease solely by mechanical measures is questioned, and the attempt is made to aid nature in her more successful methods of dealing with tuberculosis.

The results achieved by these latter methods are those to which I desire now more especially to call your attention, although, later on, where these fail or are contra-indicated, I shall endeavor provisionally to indicate the classes of cases to which erasion, excision, or even amputation are still the only methods applicable; in other words, while a strong advocate of modern scientific and conservative measures, I am not bigot enough to fail to recognize that, owing to seeing cases late in the disease, or to the failure of the patients in continuing treatment for a sufficient length of time—even when skillfully initiated by the surgeon—many cases must still remain where the older, more radical methods will be demanded.

Manifestly then, if my statements as to nature's methods of cure are correct, that one most desirable is the organization of the tubercular products, in whole or in part, into harmless scar-tissue. If then, early in the process, we can destroy or render inert the germ or its products which prevent the transformation of the granulation-tissue into a stable tissue, we shall secure all, and more, than can be effected by the most radical operation, and that, too, without danger to life, to parts, or functions which are only damaged, not utterly destroyed.

What remedy shall be resorted to which theoretically, at least, can effect this? While many rivals have been proposed from time to time, iodine still holds the first place; but it must

be iodine, which is so slowly set free from its combination that it shall prove neither irritant to the tissues nor toxic. Iodoform best fulfils these requirements and was first suggested for this purpose by Billroth and Mikulicz in 1881. Soon after this, Verneuil called attention to its efficiency in certain cases of tubercular abscess, contending that it destroyed the germs of the disease, converting a specific into a simple disease-process. Since then Moorhof in 1885, Krause, Bruns, and a host of other noted observers, have recommended and successfully employed iodoform in tuberculosis of the joints.

More than twenty years ago Barwell, when describing the natural history of tubercular arthritis, showed that among the masses of granulation-tissue into which ligaments, synovial membrane, and the other joint-structures had been converted, it was quite common to find numerous areas where transformation into scar-tissue was occurring, and pointed out that in this way a cure was effected when unaided nature was able to cope with the disease. Until a more modern pathology demonstrated that this granulation-tissue was the result of a living, multiplying germ and its products, there was neither motive nor incentive to induce observers to seek for a remedy, which, by removing or neutralizing the cause, destroying this tubercular granulation-tissue, or preventing its conversion into a permanent tissue, should enable nature to do what she was so often successfully striving to accomplish under the most adverse circumstances. It is true that Bruns and Nauwerk, examining portions of the wall of tubercular abscesses treated by iodoform injections, have described certain microscopic appearances suggestive of the entire disappearance of the miliary tubercles by destruction of the bacilli, fatty degeneration, and liquefaction of the cells. While this may, and probably must, be true for the focus of the tubercular lesion, both clinically and pathologically the condition of joints prove, I contend, that my description of organization of the granulation-tissue which has not become devitalized by the ptomaines, is in the main correct.

But will such measures avail when areas of caseation exist? Certainly, for in many instances have we not seen that the unaided efforts of the tissues are capable of either absorbing

the liquefied portions, encapsulating what remains, or of removing all but the harmless mineral salts? Morever, when studying the method of applying the remedy, it will be clear that, in many instances, most, if not all, of the liquefied caseated tubercle is actually evacuated before the introduction of the remedial agent, which then only has to deal with comparatively unaltered tubercle-tissue. A review of the nature and action of the various substances which have been employed, and the gradual evolution of the present methods of treatment so well illustrate the manner in which modern science attacks and conquers difficulties, and so clearly demonstrates the fact that to no one man belongs the credit of this great therapeutic victory, that I cannot refrain from repeating in a condensed form Senn's admirable *resumé* of the subject.

Many years ago Brainard of Chicago, after emptying the joint with a trocar and canula, injected either pure tincture of iodine or tincture of iodine variously diluted with a solution of iodide of potassium, but the local and general reaction were too great, the remedy failing to do good, and so frequently aggravating the conditions as to rule it out for the future. A two to three per cent. solution of carbolic acid was next employed by Hueter, both as an intra-articular and parenchymatous injection, repeated every other day. This remedy served a better purpose than the former, but it, too, with arsenious acid and corrosive sublimate, both advocated by Cavagni, have now been abandoned. Kolischer in 1887 reported numerous cases successfully treated by parenchymatous and intra-articular injections of an acidulated solution of calcium phosphate, employing for this purpose a Pravez syringe. Upon the other hand, E. Müller has reported negatively upon the action of this remedy from experience gained in the Tübingen clinic.

