Modeling and interpretation of the bioelectrical impedance signal for the determination of the local arterial stiffness

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Résumé en anglais	Purpose: Stiffness of the large arteries (e.g., aorta) plays an important role in the pathogenesis of cardiovascular diseases. To date, the reference method for the determination of regional arterial stiffness is the measurement of the carotid-femoral pulse wave velocity (PWV) by tonometric techniques. However, this method suffers from several drawbacks and it remains limited in clinical routine.Methods: In the present study, the authors propose a new method based on the analysis of bioelectrical impedance (BI) signals for the determination of the local arterial stiffness. They show, from a theoretical model, a novel interpretation of the BI signals and they establish the relationship between the variations in the BI signal and the kinetic energy of the blood flow in large arteries. From this model, BI signals are simulated in the thigh and compared to experimental BI data. Finally, from the model, they propose a new index (Ira) related to the properties of the large artery for the determination of the local arterial stiffness. Results: The results show a good correlation between the simulated and the experimental BI signals. The same variations for both of them with different characteristics for rigid and elasticarteries can be observed. The measurement of the Ira index on 20 subjects at rest (mean age of 44 ± 16 yr) for the determination of the local aortic stiffness presents a significant correlation with the PWV reference method (R 2 = 0.77 ; P < 0.0001 with the Spearman correlation coefficient and Ira = 4.25 * PWV + 23.54). Conclusions: All the results suggest that the theoretical model and the new index could give a reliable estimate of local arterial stiffness.
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