CLINICAL LECTURE

ON

A CASE OF ANEURISM OF THE ARCH OF THE AORTA TREATED BY GALVANO-PUNCTURE.

Delivered at University College Hospital.

By H. CHARLTON BASTIAN, M.D., F.R.S., F.R.C.P.,

Professor of Pathological Anatomy in University College, London; Physician to University College Hospital; and Senior Assistant-Physician to the National Hospital for the Paralysed and Epileptic.

PART II.

THIS case is an interesting one in several respects; but I propose to limit my remarks to three principal topics:—

- I. Concerning the mode and cause of death.
- II. Concerning the effects of the galvano-puncture in this particular case.
- III. Concerning the methods of procedure in treatment by galvano-puncture.

I. *Mode and Cause of Death.*—We learn from the patient's history that the thoracic parietes had begun to project rather rapidly below the inner end of the right clavicle, and in the neighbourhood of the sternal end of the second rib, about a month before his entry into the hospital; and that a slower increase had been taking place in the upper and more prominent part of the swelling, which was covered only by a thin layer of integument. During the interval between the second and third galvano-punctures, it became unmistakably evident (October 15th and 16th) that the lower part of the swelling was still increasing in size, although this portion of the parietes of the aneurism had not as yet been interfered with; whilst it was not until after the third operation that any increase in size of the upper part is noted (October 20th), although the two punctures in this situation had never shown the least signs of irritation, and had closed in three or four days so as to leave almost no trace behind. Again, although some amount of irritation was set up around the two punctures made on the last occasion in the lower part of the swelling, and although this continued for ten days, yet this part of the aneurism ceased to increase after the operation, and the pulsation then underwent a marked diminution. There is, therefore, no evidence to lead us to believe that the punctures themselves had, either directly or indirectly, anything to do with the increase in size of the swelling noted whilst our patient was under observation. This conclusion is, moreover, strengthened by the results of the *post mortem* examination. The examination showed us that the walls of the sac were unusually thin in almost all parts, though it also revealed an absence of any trace of inflammatory change. We have a right to infer, therefore, that the slight increase in size which took place whilst the patient was in the hospital was a result of the continuance of those pathological changes which had initiated the aneurism and led to its previous stages of growth.

Next, it is important to note that the man had no constitutional symptoms of an unfavourable nature till three days before his death. This condition was ushered in by attacks of a neuralgic character affecting the limbs—obscure both as to nature and cause, but to which he declared he had been frequently subject during the last six years. The pains disturbed his sleep for two nights, and a slight febrile condition became developed. The temperature rose to 101.8 on the night of the 26th; but, by the following morning, at ten o'clock (that is, only thirty-nine hours before his death), it had dropped to 97 degs.—this temperature being verified by two observations, and being quite in accordance with the state of the pulse and respiration at the same time. But, almost immediately after this, changes of a more rapid kind set in. A rigor occurred and the temperature rapidly rose, so that by 6 P.M. of the same day it stood at 104.6. The next morning, the temperature was a trifle higher still; the patient was troubled with an irritative cough, and vomited several times, whilst the integuments over the swelling were notably œdematous. About six o'clock in the evening, he began to have frequent fits of dyspnoea (not of a congestive type), which increased in frequency and severity, and seven hours afterwards he died—a partial collapse of the aneurismal swelling taking place at about the same time.

Now, in the light afforded by the *post mortem* examination, we are enabled pretty well to interpret these phenomena. There was, in the first place, no inflammatory condition of any of the organs found, of such an extent as to account for the high temperature; and the attacks of dyspnoea from which the patient suffered were very similar to those occasionally occurring in aortic aneurisms associated with irritation of

