

During the last few years a great deal of attention has been given to the study of the various factors which influence the development of hypertension. It is now generally accepted that the disease is a complex one, involving both hereditary and environmental factors. The hereditary factors are thought to be of great importance, and it is believed that the disease is inherited as an autosomal recessive trait. The environmental factors which are thought to be of importance are the diet, the amount of exercise, and the amount of stress. It is believed that the diet, which is high in salt and fat, is a major factor in the development of the disease. The amount of exercise is also thought to be of importance, and it is believed that a sedentary life is a major factor in the development of the disease. The amount of stress is also thought to be of importance, and it is believed that a high level of stress is a major factor in the development of the disease.

CHRONIC HYPERTENSION AND ITS TREATMENT.

In the treatment of chronic hypertension, the first step is to determine the cause of the disease. If the disease is thought to be hereditary, the treatment is usually directed towards the control of the blood pressure. If the disease is thought to be environmental, the treatment is usually directed towards the removal of the environmental factors. The treatment of chronic hypertension is usually directed towards the control of the blood pressure. The most common method of controlling the blood pressure is the use of drugs. The drugs which are used are usually of the type which act on the blood vessels, and they are usually given in the form of tablets. The most common drugs which are used are the diuretics, the beta-blockers, and the calcium antagonists. The diuretics are thought to be of great importance in the treatment of chronic hypertension, and they are usually given in the form of tablets. The beta-blockers are also thought to be of great importance, and they are usually given in the form of tablets. The calcium antagonists are also thought to be of great importance, and they are usually given in the form of tablets. In addition to the use of drugs, the treatment of chronic hypertension is also directed towards the control of the diet, the amount of exercise, and the amount of stress. It is believed that a diet which is low in salt and fat, a sedentary life, and a high level of stress are all factors which contribute to the development of the disease. Therefore, the treatment of chronic hypertension is usually directed towards the control of these factors. The most common method of controlling the diet is the use of a low salt and fat diet. The most common method of controlling the amount of exercise is the use of a sedentary life. The most common method of controlling the amount of stress is the use of a high level of stress.

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CHRONIC HYPERTENSION AND ITS TREATMENT.

During the last few years a great deal of attention has been paid to the clinical measurement of blood pressure, and not without justification, as I think that the subject is an eminently important one.

In ordinary general practice the systematic observation of blood pressure is of service, and I think the day is not far distant when a sphygomanometer, of one kind or another, will form part of the armamentarium of every medical practitioner.

In Spa practice, in which I am particularly interested, I consider the sphygomanometer of even greater service. Here we meet all kinds of diseases in the very early stage, before people have become actually ill, though they feel themselves ailing and out of sorts, and anything which helps us in our diagnosis is very welcome. That the Sphygomanometer is of great service in such cases I hope to be able to prove, but before going into any actual cases I thought that it might serve a useful purpose to enquire into our present knowledge of the subject of blood pressure and the various methods of measuring it.

At the very outset we are met with a difficulty:- What is blood pressure? And what are the factors in

its production? Is it dependent chiefly on the force of the systole of the heart or is the tonus and condition of the walls of the arteries the chief factor in its production?

This point was debated at considerable length at the Balneological Society's Meeting this year, many of the members holding that the accurate measurement of blood pressure was impossible without some means of estimating the resistance of the arterial wall, while others held that this resistance was practically negligible. Russell¹, in his book on Arterial Hypertorus and Sclerosis has strongly urged the former view, but I think that experience has proved it to be erroneous. Clinical experience is all against it: the cases in which we get very high pressure readings are often those from the condition of whose arteries we least expect it and vice versa; in old people with hard and almost pipe-like arteries we get, oftener than not, a comparatively low reading. In a series of senile cases in the Workhouse Infirmary here, I examined twenty five men with ages ranging from 65 to 89, the average age being 75, and found no reading above 180mmHg., though many of the cases had very calcareous arteries. In eleven there was a difference in the systolic pressure on the two sides - the

maximum difference being 20 mm Hg. Similarly in a series of women. I think this comparatively small difference, very significant, as indicating that the condition of the arterial wall itself has no marked influence in the blood pressure reading.

