The Plain Chest Film as an Unreliable Method to Determine Left Ventricular Size

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SUMMARY
This case report describes the disparity between the findings of the plain chest film and the echocardiogram in a patient with severe coronary artery disease. Whereas the plain chest film shows a normal cardiothoracic ratio of 50% indicating normal LV size, the echocardiogram shows features characteristic of a dilated cardiomyopathic left ventricle with low amplitude of wall motion and consequently low ejection fraction. These echocardiographic findings were confirmed at cardiac catheterization and angiography. We propose the use of echo instead of the plain chest film in the evaluation of LV size in the cardiac patient.

Additional Indexing Words:
Echocardiography Coronary artery disease Angiocardiography Dilated cardiomyopathy

The cardiothoracic ratio determined from the plain chest film is often used as an index of cardiac enlargement. This ratio is defined as the ratio between the transverse diameter of the heart to the internal diameter of the chest at its widest point just above the level of the dome of the diaphragm.1)

In fact, in the preoperative evaluation of cardiac patients, most cardiologists use cardiothoracic ratio, calculated from the plain chest film as an indicator of LV enlargement, when this ratio exceeds 50%. Whereas this indicator is felt to be a rough guide and often inaccurate it is still often used, mainly because there are no other objective methods available to estimate LV size easily and more or less objectively. This case illustrates that determination of the cardiothoracic ratio is an unreliable indicator of LV size and that echocardiography should be used as the method of choice to estimate LV size.
Fig. 1. Twelve lead standard electrocardiogram of the patient. Sinus rhythm is shown of 75 beats/min; small Q waves in lead II, III, and AVF are present consistent with an old inferior wall myocardial infarction. T waves are flat and negative in the limb leads and left precordial leads indicating ischemic repolarization disturbances.

Fig. 2. A. Frontal upright chest film of the patient. Cardiothoracic ratio is less than 50%. Left lateral edge is rounded indicating slight LV enlargement. Pulmonary vasculature is uneventful.

B. Left lateral upright chest film of the patient. Slight cardiac enlargement is seen. Pulmonary vasculature is normal.
Fig. 3. Echocardiogram of the patient. LV enlargement is striking (LV end-diastolic dimension: 85 mm, n: 55 mm). There is reduced amplitude of motion of both septum and left ventricular posterior wall, suggesting low ejection fraction. Mitral valve motion is also reduced. Wall thicknesses are in the normal range. Echocardiogram is typical for a dilated type of cardiomyopathy. The distance between 2 dots in the vertical direction is calibrated at 10 mm.

CASE REPORT

A 53-year-old man was admitted to the cardiologic clinic because of anginal symptoms for the past 2 years. Patient told that he had had 3 myocardial infarctions in the past. His recent complaints consist of chest pain and dyspnea on exertion. Pain was located behind the sternum and radiated to the jaws and left arm. He had no anginal complaints using nitrates. He used propranolol and long-acting nitrates in an adequate dosage.

On physical examination the pulse rate was 80/min regular; blood pressure 110/80 mmHg; the apex was felt 2 cm outside the mid clavicular line and a soft holosystolic murmur was heard at the apex radiating to the left side. Also a fourth heart sound was present. Routine blood tests were within normal limits. The electrocardiogram (Fig. 1) showed a normal sinus rhythm with signs of an old inferior myocardial infarction and repolarization disturbances consistent with ischemia. The frontal chest film (Fig. 2A) showed a cardiothoracic ratio of 50% and no definite signs of pulmonary congestion. On the lateral chest film slight cardiac enlargement was seen (Fig. 2B). The echocardiogram (Fig. 3) showed a large dilated left ventricular cavity and a wide outflow tract of the left ventricle characteristic of a dilated cardiomyopathy. The interventricular septum and left ventricular posterior wall are of equal thickness and have a low amplitude of motion (low ejection fraction). The low amplitude of motion of both mitral leaflets is striking. Also a large left atrium is seen.

