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Pulse transmission time and amplitude of digital pulse wave determined by fingertip plethysmography as a surrogate marker of brachial artery flowmediated dilatation

Nada Abdul Salam [1], Amal Yousif Al-Yasiri [2], Bassam Talib Al-Gailani [1]

Affiliations

Affiliations

1 Department of Physiology, Mustansiriyah University, Baghdad, Iraq.
2 Department of Basic Sciences, University of Baghdad.

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Abstract

Objective: To assess the changes in blood vessel stiffness and digital pulse wave amplitude because of flowmediated dilatation, and to explore how these two variables change when endothelial dysfunction is experimentally induced.

Methods: The experimental study was conducted at the departments of physiology at the College of Medicine, Mustansiriyah University, and the College of Medicine, Al-Iraqia University, Baghdad, Iraq, from October 14, 2021, to May 31, 2022, and comprised healthy young males who were subjected to the flow-mediated dilatation technique on the left brachial artery. Pulse transit time and the amplitude of the digital pulse wave were measured during reactive hyperaemia for 2.5 minutes from the left middle finger using a piezoelectric pressure sensor and a simultaneous Lead I electrocardiogram. Endothelial dysfunction (ED) was induced by oscillatory and retrograde shear rates. The correlation between variables was calculated in Excel running on the Windows operating system.

Results: There were 10 second-year medical students with mean age 22±0 years and mean body mass index 25.7±4.8kg/m2. During reactive hyperaemia, pulse transit time was significantly increased by 3-5% in both normal endothelium and experimentally induced endothelial dysfunction relative to the pre-occluded artery, and the difference was not significant ($p>0.05$). Digital pulse wave amplitude increased significantly in normal endothelium relative to the pre-occluded artery ($p<0.05$), but not in experimentally-induced endothelial dysfunction ($p>0.05$).

Conclusions: The pulse transit time and digital pulse wave amplitudes of the photo plethysmography signal may be used to detect changes in vessel wall diameter and tone throughout the reactive hyperaemia process. Digital pulse wave amplitude was better able to detect experimentally-induced endothelial dysfunction, as assessed by the flowmediated dilatation protocol, than pulse transit time.

Keywords: Hyperemia, Brachial Artery, Dilatation, Plethysmography, Electrocardiography, Pulse Wave, Endothelium, Running.

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