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THE GALVANO-CAUSTIC APPARATUS: ITS APPLICATIONS IN SURGERY.

By THOMAS JAMES WALKER, M.B.Lond., late Assistant-Physician and Pathologist to the Queen's Hospital, and Demonstrator of Anatomy in Queen's College, Birmingham.

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As the cases I have mentioned give no idea of the variety of circumstances in which the galvano-caustic apparatus may be employed, and as only a few cases of fistula, nevus, hæmorrhoids, etc., have been recorded by British surgeons, and by our dentists only cases of the application of the instrument to the teeth, I shall now mention a few of the cases recorded in Dr. Zsigmondy's treatise.*

He alludes to some of Professor Middeldorpf's cases, of which perhaps the most interesting is one where a *polypoid* tumour weighing over two drachms, growing in the larynx above the right vocal cord, and interfering seriously with respiration and deglutition, was removed by the cutting noose. Three times the endeavours to place the noose round the tumour failed, owing to the violent choking and spasm which the attempts caused, and the consequent depression of the larynx. The tongue, however, being seized by a pair of forceps, was drawn forwards, and the larynx thus fixed; and now, notwithstanding the choking, the end of the cannula was rapidly brought behind the epiglottis; the wire-noose was thrown over the tumour, and by means of the finger pressed down to its base; the loop was tightened; the battery set in action; and one or two turns of the screw caused the tumour to fall off. There was no bleeding, no more distress in breathing or swallowing. In four days the patient was able to leave his bed, and in twenty-eight days he quitted the hospital. It is difficult to conceive how this tumour could have been extirpated by any other instrument; and, had it not been removed, probably not even tracheotomy would have saved the life of the patient. Another of Middeldorpf's cases is interesting, as showing the powers of the instrument. He removed a supernumerary thumb from the finger of a child six months old, and with the platinum wire cut the bone smoothly through.

Zsigmondy records, among other cases occurring in his own practice, three of *amputation of the penis*—an operation to which the galvano-caustic apparatus is considered especially applicable. In one case, cicatrization of the wound required seven weeks for completion, and the patient died from a return of the disease. In a second, the operation was adopted merely as a palliative. In the third, the patient died thirteen days after the operation, from pyæmia.

Several cases of removal of *hæmorrhoids* are given, one of extirpation of the lower vascular and polypoid portion of intestine in a case of *prolapsus ani*, and another case of prolapsus in a child four years of age, in which, the portion of intestine liable to prolapse being pulled down by the finger and fixed externally by hooked forceps, four deep longitudinal grooves were made with the *Galvanokauter*; the parts suppurated, and the contraction was such that in five weeks the prolapsus was completely healed. Cases of *extirpation* of several *tumours* are related; also two cases of *castration* for serofulous disease of the testicle, in one of which the whole operation was completed by the cutting noose; in the other, the skin and cellular tissue, being anæsthetised

by a freezing mixture, were divided by a knife, the spermatic cord, etc., being divided by the cutting noose. *Amputation of the breast*, for an ulcerated medullary tumour, was performed partly with the *Galvanokauter*, but chiefly by the platinum wire, which, by means of a needle, was passed through the tumour so that the noose should include the upper segment; and, this being divided, the integumental coverings of the lower portion were divided by the *Galvanokauter*; the cutting noose was then applied, to complete the removal. This operation was undertaken not so much with the object of curing the disease, as to palliate and allow the treatment by Landolfi's paste and other caustics.

The division and cauterisation of urinary, fæcal, and other *fistulas*, are recorded; and, finally, the following case of *amputation of the lower extremity at the junction of the middle and the lower third of the thigh*.

