

## The Detection of Cardiovascular Abnormalities by the Use of Photoroentgen Films

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The mass photofluorographic techniques which in recent years have been employed extensively in the detection of pulmonary pathology have in more recent years taken on a different aspect from the standpoint of detection of cardiovascular abnormalities. With a progressive decrease in the tuberculosis death rate and also in the number of new cases, it is obvious that if the greatest benefit is to be obtained from the expenditure of public money on tuberculosis control surveys, a background for concomittant examination of the cardiovascular shadow will increase the value of the screening.

The importance of the discovery of heart diseases by the 70 mm. film has not been fully utilized and only a relatively few series have been published in an attempt to assess its value. An account of some of these series will be dealt with and it will be seen that this examination is definitely worthwhile from the standpoint of detecting new cases of heart disease, previously undiagnosed, who are candidates for treatment.

The determination of cardiac enlargement by the 4" x 5" film can be very misleading in borderline enlargement cases. The commonest causes of misdiagnoses of cardiomegaly appear to be obesity with high diaphragm and transversely lying

heart. Also the distortion produced by the proximity of the x-ray tube to the plate tends to exaggerate any apparent enlargement. Slight scoliosis or rotation of the patient may also stimulate enlargement. Personal experience in the limits of normality and a consideration of the clinical findings is necessary if an unnecessary number of patients recalled after examination is to be avoided.

The various extensive diagnostic points in detecting particular heart diseases is not dealt with here, but the reader is referred to several articles on the subject. However, in the general examination of the film, the following points should be sought routinely: any abnormalities of the C-V shadow, increased density of the shadow, displacement laterally of the right or left borders, or undue prominence of the great vessels. It is shown by several observers that the miniature x-ray can reveal this information as well as a large P-A film, if allowance is made for greater distortion at a distance of 36" from the x-ray tube compared to 60" in the large plates. There is no significant difference in the percent errors in diagnosis by large and miniature films. The tendency with the miniatures, however, is to over-read them.

The detection of cardiomegaly, the commonest abnormality found, is felt

by Ungerleider to be poorly assessed by the Cardio-Thoracic Ratio, and does not warrant the wide usage it now enjoys. He describes a more accurate method by use of prediction tables and the deviation of the transverse cardiac diameter from predicted normals as the most correct method for estimation of the individual case. His method bears the most correlation to the heart weight at autopsy and is the only method whereby enlargement of 40% or less

can be detected. There are other methods of measurement, e.g. that of Meyer, using the formula applied to two heart diameters. However, Jacob's ratio (enlargement if the heart diameter exceeds 1/2 the chest diameter at the apex) is adequate for sorting 4" x 5" photoroentgen films.

The incidence of cardiovascular abnormalities which can be expected in a given mass survey for tuberculosis is shown by the following series.

Survey	No. of Films Taken	No. Recalled for ABN. of C.V. Shadow	Percentage
A. MacLean and Royen	34,918	1,123	3.2%
B. Bostock and Morris	18,643	137	0.7%
C. Gowen	154,111	515	0.3%
D. Mathison, Morris and Wilson	7,093	158	2.2%
E. Couley	528,941	3,313	0.6%

In the series of McLean and Royen, the commonest radiological abnormalities encountered were:

- |   | % of those Recalled |
|---|---------------------|
| 1. General cardiac enlargement            | 36%                 |
| 2. Prominence of the pulmonary artery     | 26%                 |
| 3. Straightening of the left heart border | 7%                  |
| 4. Unfolding of the aorta                 | 5%                  |
| 5. Broadening of the base of the heart    | 4%                  |
| 6. Prominence of the pulmonary conus      | 6%                  |
| 7. Dextrocardia                           |                     |

On the followup of Gowen's cases, the commonest causes for the abnormal shadows in all age groups were:

- |  |       |
|--|-------|
| 1. Hypertensive heart disease                          | 30.7% |
| 2. Rheumatic heart disease                             | 20.1% |
| 3. Degeneration of myocardium                          | 16.8% |
| 4. Arteriosclerotic heart disease with hypertension    | 10.7% |
| 5. Arteriosclerotic heart disease without hypertension | 6.6%  |
| 6. Coronary heart disease                              | 5.7%  |
| 7. Cardiac enlargement-cause undetermined              | 4.9%  |

- |                        |      |
|------------------------|------|
| 8. Miscellaneous ..... | 2.5% |
| 9. Dextrocardia .....  | 2.0% |

The chief causes of pathological shadows in the Bostock and Morris series were:

- |   |       |
|---|-------|
| 1. Hypertension or arterio-sclerotic heart disease with enlargement ..... | 58.6% |
| 2. Valvular heart disease .....   | 27.7% |
| 3. Congenital heart disease .....   | 12.0% |

Some of the causes they found for abnormal silhouettes but with no cardiac diseases were:

- (a) Obesity or outstanding physique
- (b) Prominent pulmonary conus simulating mitral stenosis in young people.
- (c) Pregnancy.

