CARDIAC PROBLEMS IN RECRUITS

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I have been privileged to examine a considerable number of recruits with doubtful hearts, sent to me by various London Medical Recruiting Boards.

I have collected particulars of 140 cases seen by me up to the end of 1940. Their ages were mainly between 18 and 30, though a few volunteers over 30 are included.

The accompanying table shows the diagnosis made.

It must be realised that all those sent to me for my opinion had had heart conditions about which differences of opinion had arisen amongst the members of the recruiting Board, so that cases with well marked heart abnormalities were conspicuous by their absence and the diagnosis was rarely easy and often of extreme difficulty. This work has made me very conscious of the difficulties experienced by the members of the recruiting Boards in the field of cardiology and increasingly sympathetic towards them. It is with the object of trying to help those of you who are members of these Boards that I have chosen "Cardiac Problems in Recruits" as the subject of my address.

It seems to me best to discuss the subject under the following headings:—

1. Systolic murmurs.	6. Exocardial factors.
2. Diastolic murmurs.	7. History.
3. Tachycardia.	8. Orthodiagraph.
4. Blood pressure.	9. Electrocardiogram.
5. Exercise Tolerance Test.	10. Difference between volunteers and conscripts.

I might mention here the meaning of the different military Grades, for those of you who have not perhaps been dealing with recruits.

Category 1. Full Service Duties.

Category 2. Home Service only.

Category 3. Non-combatant duties at Home, e.g. clerks, orderlies, batmen, cooks, etc.

Category 4. Unfit for any kind of Service.

1. SYSTOLIC MURMURS

Murmurs are produced when turbulence is introduced into the blood flow and may be brought about by the following factors:—

Changes in the speed of flow.

Changes in the viscosity of the blood.

Constriction of the channel.

An organic mitral systolic murmur may vary from soft and blowing to loud and rasping, dependent on the state of activity of the heart muscle.

An organic mitral reflux is usually associated with stenosis of the mitral valve but may be found alone. The murmur is usually blowing in character, replacing or modifying the mitral first sound, conducted outwards into the axilla and may even be audible in the left subscapular region. It is also associated with enlargement of the heart, chiefly of the left ventricle and with accentuation of the pulmonary second sound. The mitral systolic found in cardiac dilatation is softer and not so well propagated and the x-ray shows an increased heart shadow. The murmur tends to disappear as the heart recovers its tone, and there is no evidence of mitral stenosis.

Tricuspid systolic murmurs, audible in the fourth right space, close to the sternal border, are relatively uncommon and are of no importance by themselves.

An aortic organic systolic murmur is relatively rare. It may be due to aortic stenosis or to dilatation of the aorta, with thickening of the valve. The murmur is loud and rough, propagated into the neck vessels and often accompanied by a systolic thrill in the second right space. Aortic stenosis is usually associated with aortic reflux and is commonly the sequel of previous rheumatic fever. A vascular murmur, due to the superficial position of the subclavian, is occasionally misdiagnosed as aortic stenosis. This murmur, however, is not propagated into the neck vessels and not associated with the typical anacrotic pulse and cardiac hypertrophy.

Pulmonary systolic murmurs are usually functional, relatively common in children and in adolescents with plastic chest walls. The murmur is poorly conducted and is considered to be due to variations in shape, with deformity of the pulmonary vessels. It may be produced by pressure of the stethoscope. It is of no import. A rough crepitant localised pulmonary systolic murmur is found frequently in cases of severe thyrotoxicosis. The murmur disappears with improvement of the condition. An organic pulmonary systolic due to congenital pulmonary stenosis is rare. When present it is loud and propagated towards the left shoulder and a systolic thrill is usually present. Other signs are:—cyanosis; clubbing of the fingers and toes; an enlarged right ventricle, seen on x-ray examination: typical electrocardiographic changes; the blood picture shows a polycythaemia.

