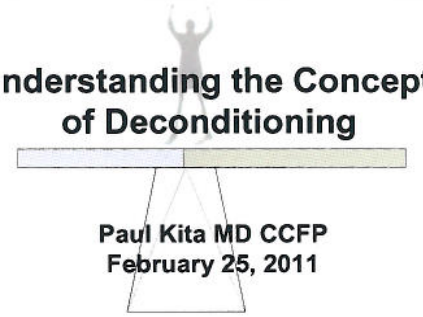
Understanding the Concept of Deconditioning



Paul Kita MD CCFP
February 25, 2011

Goals of today's presentation

- **To better understand the process of deconditioning; (causation, course of illness, treatment and prevention)**
- **To better understand why some are more susceptible to conditioning than others**
- **To better understand the relationship between frailty and deconditioning**
- **To better understand our role as healthcare providers in this process (causation and treatment)**

Deconditioning

- Definition: Multiple changes in organ system physiology induced by inactivity and (may be) reversed by activity
  - Related to:
    - a person's prior level of fitness (or frailty)
    - degree of superimposed inactivity

Siebens 1990

Deconditioning in the Hospitalized Patient

- Contributing factors:
  - Acute illness
  - Immobility
  - Adverse effects of treatment

Hoenig, Rubenstein 1991

The importance (Why you should care!)

- Within 2 days!!!
- Demographics
  - Elderly most at risk (>65 y/o)
- Incidence
  - At least 1/3 of 70 y/o have functional decline
- Prevalence
- Cost
- Human toll

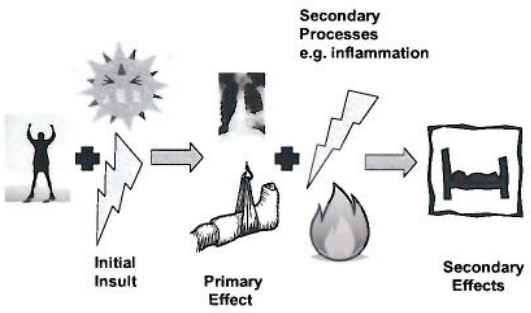
Hirsch 1990, Brown 2004, Inouye 1993, Sager 1996

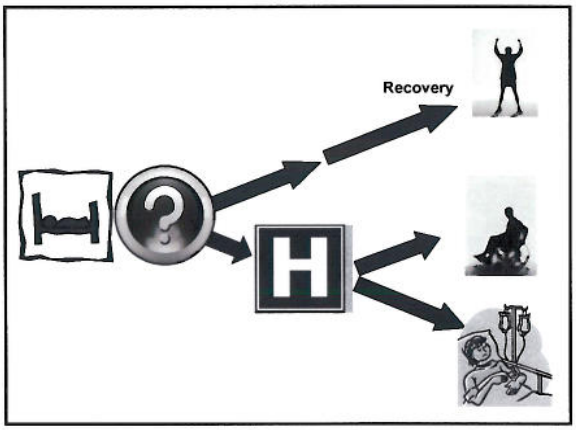
Case 1: Mr. U.N. Lucky

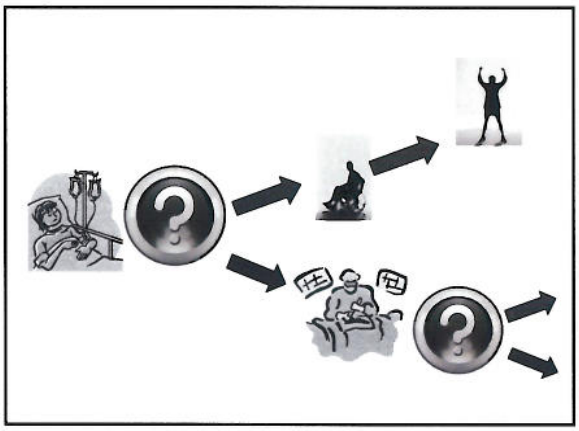
- 82 y/o man
- Falls at home, broken hip
- Not found for 12 hrs
- Presents to ER
- OR delayed
- General anesthesia
- Post-op delirium
- Urinary tract infection
- Urinary catheter, IV antibiotics
- Falls, hits head....

