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Early Detection of Aortic Dilatation in Ankylosing Spondylitis using Echocardiography

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Abstract: Early detection of aortic dilatation in ankylosing spondylitis using echocardiography. D. Thomas, W. Hill, R. Geddes, M. Sheppard, J. Arnold, J. Fritzsche and P. M. Brooks, *Aust. N.Z. J. Med.*, 1982, **12**, pp. 10–13.

Aortic root abnormalities including cusp thickening, subvalvular stenosis, and mild aortic root dilatation are the most common cardiac complications in patients with long standing ankylosing spondylitis (AS). Twenty-three patients with definite idiopathic AS (New York Criteria 1966) and twenty-two matched controls were studied with M-mode echocardiography. Only one of the AS patients had clinical aortic incompetence. Six of the AS patients had mildly dilated aortic roots (normal <3·7 cm) with a mean diameter of 3·9 cm (range 3·8 to 4·00 cm). None of the twenty-two controls matched for age, sex and blood pressure had dilated aortic roots, with a mean diameter of 3·3 cm (range 2·9 to 3·6 cm).

No correlation existed between aortic dilatation and severity of disease estimated by acute phase proteins—caerulo plasmin, alpha 1-antitrypsin, alpha 1 acid glycoprotein, ferritin and C Reactive protein.

Contrary to a previous report, mild aortic root dilatation occurs in long standing cases of AS. Although it is a non-specific finding, it does not appear to be related to age or blood pressure and may therefore be the forerunner of aortic incompetence.

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Introduction

Cardiac involvement is a well recognised complication of long-standing ankylosing spondylitis. The lesions described include: cardiomyopathy[1], complete heart block[2, 3], pericarditis[4], aortic aneurysm[5] and a variety of aortic root abnormalities[6, 7] of which lone aortic incompetence is the most common.[4, 8–10]

The prevalence of aortic incompetence varies between reported series, biased somewhat by the inclusion of cases with associated mitral valve disease, where the aetiology may be rheumatic. Excluding cases with mitral valve involvement Graham and Smythe[4] reported a prevalence of 4% for isolated aortic incompetence (21 of 519 patients) at 15 years duration of spondylitis, rising to 10% after 30 years. Davidson *et al.*[10], reported a prevalence of 1% for isolated aortic incompetence in a case review of 1000 patients with "rheumatic spondylitis" attending the Mayo Clinic between 1953 and 1958. A similar prevalence of 0·9% was reported by Ansell *et al.*[9], where two cases were detected in a survey of 222 patients followed for a mean period of 4·6 years.

Early detection of these aortic root abnormalities has been reported in thirty patients with ankylosing spondylitis by two-dimensional echocardiography[11], but seven of these patients also had Reiter's Syndrome.

Echocardiography has also been used as a sensitive detector of cardiac involvement in rheumatoid arthritis and correlations made between the persistence of pericardial effusions and the number of clinically involved joints and ESR level.[12]

The present study had two aims: Firstly, we wished to determine if M-mode echocardiography was able to detect early and therefore

mainly asymptomatic aortic root involvement. As part of the study other cardiac abnormalities e.g. pericarditis, cardiomyopathy and conduction abnormalities were sought. Secondly, we wished to ascertain whether detectable cardiac/aortic involvement correlated with clinical or biochemical indices of disease activity.

Subjects and Methods

Two groups of patients were evaluated:

1. Twenty-three patients with definite idiopathic ankylosing spondylitis (AS New York Criteria, 1966).[13] Patients with psoriasis, Reiter's syndrome, Bechet's syndrome and chronic inflammatory bowel disease were excluded. Of these, 22 were male and one female, with a mean age of 50 years (range 30–74 years). The mean systolic blood pressure was 137 ± 24 mm of mercury (SD) and mean diastolic pressure 85 ± 11 mm of mercury (SD). Twenty patients were $HLAB_{27}$ positive.
2. Twenty-two hospital controls matched for age, sex and blood pressure. Twelve were ambulant rheumatology out-patients with non-inflammatory back pain and ten were healthy hospital ancillary staff. Twenty were male, two female with a mean age of 50·9 years (range 18–75 years). The mean systolic blood pressure was 132 ± 18 mm of mercury (SD) and the mean diastolic blood pressure 79 ± 10 mm of mercury (SD). The systolic and diastolic blood pressures did not differ significantly from the index AS group

