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On the

Connection between Diseases of the Heart

and

Apoplexy.

J. H. Broadbent

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To the superficial Observer it may appear strange, that the connection between diseases of the heart and apoplexy, if it have any existence at all, should have remained so long unobserved. Upon a closer examination of the subject, however, this will cease to be a matter of surprise. It is true that Apoplexy, is a disease so well marked in its symptoms, and so direful in its consequences, as of necessity to arrest the attention, and excite the curiosity of the most unobservant; but with regard to diseases of the heart, the case is very different; many of these are extremely obscure in their origin, insidious in their progress, and very frequently masked in their symptoms. Besides this post mortem examinations of the body, were in former times of rare occurrence, nor can it therefore astonish us, that the morbid conditions of the heart, frequently presenting as they do no very striking appearances, should even where an opportunity occurred of examining the organ after death, have been frequently overlooked.

Since the brilliant addition which Laennec

made to our means of diagnosis in diseases of the chest. However, an immense advance has been made in our knowledge of cardiac disease, and not only may we now detect it however slight, even at its outset, but in the vast majority of cases, we may determine with wonderful accuracy the exact seat and nature of the affection, and moreover, in consequence of the frequency of post mortem examinations now a-days, we have an opportunity of verifying, or correcting the diagnosis formed during the life of the patient, by a reference to the appearances found after death. It has long been matter of observation, that the functions of the brain are remarkably under the influence of the varying conditions of the circulation. The utter arrestment of the functions of the brain, by excessive loss of blood is well known, and the peculiar effect of smaller losses frequently repeated, as determined by Marshal Hall and others is scarcely less remarkable. Many curious facts have been placed on record proving the effects of posture on the functions of the brain, no doubt through the medium of the circulation.

The memory in some, fallacious when in the erect posture, becomes accurate and minute so soon as the horizontal posture is assumed. The sight and hearing, have been also known to be in the same manner similarly affected. M. Bricheteau carries this a step farther, and considers the function of the brain so closely dependent upon the circulation, as to say that when we have the brain far removed from the centre of the circulation by means of a long neck, the intellect of the animal diminishes proportionably, he calls to his mind that men of fertile genius, and vivid fancy, have been generally short in the neck, and by referring to the lower animals, he fancies a further corroboration of his views may be obtained. Be this as it may however, I think that few will be found to deny the important influence which is exerted on the brain by the state of the circulation. Can we then wonder that disease of the organ by whose agency the circulation is carried on, should frequently followed by lesion of the brain.?

The precursory symptoms of an apoplectic fit

are interesting, and important, when considering the present subject especially, as indicating a disordered state of the cerebral circulation They consist among others of pain in the head, general head-ache, sense of weight and pulsation in the head, turgid appearance of the external parts of the head, lividity and redness of the face, epistaxis, various affections of the special senses, &c, &c. When the apoplectic fit is fully formed, the symptoms are still more ~~characte~~ marked, there is complete insensibility, often more or less convulsion, entire loss of voluntary motion, in short to sum up we may say that the functions of animal life are entirely suspended, whilst those of organic life remain more or less unaffected. Some of these cases so sudden, and so terrible to all appearance, terminate in so long time in complete recovery, as trace remaining of the recent obliteration of the cerebral functions. Others in which the symptoms are precisely the same terminate fatally. The morbid appearances found after death are extremely various; in some there is absolutely no morbid appearance, the state of the brain

vessels, etc, being as far as can be detected after the most minute examination perfectly natural; in others where the symptoms were during life precisely similar we find an extreme degree of turgidity of the vessels of the brain, or a clot of blood, or an effusion of serum. On what then can we suppose the apoplectic fit essentially to depend when the morbid appearances are so various? Some other writers upon finding that the precursory symptoms indicate an increased flow of blood towards the head, and upon frequently finding turgidity of the vessels, or effusion of blood or serum after death — perhaps too upon having noticed, that the symptoms following depression of a portion of the skull, closely resemble those of apoplexy, considered compression of the brain, as the causa morbi.

