3D RECONCTRUCTION OF CORONARY ANATOMY USING OPTICAL COHERENCE TOMOGRAPHY & ANGIOGRAPHY

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Introduction

Detailed analysis of flow characteristics could help us understand the underlying principles that are responsible for energy loss in the coronary arteries. Patient-specific modelling of coronary flow, however, is a challenge as CT or MRI does not offer high enough resolution for accurate reconstruction of the coronaries. Our objective was to develop a reconstruction method using Optical Coherence Tomography (OCT) scans paired with angiography. The resulting 3D model was implemented in computational fluid dynamics (CFD), and the predicted pressure and velocities were compared with *in vivo* patient data.

Methods

Patient recruitment and 3D reconstruction process

- 19 patients (21 coronary lesions) imaged using angiography and OCT
- Custom-developed Matlab algorithm was used to produce the 3D model (Figure 1).

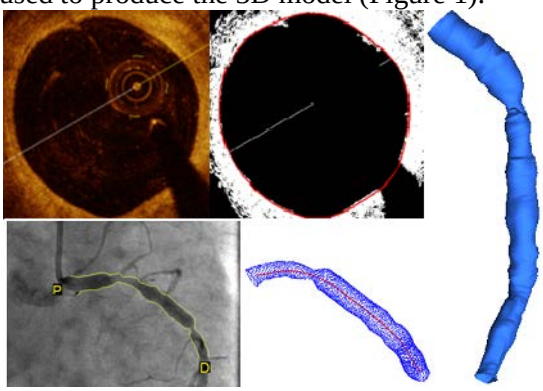

Figure 1: Reconstruction of coronary anatomy combining OCT (top) with angiography (bottom). Final 3D reconstruction shown left.

Simulation set up

- Navier-Stokes eqs for 3D laminar flow
- Flow resistance defined by patient-specific pressure and velocity boundary conditions (measured in cath lab)
- Result: distal pressure waveforms (Pd)

Results

Comparison of predicted and measured Pd

Figure 2 shows the Pd waveforms as predicted by CFD superimposed over the measured Pd waveforms. Given the rigid wall assumption, the correlation achieved (mean **r = 0.9424**, n = 21) is very high, showing that the new reconstruction method can capture the coronary flow patterns with good accuracy.

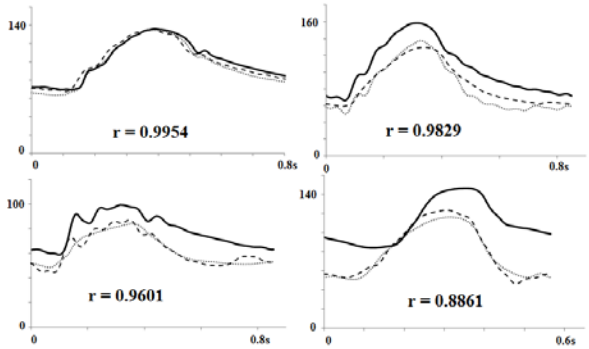

Figure 2: Measured (grey line) and predicted (dashed line) Pd waveforms (aortic pressure in black for reference) for four cases.

Discussion

There is great interest in creating realistic, patient-specific models of coronary anatomy that can have clinical applications. A new reconstruction algorithm allowing high fidelity representation of coronary anatomy has been developed. The new models can be used in CFD simulations to better examine the mechanisms of energy loss in coronary artery stenoses.

References

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