

A Microfluidic Device for the Entrainment of islets of Langerhans

A microfluidic system was developed to produce sinusoidal waveforms of glucose to entrain oscillations of intracellular $[Ca^{2+}]$ in islets of Langerhans. The device uses two pneumatic pumps to deliver pulses of glucose and buffer to a mixing channel. The mixing channel acts as a low pass filter to attenuate these pulses to produce the desired final concentration. The cutoff frequency of the device can be adjusted by varying the length of the mixing channel. The value of the cutoff frequency, 0.061 Hz, was chosen at a value between the average pumping frequency and the low frequency (~ 0.0056 Hz) glucose waves that were needed to entrain islets of Langerhans. In this way, the pulses from the pumps were attenuated greatly, but the low frequency glucose waves were not. Using this microfluidic system, a total flow rate of $1.5 \pm 0.1 \mu\text{L min}^{-1}$ was generated and used to deliver sinusoidal waves of glucose concentration with a median value of 11 mM and amplitude of 1 mM to a chamber that contained an islet of Langerhans loaded with the Ca^{2+} -sensitive fluorophore, indo-1. Entrainment of the islets was demonstrated by pacing the rhythm of intracellular $[Ca^{2+}]$ oscillations to oscillatory glucose levels produced by the device. The system should be applicable to a wide range of cell types to aid in understanding cellular responses to temporally changing stimuli.

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Thursday, Sept. 23rd at 12:15 pm in Rm 1315

Analytical Seminar