the pneumogastric nerve, an example of which some of you may have recently seen in the same ward. I allude to the case of a younger man, named Cook, for whose frequently occurring attacks of dyspnoea laryngotomy had at last to be performed. The attacks, however, persisted almost as badly after the operation, so that, in thirty hours after its performance, he died. In this case, the left pneumogastric nerve was much pressed upon and firmly adherent to the sac, and, although there was little more than a highly congested condition of the left lung, and no trace of inflammation in other organs, the temperature had (in spite of the very imperfect aeration of the blood) risen to 105.6 immediately before death. Two days before death also, as in the case of Faraday, this patient's temperature had been 100 degs. This agreement is very significant, seeing that, in the necropsy of Faraday, we also found evidence of a decided structural change taking place in the left pneumogastric nerve, which was closely adherent to a part of the sac where it had evidently of late been undergoing further attenuation. It seems to me, therefore, very probable that a rather sudden thinning in this direction, with consequent changes in the pneumogastric nerve, may have had much to do with the onset of dyspnoea and vomiting, and also with the rapid development of the febrile condition—all of which symptoms, as before stated, began to show themselves only thirty-nine hours before the patient's death. But the walls of the sac had become more and more attenuated in other parts; so that, even just before the onset of the symptoms above named, the wafer-like membrane over the roughened inner and eroded end of the clavicle seems to have given way slightly, so as to lead to the œdema of the integuments over the swelling, and subsequently to the effusion of blood which was found in the substance of the pectoral muscle. A little later on, the immediately determining cause of death (hastened, doubtless, by the cough and dyspnoea) was, perhaps, the slight rupture which occurred in the equally attenuated lower and anterior part of the aneurism—permitting the effusion of blood into the anterior mediastinum, which was in all probability followed by that partial collapse of the aneurism observed by Mr. Downes only twenty minutes after the patient's death.

II. *The Effects of Galvano-puncture in this Particular Case.*—The *post mortem* examination showed that the aneurism was very distinctly sacculated, notwithstanding the original absence of all *bruit* over its site. It happened to have, in fact, just that conformation which was peculiarly favourable to its cure by galvano-puncture. Only one vessel—the left carotid—arose from the sac. When the patient came under observation, the circulation through this vessel had already very much diminished since (as we found after death) it had but a valvular communication with the sac. Finally, the circulation through it became obliterated (probably about the 20th), without attracting attention or producing symptoms of any kind. The origin of the innominate and of the left subclavian was altogether outside the sac of the aneurism.

Within the sac we found a large clot—moderately firm and laminated—rather more than half filling the aneurismal cavity. It had no notable attachments, except around its base, where it tended to shut out the stream of blood from the sac. Everything, therefore, seemed favourably progressing towards a cure of the aneurism. But unfortunately the progress of the other changes did not allow time for its completion: the patient died too soon.

But it may naturally enough be asked, Was the clot found after death a result of the galvano-punctures? This is a question well deserving our careful attention.

It has been now thoroughly established by the labours of Dr. John Duncan, Dr. Fraser, and others, that a clot can be readily obtained in blood-vessels by the action of the galvanic current. We know, however, comparatively little about the exact nature of this clot. It is described as being of dark colour, and as differing in appearance from ordinary coagulated blood. As Mr. Holmes has pointed out in his most able lectures on the surgical treatment of aneurism (*Lancet*, 1872, vol. ii, page 327), the clot, which is first formed by electrolysis, is apt at times not to be persistent. Pulsation may cease in a tumour for a time after galvano-puncture, whilst, in a week or ten days, it may again manifest itself—apparently because the clot first formed has subsequently melted away. But, in addition to this clot of somewhat uncertain composition and durability, formable directly by the action of the voltaic current, we have to bear in mind the fact, that even a very minute clot produced in this manner may form the nucleus around which a process of spontaneous coagulation takes place. This process of spontaneous coagulation leads to the formation of a more or less colourless clot, composed, in the main, of interlaced fibres of fibrine containing white blood-corpuscles within their meshes. This colourless clot also grows by the deposition of successive lamellæ, and the whole forms a firm, coherent, and somewhat elastic substance, admirably adapted to take off the pressure of the blood, and to act as a thoroughly efficient buffer. Now it was a clot of this latter nature which we found more

than half filling the aneurism, and there are several reasons tending to show that the clot had been recently produced—as an indirect result, in fact, of the galvano-punctures.

