CNAP®-HD IN RESEARCH
SETUP & PARAMETERS

One finger sensor providing complete cardiovascular responses to tests – continuous & noninvasive

Unique combination of continuous:
- pulse rate
- blood pressure
- cardiac output, stroke volume
- systemic vascular resistance
Blood pressure, cardiac output and vascular resistance are used to differentiate between challenge and threat states.

WHY USE CONTINUOUS BP, CO & SVR IN RESEARCH?

- Examination of cardiovascular response to (psycho)physiolog. stress
  - Reactions of the human body to challenge and threat (positive and negative stress) \[^{10,11}\]
  - Quantification of emotional response \[^{12}\]


**FEATURES & BENEFITS OF CNAP®-HD IN RESEARCH**

- Full hemodynamics from only one device
- Simple and quick setup
  - One finger sensor provides all parameters
  - No placing of additional electrodes on subjects
- Quick recording
  - Parameter values in less than 15 heart beats (available end of 2014)
- Well validated parameters & system\(^1,\)\(^2\)
  - Interchangeability with clinical standards according to international criteria
- 4 analog output channels (BP waveform, mBP, CO, PPV)

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\(^2\) Clinical Evaluation Report Cardiac Output (according to Meddev 2.7.1. Rev. 3), CNSystems. 2014.
CNAP®-HD provides easy setup for cardiac output from the same finger sensor

WAYS TO MEASURE CO IN RESEARCH

CNAP®-HD
- Quick & simple setup
- Using a reusable finger sensor

Standard Impedance Cardiography
- Complex and time-consuming setup requires to undress upper body
- Placing of disposable electrodes

BIOPAC Part # NIBP100D-HD

www.biopac.com
HOW DOES CNAP®-HD WORK?

- Combination of 3 technologies/methods:
  1. Vascular unloading principle
     - Blood pressure, pulse rate
  2. Standard upper arm cuff for calibration (NBP)
  3. Pulse contour analysis (CNCO®)
     - SV, CO, SVR

CNAP-HD combines three core technologies
Integrated pressure cuff measures blood pressure continuously

CONTINUOUS BLOOD PRESSURE

Vascular unloading principle:

1. **Infrared light** is sent through the finger to measure blood volume

2. The **integrated cuff** in the finger sensor inflates & deflates to keep the blood volume constant (actio = reactio)

3. Pressure from the finger cuff equals the blood pressure → BP waveform
Combination of finger sensor with NBP provides high accuracy BP signal – equivalent to invasive arterial line

**CALIBRATION TO CLINICAL GOLD STANDARD**

1. Obtaining a first uncalibrated finger measurement
2. Obtaining a NBP measurement
3. Applying NBP pulse pressure to the finger signal
4. Calibrating the finger curve to systolic and diastolic NBP pressure

All consecutive BP values are calculated from changed calibrated finger blood pressure signal
Cardiac output measure obtained from accurate blood pressure waveform using well-known pulse contour analysis

**CNAP® HEMODYNAMICS**

- Applying Ohm‘s Law to Hemodynamics
  \[ \text{Voltage} = \text{Current} \cdot \text{Resistance} \]
- \[ \text{MAP} - \text{CVP} = \text{CO} \cdot \text{SVR} \]
- \[ \text{MAP} \approx \text{CO} \cdot \text{SVR} \]

1. **Vascular unloading** provides accurate blood pressure waveform and MAP
2. **CO** is calculated from pulse contour analysis
3. **SVR** results from CO and MAP
4. Absolute values can be **indexed** to body surface area (SVI, CI, SVRI)

* CVP = 7 [mmHg] and can be neglected
CNAP® arterial pressure is comparable with an invasive arterial line, even during general anesthesia

CLINICAL VALIDATION: CNAP®

- Erlangen, Germany[3]:
  - 88 Patients (Neuro, Abdominal, Cardiac Surgery)
- Bland-Altman Plot for mean BP:
  - Bias (SD) = -1.6 (11.0) mmHg
- Precision of CNAP® (trending) not different from invasive BP (3,2mmHg for mean BP)
- CNAP® and IBP detected simultaneously 82.1% fast blood pressure changes

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CNCO® is inter-changeable with clinical standards and tracks changes reliably

VALIDATION OF CARDIAC OUTPUT (CNCO®)

- High accuracy of non-invasive CNCO® compared to invasive clinical standards: Bland-Altman plots
  - Small bias and narrow limits of agreement
  - Percentage errors ≤ 30% (according to strict Critchley standard\textsuperscript{4,5})
- High trending ability of non-invasive CNCO® compared to invasive clinical standards
  - Concordance rates ≥ 90% (according to standard\textsuperscript{6})


\textsuperscript{5} Peyton PJ, Chong SW: Minimally invasive measurement of cardiac output during surgery and critical care. Anesthesiology 2010; 113:1220-35.

CNAP® is used in a variety of applications & scientific studies

RESEARCH EXAMPLES WITH CNAP®

The Naval Aerospace Medical Research Laboratory studied the detection of deception by use of continuous blood pressure [7].

At Pitzer College, California, a study was performed to assess the effects of mainstream media on women's physiological and psychological functioning [8].

- Reactions to commercials of Victoria’s Secret and Chrysler automobile

The Institute for Knowledge Discovery in Graz, Austria studied the influence of slow blood pressure oscillations on self-paced movements [9].

Contact us for a complete bibliography of CNAP® studies ➔ info@biopac.com

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