Dr. J.A. MacWilliam² has recently made a series of very interesting experiments to find out exactly the resistance of the arterial wall, and I quote his conclusions as I think he has fully made out his case (Heart, Vol. IV. No. 3).

"Estimations of systolic blood pressure by the obliteration method, when made with suitable precautions, give substantially correct results in ordinary conditions of normal health and also in the majority of cases of illness in the collective sense. Even when the disease affects the vascular system, with thickened arteries, &c., the indications are in the majority of cases approximately correct, the readings varying from moderate or low to very high values. It is only in a minority of cases that any serious error is liable to occur in the direction of over-estimation.

In some such cases the influence of local conditions may be very important, especially the presence of abnormal resistance in the arterial wall, depending mainly on contraction of the muscular coat. In such conditions very different readings may be obtained from

the same person on the same occasion, according to the limbs or parts of limbs examined, the using of first, or later readings, &c., &c." He concludes that it is only in cases where there is great muscular contraction in the arterial wall has the wall per se any influence in the readings and that by massage of the artery or repeated readings this muscular contraction can be overcome and a true estimation of the blood pressure arrived at.

This brings us to consider what are the main factors concerned in the production of blood pressure and all authorities are agreed that these are five in number:-

- (1) The force of the beat of the heart.
- (2) The peripheral resistance.
- (3) The elasticity of the arterial wall.
- (4) The volume of the circulating blood,
- and (5) The viscosity of the blood.

(1) The first is self-evident: the stronger the systole the greater the maximal blood pressure. At the same time it must be borne in mind that primary increase of the muscular wall of the heart alone is not sufficient to produce an increase of blood pressure, as we find that in athletes with hypertrophied hearts the blood pressure is not usually above normal. Therefore, the first factor must be combined with some

other, and I think that in this No. 2 is the most important.

(2) The peripheral resistance: under this head are included the resistance offered by the muscular tone of the arteries and arterioles and the gradual narrowing of the tubes of the arterial system, and it is here we have the key to the whole question of increased blood pressure. As we have seen the resistance of the wall per se has very little effect in the production of blood pressure, still indirectly it is all important. An artery which has its muscular and elastic layers thickened offers a greater resistance to the flow of blood from the heart and in consequence increases the work of the heart and so raises the blood pressure: the heart having to work against a heavier load increases its exertions: this is the normal response of extra work to extra strain on the part of the heart.

(3) The elasticity of the arteries has an important bearing on the production of blood pressure as, if it were not for this elasticity the flow of blood would be intermittent and the diastolic pressure always zero. Partial loss of elasticity means inefficient working of the arteries and so increased work for the heart.

(4) The volume of circulating blood is only of minor importance as a factor in normal general blood pressure. It comes in more in local conditions and requirements: less volume in one place meaning greater volume and pressure in another. This is under the control of the vasomotor centre, the needs of one place being supplied at the expense of another. This has been beautifully elaborated by Herbert French³, in an article in the Lancet, July 1912.

Here it is worth recording that abdominal massage temporarily raises blood pressure, I suppose, by the volume of blood which is driven out of the large abdominal veins: also that the abdominal vessels are the most important in relation to blood pressure, firstly on account of their size and secondly, because of their being under the control of the splanchnics which are the most easily affected of all centres by reflexes from sensory nerves.

(5) The viscosity of the blood: This has not yet been worked out and further investigation may show that it is rather an important factor if not in normal pressure at any rate in the production of high blood pressure.

I think we may now ask what is blood pressure and how is it measured?

Blood pressure is the force which the circulating blood exerts on the inside of the arterial wall and it has been measured by the direct introduction of a cannula, connected with a column of mercury, into an artery. Incidentally one might mention that this measurement agrees with those obtained by the compression method and so helps to refute Russell's view that the arterial wall per se offers much resistance to compression. Of course this method is not applicable in practice so a number of instruments have been devised. There is not space to go into all those different instruments, but roughly they may be divided into two classes, the one comprising those in which the pulse wave below the point of compression is the criterion and the other includes those dependent on the estimation of the oscillations of the artery at the seat of compression. An example of the first is the Riva Rocci and its modifications, and of the second the Sphygomo-oscillometer of Pachon.

