A Study on the Characteristics Influencing the Pressure in the Inlet of a One Dimensional Model of Arterial Structure

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Forward blood pressure waves generated by heart contraction encounter many bifurcations and changes in the structure of the vessels, creating backward waves traveling towards the heart. The existence of backwards waves, their magnitude, and their effect on increasing the pressure measured in the aortic root has been recently revisited with an ongoing debate, particularly for the outstanding question about the origin of the reflected wave present in the aortic root, and how far the reflected waves could travel in the arterial tree. The aim of this study is to investigate how the generation of bifurcations affects the magnitude of reflected waves, and how far reflected waves can travel in the backward direction with a discernible magnitude.

The non-linear one-dimensional (1D) equations of blood flow in elastic tubes have been used to develop a computational model. This model is used to trace the waves as they travel along a branching system as a surrogate of the arterial system. A structure of 15 consecutive bifurcations is used in this study. A Gaussian-shaped pulse is injected into the terminal points of a series of bifurcations. There is an imposed reflection from one of the terminal points each time, while all the other terminal conditions are kept absorbent. The magnitude of the arrival waves in the mother tube is investigated. The pressure measured in the mother tube *P(M)* is compared against the pressure pulse that was inserted in terminal point of each daughter tube *P(D).*

The ratio Rp decayed exponentially when plotted against the generation of bifurcations (figure1). There is a 100 percent decrease in the magnitude of the reflection waves originating from the first generation of bifurcations compared to the magnitude of the waves originated in the second generation of bifurcations.

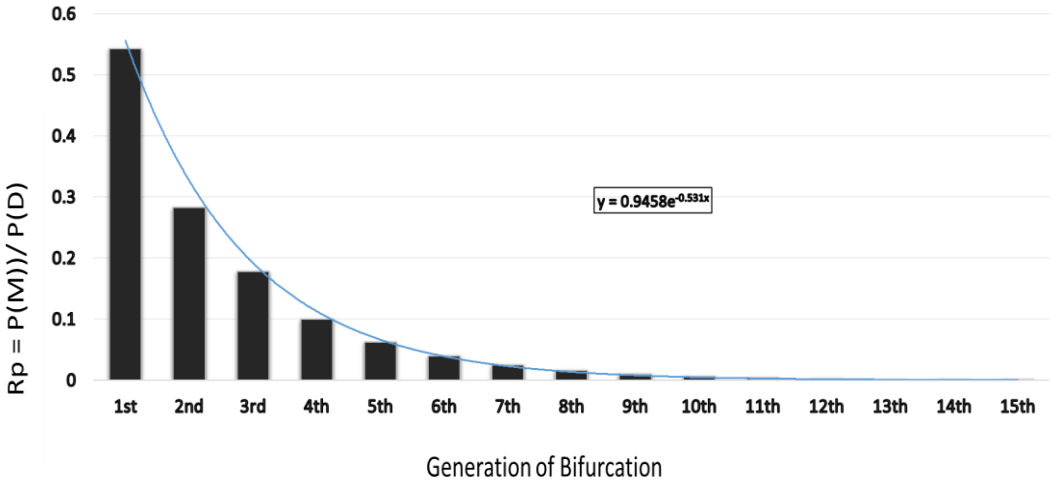

Figure 1. Ratio of the measured pressure in the mother tube P(M) over pressure measured in the Daughter tubes P(D) in 15 generation of bifurcations

A significant decrease in the amplitude of the reflected wave reaching to the root of bifurcations is evident in the simulations. For a large number of bifurcations, as is the case *in vivo*, single reflections originating at the periphery may not be discernible at the aortic root.