A lad, aged 16, was admitted into the General Hospital, Vienna, on the 15th of February, 1858, with acute periostitis of the right tibia. He went on well for a few days; but the knee-joint having become seriously involved, the practice of free incision into the joint was adopted, and, three days afterwards, the condition of the patient was as follows. The tongue was moister, and the general icteric tint less than before the incisions into the joint were practised. There was no cough, but hectic fever still remained; the pulse being about 114 in the minute, and rigors occurring once or twice a day. There was extreme emaciation, and a bed sore over the sacrum. The leg was bent outwards at the knee, at an angle of about 160°; while the toes were turned strongly inwards. The knee-joint was slightly swollen, sensitive to the least touch; any attempt at raising or moving the limb causing intense pain. The bones of the joint might be moved from side to side, causing crepitation. The extremity was somewhat less swollen than it had previously been; its cutaneous covering was puckered; the four incisions made by the surgeon were indolent, without granulations, smooth and pale. The secretion was not so copious, offensive, or frothy, as earlier. The inguinal glands were not enlarged. There appeared to be a chance for the patient, if the limb could be removed; and, Professor Zsigmondy thinking that this could safely be done by the galvano-caustic apparatus, on the 18th of March the patient was put under the influence of chloroform, and the operation performed as follows. The wire of the cutting noose was passed round the thigh, which was so emaciated that the platinum wire required was only ten inches long; this, however, being still much more than is needed in most operations, could not be heated without the full power of the battery, and could not be used more than the fiftieth of an inch thick. By turning the screw of the instrument, the wire was tightened until the obstruction to the venous circulation was so great as to cause a few drops of blood to ooze from the sinuses in the leg; and now, the combining disk being placed on the battery, the screw was slowly turned, and the tightening wire burned its way through the skin. The battery, strong as it was, was not sufficient to cause the whole length of the wire to glow; and the middle of the noose, which was unexpectedly the coolest part, made slow progress compared with the part of the wire nearer the ends. Before the skin was completely cut through, the wire broke, and had to be renewed; it was again applied in the same situation, and the operation continued. After the division of the superficial muscles, these with the skin were retracted as much as they could be; and the division of the deeper tissues was effected in a higher place than that in which the instrument had worked through the superficial structures. The noose, being now much smaller, was seen at the bottom of the wound, in a glowing heat through its whole length; it was pushed up along the bone, so as to separate the soft tissues from it, and to

* Die Galvanokaustische Operationsmethode nach eigenen Erfahrungen, etc., von Dr. A. Zsigmondy. Wien, 1860.

admit of the division of the bone higher than any of the soft tissues. The cutting noose was now removed, and a retractor applied. Up to this period there had not been a drop of blood shed in the operation; but, on the bone being sawn through, some bleeding took place from the medullary canal; and, on removing the retractor, the femoral artery sprang; it was, however, seized and tied with an ordinary ligature immediately. It was the intention of Dr. Zsigmondy to have applied a ligature to this artery, even had it not bled, as it was clearly visible at the surface of the wound, which was covered by a very thin eschar. The superficial structures were divided sufficiently low down; and the granulations in the upper part of an abscess which had been left in the stump, being loose and coarse, were removed by means of Cooper's scissors. The bleeding thus caused, as well as that from the medullary canal, was arrested by the *Galvanokauter*. The operation being completed, the only dressing applied was a large sponge bound on with a three-cornered cloth.

Immediately after the operation, extreme faintness came on; the countenance was still paler than before; the pulse was very feeble and small, 166 in the minute. Red wine was administered, with the effect of somewhat reviving the patient, who slept more quietly, and was less delirious.

Next morning. Tongue dry; pulse 132. Complexion paler than before the operation, and slightly yellowish. Patient cheerful, and pleased at the relief from pain. At the stump, the skin was somewhat retracted; it was not burned more than was requisite, being hard round the edge to the extent of about a line. In several points at the stump, the epidermis was raised into little blisters.

Second day (March 20th). Good appetite.

Third day. Spots of purpura had appeared on the breast, belly, and extremities; the wound was livid and inactive. In the evening, the patient had a rigor.

Fourth day. Two rigors, followed by heat, sweating, thirst, and frequent delirium; no cough; advancing emaciation. The complexion was still yellow; bedsores sloughing; superficial gangrene of the stump, from which the bone projected, the soft parts being retracted.

Fifth day. Diarrhœa, involuntary stools, etc. Death.