It seems obvious that changes took place within the aneurism, as a result of the galvano-punctures. Thus, after the first occasion, a slight *bruit*, not previously audible, was to be heard over the sac itself; there was also apparently an altered incidence of blood-pressure for a time, since the blood began to pass more readily through the valvular opening into the left carotid—the pulsation in this vessel became more distinct. After the second galvano-puncture, there was a slight diminution in the amount of pulsation over the upper end, the *bruit* there still continuing; and then there came a gradual diminution in the flow through the valvular opening of the left carotid, as judged by the diminished pulsation. After the third operation, the flow gradually ceased through the left carotid, and a very marked diminution took place in the amount of pulsation over the lower part of the swelling, where it had been previously increasing.

It seems almost certain, therefore, that the clot which we found in the aneurism had been produced as a result of the treatment to which the patient was submitted; this view being still further confirmed by the fact, that a button-like piece of the same kind of colourless material as that which constituted the larger clot, and of just the same diameter as its apex, was actually attached to the wall of the aneurism in a situation corresponding with the puncture made by the zinc-coated needle. I think there is good reason for believing, indeed, that the apex of this clot had been accidentally separated from the parietally attached portion, during the removal of the aneurism. For the laminated strata of the larger clot, were—to use a geological phrase—"conformable" with the surface of its upper portion. The clot had been formed by the successive deposition of laminae upon its under surface; these laminae becoming larger and larger, so as to give the whole a rudely conical shape, the base of which was already partly attached around its margin to the walls of the sac.

III. *Methods of Procedure in Treatment by Galvano-Puncture.*—The modes of performing galvano-puncture are numerous; and, concerning their respective merits or demerits very opposite opinions have been expressed by different physicians and surgeons. The subject itself is in its infancy; but the time at our disposal now will only allow me to allude to a few of the points concerning which a difference of opinion exists—and this principally with the view of explaining the reasons for the course pursued in the present case, and of suggesting the principles of a safe and tentative mode of attacking sacculated aneurisms of the arch of the aorta or of other great arteries of the body.

The risks specially attendant upon this mode of treatment are thus referred to by Mr. Holmes in the admirable lectures to which I have already referred. He says (*loc. cit.*, p. 665):—"The dangers are principally from two causes—the inflammatory action produced in the sac and the cellular tissue which surrounds it, and the gangrene or ulceration of the skin at the points of entrance of the needles."

Whichever method we adopt, we must, therefore, strive to reduce these dangers to a minimum. The principal points to be considered in this relation have reference to the nature of the battery to be employed, the strength of the current, the mode and duration of its application, and the size and nature of the needle which it is most desirable to use.

As in this method of treatment we wish to make use of the electrolytic powers of the battery current and to avoid the heat-generating effect upon the electrodes, it is better not to use the more powerful combination and larger plates of a Bunsen's or Grove's battery. We may get all the good and none of the bad effects from the careful use of the battery which we employed in the present case, viz., Foveaux's modification of Smees's battery, made by Weiss and Co.

It is upon the question as to the most advantageous mode of employing the current that the greatest differences of opinion exist. Some writers recommend the insertion of the negative pole only into the sac, whilst the positive pole is applied to the integuments outside. Others recommend the introduction of two needles into the sac, one of which is to be connected with the positive pole and one with the negative, the current being allowed to pass all the time in the same direction, and, in the hands of different operators, being either strong for a short time, weak for a long time, or even strong for a long time. But some of those who recommend the insertion of both poles into the sac, follow Pétrequin in advising that the direction of the current should be changed from time to time, during the same operation. And, lastly, a third set of writers recommend the method of procedure which we adopted in the present case, viz., the introduction of a needle or needles in connection with the positive pole into the sac itself, whilst the negative pole is applied by means of a wet sponge to the adjacent skin.

