

Accepted Manuscript

Experimental and numerical methodology to analyze flows in a coronary bifurcation

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PII: S0997-7546(16)30653-7

DOI: <https://doi.org/10.1016/j.euromechflu.2017.09.009>

Reference: EJMFLU 3211

To appear in: *European Journal of Mechanics / B Fluids*

Received date: 29 December 2016

Revised date: 6 April 2017

Accepted date: 14 September 2017

Please cite this article as: E. Doutel, J. Carneiro, J.B.L.M. Campos, J.M. Miranda, Experimental and numerical methodology to analyze flows in a coronary bifurcation, *European Journal of Mechanics / B Fluids* (2017), <https://doi.org/10.1016/j.euromechflu.2017.09.009>

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1 **Experimental and numerical methodology to analyze flows in a** 2 **coronary bifurcation**

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7 **Abstract**

8 Atherosclerosis is frequently associated to disturbed flow patterns in regions of the arteries with
9 geometrical complexity. To understand atherosclerosis development, the hydrodynamic
10 characteristics of the blood flow in arteries, such as the velocity and wall shear stress, must be
11 studied and quantified. To investigate the local hemodynamics in the Left Coronary Artery
12 (LCA) bifurcation, a methodology combining numerical (CFD) and experimental methods
13 (μ PIV and streak photography) was designed. A whole volume μ PIV experimental method was
14 developed and applied to a simplified 3D phantom of the LCA bifurcation. The experimental
15 and numerical results prove to be in a good agreement. Implications of a deviation from
16 Murray's law and the effect of different Reynolds numbers in flow behaviour were also
17 explored. A streak line photography method was used to complement the methodology and
18 analyse the flow patterns. When the deviation from Murray's law is evident, secondary flows
19 are observed and they intensify as the Reynolds number increases. The secondary flows are
20 visible in regions of low wall shear stresses (WSS). The present work reinforces, with numerical
21 and experimental support, the importance of flow patterns that are relevant for prevention and
22 treatment of atherosclerosis.

23
24 Keywords: left coronary artery; computational fluid dynamics; hemodynamics; in vitro studies; helical
25 flow; atherosclerosis

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