Clinical Assessment

A detailed history and examination was performed on all AS patients to satisfy 1966 New York Criteria, and to assess the extent and activity of the disease. Various factors were delineated; duration of AS, extent of spinal deformity (Schoeber's method[14] and Dunham Spondylometry[15]), peripheral joint involvement and respiratory involvement, spirometry and chest expansion. Previous radiotherapy was noted. An index of "Spondylitic Activity" was made using four parameters:

1. Subjective spinal pain,
2. Use of anti-inflammatory analgesics,
3. Objective evidence of peripheral arthropathy,
4. Sacroiliac joint scan ratio. Parameters 1, 2 and 3 were arbitrarily assigned a score of 1 each if positive and parameter 4 a score of 2 if positive. A total score of 5 was therefore possible.

Sacroiliitis was assessed after injection of 15 millicuries of intravenous technetium methylene diphosphonate, using a SERLE LFOV Gamma camera. Results were expressed as a ratio of sacroiliac activity to midline sacral uptake. Standard P.A. x-rays of the pelvis were used to satisfy the New York Criteria of AS.[13]

Cardiac assessment included auscultation over the mid sternum and left sternal edge with the patient erect and breath held in expiration to maximise detection of the diastolic murmur of early aortic incompetence. The resting blood pressure and a 12 lead ECG were performed.

Echocardiography

This investigation was performed on AS patients and controls using a commercial echocardiograph, transducer and multichannel oscilloscope recorder. Patients were examined in the left oblique position. Measurements of the aortic root dimension were recorded from the anterior edge of the anterior aortic wall to the anterior edge of the posterior aortic wall as recommended by Sahn *et al.*[16] Scans from the left ventricle to aorta were performed prior to measurement of the aortic root dimension. Aortic root visualisation was performed prior to measurement of the aortic root dimension. Aortic root visualisation was performed with the transducer held as perpendicular to the chest wall as possible to avoid angulation errors. Measurements were recorded at the onset of the QRS complex and three separate measurements were averaged. Recordings were excluded if variations greater than 2 mm were obtained between individual aortic root measurements on a given patient or if the technique described above was not possible for technical reasons.

The mitral valve was also scrutinised for any flutter to suggest early aortic incompetence and this was not detected.

Left ventricular internal dimension at the end of diastole (LVIDd) and the end of systole (LVIDs) were measured and used to calculate fractional shortening (FS).

The equation $FS = LVIDd - LVIDs/LVIDd \times 100\%$

This index is the percentage shortening of the left ventricular internal dimension during systolic contraction and is used as an index of myocardial contractility.

Results

Six ankylosing spondylitis (AS) patients had mild aortic root dilatation (ARD) (Fig. 1). One of those patients had echocardiographic evidence of aortic incompetence, which was also clinically apparent. None of the 22 matched controls had ARD.

The AS patients with ARD were older with a mean age of 60 years, (range 49–80) than AS patients without ARD whose mean age was 47·5 years (range 30–69). They had also been symptomatic for longer with a mean disease duration of 31·7 years (range 7–36 years) compared with a mean disease duration of 20·7 years (range 3–42 years) in the non ARD group.

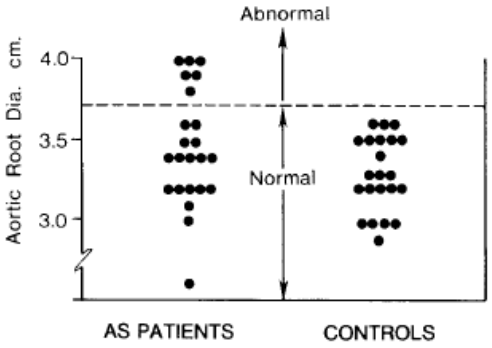

FIGURE 1. Aortic root diameter in ankylosing spondylitis (AS) patients compared with age and sex matched controls (3·7 cm upper limit of normal).