In England at the present time we have followed too closely on the Riva Rocci type and in consequence the systolic pressure has received nearly all our attention: so much so that nine men out of ten speak of so and so's blood pressure being 120 mm. Hg. as if this were a constant factor. As a matter of fact it is only part of the truth as we only record the maximum

force exerted on the arterial wall forgetting that there is also a minimal one. Certainly some men believe they can read the minimal pressure with a Riva Rocci type and I dare say they can, in some cases (where for some reason or other the pulse amplitude is large), but in the majority of cases the reading is a very difficult one indeed, and the personal equation enters into it too largely. So in the auscultatory methods of finding the minimal pressure, some authorities describing three sounds for our guidance and others five. To the ordinary man these varied sounds are very difficult to determine.

That the minimal pressure ought to be recorded as well as the maximum is coming to be recognised more and more and I should not be surprised if, in time, the minimal pressure were regarded as the more important, and for the reason that the minimal pressure represents a constant charge which the arteries have to bear and the maximal only an intermittent one.

In addition, the finding of the minimal pressure enables us to widen our scope of enquiry: we can ascertain the relations of the maximal and minimal pressures and we find that these do not always vary in the same ratio, the maximal may rise while the minimal falls and vice versa.

In a series of observations in varying conditions conducted on myself, I have found the maximal pressure vary from 130 to 140 while the minimal only rose from 90 to 105 showing that the minimal pressure is more constant than the maximal.

We are also enabled to find the mean pressure and the pulse pressure (maximal - minimal pressure) and incidentally the reserve force of the heart. This last has been worked out in America⁴ and some stress has been laid on it as affording some clue to the capability of the heart to withstand strains, such as various forms of violent exertion in school children and athletes. It is known that after a short period of violent exertion there is a rise in blood pressure which remains for some time. After prolonged exertion, however, there is a period of subnormal pressure, this negative period varying according to the recuperative power of the heart. The reserve power of the heart is thus ^{measured} ~~increased~~. A reading is taken before a period of exercise thus:-

Pulse pressure (max-min press:)

Maximal pressure. = say $\frac{35}{135}$ i.e. $\frac{1}{4}$

After exercise it is again taken, say $\frac{55}{175} = \frac{1}{3}$

if the fraction is larger after exercise as in our illustration then the heart is a good one, but if less,

then the reserve force is small, and the patient is unfit for violent exertion.

I think these few points sufficient to illustrate the importance of being able to estimate the minimal as well as the maximal pressure, and in my opinion the best and handiest instrument so far invented for this purpose is the Sphygmo-oscillometer of Pachon of Paris. I find that with this instrument also we can determine the condition of the pulse whether it is regular in time and amplitude, what is the amplitude and the variations in amplitude.

I need not dwell further on the details of the various instruments, but proceed to the consideration of normal blood pressure as measured by them. This is expressed in millimetres of mercury. We find that normal maximal pressure varies from 90 mm. in an infant to 145 mm. in an adult of 60 or so, the minimal being 20-45 mm. below this. The normal pressure is found to vary within fairly wide limits even in the same individual, some authorities recording a normal variation of 30 mm.Hg. in myself, as I have said above, I have noticed a variation of as much as 40 mm. These daily variations are due to such causes as posture, sleep, emotion, muscular exercise, smoking, digestion, &c., and it is generally conceded that we get the lowest readings in the first hours of sleep: the pressure rising during the day and

reaching a maximum in the evening. In measuring the pressure in an individual we must make allowance for all such considerations as the above, and allow for such conditions as nervous excitement, size, temperament, muscular development, &c., nervous people especially showing a high reading. However, by taking frequent readings at different times, and under different conditions, we can usually arrive at a correct estimate.

Taking all factors into consideration we can say that any individual who is under 60 and gives a constant maximal reading of over 145 is suffering from increased blood pressure.

