The effects of heart medication on the heart rates of *Drosophila melanogaster*

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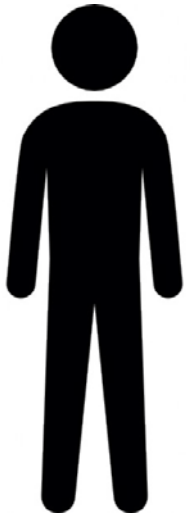
What is the leading cause of death in the United States?

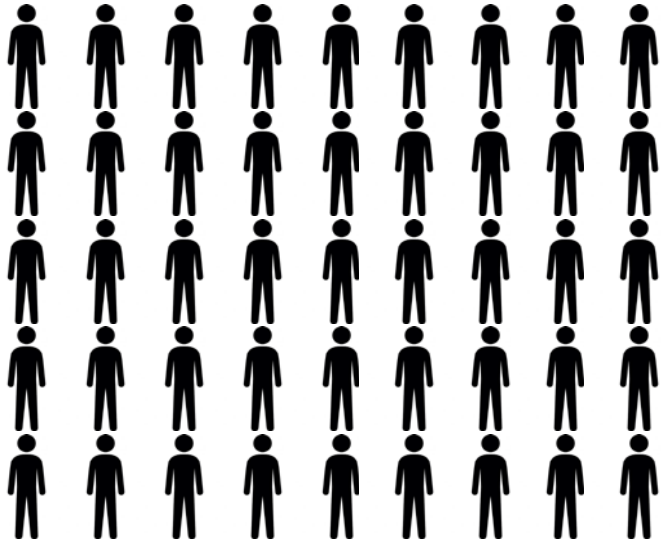
Cardiovascular Disease

Center for Disease Control and Prevention (2015)

Every 40 seconds one American dies.



Within this 30 minute presentation 45 Americans will die.



American Heart Association (2015)

Image from: https://image.freepik.com/free-icon/tall-human-silhouette_318-44430.jpg

Models of Cardiovascular Disease

Current Models:

- Mammals and zebra fish
- Similar in anatomy/physiology

Is a new model necessary?

- Current models expensive and tedious to work with
- Current need -- a model organism that is:
  - More efficient to work with in lab
  - Still an accurate model of human cardiac disease

Image from: https://img.purch.com/w/660/aHRocDovL3d3dy5saXZlc2NpZW5jZS5jb20vaW1hZ2VzL2kvMDAwLzAoOC8yNTUvb3JpZ2luYWwvbW91c2UtbGFiLXJhdCoxMDExMTctMDIuanBn

Drosophila melanogaster (*D. mel*)

Is *D. mel* a more efficient organism to work with in the lab?

- Short life span
- Genome sequenced
- Easy to culture
- Low cost

Image from: https://wellgenetics.com/image/genomeediting-1.png

Drosophila melanogaster (*D. mel*)

Is *D. mel* a potential model of human cardiovascular disease?

Anatomical differences:

