SYSTOLIC MURMURS IN 525 HEALTHY YOUNG ADULTS

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Much has been written by physicians about patients referred to them because of the discovery of a systolic murmur. Inevitably such consultant physicians have scant opportunity to judge the incidence, character, and significance of murmurs among apparently healthy people. Freeman and Levine (1933) described the systolic murmurs that they had found in a group they had examined of a thousand persons whose cardiovascular systems had been supposed normal: the value of their investigation would appear lessened by the fact that most were hospital patients suffering from illness in some other form. Contratto (1943) published an account of the systolic murmurs that he had elicited among a group of healthy Harvard students without, however, making any attempt to analyse the variability induced by altering the conditions of examination. A similar study carried out by O'Meara (1947) upon recruits to the Royal Navy made no mention of the important factor of loudness. In the paper that follows the object will be to consider, in somewhat greater detail than is commonly possible at routine clinical examinations, the systolic murmurs heard in a large group of healthy young adults.

All murmurs must be the product alike of cardiac structure and function. They may derive from local or general disease, or as a variant of the normal. The conception of this innocent or, in Parkinson's phrase, "incidental" systolic murmur has been twice revolutionized within the last generation. In consequence, largely, of the work of Mackenzie (1925), there developed the idea that an apical systolic murmur, no matter how loud, was of no importance so long as cardiac function remained good and other signs were absent. Reaction against this belief, already begun by Levine and others, was accentuated by observations made during the 1939–45 war. Parkinson and Hartley (1946) emphasized the new orientation: in 60 out of 2500 of the recruits referred to them by medical boards they diagnosed mitral stenosis on the strength of a systolic murmur alone. Referring to the same problem Master (1948) wrote: "It should be evident that proper evaluation of a loud apical systolic murmur in the absence of enlargement of the heart, diastolic murmurs, abnormal electrocardiograms, and heart failure, is of paramount importance in medical practice... I believe that this murmur should be accepted as evidence of organic heart disease unless cardiac abnormality can be disproven."

But how loud? And how can cardiac abnormality ever be disproven? To use such a phrase is surely to beg the question. Rather must all diagnosis rest upon the reciprocal assumption—that the absence of recognizable defect proclaims the normal. There has thus to be formed a critical assessment as to whether any particular murmur should be designated innocent or organic. The points examined to that end in the present series are those advocated by most authorities. It is hoped that the findings may prove of value as a control, affording a background for the clinical appraisal of patients suspected of cardiac disease on account of a systolic murmur.

MATERIAL AND METHOD OF EXAMINATION

The subjects examined were 525 young people—489 Bristol University students and 36 probationer nurses—365 were men and 160 women. With the exception of 9 men all were British.
The average age of the men was 22 and of the women 20; none was over 30. All were in robust health.

A history was taken and after the subject had been at rest for ten minutes auscultation was performed. The quality of the first sound was noted and any murmur heard was assessed in terms of loudness, location, character, length and timing, and variability.

The standard of loudness adopted was that of Freeman and Levine (1933) who divided systolic murmurs into six grades which they defined as follows: I, Extremely soft but of an appreciable duration; II, Slight; III, Moderately loud; IV, Loud; V, Very loud; VI, Loudest. They hold that murmurs of grade II loudness and upwards should be considered "usually significant" of disease. Master maintains that grade III invariably indicates an organic lesion. Everyone, of course, must form his own idea of these standards. In the present series an additional grade, grade II+, was recognized, as it was also by Contratto (1943). The loudness of this murmur, though clearly enough differentiated from that of grade I and II, was not held in virtue of the loudness alone to imply the presence of disease.

The murmurs were divided by location into three groups—those best heard at the base, at the apex, and equally well in both situations. Variability was noted as it was produced by posture, which was changed between supine, erect, and left lateral positions, by respiration, and by standard moderate exercise which consisted of six "toe-touchings."

Chest films of all subjects were taken by a mass radiography unit. In addition radioscopy with barium swallow was carried out whenever it seemed, on any grounds, that there existed a reasonable possibility of cardiac abnormality. Blood counts and erythrocyte sedimentation rates were determined as required. Electrocardiography was confined largely to cases of arrhythmia. In the opinion of Parkinson and others, it is of negligible value in the detection of early rheumatic heart disease.

All examinations, apart from those of the 36 nurses, were made twice—with an interval of one year—and a record was made of murmurs that had changed. Selected subjects were examined again at the end of a second year.

**FINDINGS**

A history that seemed beyond reasonable doubt to be that of acute rheumatism was obtained on seven occasions.