Monro secundus was the first to throw doubts on the correctness of this view of the matter, his doctrine being that since the brain is contained in a bony spherical, unyielding case, which together with the blood, serum, and membranes, it completely fills, and since also it is itself life

the other solids of the body, almost incompressible the quantity of fluid contained in it, can at no time vary, any deficiency in the blood or serum, being counter balanced by an increase in the quantity of the other contents
These views were very generally adopted, and a series of experiments were undertaken by D^r Kellie of Leith, to test their accuracy
The conclusion drawn by D^r Kellie from a numerous, and varied series of experiments on various animals, chiefly however on sheep, was favourable to the theory of Monro, and he says that we cannot in fact open to any considerable degree, the quantity of blood within the cranium, by arteriotomy or venesection, and that when the quantity of blood is by profuse hæmorrhage diminished in any sensible ~~extent~~ degree there is commonly an increased effusion of serum ~~thrown out.~~
The doctrine of Monro was therefore now proved to be correct, and apoplexy such as it could not result from pressure on the brain, was referred to other causes.
The theory of Monro however was again in its turn disturbed, and called in question

by D. Burrows, who dissatisfied with the conclusions of D. Kellie as drawn from the experiments even as stated by himself, and which I am sure cannot be wondered at by any one who has read the account of these experiments, undertook a new series himself. He experimented on rabbits, and in consequence of these experiments, came to a diametrically opposite conclusion to D. Kellie, viz that the brain is as liable to depletion by bloodletting or to congestion as any other part. These new experiments, even by many who had been in the habit of inculcating the doctrine of Monro, were considered subversive of this doctrine ~~and~~ which they now confessed to have always held, with some doubts and misgivings as to its accuracy. At the present day the world on the one hand of Monro, supported by D. Kellie's experiments, and on the other of Burrows supported by his own experiments and numerous able men as their supporters. Seeing this such difference of opinion, apparently two on mere matters of fact and considering the question to bear very closely on the subject of this dissertation

I thought I might with advantage, repeat some of the experiments on animals, and at least satisfy my own mind, and that of my friends Mess^rs Philpott and Lowndes who assisted me with, and witnessed all my experiments, as to the real state of the case. I selected rabbits as the animals to be experimented upon, as being readily obtained, and the results of these experiments I now proceed to give.

I. To the first rabbit chloroform was first given, as it was intended to tie some of the vessels, and it was well if possible to avoid giving unnecessary pain. Unfortunately the animal died from the effects of the chloroform, it was therefore hung up by the hind legs, that the effects of gravitation on the amount of blood within the cranium might be observed. After hanging for about 20 minutes, a tight ligature was placed round the neck, and the animal being laid in the horizontal posture the skull was opened. The sinuses and veins were found gorged with blood, amounting certainly to not less than half a drachm; the other parts of the brain were found proportionably

congested

II. In this rabbit the internal jugular veins were first tied, and the animal was then allowed to remain quiet for about half an hour. The eyes were observed to become remarkably brilliant, and prominent. It seemed lively and ate some head, and cleaned itself, these circumstances I mention to show that much distress cannot have resulted from the obstructed venous circulation through the brain; at the end of half an hour the carotid arteries were tied, and again the animal remained quiet for some time. The eyes now became shrunken, the movements of the animal slow and listless, and there seemed to be a tendency either to coma or syncope, in fact it appeared very much as if falling to sleep; this disappeared for a while after the animal was roused, but soon returned. The carotids and jugulars were then cut across, and after death the animal was suspended by the ears. In about half an hour it was taken down and examined as the last had been. The difference in the appearance of the brain was most remarkably, and throughout the

whole brain and membranes, there were not three drops of blood to be seen, nor was this remarkable deficiency made up for, by an increase in the quantity of serum, of which there was no trace whatever.

III. This rabbit was strangled and hung up by the hind feet. In half an hour it was taken down and examined, on removing the a portion of the skull the brain started up in a remarkable manner, projecting above the table of the skull, about a tea spoonful of blood was found in the interior of the cranium, no effusion of serum could be detected, though I cannot certainly say there was none, as it might have become mixed with the blood which escaped from the wounded sinusses and so elude observation.

