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ORIGINAL ARTICLES.

TREATMENT OF FIBROID TUMORS OF THE UTERUS BY ELECTROLYSIS, WITH A DESCRIPTION OF APOSTOLI'S METHOD.

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Unfortunately, the term "electrolysis," as applied to the treatment of disease, has been by many, for some unaccountable reason, greatly misunderstood. Because an electric battery is one of the requisites of treatment by electrolysis, the term has become synonymous with any form of electrical application, whether of the galvanic, faradic or static variety. This is a mistake. To successfully treat any particular diseased condition by electrolysis, certain scientific principles are involved, that are as necessary for us to understand as it is for an inventor to understand certain scientific principles before he can successfully construct an electric motor.

Electrolysis is simply an expression for an electrical phenomenon. It is necessary for us to have certain conditions present in order to obtain this phenomenon: 1. A continuous current of electricity; 2, an electrolyte; 3, means of conveying the current through the electrolyte. And unless we have present in every case upon which we operate these requisites, and bring them into such relationship that the electrical current conveyed through the electrolyte by means of suitable conductors will dissolve the molecules of the electrolyte into their constituent elements, we do not get electrolysis.

So far as the phenomenon electrolysis has been utilized in medicine, it has been for the purpose of removing abnormal tissue. In order to accomplish this, certain other requisites are necessary. 1, the tissue to be dissipated must be an electrolyte or contain electrolytes; 2, the tissue must be in a position where it may be electrolyzed without endangering neighboring tissues; 3, its surroundings must be such as will favor the removal of the *ions* by absorption or otherwise, that have been freed by the electrolytic action; 4, some means of ascertaining the strength of the current must be at hand.

Before considering the above points more in detail, I wish to refer to two other phenomena of the con-

stant galvanic current, which do not properly come under the head of electrolytic action, but which are utilized in the treatment of fibroid tumors. I refer, 1, to the cataphoric action of the current; 2, to the local effects of the two poles.

The subject of the treatment of fibroid tumors of the uterus by the continuous galvanic current, therefore, presents the following points for our consideration: 1. The tumor. 2. Means for generating a continuous current of electricity. 3. Means of measuring or gauging the current. 4. Electrolytic action of the current. 5. Cataphoric action or electrical osmosis. 6. Local effect of the poles. 7. The apparatus and general detail.

I. *Consideration of Tumors.*—I will not go into a long discussion of the history, causes and pathology of fibroid tumors of the uterus, because it does not particularly bear upon the subject of the evening. However, to facilitate a description of my method of treatment, I will make the old division according to location into, 1, submucous; 2, interstitial; 3, sub-peritoneal. The nomenclature of this division sufficiently explains itself. To still further expedite matters, allow me to divide these tumors according to their condition, into the hæmorrhagic and the non-hæmorrhagic. By hæmorrhagic we will include those tumors that produce from a simple excess of the menstrual flow to the most alarming continuous hæmorrhage. The non-hæmorrhagic will include all others.

II. *The Current.*—The current of electricity used in electrolytic therapeutics should be one of moderate quantity compared to the intensity. It should be very uniform and without interruption. The direction of the current should always be known. Any means of generating electricity that will be practicable, and at the same time answer the above requirements, will be suitable for our purpose. I have found nothing better than some form of the chemical battery. In the beginning of my work with electrolysis I used some form of the ordinary zinc and carbon battery with a solution of dilute sulphuric acid and bichromate of potash. For purposes of epilation, strictures of the urethra and uterine canal, and other of the smaller operations, this battery answers the purpose admirably, where it is properly cared for. For accomplishing more decided work, however, this variety of battery becomes impracticable, because of the labor required to keep it in proper order. The results of my experiments have led me to adopt for office purposes the ordinary crow-foot gravity cell. This cell is furnished to me by the

McIntosh Galvano-Faradic Co., of this city. These cells are coupled in tandem, and connected with a selective switch board arranged in such a manner that any number of cells from any part of the battery can be brought into the circuit. A large number of these cells can be placed in a closet or other convenient place and attached to the switch-board by means of a cable of wire. The storage battery can be utilized for this purpose, but is as yet impracticable for long and constant work. The dynamo has been suggested, and will without doubt, with time and improved motors, take the place of all other forms of generating electricity for office use, both for cautery and, with proper resistance coils, for electrolytic work.

