Echocardiographic Findings in Chronic Corpulmonale

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Abstract

M-mode & two dimensional findings in ten cases of Chronic Corpulmonale due to Chronic obstructive airway disease were studied. In M-mode, the findings were (1) visualisation of tricuspid valve in all phases of Cardiac Cycle (2) triangular Configuration of tricuspid valve (3) visualisation of pulmonary valve in all phases of Cardiac cycle (4) systolic notch in pulmonary valve (5) paradoxical motion of interventricular septum (6) prominent diastolic notch in interventricular septum. In two dimension, the findings were (a) right ventricular dilatation, (b) pulmonary artery dilatation, (c) right atrial dilatation, (d) incomplete closure of tricuspid valve, (e) diminished septal leaflet motion of tricuspid valve (f) two step relaxation of interventricular septum. The left ventricular function parameter study showed statistically significant decrease in (i) left ventricular internal diameter in diastole and (ii) left ventricular mass as compared to controls. The above findings are discussed.

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Introduction:

Chronic obstructive airway disease is one of the major health problems in Nepal (Pandey et al. 1984). Many of these patients develop Chronic Cor pulmonale. (Pandey et al. 1984) In the present paper, echocardiographic findings in Chronic Cor pulmonale have been described.

Material and Methods

Ten cases of Chronic obstructive airway disease with Chronic Cor pulmonale were selected for study. There were 5 males and 5 females with age ranging from 35 years to 73 years. The following criteria was used for diagnosis of Chronic obstructive airway disease with Chronic Cor pulmonale:

1. History of cough for at least three months a year for more than three years.
2. Presence of dyspnea.
3. Presence of following X-ray Chest FA findings --
   (a) Cardiomegaly
   (b) Lung findings "consistent with Chronic obstructive airway disease" as reported by radiologist
4. Presence of at least two of the following ECG findings indicating right ventricular overload:
   (i) S1S3 pattern
   (ii) Right axis deviation
   (iii) S3S4 pattern
   (iv) R:S ratio in V1 less than or equal to 1.0
   (v) Tall R wave in V1 (R:S ratio more than 1.0)
   (vi) Tall peaked P waves (P pulmonale) in II, III & aVF
5. Absence of other associated Cardiovascular disorder.

These were the cases attending out patient department or admitted to indoor at Tribhuvan University Teaching Hospital, both Male and two dimensional echocardiography were done. Ten Controls, matched for age, sex, height & weight were also studied for comparison. Besides the study of abnormal echocardiographic findings in patients of Chronic Cor pulmonale, their left ventricular function was also studied in detail. The following parameters, in relation to left ventricular function, were calculated from Mmode recordings obtained in a paraloid film in Chronic Cor pulmonale cases as well as in control cases:

1. Left ventricular internal diameter in end diastole and in systole
2. Left ventricular end diastolic volume and systolic volume
3. Stroke volume
4. Ejection fraction
5. Percentage shortening
6. Left ventricular mass
The following formula were used to calculate the above parameters—

\[
\text{Diastolic volume} = \frac{7 \times \text{Diastolic diameter}^4}{2.4 + \text{Diastolic diameter}} \quad (\text{Teichholz et al. 1976; Kronik et al. 1979})
\]

\[
\text{Systolic volume} = \frac{7 \times \text{Systolic diameter}^4}{2.4 + \text{Systolic diameter}} \quad (\text{Teichholz et al. 1976; Kronik et al. 1979})
\]

\[
\text{Stroke volume} = \frac{\text{Diastolic volume} - \text{Systolic volume}}{\text{Diastolic volume}}
\]

\[
\text{Ejection fraction} = \frac{\text{Diastolic diameter} - \text{Systolic diameter}}{\text{Diastolic diameter}} \times 100
\]

\[
\text{Percentage shortening} = \frac{\text{Diastolic diameter} - \text{Systolic diameter}}{\text{Diastolic diameter}} \times 100
\]

\[
\text{Left ventricular mass} = 1.04 \left( \frac{\text{Diastolic diameter} + 1/2 \text{V post wall thickness}}{\text{Diastolic diameter}^3} \right) - 14 \quad (\text{Troy 1972})
\]

Similarly, right ventricular diameter of chronic cor pulmonale cases and the control cases were measured. Right ventricular diameter was recorded in the left lateral position, in the view which revealed the maximum depth of that chamber.

Statistical analysis:

Statistical analysis of the data obtained was performed by the use of student 't' test

\[
t = \frac{x_1 - x_2}{\sqrt{\frac{(SD_1)^2}{n_1} + \frac{(SD_2)^2}{n_2}}}
\]

Where,

\[x_1 = \text{Mean value of chronic cor pulmonale cases}\]

\[x_2 = \text{Mean value of control}\]

\[n_1 = \text{Number of chronic cor pulmonale cases}\]

\[n_2 = \text{Number of control}\]

\[SD_1 = \text{Standard deviation in chronic cor pulmonale cases}\]

\[SD_2 = \text{Standard deviation in Control}\]

At 18 degree of freedom (DF = n1 + n2 - 2), P value of less than 0.05 was considered statistically significant.

