Homeostatic Control of Glucose

Scientific Foundations

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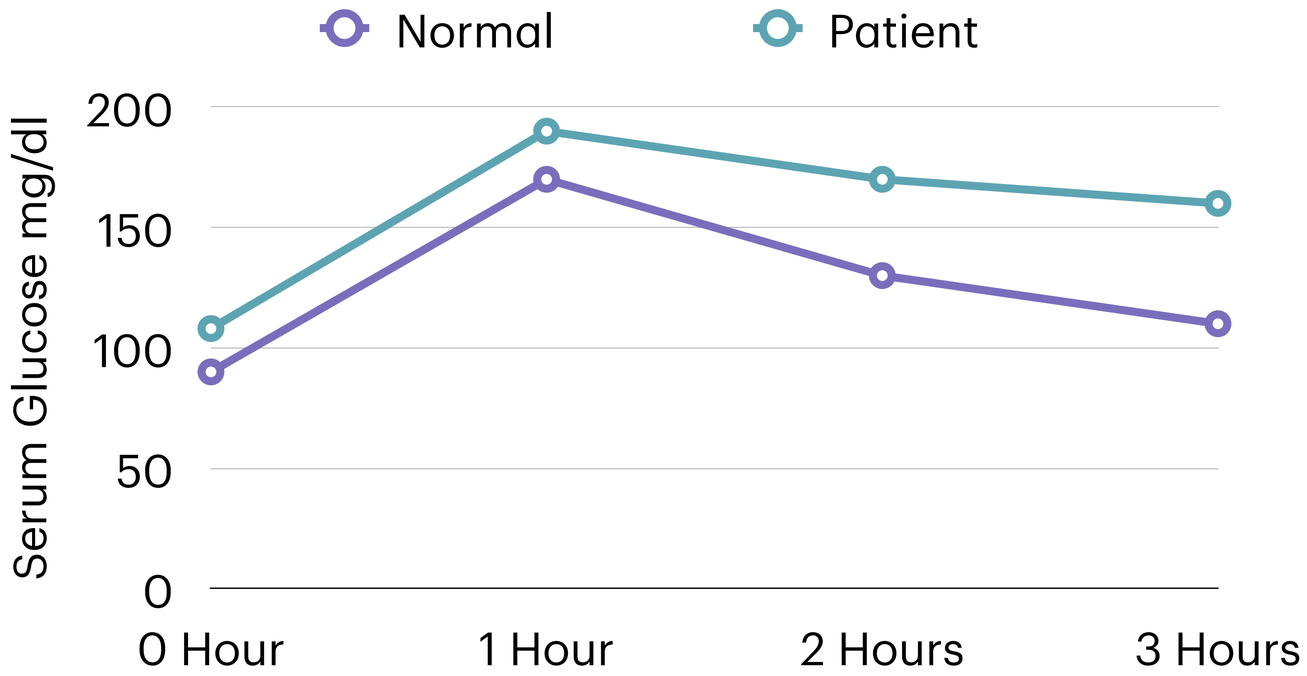
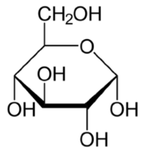
You are reviewing a patient's blood work after a routine checkup. You are concerned about the patient's blood glucose concentration and level of A1C:

- Glucose - 110 mg/dl (6.1 mmol/L)
- Hemoglobin A1c - 6%

You order a glucose tolerance test in which the patient fasts for at least 8 hours and then drinks a solution containing a set concentration of glucose. Blood samples are taken before drinking the solution and then at 1 hour, 2 hours, and 3 hours after drinking the solution. The results are shown below and compared to normal. What can you conclude from the test results?

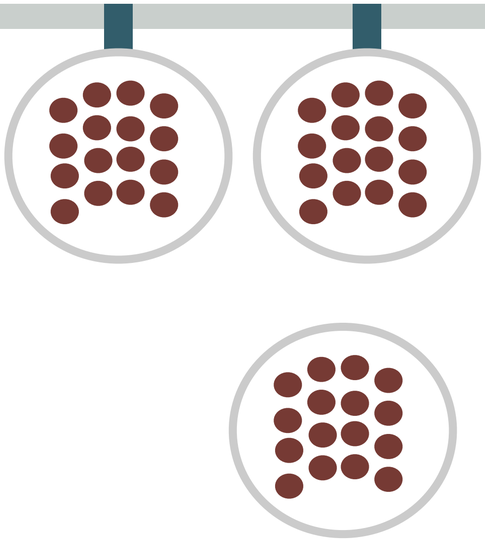


To lower serum glucose levels, β-cells release insulin when glucose concentrations rise.
How do β-cells detect glucose concentration and use that information to release insulin?
(Hint: they do not have a receptor for glucose.)