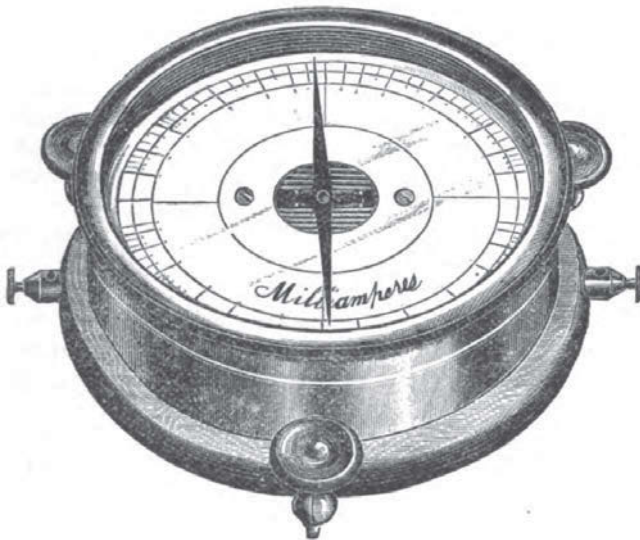


Fig. 1.—McIntosh's Milliampère Metre.

III. *Measurement of Current.*—With the advance in electrical therapeutics we have found it necessary to adopt some means of measuring approximately the strength of current employed. Especially is this desirable when the enormous strength of current is used that is necessary in the treatment I am describing. It is unwise to employ a current of more than 25-milliampère strength through the vital tissues of the body, without being in a position to watch every variation of intensity, and this can only be determined with accuracy by the employment of a galvanometer. (Fig. 1). I take pleasure in being able to exhibit a galvanometer to the Society this evening that answers all requirements for therapeutic purposes. This instrument was constructed, after a large amount of work and experimentation, by Dr. McIntosh, of the McIntosh Galvano Faradic Co., of this city. It has been graduated in the presence of an absolute galvanometer, and each instrument that is constructed is graduated by actual comparison in the same way, which is a point that is absolutely necessary if accuracy of measurement is to be obtained. Many of the galvanometers that have been thrown upon the market of late, for medical purposes, have been little better than worthless. This instrument is graduated for milliampères, and will measure accurately a current from 1 to 1,000-milliampère strength.

The maximum current that can be safely passed through the body, consistent with our present expe-

rience and knowledge, is about 1,000 milliampères. To get this power I use a battery composed of 115 gravity cells.¹

IV. *Electrolysis*, the principal action that we seek in causing the absorption of fibroid tumors or any other pathological growth, is not a new phenomenon in electro-chemistry. This action has been utilized in the commercial world for a number of years, and its value is constantly increasing. The same principle that is used in electro-plating can be made valuable in medicine, in relaxing the loosely combined elements of a fibroid tumor and causing their deposit where they will be carried from the system.

A strong current of electricity is passed through a growth of this character, and in its substance it finds many electrolytes which are dissolved into their constituent elements. These elements, according to their electrical tendencies, travel toward the negative or the positive pole of the battery, and may be disposed of in the following four ways: 1. "Many of them immediately make similar or dissimilar combinations with neighboring elements of opposite electrical tendencies, making thereby new compounds which act as foreign particles; as foreign bodies they are promptly removed by the nearest absorbents. 2. Other elements, as they become free from their original molecules, make combinations with elements which are already leaving the tissues through one of the innumerable minute vascular canals. 3. Many, in the form of gas, pour into the atmosphere beneath and surrounding the electrodes. 4. Others attack the electrodes and are disposed of in the form of deposit on their surfaces."

The cataphoric action of the galvanic current should also be recognized as playing its part in the promotion of absorption. It is by this property that fluids are determined in mass from the positive to the negative pole. This action, in producing an unnatural turgescence of fluid at the negative pole, favors its osmosis into the surrounding absorbents, and thereby accomplishes its removal.

