Detection of Systolic and Diastolic Durations on Cardiac Output and Arterial Pressures

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In coronary artery bypass graft patency research, the graft quality is often quantified by analysis of simultaneously recorded physiological signals such as graft flow, electrocardiogram, arterial pressure and cardiac output. From these recordings the diastolic filling and the pulsatility index can be estimated giving an indication of the quality of the graft and anastomosis. In this paper we present two methods to measure systolic and diastolic durations from arterial pressure and cardiac output recordings. The methods located the systolic and diastolic start which was defined as extrema or zero-crossings. The signals were initially baseline filtered and a ruleset was applied to determine whether to choose the extrema or zero-crossing. The methods were evaluated by comparing the systolic and diastolic durations between the two methods in 96 measurement sets from 8 pigs undergoing bypass surgery. Furthermore we compared diastolic filling and pulsatility index. We obtained a mean difference between arterial pressure and cardiac output, in systolic and diastolic duration of -119.84ms ($\pm$78.82ms) and 118.57ms ($\pm$ 97.49). The correlation between systolic and diastolic duration was 30.97% and 80.54% respectively. For diastolic filling and pulsatility index we obtained a mean difference between arterial pressure and cardiac output of -13.36% ($\pm$ 11.47) and -0.03 ($\pm$1.90) respectively, with correlation coefficients of 56.19% and 56.29%. The results indicate a correspondence between the systolic and diastolic detection of cardiac output and arterial pressure, which indicates that the developed methods work. However, there is a better correlation between the diastolic durations and a bias between the two measurements, which is expected as systolic start for arterial pressure signals is delayed and the systolic period is shorter compared to cardiac output. The use of more than one technique to detect the systolic and diastolic can be used to ensure more stable results when performing coronary graft patency assessments.