Lecture Notes

UJ | SCHOOL OF MED

PHYSIOLOGY

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019

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Physiology Lecture 12 FINALLY

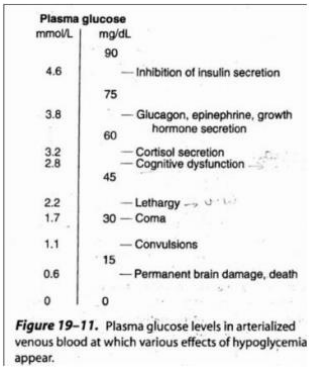


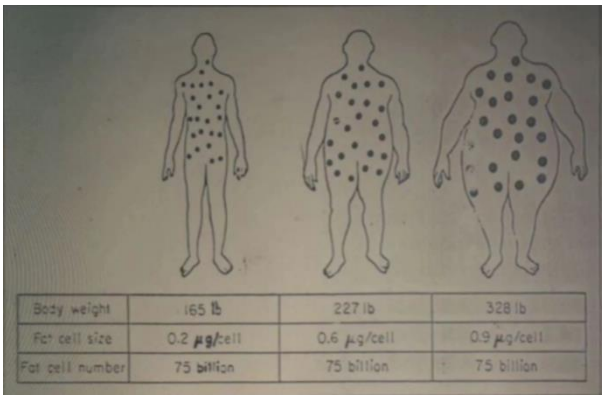
Figure 19–11. Plasma glucose levels in arterialized venous blood at which various effects of hypoglycemia appear.

- Coma will occur either because of HYPERGLYCEMIA (severe acidosis) OR HYPOGLYCEMIA (when plasma glucose level below is 40mg/dl).
- In Physiology, we can classify Diabetes into 2 types:
  i. insulin-dependent diabetes mellitus (or juvenile diabetes). This type is genetic. The problem resides in the pancreas where it is caused by a lack of insulin secretion. The usual onset occurs at the age of children.
  ii. non-insulin dependent diabetes mellitus (or maturity onset diabetes). It is caused by reduced sensitivity of target tissues to the metabolic effects of insulin.
- EXTRA :
  i. the hyperosmolar hyperglycaemic state is a metabolic complication of diabetes mellitus (DM) characterized by severe hyperglycaemia, extreme dehydration, hyperosmolar plasma, and altered consciousness. It most often occurs in type 2 DM .
  ii. genetic factors play a role in Diabetes type 2.
- Remember , the case of downregulation in which the insulin is either normal or high is regarding type 2 diabetes mellitus .

Type 1 Diabetes	Type 2 Diabetes
Young , Usually <20 years	Old , Usually > 40 years
Body mass is low - normal	Body mass is obese
Plasma insulin is low or absent (that is why they take insulin injections)	Plasma insulin is normal - high
Plasma glucose is increased	Plasma glucose is increased
Insulin sensitivity is normal	Insulin sensitivity is reduced
Therapy is insulin	Therapy is weight loss, thiazolidinediones, metformin, sulfonylureas, insulin

- Btw, early on, or in mild cases, diet, weight loss & exercise can be extremely effective in diabetes mellitus and may be the only treatment necessary.
- Notice the therapy part , insulin is a must for type one diabetes while it's a final choice for type 2, this means there are alternatives before using insulin.
  i. Diet & exercise.
  ii. Oral Drugs like the ones mentioned above to do one of the following (we can use 1 or more) → (multiple classes of drugs independently address different pathophysiologic features that contribute to the development of T2D) :
    1. increase the function of insulin sensitizers in the liver cells (e.g., biguanides)
    2. increase the function of insulin in the peripheral tissues (e.g., glitazones)
    3. increase the insulin secretion by the pancreas (e.g., sulfonylureas)
    4. decrease the absorption of glucose (e.g., alpha-glucosidase inhibitors)
- The duration of the treatment depends on the will of the person. If he returns to normal weight, then insulin will function normally again.
- If drugs, diet & exercises did not do their job, insulin will be given to type 2 diabetes mellitus patients. Be aware that this approach is limited in controlling elevated glucose levels or in controlling obesity that predisposes to this disease.

- If diabetes is untreated, it leads to:
  i. Renal failure.
  ii. Erectile dysfunction.
  iii. Blindness.
  iv. Coronary arterial diseases.
  v. Increased risk of cancer.
- Of these, Cardiovascular disease is the most prominent. For example, more than 65% of people with diabetes die from heart diseases.
- In fact, adults with diabetes have heart diseases death rate about 2-4 times higher than adults without diabetes.
- Also stroke accounts for approximately 20% of diabetes related deaths and risk for stroke is also 2-4 times higher among people with diabetes.
- Notice in the following figure , fat cell number doesn't change while fat cell size does change based on the body weight , so obesity is caused by increasing the size of the cell not the total number of fat cells .

