Brain control of insulin

Mary ET Boyle, Ph. D.
Department of Cognitive Science
UCSD
1922 Insulin

1930’s glucagon

1960-1970’s somatostatin & pancreatic polypeptide

late 1980’s amylin

1997 ghrelin

pancreatic hormone discovery timeline

- α-cells glucagon
- β-cells insulin & amylin
- δ-cells somatostatin
- ε-cells ghrelin

F-cells pancreatic polypeptide

exocrine - acinus

unconditioned stimulus: insulin
unconditioned response: hypoglycemic
neutral stimulus: odor
conditioned response: hypoglycemic

Note: For this experiment a non-physiological level of insulin was injected.

Cephalic phase of insulin secretion:

- Autonomic and endocrine response **not** related to nutrient absorption.
- Humans: increase in circulating insulin in response to eating imaginary food (hypnosis).
- Sight, smell and expectation of food.
- Cephalic phase is also subject to being conditioned.

“A rapid increase in circulating insulin after oral glucose, before any increase in circulating glucose, has been shown in normal subjects.”

Blocking vagus nerve input abolishes cephalic phase of insulin release:

trimetophane (trimethaphane) blocks the descending parasympathetic activity nicotinic receptor blocker.

the importance of the cephalic phase of insulin response:

1-3% of the total insulin released after a meal is associated with the cephalic phase

glucose intolerant without cephalic phase

amount of insulin secreted during cephalic phase is inversely related to circulating glucose

insulin released during cephalic phase

circulating glucose

insulin administration right after food intake improves glucose tolerance in obese and type 2 diabetic individuals

Transport of circulating insulin from the blood to the CNS:

Insulin receptors are expressed in most tissues of the body. Insulin sensitive: liver, muscle, fat. Insulin insensitive: red blood cells. Insulin is transported across the blood brain barrier – insulin receptors are concentrated in brain areas involved in energy homeostasis.

Olfactory bulb, hypothalamus, pituitary, cerebellum, cortex and hippocampus, choroid plexus.
Review

Autonomic regulation of islet hormone secretion – Implications for health and disease

B. Ahrén
Department of Medicine, Lund University, Malmö, Sweden
Relationships Between the Autonomic Nervous System and
the Pancreas Including Regulation of Regeneration
and Apoptosis

Recent Developments

Takayoshi Kiba, MD, PhD