RSPT 2258

Geriatrics – Part 2

Anatomic & Physiologic Changes

- aging "in a nutshell"

loss of cells & slowing of their function
↓
decline in functioning of immune system
↓
increased morbidity
↓
failure of 1 or more physical systems
↓
death

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Anatomic & Physiologic Changes

- all animals
  - replace muscle with connective tissue
  - dry out
  - body fat moves to middle of body
  - bones become more porous
  - decline in sensory perception
  - speed, strength, reserve capacity decline
  - efficiency of organs & immune system declines
- we can recognize & describe it but can we explain why it occurs?

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Theories of Aging

- caloric restriction model
  - known that feeding lab restricted calories produces a lab full of old rats
  - 40-50% older if fed nutritionally complete diet every other day
  - same effect on higher mammals??
  - no explanation for this finding
- 2 principal groups of theories of aging
  - _____
  - _____

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Error Theories of Aging

- mainly descriptive – rely on observation
- *Wear & Tear Theory*
  - recognizes that cells & tissues wear out when exposed to _____
  - adequate description but doesn't explain why
- *Rate of Living Theory*
  - the greater the rate of O_2 metabolism → _____
  - may explain
    - Galapagos tortoise → 150 yrs
    - shrew → 1 yr
  - again- adequate description but doesn't explain why

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Error Theories of Aging

- *Cross-Linking Theory*
  - the greater the rate of O_2 metabolism → shorter the life span
    +
  - binding of glucose to protein that causes various problems
    ↓
  - protein becomes impaired and is _____
- *Error Catastrophe Theory*
  - production of proteins and the reproduction of DNA sometimes is not carried out with accuracy
  - DNA is so vital that natural repair processes kick in when an error is made
  - but the system is incapable of making perfect repairs on these molecules every time → _____
  - similar to *Somatic Mutation Theory*

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Programmed Theories of Aging

- *Genetic Program Theory*
  - life span of an organism is programmed in the _____
  - shown in lab
    - normal cell populations grew and doubled for a period of time, then ceased & died
      - cells from embryo – doubled 50 times
      - cells from young adult - doubled 30 times
      - cells from older people – doubled 20 times
      - cells that had been frozen for many years, then thawed – retained genetic memory of how many times they had doubled – they picked up where they left off!

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Programmed Theories of Aging

- *Endocrine Theory*
  - extension of Genetic Program Theory
  - biological time clock in each cell is activated by _____
- *Immunological Theory*
  - aging of the immune system influences the aging process
    - thymus decreases in size & function in early adulthood
    - reduction in _____ function

      ↓

      programmed decline in _____

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Programmed Theories of Aging

- *Autoimmune Theory*
  - body develops more autoimmune antibodies that destroy _____ (arthritis, diabetes)

    +
  - decreasing function of immune system → more prone to infections, neoplasms

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Programmed Theories of Aging

- *Free Radical Theory*
  - aging process is chemical (caused by free radicals)
  - O_2 metabolism → CO_2+H_2O+OH^-

↓

very reactive (try to combine with other cells)

↓

_____

  - free radicals are destroyed by protective enzymes (antioxidants)
    - vitamin _____
    - vitamin _____
    - _____
    - _____

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Physical Changes, Morbidity, Mortality

Decline in Organ Systems

- breathing capacity declines
- brain loses neurons
- kidneys less efficient
- bladder capacity declines
- muscle mass declines
- hearing decreases

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Decline in Organ Systems

Physical Capacity Remaining at Age 75

Physical Measure	% Capacity Remaining at 75
Brain weight	56
Blood flow to brain	80
Speed of return to equilibrium of blood acidity	17
Cardiac output at rest	70
Kidney filtration rate	69
Kidney plasma flow	50
Number of nerve trunk fibers	63
Nerve conduction velocity	90
Number of taste buds	36
Maximum oxygen uptake (during exercise)	40
Maximum breathing capacity (voluntary)	43
Vital capacity	56
Hand grip	55
Maximum work rate	70
Basal metabolic rate	84

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Functional Ability

- = ability to accomplish the _____
- most older people do not feel that their lives are impaired as long as they can do what they want
- assessed with surveys of ADLs
  - "Can you take a bath or shower?"
  - "Can you walk?"
  - "Can you prepare your own meals?"
- ~5% of >65y are institutionalized
- in general, rates of disability go up with age & with decreasing income ∴ safe to conclude the oldest & poorest have the highest rates of functional disability

