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Glucose Transport in Jurkat Cell: Concentration-Dependent Regulation

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In this study, a mechanism by which glucose level modulates glucose transport in Jurkat cells was investigated. Glucose uptake was more efficient in the cells cultivated in low glucose (2.5 mM) medium than that grown in high glucose (20 mM) medium. V_{max} (0.74 nmol/ 10^6 cells · min) of glucose uptake measured with the cells grown in the low glucose medium was higher than the one (1.06 nmol/ 10^6 cells · min) in the high glucose medium while K_m was almost consistent through the change of glucose levels, indicating the increase of glucose transporter number. However, the RT-PCR performed to assess the level of mRNA transcript of glucose transporters after 4-hour incubation showed that Jurkat cells express GLUT1 and 3 but not GLUT2, 4, or 5 and that the levels of the mRNA transcripts did not change with either glucose concentrations or the length of incubation time. This result was consistent with next result that the enhancement of glucose uptake could occur as early as 4 hours after the incubation in low glucose medium. These results suggest that the increase of glucose uptake observed in the cells grown in low glucose medium does not require the de novo synthesis of glucose transporters. To investigate if the enhance of glucose uptake was mediated by the activation of preexisting transporter, two different kinase inhibitors, SB202190 and wortmannin, were tested. SB202190, a p38MAPK inhibitor, was efficient to block the hypoglycemia-induced enhancement of glucose uptake while wortmannin, a PI3K inhibitor, was not successful. This result implies that the signalling pathway from the hypoglycemia to the increase of glucose uptake includes p38MAPK and its upstream kinase, AMPK. The incubation of cells in low glucose medium increases the intracellular AMP and active form of p38MAPK, showing a maximum level at 1 hour.

Taken together, these data suggest a signalling pathway for the hypoglycemia; a low glucose condition induces an enhancement in intracellular AMP level with the activation of AMPK, and then this in turn activates p38MAPK and finally glucose transporters.

Keyword : Glucose, Hyperglycemia, Hypoglycemia, AMPK