A British Medical Association Lecture ON SOME ASPECTS OF CARDIAC DISEASE.*

BY
JOHN HAY, D.L., M.D., F.R.C.P.,
HONORARY PHYSICIAN, ROYAL INFIRMARY, LIVERPOOL.

So much of what appears in the journals dealing with the neo-cardiology, as it has been termed (a term applied partly, I think, in derision), is so technical and so difficult of comprehension that there is a tendency to miss those points which are of real and genuine practical value.

When one remembers that Mackenzie's book, *The Study of the Pulse*, was published in 1902, and that it is only ten years since the electrocardiograph began to be applied seriously to the elucidation of the arrhythmias, it is not difficult to understand why there is still so much haziness and even frank ignorance concerning the newer and more correct views of cardiac disorders. During the last twenty years the whole conception of the arrhythmias and their relation to cardiac failure has been changed.

If these views were nothing more than a revised nomenclature with little or no bearing on prognosis and treatment I would not trouble to discuss them with you; but the reverse is the case. Recent work has made diagnosis more certain, and correct knowledge of the heart is more concise, and as a natural corollary prognosis and treatment are placed on a surer and sounder basis.

I propose to discuss one form of arrhythmia, an irregular action which is extremely common, and which for this, if no other reason, is of considerable importance to us all as practitioners. I refer to auricular fibrillation, and may I make one point here—it is this: irregular action of the heart is not merely a matter of degree—there are definite, clearly demarcated types, varying fundamentally, and it is most important to be able to differentiate between those forms of irregular action which are of no moment and those which indicate serious changes.

Auricular fibrillation is not only of common occurrence, but it is also a serious handicap to the efficiency of any heart, healthy or diseased. The term "fibrillation" is unfortunately often applied rather loosely, showing a lack of appreciation of the fact that fibrillation is a sharply defined condition. An auricle is either fibrillating or it is not fibrillating, and the presence of fibrillation can generally be recognized during the ordinary clinical examination without any special instruments other than a stethoscope and a trained intelligence. At least 50 per cent. of all cases of persistent irregularity are due to fibrillation, and 60 to 70 per cent. of the patients admitted into hospital suffering from cardiac failure show this form of arrhythmia. Experimental work by Eyster and Swarthout on dogs has shown that fibrillation diminished the cardiac output by 40 per cent., and from clinical evidence it is clear that the inception of fibrillation means a sudden and definite increase in the load which the heart has to bear.

Before describing in detail the characteristics of this change and the method of its recognition may I first present a few clinical pictures?

In each of the five patients to be described the heart was beating in a frequent and disorderly manner—possibly with great frequency. It is well to remember that fibrillation may be associated with all grades of cardiac distress.

CASE I.

I have in my mind a man of 69, subject to attacks of "palpitation and fluttering action of the heart." These would come on at any time and without apparent cause, and last as a rule several hours. Their onset was sudden—he knew the moment they began and he knew also the moment of their cessation. He was not greatly distressed by them, but during an attack he did not feel quite himself and was conscious of the rapid and irregular action of his heart. Otherwise he was not inconvenienced and had no hesitation, for example, in setting out on a journey by train. (See Fig. 6.)

CASE II.

The second patient, a man of 80, was entirely, or almost entirely, unconscious of any change in his heart. On cross-examination, however, he admitted that he was more easily puffed, and that on effort he experienced a little palpitation; beyond that, nothing. The heart showed no deviation from the normal except the typical irregularity and slight increase in frequency. (See Fig. 4.)

CASE III.

In the third case the subjective symptoms were more definite. He was apparently a healthy man of 50. On May 19th he ran hard for a train—a distance of three-quarters of a mile. He caught it, but the shortness of breath and the palpitation caused by the extra effort did not pass off as he had expected. They persisted, and when I saw him on May 22nd he still complained of these symptoms and also of a peculiar "dithery and shaky feeling." On examining the heart I found the ventricular rate 140, many of the systoles failing to send a pulse to the wrist. There were no bruits and no increase in the cardiac dullness. Fibrillation had supervened in a heart which, up to that moment, had been for all practical purposes a sound heart with an ample reserve. (See Fig. 3.)