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Morbidity

- = incidence of disease & ill health
  - acute conditions – _____
  - chronic conditions – _____, characteristic of elderly
- morbidity of the population has changed dramatically in last century
  - some diseases wiped out
  - major change in morbidity of children
    - 1900 – infant death rate: _____ /1000 live births
    - today – _____ /1000 live births
- improved sanitation, control of infection, prevention of communicable diseases → majority of deaths now occur late in life from _____

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Morbidity

- despite compromised immune systems, older folks have more time to develop immunity to infectious disease → less prone to acquire infectious illness
- however, those in frail health who do contract an infectious condition are more likely to die from it

- most chronic illnesses are more prevalent in later life
- these conditions are not prone to cure – _____

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Mortality

- = _____
- many of the chronic conditions don't cause death
- some evidence that people in frail health who suffer from chronic illness more likely to die from an _____
- leading causes of death of 65+ years (CDC, 2007)
  1. heart disease
  2. cancer
  3. CVA
  4. COPD
  5. Alzheimer's
  6. diabetes
  7. influenza & pneumonia

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Pulmonary Changes Associated With Aging

- remember- aging is normal, progressive, irreversible

- gradual decline in all body systems, but a major cause of reduced functional ability is the decreased capability of the respiratory system to pick up and deliver O_2 to arterial blood

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Pulmonary Age-Related Changes

Trachea & Bronchi

- progressive calcification of cartilage → _____
- smooth muscle fibers in **lamina propria** replaced with fibrous connective tissue
- distensibility of bronchioles is _____
- epithelial cells show degenerative changes
- ciliary & phagocytic activity slows

_____

- anatomic dead space _____

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Alveoli

- infants have _____million alveoli
- 8 yo has _____million
- number remains essentially constant throughout old age
- gradual deterioration in alveolar septa → increases size of alveoli → _____
- cross-links develop between collagen fibers in alveolar wall → limits expansion during inspiration → _____

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Lungs

- loss of _____
- increased _____ of thorax (calcification of costal cartilage)
- bone loss → decreased space between spinal vertebrae → decreased *thoracic* compliance

increases _____

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Lungs

- despite alterations in structure & function, lungs appear to be relatively durable
- unless affected by disease – capable of maintaining adequate gas exchange for life span
- lung function declines after 25 y

VC	↓
PEFR	↓
IC	↓
FEF_{25-75}	↓
FEV_1	↓
DL_{CO}	↓
RV	↑
FRC	↑

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Lungs

- loss of elasticity → _____
- cross-linking of collagen fibers + calcification of costal cartilage → decreases chest wall compliance

_____

- remember – PFT in elderly may take longer & require more demonstration
- level of comprehension may assist in interpretation

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Pulmonary Gas Exchange

- pulmonary gas exchange altered in elderly
  - physiologic shunt (P > V, P ≠ V) increases to ~15% at age 70
  - diffusing capacity decreases (20%)
  - pulmonary blood flow decreases
  - ventilation/perfusion inequalities more pronounced in elderly
    - loss of elastic recoil → decreased support of small airways → early airway collapse, esp. in lower lung regions → shifts distribution of ventilation to upper lung regions
    - majority of blood flow still in lower lung regions

_____

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Pulmonary Gas Exchange

- result –
  - *oxygenation*
    - PaO_2 _____
    - P_AO_2 _____
    - $AaDO_2$ & a/A gradient
      (P_AO_2 - PaO_2) (PaO_2 ÷ P_AO_2)
    - still adequate to perfuse tissues (if no lung disease)
  - *carbon dioxide*
    - $PaCO_2$ _____
    - due to high _____

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Control of Breathing

- ventilatory response to hypoxemia _____with age
- ventilatory response to hypercapnia _____with age
- thought to be due to the changes in
  -
  -
  -

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Implications

- aging processes are normal, inevitable & irreversible
- _____ is best practice
- almost ½ of >70yo c/o dyspnea on exertion → **not normal!**

- most common symptom of respiratory disease is _____
  - nocturnal dyspnea, orthopnea – cardiac cause
  - chest pain – cardiac, pneumonia, PTE, PTN, muscle fatigue after coughing, rib Fx

- pulmonary problems are the most common _____ complication among elderly
  - problem is → older people with pneumonia may not cough, have a fever or elevated WBC
  - tachycardia & tachypnea may be the only sign

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