IV. In this experiment I wished to have a death which would influence the state of the circulation in the brain, as little as possible — or rather, which would alter the amount of blood as little as possible — the thorax was rapidly opened and all the great vessels leading from and to the heart, were compressed between the finger and thumb., Convulsions immediately

occurred, and the animal was soon dead
it was left on its side for about 20 minutes
The brain when examined exhibited an
intermediate state of injection, but the
quantity of blood approached much nearer
certainly to half a drachm in quantity.
than to 5 drops. In this rabbit the spinal
canal was opened to see if there were
any spinal fluid accumulated here,
but no more was found than necessary
to lubricate the surfaces. The amount of
blood was about natural, that is, the vessels
neither appeared gorged nor empty.
V In this rabbit the vessels of the neck
were again cut across, and the animal
was then hung up by the nose, and in
20 minutes examined. The same anæmic
appearance was remarked, as in the other
case of death from Hæmorrhage, and no
more serum was detected, than sufficient
to moisten the surfaces. The spinal cord
was also examined, and less blood found
than in the last mentioned experiment, and
no serum. I have not entered as minutely
as I might have done into the appearances

presented by each part of the brain, from a desire not to occupy too much of your time, but I may say that the whole organ was in every case *thoroughly* and *minutely* examined, and found to correspond in ~~their~~ its appearance with those mentioned.
Whatever therefore I was inclined to presuppose ~~therefore~~ from the arguments of Monro, the experiments of Kellie, and more particularly from the able reading type paper of Dr John Reid on the subject, which carries conviction with it, my own experiments lead me undoubtedly to think that Dr Burrows expresses the truth when he says that haemorrhage and posture have a decided influence on the quantity of fluids within the cranium, for in none of my experiments did I find that the quantity of ~~xx~~ serum was increased, when the blood was diminished; in fact I found no serum whatever in any of the rabbits, and I certainly think it would be contrary to all we know of effusions of serum, to suppose, that it should take place from unusually empty vessels, instead of from vessels more than usually distended with blood.

Besides conclusions drawn from these experiments on animals, there are many circumstances which must have occurred to or at least be familiar, to most people, which favour the idea of a varying amount of pressure at different times, such for instance as the starting of the eyes, when any thing obstructs the flow of blood from the head. During headache too, if severe, a throb of pain may be felt with each pulsation of the heart which gives precisely the idea of expansion of the artery and compression of the brain. The influence of position in hastening or retarding syncope, during blood letting, also favours the idea of varying pressure in different circumstances. If a person be bled in the recumbent posture it is well known that a much larger quantity of blood may be taken before syncope occurs, than when blood is taken in the erect posture, and this I think may be explained by supposing that in the ~~former case~~ latter position diminution of pressure sooner occurs, rather than in any other manner as for instance by supposing that syncope occurs more rapidly in the erect

posture, because the patient is not only exhausted by the loss of blood, but is also at the same time fatigued by the muscular effort required to maintain the erect posture. Mr Lowndes related to me an interesting case which had occurred to him, and which I think throws some light on the true nature of syncope. He had a child under his care about 5 months old in which a membranous protrusion had been present, from the time of birth, in the centre of the occipital bone, this communicated with the cavity of the cranium, and was distended with the cerebro-spinal fluid. Mr L. evacuated by a portion of the fluid with a view to bring the sack on a level with the surface of the bone. After a very small quantity of fluid had escaped, alarming syncope occurred, which I think could be attributed to nothing but the diminution of the pressure on the brain, for the puncture of the cyst could hardly have been perceived by the child, and the stimulus to the heart's action had not been here removed as in the case of bloodletting, and yet the syncope supervened

almost immediately, here however the pressure on the brain was at once diminished, the fluid coming direct from the cavity of the Cranium, instead of more gradually, and from at the same time the system at large as it does in the case of bloodletting. I must hope that this long preamble will not be deemed impertinent to the subject of this paper, as it must obviously bear closely upon it I think. I am however in spite of these experiments inclined to think that in the human cranium the variations in quantity of the blood are much less than in such animals as rabbits. The human skull is no doubt as Monro says an unyielding bony case, and the actual Compression which the heart can at any time effect of the cerebral substance must be very trifling, the difference in the amount of blood may in the human subject may in part I think be attributed to the expulsion of a certain quantity of the cerebro-spinal fluid into the spinal canal, or even to the descent to a certain extent of the cerebral substance itself. In rabbits however as I said before I failed in any case to find serum at all

consequently in them such an explanation as the above cannot hold

When we consider the extremely delicate cells of which the cerebral matter is composed, I think it cannot be matter of surprise, that a slight increase in the quantity of blood, or even a difference in the relative quantities of venous and arterial blood, should prove hurtful, ~~as~~ as it must give rise to an unequal pressure at different parts of the cerebral substance and this materially alter~~s~~ the shape of and distort~~s~~ certain sets of vesicles, thus probably rendering them unfit for the discharge of their functions. Why however this should occur in one case and not in another, is a mystery. There can be no doubt however that the alteration of the relative amount of blood in the veins and arteries must have the effect of causing increased pressure on certain parts of the brain

