Validity of Hoffman and Rigler Sign in the Evaluation of Left Ventricular Enlargement

Genevere A. Serna, MD; Alfredo F. Villarosa, MD

Background --- Hoffman and Rigler in 1965 had proposed a radiologic diagnosis of left ventricular enlargement using autopsy specimen as reference standard. However, this finding was contested by Braunwald due to the obliquity of the chest and the back displacement of the left ventricle owing to the right ventricular enlargement, which may influence this measurement. With the advent of echocardiography, there is now a much better and easier alternative to review Hoffman and Rigler’s original work of more than 40 years ago. Thus, this study was conducted to validate the Hoffman and Rigler sign in the detection of left ventricular enlargement.

Methods --- This was a validation study involving 200 adult patients who had chest radiograph in lateral projection and 2D echocardiography done within three months from the chest radiograph. Hoffman and Rigler sign was determined by drawing a 2 cm line upward along the inferior vena cava from the point where the left ventricle and the inferior vena cava cross in the lateral projection. At the upper end of this line, a second line will be drawn posteriorly parallel to the endplates of the vertebral bodies up to the point where it crosses the posterior margin of the left ventricle. When the value is more than 18 mm, one can postulate left ventricular enlargement with considerable degree of certainty. The radiographic findings were compared with echocardiography to determine presence or absence of left ventricular enlargement.

Results --- The Hoffman and Rigler sign has a sensitivity of 92.5 %, specificity of 83.3%, positive predictive value of 78.7 % and negative predictive value of 94.3 % in the diagnosis of left ventricular enlargement. The kappa test results proved that there is a strong agreement of Hoffman and Rigler sign of >18 mm with the left ventricular enlargement by 2D echocardiogram.

Conclusion --- The Hoffman-Rigler sign is a valuable alternative in the evaluation of left ventricular enlargement when cardiac ultrasound is not readily available. Phil Heart Center J 2008; 14(1):39-41.

Key Words: Hoffman-Rigler Sign ▪ Left ventricular enlargement ▪ 2D Echocardiography ▪ Chest X-ray
in an adult, one can postulate left ventricular enlarge-
ment with a considerable degree of certainty. How-
ever, according to Braunwald, although the Hoffman
and Rigler sign may be helpful, it is far from being
accurate because of the obliquity of the chest and the
back displacement of the left ventricle owing to the
right ventricular enlargement, which may influence
this measurement. Whereas Hoffman and Rigler made
use of autopsy studies as comparatives for their ra-
diological findings, the advent of echocardiography
would offer a much better and easier alternative to
review Hoffman and Rigler’s original work of more
than 40 years ago. It is also worthwhile to highlight
the fact that in most secondary and smaller hospitals in
the Philippines, echocardiography is not readily avail-
able. If the accuracy of a simple radiological measure-
ment like this can be validated using echocardiography
as the gold standard, this can, in support of history,
physical findings and electrocardiogram (ECG) evi-
dence, assist the clinician in detecting left ventricular
enlargement with much more certainty in the absence
of echocardiography.

Thus, this study was conducted to determine the
validity of Hoffman and Rigler sign in the determina-
tion of left ventricular enlargement using echocardiog-
raphy as the gold standard.

Methods
This was a validation study done in the Radiologic
Sciences Division of the Philippine Heart Center from
June to September 2007. Included were patients above
20 years old who had CXR taken with lateral view,
which are adequate for cardiac evaluation and 2D echo
done within 3 months from each procedure. Excluded
were the following: patients with significant large pleu-
ral effusions; patients with lung parenchymal disease
overlying the lower lung fields; patients with anoma-
lies involving cardiac rotation; patients with thoracic
and vertebral deformities; and patients who had surgi-
cal intervention done within this time period.

Chest Radiography
The enlargement of the left ventricle was determined
in the lateral projection of the chest utilizing Hoffman
and Rigler method with the use of a 12-inch measur-
ing ruler. This measurement was determined by draw-
ing a 20mm line upward along the inferior vena cava
from the point where the left ventricle and the inferior
vena cava cross in the lateral projection. At the upper
end of this line, a second line was drawn posteriorly
parallel to the endplates of the vertebral bodies up to
the point where it crosses the posterior margin of the
left ventricle. A value of less than or equal to 18 mm
is considered to have no left ventricular enlargement.
Hoffman and Rigler method is depicted in Figure 1 as
measurement A.