On clinical examination no thrills were felt. As was to be expected a third heart sound was often audible. Not infrequently the pulmonary second sound was accentuated. No note was made of either finding. Parkinson and Hartley (1946) consider that there is no basis for the popular belief that an accentuated pulmonary second sound supports the presence of mitral disease. Only once was there heard an abrupt, slapping, apical first sound of the type ascribed classically, in the absence of tachycardia, to mitral stenosis. The man concerned had also an aortic diastolic murmur—the only diastolic murmur in the whole series—with a grade II systolic murmur at the apex. Rheumatic heart disease with aortic incompetence and a probable mitral lesion was diagnosed.

Of the 525 young adults examined, systolic murmurs were heard, within the conditions imposed for auscultation, in 179 (34%). They were present in 44 per cent of the women examined and in 30 per cent of the men. These murmurs were assessed as follows: 53 (10% of all hearts examined) were put in grade I category of loudness, 105 (20% of all) in grade II, and 21 (24% of all) in grade II+. None was placed in a higher category. The 2:5 per cent placed in grade II+ were subjects in whom there was a murmur that some authorities might consider sufficiently loud to identify valvular disease without further evidence. That decision must necessarily rest upon a difficult and uncommunicable auditory impression. In all grades murmurs were more frequent among the women than the men, this tendency increasing as the murmurs became louder. Grade II+ murmurs were found two and a half times more often among the women. It was found that murmurs at the base alone constituted about 60 per cent of all heard, those at the apex alone,
and at the base and apex equally, numbering some 20 per cent each. This tendency was much the same in both sexes. There were no strictly localized pulmonary or parasternal murmurs.

Much importance is given to the character of a systolic murmur. According to Master (1948) a "harsh," or "seagull," type of murmur suggests organic disease. There is general acceptance that murmurs may be identified as "harsh" apart from being merely "loud." On the other hand, murmurs that are innocent, or "incidental" are commonly described as "soft," or as consisting of a "whiff" of sound. Obviously discrimination again depends entirely upon the hearing of the man with the stethoscope. It can well be maintained, however, that this significant quality of harshness is plainly enough recognizable to the initiate in much the same way as is the presystolic crescendo sometimes heard in mitral stenosis with normal rhythm. Of the murmurs heard in this series no more can be claimed than that they all seemed to be "soft" rather than "harsh."

Few physicians have, as yet, enjoyed the opportunity of training their clinical appreciation of the length and timing of murmurs by phonocardiographic control. Nevertheless, provided that the heart rate is not rapid, it has become the fashion to claim considerable accuracy in the estimation of these niceties; indeed, there is often no great difficulty. That an attempt should be made is reasonable enough. In this survey there were a few murmurs whose timing could not be decided with any precision. It may be said, however, that most appeared to be short and to occur late in systole. A few were longer and extended back towards the first sound. None "replaced" that sound.

The 53 murmurs (10% of all hearts examined) that were placed in grade I were inaudible at any site, or in any posture or phase of respiration, before exercise. A further 80 murmurs (15% of all) were either immediately detected as of grade II intensity on the first auscultation, that is in the supine position at rest, or could be made to appear to that intensity by the standard exercise, or by some adaptation of posture or respiration. The effect of exercise, it was found, was almost invariably to increase loudness and in less degree the supine posture tended to the same effect. Expiration usually enhanced a murmur but occasionally diminished it. None of these murmurs was persistent. By finding a suitable combination of circumstances within the standard form of examination there were further found 4 subjects in whom a systolic murmur of grade II+ became audible but did not persist. The remaining 35 systolic murmurs (7% of all hearts examined) were persistent at their particular site, though altering in loudness in response to the standard variations of posture, respiration, and exercise.

The appearance and disappearance of systolic murmurs over a period of one year was also recorded. Thus, of the 161 systolic murmurs heard in 1949–50, 61 had not been discovered in 1948–9, whereas 38 heard in 1948–9 had disappeared by 1950. A special check was made upon students in whom a systolic murmur, many of them in grade II and several even in grade II+ grades of loudness, had appeared during the year. This gave an impression that they were, on the whole, above the average in the vigour and success of their sporting activities. Nearly all had put on weight—a usual characteristic of the student period.

On no occasion did the mass radiography unit report a finding suggestive of a cardiac lesion. Leggat (1950) put forward a claim that such investigation may be of value in identifying some cases of cardiac disease. It is obvious, however, that no reliance can be placed upon this method alone. In fact, many subjects were submitted to radioscopy. The only definite abnormality found was a moderate left ventricular enlargement in the man with the aortic regurgitation. Neither did blood examination reveal any significant anaemia or other disorder.

**Combination of Factors**

Assessing all these factors in combination it was found that 10 murmurs were both of grade II+ intensity and persistent. Of these, 6 were maximal at the base, 1 was heard equally well at both base and apex, and only 3 were maximal at the apex.