In the Mathison, Morris and Wilson survey, the abnormal shadows investigated were due to:

- |  |       |
|--|-------|
| 1. Hypertensive cardiovascular disease ..... | 46.6% |
| 2. Rheumatic heart disease .....             | 28.9% |
| 3. Arteriosclerotic heart disease .....      | 16.6% |
| 4. Congenital heart disease .....            | 6.6%  |
| 5. Thyrotoxic heart disease .....            | 1.1%  |

These various causes of pathology in these surveys, although not directly comparable, indicate the relative frequency of conditions detected by this method and show good correlation among the surveys.

It is felt by Gowen, that in a given mass survey, about 20 to 55% of the cardiac diseases discovered, were pre-

viously unknown to the patient. However, only about 3% of the cases discovered on followup, are in need of therapy or counselling. Therefore, he stated that "it is difficult to ascribe much pertinent heart disease case finding potentiality to chest x-ray surveys".

On the other hand, Mathison, Morris and Wilson are of the opinion that the mass chest x-ray survey is an "excellent method of case finding in heart disease". Their number of cases found was four times that of tuberculosis. They feel that it is of value because:

1. The advances in surgical treatment of congenital heart disease makes early detection essential.
2. Earlier recognition of rheumatic and degenerative types of heart disease with proper advice and treatment may prolong life expectancy.
3. Since a number of those who were unaware of their cardiac lesion were engaged in strenuous occupations, they can be aided by a change in employment compatible with their cardiac limitations.

Surveys have shown that the cardiac, not in failure, is capable of producing many valuable years of service without significant risks. Stroud surveyed 40,000 persons in 1,000 different employments and concluded that the cardiac could safely handle at least 25% of the jobs. Coupled with the fact that 1 in 17 persons in the United States has one of the cardiovascular-renal diseases, then pre-employment and periodical examinations of the cardiac or hypertensive is of

utmost importance. This should include as well as a miniature x-ray, trends in weight, blood pressure, cardiographic patterns and heart size, the significance of which could be better understood if there was a pre-employment base line.

In a survey of 391 subjectively normal persons, Mortensen detected a total of 129 cardiac abnormalities, or 7% diagnosable heart disease. Of these, 23% had B.P. readings above normal, nearly one-half being advanced hypertension. Only half of the hypertensives had previously known of their hypertension.

In a survey of Phillips, et al, it was found that the most cases of cardiac disease were detected by physical examination. The results of methods of diagnosis were:

1. All rheumatic heart disease and 85% of the hypertensives were discovered by physical examination.
2. E.C.G. was abnormal in 65% of all heart disease.
3. Fluoroscopy revealed abnormalities in 50% of heart cases. It was of no value in coronary artery disease.
4. Miniature radiography was of minimal value in the detection of heart disease. It was suggestive in only 7 of 162 cases, all of which were diagnosed by other techniques.

#### Conclusion:

From these studies it may be concluded that the examination of miniature x-rays for the presence of abnormalities in mass tuberculosis surveys, will reveal some abnormality of the cardiovascular shadow in 0.5% to 3% of the cases examined. On further examination, approximately

5% to 6% of these will be found to have no cardiac disease. Of those diagnosed as heart disease, 9% to 10% is previously unknown to their physician, and from 21% to 56% of the cases of heart disease are previously unknown to the patients. The vast majority of the abnormalities are found in the age group over 45 years. The commonest abnormality encountered is cardiac enlargement. 18% of the cases of cardiac enlargement are associated with heart disease.

It has been shown that the common radiological patterns sometimes thought to be suggestive of heart disease, are not as a rule associated with clinical signs of disease, and therefore such patterns themselves do not suffice for a diagnosis of heart disease.

So it is seen, that although there are mixed opinions regarding the value and potentialities of miniature x-ray surveys in the detection of heart disease, it is generally agreed that a sufficient number of new cases are revealed by this method to make it worthwhile. The cardiac silhouette study and the follow up of abnormal patterns in conjunction with mass tuberculosis surveys is a valuable routine, but a poor method of diagnosis of heart disease when compared to mass electrocardiography and physical examination.

It is important that all available clinical information which can be obtained from the miniature film be utilized, and that the patient be referred for proper treatment of any abnormality which may be discovered.

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