Case 2: Ms. Willa B. Sick

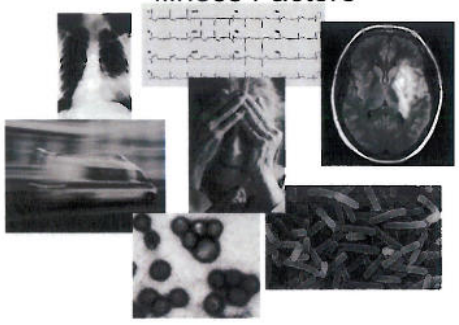
- 79 y/o woman
  - Becomes ill with viral URTI
  - Takes to her bed, poor intake
  - Found delirious, short of breath, swollen ankles
  - Taken to ER, admitted with pneumonia, CHF
  - Rx: oxygen, antibiotics, bronchodilators, diuretics, corticosteroids
  - 2 weeks later she's transferred to Rehab, unable to walk, oxygen dependent and depressed



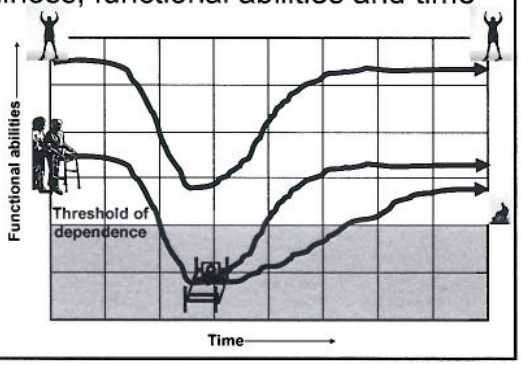




Deconditioning: Illness Factors



Illness, functional abilities and time



Primary FX of Deconditioning

Musculoskeletal system
"if you don't use it you'll lose it"

Cardiovascular system
orthostatic hypotension

Other system FX…

Polio

Immobility studies

Deitrick, American Journal of Medicine 1948

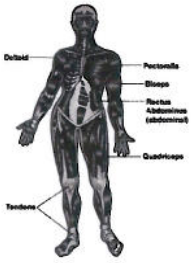
The Space Race

The role of muscle in Health

Predominant function is locomotion

Other:

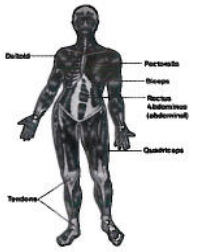
- nutritional storehouse "savings bank"
- warmth (generator)
- padding, protection
- metabolic



Deconditioning: musculoskeletal system effects

Muscular atrophy

- Rate
  - 5% mass / wk
  - Up to 40% loss of strength in 6 wk
  - Daily loss of initial strength 1-1.5%
  - Lower > upper ext
- Fast twitch vs.. slow twitch
  - (anaerobic vs.. aerobic)
  - Type II vs.. Type 1
- Extensor vs.. flexors
- Anti-gravity muscles



Bloomfield 1997: Berg 1991,1997 :Muller 1970

Deconditioning: musculoskeletal system effects (cont.)

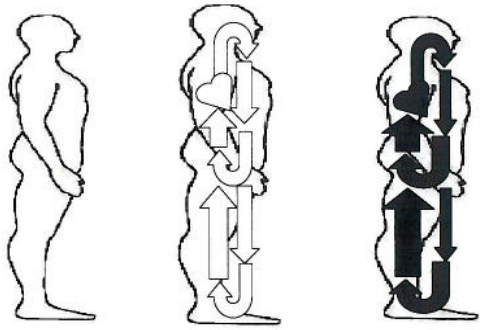
- Bones
  - resorption > formation

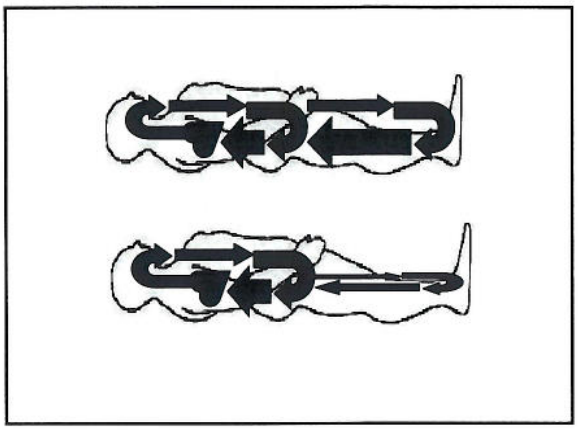
  Lower > upper extremity
- Joints
  - Scarring and necrosis or articular surface
  - Decline of periarticular cartilage
  - Osteophyte formation
- Connective Tissue
  - Stiffening of tendons and ligaments

