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A New Age-Related Model for Blood Stroke Volume

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Abstract

Background: A new computer model for systolic pulse waves within the cardiovascular system is presented. The emphasis was made on blood stroke volume (BS). The new waveform for pulse wave demands the re-computing of the BS. The authors showed the applicability of suggested model for arterial aging problem.

Metods: Suggested model is based on the well-known Korteweg-de Vries (KdV) equation. Instead of the common accepted solitary wave, the periodical cnoidal wave is used. Both waves are exact solutions of the KdV equation. The cnoidal waves are described by the Jacobi elliptic functions. Depending on a specific parameter called the elliptic module, m ($0 \le m \le 1$), these functions can be either harmonic or hyperbolic type.

Results: The explicit expression for the dimensionless BS was obtained. The dimensionless BS depends, as was found, on the elliptic module only. Dimensional analysis demonstrates the dimensionless BS has limited range of variation. This allows the direct estimation of elliptic module that turns out to be close but not exact equal to one. It is shown, that correct calculations of BS can not be done at m=1 (corresponds to simpler soliton model), and the periodicity of pulse waves has to be taken into consideration.

Conclusions: Only the cnoidal model with the limited wavelength provides the correct computing of the BS. The natural bounds of dimensionless BS were found for the first time.

Keywords: *systolic pulse waves, blood stroke volume, Korteweg-de Vries equation, cnoidal waves, solitons, dimensional analysis, aging arterial.*

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