CASE IV.

The fourth example is that of a woman who had been under observation for years, suffering from mitral stenosis. Up to the present breakdown she has had, in spite of her valvular disease, good cardiac reserve, and has lived a useful and active life within her frankly recognized limitations. She will tell you that suddenly, naming the day and the hour, she became conscious of an irregular and rapid action—or she may describe it as a peculiar fluttering behind the breast bone. With this there were some precordial pain and a sense of shortness of breath. These symptoms increased and, as she was not treated, were followed by cyanosis, venous engorgement, and oedema, with distension of the abdomen and some abdominal pain, and an engorged and pulsating liver—all the signs of grave cardiac failure. On examination the action of the heart is found to be extremely rapid; the heart has become dilated, the typical presystolic murmur has disappeared, and the pulse is running, feeble, and irregular.

CASE V.

The last and fifth case is of a different type, but again one with which we are all only too familiar. I refer to the sudden onset of acute and overwhelming cardiac failure in a patient of middle age or of more advanced years. Such a man of, say, 60, in apparently good health, known to have a high blood pressure, awakes in the small hours in acute physical and mental distress. This is characterized by extreme dyspnoea and restlessness; his face is grey and pallid, he is bedewed with cold sweat, and his extremities are cold and clammy. There is no cedema and no engorgement of the liver. The heart is found to be beating tumultuously with extreme rapidity—the "delirium cordis" of the older writers. The radial pulse is irregular in force and frequency, and there are many small and almost imperceptible pulsations, in striking contrast to the apparently forceful action of the ventricles. He dies in a few hours of rapidly progressive cardiac failure chiefly affecting the left ventricle.

These instances are given as illustrations of the varied character of the clinical picture which may be presented by patients in whom auricular fibrillation has supervened. I hardly need to emphasize the fact that in each of these patients it was essential for correct treatment and prognosis that the nature of the sudden change in the heart should be clearly recognized.

What are the characteristics by which it can be recognized? They are largely embodied in the five cases related above.

Onset.—The onset is sudden. The transition from a normal rhythm to fibrillation is instantaneous and patients can often give a clear account of the commencement of the attack. Similarly in those patients in whom the fibrillation occurs in paroxysms the offset may be equally perceptible. On the other hand, fibrillation may not cause any sensations, pleasant or otherwise, until the reserve power of the heart is definitely encroached upon.

Irregularity.—The ventricular action is completely irregular and often frequent when the heart is free from the action of drugs; but the rate may vary within very wide limits, and when moderate the irregularity may not be very noticeable, though if the pulse be observed over a few minutes it is probable that the typical disorderly rhythm will manifest itself, and this will be more noticeable after exercise. It is also not unusual to find that the rate of the ventricular contraction is greater than the pulse rate, since some of the beats fail to be transmitted to the wrist.

Liability to Cardiac Failure.—It is the rapid and relatively inefficient action of the ventricles which increases the liability to cardiac failure, and if preceding the onset of fibrillation the myocardium is unsound, or if there is marked arterial hypertension, the onset of cardiac failure may be rapid and the distress great. It was this type of rapid and irregular ventricular action that was named "delirium cordis" by such writers as Balfour in his delightful book *The Senile Heart*.

Dilatation of the Heart.—When present dilatation supervenes as the result of the rapid and disorderly action and not as the cause, and if the fibrillation ceases the dilatation rapidly disappears. Similarly the heart shrinks when the

* Delivered before the Mid-Cheshire Division, June 15th, 1922.

ventricular action is slowed by digitalis, even if the fibrillation persists.

These, then, are briefly the clinical characteristics.

ETIOLOGY.

The etiology is simple. There are two large groups in which most of the cases may be included:

1. *The rheumatic*—in which the most common form of valvular disease is mitral stenosis, and the age period covers from 20 to 50.

