ADRENALIN

IN

Severe Rheumatic Heart Block.

BY

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There are two subjects to which attention will be specially directed in this paper. The first is the value of adrenalin in conditions of heart block when the symptoms are so severe that death seems imminent. The second point is the early appearance of a definite and grave cardiac lesion as the result of rheumatic infection, and before any other evidence could be detected as to what the nature of the illness was.

My attention was directed to the use of adrenalin in the Stokes-Adams syndrome by papers by Phear and Parkinson⁽¹⁾ and Parkinson and Bain.⁽²⁾ They found that it was possible for heart block to be reduced, and even for complete heart block to be abolished, by the subcutaneous injection of adrenalin. A very important point which they seemed to establish was this, that the ventricular standstill which is often accompanied by such alarming symptoms may be abolished or much modified by this treatment. The suggestion seemed so valuable that I made a mental note of it for use when an emergency presented itself.

The second point is the involvement of the heart muscle at a very early stage of rheumatic infection. There is a valuable paper by Parkinson, Hope Gosse, and Gunson⁽³⁾ recording a study of fifty cases of acute rheumatism as regards the heart and its rhythm. In 15 of the 50 cases (30 per cent.) some degree of auriculo-ventricular heart block developed, but it was usually merely a lengthening of the A-C interval and led to no symptoms. Had they not been making frequent polygraph tracings the heart block would usually have been overlooked under ordinary clinical examination. They found no case of complete heart block. What they have established is that the part of the myocardium known as the conducting tissues is not infrequently slightly affected by rheumatic infection in the acute stage. Definite signs of myocardial involvement, such as dilatation, are always difficult to determine and are not usually present in the early stages of rheumatic infection. It came, therefore, as a great surprise to me to find, as in the following case, that the conducting tissues might be selected by the rheumatic poison before there was any evidence of rheumatism, and that alarming symptoms of heart failure might supervene before one had any clear idea as to the nature of the illness.

My experience of heart block at an early stage of rheumatic infection does not stand alone. In 1916 Dr. Paul White⁽⁴⁾ wrote as follows:—"The detection of an acute heart block prior to the finding of other signs of rheumatic fever infection is so unique and important as to deserve special mention." His patient was a lad of 18 years who after four days of indefinite illness was found to have partial heart block with many dropped beats. After admission to hospital his joints became swollen and he passed through an ordinary attack of acute rheumatism. In this patient the heart block was accidentally discovered and had not been the cause of any special symptoms. The author emphasises the facts that the myocardium not only gave the first evidence of the importance of the illness but also showed at

least temporary damage, while no evidence was found of endocardial or pericardial involvement. Another example of the involvement of the conducting tissues by the rheumatic poison before other evidences of the disease had shown themselves has been recorded by Dr. Daniel Routier.⁽⁵⁾ His patient had complete heart block, with attacks of unconsciousness, after a fortnight's illness characterised by gastro-intestinal symptoms. Articular lesions developed later and the subsequent course was that of an attack of rheumatic fever. He emphasises the selective action of the rheumatic poison on the conducting tissues of the heart at an early stage of the disease. A case of partial heart block occurring during an attack of rheumatism has been recorded by Cowan, McLeod, and Paterson.⁽⁶⁾ The patient was a girl of 17 years who was admitted to hospital suffering from acute arthritis. The pulse was found to be irregular and tracings showed that this was due to defective conduction in the A-V bundle, every second or third auricular stimulus failing to reach the ventricle. There was no evidence of any other cardiac lesion save that in the conducting tissues. The irregularity of the heart gradually became less marked and eventually the A-V action became normal. Another case of complete heart block in a youth, accompanied by attacks of syncope, is recorded by Laursen.⁽⁷⁾ He was suffering from acute articular rheumatism, and under treatment by salicylate of soda made a good recovery as regards the rheumatism and the heart block. The author considers that it was clearly a case of rheumatic infection of the bundle of His, without other cardiac involvement. Other cases of heart block during rheumatic fever have been recorded by Magnus-Alsleben⁽⁸⁾ and by Lundsgaard,⁽⁹⁾ so that the liability of the conducting tissues of the heart to be attacked by the rheumatic poison has been fully demonstrated.