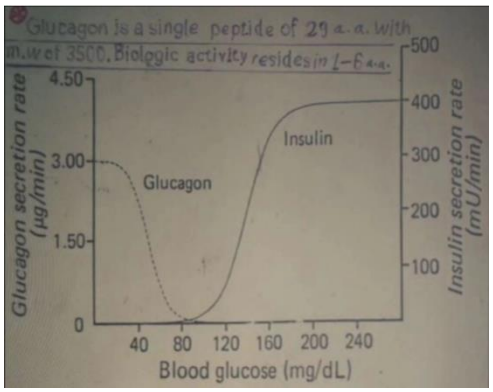


- NOTE : most people with obesity have diabetes (type II) but not always.
- How can you know if you are overweight or underweight?
  1) The relationship between Height and Weight: Your height minus 100 (in males) OR 105 (in females) = your normal weight. For example, if a man is 170 cm tall then we subtract it by 100 , his weight should be 70 kg.
  2) Measuring the waist: It must be less than half of your height.
  Then we calculate BMI (body mass index) :

$$BMI = \frac{(\text{weight in kilograms})}{\text{height in meters}^2}$$

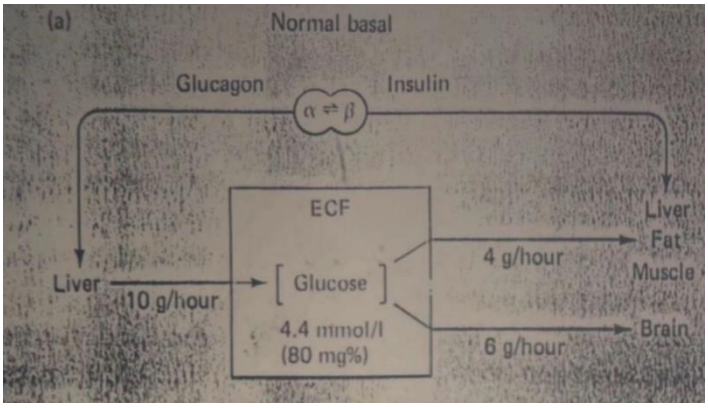
- Obesity is the most common and most expensive nutritional problem in the USA. A convenient and reliable indicator of body fat is the BMI. in the USA, 55% of the population are overweight and 22& are obese. the incidence of obesity is also increasing in other countries. Indeed, the Worldwatch Institute has estimated that although starvation continues to be a problem in many parts of the world, the number of overweight people in the world now is as great as the number of the underfed.

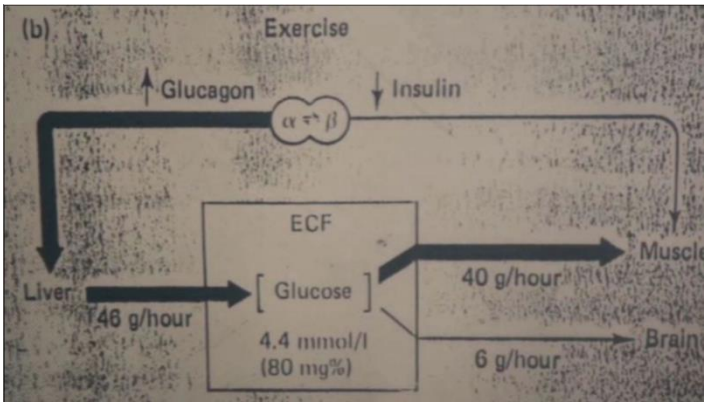
- Remember these hormonal interactions ☺ :
  i. Permissive hormonal interaction: For hormones to function normally, they need the action of another hormone. Like how the Adrenaline needs the thyroxine to function normally on lipids.
  ii. Synergism: When many hormones function together, they complement each other.
  iii. Antagonism: When a hormone opposes the action of another hormone. Like the case of Glucagon and Insulin. Insulin decreases blood glucose level while glucagon increases blood glucose level.
- Note : insulin is the only hypoglycaemic hormone and glucagon is the most potent hyperglycaemic hormone .

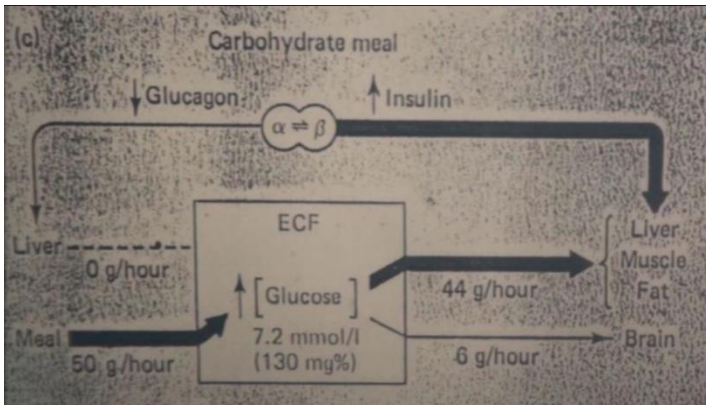


Glucagon

- It is the other major pancreatic islet hormone that is involved in the regulation of body fuel metabolism.
- Ingestion of protein appears to be the major stimulus to the secretion of glucagon.
- Glucagon's principal target tissue is the liver.
- Like insulin, glucagon is secreted first into the portal blood and is therefore anatomically well-positioned to regulate hepatic metabolism.
- Although the amino acids released by digestion of a protein meal appear to be the major glucagon secretagogue (means increase the secretion), glucagon's main actions on the liver appear to involve the regulation of carbohydrate and lipid metabolism.
- Glucagon is particularly important in stimulating glycogenolysis (which needs the action of cortisol - permissive) , gluconeogenesis & ketogenesis (so we can conclude it functions on carbohydrates, lipids & proteins).
- Glucagon doesn't act solely on the liver, but also has glycogenolytic action on cardiac and skeletal muscle and lipolytic action on adipose tissue, and it promotes the breakdown of proteins by several tissues.
- However, these effects on protein tissue breakdown appear to be more prominent when tissues are exposed to pharmacological concentrations of glucagon.
- At more physiological concentrations, the liver appears to be the major target tissue.
- A diagrammatic representation of the patterns of glucagon & insulin release at rest (A) , during exercise (B) , and following a meal of carbohydrate (C) and the consequential changes in glucagon distribution .
- It's very important to memorize the content of these figures .







Done By :

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