The local effect of the current at the two poles of the battery is very different with a high tension current. The effect of the positive pole is termed by Dr. Apostoli the galvanic-caustic effect of the positive pole. This is an action of a great deal of importance, and from which a great advance is contributed in the treatment of hæmorrhagic fibroid tumors of the uterus. The phenomenon is obtained only by the employment of a very strong current, from 50 to 1,000-milliampère strength, and concentration of this current at the point of contact of the positive pole of the battery to the tissues. This electrode must be of small size, and of some unattackable metal. The effect obtained upon vascular tissues or mucous membrane by thus concentrating the current is to produce an eschar. This eschar, however, if the current has been proper, will be found to be simply a coagulation and a hardening of the mucous membrane and the tissues beneath it for some little distance. This process of contraction and coagulation modifies the calibre of the vessels of the circulation so that hæm-

¹ Since writing the above I have been able to use still higher currents in special cases.

orrhages are less liable to occur at the point of application; at the same time it does not destroy the circulation sufficiently to produce strangulation and death of the part. There is nothing that will so effectually stop all forms of excessive hæmorrhages or leucorrhœa, without producing a troublesome slough, and a subsequent contraction, as this particular application of electricity when made to the mucous membrane of the uterus.

The local effect of the negative pole is the opposite of that of the positive when the current is strong and concentrated. The action of this pole is one of liquefaction instead of hardening and coagulation. Its eschar resembles much that of a caustic alkali.

V. *The Electrodes* used in the treatment of fibroid tumors by Dr. Apostoli's method are few in number. Two electrodes are always necessary at every operation. One of these is applied externally on the surface of the body, the other in some form internally. Where powerful currents are employed, such as I have described, the first object is to devise means of conducting them through the parts desired, without producing harm to innocent tissues, or pain to the patient. One pole, the internal, is usually the active one. This is either a sound that fits accurately the uterine canal, or a pointed electrode which enters a presenting portion of the tumor. This is constructed of unattackable metal, platinum when in form of sound, platinum and iridium when in form of needle.

soft metal, of appropriate dimensions, has loosely stretched over its concavity an animal membrane which is fastened to its circumference securely enough

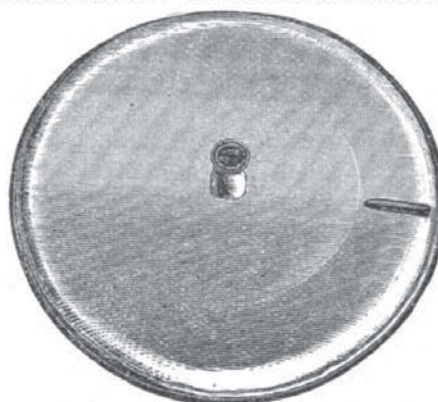


Fig. III.—Martin's Abdominal Electrode.

to render it water-tight. Between the concavity of the disk and the membrane is left a space one and one-half inches in thickness, which is filled with a warm saturated solution of chloride of sodium. The electrode is filled through a stopper on the surface of the metal. The connections are also made from this surface.

This electrode, when filled, is applied to the surface of the body so that its membrane surface is in contact with the skin. It adapts itself accurately to all irregularities, covers a large surface, and causes a



Fig. II.—Martin's Inter-uterine Electrode.

Some means of insulating the vaginal portion of the electrode must be devised. (Fig. 2.) Needles used in electrolysis should be insulated up to within one inch of the point in order to protect external tissues. After the proper internal electrode has been selected and placed in position, and before the current is turned on, the circuit of the battery must be closed by applying some form of convenient electrode externally that will give the minimum resistance without excessive pain. This has been one of the most difficult things to accomplish in the use of strong currents. This external electrode should be placed upon the abdomen in as close proximity to the internal one as possible. It should have a large surface in order to diffuse the current. All parts of the surface should conduct equally, and fit accurately into all irregularities of the surface.