Though various diseases of the heart have been found associated with apoplexy so frequently, as to give rise to the idea of a close connection existing between them, they cannot all be supposed to give rise to

it is exactly the same manner. I shall therefore go through the various diseases of the heart, supposed to be connected with apoplexy in turn and consider rationally what their modus operandi might be ~~suppo~~ expected to be a priori.

In the first place simple hypertrophy of the left ventricle, does sometimes occur, independent of organic disease, resulting probably from a kind of chronic inflammation of the substance of the heart and independent of any valvular disease. In such a case we can easily imagine, that the organ acting with an immense increase of force, and without any ~~valvular~~ obstruction to the flow of blood from its cavity, must have a great tendency to stretch, and even to rupture the vessels of the brain. We know accordingly that such persons, are extremely liable to active Hæmorrhage in various parts of the body, they have a florid complexion, a full strong pulse at the wrist, they are liable to pain in the head, giddiness, ringing in the ears flashes of light before the eyes, and after

symptoms of cerebral disturbance
M Bricheteau thinks this the most common cause of apoplexy, and fails to mention any diseased state of the Valves, or arteries of the brain. He should however expect them rather congestive apoplexy as a result of this disease than rupture of the vessels, as these may be supposed to be free from that most common of all causes of rupture, atheromatous or calcareous degeneration, in mere simple Hypertrophy. When however the hypertrophy of the left auricle depends upon disease of the valves, the case is very different, here it is true the hypertrophy is to some extent an effort (pronounced) of nature, to enable the heart to overcome an obstacle, but whoever has felt the remarkable force of pulse, in some of the sufferers from this disease, must confess that Nature seems to take the lead of the disease.
In such patients the radial pulse, strikes the finger like a thick cord, and every artery may be seen pulsating with extraordinary force and vehemence. When at this same time we remember that the same

ossific and atheromatous deposits which have affected the valves of the of the heart, very frequently affect the arteries of the brain, depriving them of their elasticity and destroying their structure, we cannot be surprised that rupture of these vessels should be the result, and extensive clots of blood be effused into various parts of the brain. If the hypertrophy is dependent on disease of the mitral valve, rendering it incompetent of closure, there will result obstruction to the flow of blood from the right side of the heart, and consequent on this, obstruction to the return of venous blood from the brain. We have as here it is true the same powerful pulse as in the last case, its force is broken but it is a sudden stroke, and it forces blood, be it remembered, into vessels which cannot freely empty themselves by reason of an obstruction, so that we may still expect rupture of the arteries, but more frequently effusion of serum from the veins It appears unaccountable that if hypertrophy of the left ventricle, more especially the simple simple hypertrophy, do cause apoplexy

that violent exertion, during which the heart propels with great increase of power, the blood towards the brain, should not more frequently cause the disease than it does; but this may in some measure be accounted for. In the first place the apoplectic fit seldom occurs, even in those suffering from cardiac disease, unless the hypertrophied organ be excited to increased action by some cause, or unless its force remaining resume some impediment occur to the return of the blood from the brain. The hypertrophy is here certainly the predisposing cause, but the exciting cause is something which hurries the action of the hypertrophied heart, or prevents the return of venous blood from the brain which is much the same thing. We have then the action of the already hypertrophied heart, increased in force by excitement, acting on vessels already stretched to the utmost, and deprived of their elasticity or in whose coats atheromatous or calcareous matters have been deposited rendering their brittle as porcelain or soft almost as fat