A *post mortem* examination disclosed, in addition to the appearances of extreme anæmia, only metastatic abscesses in both lungs, varying from the size of a bean to that of a walnut. The soft parts at the stump had retracted, so that the wound appeared as a hemisphere, with the bone projecting from its centre. The wound was black, dry, and without any sign of reaction.

Having described the instruments used in galvanocauteric operations and given illustrations of the cases in which they may be employed, I will add a few considerations on the advantages and disadvantages of the apparatus as compared with others for which it may be substituted: viz., caustics, cutting instruments, ligatures, and crushing instruments.

In comparing the galvanic cautery with other *escharotics*, we must take into consideration the degree to which it acts on the tissues, the pain it causes, the nature of the wound produced, and the convenience of application. We cannot substitute the galvanic cautery for any of the milder caustics, which act rather as astringents. From more powerful caustics, such as chloride of zinc, Vienna paste, etc., the galvanic cautery differs in the fact that its working is limited to the part to which it is actually applied, and that it works therefore to but a limited depth. This property may be an advantage or disadvantage according to circumstances; in many cases complete but superficial destruction of tissues is all that we desire, and this could be effected with much more certainty by the instruments now under consideration than by any potential caustic; while on the

other hand their application would be decidedly contraindicated where we wished to effect any considerable destruction of tissue as in the treatment of cancer, etc. The galvanic cautery must be preferred to the actual cautery heated as usual, under all circumstances, when the size of the part to which it is to be applied is not great; but in this case the slowness of the galvanic operation, from the necessarily small size of the cautery, must render the ordinary heated iron the more suitable instrument, notwithstanding its liability to be cooled. As to the amount of pain caused by the galvanic cautery, I believe that, during the application of the instrument, this is probably as great as or greater than that produced by any other caustic; but in almost all cases it ceases on the withdrawal of the instrument. The reason why it should produce less pain than the ordinary actual cautery, I have already discussed. With regard to the wound left by this form of cautery I would merely observe, that from the cases mentioned above, where pyæmia followed the use of the instrument, it is clear that it possesses no peculiar virtue which would prevent such a result: the eschar separates usually within a week from the application, though sometimes it adheres even longer; as to the extent to which contraction takes place after the separation of the eschar I had no opportunity of judging. As to convenience of application, the galvanic cautery undoubtedly possesses an advantage over all other escharotics, and more especially over the actual cautery, in that it may be brought into contact with the part in a perfectly inert condition, a property of great importance where the part affected is situated at the bottom of any of the natural cavities or canals. In a recent number of our JOURNAL we have an eminent surgeon advocating the treatment of stricture of the urethra by caustic; this plan has been practised in Germany, more than it has in recent years in our own country, and a galvanic cautery for the urethra is manufactured, which, being introduced as far as the stricture in an inert condition, is then brought into action by a pressure of the thumb on the slide on the handle of the instrument. Of course there are many instruments contrived to enable us to introduce potential cauterics harmlessly to the point at which we wish to apply them, but none of these can be so perfect and simple as the galvanic cautery.*

Comparing the galvanocauteric apparatus with the *écraseur*, I see no advantage which the former possesses in any but exceptional cases. The special advantage which both these methods of operating possess, is their hæmostatic action; and there is no case mentioned by Zsigmondy where the action of the cutting noose was more decided in this respect, than is that of the *écraseur*; the cases where the former instrument was employed being precisely similar to those where the latter is applicable. As regards the nature of the wound left after the operation, the *écraseur* must be acknowledged to have the advantage; the application of this instrument is almost always followed by a rapidly healing sore, while the cutting noose must always leave a burn, with a thin eschar, requiring considerable time to heal. A statement has recently appeared in the French medical journals, that many of those patients, on whom Chassaignac has operated by means of the *écraseur* for removal of the protruding bowel in prolapsus of the rectum, are now returning to the hospitals with stricture; if this be true, one cannot but suspect that such an evil consequence would be even more likely to follow the same operation by the cauterising ligature. As regards the pain caused by the two modes of operating I can only form a surmise, as in almost all cases where I have used or seen used the *écraseur*, chloroform has been administered. I should conjecture that the pain of the