Dr. Apostoli at last hit upon the following plan, which he has found to answer the purpose perfectly: A mass of potter's clay is made about into the consistency of soft dough by moistening with water, and is then spread upon the abdomen of the patient in a mass an inch or more in thickness. This is connected with the battery by placing upon its free surface a plate of soft metal with appropriate connections. This apparatus, while it answers the purpose, is a very inelegant form of electrode. In this direction I am able to offer a very decided innovation. Dr. McIntosh has succeeded in constructing for me this electrode (Fig. 3). A concave disk of

diffusion of the current so perfectly, and makes connections so complete, that I have been able repeatedly to use a current of 75 to 1,000 milliamperes without producing the slightest blistering of the integument and without producing even a disagreeable sensation.

VI. *Details of Application.*—There are three distinct operations that are called for in the rational treatment of fibroid tumors of the uterus by electrolysis. They vary both according to symptoms and conditions. The first that I will consider is for the relief of excessive hæmorrhage. I consider this of first importance because it is one of the most distressing symptoms we meet with in dealing with these difficulties, and a symptom which often baffles every other resource.

I will not go into a description of the different conditions that *may* be present in hæmorrhagic fibroids, but will confine myself to the few conditions that must be present to allow of benefit from this treatment. We have excessive hæmorrhage which may be continuous or periodic. The hæmorrhage is from the cavity of the uterus. The uterine canal must be accessible to a flexible probe. There must be no acute metritis, peri- or parametritis present. With these requisites, positive and negative, we may proceed to operate. An assistant, if the patient is reasonably strong, is not necessary. The application is preferably given in the office.

The patient's clothing is loosened, and she is in-

structed to assume the dorsal position upon an operating chair or table. A speculum is introduced or not according to convenience of operator, and the direction, size and depth of the uterine canal is ascertained by means of a soft metal probe. A uterine sound electrode composed of pure platinum, corresponding as nearly as possible with the size of the uterine canal, is selected, and made to conform to the general direction of the canal as indicated by the probe. This electrode is then introduced to the bottom of the uterus, and the insulating shield is pushed up until it touches the cervix and covers perfectly the intra-vaginal portion of the metal. When the electrode has been satisfactorily applied and connected with the positive pole of the battery, Martin's large abdominal electrode, properly prepared and attached to the negative pole of the battery, is applied to the lower portion of the patient's abdomen in such a manner as to bring its whole surface in contact with the skin.

After the electrodes have been securely placed and the connections are found to be perfect, the operator should commence turning on the current. This should be done very gradually at first in order that the patient may experience no shock. If the patient complains of a dull pain internally while the current is being increased, the operator should stop for a few seconds, and he will often find that the pain will cease, after which the current can again be increased to the desired strength without excessive pain. At the first not more than a 50-milliampère current should be used. If the patient bear this well, it should be increased at each succeeding operation until a strength of from 100 to 500 milliampères is obtained. The first operation should last about five minutes, and if well borne the succeeding ones can safely be lengthened to ten or twelve minutes. In finishing the operation the current should be decreased in strength a cell at a time very slowly, until it is entirely excluded. After the operation the patients should remain quiet for half an hour, when they can return to their homes, with instructions to keep very quiet for at least twenty-four hours.

This operation has two effects. It checks hæmorrhages, and reduces the size of the tumor. The local coagulating effect of the platinum electrode upon the inner surface of the uterine canal checks the hæmorrhage, and the electrolytic effect of the powerful current through the tumor favors its absorption. A number of repetitions of the operation are necessary to control severe hæmorrhages. It is impossible, at one sitting, for the internal electrode to come in contact with all the surface of the canal, no matter how much pains may be taken to make an accurate adjustment. Nothing but repeated operations can accomplish this. Unless the current is too strong there will be but very little subsequent sloughing at the place of contact of the positive pole. If troublesome sloughing *should* occur after an application, a somewhat weaker current should be used afterwards. It must be remembered that coagulation, and not cauterization of the tissues, is the point sought.