2. *The senile*—in which males predominate. In this must be included patients suffering from myocardial degeneration, arterio-sclerosis, and chronic interstitial nephritis.

The remaining cases are those in which the fibrillation originates in infections such as pneumonia and influenza, or results from sudden physical strain.

A point I should like to emphasize here is that fibrillation is not confined to any one type of cardiac lesion. It may develop in any heart, though it is unusual to find it in the absence of some definite pathological condition.

The essential nature of auricular fibrillation is a specific and fundamental change in the activity of the auricles. Normally the auricles contract in response to a stimulus which originates at the sino-auricular node, and this contraction is a co-ordinated movement eventuating in the expulsion of the auricular contents. This ceases when fibrillation begins. The fibrillating auricle thus remains in a state of continued diastole and on inspection its wall is seen to be tremulous. It is not inactive, but its activity is no longer normal.

I do not propose to discuss the cause for this peculiar condition, but the explanation which is at present generally accepted is that of "circus movement," ably described by Sir Thomas Lewis in his Oliver-Sharpey lectures for 1921.

Essential Character of Fibrillation.

Whatever theory of fibrillation is accepted there is at all events no doubt that all evidence of pre-systolic contraction of the auricle disappears. With fibrillation, for example, the typical presystolic bruit of mitral stenosis is no longer heard—a mitral diastolic may and often does persist, but even when it is audible up to the first sound it has lost its presystolic crescendo accentuation, and in a lengthened diastolic pause the bruit generally fades away before the subsequent first sound.

An analysis of the jugular records taken from the vein shows that the wave *a* in the phlebogram, so characteristic

FIG. 1.—The jugular pulse is auricular in type; the wave *a* is well marked and occurs regularly. The murmurs are indicated on the tracing: presystolic, systolic, and early diastolic.

FIG. 2.—From same patient as Fig. 1 after the onset of fibrillation, showing an entire change in the character of both jugular and radial pulses. The rhythm is now disorderly. The wave *a* present in the previous tracing has disappeared. The murmurs are charted on the record. Note that the presystolic murmur has disappeared.

of systole of the right auricle, is no longer present. On the other hand, there may be, during diastole, peculiar small oscillations in the phlebogram.

Again, the electrocardiograph gives conclusive evidence of the cessation of normal activity in the auricle by the disappearance of the deflection *P*—a deflection due to auricular contraction and present in every normal record.

At the same time there are in the electrocardiograph numerous small deflections, *f f*, occurring at the rate of 450 to 500, which are caused by the peculiar electrical changes accompanying fibrillation, and are characteristic of the change.

FIG. 3.—Electrocardiographic records showing result of quinidine sulphate in a patient suffering from auricular fibrillation. Top record, taken during fibrillation, shows irregular action of the ventricles, and the characteristic small deflections *f* due to the fibrillation. Lower record shows normal rhythm after 0.4 gram of quinidine sulphate. The oscillations *f f* have disappeared. A premature beat arising in the auricle is shown at *P*.

We have therefore this peculiar condition present in the auricles, and from this fibrillating mass impulses pour upon the ventricles through the normal channel—the auriculo-ventricular bundle. The ventricles respond as best they can

FIG. 4.—Simultaneous tracings of the jugular and radial pulses. Note the absence in the jugular tracing of any wave *a* preceding a ventricular systole. From Case II. Typical disorderly rhythm.

to this irregular bombardment. The junctional tissues do, however, put some check on the number of stimuli passing through them, and the ventricular rate probably depends on the degree of block present. When this is marked the ventricular rate is infrequent, but when the impulses pass on to the ventricles with little hindrance the rate tends to become excessive. By judicious medication this can be controlled.

FIG. 5.—Typical radial tracings from case of auricular fibrillation, showing lack of correspondence between the length of diastole and the magnitude of the succeeding systole.

Whether the rate be frequent or the reverse the ventricular action is no longer regular—it is disorderly, a haphazard rabble of beats. Exercise increases both the cardiac frequency and coincidentally the degree of the arrhythmia.

DIAGNOSIS.