We are now in a position to discuss our subject proper:- Chronic increase of blood pressure and its treatment.

Looking at the subject from a clinical standpoint the cases met with seem to fall naturally into two groups: the one in which the high pressure seems to be primary and the other in which it is secondary to some well marked heart or kidney disease. In the former the high pressure is the disease, while in the latter it is only a symptom: the best name for the one is hypertension or pre-sclerosis and for the latter the term true high blood pressure should be reserved.

We thus regard hypertension as a distinct disease entity and its investigation has somewhat altered our views regarding Cardio-vascular kidney or chronic Bright's disease: in fact, we regard hypertension or pre-sclerosis as the early stage of Bright's, which, if neglected, leads on to general fibrotic, or sclerotic changes in the cardio-vascular and renal systems, if not in all the organs and tissues of the body. True high blood pressure on the other hand, is always secondary to some well marked chronic heart or kidney disease, or at any rate is an advanced stage of pre-sclerosis where secondary changes have taken place in the heart or kidneys: we can regard it as a symptom - not as a disease.

This classification is important from the point of view of treatment as in the early cases the reduction of pressure is imperative if further changes are to be averted while in the latter, advanced or secondary cases, the high pressure is often essential for the well-being of the organism and its reduction is by no means always beneficial.

Taking then hypertension to mean a chronic rise of blood pressure without any discoverable lesion, and regarding it as a separate disease entity, let us enquire what we know of its symptoms, aetiology and treatment.

Hypertension is a subtle condition often lurking where least expected, but if not arrested, leading slowly but surely to an inevitable end, and at the present time our only means of diagnosing the condition is by the sphygomanometer. The patient comes complaining probably of some obscure symptoms and on examination we can find nothing much wrong: the radial feels resistant, perhaps a little thickened, but we can't be sure: the aortic second may be a little accentuated, a systolic whiff may be heard in the aortic region: nothing else can be made out and the urine is normal. All the same the pressure reading is 160 or more and the patient is suffering from a condition which, if not arrested, will inevitably lead to his premature decease.

In the early stages of the disease symptoms are conspicuous by their absence, and what there are, are usually ascribed to worry or overwork or even neurasthenia. Close questioning may reveal such symptoms as the following:- disturbed sleep, loss of energy, ~~distaste~~ for active exercise, headache, cold hands and feet, constipation, flatulence, ~~gastric~~ disturbance, giddiness - nothing definite but combined with an accurate series of pressure readings found to be constantly above normal, pointing only too surely to the presence of hypertension or pre-sclerosis.

Of course, when the disease is well established we get more definite symptoms, the arteries are thickened and resistant, the heart is hypertrophied and a ring-ing second aortic is present, the urine is of low specific gravity and contains perhaps a trace of albumen: the patient is short of breath and cannot do as he used to in any way; but he has now got beyond the pre-sclerotic stage and has entered on the second or sclerotic stage. Finally, he will reach a third where oedema of the legs sets in and his heart begins to fail: he becomes uraemic or possibly gets a slight stroke, and ultimately he dies from uraemia, or with all the symptoms of apoplexy.

The aetiology is alike obscure. The most generally accepted theory is that the disease is the result of a toxaemia, chemical or bacterial, intestinal or renal. As a proof of this we have the experiments made with adrenalin and pituitary extracts: the effects of the poisons of specific infections such as the acute fevers or syphilis: the work of Metchnikoff on the bacterial toxins formed in the alimentary tract: the more recent experiments showing that pressor substances found in the urine and derived from the putrefaction of proteid in the bowel give rise to increased blood pressure.

Since the experiments with adrenalin and its effect in producing arterio-sclerosis in animals, the supra-renal glands have been held to be mainly responsible in the production of hypertension in man and many arguments can be advanced in favour of this. One of the functions of the supra-renals has been proved to be the destruction of fatigue products and from this it is not difficult to postulate a theory:- increased "pace" in living: constant worry: increased tissue waste: increased supra-renal activity, increased adrenalin in the blood: increased blood pressure. I heard Sir Berkeley Moynihan the other day saying that he was looking for an early case of hypertension in order that he might transplant the supra-renals, so inhibiting their action, reducing the output of adrenalin, and so curing the patient.

