

Blood Glucose Regulation during Prolonged, Submaximal, Continuous Exercise: A Guide for Clinicians

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Abstract

Management of many chronic diseases now includes regular exercise as part of a viable treatment plan. Exercise in the form of prolonged, submaximal, continuous exercise (SUBEX; i.e., ~30 min to 1 h, ~40–70% of maximal oxygen uptake) is often prescribed due to its relatively low risk, the willingness of patients to undertake, its efficacy, its affordability, and its ease of prescription. Specifically, patients who are insulin resistant or that have type 2 diabetes mellitus may benefit from regular exercise of this type. During this type of exercise, muscles dramatically increase glucose uptake as the liver increases both glycogenolysis and gluconeogenesis. While a redundancy of mechanisms is at work to maintain blood glucose concentration ([glucose]) during this type of exercise, the major regulator of blood glucose is the insulin/glucagon response. At exercise onset, blood [glucose] transiently rises before beginning to decline after ~30 min, causing a subsequent decline in blood [insulin] and rise in blood glucagon. This leads to many downstream effects, including an increase in glucose output from the liver to maintain adequate glucose in the blood to fuel both the muscles and the brain. Finally, when analyzing blood [glucose], consideration should be given to nutritional status (postabsorptive versus postprandial) as well as both what the analyzer measures and the type of sample used (plasma versus whole blood). In view of both prescribing exercise to patients as well as designing studies that perturb glucose homeostasis, it is imperative that clinicians and researchers alike understand the controls of blood glucose homeostasis during SUBEX.

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Abbreviations: (ACSM) American College of Sports Medicine, (ADP) adenosine diphosphate, (AMPK) adenosine monophosphate kinase, (ATP) adenosine triphosphate, (cAMP) cyclic adenosine monophosphate, (CB) capillary blood, (E) epinephrine, (F26BP) fructose-2,6-bisphosphate, (FFA) free fatty acid, (GLUT) glucose transporter, (HSL) hormone-sensitive lipase, (IRS-1) insulin-receptor substrate-1, (NE) norepinephrine, (OGTT) oral glucose tolerance test, (PI3-K) phosphatidylinositol 3-kinase, (SUBEX) prolonged, submaximal, continuous exercise, (T2DM) type 2 diabetes mellitus, (VB) venous blood, (VO_{2max}) maximal oxygen uptake, (VP) venous plasma

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