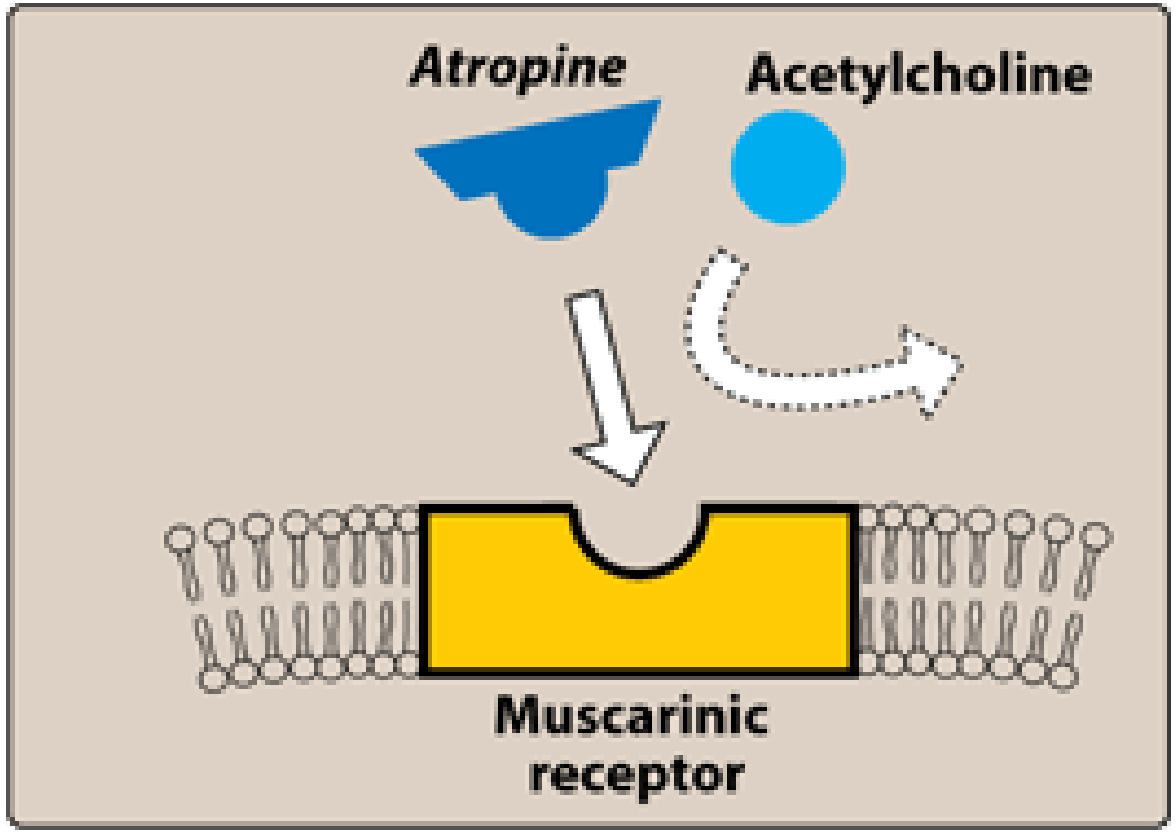
- Only one cardiac chamber
- One layer of cardiomyocytes
- Lacks coronary arteries

Similarities:

- Protein and genetic makeup
- Physiological similarities
  - Structural defects, arrhythmias (irregular heart rhythm), cardiomyopathies (disease of the heart muscle)

Image from: https://wellgenetics.com/image/genomeediting-1.png

Atropine



- Acetylcholine binds to muscarinic acetylcholine receptors aiding in parasympathetic influence on heart rate
- Atropine binds and blocks these receptors → Heart rate increases

