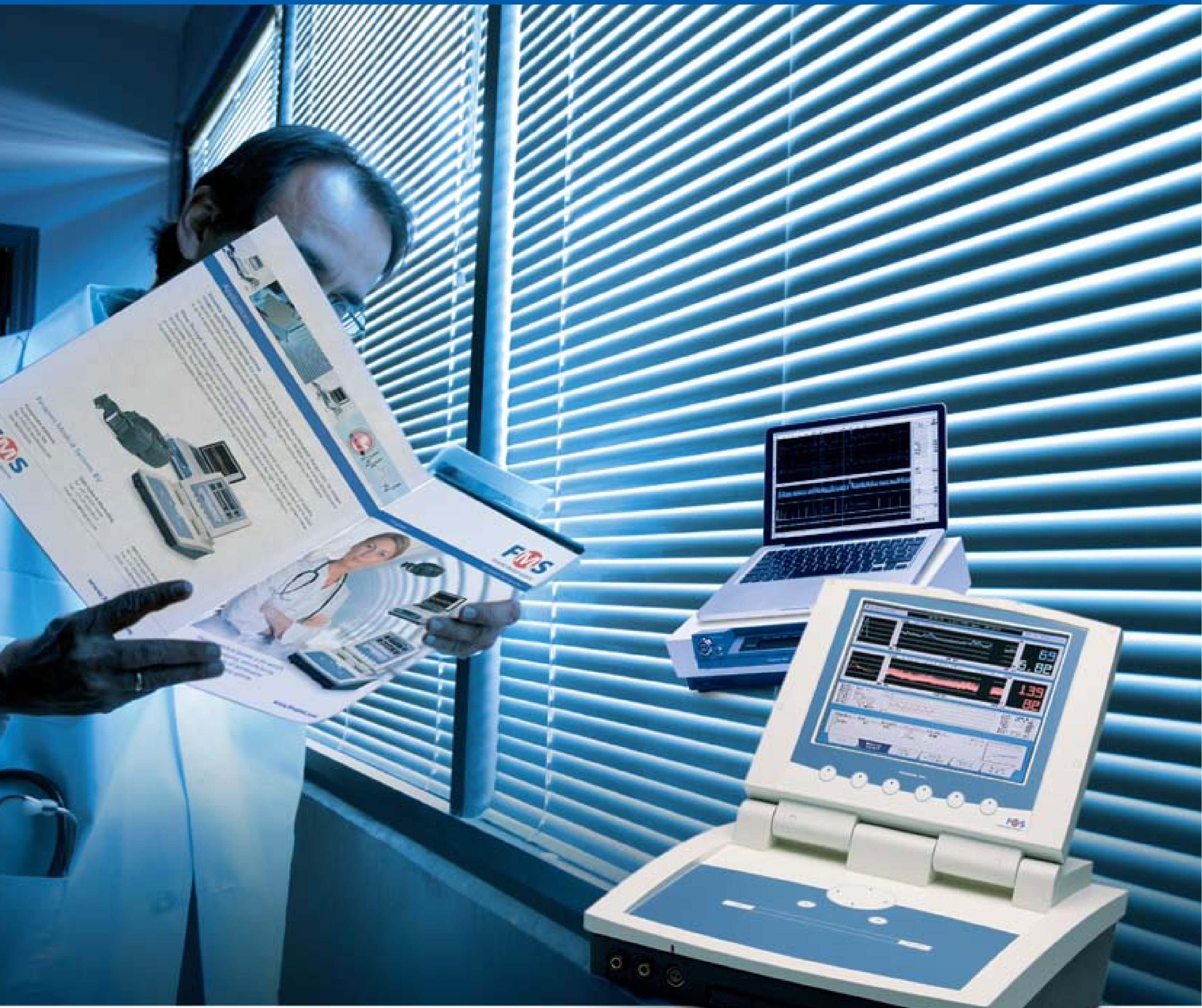
FMS

Finapres Medical Systems

CRT

non-invasive hemodynamics



Optimizing Cardiac Resynchronization Therapy using the Finometer®

www.finapres.com

Research

Background

Continuous non-invasive hemodynamic monitoring to optimize atrioventricular delay in cardiac resynchronization therapy*

Atrioventricular (AV) delay of cardiac resynchronization devices should be optimized after implantation. Currently this is performed using echocardiography. The most frequently used method of optimization relies on assessment of left ventricular inflow measured using transmitral Doppler flow.