The diagnosis of this condition during the ordinary clinical examination depends, therefore, upon a clear recognition of these essential characteristics which I have described. Careful cross-examination may elicit valuable information concerning the onset. The change in the character of the murmurs in the case of a patient suffering from mitral stenosis would of course be more than suggestive. But the most significant feature is the specific character of the arrhythmia, and in most instances palpation of the pulse should justify a positive diagnosis. The beats come hap-

hazard; the normal relation between the size of the beats and the antecedent pause no longer holds, and the rate of the pulse is no sure indication of that of the ventricles. The faster the heart the more obvious is the disordered character of the action. When the rate is within normal limits the arrhythmia is more subtle and is less arresting. Even then, however, sooner or later, with patience, the characteristic inconsequence of beats will appear, and suspicion passes into certainty.

Auricular fibrillation presents one other characteristic of great diagnostic value, and that is the specific response to the digitalis group—namely, a marked slowing of the ventricular rate, which is sometimes accompanied by the appearance of "coupled beats."

With these clinical characteristics clearly in mind it should be possible to arrive at a diagnosis, but there are certain forms of irregular action which may cause some little difficulty.

Sinus Arrhythmia.

Each respiratory movement may be associated with a decided arrhythmia, a quickening of the rate with inspiration and a lagging with expiration. When this is unduly exaggerated it may simulate fibrillation, but on holding the breath the heart becomes regular. A clear relationship to the respiratory phases is decisive. This form of irregularity is frequently present in adolescence and is of no moment.

FIG. 7.—This record shows the coupled beat which often occurs when digitalis is pushed in cases of fibrillation of the auricle. It is an indication to stop the administration of digitalis. The second systole in each coupling is ectopic, and is just perceptible in the radial tracing.

Then, if *ectopic or premature beats* become numerous the arrhythmia simulates that of fibrillation. When occurring only occasionally or at regular intervals, giving rise to a premature or ineffectual beat every second, third, or fourth beat, it is obvious that there is a fundamental or dominant rhythm. Exercise, by increasing the rate, generally brings about a disappearance of this irregularity.

It is this form of arrhythmia which is that most likely to cause difficulty, and there is no doubt that when it is still further complicated by the appearance of "pulsus alternans" it may be impossible to make a confident diagnosis without a

FIG. 8.—Polygraph record showing sinus arrhythmia. The rate is quickened with inspiration and slowed during expiration. *a* = wave due to systole of the auricle, *c* = record of carotid pulse.

polygraph or electrocardiograph record. Similarly cases of auricular flutter and cases of heart-block simulating fibrillation will probably require the employment of instruments of precision before a positive diagnosis can be made; but here again exercise and an increase of the ventricular rate tend to give a regular action.

TREATMENT.

When fibrillation is present the primary object of treatment is to reduce the ventricular contractions to a number

within normal limits. In the most urgent cases of all, when the condition of the patient is so grave that it is obvious that unless the heart is slowed down at once death within a few hours is inevitable, strophanthin must then be administered intravenously in a dose varying from 0.5 to 1 mg. The result is sometimes as satisfactory as it is dramatic. Within an

hour the condition of the patient is altered from one of acute distress to relative comfort: a liver obviously engorged and pulsating has shrunk materially; the cardiac thrust has moved in towards the nipple; the breathing is easier and the heart rate has fallen to a normal frequency.

In less urgent cases full dosage with the tincture of digitalis will probably be adequate:

3j or 3jss of the tincture as an initial dose, preceded by a purge, will generally give some relief within twenty-four hours; or the tincture may be prescribed in mxx doses three or four times in the twenty-four hours.

The digitalis group acts mainly by depressing the junctional tissues and hindering the passage of stimuli from the auricle to the ventricle. Digitalis should be continued until a specific response has been obtained; when the ventricular rate is down to 70 or 80 then the dose must be reduced until just sufficient is taken to maintain this speed. The most satisfactory response undoubtedly occurs in the rheumatic group. The danger is that the patient may cease to take digitalis when the symptoms have disappeared, or as it often happens, the doctor in charge discontinues the administration for fear of the so-called cumulative effects. The result is that within

FIG. 9.—Premature beats.

a few weeks the ventricular rate mounts and the dyspnoea and other indications of cardiac distress return. Certain patients are dependent on the help to be obtained from digitalis, and must never entirely cease to take it in appropriate doses, for digitalis is essential to their well-being.