Now, before making any comments of my own on these different methods of procedure, I will quote the conclusions arrived at by Baumgarten and Wertheimer, as given by Meyer (*Electricity in its Relations to Practical Medicine*, translation by Hammond, 1869, page 470). He says:—"The numerous experiments made by them on animals invariably gave the following results. 1. If the needle connected with the negative pole was introduced alone into the blood-vessel, while the other needle was applied to the surrounding parts, no coagulation took place. 2. The introduction of both poles produced a slow, rather weak, and rarely perfect coagulation. 3. The introduction of the positive pole alone, with the application of the negative pole to the neighbouring parts, always brought about a rapid and complete coagulation." It would seem, therefore (if we are to rely upon the observations of the experimenters above mentioned), that the third mode of procedure is the best, even from the point of view of the readiness with which coagulation is brought about, and its satisfactory nature; but it was not for these reasons alone that I was led to adopt this method, and discard those which consisted of the introduction of the negative pole into the sac, either alone or in combination with the positive pole. Whilst these latter methods seem to me to be open to grave practical objections, I know no compensating advantages to recommend them. In several cases in which the negative pole only has been inserted into the sac, blood has actually spirted out or come away in smaller quantity on withdrawal of the needle (see Holmes's Lecture in *Lancet*, 1872, vol. ii, pp. 697, 708), and it has generally happened that bleeding has been more prone to occur through punctures which have been in connection with a negative needle. Then, again, the bulk of gas given off from the negative pole is always much greater than that which appears at the positive pole, and this leads to the formation, in the former situation, of a loose frothy coagulum, as any of you may easily satisfy yourselves by introducing the poles of a battery into a little egg-albumen. Now, independently of the *à priori* undesirability of liberating a larger quantity of gas than is necessary within the circulatory system, this liberation tends to produce effects which the case we have been considering to-day seems to show should be especially avoided. A copious liberation of gas is apt to cause swelling and distension of the aneurism, in confirmation of which I need only refer you to the valuable paper on "The Treatment of Aneurism by Electrolysis," by Dr. Duncan and Dr. Fraser (*Edin. Medical Journal*, August 1867). Now this of itself is a condition of things which we should generally strive to prevent. On the other hand, if we seek for the reasons which should induce us to employ the negative pole, none are to be found which do not seem to be born of an over-zealous wish to accomplish too much in a short space of time, whilst some of those who recommend it base their reasonings upon an altogether unsafe foundation. They argue that adequate results cannot be produced with the positive pole alone and moderately weak currents, because, under totally different conditions, a wholly different fluid (such as egg-albumen) is not appreciably affected. But they should recollect that the changes in a fluid so chemically complex and unstable as blood, cannot safely be measured by those which will occur in a fluid like egg-albumen. And, moreover, if we be not dealing with a case where galvano-puncture is resorted to with the view of producing a considerable and immediate coagulation, with the view of warding off an actually impending rupture (as in the case recently operated upon in this hospital by Mr. Beck), I think we should always strive to advance slowly and cautiously. We should operate with the view of initiating the formation of a laminated clot by starting the formation of a small nucleus in connection with the wall of the vessel, rather than with the view of producing a large non-laminated clot immediately.

Because, therefore, the introduction of the negative pole into the sac can do nothing more, even according to its advocates, than increase the size and amount of the clot by a material which is admitted to be less durable and tenacious than that formed around the positive pole (Drs. Duncan and Fraser, *loc. cit.*, page 14); because it is very questionable whether this is to be regarded as an advantage in the class of cases which we are now considering; and, finally, because its use seems to carry with it the positive disadvantages of favouring hæmorrhage, of liberating an unnecessary amount of gas within the circulatory system, and of occasionally producing an unsafe distension of the sac itself, I am decidedly of opinion that it is undesirable to introduce both poles into the aneurism.

The method which I should adopt in any future case, therefore, would be that to which I have already had recourse; and you will find that in one of the most satisfactory cases yet on record of decided relief, practically amounting to cure, of an aortic aneurism, the treatment was conducted in this fashion by Dr. McCall Anderson of Glasgow. (*Lancet*, 1873, vol. i, page 211.)

We come now to the question as to the nature and size of the needle to be used in galvano-puncture, and as to the strength of the current.

