Validity of Indicator-Dilution Determination of Cardiac Output in Patients with Aortic Regurgitation

By Philip Samet, M.D., Cesar Castillo, M.D., and William H. Bernstein, M.D.

A previous study from this laboratory analyzed the effect of mitral regurgitation on the validity of the indicator-dilution determination of cardiac output. The potential problem of unrecognized early recirculation of indicator particles on the primary indicator time-concentration curve was discussed. The purpose of this report is to extend these observations to patients with aortic regurgitation.

Methods

Indicator-dilution curves were recorded from the pulmonary artery and a systemic artery after right atrial injection as previously described. A total of 298 separate catheterization studies are included in this report. Each value for pulmonary and systemic arterial output represents the mean of two separate determinations; a total of 1,192 dye curves were thus analyzed. The subjects were divided into three groups. The first and second groups are identical to those mentioned earlier. The third group included 129 catheterizations in patients with varying degrees of aortic regurgitation with or without other valvular lesions. This third group of 129 patients was divided into four subgroups (grades I to IV) of progressively increasing degrees of aortic insufficiency. There were 74, 25, 17, and 13 patients in these four subgroups, respectively. Patients with known or suspected tricuspid or pulmonic regurgitation were excluded from this study.

Results

The mean cardiac indices and the standard deviations for the three groups of patients after pulmonary and systemic arterial sampling are shown in Table 1. There was no significant difference in these two values for the first group (P = 0.26). The differences were significant for the second group, P = 0.005. The respective P values for the four grades of aortic insufficiency were 0.02 for grade I insufficiency, 0.01 for grade II, 0.10 for grade III, and 0.08 for grade IV. For the entire group of 129 patients in group 3, P = 0.001. The data are presented in Table 2.

Data on the first two groups have been published in Figures 1 and 2 in the earlier study. The data for the aortic insufficiency group are shown in Figure 1 presented below. There was no physiologically significant difference between output levels of the pulmonary and systemic arterial dye curves.

<table>
<thead>
<tr>
<th>Sampling site</th>
<th>Cardiac index (L/min/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>3.19 ± 0.7*</td>
</tr>
<tr>
<td>Systemic artery</td>
<td>3.17 ± 0.7</td>
</tr>
</tbody>
</table>

*Mean ± standard deviation.

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Table 1

Cardiac Indices Determined on Use of Pulmonary and Systemic Arterial Sampling Sites in Three Groups of Patients

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Table 2

Cardiac Indices Determined on Use of Pulmonary and Systemic Arterial Sampling Sites in Four Subgroups of Patients with Aortic Regurgitation

<table>
<thead>
<tr>
<th>Sampling site</th>
<th>Cardiac index (L/min/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade I</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>2.42 ± 0.6*</td>
</tr>
<tr>
<td>Systemic artery</td>
<td>2.39 ± 0.6</td>
</tr>
</tbody>
</table>

*Mean ± standard deviation.

The magnitudes of the pulmonary-systemic arterial differences were compared for the different groups 1 to 3 and for the four grades of group 3. None of these differences was significant.

Discussion

The data obtained in this study demonstrate that the systemic arterial indicator-dilution curve provides a valid measure of cardiac index even in the presence of aortic insufficiency of varying magnitude provided that a straight line semilogarithmic extrapolation of the downstroke of the curve is possible. Furthermore, there is no progressively greater difference between the systemic and pulmonary arterial indices as the severity of aortic regurgitation increases. In the event that straight-line extrapolation is not possible, the pulmonary arterial dilution curve after right atrial injection provides a measure of cardiac index. The potential problems raised by Rahimtoola and Swan are of limited practical import.

Summary

Indicator-dilution determinations of cardiac index were performed in 298 catheterization studies in three groups of patients, many with aortic regurgitation. The absence of physiologically significant differences between the two sampling sites, the pulmonary artery and systemic artery after right atrial injection, demonstrates that even severe aortic regurgitation does not vitiate the indicator-dilution determination of cardiac output after right heart injection and systemic arterial sampling if the downstroke of the primary dilution curve permits a straight-line semilogarithmic extrapolation.

References

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