Hypertrophy of the right side of the heart, is occasioned either some way as that of the left, either by some obstruction to the flow of blood from its cavity, by narrowness of the orifice of the pulmonary artery, or by incompetence of the auriculo-ventricular valves. It is easy to see how obstruction to the flow of blood from either of these causes, must give rise to congestion in the head, and we have at the same time the left ventricle propelling blood with undiminished force, into vessels already full, and which cannot be fully ~~emptied~~ emptied in their parts of the body this affection of the heart, gives rise to passive hemorrhages, and effusions of serum, ~~in different parts of the body~~, and of the brain is to a certain extent, subject to the same laws with regard to its circulation, as other parts we should expect the same thing to take place in the brain. From the limited observations however which I have been able to make, I should say that in a great number of cases, the heart disease, and the apoplexy, are the result of the same morbid condition

of the blood, or perhaps to a diseased state of nutrition, which leads to the deposition of atheromatous or calcareous matter in the valves of the heart destroying their function, and so giving rise to subsequent disease of that organ, or in the coats of the arteries of the brain, and other parts, rendering them unusually liable to rupture, and perhaps also to exude the serous parts of the blood. This change in the structure of the arteries of the brain, is much more common in old people than in young and hence one reason certainly of the more frequent occurrence of apoplexy in the one than in the other. This change may occur in the arteries of the brain, without affecting the valves of the heart, or aorta, we shall nevertheless have a tendency to apoplexy even in this case, should any thing give rise to an inordinate increase in the action of the healthy heart.

There are certain circumstances which for ages have been known to be peculiarly liable to cause apoplexy, the examination of which may afford additional evidence

in favour of the connection between diseases of the heart and apoplexy. All of them either increase the flow of blood towards the head, or obstruct its return therefrom. In the first place mental excitement is known to be a very frequent cause of apoplexy, and is always strictly forbidden to those in whom the apoplectic tendency has shewn itself or is suspected, it is well known to increase the hearts action, and that herein lies its danger Which there can be no doubt. Violent exercise which has the same effect on the hearts action, is also peculiarly dangerous to persons apoplectically inclined. The warm bath is not more remarkable as a stimulus to the heart, than as attended with a peculiar danger to these people. On the other hand, straining, the lifting of heavy weights, stooping, tight neck cloths, have all the effect of obstructing the return of blood from the head and are consequently in a somewhat different way perhaps, but almost as certainly dangerous to persons inclined to apoplexy

These are facts Which acknowledged by

all, and by analogy should we not expect to find diseases of the heart, which tend to increase the violence of the flow of blood towards the head, or obstruct the return from it to have the same effect-

Having now stated what might be expected theoretically ~~expected~~ to be the connection between diseases of the heart and apoplexy I give some statistics in a tabular form, which I think prove almost to a demonstration the fact, and Dr Hope was not far wrong when he said, that so close is the connection between the two diseases that they bold the relation almost of cause and effect. In the first table I give the percentage of diseases of the heart in cases of apoplexy, as noticed by some of the most recent authors on the subject. The particular disease of the heart is not mentioned in the table unfortunately, which is taken from Dr Burrows work

Andral	25 cases	15 diseased heart	60
Cloudinning	28 —	15 —	53.5 per cent
Hope	39 —	27 —	69.4 —
Burrows	34 —	23 —	67.6 —
Guillemin	6 —	4 —	66.6 —
Total	132 —	84 —	63.6 —

In the next table the relative frequency of hypertrophy with valvular disease, simple hypertrophy, and simple valvular disease, are given in 59 cases of apoplexy recorded by Andral and Bouillaud.

	Number of Cases	Heart diseased	Hypertr. with Valv. disease	Hypertrophy	Valv disease
Andral.	25	15.	9	4	2
Bouillaud	34	23	10	6	6
Total	59	38	19	10	8

A question however still more interesting, is, whether a particular kind of Heart-disease, is associated with a particular form of apoplexy ~~so~~ more frequently than with any other form, — whether for instance serous apoplexy is more common in obstructive disease of the heart, as relative to the brain, — and congestive, or hæmorrhagic apoplexy with in ~~simple~~ hypertrophy of the left side, with or without valvular disease I have endeavoured to make a table giving such information as this, but the statistics of a Hospital are not favourable for it. The result of a number of cases occurring in private practice, where disease is more frequent, and where the symptoms would be more easily

ascertained, would be the proper material for constructing such a table.