* A very perfect instrument of this kind for applying caustics to the larynx has been manufactured by Leiter of Vienna; this I shall describe fully in a Treatise on the Laryngoscope, on which I am engaged.

two operations would be about equal. The *écraseur* may be made sufficiently strong to make its way through any of the tissues through which the galvano-caustic wire has been carried, in the operations above mentioned; and amputations have been performed by the latter as by the former instrument. It is in convenience of application that the galvano-caustic cutting noose must occasionally possess a great advantage over the *écraseur*; for example, in the case of polypoid tumour in the larynx, the *écraseur* could not have been applied. In cases where very vascular tissues have to be divided, as in a case of hypertrophied clitoris mentioned by Zsigmondy, in the peduncle of which several large arteries could be readily felt pulsating, the operation might be carried out somewhat more rapidly with the cutting noose, than with the *écraseur*; but even with the former, the division must be carried on slowly, and the comparison which Zsigmondy makes, when he speaks of galvano-caustic operations as being accomplished in a few minutes, while an operation with the *écraseur* lasts an hour or more, is an excessive exaggeration.

Over the *ligature* the apparatus under consideration possesses those advantages, which have frequently been urged in favour of the *écraseur*; the most prominent being that the part to be removed, as for example, a mass of hæmorrhoids, a uterine polypus, etc., is removed at once, and not left a putrescent appendage to the body until separated by ulceration, or a sensitive and inflamed part with an ulcerated neck, requiring tightening of the ligature before it is completely separated from the body, as is the case where the ligature is imperfectly applied, so as not completely to strangulate the included tissues.

To any *cutting instrument* the galvano-caustic apparatus must be decidedly preferred, in cases where the paramount indication is the employment of an operation which avoids loss of blood; but in selecting our cases we must always bear in mind, that if, on the one hand, we are saving our patient from the exhaustion caused by hæmorrhage, we are, on the other, losing the chance of primary union which might result should cutting instruments be employed, and are insuring a suppurative process which may damage the system no less than would loss of blood. This reminder I make in allusion to such a case as that of amputation at the thigh described in another part of this paper; and I would suggest that, if the employment of accupressure needles, as advocated by Dr. Simpson, improve our chance of obtaining primary union as much as I am inclined to think it will, this consideration gains considerable weight.

As I have employed one case of tumour in the larynx to illustrate the advantages of the galvano-caustic mode of operating, I must mention another, which I shall more fully describe in my work on the laryngoscope, in the treatment of which cutting instruments are to be preferred. The case, which I frequently had opportunities of observing, was under the charge of Dr. Carl Stoerk, of the Vienna General Hospital. A child, about six years of age, laboured under aphonia, disordered respiration, etc., which were found, by laryngoscopic examination, to depend on a small apparently fibrous polypoid tumour, growing from the angle of the rima glottidis and projecting between the vocal cords. The application of lunar caustic doing nothing towards the alleviation of the symptoms, and the tumour continuing to grow, further measures were discussed, and naturally removal by the cutting noose suggested itself to us; but the operation for removal, we thought, must be a momentary one, one which would completely remove the growth, and one which would hold it secure, and prevent its passing into the trachea when removed. The galvanic cutting noose would fulfil none of these conditions; and at the time when I left Vienna, the instrument-maker was preparing a pair of curved scissors with, on

the convex surface of each blade, little hooks directed inwards, which would hold anything divided by the blades. Of the issue of the case I have not yet heard.

It may occasionally happen that the galvano-caustic method should be preferred to the knife in cases of fistula, either on account of the great vascularity of the tissues to be divided, and the chance of dividing vessels awkwardly situated for the ligature, or from the obstinate tendency of the divided parts to heal so as again to leave fistula, when the action of the cautery on the divided surfaces would probably lead to healing from the bottom. It was in the treatment of fistula, I believe, that the principle of employing galvanic heat was first applied by Mr. Marshall; and the success attending this plan of treatment certainly appears as great as that following any other of the decided measures which are employed in the treatment of this affection. In all ordinary operations, however, I think the rapidity and ease with which cutting instruments may be used, must render the use of the galvano-caustic apparatus a surgical error. The opening of abscesses, and similar operations by this apparatus, as practised by Zsigmondy, etc., only illustrates the tendency that exists in surgery as in other branches of medicine, to work every novelty to excess.

