Novel Concept of Measuring Percutaneous Oxygen Saturation Monitor during Cardio-Pulmonary Bypass.
Asahina T., Takii Y., Nishigoori T., OzakiM. Anesthesiology 2003; 99: A557

Introduction
In cardiac surgery with cardiopulmonary bypass (CPB), most anesthesiologists monitor oxygenation by arterial blood gas analysis (ABG) every 30 minutes only. CPB blood flow may not generate pulsations; therefore, pulse oximeters may not detect oxygenation (SpO2) during the CPB period.

Methods
During cardiac surgical cases with CPB, we attached a blood pressure cuff on forearm right beneath the elbow with a small pump prototype (Oscillation Plus). It inflates and deflates the cuff alternately from 0 to 30-50 mmHg pressure at 0.6-1Hz. Each patient had a cannula placed in a radial artery. During total bypass, this pump was activated. Then, fingertip SpO2 was measured by a pulse oximeter (Masimo Radical). Comparison of the pulse oximeter SpO2 to the CPB device ABG (C-SO2) and radical artery ABG (R-SO2) was made every 30 minutes.

Results
We studied 10 patients. SpO2 was undetectable if the prototype pump did not stimulate the finger during CPB. With stimulation by Oscillation Plus, these pulse oximeters showed a plethysmographic waveform, pulse rate and blood oxygen saturation value during CPB. Plethysmographic waveform shapes were altered due the Oscillation Plus. Pulse rate was coincidence with oscillations of the pump or multiples thereof. At the point of blood sampling, the SpO2, C-SO2, R-SO2 values showed 99.2 ± 1.03, 99.66 ± 0.33 and 99.78 ± 0.28 (period of after the initiation of CPB), 99.6 ± 0.52, 99.69 ± 0.31 and 99.83 ± 0.25 (period of during CPB), 99.7 ± 0.67, 99.87 ± 0.21 and 99.75 ± 0.36 (period of just before coming off CPB), respectively.

Conclusion
Sampling of ABG every 30 minutes is not sufficient risk management during CPB. This technique has the possibility of non-invasive continuous oxygenation monitoring during CPB.
Comparison of the pulse oximeter SpO₂ to the CPB device ABG (C-SO₂) and radical artery ABG (R-SO₂) on each period.

<table>
<thead>
<tr>
<th>Period</th>
<th>SpO₂ (%)</th>
<th>C-SO₂ (%)</th>
<th>R-SO₂ (%)</th>
<th>Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>after the initiation of CPB</td>
<td>99.2±1.03</td>
<td>99.66±0.33</td>
<td>99.78±0.28</td>
<td>35.85±1.25</td>
</tr>
<tr>
<td>during CPB</td>
<td>99.6±0.52</td>
<td>99.69±0.31</td>
<td>99.83±0.25</td>
<td>29.6±2.54</td>
</tr>
<tr>
<td>just before coming off CPB</td>
<td>99.7±0.67</td>
<td>99.87±0.21</td>
<td>99.75±0.36</td>
<td>32.16±2.99</td>
</tr>
</tbody>
</table>

All data are expressed by mean (n=10) ± S.D. All difference between each data is not significant (n.s.). Temp. indicated finger tip temperature.

Figure 1

Figure 2