Preconditioning
A New Concept About the Benefit of Exercise
Raúl J. Domenech, MD

Case presentation: A 45-year-old man with coronary artery disease is found to be in good condition after his annual medical checkup, and his doctor advises him to continue with the same drugs, a prudent diet, entertainment, and regular exercise; however, the patient is afraid that he will not have time to exercise regularly.

Benefits of Exercise
Clinicians have learned about the beneficial effects of several factors that may prevent a myocardial infarction (MI), including avoidance of smoking; treatment of high blood pressure, diabetes, dyslipidemia, and obesity; and regular performance of exercise. This last factor is based on epidemiological observations such as a decrease in the incidence of MI in men who perform heavy work; however, it is only in the last few years that the beneficial effect of exercise has obtained plausible explanations of its own, that is, apart from its effect on other risk factors. There are at least 3 distinct mechanisms for this benefit: (1) Improvement of endothelial function, thereby preventing atherosclerosis and coronary occlusion; (2) prevention of remodeling after MI through the expression of oxidative metabolism–related genes; and (3) delaying acute ischemic injury after a coronary occlusion by preconditioning.

Since the discovery of ischemic preconditioning by Murry et al in 1986, studies have appeared in the literature searching for its mechanisms and for alternative ways to trigger it. The concept that 1 or 2 episodes of brief ischemia (5 minutes in duration each), induced a few minutes or a few hours (early preconditioning) or 24 to 72 hours (late preconditioning or second window) before a prolonged coronary occlusion, followed by reperfusion substantially decreases the speed of the ischemic injury and limits infarct size is firmly established in all animal species studied in the experimental laboratory. It is one of the most powerful means of protecting the myocardium with the exception of early reperfusion. Several lines of evidence in coronary patients suggest but do not prove that the human myocardium is also protected by ischemic preconditioning. For example, preinfarction angina is associated with a smaller infarct size; a lower incidence of congestive heart failure, shock, and ventricular arrhythmias; and decreased mortality.

The protective effect of ischemic preconditioning can be reproduced by several drugs, thus avoiding the necessity of ischemic periods to induce it. Pharmacological preconditioning is potentially a strong therapeutic tool. For example, the opening of mitochondrial ATP-sensitive potassium channels appears to be an important mediator of ischemic preconditioning. The administration of a mitochondrial ATP-sensitive potassium channel opener before planned procedures that involve a potentially ischemic insult (such as coronary artery surgery or angioplasty in the presence of a non-
**References**


Preconditioning: A New Concept About the Benefit of Exercise
Raúl J. Domenech

Circulation. 2006;113:e1-e3
doi: 10.1161/CIRCULATIONAHA.105.569863
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2006 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/113/1/e1

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/