The history of my patient's illness is as follows :—A schoolboy of 17 years was noticed by a brother at 3 a.m. to have a fit. The patient had just returned to bed after having risen to take a drink of water. From 3 a.m. to 5 a.m. he had a series of fainting turns, and at 5 a.m. another fit. A doctor was summoned and found the condition to be as follows :—Numerous fainting turns occurred in which the patient turned pale, but did not lose consciousness. He complained of the faint feeling. In the more severe attacks or "fits" he became pale, the legs and arms were fixed and he lost consciousness; some twitching of the limbs and face occurred, he breathed deeply, the face became flushed, and he recovered consciousness. The severe attacks occurred only occasionally until mid-day and then became more frequent. After a severe attack there was usually vomiting or violent retching. Everything swallowed was promptly vomited. He was seen by me at 2 p.m. on the same day. The boy was feeling tired and exhausted. The pulse was at times steady and regular at 80 per minute, and at other times irregular with pauses of varying length. These pauses were characterised by a feeling of faintness on the part of the patient. During 20 minutes the pulse stopped twice for long intervals and each time a "fit" as described above occurred—clearly an example of the Stokes-Adams syndrome. The periods of ventricular standstill were so prolonged that one wondered if the ventricle would ever resume beating. He seemed too dangerously ill to allow of a polygraph tracing being taken. Examination of the heart showed a strong impulse at the apex, normal heart sounds, and a pulmonary systolic murmur.

As regards the cause of this attack there was not much information to be obtained. Two days previously the boy had been at Lord's cricket ground for practice at the nets, and had arrived home very tired, with a temperature of 99.5° F. The next day he felt better, but remained indoors as he still

felt rather slack. Apart from this he complained of no symptoms of discomfort. As regards his previous health he had always been delicate. Some three years ago he had had an attack of tuberculous pleurisy with effusion. He had never suffered from rheumatic infection and his doctor had never detected any sign of heart disease. Three weeks previously he had been in the sick room at school for a few days with sore throat and vomiting. Influenza was prevalent in the school at the time and he was regarded as a victim. He had recovered completely from this attack.

The diagnosis of severe heart block was easily made but its successful treatment was a difficult problem. There was no indication as to the cause of the condition. It was decided to try the effect of adrenalin. Four minims of adrenalin solution (1-1,000) were given hypodermically. After this I waited for 20 minutes, during which time the boy had very few faint turns and no severe ones. He was seen again three hours later. There had been no further severe attacks, no faints, and no vomiting or retching. He had slept quietly for an hour and a half and had then taken some nourishment. As a matter of fact from the time of the first injection of adrenalin there occurred no more attacks of the Stokes-Adams syndrome, and very few faint turns. The accompanying polygraph tracing shows the state of heart block present at this second visit. He was given a similar injection of adrenalin the same evening; two similar injections on each of the two following days; and one injection daily for the next two days. The total amount was 32 minims of adrenalin solution in five days.

The progress of the case threw a flood of light on the nature of the severe onset. The night of the onset his temperature was 100° F. and on the following morning 101° F. He sweated profusely during the night and complained of pain in the left ankle, which was found to be swollen and tender. He passed through an ordinary attack of rheumatic fever, the temperature reaching its maximum (102° F.) on the second day, and falling to normal on the fifth day under salicylate of soda treatment. Other joints were swollen and tender, including the right wrist, the right ankle, and the left elbow. He progressed well and in a week was convalescent. When seen three months later the boy was in his usual state of health, the heart was free from any abnormality, and there were no symptoms of any cardiac disability. Six months later he was taking his full share in all the school sports.

The course of this attack of heart block can be best studied in connection with the polygraph tracings. The tracing (Fig. 1) was taken 11 hours

FIG. 1.

after the first "fit" was noticed and three hours after an injection of adrenalin. It will be seen that the ventricular rate is at times very irregular, varying from 35-40-45 per minute, while the auricular rate is regular at 90

per minute. The longest ventricular standstill in this tracing is one of six seconds, but there was no accompanying complaint of faintness by the patient. During the following night there were several faint and giddy turns, which were relieved by an injection of adrenalin. These were probably the result of a more prolonged ventricular standstill. From that time onwards there were no symptoms of any kind associated with the heart block. On the third day of the illness another tracing (Fig. 2) was taken.

FIG. 2.

