From 1552 BC to 2015: How Science Made Diabetes Treatable

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Outline

1. A (Very!) Short History of Diabetes

2. Diabetes Research and Treatment Today
Diabetes: one of the oldest diseases known to man.

First documented in 1552 BC
Egyptian physician: Hesy-Ra

Symptoms:
- Rapid weight loss
- Frequent urination
- Urine attracted ants

Hesy-Ra (public domain)
1st century CE: Arateus

“A melting down of flesh into urine”
Coined the term “diabetes mellitus”
Diabetes: siphon, passing through
Mellitus: sweet (sugar)
Diabetes is a death sentence through the early 20th century!

Scientific lesson: Must understand the disease biology, not just the symptoms!

Effects of insulin therapy from Geyelin 1922 (public domain)
1889: Finding a cause for diabetes

Minkowski/von Mering

Removed pancreas from dogs

Rapid onset of diabetes

Scientific lesson: Key discoveries are often unexpected!
1869: Looking closely at the pancreas

Paul Langerhans – two types of pancreatic structures

**Islets**

Are the islets important in diabetes?

Diabetes = loss of an islet protein (insulin)

Can we isolate insulin and use it to treat patients?
1921: Banting/Best and Macleod

Treated diabetic dogs with pancreatic extract

Some success…but lots of technical problems

Scientific lesson: If at first you don’t succeed, try and try again.
Banting/Best and Macleod/Collip

1922: Treated diabetic children

Scientific lesson: When you find something big, run with it!
What does insulin do?

Insulin (hormone) “food signal”

Energy uptake and storage

Breakdown of stored energy (fat, proteins)
Insulin and glucose (sugar)

Effect of insulin on glucose uptake and metabolism (public domain)
Type 1 vs Type 2 diabetes

Type I diabetes (10%, <30 at diagnosis)

Type 2 diabetes (90%, assoc. with obesity)
Recap

Insulin is a hormone that controls glucose metabolism.
Type 1 diabetes: insulin is absent
Type 2 diabetes: the body doesn’t respond properly to insulin

Questions??
Outline

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Current diabetes treatments

Insulin pumps

Synthetic insulin produced by engineered bacteria or yeast

Glucose-lowering drugs
What problems remain

Today: diabetic life expectancy is 10-13 years lower than for non-diabetics.

A cure has remained elusive.

does not equal
Insulin is very complicated!

Insulin in the bloodstream binds to the insulin receptor on the cell membrane. This binding leads to the activation of GLUT-4 proteins, which then transport glucose into the cell. The process is illustrated in the figure.

*Insulin action on the cell process (Figure 1.1.2)* by The firesofedition (CC BY-SA 3.0)
Complications: blood vessels

Microvascular (small vessels):
- Kidney disease
- Nerve death
- Eye disease
- Pain/suffering

Macrovascular (large vessels):
- Atherosclerosis
- Heart attack
- Stroke
- Death (>65%)
New research in type I diabetes

Stem cells!

Stem cells → Insulin-producing cells

“Artificial pancreas”

Transplantation into diabetic mouse

“Drawing of a grey mouse” by Jan Gilbank (CC BY 3.0); Stem cell figure adapted from Pagliuca et al., 2014
Conclusions

Diabetes: a research success story
One door opens another…

**Research today aimed at:**
- Decreasing diabetic complications
- Stem cell therapies (type I)
- Preventing type 2 diabetes and pre-diabetes (~30% of population)
What can you do?

Lead a healthy lifestyle (diet and exercise)
Support biomedical research
Thank you!

SITN would like to acknowledge the following organizations for their generous support of this event.

Harvard Integrated Life Sciences

HILS

addgene

The nonprofit plasmid repository