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Evaluating the Role of Cellular Swelling in Glutamine's Induction of Heat Shock Proteins

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The goal of this study was to elucidate the mechanism by which the conditionally essential amino acid glutamine (Gln) exerts cellular protection in acute infection or trauma. Specifically, this study tested the hypothesis that cellular uptake of Gln causes the cell to swell, which in turn induces expression of protective heat shock proteins (HSPs). Gln has previously been shown to accelerate expression of HSPs at least in part by providing a key metabolic building block for HSP synthesis. The full mechanism, however, is only incompletely understood. Previous work has demonstrated that the synthetic amino acid α -aminoisobutyric acid (α -AIB) exhibits a protective effect similar to Gln. Since both α -AIB and Gln are pumped into the cell by symport of sodium ions, both amino acids cause the cell to become hypertonic (i.e. to swell). This osmotic swelling is the only known effect α -AIB has on cells. In order to investigate what role cellular swelling might play in Gln's protective action, rat intestine cells (strain IEC-18) were treated with varying concentrations of Gln and α -AIB and subjected to heat shock at 43°C (stress) or 44°C (lethal). Cell viability was assayed and HSP induction was quantified by western blotting. It was determined that both Gln and α -AIB promote cell survival ($n=9$, $p<0.05$) and induce HSP25, HSP32, and HSP70 ($n=7$, $p<0.05$) in heat shocked cells relative to controls. Dose response curves for α -AIB and Gln were not significantly different. It was concluded that Gln's protective mechanism is mediated in part by causing cellular swelling.

Information about the Author:

Diana Stutzman is a fifth year senior at Valparaiso University, graduating this May with a Bachelor of Science in biochemistry. She presented her research during the summer of 2011 at the University of Colorado Anschutz Medical Campus with alumnus Dr. Paul Wischmeyer. Last year she presented data from research with Valparaiso University's Dr. Thomas Goynes during the summer of 2010. She is currently searching for a job in biomedical research and pharmaceutical development.

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