Functional heart murmurs are extremely common and are almost invariably systolic. They occur chiefly at the apex, but are also found down the left side of the sternum. Probably they are most often found in cases with excitable and rapid heart action and not infrequently in those with neuro-circulatory asthenia. Sometimes the murmur modifies a loud rough first mitral sound and occasionally there is a palpable thrill and the condition is then likely to be diagnosed as mitral stenosis. The main points of difference are that the characteristics of this type of functional murmur tend to disappear as the heart quietens and the fact that in mitral stenosis the presystolic murmur, except when the stenosis is considerable, is very localised. A similar condition is frequently found in acute thyrotoxicosis.

Haemic murmurs are considered due to turbulence from decreased blood viscosity and are heard at both base and apex. They should only be diagnosed as such if associated with severe anaemia. Personally, I am not fond of the term "haemic murmur" and refrain from using it if possible. I have seen so many patients with marked anaemia whose heart sounds are perfectly clear and I am therefore inclined to consider the murmur, when present, as due to lack of tone of the heart muscle, with slackness of the valve ring. I prefer the term "atonicity murmur."

Cardio-respiratory murmurs are very common. They are usually best heard over the third and fourth left spaces, but are also present at times over the apex. The murmur is usually best heard in the upright posture and varies with respiration. It tends to disappear on holding the breath, but is increased by exercise. It is very variable at different examinations and is often present in healthy people.

Certain murmurs I have labelled as **exocardial**. They are usually heard down the left side of the sternum, but occasionally at the apex. They are harsh and often loud, but are not conducted, are superficial and their intensity may be diminished by pressure of the stethoscope. They may be due to a localised pericardial roughening, but usually there is no history of previous heart trouble. They are sometimes misdiagnosed as congenital heart lesions, but their position and characteristics do not fit in with any of the known congenital heart abnormalities.

Functional murmurs *per se* do not suggest any cardiac abnormality, but their presence makes it absolutely necessary to decide as to their nature. The points I have found most useful in deciding that a systolic murmur is functional and not organic, are the following:—

The absence of cardiac enlargement.

The absence of a presystolic murmur.

No accentuation of the pulmonary second sound.

Murmur not heard posteriorly.

X-ray shows no enlargement of the pulmonary conus or of the left auricle or right ventricle.

In my series 85 per cent of those with functional murmurs were recommended for Overseas or Home Service.

Sometimes a considerable amount of difficulty is experienced in deciding whether a congenital heart abnormality is present. The main characteristic of a congenital murmur is its loudness. There is usually an associated thrill, which, when found, will negative the murmur as being exocardial. Most congenital murmurs met with in recruits are systolic in time, with the exception of patent ductus arteriosus, where the murmur continues into diastole.

Patent ductus arteriosus is one of the commonest congenital cardiac abnormalities met with, since the condition is compatible with normal heart function. There is a loud phasic murmur over the second left space, mainly systolic but continuing into diastole and propagated towards the left shoulder. A thrill is usually felt over the area of maximum intensity.

This abnormality may occur alone, or may be associated with patency of the interventricular septum or with pulmonary stenosis.

Patent interventricular septum—*Maladie de Roger*—may also occur as an isolated lesion and is then compatible with normal heart function, often for a considerable number of years. This abnormality is the commonest congenital defect. There is a harsh systolic murmur and thrill over the third and fourth left spaces. There is absence of cyanosis and of cardiac enlargement so long as the blood shunt is from the left ventricle to the right.

Patent foramen ovale, where the opening is small, may be regarded as almost normal. There are no distinguishing signs during life. Where the septal defect is large, a left to right shunt occurs which causes marked dilatation of the right heart and pulmonary artery, on account of the increased quantity of blood passing into it, whereas the left heart and aorta remains small and undeveloped because of the decreased amount of blood. Cyanosis, however, does not occur unless the shunt is reversed, usually as a terminal event. In late stages the heart reaches an enormous size. Radiological appearances are characteristic, namely, a large, globular heart shadow, very large pulmonary conus and enlarged main branches of the pulmonary artery.

Fallot's Tetralogy is the commonest of the complex congenital cardiac abnormalities and is the most common cause of congenital cyanosis in adult life, accounting for 85 per cent of all cyanotic cases reaching adult life. Anatomically, the tetralogy consists of:—

Pulmonary stenosis.

Patent interventricular septum.

