



Heart's Vortex: Intracardiac Blood Flow Phenomena

Ares Pasipoularides

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This outstanding resource provides a comprehensive guide to intracardiac blood flow phenomena and cardiac hemodynamics, including the developmental history, theoretical frameworks, computational fluid dynamics, and practical applications for clinical cardiology, cardiac imaging and embryology. It is not a mere compilation of the most up-to-date scientific data and relevant concepts. Rather, it is an integrated educational means to developing pluridisciplinary background, knowledge, and understanding. Such understanding allows an appreciation of the crucial, albeit heretofore generally unappreciated, importance of intracardiac blood flow phenomena in a host of multifaceted functional and morphogenetic cardiac adaptations.

The book includes over 400 figures, which were prepared by the author and form a *vital part of the pedagogy*. It is organized in three parts. Part I, *Fundamentals of Intracardiac Flows and Their Measurement*, provides comprehensive background from many disciplines that are necessary for a deep and broad understanding and appreciation of intracardiac blood flow phenomena. Such indispensable background spans several chapters and covers necessary mathematics, a brief history of the evolution of ideas and methodological approaches that are relevant to cardiac fluid dynamics and imaging, a qualitative introduction to fluid dynamic stability theory, chapters on physics and fluid dynamics of unsteady blood flows and an intuitive introduction to various kinds of relevant vortical fluid motions. Part II, *Visualization of Intracardiac Blood Flows: Methodologies, Frameworks and Insights*, is devoted to pluridisciplinary approaches to the visualization of intracardiac blood flows. It encompasses chapters on 3-D real-time and “live 3-D” echocardiography and Doppler echocardiography, CT tomographic scanning modalities, including multidetector spiral/helical dataset acquisitions, MRI and cardiac MRA, including phase contrast velocity mapping (PCVM), etc. An entire chapter is devoted to the understanding of post processing exploration techniques and the display of tomographic data, including “*slice-and-dice*” 3-D techniques and cine-MRI. Part II also encompasses an intuitive introduction to CFD as it pertains to intracardiac blood flow simulations, followed—in separate chapters—by conceptually rich treatments of the computational fluid dynamics of ejection and of diastolic filling. An entire chapter is devoted to fluid dynamic epigenetic factors in cardiogenesis and pre- and postnatal cardiac remodeling, and another to clinical and basic science perspectives, and their implications for emerging research frontiers. Part III contains an *Appendix* presenting technical aspects of the method of predetermined boundary motion, “PBM,” developed at Duke University by the author and his collaborators.

Key Features:

- Highly-illustrated content with informative, insightful figures and graphs
- Specialized focus on cardiac (patho-)physiology and intracardiac blood flow phenomena in health and disease, including interactions of intracardiac flow patterns with myocardial histoarchitectonics and cardiac morphology
- Powerful new pathophysiologic concepts using fluid dynamic reasoning and digital imaging-

- assisted, patient-specific computational fluid-dynamics
- Practical applications to physiological and clinical problems
 - Extensive coverage of imaging and diagnostics:
 - High-fidelity multisensor catheterization,
 - Angiographic, noninvasive imaging modalities, including:
 - Conventional and 3-D real-time and “live 3-D” echocardiography and Doppler echocardiography
 - CT tomographic scanning modalities, including multidetector spiral/helical dataset acquisitions
 - MRI and cardiac MRA

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