Owing to the action of zinc chloride inducing marked fibroid changes in softened tissues, Lannelongue has quite recently employed parenchymatous injections of this agent at the periphery of the tubercular process, in order to effect encapsulation of the focus, imitating one of nature's methods of cure; thus, four or five injections are made of eight or ten drops of a ten per cent. solution around the periphery of the subquadricipital

synovial pouch of the knee-joint. Although L. Sayre antedated him by thirty years, Landerer published in 1888 the results obtained by the employment of balsam of Peru in tubercular affections; the good effected he attributes, not to any anti-tubercular power, but to its stimulating effect so increasing the vitality of the tissues as to render them proof against the tubercular bacillus. This balsam can be employed as a 20 per cent. ethereal solution for injecting into fistulæ, but for parenchymatous and intra-articular use a sterilized emulsion of one part in four of oil of sweet almonds, redered alkaline by a 0.07 per cent. solution of sodic chloride, should be employed. Some caution is requisite in the use of this drug, as Bruns and others have called attention to its irritating effects on the genito-urinary tract.

Naphthol-camphor was experimented with by Périer at the Lariboisière Hospital and later highly vaunted by Reboul as very slightly toxic, decidedly antiseptic, and antibacillary; moreover the drug is absorbed and can be detected in the urine for eight days after ceasing to employ it, which fact seems to indicate that this remedy may serve to prevent relapses by its prolonged action. From 50 to 100 grams of naphthol-camphor have been employed as an injection in joint-tuberculosis and cold abscesses.

Finally Billroth, Mikulicz, Verneuil, Moorhof and others introduced, as has already been said, iodoform as superior to all other remedies. We should anticipate this decision from the results of experimental research, because Troje and Tangl have demonstrated that iodoform destroys the bacilli if kept in contact with them in sufficient concentration for prolonged periods, while, when employed in less quantity, the virulence of the germs is diminished; Gosselin's experiments and observations tend to prove the same thing.

How shall iodoform be employed? First and last, that which demands most care and is absolutely imperative, is *asepsis*. The best preparation of iodoform is a ten per cent. mixture of the drug in equal parts of glycerine and water, the whole carefully sterilized by boiling for five minutes in a water bath; never use anything but a recently sterilized preparation. Olive oil will also serve as a menstruum, the same proportion of iodoform

being employed and similar precautions taken in sterilizing the mixture by heat; but the first formula is the better. The field of operation must be carefully cleansed by the use of ether or turpentine one part, alcohol seven parts, followed by soap and hot water; a corrosive sublimate dressing should then be applied to remain some hours, preferably over night. If doubt exists as to the thoroughness of the asepsis, or when time does not suffice for the prolonged application of an antiseptic dressing, just before puncturing I prefer to again cleanse the parts with a solution of potassium permanganate followed by a saturated solution of oxalic acid, and, after this, by free douching with a mercuric solution.

The trocar and canula having been sterilized by heat, the joint should be carefully punctured obliquely at a safe point, first drawing the skin to one side, then all fluid, if any such be present, is to be evacuated by pressure and the articulation repeatedly and thoroughly washed out with a recently boiled 3 per cent. solution of boric acid until the fluid returns clear. When no fluid exists this preliminary washing should be omitted. From one to eight drachms of the iodoform mixture should then be slowly injected into the joint by means of a sterilized syringe, the canula withdrawn and the puncture sealed with aseptic cotton and collodion. An antiseptic gauze pad had better be placed over the collodion dressing and held in position by a bandage for a few days. Diffusion of the iodoform throughout the joint is to be secured by kneading the parts and by passive motion. No fixation of the articulation is necessary unless motion causes marked pain, although I am in the habit of keeping the joint quiet at first.

How often should the injection be repeated? As the action of the iodoform must be continuous, the intervals must depend somewhat upon the probable extent of absorbing surface and the amount of iodoform used at each injection; sometimes the injections require repetition as often as once in every eight days, in other cases once in six weeks will suffice.

Where intra-articular adhesions exist, cutting off a portion of the joint-cavity, the drug cannot of course reach all the diseased portions; again, when the broken down tubercular masses

cannot be evacuated through a large canula, nothing can be effectually done unless free incision into the joint be made, its interior thoroughly curetted, cleansed by careful rubbing with iodoform gauze, the wound accurately sutured, and then the injection be made, as has been done with such great success by Billroth.

It is hardly necessary to say that if abscess formation is imminent and the skin has become thinned, the puncture must be made at some point where the integument is perfectly sound. Having said that the trocar should be introduced into each articulation at a safe place, it will be proper here to specify these points: thus, for the wrist-joint, enter the trocar just below the styloid process of the radius or ulna; for the shoulder, access may be had by entering the joint either internally or externally to the coracoid process of the scapula, or better, behind, just where the scapular spine expands into the acromion process; for the hip-joint, enter the trocar just above the trochanter major with the limb adducted and inverted, carry the instrument a little forward as it is thrust onward until the head of the femur is reached, when, by forcibly adducting the limb, room can be made to pass the trocar into the articulation; the knee can be punctured upon either side of the patella; in case of the ankle, the trocar must be entered in front below either malleolus and then by directing its point upwards the joint will be reached.

