Hypotheses for senescence

EVOLUTION OF AGING

What is aging?

- Human senescence
- When does it start?
- Age-related mortality
- Performance declines
- Organ function declines

Why do we age?

- Group hypotheses

Do all species have senescence?
- Examples

Overcrowding

- Senescence as a mechanism to prevent overcrowding.
- Genes "for" aging?
- Group vs. individual selection?

Wynn-Edwards, 1962

Antagonistic Pleiotropy

- Evolution has BIGGER effects the YOUNGER you are.
- Gene that helps early survival might be favored even if it kills you in old age
- Infectious Diarrhea and Hypertension
- Tradeoffs.

Insulin resistance as antagonistic pleitropy

- Insulin resistance improves infants ability to survive infectious diarrhea in SGA babies
- Insulin resistance leads to diabetes in old age

Declining power of selection

- Population pyramid
- Imagine a gene that keeps you healthy for 10 years after it is turned on
- If gene is expressed at age 5 – it will affect many more people and have greater effect on reproduction than if expressed at age 55.

Declining power of selection

- Gene with positive effects
- More strongly selected for if expressed early

- Gene with negative effects
- Less strongly selected against if expressed late

Disposable soma

- Effort towards repair compete with efforts towards reproduction
- Testosterone –higher expression may lead to improved reproductive success but worse health and longevity

Somatic cells support germ cell lines

Disposable Soma hypothesis

- Parts have a shelf life?
- Automobile analogy –
  - Most cars are designed to have parts wear out at more or less the expected life span of the car
  - Pointless? A transmission that lasts 400,000 miles if rest of the car wears out at 150,000 miles

Synchronicity of Aging

- An organ that wears out well before other organs will be subject to negative selection to prolong its life

- An organ that fails long after the others is "overengineered" and resources for durability of this organ would be trimmed to bring it in line.

Human life span and the fountain of youth

- Humans have longest life span of any mammal
- Is there a theorectic maximum life span?

- How likely is a single contributor to aging (e.g. free radicals) that can be overcome with a new treatment?

Salmon

- Age all at once.
- Single reproductive event
- No investment in maintenance of soma following massive reproductive effort

Aging Summary

- Crowding Hypothesis
- Antagonistic Pleitotropy
- Declining Power of Selection
- Disposible Soma

- Proximate hypotheses for aging
- Wear and tear
- Accumulation of mutations
- Free radical hypothesis
- Inflammation

Sacrifice of late survival for enhanced early reproduction!