Artery Research
Vol. **25**(**S1**); 2019, *p.* S172
DOI: https://doi.org/10.2991/artres.k.191224.157; ISSN 1872-9312; eISSN 1876-4401
https://www.atlantis-press.com/journals/artres

P134 A New Method for Non-invasive Measurement of Arterial Wave Intensity, Speed and Reflection

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ABSTRACT

Introduction: The ventricles accelerate and decelerate blood; the resulting disturbances propagate through the arterial system as waves. These waves contain clinically useful information: e.g. their magnitude and timing varies with cardiac performance and their speed depends on arterial stiffness. These properties can be studied using Wave Intensity Analysis (WIA) [1] and have been shown to be altered in heart failure [2]. Conventional WIA relies on invasive catheter measurements of blood pressure and velocity. We have developed and validated a new non-invasive ultrasound-based method that allows accurate WIA.

Methods: Employing a novel WIA formulation [3] based on diameter and velocity, and a ultrafast ultrasound imaging system (Verasonics, Kirkland, USA), wave intensity was measured in the abdominal aorta of rabbits. B-mode images were acquired at 1000 Hz, and diameter and velocity measured using standard cross-correlation techniques (the latter after spatio-temporal filtering to enhance the blood signal). Comparative measurements were made with a conventional WIA catheter-based system (Phillips Volcano, San Diego, USA). Ventricular dysfunction was induced by administering esmolol.

Results: Measured non-invasive peak wave intensities showed good agreement with catheter-based ones ($\rho = 0.73$, $p = 0.04$, $n = 8$). Changes in the intensity and timing of the forward compression wave could be detected 1 minute after esmolol administration ($n = 10$): peak intensity reduced by 30.3% ($p = 0.003$) and was delayed 9.30 ms ($p = <0.001$).

Conclusion: This new method enables wave intensities, reflections and speeds to be obtained non-invasively at any ultrasound accessible site. It could provide a clinically useful way to detect heart failure, and alteration of arterial tone and stiffness.

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