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Efficacy of Taurine in Altering Insulin and GABA Levels in a Pancreatic Beta Cell Line

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Release of insulin and glucagon from the endocrine pancreas is regulated by a number of neurotransmitters, including glutamate, GABA, and somatostatin. In the GABAergic system, GABA binding to $GABA_A$ receptors opens chloride channels on α cells, hyperpolarizing these cells thereby regulating glucagon release. We have shown that the taurine is a potent GABA agonist in the brain, hyperpolarizing post-synaptic neurons [1,2]. We have also previously shown that taurine treatment alters glucose homeostasis and pancreas remodeling [3] and alters insulin and GABA levels in a pancreatic β cell line (Hit-T15) [4]. Here, we test the efficacy of taurine in altering GABA and insulin levels in an insulinoma cell line (Rin-m).

The insulinoma cell line was grown in culture, treated with either 1 mM glucose (a concentration that does not promote Ca^{2+}-dependent exocytosis, 3 mM glucose (a concentrations know to promote Ca^{2+}-dependent exocytosis) and 1 mM taurine, which also promote Ca^{2+}-dependent exocytosis. Cells were treated for 24 hr, fixed and prepared for immunohistochemical analyses. The data were collected by confocal microscopy. Gain and offset for the acquisitions were identical for these three treatments. Statistical analyses were performed on intensity values using a one-way ANOVA and Dunn's post-test analyses. Following analyses, images were 3D rendered using Imaris Software (Bitplane Technology)

Our data show that 3 mM glucose statistically decreases insulin and GABA levels (Figs. 1, 2) compared to controls (Table 1). Conversely, 1 mM taurine appears to allow these cells to retain insulin, but to release GABA. While insulin and GABA are both stored in and released from large dense-core vesicles, GABA is also stored in and released from small synapse-like microvesicles. The data suggest that perhaps in insulinoma cells, taurine is eliciting its effects by inhibiting insulin release, but is promoting the release of GABA from the small synapse-like microvesicles.

References

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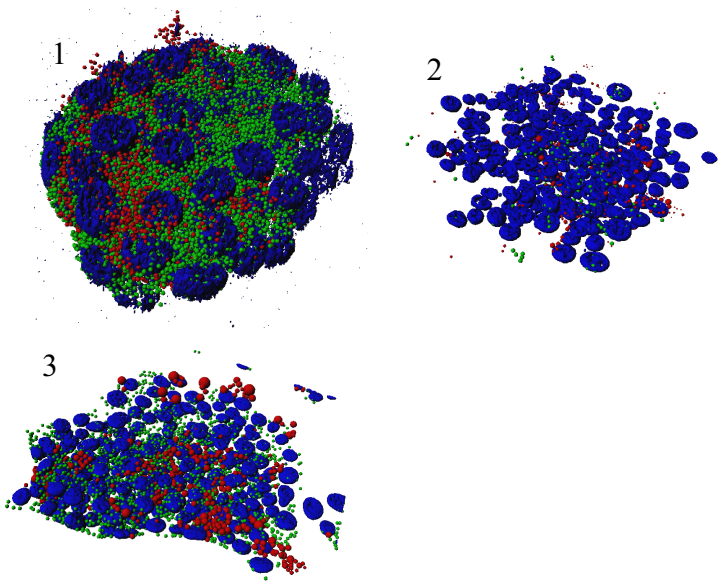
TABLE 1. Statistical analyses of relative intensities values for somatostatin and GAD67 immunoreactivity. Statistical p values are reported comparing data to 1 mM glucose, which serves as a control.

	Insulin		GABA	
1 mM glucose	Mean: 55.0 SE: ± 0.8		Mean: 60.6 SE: ± 2.4	
3 mM glucose	Mean: 43.9 SE: ± 0.9	p <0.01	Mean: 31.4 SE: ± 0.9	p <0.001
1 mM taurine	Mean: 103.6 SE: ± 1.9	p<0.001	Mean: 52.1 SE: ± 1.3	p<0.05

FIG. 1. Rin-m insulinoma cells treated with 1 mM glucose. Staining for insulin (green) and GABA (red). This treatment serves as a control for this cell line.
FIG. 2. Rin-m insulinoma cells treated with 3 mM glucose. Insulin and GABA levels are decreased with this treatment.
FIG. 3. Treatment with 1 mM taurine also significantly lowers both insulin and GABA.



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