Dextra position of the aorta. (The vessel arises from both ventricles astride the septal defect.)

Right ventricular hypertrophy.

In this congenital abnormality, only part of the blood enters the lungs and the enlarged aorta receives blood from both ventricles. Clinically, there is a loud pulmonary systolic murmur and thrill. X-ray examination shows a typical silhouette—"coeur en sabot." The E.C.G. shows marked right axis deviation.

One other congenital heart abnormality which may be missed, especially if the blood pressure is not taken, is coarctation of the aorta, in which there is narrowing of the aorta just beyond the origin of the left subclavian. The main features are high blood pressure of the upper extremities and low pressure of the lower limbs. Careful examination will probably discover pulsations of the enlarged branches of the subclavian arteries over the back. Radiologically, notching of the under surfaces of the ribs is pathognomonic.

Other congenital heart lesions are not likely to cause difficulties.

It is advisable to reject all cases with congenital heart abnormalities, even where the heart function is excellent and the x-ray picture is negative, owing to the possibility of the occurrence of malignant endocarditis.

2. DIASTOLIC MURMURS

The presence of a diastolic murmur invariably indicates organic valvular disease. Thus, when found, the recruit is automatically classified in Category 4 as unfit for any form of military service.

The only two diastolic murmurs likely to be met with in recruits (with the rare exception of the 'machinery murmur' of patent ductus arteriosus, which, commencing in systole, is prolonged

C.T.R. = Cardiac—thoracic ratio.

into diastole), are those of mitral stenosis and of aortic reflux. The former is chiefly late diastolic or presystolic and is a rough crescendo murmur running up to a sharp first mitral sound. In more advanced cases there is also a soft diastolic murmur commencing early in diastole and diminuendo in character. It may be continuous with the presystolic murmur. When auricular fibrillation occurs, the presystolic element tends to disappear, leaving only the diminuendo diastolic. As regards the diagnosis of mitral stenosis, the most important feature is the sharp first mitral sound and the accentuated pulmonary second sound, which are invariably present in all stages of the lesion. If the mid-diastolic, or diminuendo, murmur is heard, the diagnosis of mitral stenosis is established, but it is not always easy to decide, in over-acting, rapidly beating hearts, whether the loud first mitral sound is preceded by a short presystolic or not. Lying the patient on his left side will often bring out the murmur and also the thrill. Whenever I hear a loud, sharp, first mitral sound in a quietly beating heart, I always suspect mitral stenosis. This sharp first sound is often accompanied by a soft localised systolic murmur. Exercise will usually bring out the typical presystolic crescendo murmur, with disappearance of the systolic. In really difficult cases the greatest help is obtained from screening the patient, when the typical characteristics of the mitral stenotic heart are easily seen. An E.C.G. will also help in certain cases. In my experience, mitral stenosis is often diagnosed unwarrantably.

Aortic reflux, on the other hand, is frequently missed. In recruits, the lesion is almost invariably the result of past rheumatic carditis, as that due to syphilitic aortitis or atheroma of the aorta, only occurs in the latter half of life. The following are the chief features of the aortic reflux murmur of rheumatic origin:—

- (a) The murmur is best heard over the third left space, close to the sternum and in early cases may only be audible at this spot.
- (b) The murmur is high pitched and may be almost inaudible with a bell chest piece, though more easily appreciated with a phonendoscopic chest piece.
- (c) Aortic reflux is usually associated with mitral stenosis and the murmur often appears to be a fading away of the accentuated pulmonary second sound.
- (d) The left ventricle tends to be enlarged and hypertrophied, with a strong heaving impulse and a loud booming first mitral sound.
- (e) The pulse tends to be full and collapsing in character, with a large pulse pressure, i.e. over 50 mm.

X-ray confirms the left ventricular enlargement and the E.C.G. may show a left axis deviation.

3. TACHYCARDIA

(a) Is frequently found in recruits and is usually due to *nervousness*. The heart rate will therefore, tend to lessen as the man gets more used to his surroundings. The exercise test will often be excellent, the rate one minute after being considerably lower than that just previous to the test. Such cases may often be graded for Active Service.