I believe it has been shown that infective fevers produce increased activity of the supra-renals sufficient to cause marked hypertrophy of the glands and this would seem to support those who find a history of typhoid fever in many of their cases: one authority⁵ at least, lays great stress on this, and says a previous history of typhoid has occurred in the majority of his cases.

At any rate there is a strong case for those who postulate a constant change in the supra-renals before

the onset of hypertension, but we cannot get away from the fact that so far such change is not demonstrable. Those who favour the intestinal or renal toxæmia postulate a poison or pressor substance circulating in the blood which irritates the arteries and capillaries so leading to their contraction and hypertrophy and thus increasing the blood pressure.

Herbert French³ has invented a theory which, at any rate, has the merit of originality. He disdains "to take refuge in that shelter of the destitute, alimentary auto-intoxication," and postulates a stagnation of the blood in the abdominal vessels brought about by sedentary habits: he imagines such a stagnation that the visceral vessels become sclerosed and cease to expand and contract or nearly so: on the top of this the individual usually over-eats himself and is constantly sending nourishment to his already over-loaded bowel, this demanding an extra supply of blood for its digestion: the usual vasomotor response of dilating the gastric vessels while contracting the peripheral ones being feeble or absent, the heart has to take its place and by pumping harder and faster sends the increased blood supply, not only to the abdomen, but all over the body and so increases the blood pressure. He thus does not rely on the peripheral resistance as the main factor in the production

of increased pressure and in this, of course, he is at variance with most other authorities.

Many people believe that mental stress and anxiety long continued cause a gradual increase of blood pressure, and in my own experience, I have notes of one such case. A patient whose circumstances in life suddenly altered for the worse gradually developed a blood pressure which rose from 120 to 180 in three years without further symptoms of any kind, and she says she feels quite well. This is quite in agreement with the findings of others and I have no doubt that mental anxiety and worry are potent factors in the production of high pressure, especially when combined with sedentary habits.

There is a further class of cases which might be called the functional or neurotic type: there is a large class of highly strung individuals who constantly show a high systolic reading and seem to remain in perfect health, but I consider they do not live so long as their more phlegmatic brethren; their tissue waste per minute of time is too great. All the same they seem to manage along quite well without treatment of any kind.

Amongst other causes of hypertension may be mentioned lead poisoning, excessive meat-eating, over indulgence in alcohol or tobacco but these come, more or less, directly under the heading of alimentary toxæmia.

By far the majority of our cases are found to be people of sedentary habits who sit at their desks too much and worry too much about business: certainly physical exertion does not seem to predispose to pre-sclerosis as the hard working out-of-door labourer seldom, if ever, develops it. I am rather inclined to think it is a disease of the "rich" who eat too much, sleep too much and exercise too little. The exact mode of its coming about we are unable at present to determine but we can hope that the future will reveal it.

Finally, with regard to treatment. This, of course, will depend on the class of case with which we are dealing: in the secondary cases treatment must be directed to the underlying condition, the high blood pressure often being necessary to the proper functioning of the organism and consequently often best left alone. Similarly in the advanced cases, and only in exceptional circumstances, must an attempt be made to lower the pressure: for example, if symptoms of apoplexy are threatening an attempt must be made, and many drugs are recommended for the purpose, e.g., nitro-glycerin, erythrol-tetranitrate, the nitrites, &c. Unfortunately, only too often they prove of no avail and the patient dies with all the symptoms of

cerebral haemorrhage. I have resorted to vivisection in two cases, withdrawing as much as one pint of blood, without reducing the pressure more than 20~~m~~, but both cases died with symptoms of apoplexy. I do not think vivisection of any avail in this condition, as the amount of blood is so quickly made up, and the pressure soon rises again.

