Title: CORONARY VASODILATORS ENFLURANE, ISOFLURANE AND DIPYRIDAMOLE INDUCE MYOCARDIAL OXYGEN SHUNTING

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INTRODUCTION: Coronary vasodilation induced by pharmacologic agents uncouples myocardial blood flow (MBF) from metabolic demands and disrupts autoregulation. The volatile anesthetics isoflurane (ISO) and enflurane (ENF) have been shown to act as coronary vasodilators, impairing MBF autoregulation and improving myocardial oxygen balance as reflected by an increase of coronary-venous O_2 hemoglobin saturation[1] .However, an increased coronary-venous pO_2 does not necessarily reflect a better tissue oxygenation, as has been demonstrated during ISO[2] or dipyridamole (DIP) administration[3]. We therefore compared the effects of the coronary vasodilators ENF, ISO, and DIP on myocardial oxygen balance and on myocardial oxygen pressures, the latter determined by means of a platinum multiwire surface electrode (MDO)[4] .

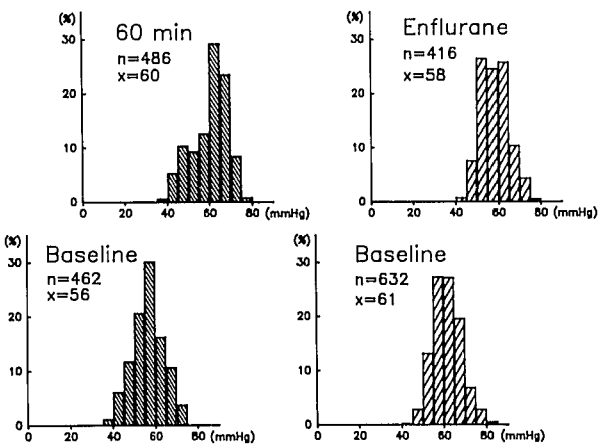
METHODS: The study was performed in 24 mongrel dogs anesthetized with a narcotic (piritramid). One control group (n=5) and three groups with coronary vasodilators (ENF: n=6, ISO: n=8, DIP: n=5) were tested. A highly flexible silicon caoutchouc disc was fixed with atraumatic sutures on the surface of the left ventricle to serve as an electrode holder for the MDO. To obtain representative pO_2 -histograms 100 single tissue-pO_2 -values were registrated prior to each MBF measurement. MBF was determined by radioactive MS technique. Pressures were measured in the left atrium and the aorta. Blood gases and O_2 -contents were determined in arterial and coronary-sinus blood samples.

Experimental protocol: Following the preparation period, animals were allowed to stabilize for 30 min before baseline values were obtained. ENF or ISO were administered in equianesthetic end-tidal concentrations of 1.1 and 0.7 Vol%, respectively, and measurements repeated after 1 hour. In the DIP animals 0.4-0.5 mg/kg DIP were slowly injected and measurements repeated after 20 min. The animals of the control group received no coronary vasodilators, measurements were repeated after 1 hour.

Statistics: Mean values ± SEM; Wilcoxon matched pairs signed rank test; Kruskal-Wallis test.

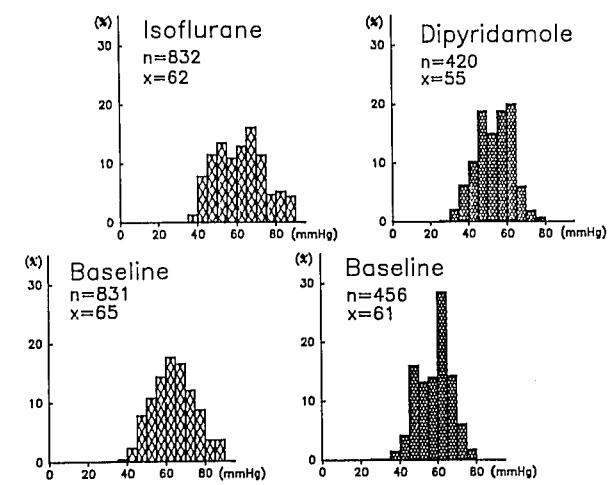
RESULTS: No significant changes occurred in the control animals. Mean aortic pressure decreased to 69 ± 6 , 73 ± 4 and 67 ± 5 mmHg in ENF, ISO, and DIP animals, respectively. MBF decreased with ENF (105 and 86 ml/min/100g), was essentially unchanged with ISO (99 and 119) and increased with DIP (100 and 404). The subendocardial to subepicardial blood flow ratio remained unchanged in all groups. Coronary vascular resistance decreased significantly in all three coronary vasodilator groups. Coronary-venous pO_2 remained unchanged with ENF but increased by 22% with ISO and by 68% with DIP. The myocardial O_2 -delivery to consumption ratio increased by 6% with ENF, by 47% with ISO, and by 280% with DIP. Myocardial surface tissue pO_2 (shown as pO_2 -distribution curves in the figure) remained unchanged in the control, ENF and ISO animals but was slightly decreased in the DIP group.

DISCUSSION: All coronary vasodilators, ENF, ISO, and DIP disrupted MBF autoregulation to different extents in this study, increasing MBF out of proportion to myocardial metabolic demands. However, this potentially beneficial effect was not accompanied by an increase in myocardial



PtO_2 .As no transmural redistribution of MBF occurred, shunting of O_2 is the most likely explanation. As MS could not be detected in the coronary-venous reference samples, we assume that functional shunting occurred on the microcirculatory level during application of the coronary vasodilators.

We conclude: 1. Myocardial oxygen balance or coronary/venous pO_2 are only poor parameters for tissue oxygenation. 2. Coronary vasodilation by ENF, ISO and DIP induces functional shunting of O_2 in the microvasculature.



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