(b) May be due to *thyrotoxicosis*, but other signs of the condition are usually found if looked for, namely, enlargement of thyroid, moist skin, tremor of hands and a history of loss of weight, etc. These cases are unfit for Service.

(c) Is often found in cases of *neuro-circulatory asthenia*, but in these the E.T.T. is poor and the mentality of the man anxious. This condition was met with in 14 of my 140 cases. The average age was 25 years. Their occupations were interesting; 2 were butchers; 1 a labourer, 1 a sheet metal worker and the other sedentary workers, 11 were conscripts. Physique was on the whole below standard. Histories of shock, rheumatic fever and over-work were noted. The chief symptoms were exhaustion, undue dyspnoea, left mammary pain, faintness and palpitations. Tremor and moist, sweating palms were present in some. The response to E.T.T. was poor, the high pulse rate prior to the test increasing markedly, sometimes reaching as high as 180 and taking much longer than usual to regain the original rate. All cases showed more or less dyspnoea on effort. The milder cases can be accepted for non-combatant duties, but the more marked cases should be rejected, as they are a bad Service risk.

(d) **Paroxysmal tachycardia** is occasionally met with in recruits. Rarely does an attack occur during the examination and the diagnosis usually has to be made from the

history. This is generally fairly typical. The paroxysmal attack begins suddenly and after lasting from a few seconds to several hours or even days, tends to stop equally suddenly. There is usually no causal factor, though abdominal flatulence is sometimes suggested by the recruit. During the paroxysm, exercise or emotion has no effect on the rate. The rhythm is usually regular and the rate ranges between 150 and 200. The commonest type is the auricular, which is usually found in otherwise normal hearts and is compatible with a long life. The more uncommon ventricular type is usually found in those with damaged myocardium. The former (auricular) may be accepted in Category 3 if the cardio-vascular system is otherwise normal, but the latter should be rejected. The E.C.G. is often extremely helpful in diagnosing the condition and, if possible, the case should be sent to a cardiologist. A normal E.C.G. between attacks, or an auricular type of paroxysm, is compatible with a sound cardio-vascular system.

(e) **Auricular fibrillation** is occasionally met with. There were no cases in this series, but I have had two since. If the condition is due to mitral stenosis, the case is unacceptable for any kind of Service. If, however, it has resulted from a previous toxic state, such as influenza, it would be possible to advise the recruit to have normal rhythm restored (by quinidine) and present him again some months later, with every chance of being accepted for Active Service.

4. BLOOD PRESSURE

The systolic blood pressure of many recruits is unduly high, often 140 to 160, on account of nervousness, but in these cases the diastolic is normal, between 80 and 90 and if other factors are favourable, the man may be considered fit for Active Service. On the other hand, a high diastolic, namely 100 or over, is usually evidence of hyperpiesia, which makes the man unacceptable for Service. In doubtful cases the recruit should be told to come up again for re-examination.

5. EXERCISE TOLERANCE TEST

The E.T.T. used by the Medical Recruiting Boards consists of getting the recruit to step up on to a chair 20 times in one minute, the pulse being taken immediately before the test, immediately after and again after one minute's rest, when also dyspnoea or other distress is noted. This test is an arbitrary one and obviously the result must only be taken as a general indication of the condition of the cardio-vascular system. The test so much depends on the man's usual activities, i.e. heavy work or sedentary occupation and on whether he has kept himself in training. Recent influenza, or other debilitating illness may often result in tachycardia with poor E.T.T. and it would, in such cases, be advisable to postpone the examination for a period, say, three months, to enable recovery to take place. In recruits where the E.T.T. is below standard and where there is no other detrimental finding, I usually recommend them for a course of preliminary physical training with a view to grading.

6. EXOCARDIAL FACTORS

There are certain exocardial factors which have to be considered when assessing the man's capabilities for Service.

Physique. A small light physique is obviously not suitable for carrying a heavy pack, though the man may be quite fit for an air crew.

Other diseases may be found to be the cause of 'cardiac' symptoms, such as *chronic bronchitis, anaemia* or some form of *toxaemia*.