I shall not adduce extended statistics to prove the efficacy of the iodoform treatment, but shall merely give the results obtained by a few representative surgeons, such as Bruns, Krause and Trendelenburg abroad, and Senn, in America, adding my own hearty endorsement of the latter's opinions, although, so far as I can gather, I had employed the method before he had commenced its use himself, having been led to do so by having seen the results obtained in a patient of his predecessor, the late Chas. T. Parkes.

Bruns cured eighty out of one hundred cases of tubercular abscess, while he had a similar success with fifty cases of tubercular arthritis, in the course of four years. Krause, in the course of two years, submitted to the iodoform treatment thirty-

six cases of tuberculosis of the knee-joint, thirteen of the hip, six of the tarsus, five of the wrist and one of the elbow. When reported, the treatment had been completed and a cure had been effected in the following cases, viz., of the knee, fifteen; of the hip, four; of the tarsus, one; of the wrist, three. Of one hundred and thirty-five cases of all grades of severity treated by Trendelenburg, sixty-eight per cent. were stated to have been favorably effected. Senn has also reported some admirable results, and my own experience has led me to repose an ever increasing confidence in the efficacy of iodoform in articular tuberculosis.

Is this plan of treatment solely productive of good without any attendant risks, at the worst merely failing to effect a cure? Certainly not; but the risks are insignificant, compared with those of the ordinary operative interference, so commonly resorted to, while nearly all are avoidable by taking proper precautions, as is shown by the experience of Bruns, presently to be quoted. Death, during the operation, occurred in a case of Boeckal's, where the abscess communicated with the subclavian artery. Severe hemorrhage followed the the injection in three cases of König's from arterial erosion, but was arrested by ligaturing respectively the gluteal, the deep femoral, and external plantar arteries. Lindner also had two fatal cases of hemorrage, the blood coming in one from the femoral artery and in the other from the iliac vein. All these accidents would have been equally noted if incision with scraping, erasion, or excision had been practiced. Dollinger and Trendelenburg, as well as others, have observed gangrene of the superjacent parts and iodoform intoxication from the employment of the ethereal solution, but the first objection does not hold good for the glycerine or oil formulæ; while with proper precautions the employment of the same menstrua practically does away with the risks of intoxication, although Heusner reports this accident from an intra-articular injection in a child containing only 0.1 of a gram of the drug, and Bramann another from 0.2 of a gram, although later the same amount was employed with impunity. The lesson to be learned is clear enough, viz., never to employ any but an oily or gly-

cerine vehicle, and not to exceed thirty grains of iodoform for the first injection in an adult, with much less in the case of a child. That such precautions will prevent accidents is proved by the experience of Bruns, nothing unpleasant having occurred in one hundred and eight cases treated by him. Of course, neglect of the strictest antiseptic precautions will often determine true suppuration in, and destruction of, a joint, and perhaps the loss of a life, but that is an entirely preventable accident.

But some will say, "Are operations never necessary? Will use of iodoform entirely supersede the knife?" Manifestly not, for, unless employed in the comparatively early stages of the disease, iodoform can do nothing more than possibly render the field of operation less tubercular and therefore make it more likely that all diseased tissues will be removed by the knife. Even if apparently seen at a stage when, efficiently employed, iodoform should effect a cure, certain cases will progress from bad to worse, requiring erasion, atypical resection, or typical resection according to the condition found after incision, the former two being probably more generally applicable to the cases developing in adults, which are usually primarily synovial, the osseous lesions being secondary and therefore more limited than in the case of children, where the reverse commonly obtains. When, then, a three months' faithful trial of iodoform fails to effect improvement, which in its incipiency should be indicated by shrinkage of the capsule, some operation is probably indicated, this decision being arrived at upon the same grounds as in other cases where the more usual forms of treatment by rest, etc., have failed. Again where sinuses are present or form, with evidences of amyloid changes in the viscera, or where lung tuberculosis is present, is threatened, or developes during the course of treatment, in my judgment amputation, and amputation only, is indicated as a life saving measure, even in the face of decided local improvement from the treatment.

In conclusion, let me beg all of you who have to treat such cases, to give this method a fair and impartial trial, and that, too, upon such an extended scale as will eliminate the chance of

error, not despising any of the minute precautions upon which I have insisted, and I am convinced that you will, from the scepticism which I myself first felt, pass on to the firm faith I have attained to, that by a proper choice of cases, and by educating the profession and the public, in the near future erasions and excisions for tuberculosis of the joints will be as rare as amputations for these maladies have already become.