Observations

1. Abnormal M-Mode Echocardiographic findings in Chronic Cor Pulmonale cases:

(A) Tricuspid valve was visualised in all phases of cardiac cycle. It was noted in five out of ten cases. (figure 1)

(B) Tricuspid valve had triangular configuration. It was noted in 5 out of 10 cases. (Figure 1)
Figure 1:
(a) Tricuspid valve is visualised in all phases of cardiac cycle
(b) Tricuspid valve has triangular configuration
Rv = Right ventricle, Tv = Tricuspid valve
Ivs = Interventricular septum
Lv = Left ventricle, Lvpw = left ventricular post wall
(C) Pulmonary valve was visualised in all phases of cardiac cycle. It was noted in 4 out of 10 cases. (Figure 2)

(D) Systolic notch was noted in the pulmonary valve. It was noted in two out of ten cases. (Figure 2)

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Figure 2:

(a) Pulmonary valve is visualised in all phases of cardiac cycle
(b) There is a systolic notch in the pulmonary valve as indicated by the arrows

Pv = Pulmonary valve
↑ = Systolic notch in pulmonary valve
(E) Paradoxical motion of interventricular septum was noted in two out of ten cases. (Figure 3)

(F) Diastolic notch in interventricular septum was noted in one out of ten cases. (Figure 3)

Figure 3: (a) Paradoxical motion of interventricular septum
(b) Diastolic notch in interventricular septum as indicated by the arrows

RV = Right ventricle, Ivs = Interventricular Septum
LV = left ventricle Ch = Chordae
LVPW = left ventricular post. wall
↑ = Diastolic notch in I. v. septum
It shows two step relaxation of interventricular septum
1. beginning of diastole: l.v. septum moves anteriorly
2. immediately after onset of diastole: l.v. septum moves posteriorly
3. rest of diastole: l.v. septum moves anteriorly remains anteriorly.

II Abnormal two dimensional Echocardiographic findings in chronic cor pulmonale cases
(a) Pulmonary artery dilatation - in two out of ten cases,
(b) Right ventricular dilatation in ten out of ten cases.
(c) Septal leaflet motion of tricuspid valve was noted to be diminished in one out of ten cases.
(d) Incomplete closure of tricuspid valve - in one out of ten cases.
(e) Two step relaxation of interventricular septum in two out of ten cases. (Figure 4)
(f) Right atrial dilatation in two out of ten cases.
Table 1 Right ventricular diameter in control and chronic cor pulmonale cases.

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diameter in M-Mode

Ventricular diameter was 3.4 cm ± 0.68 in chronic cor pulmonale cases as compared to right ventricular diameter of 2.1 cm ± 0.31 in control cases. Such a difference was statistically significant (P value less than 0.05). It was an expected difference, major criteria to inclusion in the present study of chronic cor pulmonale cases.

2: Echo in M-Mode

In the present study in chronic cor pulmonale cases we were able to note a value in the right ventricle throughout the cardiac cycle in four out of ten cases (Figure 2).

The occurrence of "notching" is a valuable sign for pulmonary hypertension (Shihara et al. 1974). Figure 2 shows systolic "notching". It was seen in two out of ten cases in the present study. The explanation for the mid systolic valve with pulmonary hypertension is not yet clear (Tahara & Tanaka 1979). The biggest problem with this sign is that it is not always present.

Echo in M-Mode

Appearance of tricuspid valve area limited to the recording of the early systolic pressure, no important findings in tricuspid valve echo have been recorded in all of diastole, its motion resembles that of mitral valve (Schiller 1978). In situations which give rise to elevated systolic pressure, no important findings in tricuspid valve echo have been recorded in all of diastole, its motion resembles that of mitral valve (Schiller 1978).
Interventricular septum Echo in M-Mode

Normally, in the M-Mode, the interventricular septum and the posterior wall of left ventricle is seen to move towards the left ventricular cavity during systole but in situations where there is right ventricular volume overload, paradoxical septal motion may be seen, so that during systole, the septum moves anteriorly towards the right ventricle (Weyman et al 1975, Hayashida et al 1976, Kanasawawa et al 1977). In the present study in chronic cor pulmonale cases, such paradoxical motion of interventricular septum was seen in two out of ten cases (Figure 3).

Exaggerated diastolic notch in inteventricular septum was noted in one out of ten cases of present cor pulmonale cases (Figure 3). Such an exaggerated diastolic notch is again an indication of right ventricular overload (Weyman et al 1977).

Two dimensional Echo findings

Two dimensional ECHO study revealed right ventricular dilatation in all the present cases of chronic cor pulmonale. Pulmonary artery & right ventricle were seen dilated in two out of ten cases. Such findings go in favour of long standing pulmonary hypertension. Incomplete closure of tricuspid valve was noted in one out of ten cases indicating the presence of tricuspid regurgitation in that case as a result of atrioventricular ring dilatation. The same is true of diminished septal leaflet motion of tricuspid valve seen in one of the present cases. One of the interesting finding noted in the present study was the finding of two step relaxation of interventricular septum in two of the ten cases. During diastole the sequence of interventricular septum movement was as follows: anterolateral motion→posterior motion→anterior motion (Figure 4). These were the cases who did not have paradoxical motion of interventricular septum.

Such kind of two step relaxation of interventricular septum has been described in cases of mitral stenosis who had right ventricular overload (Weyman et al 1977, Weyman 1975). Such a motion has been demonstrated to result from an inequality in filling of the two ventricles during early diastole (Weyman et al 1977). The development of right ventricular overload in mitral stenosis is the result of pulmonary hypertension. In Chronic Cor pulmonale cases also, the right ventricular overload is the result of pulmonary hypertension. It is possible that similar mechanism may be operating in both the situations.

Left ventricular function parameters

Left ventricular internal diameter diastole and left ventricular mass were significantly less (P value less than 0.05) in chronic cor pulmonale cases, as compared to control (Table 1). There is right ventricular overload situation in chronic cor pulmonale cases. The interventricular septum tends to move anteriorly in such situation which might then affect the left ventricular internal diameter.

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References