Blood pressure analysis on time scales from seconds to days
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The company BMEYE located in the AMC in Amsterdam (formerly the TNO Biomedical Instrumentation research unit) has a long tradition of research in the area of non-invasive hemodynamic measurements. The BMEYE core technology includes continuous, non-invasive finger arterial pressure measurement, which has found its way to the market in several medical devices, best known the Finapres (1-47), the Portapres (48-55) and the Finometer (42,43). Continuous blood pressure measurement in space research depends solely on the specially developed BMEYE finger arterial pressure measurement devices (40,46).

BMEYE has worked on continuous model-based cardiac output calculation from pressure, resulting in the Wesseling pulse contour method (56,57) and the Modelflow method (58-66), using an elegant three-element Windkessel model.

Another long-standing interest is in blood pressure control and baroreflex, resulting in elaborate models of the circulation (57,67,69,72). A recently developed method to determine baroreflex sensitivity (73) is currently resulting in several publications (74-76) offering new insights in this field.

Cooperation with clinical partners has always been very important. Newly developed methods require new research for validation; new research may require new methods. New applications of the BMEYE methodology also result in interesting new research. To mention but a few: the analysis of non-invasive pressure wave shape to detect pre-symptomatic signs of orthostatic intolerance during head-up tilt (82), plethysmography of the finger pulse as a non-invasive method for predicting drug-induced changes in left ventricular preload (77) and continuous non-invasive hemodynamic monitoring to optimize atrioventricular delay settings of pacemakers in cardiac resynchronization therapy (86).
Algorithms that can be applied to non-invasive pressure recordings to determine cardiac preload on basis of systolic pressure variation (78) or pulse pressure variation (84) are also interesting. Ventricular filling pressures has also been associated to heart rate recovery after exercise in patients with suspected coronary artery disease (85). Several studies suggest a relation between pulse pressure and endothelial dysfunction (80), pulse pressure and coronary vasomotor dysfunction (83) or pulsatility and coronary artery disease (79). Reactive hyperemia in the finger has been suggested to non-invasively identify coronary atherosclerosis (81).

With the trend towards continuous non-invasive patient monitoring we feel that finger blood pressure measurement will become the basis for many new systems for diagnostic purposes, assessment of key risk factors and monitoring of acute vital signs in daily clinical patient care.
References

**Finapres**


*Portapres*


**Pulse Contour and Modelflow**


**Baroreflex**


70. Goedhard WJA, Wesseling KH, Settels JJ. *Baroreflex pressure control responding to orthostatic changes with age*. In: Psychophysiology of Cardiovascular Control. Models, Methods and Data. 1985; (Orlebeke JF et al, eds), Plenum, New York: 191-202


Other research


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