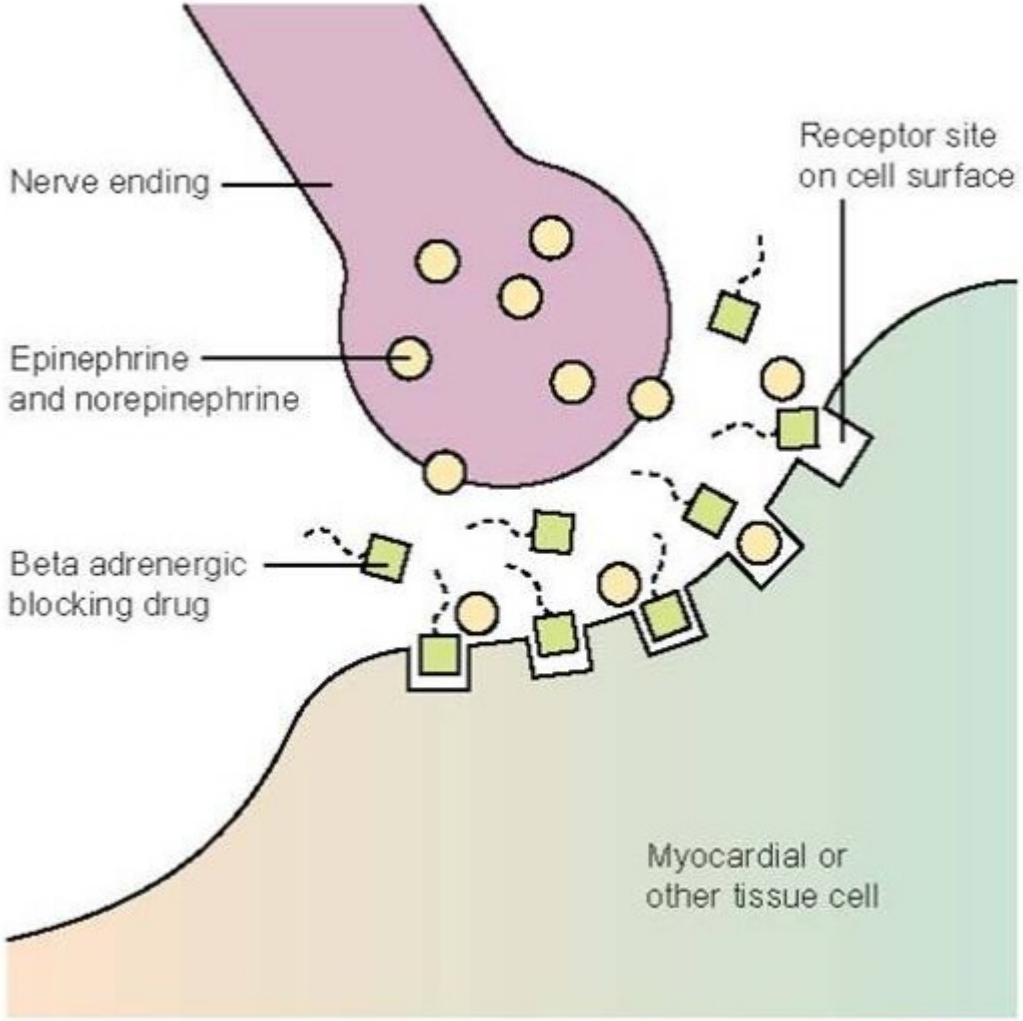
https://healtheappointments.com/wp-content/uploads/2017/02/Competition-of-atropine-and-scopolamine-with-acetylcholine-for-the-muscarinic-receptor..gif

Could atropine work similarly in *D. mel*?

Ren et al. (2015)

Analysis of the protein structure of one muscarinic acetylcholine receptor in *D. mel* is similar to humans.

Propranolol hydrochloride



- Epinephrine and norepinephrine bind to beta adrenergic receptors to aid in sympathetic influence on heart rate
- Beta blockers like propranolol hydrochloride bind and block these receptors → Heart rate decreases

https://marianuniversityscienceblog.files.wordpress.com/2010/10/picture-beta-blockers.jpg

Could propranolol hydrochloride work similarly in *D. mel*?

Spindler et al. (2013)

D. mel have G-protein receptors similar to beta1-adrenergic receptors in humans.

Research Question

I hypothesized that atropine and propranolol hydrochloride in the growth media of third instar larvae would cause an increase and decrease respectively in the heart rates of *D. mel*.

In other words:

Give atropine to *D. mel* larvae → increase in heart rate

Give propranolol hydrochloride to *D. mel* larvae → decrease in heart rate

Methods

Day 1:

- Adult flies moved to fresh vials

Days 2-5:

- Adult flies mated
- Larvae hatched and grew

Day 6:

- Second instar larvae moved to fresh media
- Atropine or propranolol hydrochloride was administered