Through the kindness of D^r Gairdner I had the opportunity, of examining several of the books containing the records of post mortem examinations, and have collected eight cases of apoplexy in which both the heart and the brain were examined, and subjoin a brief account of each of these.

I Case of serous apoplexy, veins also somewhat more turgid than natural, no cardiac disease, and no atheromatous deposits mentioned.

II apoplectic clot found in one of the lateral ventricles, slight atheroma of the aorta, no cardiac disease, and no atheromatous deposit mentioned as occurring in the cerebral arteries

III Serous apoplexy. Heart normal, no mention made of the state of the arteries.

IV Hæmorrhage into right optic thalamus, atheromatous state of the arteries. Hypertrophy of the heart, chiefly of the left side, weight 17 oz, signs of former pericarditis visible.

V ~~Coma, and partial paralysis~~. Increased arachnoid effusion, arteries of the base of brain atheromatous, liver fatty, no cardiac disease

VI. Sub arachnoid Space over the anterior lobes of the brain was found to be the seat of hæmorrhagic extravasation, clots were also found in the substance of the brain; arteries at the base atheromatous, heart enlarged, weighing 13 oz, left ventricle chiefly enlarged, aortic and mitral valves competent, but studded with atheromatous deposits

VII. Serous apoplexy, brain diminished in size, heart natural, state of arteries not mentioned

VIII. Sanguineous sub-arachnoid effusion consequent on a fall, aorta slightly atheromatous, no cardiac disease

If it be allowed to draw conclusions from so limited a number of cases, it certainly would seem that the atheromatous depositions in the coats of the arteries ~~is~~ are more frequently associated with apoplexy than with cardiac disease, for we find that in five out of the eight cases recorded above the state of the arteries was diseased, whilst in only two was there cardiac disease present, these are both cases of Hypertrophy of the left ventricle, and coexist in both cases with the atheromatous condition of the cerebral arteries; - as we

should have expected I think, the apoplexy was consequent on serious effusion in both these cases, no doubt from rupture of a vessel.
Of the four cases Serous apoplexy mentioned three are independent of the diseased state of the arteries, and all are unassociated with cardiac disease, this too might I think in some measure have been expected to be the case, for these passive effusions may result from obstruction of the flow of blood through the lungs from any cause, independent of cardiac disease;— emphysema, chronic bronchitis, tubercle, might well rise to this obstruction, and consequent congestion of the brain, followed by serous effusion as occurs in other parts from the same cause.
From the tables before given them and from considering the rationale of the action of cardiac disease, I think it may be concluded, that— there is a close connection between apoplexy and various cardiac diseases, and the question now comes to be has anything been gained in a practical point of view by the discovery of this connection. Certainly I think there has, and that it is a fact of

nd more interesting to the pathologist, than to the practical physician. To be aware of the tendency to a disease, and of the causes of that tendency, is a point gained, of immense importance, many a disease might be prevented which though incapable of being cured when ~~the disease~~ fully developed, yet by a timely caution may with very great certainty be prevented; even this much dreaded disease Phthisis pulmonalis is a good example of this Where therefore we meet with disease of the heart ~~with~~ associated with, valvular disease, more especially, where it has apparently supervened gradually, without any symptoms of inflammation, and where the sufferer is advanced in life, we may be assured, that there is a tendency to apoplexy which may be actually brought on by any of those exciting causes of apoplexy mentioned in a former part of this paper. We ought then to induce the patient, although he may have as yet suffered from no symptoms of cerebral disorder, to avoid every thing which can excite the circulation & or cause an impediment to the return of blood from the head. If the action of the heart be excessive

it may be reduced by means of an unstimulating or low diet, by sedative medicines or colon if accompanied by arterial disorder by small local bleedings or blisterings of the cardiac region. When the attack of apoplexy has however come on, does the presence of cardiac disease in any degree modify our treatment? not very materially I think, but it must be kept in mind that excessive bloodletting in valvular disease of the heart, cannot be borne, it will be extremely likely to cause fatal syncope, we must therefore bleed with caution. Dr Burrows points the result of his experiments is enclined to think the posture of the patient of great importance, and of course recommends that the patients head should be well raised anything that may assist the venous circulation at the same time being removed from the neck, in this I think most physicians will agree with Dr Burrows.

W. W. Broadbent.

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