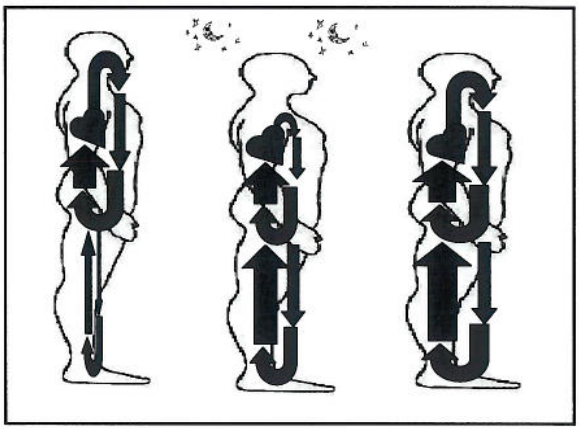
Leblanc 1990

Deconditioning: Cardiovascular effects

- Orthostatic Hypotension
  - Deconditioning
    - Immobility
  - Neurogenic
  - Iatrogenic
    - medication
      - Anti-hypertensives
      - Diuretics





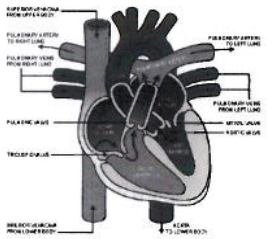


Orthostatic Hypotension
Other Factors:

dehydration
anemia / hemorrhage
fever
edema
medication
vomiting
diarrhea
surgical drains
ostomy

Deconditioning: Cardiovascular effects

- Other stuff
  - Decreased cardiac output
  - Decreased stroke volume (- 30 %)
  - Decreased Oxygen delivery
  - Stiffening of ventricle
  - Decreased cardiac ventricular mass



Perhonen 2001

Deconditioning: other systems

- Neurological
- Balance
- Respiratory
- Gastroenterological
- Urinary
- Endocrine
- Circadian rhythms
  - Sleep disturbance
- Visual system
- Psychological

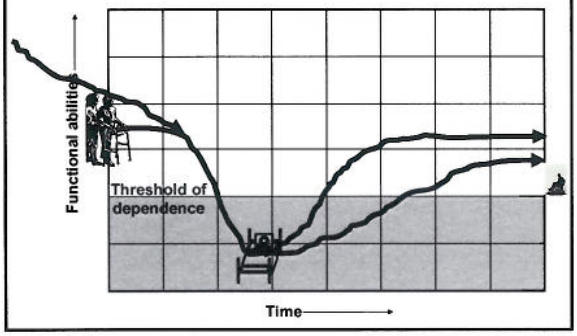
Vernikos 2010

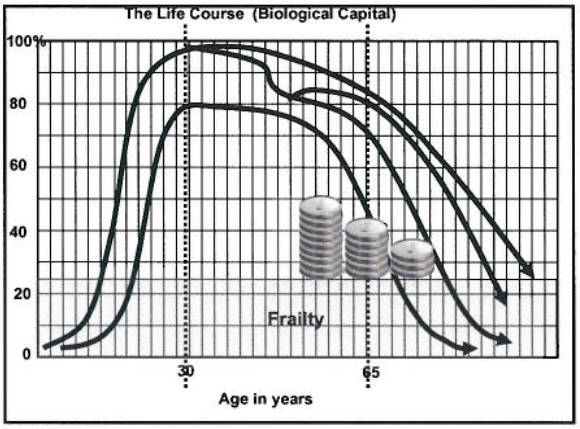
Why are elderly people so much more susceptible to deconditioning?

and

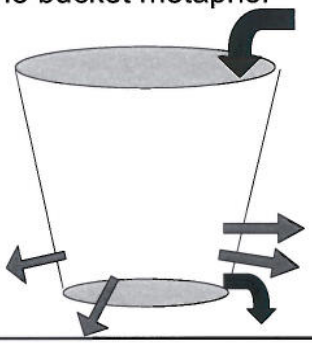
Why are some elderly so much more vulnerable than others?

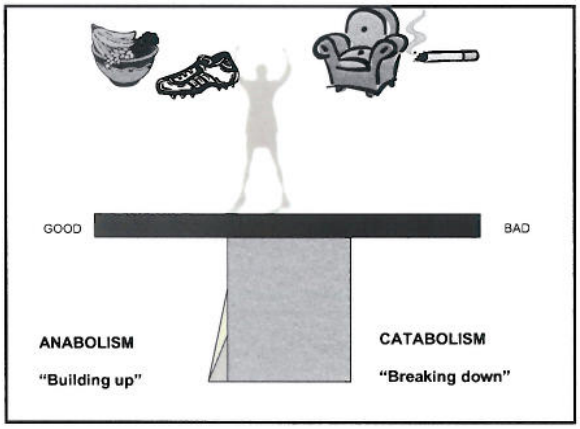
Illness, functional abilities and time





Life course, biological "capital" the bucket metaphor





Frailty, what is frailty?

