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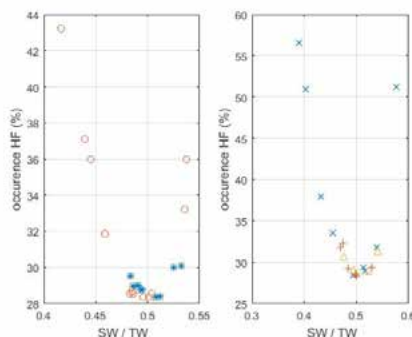
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A look at heart failure based on the study of end-systolic pressure-volume relation (ESPVR)

Rachad M Shoucri

Royal Military College of Canada, Canada

Parameters describing the linear and non-linear models of the end-systolic pressure-volume relation (ESPVR) in the heart ventricles have been derived, relations of these parameters with the ejection fraction (EF) have been obtained. The relations between the parameters of the ESPVR and EF can be applied to the study of the problem of heart failure with reduced or preserved EF (HFpEF). The results of this study show that important information concerning the problem of HFpEF can be derived from the parameters describing the ESPVR. Applications to clinical data published in the literature show the consistency of the mathematical formalism used to calculate the equation of the non-linear ESPVR in which formalism is based on the theory of large elastic deformation of the myocardium. The results presented in the figures show one possible application, the relation between the percentage occurrence of heart failure (HF) and the ratio SW/TW (SW=stroke work, TW=total area under the ESPVR). The results are presented on two figures for the purpose of clarity for five clinical groups: normal*, aortic stenosis o, aortic valvular regurgitation +, mitral regurgitation ^, miscellaneous cardiomyopathies x. Note that both curves have a minimum around $SW/TW \approx 0.5$. Note also that the normal group (*) appears near the minimum of the curve on the left hand side (corresponding to $EF \approx 0.67$). The case of aortic stenosis on the left hand side appears in three subgroups. Calculation indicates an optimal value of $SW/SW_x \approx 0.8$ (SW=stroke work, SW_x =maximum stroke work corresponding to a given ESPVR). The quantity $SWR=SW_x-SW$ is the stroke work reserve; we have calculated $SWR/SW \approx 0.25$ for $SW/TW \approx 0.5$.



Biography

Rachad M Shoucri completed his BSc in Electrical Engineering at Alexandria University, Egypt; MSc in Optical Physics and; PhD in Theoretical Physics at Laval University, Québec, Canada. After graduation in 1975, he worked for five years at the Hôpital Saint-Sacrement and the Institut de Cardiologie de Québec where he developed his current interest in Mathematical Physiology and in the application of mathematics in cardiology. Since 1981, he is working in Department of Mathematics and Computer Science at Royal Military College of Canada, Kingston, Ontario.

shoucri-r@rmc.ca

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