FIG. 10.—Shows the rapid drop in the heart rate after the injection of the strophanthin, from 120 to 81 in twenty-five minutes.

There are, of course, well-recognized indications for diminishing or stopping digitalis, such as: (1) a ventricular rate of 70 or under; (2) nausea or vomiting or diarrhoea; (3) a "coupled beat" which has appeared as the result of treatment with digitalis. This coupling is a specific response; it is an indication of saturation and that digitalis should be

stopped. The nausea and vomiting may be a true indication of toxic dosage or merely the outcome of the resentment of an engorged stomach to a nauseous drug. If there is reason to believe that the latter is the case, then the digitalis should be continued, but given well diluted or in a bland bismuth draught. When the tincture is badly tolerated the patient can sometimes take with comfort either Nativelle's digitalin granules or the tincture of strophanthus.

In the mildest cases of all, with only a moderate acceleration of the ventricular rate and no distress, regulation of the life and the exhibition of mild haematinics over a long period yield the best result. There are few better cardiac tonics than an adequate supply of good blood to the heart through the coronaries. This is especially applicable to the cases of fibrillation occurring in patients with high blood pressure and arterio-sclerosis.

Can we Stop Fibrillation?

Sometimes fibrillation ceases spontaneously and may never recur; more often it is permanent. Recently much has been written about the action of quinidine sulphate and its power of terminating fibrillation, and it may be of interest to you to refer to this line of treatment.

My experience covers 17 cases in which I have given quinidine with the object of restoring a normal rhythm. In 6 of the 17 the treatment failed. Either the patient could not tolerate the drug or the cardiac failure was accentuated by the quinidine. In 11 of the 17 a normal rhythm was obtained, but two of these relapsed and persisted in their fibrillation. Ultimately in 9 of the 17 patients the normal rhythm was maintained. (See Fig. 3.) It is possible if not probable that as time goes on some of these 9 may fall from grace. On resumption of the normal rhythm some patients feel materially improved, others do not admit to much, if any, benefit.

In my opinion the treatment is not free from danger, and the action of the quinidine should be most carefully checked. My practice is to have an electrocardiogram taken twice a day and the changes in the auricular and ventricular contractions noted. I give the drug in capsules in doses of 0.2 gram spread over the twenty-four hours, so that the patient receives ten doses, or 2 grams, a day. Its indiscriminate use is dangerous, and it should only be given in carefully chosen cases and with the patient under continuous observation. I should like to emphasize this as I have met several instances where, through ignorance, quinidine sulphate has been prescribed recklessly and without any attempt at adequate supervision.

Summary.

Irregular action of the heart is not merely a matter of degree. The types differ fundamentally and their significance varies widely.

The most important group is that of fibrillation of the auricle, characterized by a specific and fundamental change in the activity of the auricles, and a frequent and disorderly action of the ventricles. This increases the load of the heart and is the most common cause of cardiac failure. The recognition of this form of irregularity is not difficult, requiring only the fingers and a trained intelligence.

Fibrillation is not confined to any one particular form of cardiac lesion, but may occur at any age, and when once established tends to persist.

The digitalis group produces a remarkable slowing of the ventricular rate with consequent improvement in the patient.

Auricular fibrillation can in 50 per cent. of the cases be terminated by quinidine sulphate, but in many patients the fibrillation recurs, and the exhibition of this drug is not without danger.

THE Dutch Society for Combating Alcoholism will hold a Congress at the Hague on September 11th, when the following subjects will be discussed: Alcoholism and criminality, introduced by Professor Bongers, and treatment of chronic alcoholism, by Dr. F. S. Meijers.