The needles previously employed by most operators seem to have been larger than it is at all necessary to use, whilst some of them, such as Weiss's modification of Dr. Duncan's needle, are unquestionably very much too large. Recognising the desirability of reducing to a minimum the chance of hæmorrhage through the punctures and of inflammation in the track of the needle, and, at the same time, of diminishing the painfulness of the operation, I was led to use a very small hare-lip needle. Of course, the needle must be large enough, and used in such a manner as to avoid all chance of breakage. The smaller the needle, the greater would be the amount of heat developed in it by the passage of the current, if this were strong and evolved from a large-plated Bunsen's or Grove's battery; but, using such a comparatively weak current as we employed from one of Foveaux's batteries, we get rid of the heat-effects, and also, therefore, of any disadvantage which might otherwise attend the use of a small needle. But, whilst it is desirable to keep down the strength of the current as much as possible, in order to diminish the shock and pain which its passage may occasion (Dr. Duncan, *loc. cit.*, page 8), and also with the view of avoiding, as much as possible, the two special risks of inflammation in the sac, or of inflammation or gangrene of the skin at the seat of puncture, we should do all in our power to increase the amount of chemical action excited by the weak current at the positive pole. For you must understand that the experiments of Dr. Fraser and others have unmistakably established the fact that the coagulation induced in the blood by the passage through it of a galvanic current, is wholly attributable to the electrolytic or chemical changes which the current occasions. If, therefore, after the fashion originally introduced by Steinlein, we cover the positive pole with an easily oxidisable metal, such as zinc, we are enabled to summon to our aid what Faraday always distinguished as the "secondary" effects of electrolysis. The salts as well as the fluid of the blood are decomposed by the action of the current, and a part of the oxygen and acids which are liberated at the positive pole will combine with the zinc and corrode the surface of the needle. Some of the salts thus formed will aid in producing further coagulation around the needle. Corrosion occurred to a marked extent in our last operation, when a current from eleven cells of the battery was allowed to act upon a needle which had been plated with zinc,* although no corrosion was produced in an ordinary steel needle submitted to the same influences. Of course, a gilt needle would be still less amenable to the action of these "secondary" effects of the current.

With regard to the strength of the current, it was found that eleven cells acting for half an hour, although producing no pain or obvious sensation at the time, did induce some amount of irritation of the skin around the punctures. The current from eight cells, however (the battery being in good condition at the time), produced, on the previous occasion, no irritation, so that all traces of this needle-puncture had disappeared in four or five days. This needle also was insulated within half an inch of its point merely by two layers of spirit varnish; and probably, in employing a comparatively weak current such as this, no insulating material is needed. This, indeed, is the opinion of Dr. Althaus. At all events, it seems desirable that the needle should not be pushed too far into the sac, and that the part of the needle actually in the sac and within its coats should not be insulated, because clot should form in contact with the wall of the aneurism, so that it may be left adhering to it on the withdrawal of the needle.

Conducted upon the principles now laid down, the treatment of aneurisms of the arch of the aorta or of other large vessels may, doubtless, in a large number of cases, be safely attempted by galvano-puncture. The treatment should be painless, non-irritating, tentative, and slow; and I believe that it is a method from which, in the future, we may look to obtain the most satisfactory results.

AN UNUSUAL FORM OF BIRTH.

THE following case, happening to me this week, and not being of everyday occurrence, may prove worthy of record.

Mrs. A. was in labour with her fourth child. A foot and hand presented; the second foot was sought for and brought down; at the same time, a head descended. Interference was now suspended, and presently, the pains being vigorous, a head and lower extremities were extruded together from the vagina. The advent of twins was announced, when another pain completed the birth of a single child thus doubled up. It was an eight months' child, and appeared to have been some time dead. The nurse stowed it away in a corner; but, to her astonishment, half an hour after my departure, a feeble cry was heard, and the little creature proved to be alive.

EDWARD GARRAWAY, Faversham.

* The needle was prepared for me by Messrs. Weiss and Co.