Limitations of the Echocardiographic Method

1. Meeting the echocardiographic target may not yield maximal achievable hemodynamic benefit.
2. Optimization is typically limited to resting heart rate, which may limit optimization of cardiac performance.
3. Echocardiography requires a skilled operator, can be technically difficult and does not lend itself to multiple measurements of different combinations of pacing parameters.
4. Recent research has shown that optimal parameters vary over time, and reprogramming may be appropriate. (O'Donnell, D; 2005)

Alternative Method: Continuous Non-Invasive Blood Pressure Measurement to Measure the Effect of Changes in AV Delay

- As biventricular pacing therapy aims to improve the function of the heart, non-invasive measurement of the consequences of cardiac function on the vasculature (such as the blood pressure) likely represents a useful target for optimization.
- A finger photoplethysmograph (Finometer®, Finapres Medical Systems, The Netherlands) was applied to monitor arterial blood pressure while AV delay was altered to identify optimal parameters.

  The Finometer® uses an inflatable finger cuff and the Finapres technology to yield beat-to-beat blood pressure.
- Cardiac output and stroke volume are calculated using the Modelflow® method.

Methods

- Each tested AV delay was compared with a reference AV delay of 120ms and VV delay of 0ms.
- The difference in mean systolic BP (ΔBP) between the 10 beats immediately before and the 10 beats immediately after a transition was calculated.
- Each transition was repeated to obtain at least 6 replicate measure.

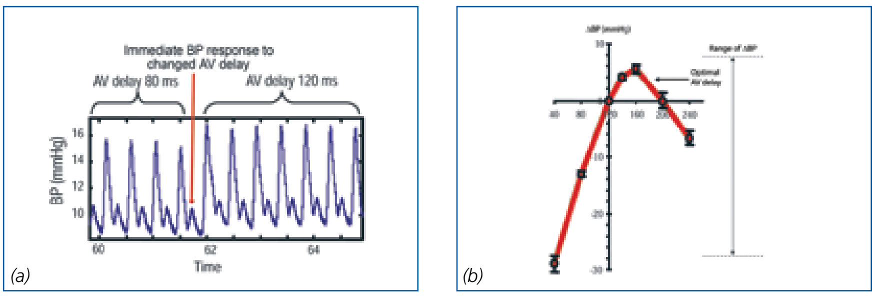


FIGURE 1 - *Effect on blood pressure of altering AV delay (a) Blood pressure response to change (b) For each AV delay, ΔBP in relation to 120ms AV delay.*

*Based on a poster presented at the 54th Annual Scientific Session of the American College of Cardiology (2005); Orlando, FL, USA.

Results

- Using continuous non-invasive blood pressure measurements, changes in systolic blood pressure were detected as AV delay was changed.
- Systolic blood pressure displayed a parabolic pattern of distribution around the optimal AV delay.
- The optimal AV delay varied between individual patients (median 160, range 120-200 ms).
- Blood pressure became progressively lower as AV delay was changed away from the individuals patient's hemodynamic optimum.
- Even small changes in AV delay cause a statistically significant decline in blood pressure. A delay 40ms less than the individual's optimum reduced SBP by 4.9 ± 1.1 mmHg ($p<0.003$); a delay of 40ms above optimal decreased SBP by 4.4 ± 0.73 mmHg ($p<0.0005$).
- Changes in AV delay exceeding 40ms caused SBP to fall even further. The average decline across all patients is shown in Figure 2 for the heart rate of 130 bpm.
- The mean absolute difference between the two determinations of optimal AV delay 3 months apart was 3ms (standard deviation 8ms). Same-day reproducibility was also 3ms (standard deviation 8ms)
- The standard deviation of difference between two individual measurements of ΔBP, 3 months apart, was 3mmHg, which is 3% of the mean systolic blood pressure.