Of the subjects with persistent murmurs maximal at the apex, 2 women and 1 man, all of them
British, one had a rheumatic history and another a strong family history of rheumatic heart disease. During two years of observation their health remained excellent. The murmurs were not strikingly prolonged, neither did they seem to extend far back into early systole; in every other way these subjects appeared normal. Nevertheless, it was surmised that the first two of them probably, and the third possibly, had a minimal rheumatic heart lesion. A further 2 students were placed in the "possible" category. These had rheumatic histories with apical grade II murmurs, one of which, however, was not persistent.

Thus, of these 525 young adults, all apparently in robust health, 1 was considered certainly affected by rheumatic heart disease with aortic regurgitation. In 2 there existed, on the strength of a rheumatic history in conjunction with a persistent apical systolic murmur of grade II+ intensity, a reasonable likelihood of minimal rheumatic heart disease. A further 3 were found in whom the grounds for such a suspicion were less. In fact hesitation was felt about deciding that any of the hearts examined in this series were abnormal on the strength of a systolic murmur alone. Neither were there any findings to arouse suspicion of a congenital cardiac defect.

The man with aortic incompetence, who had been playing rugby football, was advised to give the game up, and to obtain penicillin cover for any dental extraction. No suggestion that anything abnormal had been found was made to any of the other subjects examined.

**DISCUSSION AND CONCLUSIONS**

In the assessment of isolated systolic murmurs all decision must be thrown back upon the ear and experience of the physician. Such experience cannot be acquired easily. Evans (1946) making use of phonocardiography, concurred with the general view that innocent murmurs are usually short, appearing late in systole; in his opinion they might also on occasion be "loud," but "never rough or harsh."

Necropsy proof of such conclusions is necessarily almost always lacking. Nevertheless, despite the difficulties, it is reasonable that every doctor should make an effort to establish for himself a clinical conception of murmurs supposedly innocent, since the passage of years can be expected to confront his judgments with a large measure of proof or refutation. The following points, taken from the present survey may, therefore, seem worthy of statement or re-emphasis.

Variability in loudness is the fundamental characteristic of nearly all systolic murmurs heard in young adults. An increased heart rate, as a result of exercise or excitement, is by far the most potent factor in augmenting loudness.

In order to obtain comparable findings every physician must establish for himself his own technique of examination. The standard exercise adopted in this investigation was that of six moderately energetic "toe-touchings." Freeman and Levine (1933) showed that violent exercise will produce a murmur almost invariably in the young or middle-aged. In confirmation of this, 9 probationer nurses, in whose hearts no murmurs had been heard after auscultation with the standard technique, were further examined after they had jumped up and down vigorously and had become breathless. Transient systolic murmurs, several of which reached a grade II intensity then became audible in 8 out of the 9.

The higher grades of loudness at the apex are widely held to indicate the presence of mitral disease. Nevertheless, it does not, of course, follow that faintness, or indeed absence of a murmur excludes an organic lesion. Levine has called attention to the fact that even the loudest organic murmur must at first have been of minimal intensity.

The character of harshness is not as readily distinguishable from mere loudness as is often maintained. At slow heart rates the length and timing of systolic murmurs can, however, usually be appreciated clinically with fair accuracy.

Persistence and localization are characteristics still more readily detected. In only 3 subjects out of 525 examined were they found together; 2 of these 3 had strong rheumatic histories. The murmurs associated with proven mitral lesions are commonly persistent and localized. It is
SYSTOLIC MURMURS IN YOUNG ADULTS

suggested, therefore, that the combination of these qualities affords the most practical grounds for suspicion, despite the absence of any other abnormality, that a systolic murmur may indicate a minimal mitral lesion.

In many young adults systolic murmurs, as measured by a constant standard, come and go over periods of a few months. These fluctuations are found particularly among the more vigorous and robust subjects.

The loudest and most persistent murmurs, in all areas of localization, occurred in this series in the ratio of approximately 3 women to 1 man. This is slightly greater than the sex selectivity of rheumatic heart disease, and might, therefore, be taken to imply that such a murmur is somewhat more likely to indicate a rheumatic lesion when heard in a man.

It is of fundamental importance to avoid causing in the mind of any person found to have a slight cardiac murmur any suspicion that his heart be thought abnormal, or even that it might be the subject of any special interest. Lack of care in this may cause far greater harm than the occasional failure to discover minimal disease. In this series nothing was said of any finding except to the man who had the aortic regurgitation. Reasonably, perhaps, advice about dental extractions might have been given to two or three more.

SUMMARY

Routine examination revealed a systolic cardiac murmur in 179 out of 525 healthy young adults. Rheumatic heart disease was diagnosed in one subject and suspected in five. No other cardiac disability was suggested by a murmur.

The variability of systolic murmurs, and the importance of a standard technique of examination and investigation, are re-emphasized. Modern views concerning "loudness," "length," and "quality" of systolic murmurs are summarized.

A combination of apical localization with persistence may be a practical indication of early mitral disease. Attention is called to the difficulty of obtaining corroboration of any judgment concerning an isolated systolic cardiac murmur.

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