Left and right heart catheterization studies were performed (Table I). Pressures at the right heart side were augmented with a pulmonary artery pressure of 52/29 (mean 40) mmHg; the pulmonary capillary wedge pressure was 55/28 mmHg;
Table I. Results of Cardiac Catheterization and Angiography

<table>
<thead>
<tr>
<th>Pressures (mmHg)</th>
<th>EDV</th>
<th>ESV</th>
<th>Cardiac Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA 7/4</td>
<td>144 ml/M²</td>
<td>(n: 70±20 ml/M²)</td>
<td></td>
</tr>
<tr>
<td>RV 52/9/11</td>
<td>117 ml/M²</td>
<td>(n: 25±10 ml/M²)</td>
<td></td>
</tr>
<tr>
<td>PA 52/29</td>
<td>EF 0.19</td>
<td>(n: 0.56-0.78)</td>
<td></td>
</tr>
<tr>
<td>PCW 55/28</td>
<td>V_max 46 sec⁻¹</td>
<td>(n: 42-76)</td>
<td></td>
</tr>
<tr>
<td>LV 140/20/35</td>
<td>3.3 L/min/M²</td>
<td>(n: 2.5-6.1 L/min/M²)</td>
<td></td>
</tr>
<tr>
<td>Ao 140/96</td>
<td></td>
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RA=right atrium; RV=right ventricle; PA=pulmonary artery; PCW=pulmonary capillary wedge; LV=left ventricle; Ao=aorta; EDV=end-diastolic volume; ESV=end-systolic volume; EF=ejection fraction; V_max=velocity of contraction at zero load; index of myocardial contractility; ml=milliliter; M=meter; min=minutes; L=liter.

Fig. 4. End-diastolic frame of cineangiogram in RAO position of the left ventricle of the patient. There is a large left ventricle seen filled with contrast medium. When the whole movie was shown a poorly contracting left ventricle was observed. On the left bottom is shown the corrected value for X-ray distortion and magnification (1 cm²).

the LV pressures were 140/20/35 mmHg; V_max was 46 sec⁻¹ (n: 42-76 sec⁻¹), cardiac index 3.3 L/min/M².

Left ventriculography on right anterior oblique (RAO) projection showed a dilated and a poorly contracting left ventricle (Fig. 4) with hypokinesis of the anterior wall and akinesis of the inferior wall. Ejection fraction was calculated at 19% (n:56-78%). Coronary arteriography, performed by the Sones technique, showed 3 vessel coronary artery disease with remarkable stenotic lesions in the right coronary artery and the descending and circumflex branch of the left coronary artery. Main stem of the left coronary artery was normal.
Clinical recognition of LV enlargement depends chiefly on physical and roentgenologic examination. LV enlargement could be suspected by finding of a displacement of the apical impulse on palpation and on determination of the cardiothoracic ratio from the plain chest film.

Also cardiac enlargement could be indicated by electrocardiography. In clinical practice knowledge of LV size is of utmost importance because of rationale of medical and surgical therapy. It is well known that cardiothoracic ratio calculated from the plain chest film is often misleading, because this measurement is mainly dependent on the habitus of the patient. Therefore several other procedures to determine LV size from the plain chest film are used. However, determination of LV size from the plain chest film remains a difficult method. What method should be used then to determine LV size? The available method should be easy to handle, cheap and reproducible. Since introduction of ultrasound in cardiologic practice, it has been shown that echocardiography is a good method to estimate LV size, and is furthermore easily available, reproducible and cheap.

This case report has shown that in a patient with a positive history of several myocardial infarctions no signs of heart failure on physical examination could be present. In this particular case calculated cardiothoracic ratio was normal and the size of the heart was believed to be within normal limits.

Echocardiography showed that cardiac size was enlarged having the characteristic features of the dilated cardiomyopathy. Echocardiographic findings were confirmed at cardiac catheterization and angiography, where also a dilated cardiomyopathic left ventricle was seen. As a conclusion we would state that LV size of cardiac patients in clinical cardiology should be estimated by echocardiography instead of the plain chest film. This case has illustrated that significant LV enlargement could exist in the presence of high LV end-diastolic pressure and pulmonary capillary wedge pressure, whereas the cardiothoracic ratio as calculated from the plain chest film was within normal limits.

References