Global impairment of physiological reserves involving multiple organ systems.

Associated with increased vulnerability and impaired capability to withstand intrinsic and environmental stressors; a limited capacity to maintain physiological and psychosocial homeostasis

Frailty, what is Frailty?

- Fried (2001)

3 of the 5 following criteria:

- muscle weakness
- subjective fatigue
- reduced physical activity
- Low gait speed
- Unintended weight loss (>10 lbs in 1 yr)

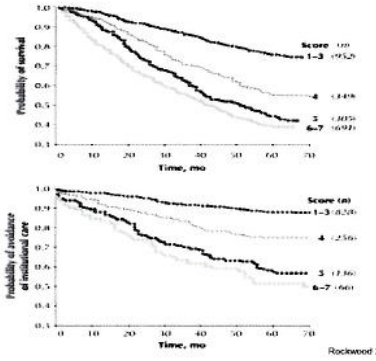
- Rockwood (1994,2005)

"accumulation of deficits"

- Balance between assets and liabilities
  - Multisystem impairment
  - Instability
  - Change over time
  - Heterogeneity
  - Related to aging
  - Risk of adverse outcomes

CSHA Clinical Frailty Scale Rockwood 2005

1. Very Fit –robust, active most fit for age
2. Well - without active disease, but less well than category 1
3. Well, with treated co-morbid disease
4. Apparently Vulnerable – not dependent, but complain of fatigue, have symptoms
5. Mildly Frail – dependence on others for IADL's
6. Moderately Frail – help needed with both IADL and BADL
7. Severely Frail – completely dependent or terminally ill



Rockwood 2005

Components of Frailty

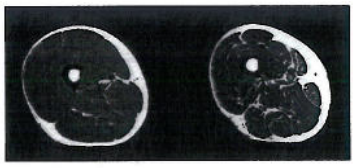
- Sarcopenia
- Inflammaging
- Neurohumoral response
- Lifestyle: diet, exercise/ inactivity, habits
- Cognitive
- Psychological factors
- SES

Frailty: Sarcopenia

- Decrease in lean body mass
  - Loss of muscle
  - Loss of reserve
- Myosteatosis
- Decrease in no. of motor units
- Decrease in motor neurons
- Fatigue?

- EFFECTS:
  - Decrease in mobility
  - Increased energy expenditure
  - Metabolic effects
    - Insulin resistance
    - Thermoregulation
    - Loss of appetite cues
  - Other:
    - Inflammation
- Frail Obese
  - Increase expression of procoagulants and inflammatory elements

Frailty: Sarcopenia



Inflammation

Response to tissue damage

dolor	**PAIN**
calor	**HEAT**
rubor	**REDNESS**
tumour	**SWELLING**
functio laesa	

LOSS of FUNCTION

Frailty: Inflammation

- Increased expression of pro-inflammatory cytokines
  - Interleukin-1
  - Interleukin-6
  - TNF alpha
  - CRP
- Prolonged inflammatory response
- EFFECTS
  - Activated immune system
  - Catabolic
  - Activated coagulation system (D-dimer)
  - Anorexia
    - (further catabolism)
  - Pain
  - Fever
  - Activates HPA axis

Interleukin-6 (IL-6) "the Geriatrician's cytokine"

- Pro-inflammatory cytokine
  - lymphocytes to increase immune response
  - all cells under certain circumstances
  - especially **ADIPOSE** tissue
- decrease grip strength, gait abnormality, sarcopenia, pro-coagulation, central obesity, osteoporosis
- interferes with iron and glucose metabolism
- Atherosclerosis, Parkinson's, Alzheimer's
  - Disease aggravation

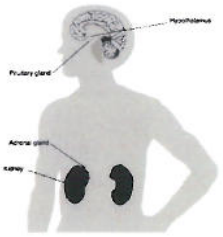
Stress Response

"Fight or flight"