The second operation to which I will call your attention is for the reduction of tumors that have

grown in such a manner that they have distended or occluded the uterine canal so that it will not admit a sound electrode, and thereby renders intra-uterine *treatment proper* impossible. In these cases an *artificial* canal should be established in the obstructing portion of the tumor by means of negative-galvanopuncture entering the tumor from the cervical canal. For this operation the patient is also placed in the dorsal position. The position of the cervix is ascertained, and by aid of a proper speculum a sharpened probe of platinum and iridium is thrust a safe distance into the centre of the presenting fibroid. The vaginal portion of the electrode is properly insulated as in the other operation, and is then connected with the *negative* pole of the battery. The abdominal electrode is attached to the positive pole and applied as for the previous operation, and with proper precautions the current is gradually turned on until the desired strength is obtained, this being as high as 150 milliampères, often without pain or harm to the patient. Contrary to ordinary expectations, the *pain* produced by this operation is not sufficiently severe to require an anæsthetic, and with the exception of the first séance, when the new canal is established, the succeeding treatment is no more disagreeable than the ordinary use of the internal electrode in the uterine canal. Before any internal needle or puncture operation a vaginal injection of 1 to 5000 bichloride of mercury should be given, and repeated each day as long as the treatment is continued. An interval of about five days should elapse between the first and second applications, and the duration of the séance should be from five to ten minutes.

The first effect derived from the employment of this method is the establishment of a new channel to take the place of the distorted and obstructed uterine canal and by which subsequently the tumor will be treated. The second effect is the direct electrolytic action of the current upon the growth. The channel left after the withdrawal of the probe is somewhat larger in diameter than the electrode itself, and will remain for a number of days penetrable to the probe. There is but slight suppuration from its surface, but should there be any considerable hæmorrhage from the artificial canal, one application of the electrode with the current reversed making the positive pole the internal will give relief. One imperative point in these operations is the proper selection of poles to be employed. The immediate effect of the negative pole is to liquefy the tissues with which it comes in contact like a caustic alkali, and it should be selected for the establishment of a canal, while the effect of the positive pole is to coagulate and harden tissues coming in contact with it, like a caustic acid, and it should always be employed to check hæmorrhage either from the artificial canal or the natural uterine canal itself. Therefore for the rapid reduction of the tumor the negative pole is decidedly preferable, and should always be applied unless the presence of hæmorrhage demands the use of the positive.

The *third* and last operation to which I will call your attention is the extra-uterine galvano-puncture, or the needle operation proper. Tumors that call for this form of treatment are those that are not

amenable to the other two forms already considered.

This variety, usually of the sub-peritoneal type, often pedunculated, can be reached either by puncture through the vaginal wall, using great care not to injure the bladder or other important organs, or where this is not feasible by puncturing through the abdominal wall. Everything else being equal, the needle should be introduced into the tumor through the vagina, because if it is at all possible, the tumor lies in contact with the vagina; consequently the tissues that it is necessary for the needle to traverse are unimportant, while the abdominal wall with its fat, muscle, and peritoneal layers is too formidable to penetrate even with a needle unless actuated by absolute necessity. If the puncture is to be made through the vagina, a thorough vaginal injection of the bichloride solution should be employed, and for this operation, unless the patient has more than ordinary fortitude, an anæsthetic should be administered. For this purpose I employ, as preferable, the mixture of equal parts of alcohol, ether and chloroform, on account of its prompt action and transient effects.

After it has been definitely determined that this operation is the only alternative the patient is placed in the dorsal position, and all instruments being in readiness, the anæsthetic is pushed promptly to a surgical degree and then entirely withdrawn. A suitable speculum is introduced and a needle with proper curve, and insulated with hard rubber to within one inch of the point is thrust through the vaginal walls into the tumor. The position of the bladder should have been ascertained by means of a probe or catheter, before commencing work. When the needle has been satisfactorily adjusted the speculum is carefully withdrawn and the needle connected with the negative pole of the battery. The same external electrode, should be adjusted with the same care, and in the same manner as in the other operations described and connected with the positive pole. The current is now gradually turned on until a strength as indicated by the galvanometer is reached of 500 to 1,000 milliampères. In the meantime the patient is allowed to come out from the influence of the anæsthetic, which usually occurs without any struggling; a peculiarity of the anæsthesia by the A. C. E. mixture which makes it very desirable for this work.

