Biosci Rep. 1985 May;5(5):393-400.

The role of high rates of glycolysis and glutamine utilization in rapidly dividing cells.

Newsholme EA, Crabtree B, Ardawi MS.

Abstract

The rates of utilization of both glucose and glutamine are high in rapidly dividing cells such as enterocytes, lymphocytes, thymocytes, tumour cells; the oxidation of both glucose and glutamine is only partial, glucose to lactate and glutamine to glutamate, alanine or aspartate; and these partial processes are termed glycolysis and glutaminolysis respectively. Both processes generate energy and also provide precursors for important biosynthetic processes in such cells. However, the rates of utilization of precursors for macromolecular biosynthesis are very low in comparison to the rates of partial oxidation, and energy generation per se may not be the correct explanation for high rates of glycolysis and glutaminolysis in these cells since oxidation is only partial and other fuels can be used to generate energy. Both the high fluxes and the metabolic characteristics of these two processes can be explained by application of quantitative principles of control as applied to branched metabolic pathways (Crabtree & Newsholme, 1985). If the flux through one branch is greatly in excess of the other, then the sensitivity of the flux of the low-flux pathway to regulators is very high. Hence, it is suggested that, in rapidly dividing cells, high rates of glycolysis and glutaminolysis are required not for energy or precursor provision per se but for high sensitivity of the pathways involved in the use of precursors for macromolecular synthesis to specific regulators to permit high rates of proliferation when required - for example, in lymphocytes in response to a massive infection