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Fluid dynamics of coarctation of the aorta: analytical solution, *in vitro* validation and *in vivo* evaluation ZAHRA KESHAVARZ-MOTAMED, Institute for Medical Engineering and Science, Massachusetts Institute of Technology; Harvard-MIT Division of Health Sciences and Technology — Coarctation of the aorta (COA) is a congenital heart disease corresponding to a narrowing in the aorta. Cardiac catheterization is considered to be the reference standard for definitive evaluation of COA severity, based on the peak-to-peak trans-coarctation pressure gradient (PtoP TCPG) and instantaneous systolic value of trans-COA pressure gradient (TCPG). However, invasive cardiac catheterization may carry high risks given that undergoing multiple follow-up cardiac catheterizations in patients with COA is common. The objective of this study is to present an analytical description of the COA that estimates PtoP TCPG and TCPG without a need for high risk invasive data collection. Coupled Navier-Stokes and elastic deformation equations were solved analytically to estimate TCPG and PtoP TCPG. The results were validated against data measured in vitro (e.g., 90% COA: TCPG: root mean squared error (RMSE)= 3.93 mmHg; PtoP TCPG: RMSE= 7.9 mmHg). Moreover, the estimated PtoP TCPG resulted from the suggested analytical description was validated using clinical data in twenty patients with COA (maximum RMSE: 8.3 mmHg). Very good correlation and concordance were found between TCPG and PtoP TCPG obtained from the analytical formulation and in vitro and in vivo data. The suggested methodology can be considered as an alternative to cardiac catheterization and can help preventing its risks.

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