Velcro-based finger sensors distort BP measurement

NIBP100D by CNAP Systems

FINGER-CUFFS PREVENT THE VELCRO EFFECT

The Velcro effect: BP depends on Velcro fixation of the finger cuff: The tighter the fixation, the higher the measured BP (positive correlation).²

Nexfin using Velcro:
- Sensitive to fixation
- Sensitive to malapplication

CNAP™ without Velcro:
NIBP100D
- 3 fixed cuff sizes
- Automated fastening
- Safe application

Range of under/overestimation of BP (against A-line) by using Velcro based finger sensors:²

<table>
<thead>
<tr>
<th></th>
<th>Too loose</th>
<th>Too tight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sys</td>
<td>+13.5</td>
<td>+10.8</td>
</tr>
<tr>
<td>Dia</td>
<td>+8.5</td>
<td>-22.2</td>
</tr>
<tr>
<td>Mean</td>
<td>+10.8</td>
<td>-18.5</td>
</tr>
</tbody>
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Deviations up to -36mmHg and +24mmHg

NIBP100D by CNAP Systems

Competition (Nexfin and Finapres):

Nexfin system:

- The Nexfin system uses a Velcro strap for the finger cuff (single finger) which causes what is called the ‘velcro effect’. Similar to a respiration belt, the measurements are affected by the amount of pressure exerted on the Velcro/finger. A paper has been referenced regarding this finding (see - last page reference by CNSystems).
- Because the Nexfin system uses a single finger for pressure readings, the pressure must be released once a minute at which point, blood pressure is not being recorded for a few seconds, thus, it is not continuous blood pressure.
- The Nexfin system records additional signals such as CO, SV, dP/dT and SVR, however, you would pay much more for the Nexfin system ($25k) and end up with limited physiological recording option versus purchasing the CNAP system with an MP150 system and amplifiers.

CNAP System: NIBP100D

- CNAP double finger cuff guarantees an accurate, error-free measurement. Record from one finger for up to 60 minutes, switch between fingers manually, or automatically in 5 minute intervals.
- Suitable for therapy decisions at NI gold standard grade.
- Continuous finger-BP calibrated to upper arm by integrated NBP –the non-invasive standard for decades.
- The NIBP100D noninvasive blood pressure system provides a continuous, beat-to-beat, blood pressure signal recorded from the fingers of a subject.
- The finger cuffs (included with system) come in three sizes to accommodate children through large adults.
- The CNAP system has been validated against actual invasive blood pressure (A-line) – (see figure 2 below).
- The monitor displays values for systolic, diastolic, mean blood pressure, and heart rate along with a pressure and pulse trend.
- The CNAP system uses a click wheel which gives the user total control of settings including averaging options, trend display settings, automated finger cuff adjustment settings and much more.
• The NIBP100D interfaces with an MP150 data acquisition system (or third-party data acquisition system), via a DA100C and TC1105 Interface Connector.

• The NIBP100D is calibrated using a standard blood pressure cuff that is placed around the subject’s upper arm. The unit automatically takes a blood pressure measurement from the subject and uses the value for calibration purposes. During the calibration process the system locates the pulse at the finger and performs a partial occlusion. Calibration period takes less than three minutes—that time includes placing the cuff around the upper arm and the sensor on the fingers.

• It will switch from one finger to the next during the course of the recording to relieve the pressure from the occluded finger. The interval between finger rotations is user-selectable and can be as long as 60 minutes. During the rotation, the system takes another calibration reading to ensure that values are accurate.

Measuring range

• Sys: 40 - 250 mmHg (5.3 - 33.3 kPa)
• Dia: 30 - 210 mmHg (4 - 28 kPa)
• Mean: 35 - 230 mmHg (4 - 30.6 kPa)
• Heart rate indication range 20-200 bpm
• Accuracy ±5 mmHg (0.6 kPa)

Figure 1: Different blood pressure waveforms and amplitudes in the (1) A. brachialis, (2) A. radialis and (3) A. digitalis, resulting in different systolic and diastolic values.

Figure 2: Blood pressure tracings showing the agreement of CNAP™ (solid line) with IBP (dotted line) during anesthesia.