Let me, before drawing my final conclusions, point out certain disadvantages which the mode of operation under review intrinsically possesses, and which must not be overlooked in comparing it with any of the other methods alluded to. In the first place, the galvano-caustic apparatus, including the most useful instruments, and properly fitted for a surgeon's use, cannot be obtained, even in Vienna, at a much lower cost than ten pounds; and the price of a well finished set is twenty pounds. Zsigmondy, taking the average of thirty times of using the apparatus, each time for about two hours and a half, considers the expense of every time the battery is used at about three shillings; and even this is a consideration where in hospital practice one would substitute the use of the galvanic cautery for that of the ordinary one, or some equally inexpensive operation. A greater disadvantage is the liability of the apparatus to get out of working order; this I saw in the cases where Dr. Zsigmondy operated: a globule of mercury is very apt to be spilt, and to form a direct channel of communication between the elements of the battery, which completely prevents the passage of the current by the circuitous course of the conducting wires, and the platinum instrument in use. Many other causes also contribute to render the action of the battery somewhat uncertain.

Again, the constant emptying and filling of the cells with the strongest nitric and with sulphuric acid, the amalgamating of the zinc elements, etc., involves an amount of labour and a risk of destruction to property, which must, in common with the bulk and weight of the apparatus, interfere materially with its employment in private houses. Indeed, it was not unusual in Vienna to have the instrument-maker in the ward during the operations to look after the battery. Lastly, the operator is too dependent on others, on the assistant who is attending to the mutation-disks, etc. His instruments must always be connected with the battery by heavy conducting wires, which, even when of considerable length and as light as possible, cannot fail to interfere with the freedom of motion which the hands and instrument of the operator should possess. I must add, that the smell and smoke caused by the burning, and occasionally blazing tissues, must be considered an evil; great as is the horror which patients feel towards the knife, it would, I imagine, be exceeded by that produced by an operation with such accompaniments as these.

Having now endeavoured, as fairly as possible, to lay before the profession facts and considerations, from which

they may form an opinion on the galvano-caustic mode of operating, I will finally state my own conviction, that it is only in exceptional cases that the galvano-caustic apparatus should be substituted for either caustics (were it not for the cumbersomeness of the apparatus, it should always supersede the common actual cautery), the *écraseur*, or cutting instruments. Hence, I would not advise every practising surgeon to possess himself of the instruments; but, since these exceptional cases not unfrequently occur, I would have each surgeon aware of this mode of operating; and in each large district there should be an operator possessed of the apparatus, to whom application could be made, in a case where this plan of operating was indicated.

Before the introduction of the *écraseur*, the galvano-caustic mode of operating was more required than now; and it is probable that our having heard so little of it recently in England, may depend on the employment at present of the *écraseur* by those who otherwise would have used the galvanic apparatus.

ACCIDENTAL SEPARATION OF THE PLACENTA AT THE SEVENTH MONTH OF PREGNANCY:

ALARMING SYNCOPE: INDUCTION OF PREMATURE LABOUR: RECOVERY.

By G. E. STANGER, Esq., Nottingham.

Mrs. H., aged 36, mother of three children, healthy, and moderately robust, had arrived at the end of the seventh month of pregnancy, when she took a long walk on the 20th March, 1861. On her return home, and even before she arrived there, she felt extremely faint, and was scarcely able to walk. She soon became so alarmingly exhausted, that a messenger was sent for me in great haste, as her husband thought she was dying. On my arrival, at 3.30 p.m., I found my friend, Mr. Higginbottom, in attendance. The patient was lying prostrate on the bed, blanched, and in a state of syncope. She could only speak in a whisper; but she complained that her body felt very large, hard, and distended. The pulse was very indistinct and fluttering, and her whole appearance indicated extreme danger. She was not aware that she had used any undue exertion, or that she had slipped or injured herself in any way; but I felt convinced that hæmorrhage had taken place into the womb, and was in all probability still going on. The abdomen was as large as might be expected at the expiration of the full term of pregnancy. No fetal sounds could be heard; and the patient remarked that she had not perceived any movement of the child after leaving home in the morning. At this time there was not the slightest hæmorrhage externally; neither was there any indication of the approach of labour; and, on examination *per vaginam*, the os uteri was in its normal condition.

