

Title: POST-SYSTOLIC SHORTENING: A SENSITIVE INDEX OF MYOCARDIAL ISCHEMIA DURING HALOTHANE ANESTHESIA

Authors: B. J. Leone, M.D.; R. M. Norris, M.D., A. Safwat, M.D., and P. Foëx, M.D. D.Phil.

Affiliation: Nuffield Department of Anaesthetics, Oxford, U.K. OX2 6HE

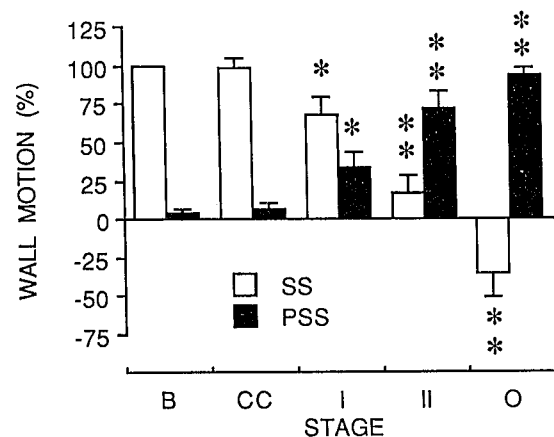
Decreases in regional systolic shortening (SS) occur with, and are often used as an index of, regional myocardial ischemia (1). However, SS in normal myocardium decreases with increasing concentrations of inhalational anesthetics (2). Changes in left ventricular relaxation occur with ischemia and are associated with continued contraction by the ischemic segment during relaxation, termed post-systolic shortening (PSS) (3). In contrast to SS, PSS does not increase in normal myocardium with increasing concentrations of inhalational anesthetics (2). We studied the changes in PSS with graded reductions in coronary blood flow to determine whether PSS is as sensitive as SS to regional myocardial ischemia with a constant depth of anesthesia.

Methods: Eight mongrel dogs were anesthetized with halothane (1% end-tidal) and a left thoracotomy performed. The heart was exposed and suspended in a pericardial cradle, and the animals instrumented so as to measure aortic and left ventricular (LV) pressures, aortic flow and stroke volume (SV), and left anterior descending coronary artery (LAD) blood flow (CBF). Two pairs of 5 MHz sonomicrometry crystals were implanted parallel to the LV short axis in apical (LAD-supplied) and basal (non-LAD-supplied) subendocardium. A micrometer-controlled snare was placed distal to the LAD flow probe. Hemodynamic and regional myocardial function data were recorded during baseline conditions (B), LAD critical constriction (CC) (defined in this study as minimal to absent pulsatile LAD flow with minimal deterioration of LAD regional function), the first evidence of LAD PSS as seen on an LV pressure-dimension loop (I), obvious hypokinesia (II), and total LAD occlusion (O). SS (expressed as a percentage of baseline) and PSS (expressed as a percentage of total segmental shortening) were calculated. The results were analyzed by two-way analysis of variance (parametric or non-parametric, as appropriate) and independent paired t-tests or Wilcoxon matched pairs test between progressive stages of ischemia only. $P < 0.05$ was considered significant.

Results: Global hemodynamic values were unchanged until O, when only HR (+5%), SV (-10%) and LV end-diastolic pressure (+28%) significantly changed. CBF significantly decreased with each stage of ischemia

(B, $100\% \pm 0$; CC, $70.6\% \pm 7.5$; I, $58.4\% \pm 10.5$; II, $41.0\% \pm 8.1$; O, $0\% \pm 0$; all $P < 0.01$ vs preceding stage). LAD SS significantly decreased with each stage of progressive ischemia after CC. This was accompanied by significant increases in LAD PSS (Fig.).

Discussion: PSS was found to be as sensitive as SS to regional myocardial ischemia. Because SS changes with both ischemia and anesthetic depth, this index becomes less specific for the detection of intraoperative myocardial ischemia. PSS, which is unaffected by increasing concentrations of volatile anesthetics, is a more specific index of regional myocardial ischemia.



* denotes $P < 0.05$, ** denotes $P < 0.01$

References: 1) Vatner SF: Correlation between acute reductions in myocardial flow and function in conscious dogs. *Circ Res* 47:201-207, 1980.

2) Francis CM, Foëx P, Lowenstein E, Glazebrook CW, Davies WL, Ryder WA, Jones LA: Interaction between regional myocardial ischaemia and left ventricular performance under halothane anaesthesia. *Br J Anaesth* 54:965-980, 1982.

3) Doyle RL, Foëx P, Ryder WA, Jones LA: Differences in ischaemic dysfunction after gradual and abrupt coronary occlusion: effects on isovolumic relaxation. *Cardiovasc Res* 7:507-514, 1987.