# Quantitative assessment of regional wall motion abnormalities using dual-energy digital subtraction intravenous ventriculography

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Healthy portions of the left ventricle (LV) can often compensate for regional dysfunction, thereby masking regional disease when global indices of LV function are employed. Thus, quantitation of regional function provides a more useful method of assessing LV function, especially in diseases that have regional effects such as coronary artery disease.

This dissertation studied the ability of a phase-matched dual-energy digital subtraction angiography (DE-DSA) technique to quantitate changes in regional LV systolic volume. The potential benefits and a theoretical description of the DE imaging technique are detailed. A correlated noise reduction algorithm is also presented which raises the signal-to-noise ratio of DE images by a factor of 2-4.

Ten open-chest dogs were instrumented with transmural ultrasonic crystals to assess regional LV function in terms of systolic normalized-wall-thickening rate (NWTR) and percent-systolic-thickening (PST). A pneumatic occluder was placed on the left-anterior-descending (LAD) coronary artery to temporarily reduce myocardial blood flow, thereby changing regional LV function in the LAD bed.

DE-DSA intravenous left ventriculograms were obtained at control and four levels of graded myocardial ischemia, as determined by reductions in PST. Phase-matched images displaying changes in systolic contractile function were created by subtracting an end-systolic (ES) control image from ES images acquired at each level of myocardial ischemia. The resulting wall-motion difference signal (WMD), which represents a change in regional systolic volume between the control and ischemic states, was quantitated by videodensitometry and compared with changes in NWTR and PST.

Regression analysis of 56 data points from 10 animals shows a linear relationship between WMD and both NWTR and PST: WMD = $-$2.46 NWTR + 13.9, r = 0.64, p $<$ 0.001; WMD = $-$2.11 PST + 18.4, r = 0.54, p $<$ 0.001. Thus, changes in regional ES LV volume between rest and ischemic states, as measured using the described imaging technique, appear linearly related to changes in wall-thickening, as measured using transmural ultrasonic crystals. This type of image analysis may prove useful in a variety of clinical and research applications and further investigation is proposed.