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Letter to the editor

Why the cardiovascular studies should start with the radial oscillation of arterial wall rather than from axial flow motion of blood

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Most hemodynamic studies of the ventricular-arterial (VA) system focused on the motion of the blood and utilized the Navier- Stokes equation as the starting momentum equation by taking the arterial wall merely as the boundary. Some important forces arising from the oscillatory elastic arterial wall actually have dominant effect on the blood motion [2]; hence not taking these forces into the first order account causes the resulting flow wave models physically incorrect. Due to the high dissipation associated with blood flow, these blood flow models are also physiologically unrealistic [4]; they cannot explain the high efficiency of the VA system and the fact that the arterial pulse can reach the far ends of the system.

We built a different hemodynamic theory by considering the VA system as an irrigation system that supplying coupled distributed steady pulsatile hydraulic pressure driving forces to distribute blood. A PR wave equation [2] that took the arterial wall, not the blood, as the major wave medium may manifest the concept of Greek physician Galen [5] that arterial pulse is transmitted through its wall. This unique power saving mechanism of the VA system not only lowers the burden of the heart, but also makes the resonance behavior of the arterial system feasible [3, 4]. A multi-rank model was then proposed to link the whole VA system together [1]. Our model provides a scientific basis for the collective behavior of the circulatory system to be reflected in the arterial pulse at any site of the body.

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References

[1] Y.Y. Lin Wang, W.K. Wang, A hemodynamics model to study the collective behavior of the ventricular-arterial system, J. Appl. Phys. 113 (2) (2013), 024702. https://doi.org/10.1063/1.4775754.
[2] Y.Y. Lin Wang, W.K. Wang, PR wave equation - a primary and realistic arterial pressure wave equation for quantitative and collective study of the cardiovascular system, Chin. J. Phys. 52 (2014) 916–926, https://doi.org/10.6122/CJP.52.916.
[3] Y.Y. Lin Wang, W.K. Wang, From a basic principle of evolution to the heart rate of mammals, J. Physiol. 593 (2015) 2241–2242, https://doi.org/10.1113/JP270123.
[4] Y.Y. Lin Wang, W.K. Sze, C.C. Lin, J.M. Chen, C.C. Houng, C.W. Chang, W.K. Wang, Examining the response pressure along a fluid-filled elastic tube to comprehend Frank's arterial resonance model, J. Biomech. 48 (2015) 907–910, https://doi.org/10.1016/j.jbiomech.2015.02.026.
[5] A. Pasipoularides, Galen, father of systematic medicine. An essay on the evolution of modern medicine and cardiology, Int. J. Cardiol. 172 (1) (2014) 47–58, https://doi.org/10.1016/j.ijcard.2013.12.166.

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