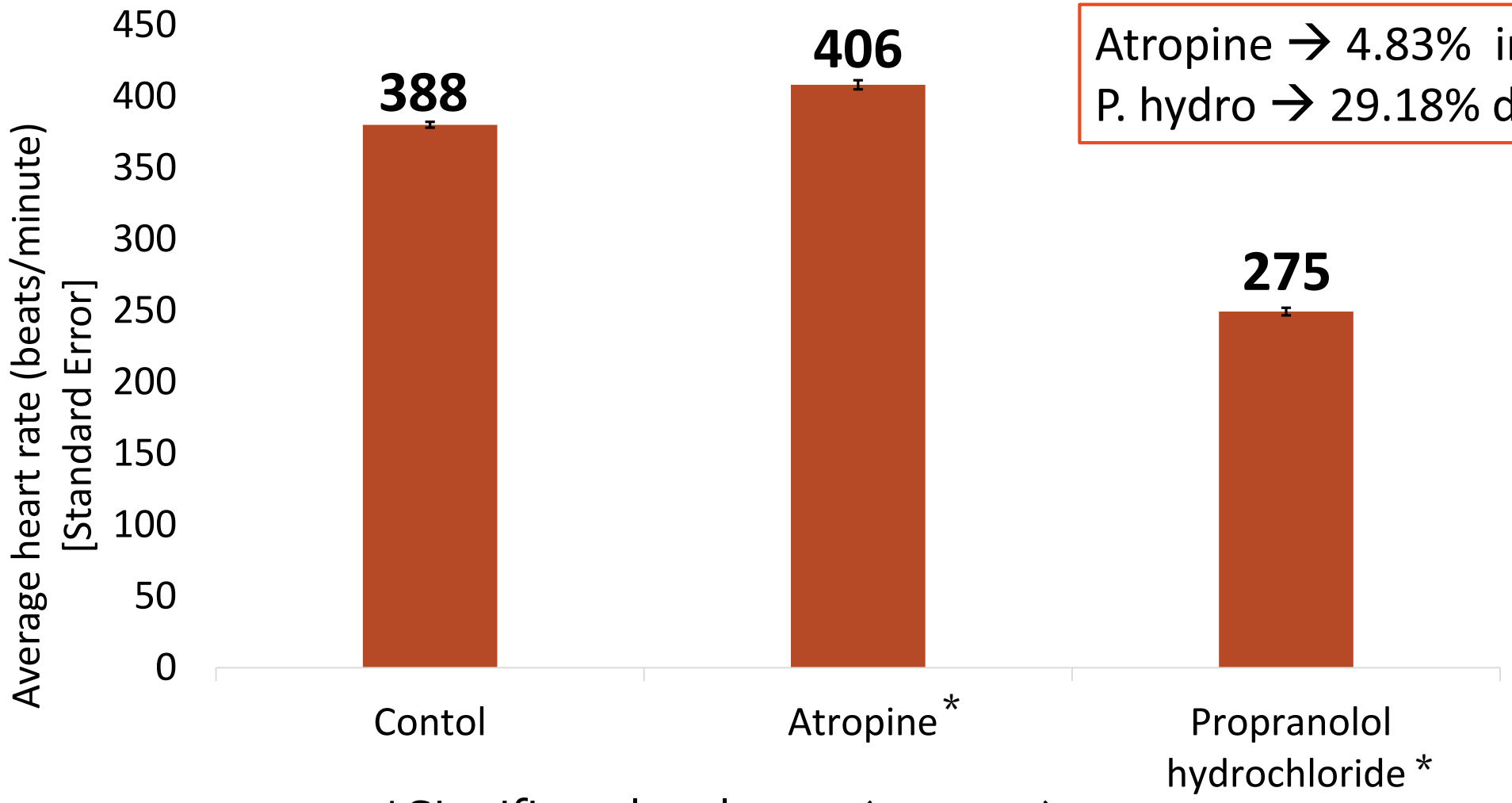
Day 7:

- Third instar larvae heart rates recorded

Recording Heart Rate

- Heart rate recorded 3x per larva in 15 second intervals (50 total for each group)
- Tap-counter app and timed video

Results



Atropine → 4.83% increase
P. hydro → 29.18% decrease

*Significantly relevant ($p<0.001$)

Discussion

The hypothesis was supported.

- Propranolol hydrochloride decreased heart rate
- Atropine increased heart rate

Future research:

- Eliminate bias through blinded study
- Eliminate human error with technology
- Alter concentrations to better compare to other research

Discussion

- *D. mel* could be a potential model for human cardiovascular disease research.
- Additionally, *D. mel* could be used in preliminary pharmaceutical testing for new medication.

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Questions?