This shows an auricular rate of 70 with a ventricular rate of 45-50. There is a long A-C interval, namely, two-fifths of a second, and at times the ventricle fails to respond to the auricular stimulus. There are no long ventricular pauses as before. Three days later another tracing (Fig. 3) shows

FIG. 3.

much the same condition, with the auricle beating more slowly at 60 per minute. Four days later the tracing (Fig. 4) may be taken as normal.

FIG. 4.

Auricle and ventricle are beating regularly at 58-60 per minute. There are no missed beats, and the A-C interval is only very slightly increased. Later tracings showed the rhythm to be normal in every way.

In this case the conducting tissues of the heart were involved at an early stage of the rheumatic infection, with possibly other myocardial involvement, but in areas which are silent as regards symptoms. One cannot conceive of a severe inflammatory process as the condition present or that the production of Aschoff's nodes was going on. The cessation of symptoms and the rapid recovery are against such a view. It seems to be more probable that there was some toxic disturbance in the conducting tissues, possibly some œdema or vascular disorder, and that the local disturbance

was a temporary one. The joint symptoms in rheumatic fever are often temporary and fleeting and I think it was Sir Archibald Garrod who suggested that the arthritic phenomena might be toxic in origin as contrasted with the endocardial and pericardial phenomena which are inflammatory in character. Such a view would appear to be the best explanation of a temporary disturbance in the conducting tissues of the heart.

Soon after the onset of auriculo-ventricular dissociation in this lad attacks of the Stokes-Adams syndrome developed and threatened life itself by a prolonged standstill of the ventricles. How near he was to a fatal issue it is impossible to say, but from the observer's standpoint it may be stated that the symptoms were very alarming. The question arises as to whether adrenalin really checked the attacks or whether they would have ceased naturally and without it. There is very strong evidence against the latter view. At the time adrenalin was given the attacks had been going on for 11 hours, and were becoming more frequent—two in the last 20 minutes. Adrenalin was given because of the published reports as to its value in cases of severe heart block. It was not a case of the haphazard trial of a drug but an attempt to repeat the experience of other observers. No other drug in my experience has ever produced a result comparable to that which followed the adrenalin injection. From the time of the injection no further attacks of severe heart block (Stokes-Adams syndrome) occurred. From that time no sign of cardiac embarrassment or danger appeared. The boy passed from a condition of imminent danger to one of ordinary illness.

What is the exact action of adrenalin in such cases? Clinically speaking one can say that it had checked the prolonged standstill of the ventricles which was the immediate danger. It had not removed the auriculo-ventricular dissociation which persisted for some days longer although always to a diminishing extent. Pharmacologically speaking one has a difficulty in determining the exact action of adrenalin, a difficulty comparable to that still existing as regards digitalis. The problem is as to whether these substances act on the heart muscle directly or through the nerves supplying the heart. It is taught that adrenalin stimulates the sympathetic nerves, thereby increasing the activity of the conducting tissues, and also that it acts directly on the ventricular muscle, thereby increasing the rate of the ventricles. Under normal conditions one cannot see how this latter action could apply, because the ventricular rate is always dependent on the auricular rate and follows it closely. When there is auriculo-ventricular dissociation with a very slow ventricular rate anything which increased the rate of the ventricles would be helpful. This is what adrenalin appears to do, either by direct stimulation of the sympathetic or by direct stimulation of the ventricle. The result is that a tendency to prolonged standstill of the ventricles, from which come the dangerous symptoms, is checked or abolished as long as the effect of the adrenalin lasts. It may be that the idio-ventricular mechanism which exists in every heart, and which comes into play in cases of complete A-V dissociation, after a longer or shorter time, may be stimulated into activity by adrenalin in those cases of prolonged ventricular standstill.

REFERENCES AND LITERATURE.

1. *The Lancet*, 1922, i., 933.
2. *Ibid.*, 1924, ii., 311.
3. *Quart. Jour. of Med.*, 1920, xiii., 363.
4. *Amer. Jour. Med. Sci.*, 1916, cli., 589.
5. *Arch. Mal. de Cœur*, 1914, vii., 316.
6. *Quart. Jour. of Med.*, Jan., 1910, p. 115.
7. *Arch. Mal. de Cœur*, 1916, ix., 447.
8. *Zeits. f. Klin. Med.*, 1910, lxi., 82.
9. *The Lancet*, 1916, cxc., 125.