Conclusions

- AV optimization using acute hemodynamics can be performed objectively and rapidly by non-invasive photoplethysmography.
- At 130 bpm, every patient shows a clear optimal AV delay for acute blood pressure.
- The consequences of non-optimal AV delay are visible as a significant loss of arterial blood pressure.
- AV optimization by non-invasive blood pressure is highly reproducible on the same day and at 3 months.

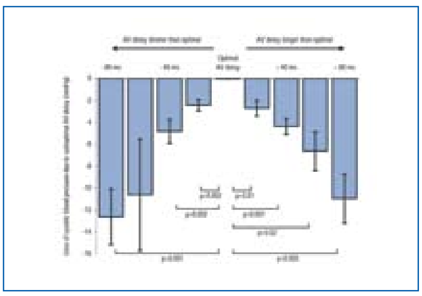


FIGURE 2 - *Effect of changing AV delay away from optimal*

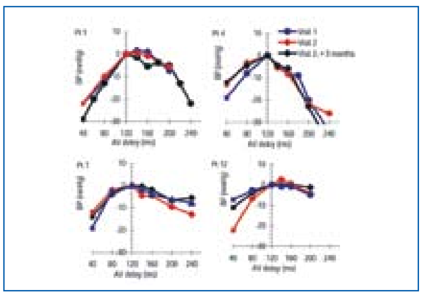
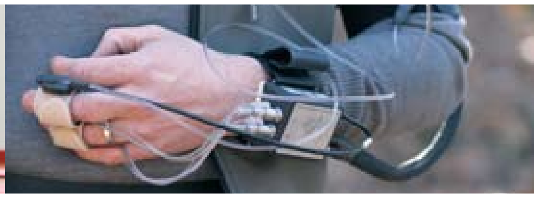


FIGURE 3 - *Reproducibility of AV optimization*


Finometer® PRO and Finometer® MIDI

The Finometer® PRO and the Finometer® MIDI are non-invasive stationary blood pressure measurement and beat-to-beat hemodynamic monitoring systems that incorporate proprietary ModelFlow® methodology for Cardiac Output.

The optimal methodological and technological synchronization offers unlimited possibilities for meeting the most challenging needs of modern medical practice and scientific research.

The Finometer's advantage is its accurate and robust continuous measurement in an all-in-one concept, which makes it a versatile non-invasive beat-to-beat monitoring system. The Finometer® not only captures the continuous blood pressure waveform, but also automatically computes up to 15 important beat-to-beat hemodynamic parameters including Cardiac Output (CO), Stroke Volume (SV), Total Peripherial Resistance (TPR), Pulse Rate Variability (PRV) and BaroReflex Sensitivity (BRS). It is suitable for a wide range of clinically and scientifically focused measurements in hospitals, clinics and research institutions.

The Finometer® PRO is the Finapres stand alone solution with the option to export and import data using BeatScope® software. The Finometer® PRO is able to show real time all 15 important hemodynamic parameters. The compact and easy to use design makes the Finometer® PRO very suitable for bedside applications and scientific research.

Changes in blood pressure are sometimes more important than absolute values. When trends are most important the Finometer® MIDI is the optimal solution for hemodynamic monitoring. Trends can easily be visualized using BeatScope® software installed on a PC.

BeatScope® and BeatScope® Easy are PC based software applications offering a range of solutions for patient treatment and scientific research. BeatScope® Easy offers insight in blood pressure waveforms and beat-to-beat trending of blood pressure and heart rate parameters. BeatScope® additionally offers an extended range of hemodynamic parameters including stroke volume (SV), total peripheral resistance (TPR) and cardiac output (CO), baroreflex sensitivity (BRS) and Pulse Rate Variability (PRV).

900715-592-40

Portapres®, Finometer® PRO and Finometer® MIDI are the commercial names for Portapres® Model-2, Finometer® Model-1 and Finometer® Model-2.

FMS, Finapres Medical Systems BV

Corporate Address:
Paasheuvelweg 34a
NL-1105 BJ Amsterdam ZO
The Netherlands

FMS Sales & Marketing
Tel: +31 20 697 2228
Fax: +31 20 609 0677
Email: sales@finapres.com

FMS Customer Service
Tel: +31 20 609 0974
Fax: +31 20 609 0677
Email: info@finapres.com

FMS
Finapres Medical Systems

www.finapres.com