ACCORDING to a warning issued by the U.S. Public Health Service, leprosy is on the increase in the United States. Statistics show that there are 1,200 lepers at large in twenty-five States, contact with whom may further spread the disease. It also appears to be prevalent in Latin America, for Dr. R. F. Parra, physician-in-chief of the Agua de Dios Leprosarium, Colombia, reports that there are now 2,726 lepers segregated there. Chaulmoogra oil is being used in the treatment of 122 of these patients.

An Address

ON

ACUTE ARSENICAL POISONING.*

BY

SIR WILLIAM HENRY WILLCOX, K.C.I.E., C.B., C.M.G.,
M.D., F.R.C.P.,

PHYSICIAN TO ST. MARY'S HOSPITAL, LONDON, AND LECTURER ON
FORENSIC MEDICINE IN THE MEDICAL SCHOOL.

DURING the last few years our knowledge of the physiological, therapeutical, and toxicological effects of arsenic has been greatly extended, owing largely to the greatly increased use of preparations of arsenic in the treatment of disease. Thus the use of arsenobenzol derivatives for the treatment of syphilis is worldwide, and many other organic arsenical compounds are largely used in pharmacology. In some cases toxicological effects have followed the therapeutic use of these powerful remedies, and a study of these effects has not only enlarged our conceptions of the physiological and toxicological action of arsenic generally, but it has also stimulated the study of the quantitative tests for the efficiency of important organs of the body—for example, the liver.

Application of advances in pathological and chemical technique has enabled the toxicological effects of arsenic to be studied with more precision and detail, and thus has led to an extension of knowledge.

It will be my endeavour to call attention to the recent advances in our knowledge of the toxicology of acute arsenical poisoning, to give a summary of the salient points, and to illustrate them where possible by classical examples. Acute poisoning by white arsenic and similar inorganic compounds will be considered, and reference will be made to poisoning by arsenobenzol derivatives. Arseniuretted hydrogen will not be dealt with.

Arsenic is one of the commonest and oldest known poisons. It is stated to have been discovered in the third century. Its toxicology overshadows that of all other poisons in importance. Its poisonous properties are known to everyone and its preparations are easily accessible. It is almost tasteless, and can be introduced into food without fear of detection. It produces symptoms which closely simulate natural diseases, and it is not therefore surprising that as a homicidal poison it has easily held the first place for centuries.

Arsenical poisoning may be homicidal, suicidal, accidental, or produced when taken for the purpose of causing abortion or as a quack medicine. Out of 1,000 recorded cases from 1752 to 1911 collected by Witthaus the reasons for taking the poison were as follows:

Homicidal...	...	...	...	42.6 per cent.
Suicidal ...	...	...	...	23.0 "
Accidental ...	...	...	...	20.0 "
As an abortifacient ...	...	...	...	3.3 "
Due to quack medicine ...	...	...	...	0.4 "
Motive unknown ...	...	...	...	10.7 "

These figures, however, cannot express the true proportions, since suicidal and accidental cases are commonly not recorded. Homicidal poisoning must represent only a small minority of all acute arsenical cases. It is certain, however, that as a poison used for homicidal purposes the absolute number of cases far exceeds those of any other poison.

Preparations Used.

Arsenious oxide (As_2O_3) is the preparation most commonly used for criminal purposes; it is a white inodorous powder, almost tasteless, and slightly soluble in water; about 1/2 grain dissolves in an ounce of cold water, and 6 to 12 grains in a similar quantity of boiling water. It can be added to food and drink without fear of detection, and persons wishing to use it for criminal purposes appear to have no difficulty in obtaining it.

When sold to the public the regulations of the Poisons Acts should be complied with, and one of the conditions of sale of white arsenic is that it should be coloured by the admixture of at least one-sixteenth of its weight of soot or indigo. The evidence of recent notable trials shows that this rule is sometimes honoured in the breach rather than in the observance (Armstrong case).

An easily available source of white arsenic which is often forgotten is the chemical laboratory. The poison can be

* Given before the Medico-Legal Society, July 4th.