A Comparison of Invasive Arterial Blood Pressure Monitoring with Fluid-filled Catheter and Pressure Guide Wire

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Background

It has been reported that aortic systolic blood pressure (aSBP) is a more powerful predictor of cardiovascular diseases than brachial SBP (bSBP).

Pressure guide wire can obtain aortic pressure waveforms accurately, whereas fluid-filled catheters distort the original pressure waveforms because the sensitivity for the high frequencies is low.

The difference of pressure waveforms between pressure guide wire and fluid-filled catheter has not been fully investigated.

Objective

To compare the aSBP obtained by pressure guide wire and that of fluid-filled catheter.

Subjects

Participants: Forty three patients (67.9 ± 8.8 years, 30 males) underwent cardiac catheterization at our institution from December 2007 to December 2008.

Excluded: Patients with low left ventricular function, severe valvulitis, atrial fibrillation, atrial flutter, severe arrhythmia, cardiomyopathy, or acute myocardial infarction. Patients who were considered to be ineligible for this study by physician.

Methods

Measurement

Subjects were rested at least 5 minutes prior to measurement. Subsequently, the right and left bSBPs were measured simultaneously. Cardiac catheterization was performed by pressure guide wire (RADI Medical Systems) and fluid-filled catheter from radial or femoral arterial puncture.

Analysis

Ten stable and consecutive pulses were used for analysis. The mean arterial pressure of pressure guide wire was calibrated with that of fluid-filled catheter. After calibration, aSBP and aDBP (aortic diastolic BP) by each catheter were compared.

Baseline characteristics of the patients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>n</th>
<th>mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>43</td>
<td>67.9 ± 8.8</td>
</tr>
<tr>
<td>Brachial SBP [mmHg]</td>
<td></td>
<td>132.8 ± 18.9</td>
</tr>
<tr>
<td>Brachial DBP [mmHg]</td>
<td></td>
<td>67.2 ± 12.0</td>
</tr>
<tr>
<td>Brachial PP[mmHg]</td>
<td></td>
<td>65.6 ± 14.2</td>
</tr>
<tr>
<td>Radial AI [%]</td>
<td></td>
<td>79.9 ± 12.4</td>
</tr>
<tr>
<td>HR [bpm]</td>
<td></td>
<td>64.5 ± 9.5</td>
</tr>
<tr>
<td>Height [cm]</td>
<td></td>
<td>159.8 ± 9.8</td>
</tr>
<tr>
<td>Weight [Kg]</td>
<td></td>
<td>62.8 ± 10.7</td>
</tr>
<tr>
<td>BMI [Kg/m²]</td>
<td></td>
<td>24.5 ± 3.2</td>
</tr>
</tbody>
</table>

Results (1)

(1) Comparison of aSBP and aDBP measured by pressure guide wire or fluid-filled catheter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pressure guide wire (mmHg)</th>
<th>Fluid-filled catheter (mmHg)</th>
<th>Difference (mmHg)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>aSBP</td>
<td>143.9 ± 22.0</td>
<td>140.3 ± 21.6</td>
<td>-3.6 ± 3.5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>aDBP</td>
<td>74.5 ± 11.1</td>
<td>76.7 ± 11.5</td>
<td>1.1 ± 2.0</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Fluid-filled catheter underestimated aSBP with 3.6 mmHg, and overestimated aDBP with 1.1 mmHg compared to those measured by pressure guide wire.

(2) Bland-Altman plots of aSBP and aDBP measured by pressure guide wire and fluid-filled catheter

Results (2)

Typical example: No. 1

75 years old, female, 146.8cm 54.7Kg

rAI:91%, brachial SBP/DBP: 140/55 mmHg

Fluid SBP/DBP/MAP: 148/59/94

The difference of aortic SBP and DBP were -3 mmHg and 2 mmHg, respectively.

Typical example: No. 2

76 years old, female, 147cm 51.4Kg

rAI:79%, brachial SBP/DBP: 122/40 mmHg

Fluid SBP/DBP/MAP: 123/43/72

The difference of aortic SBP and DBP were -6 mmHg and 1 mmHg, respectively.

Summary

Fluid-filled catheter underestimates SBP and overestimates DBP compared to pressure guide wire.

Aortic BP measured by fluid-filled catheter may be inaccurate because of the distortion of pressure waveform.

Conclusion

Pressure guide wire, rather than fluid-filled catheter, should be used for the accurate recording of aortic blood pressure.