ON THE CAUSES OF UNAVOIDABLE HÆMORRHAGE DURING MISCARRIAGE OR LABOUR WHEN THE PLACENTA IS PRÆVIA.

By J. MATTHEWS DUNCAN, M.D.,

Physician to the Royal Maternity Hospital, and Lecturer on Midwifery in the School of Medicine, Edinburgh.

[Concluded from page 599 of last number.]

It is well known that the amount of blood lost may be very great, and produce alarmingly sudden death before any placental detachment takes place, and in every variety of placenta prævia; but it is a natural consequence of the laws of spontaneous premature detachment that, as a general rule, the hæmorrhage will be greater in proportion to the centrality of the placental attachment, and in proportion to the largeness of the body to be expelled—in other words, the age and size of the child; and I believe these statements are confirmed by clinical experience. When the placenta is centrally attached, the hæmorrhage begins with the early part of the dilatation of the internal os, and continues as long as in any other kind of previous placental insertion.

When, on the other hand, the placenta is prævia, but does not cover the os internum, nor has its margin close to it, then there may be some dilatation and progress of labour before detaching expansion takes effect or begins.

When the child is not premature and small, but at the full time and big, then the amount of spontaneous premature separation will reach its utmost, and may be considerably more than if the child were small; for a small child will pass through the internal os uteri and lower uterine hemispheroid when these are much less expanded than the degree of expansion, and consequent placental separation, required to transmit a big child.*

Most authors, among whom Legroux† enumerates Duparcque, Desormeaux, Dubois, and Depaul, ascribe to the pains an influence in increasing the hæmorrhage. Legroux, on the other hand, believes the hæmorrhage to be, in unavoidable as also in accidental cases, not systolic, but diastolic; not increased by pains, but arrested by them. He has satisfied himself of this by feeling it duly flow and stop in an actual case, and he points out that the increase of discharge simultaneous with the coming on of a pain is the result of the expulsion of blood accumulated during the absence of a pain; that the increase with the prevalence of a pain is apparent, not real. In these views Barnes‡ coincides. I also agree generally with the view of Legroux; but, in actual practice, I have not observed increase of bleeding with pains in unavoidable and stoppage in accidental hæmorrhage, with any such marked constant regularity even of appearance or seeming, as would lead me to accede to the diagnostic principle, so generally laid down, of increase with each pain in the flooding of placenta prævia and decrease with each pain in accidental hæmorrhage.

At the bedside, it is very difficult to get these various points verified, in consequence of confusion of blood flowing from vessels with blood flowing which has already been for some time extravascular, that is, in the uterus or vagina. One would, *à priori*, expect the following course, and I believe it to be consistent with most observations. Hæmorrhage will take place from vessels, in a more or less considerable gush, during and immediately after every act of separation or of increase of separation, but not necessarily with each pain. Such hæmorrhage will be with pains, not between them. It often happens that, while pains go on hæmorrhage stops for a time, and it is hereby explained. But hæmorrhage may go on between the pains, before the limit of premature spontaneous separation is reached, as in cases of accidental hæmorrhage. After the limit of spontaneous premature separation is reached, the hæmorrhage, if any, will be, as in accidental cases, during the absence of pains or between them. In thus describing the hæmorrhage, reference is made only to hæmorrhage from vessels, not to expulsion of blood from the vagina or uterus, which is so apt to obscure the evidence derivable from observations.

The latter part of this statement is clearly implied in the following passage from Gendrin.§

"Dans les cas où les eaux se sont écoulées peu à peu par une rupture

* "Suivant Puzos, les hémorrhagies sont rarement mortelles avant le cinquième mois de la grossesse. L'expérience confirme tous les jours la vérité de cette assertion." Desormeaux et P. Dubois, *Dict. de Médecine*, article Mitrorrhagie, 2nd edit., tome xix, p. 663.

† *Archives Gén. de Médecine*, 1855, vol. ii, p. 643.

‡ *Lectures on Obstetric Operations*, 2nd edition, p. 413.

§ *Traité Philosophique*, etc., p. 197.