It is to the earlier cases we must turn if our efforts are to be of any avail. Each case must be taken on its own merits, and a careful enquiry made into all the details of the daily routine, with the result that a complete change of life may have to be recommended. Moderation in everything must be our watchword: the anxious and careworn business man must be made to forget his worries in some congenial form of outdoor exercise and his business cares must be forgotten when his desk is closed. His sedentary habits must be changed: some graduated form of exercise being ordered so that his vasomotor centres may be encouraged to resume their erstwhile activity and the vessels resume their elasticity. I am convinced that in this we have a more efficient treatment than all the drugs in the pharmacopoea: enquire carefully into the mode of life of the patient and alter it accordingly.

Next, and just as important, a carefully regulated diet must be prescribed. Too often we find that the victim of hyperpiesis takes three meat meals a day and this must be altered. A fish and milk diet is the

ideal one, at any rate for some considerable time. I have a patient who has lived on this for six years and who says that his symptoms (headache, oppression, shortness of breath, &c.) immediately return if he goes back to his meat meals. (Incidentally I might mention that this patient has had a pressure of 260/135 for the last three years and does not seem very much the worse for it).

At any rate, all cases should be restricted to one meat meal a day. Alcohol and tobacco similarly must be restricted - the less of both the better.

With regard to drugs, I am afraid all we can say is that they afford a temporary means of reducing the pressure. They may be divided into two classes, (1) The vaso-dilators which act by dilating the blood vessels and so easing the load of the heart, and (2) A miscellaneous group which depend on their secondary effects to reduce the pressure.

(1) Included in this group are amyl-nitrite, nitro-glycerin, potassium nitrite, Sod. nitrite, erythrol tetra. nitrate, mannitol, vasotonin, diuretin and agurin. Of these nitro-glycerin is effective in producing a temporary fall quickly, but the effect soon passes off. Erythrol tetratnitrate too often produces headache. The best drug for prolonged administration is Sod. Nitrite: prescribed as a one-

grain tablet four times a day at first and reduced to one or two a day, and its administration can be continued indefinitely. I think I am right in saying that this is the only drug which will stand the test of time.

(2) In the second group are included such as:- Veratrium viride, aconite, Iodine, arsenic, Trunc^{er's}~~er's~~'s serum, thyroid extract, the salicylates, calomel, chloral, chloroform, hypophysis extract, morphin and potass. bicarbonate. Of these the most useful are the iodides, and their prolonged administration seems to have some good effect. Morphin, hypodermically, acts well in some cases. In one case particularly, I can recall very good effects: a lady of 49 who ran a constant systolic pressure of 290 to 300, was subject to what have been called "slight strokes," &c. She manifested frequently symptoms of cerebral haemorrhage, sometimes becoming aph^{er}~~er~~^{ic}, at others complained of loss of power in one or two limbs, &c. After $\frac{1}{4}$ grs. morphia hypodermically she settled down and on awaking seemed quite well, though sometimes there was some headache or sickness. In the end she died with all the symptoms of apoplexy, though probably she did not have a cerebral haemorrhage.

In conclusion I should like to refer to the treatment of the condition at a Spa such as we have at

Harrogate. Here we have the patient under ideal conditions: work and worry are left behind, and he comes prepared to help us in every way. His whole life can be ordered as we wish, diet of fish or whatever we consider necessary, exercise prescribed as required, and above all definite hours of rest. Elimination can be encouraged in every way, toxic material removed from the bowel by aperient water or intestinal lavage; the function of the liver and kidneys stimulated. The imbibition of large quantities of saline waters exercises the vessels by producing a temporary hydraemia, and diuresis and diaporesis are stimulated. Metabolism can be encouraged by massage and massage baths and reduction of pressure can be brought about by a variety of warm saline baths. It has been found by experiment that a course of warm saline baths has a cumulative effect in reducing the blood pressure, the effect remaining after discontinuing the baths. I do not propose going into any fuller detail as to the various baths employed, indeed there are so many, their description would be tedious and in the end their action is the same, but, combined with the supervision and general treatment at the Spa I think we have the best means of dealing with a most subtle and obscure condition.

B I B L I O G R A P H Y.

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3. FRENCH in Lancet, 13th July 1912.
4. FAUGHT, Blood Pressure.
5. EDGECOMBE, In a paper read to the Harrogate Medical Society.

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