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On the Issue of Optimal Trans-Mitral Flow

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The mean value of 4 for the formation number appears to indicate the existence of a universal time scale that may describe the optimum range for trans-mitral flow during diastole. The statistical significance and importance of the narrow range of the formation number becomes obvious when one considers the broad spectrum of the ages and backgrounds of the test subjects. A low formation number might indicate poor volume efficiency due to low average velocity or a short diastolic period. A typical example can be found for the cases with dilated cardiomyopathy when decreased systolic function and increased cardiac chamber size is accompanied by reduced left ventricular wall motion, increased filling pressures and abnormal relaxation of heart muscle. A high value of Formation numbers can be indicative of a high heart rate which results in excessive mean velocities through the mitral valve. The results presented in Figure 1 indicate that the normal heart as a responsive system operates around a Formation number of approximately 4. Whether this base line has a significant fluid mechanical value is an important issue that needed to be addressed through an understanding of the vortex formation process. Gharib et al. (1998) showed that the formation number of 4 is directly related to the circulation saturation of forming vortex rings. Kruger and Gharib (2000) extended these studies to show that this range of formation number is associated with the optimal (maximum) impulse that can be produced by a forming vortex ring. These studies all indicate that perhaps the formation number of 4 is an effective parameter for defining an optimal range of trans-mitral flow dynamics. It is important to mention that other trans-mitral flow parameters such as peak E-wave to A-wave velocity ratio are not as robust as Formation number. In this report, we will discuss these parameters and other important aspects of Formation number in defining the optimal transmitral flow.

References

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