JURA
Journal of Undergraduate Research in Alberta

USING THE RESERVOIR WAVE APPROACH TO STUDY THE HORIZON EFFECT

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INTRODUCTION

Differing theories and models have been explored in the field of arterial hemodynamics in an effort to better understand how the blood flows in the body.

The existence of discrete reflection sites remains a source of disagreement. As a wave proceeds along an artery, any local change in impedance will result in partial reflection. Thus, because of the great complexity of the arterial system, it has been suggested that no distinct reflector sites should exist. On the other hand, there is recent experimental evidence using the reservoir-wave approach (RWA) that implies discrete positive and negative reflection sites. The pattern of wave propagation and reflection is plausible, as are the modifications produced by pharmacologic interventions [1].

The classical, frequency-domain, "impedance analysis" approach uses Fourier analysis to break down pressure and flow waveforms into summations of sinusoids, resulting in an impedance spectrum [2].

The RWA is a novel alternative, positing that measured pressures and flows are the instantaneous sums of "excess" (wave-related) and reservoir (volume-related) components [2].

The "Horizon Effect" (HE) [3] implies that a reflector site can never be reached no matter how far into the periphery one measures (Figure 1). As such, it supports the idea that there are no distinct reflector sites.

Measuring peripheral pressure and flow and using the RWA, the purpose of this study was to evaluate the HE and the question of fixed reflector sites.

METHODS

Eight anesthetized pigs were catheterized and pressure and flow were measured simultaneously at 4 locations: the aortic root and the brachial, carotid and renal arteries. Pharmacologic interventions were used to manipulate propagation and reflection patterns. MatLab (The MathWorks Inc., Natick, MA) was used to calculate the reservoir pressure, the local wave speed and to carry out wave intensity analysis (WIA) to obtain the forwards and backwards components of pressure.

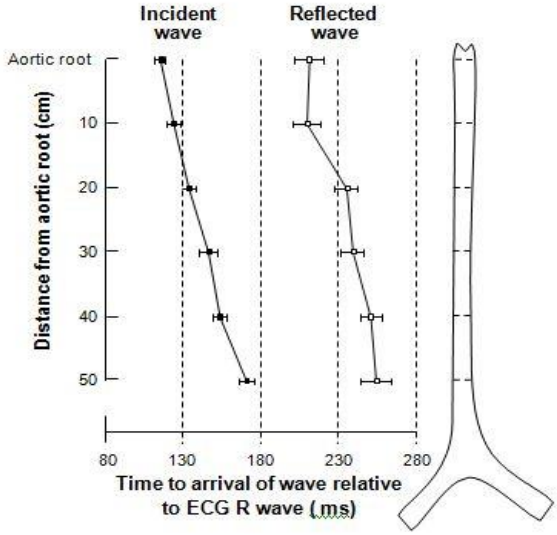

Figure 1: The difference in arrival time between the reflected wave (open marker) and the incident wave (closed marker) stays constant as the measuring site is moved down the aorta [3].

RESULTS

Analysis has been completed on 4 of the 8 animals studied. Each showed minimal backward wave activity at the aortic root and in the carotid artery. However, in the brachial and renal arteries, no backward waves could be detected.

DISCUSSION AND CONCLUSIONS

Backward waves were scarcely detected in the periphery using either the RWA or classical analysis. This may suggest that the pig model was inappropriate to study the HE. Porcine anatomy does not allow measurement at remote peripheral sites and reflection sites cannot be studied if no reflections are to be found. Further analysis of the data is needed before more definitive conclusions can be made.

REFERENCES

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