Echocardiography
Left ventricular end-diastolic diameters were acquired
from standard M-mode echocardiographic image.
Measurements were defined as normal or enlarged
comparing to the reference values. LV (ed) of 4.5 – 5.0
is considered normal.

Statistical Analysis
Data was described as frequency and percent distribu-
tion. Validity measures such as sensitivity, specificity,
positive predictive value, negative predictive value
and overall accuracy were determined. Significance of
agreement of test criteria was determined using Kappa
test.

Figure 1. Hoffman and Rigler Method of determination of Left
Ventricular Enlargement

Results
Left ventricular enlargement was assessed in chest ra-
diography using Hoffman and Rigler sign (measurement
A) in 200 patients above 20 years old who had
CXR taken with lateral view which are adequate for
cardiac evaluation and 2D echo done within 3 months.
These patients were followed-up from June to Septem-

Table 1. The relation of left ventricular enlargement on chest
radiography and echocardiography

<table>
<thead>
<tr>
<th>Chest Radiography</th>
<th>LV Enlargement by 2D Echocardiogram</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Hoffman and Rigler &gt;18 mm</td>
<td>74</td>
<td>20</td>
</tr>
<tr>
<td>Hoffman and Rigler &lt;18 mm</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td>80</td>
<td>120</td>
</tr>
</tbody>
</table>
From Table 1, it can be seen that among 200 patients with chest X-ray (lateral view) and echocardiogram, left ventricular enlargement was present in 94 (47%) on chest radiography (lateral) and 80 (40%) patients on echocardiography. Among 94 patients with measurement A of >18 mm on chest radiography, 74 (78%) patients had echocardiographic evidence of LV enlargement, while among the 106 patients with measurement A of <18 mm on chest radiography, 6 (5%) patients had left ventricular enlargement on echocardiography. These 6 patients had LV (ed) ranging from 5.3 to 5.4. Among the 94 patients with measurement A of >18 mm, 20 (21%) had no LV enlargement on echocardiography. Of these patients, 13 (65%) had right ventricular enlargement while 7 (35%) had left atrial enlargement on echocardiography.

### Table 2. Validity of Hoffman and Rigler Sign in the determination of left ventricular enlargement.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive Predictive Value (PPV)</th>
<th>Negative Predictive Value (NPV)</th>
<th>Overall Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoffman and Rigler</td>
<td>92.5 %</td>
<td>83.3 %</td>
<td>78.7 %</td>
<td>94.3 %</td>
<td>87%</td>
</tr>
<tr>
<td>Sign for Diagnosis of Left Ventricular Enlargement</td>
<td></td>
<td></td>
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</table>

Kappa coefficient = 0.737 ± 0.070  P value = 0.000

Validity measures of Hoffman and Rigler Sign in the determination of left ventricular enlargement is shown in Table 2. The probability of left ventricular enlargement among patients with measurement A of >18 mm is 78.7 %, while the probability of having no left ventricular enlargement among patients with measurement A of <18 mm is 94.3 %. The ability of the test to detect left ventricular enlargement is 92.5%. The kappa test results proved that there is a strong agreement of Hoffman and Rigler sign of >18 mm with the left ventricular enlargement by 2D echocardiogram.

### Discussion

The purpose of this study was to evaluate the validity of the Hoffman and Rigler sign for determination of left ventricular enlargement. Using this method, Hoffman and Rigler concluded that when measurement A is >18 mm, left ventricular enlargement can be postulated with considerable confidence. It was found out that only 78.7 % of patients with left ventricular enlargement in echocardiography were correctly identified. 17% were false positive, whereas 8% were false negative.

This study found that Hoffman and Rigler sign is a useful tool to assist clinicians in evaluating left ventricular enlargement. In the majority of cases, this method provides additional support for assessing the severity of the cardiac disease and offers reasonable motivation for early referral to cardiac units. Although this measurement has a sensitivity of 92.5 % and specificity of 83.3 %, it can never be used as the sole criterion for diagnosis.

### Conclusion

When left ventricle extends more than 18 mm posterior to the posterior border of the inferior vena cava at a level 2 cm cephalad to their crossing, Hoffman and Rigler sign is a valuable alternative in the evaluation of left ventricular enlargement. History and clinical findings remain the paramount arms in decision-making. This sign should therefore be used to complement other evidence of left ventricular enlargement when echocardiography is not readily available.

### References