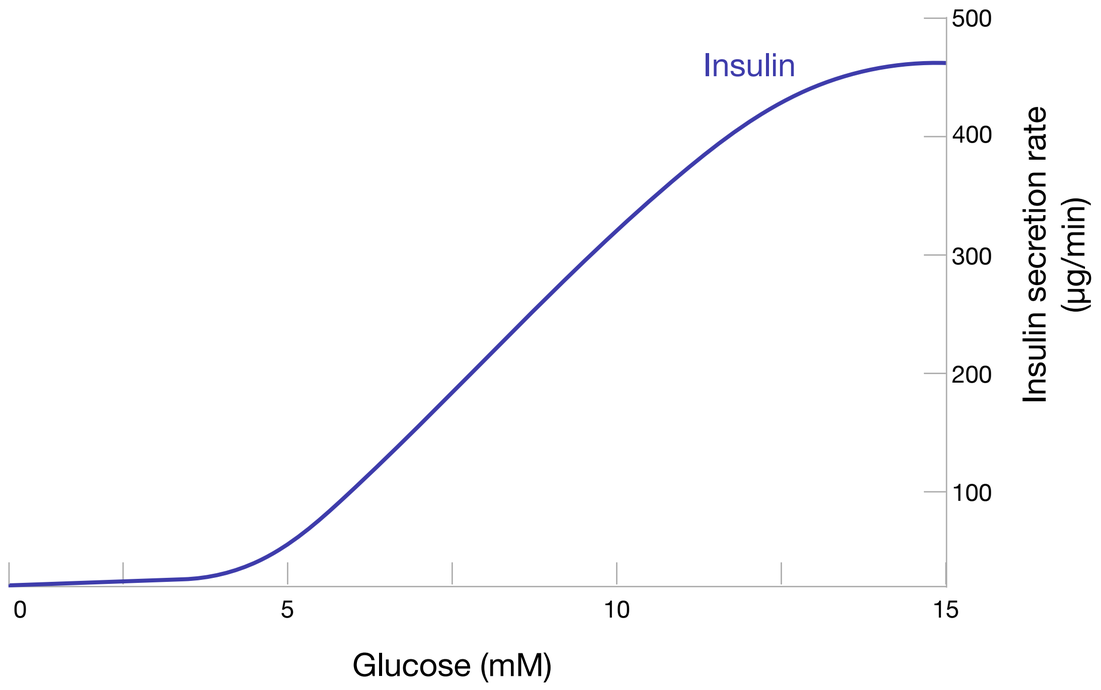


Interstitium

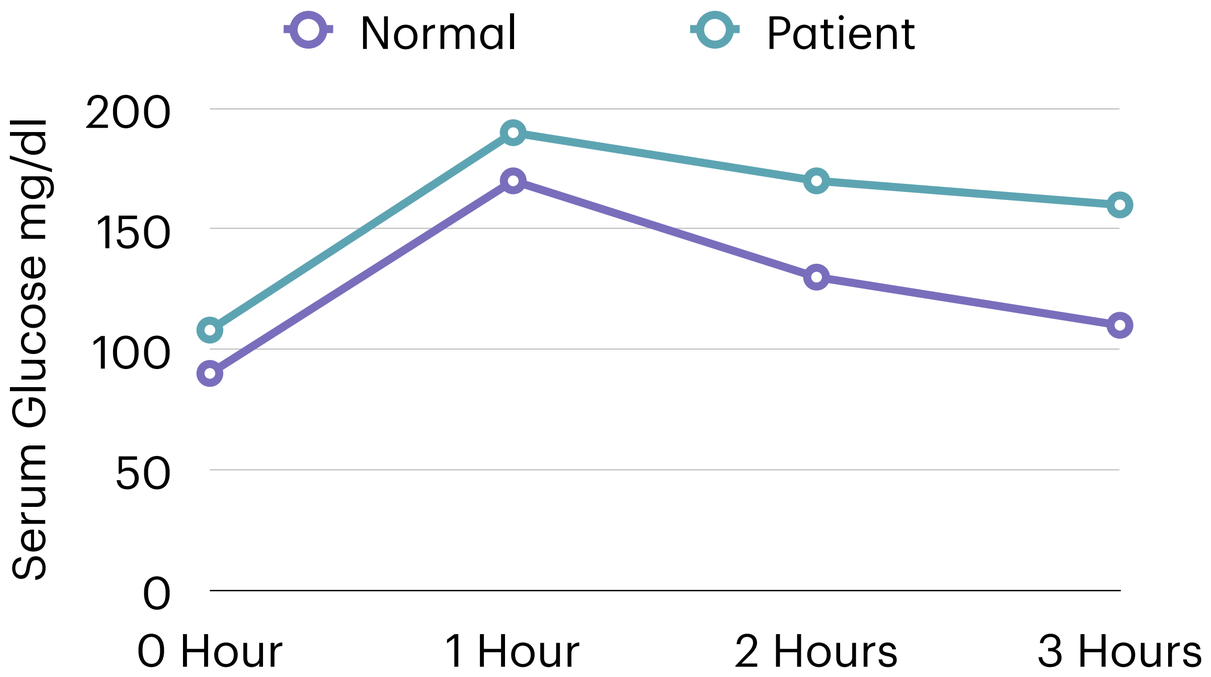
Cytosol



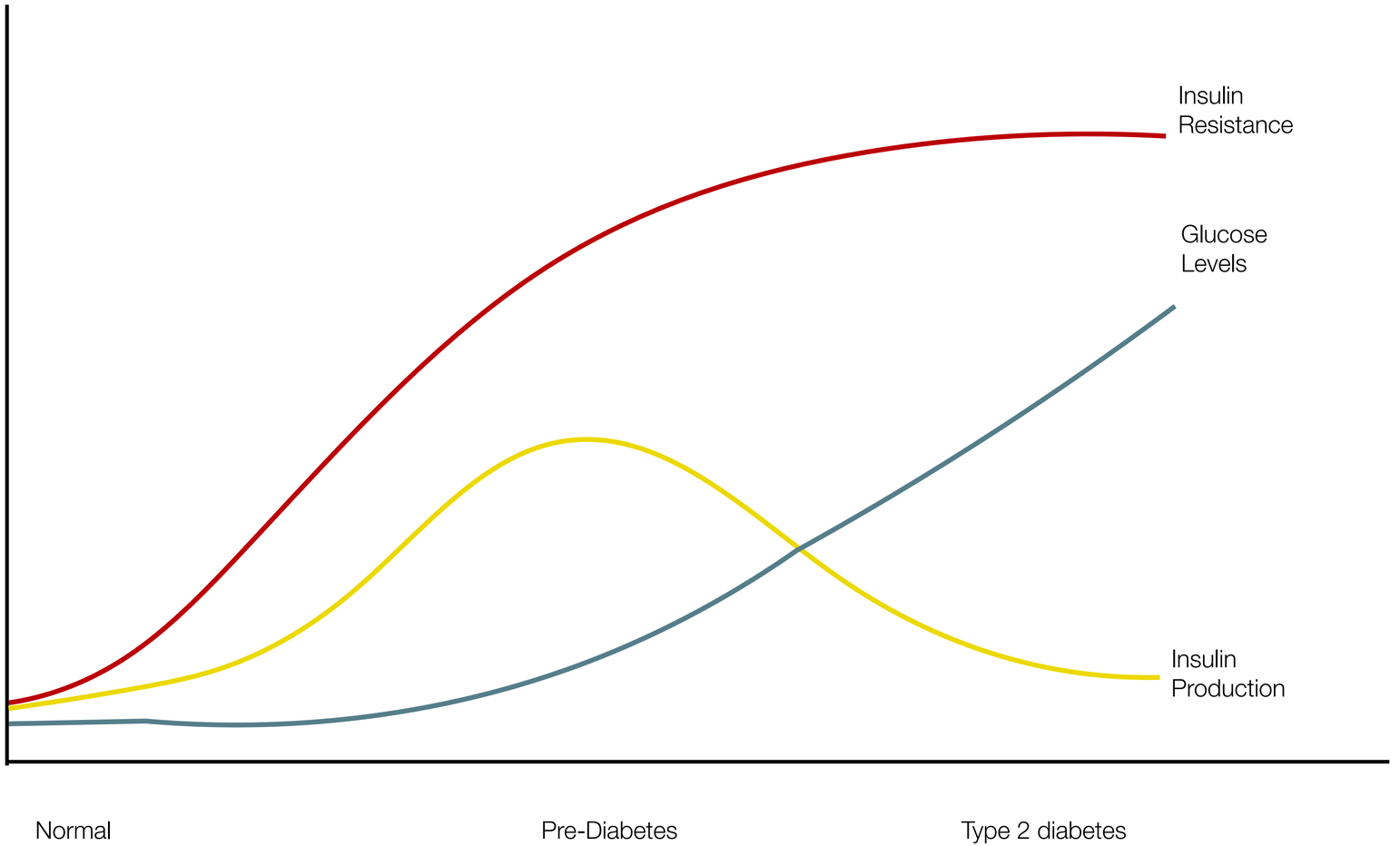
To maintain glucose concentrations in a narrow range, the release of insulin must be tightly regulated. The chart below shows the rate of release of insulin as glucose concentration increases. Why does insulin secretion start to increase at 5 mM glucose? What would happen if insulin secretion increased at 1 mM glucose?



1. Why does our patient's serum glucose levels decline more slowly than normal?
2. What physiological and cellular changes reduce the patient's ability to control glucose levels?
3. What could cause the patient's serum glucose to reach levels defined as diabetic?
4. How could you increase the effectiveness of the patient's response to glucose?



Insulin resistance increases during pre-diabetes.



Insulin signaling pathway in skeletal muscle.