7. HISTORY

Previous rheumatic fever must be taken into consideration, especially if there is a history of a long stay in hospital, or being stopped school games. I am always doubtful of recommending for Active Service abroad anyone who has had severe rheumatic fever, even if the heart appears to have recovered completely. Other serious illnesses, especially pulmonary affections, will tend to affect the man's resistance and it would therefore probably be advisable to put him into Grade 2 or 3.

8. ORTHODIAGRAPH

In assessing doubtful hearts the orthodiagraph is of the greatest value. The shadow of the mitral stenotic heart, with the small aortic knob, prominent pulmonary conus, straight convex left border and rounded right border in the antero-posterior position, together with the backward displacement of the oesophagus by the enlarged left auricle in the right oblique position, is typical. The strongly pulsating aorta with enlarged left ventricle is seen in aortic reflux. In organic mitral reflux, there is left ventricular enlargement and sometimes also right ventricular. Sometimes cardiac enlargement is found without valvular disease or other obvious cause, such as hypertension. This may be due to dilatation from a past toxic myocarditis, or from physical overstrain. It is advisable to reject these cases for all forms of service. In cases where difficulty arises in deciding whether a loud rough murmur down the left sternal border is a congenital abnormality or exocardial, orthodiagraphic examination will often clinch the matter.

9. ELECTROCARDIOGRAM

Electrocardiography, so far as recruits are concerned, is in my opinion less valuable than orthodiagraphy. Sometimes a serious abnormality is found. In four of my cases abnormalities of the conductive system were found and all were graded Category 4. Premature contractions are accurately shown, but these by themselves do not affect the assessment. Auricular fibrillation is diagnosed with certainty by E.C.G. and distinguished from other less serious arrhythmias. Sinus arrhythmia, when marked, is often difficult to differentiate from premature contractions or from auricular fibrillation except by E.C.G., though the effect of deep breathing and of exercise is of diagnostic value.

10. Finally there is usually a difference in the mentality of **volunteers and conscripts**. The former, owing to their anxiety to join up, either fail to mention past illnesses and present symptoms, or make light of them, whereas the conscript sometimes is inclined to make the most of his adverse medical history and to trot out his symptoms in their entirety. It is therefore important to get details of their activities at school, the nature of their occupation and how they spend their free time.

In conclusion I should like to stress the fact that the value of an accurate cardiac assessment lies, not only in the prevention of enrolment of unfits, but also in avoiding the wastage of man power from rejection of those with functional murmurs but otherwise normal hearts. My object has been to emphasise its importance and to show the difficulties experienced in certain cases in arriving at a decision on clinical findings alone.

140 RECRUITS—TABLE OF CARDIAC LESIONS FOUND, WITH RESULTANT GRADING

1. Chronic Valvular Disease all placed in Category 4

36 cases

Mitral stenosis	..	..	..	..	I2
Double mitral lesion	..	..	..	..	2
Mitral stenosis with aortic reflux	..	..	..	..	II
Double mitral with double aortic	..	..	..	..	I
Aortic reflux with enlargement	..	..	..	..	9
Aortic stenosis	..	..	..	..	I

2. Congenital abnormalities all placed in Category 4

3 cases

Patent Ductus	..	..	..	..	I
Lutenbacher's disease	..	..	..	..	I
Fallot's Tetralogy	..	..	..	..	I

3. Abnormal Electrocardiograms only all placed in Category 4

3 cases

Nodal rhythm rate 44	..	..	..	..	I
Partial A-V block	..	..	..	..	I
Interventricular block	..	..	..	..	I

4. Cardiac enlargement without V.D.H. all placed in Category 4

5 cases

5. Neuro-circulatory asthenia

13 cases

8 cases placed in Category 3

5 cases placed in Category 4

6. Hyperpiesia

2 cases both placed in Category 4

7. Thyrotoxicosis

1 case placed in Category 4

8. Functional Systolic murmurs all placed in Categories I or 2

68 cases

					Category I-2
Apical	..	..	..	43	79 %
Pulmonary	..	..	..	4	75 %
Exocardial	..	..	..	8	75 %
Cardio-respiratory	..	..	..	13	92 %