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Letter to the Editor

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Dear Editor,

We have read the research article “Computing pulsatile blood flow of coronary artery under incomplete boundary conditions” by WenJun Pu et al. published in *Medical Engineering and Physics*, with interest. The authors compute pulsatile coronary blood flow using a 3D reconstruction in diseased arteries (1). They conclude that ignoring the effect of inertia may significantly affect the accuracy of computed flow, providing important new evidence for the development of computational tools aimed at improving diagnosis and treatment of ischaemic heart disease. This finding is consistent with work conducted by our own group using 1 dimensional models of coronary flow (2).

We would however, dispute the authors’ claim that virtuQ, a 3D model of absolute coronary flow (3), necessitates exclusion of side branch flow due to the absence of distal pressure boundary conditions at side branches. While the original description of the virtuQ technique did not include side branch flow, morphometric scaling laws have now been leveraged to include this in simulations. Murray’s law of branching mass transport networks dictates that single lumen geometries of coronary arteries will contain taper localised to bifurcation points (4), at which, proportional flow (Q) splitting (or terminal vessel resistance (R)) may be given by:

$$D \; \alpha \; Q^c \qquad D \; \alpha \; \frac{1}{R^c}$$

Where D denotes vessel diameter. C denotes the flow diameter scaling exponent, this was 3.0 in Murrays original law, but challenged by the Huo-Kassab law which suggested a value of 2.33 (5). A recent meta-analysis in mammalian coronary arteries supported the Huo-Kassab law, deriving an exponent of 2.39 (6). This exponential law allows for flow splitting at bifurcation points, without the need for an invasively measured side branch pressure boundary condition (7) and can also be localised to points of vessel bifurcation (8). While it may be an interesting question to determine whether an invasively measured distal boundary at side branches improves model accuracy, techniques currently exist to allow side branch flow quantification without such invasive measurements. Furthermore, these pressure measurements in coronary side branches would likely be prohibitively time-consuming and too technically challenging for widespread uptake.

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