This operation should last for about eight minutes the first time, and subsequently, if it is deemed desirable, a longer time can be given. When the operation is terminated, and the current has been gradually withdrawn, the needle will be found loosened and its removal is accomplished with ease and very little pain.

The abdominal operation is performed where the tumor is of the large sub-peritoneal variety, that cannot be safely attacked from the uterus or vagina, and where the tumor rises above the cavity of the pelvis, and is in contact with the abdominal wall. Here, after necessary antiseptic precautions have been carried out, the needle is thrust through the abdominal wall into the substance of the tumor at its most prominent part, and is then connected with the negative pole of the battery. The other electrode, the same variety as described in the other operations, should

be placed upon the abdomen in close proximity to the needle. The current should be 300 to 1,000 milliampères strength, and the duration of the operation ten minutes.

Herein I have endeavored to give you an idea of the present status of the treatment of fibroid tumors of the uterus by means of the strong current of electricity. The use of the strong current was adopted by Dr. Apostoli, of Paris, he being the first to devise electrodes and rational means by which it could be made tolerant. To the extent of discussing the strong current and utilizing the coagulating effect of the positive pole for the checking of uterine hæmorrhages, I have described Dr. Apostoli's methods. Otherwise I have not confined myself to any one system, but have endeavored to give the best means, according to my knowledge and judgment, that have been developed, up to the present time, for the relief of this distressing malady. The scope of the subject is too broad to admit its being satisfactorily dealt with in one short paper, and, I therefore beg to submit, at the risk of wearying your patience, the following conclusions, which may cover a few points of importance that time would not allow me to discuss in the body of the paper.

CONCLUSION.

1. A means of generating a continuous current of electricity which can be increased per 10 to 1,000 milliampères in strength, is necessary in order to obtain all the benefits of this treatment.

2. Hæmorrhages from hæmorrhagic fibroid tumors can be cured by the local coagulating effect of the positive pole applied inter-uterine.

3. The inter-uterine electrode, when positive, should be of unattackable metal, conforming as nearly as possible to the size and shape of the uterine canal and having the vaginal portion insulated.

4. When the cervical canal cannot be entered a negative galvano-puncture should be made into the presenting part of the obstructing mass of the tumor and an artificial canal, which is to take the place of impenetrable uterine canal, in all subsequent treatments be formed.

5. The intra-uterine electrode should in all cases be negative, unless there is hæmorrhage or excessive leucorrhœa, when the positive pole is always required. The same patient may, however, present successive symptoms demanding the use of each pole.

6. The strength of the current should be the strongest possible consistent with the desired therapeutic effect and the endurance of the patient.

7. Cases of intolerance of high doses arrange themselves under the three following heads: 1. Hysteria. 2. Enteritis. 3. Acute nephritis, peri- or parametritis; the most tolerant being the deep uterine and profusely hæmorrhagic.

8. The duration of the operation should be from eight to ten minutes, according to the toleration of the patient.

9. The number of operations is necessarily dependent upon and influenced by the result to be accomplished. A severe hæmorrhage can be checked in from four to five sèance, while a general reduction of

the tumor necessitates many operations, varied, of course, according to size and location. In many cases simply a restoration to health and a relief from the prominent and annoying symptoms must be accepted as a substitute for an actual cure.

10. The time of commencing the treatment matters but little, if the tumor is not rapidly growing, and no excessive hæmorrhage is present. The operation should be inter-menstrual, if possible, but if hæmorrhage is continuous operate during the flow. The séances should occur two or three times a week if compatible with the endurance of the patient, and should be as regular as possible.

11. Extra-uterine puncture should be regarded only as a last resort, but every means of reaching the tumor through the uterus being impracticable, seek, if possible to make the operation extra-peritoneal, should this in turn prove equally unadvisable, use as a final alternative the abdominal puncture.

12. Strictest cleanliness and thorough antiseptic precautions are absolutely demanded in operations connected with this treatment.

163 State Street, Chicago, February, 1887.