

Furosemide and Systemic Circulation during Severe Exercise

M. MANOHAR

Department of Veterinary Biosciences, College of Veterinary Medicine, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, U.S.A.

Summary

Distribution of cardiac output was studied in 11 healthy adult grade ponies using radio-nuclide labeled 15 μm diameter microspheres injected into the left ventricle. Measurements were made at rest, during severe exercise (SE) without furosemide, as well as during SE 10 min and 120 min after intravenous furosemide administration (1.0 mg/kg). Renal and splanchnic organ perfusion was also studied in 9 splenectomized ponies at rest, sub-maximal and maximal exercise. During SE, heart rate, cardiac output, mean aortic pressure, and $\dot{V}O_2$ were 220 ± 4 beats/min, 720 ± 44 ml/min/kg, 169 ± 4 mm Hg, and 126 ± 9 ml O_2 /min/kg, respectively. During SE blood flow to cerebellar gray matter, pons, and medulla increased despite marked hypocapnia and acute hypertension, but in other brain regions blood flow was unchanged. With SE adrenal blood flow increased, but in the kidneys, spleen, pancreas, small intestine, and colon intense vasoconstriction caused blood flow to decrease precipitously. During SE, blood flow in the diaphragm, intercostal muscles, gluteus medius, biceps femoris, triceps brachii and longissimus dorsi muscles increased. It is concluded that SE caused redistribution of blood flow away from kidneys and splanchnic viscera; the latter responded homogeneously. Furosemide administration caused mean aortic pressure to decrease significantly from pre-furosemide SE value but heart rate, $\dot{V}O_2$, cardiac output and muscle blood flows remained similar for SE performed without and with furosemide. At 120 min post furosemide, vasoconstriction intensified in the kidneys, spleen and colon. Thus, furosemide did not modify the overall circulatory response to SE although the exercise-induced increase in blood pressure was somewhat attenuated. Renal and splanchnic organ perfusion of splenectomized ponies during maximal exercise behaved quite similarly to that in normal ponies but in contrast to normal ponies, sub-maximal exercise also caused a redistribution of blood flow away from renal and splanchnic tissues.

Index terms: Blood flow; splanchnic organs; kidneys; diaphragm; skeletal muscles; hemodynamics; splenectomy; microspheres.

Introduction

Strenuous exercise causes a dramatic increase in whole body oxygen consumption ($\dot{V}O_2$) which is met by both an augmentation of cardiac output and increased oxygen