The 22 control patients showed a positive correlation with age and ARD, but in all cases this fell below the range measured in the six AS patients with ARD (Fig. 2).

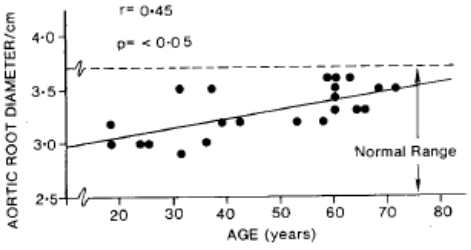

FIGURE 2. The relationship of aortic root diameter with age in 22 control patients without idiopathic ankylosing spondylitis ($r = 0 \cdot 45$, $p < 0 \cdot 05$).

Fractional shortening on the left ventricle was assessed echocardiographically. The mean FS was 35% (range 21–49%) which was similar to that of the controls (mean 38%, range 28–45%). Significant cardiomyopathy was excluded on this basis. The only value below normal i.e. 21% occurred in the patient with clinical aortic incompetence. Atrio ventricular conduction abnormalities occurred in four AS patients, two patients with ARD and two patients without ARD, and consisted of complete and incomplete right bundle branch block, first degree heart block and atrial fibrillation.

The six patients with ARD did not differ significantly from the 16 AS patients without ARD in terms of disease severity assessed clinically with an activity index and with deformities such as spinal mobility or chest expansion.

There was no correlation between systolic blood pressure plotted against ARD in AS patients (correlation coefficient = 0·047) or between diastolic blood pressure and ARD in AS patients (correlation coefficient = 0·014).

Discussion

Echocardiography provides a useful non-invasive method for investigating cardiac chamber size and ventricular function in both health and disease.[12, 17, 18] Echocardiographic measurement of the aortic root diameter has shown to correlate closely with actual anatomical size at operation in patients with aortic valve disease.[19]

In the present study six AS patients (27%) showed mild aortic root dilatation (ARD) whilst none of the age and sex matched controls demonstrated ARD despite showing an increase in aortic root dimension with age. This suggested that ARD in the six AS patients was unlikely to be age related. Elevated blood pressure may also produce ARD on echocardiography.[17] In the present study the matching of blood pressures in controls and AS patients would make this variable an unlikely aetiological factor accounting for the observed ARD. Spinal deformity may alter the beam direction of M-mode echocardiography resulting in a systematically larger aortic root dimension in AS patients, compared with otherwise suitably matched controls, or AS patients with lesser degrees of spinal involvement. This variable is probably not important, since if the spinal involvement in the six AS patients with ARD assessed by Spondylometry and chest expansion, is matched for severity by six other AS patients in the study, then the mean aortic root dimension in the former group remains significantly greater (p value $< 0 \cdot 001$). For these reasons, we believe that the ARD is directly related to aortic root involvement as part of the ankylosing spondylitis process. The clinical significance of this observation will depend on subsequent demonstration of aortic incompetence in these cases.

An attempt was made to quantify the extent and severity of ankylosing spondylitis using an activity index. This activity index did not differentiate between those patients with ARD and those without ARD. Also there was no correlation found between ARD and disease activity measured by accepted laboratory indices of inflammation.[20]

It was also interesting to note that four of the six AS patients (66%) with ARD gave a past history of spinal radiotherapy, as opposed to only 13% of AS patients without ARD. We feel this is possibly related to duration of disease activity rather than to the effect of radiation per se, since radiotherapy was a common form of treatment in the 1940's.

Khan *et al.* have recently studied mortality among patients with ankylosing spondylitis

using Life Table analysis. Reduced life expectancy was seen in patients with ankylosing spondylitis due primarily to an increased incidence of cardiovascular and cerebrovascular disease.[21] It will be important to see whether patients with aortic root dilatation go on to develop aortic incompetence leading to an increased mortality. In view of these findings echocardiographic assessment of aortic root size may be important as a prognostic index in patients with idiopathic ankylosing spondylitis.

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