Under these circumstances, both Mr. Higginbottom and myself felt some difficulty in deciding what course we should pursue; for, on the one hand, we feared that, if we did not interfere, and the hæmorrhage continued, she must inevitably sink; and, on the other hand, if we attempted to induce premature labour, the blood might flow more rapidly as soon as it was allowed to escape from the womb, and death might ensue before we had accomplished the delivery.

We determined, therefore, to wait for a time, especially as there seemed to be now and then an attempt to rally; and we hoped that the os uteri might begin to dilate.

She continued in much the same state during the evening. Mr. Higginbottom remained with her the whole time, as I was only able to call occasionally, in consequence of another engagement.

At 10 p.m., the symptoms not being in any degree improved, we decided on the propriety of bringing on labour; but, before doing so, we requested the opinion of Mr. Wright, the senior surgeon to the Nottingham General Hospital. Mr. Wright at once recommended this practice, and considered that the situation of the patient was so critical that it was doubtful whether she would survive the operation. Soon after this advice had been given, hæmorrhage began to take place from the vagina in considerable quantity; and the syncope became still more alarming. I, therefore, immediately introduced a straight silver catheter into the uterus, and let off the liquor amnii. By the conjoint and persevering efforts of Mr. Higginbottom and myself, the os was sufficiently dilated to allow of a foot being brought down; but so rigid and unyielding was it that it was a long time before we could succeed in laying hold of the second foot, and even then the exertion required to extract the body was so great that the head was separated from the trunk, which, of course, greatly retarded the operation. We succeeded, however, at length, in removing the head; and we were rejoiced to find that during the two hours that we were engaged in effecting the delivery, very little hæmorrhage occurred. The placenta was removed without any difficulty, being already partially, if not altogether, separated. Slight hæmorrhage occurred about half an hour after; and great faintness and exhaustion continued for many hours; but the flooding was checked by the application of firm pressure. The patient recovered in a few days without any drawback.

REMARKS. I think it can scarcely be questioned that the plan which was pursued in this case was the only practicable one. Whether the operation ought to have been performed earlier, may, perhaps, admit of some difference of opinion. If I were to meet with another case of the kind, I should, as soon as I was satisfied that a separation of the placenta had taken place, puncture the membranes, and then wait for the appearance of urgent symptoms before I forcibly dilated the os uteri.

The following case will shew the danger of delay in such instances.

Several years ago, I was summoned to a patient at the same period of pregnancy as the above. She was a person of remarkably lax habit, and had copious floodings in several of her confinements. On this occasion she had been exerting herself at the garden in pulling up vegetables, and went home very much fatigued. When I saw her, at 6 a.m., she was very much depressed, tossing about in bed, and bathed in cold perspiration. She said that she felt as if she should burst; and the abdomen was very hard and distended. There was no appearance of hæmorrhage externally; but I felt satisfied that blood was being effused into the uterus, and was convinced that she could not continue long, unless something was done for her. I sent a messenger immediately for Mr. Wright; but she died before he arrived.

I made a *post mortem* examination of the body the same day, in conjunction with my friend, Mr. Thomas Wright. We found the placenta separated throughout its whole extent, and the uterus distended by an enormous coagulum.

In this case, doubtless, the hæmorrhage had been going on slowly during the whole night; and there seems very little question that, if the patient had been seen sufficiently early, and prompt measures had been adopted, her life might have been saved. I apprehend that some sudden exertion or strain in these cases produces a slight separation of the placenta; that the blood which is then effused acts as a wedge to detach more and more of it, until in time the whole mass may be separated without any blood escaping from the womb. I do not remember to have met with any account of such cases in obstetric works; and I should be glad if some-