adrenaline/ epinephrine

cortisol

stress hormone



Frailty: Neurohormonal changes

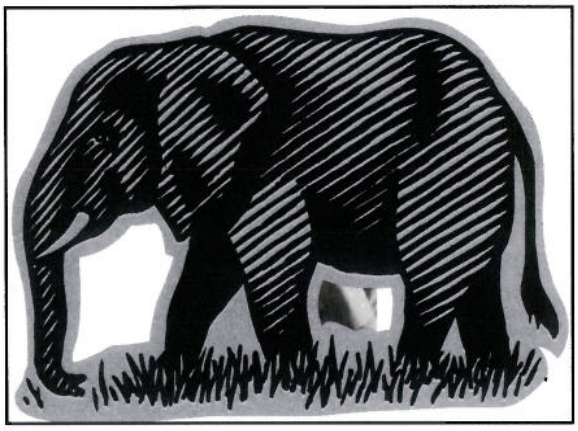
- Increased cortisol
- Decreased sex hormones
  - (testosterone, estrogen, DHEA)
- Decreased Growth hormone
  - ILF-1
- Increased myostatin
- Increased globulin
- Increased fibrin
- EFFECTS
  - Increased catabolism
    - Muscle, bone
  - Insulin resistance
  - Increased inflammation
  - Anorexia
  - Decreased anabolism

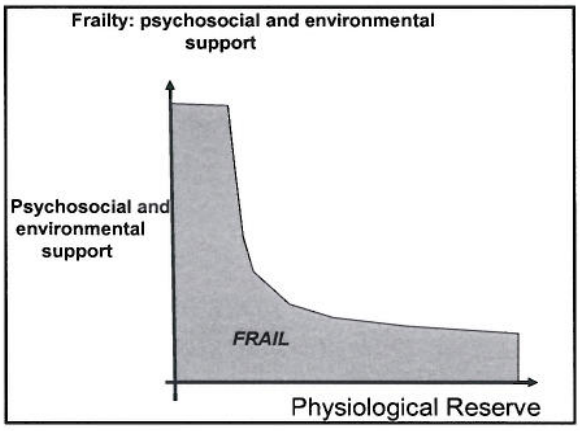
Frailty: gender

- Gender differences?
  - Females > males
    - Role of hormones
      - Menopause vs.. andropause
    - Body composition
    - Mortality
      - Males> Females

Frailty: nutrition

- Anorexia of ageing
  - In response to decreased activity and metabolism
- Altered satiety mechanisms
  - Cholecystokinin
  - Decreased gastric compliance
- **Hormonal changes & cytokines**

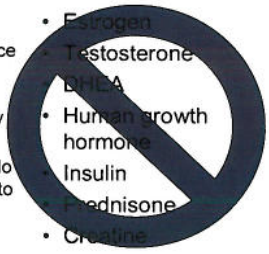




Deconditioning: Iatrogenic Factors

Treatment for frailty and deconditioning

- Medication
  - There is little evidence that any specific medication is of benefit treating frailty and deconditioning
  - Complex problems do not usually respond to unidimensional solutions



Medication (cont.)

- Possibly of benefit:
  - Angiotensin converting enzyme inhibitors
    - ACE-inhibitors (ramipril)
  - Statins
    - "cholesterol medication"
  - Vitamin D supplement
  - Megesterol (Megace)
    - Adrenocorticoid effect
  - Erythropoeitin?
  - ASA?
  - Omega-3 fatty acids?

Exercise

- Fiatorone (NEJM 1994)
  - Resistance training, protein in LTC (~87 y/o)
    - 100% increase in strength
    - 3% inc. in size of lwer ext. ms
    - Gait velocity inc. 12%
    - Increase in mobility and spontaneous phys. activity
  - Statistically significant
    - Control group showed marginal change or decline
- Fiatorone (JAMA 1990)
  - Benefits of exercise in nonagenerians, 8 weeks
    - Inc. strenght 174%, muscle bulk (9%), gait speed inc. 50%
- Exercise decreases fatigue, increase function, quality of life
- Cochrane Review 2007

Nutrition

- The importance of adequate nutrition is without question; several studies show:
  - Supplements shown to increase mobility and decrease LOS
  - Decrease post-op complications, weight loss, and fatigue, increase grip strength
  - Supplements seem of benefit in the immediate post-op period, benefit decreased over time
  - Pre-op malnutrition assoc. with bad outcome

Model of Care

- Elder friendly environment
- Nursing Intervention
  - Unique opportunity
  - Education?
  - Confidence?
  - Staffing , $$
  - Deconditioning as a negative indicator?

Surgical Procedures

- Minimally invasive surgery
  - Laparoscopic procedures
  - Endovascular catheter procedures
    - Angioplasty
    - EVAR
      - Significant decrease in short term morbidity and mortality, BUT....
  - Anesthetic
    - Epidural, regional blocks

Surgical Pathways "Conventional" vs. "Fast track" pathways

Basse; Br J Surg (2002)

- compared 28 pts undergoing open colon resection, general anesthesia, epidural catheters
- FAST TRACK (ave. age 74 vs.. 64 y/o)
- Early feeding, mobilization (pathway) early removal of tubes & catheters,
- OUTCOMES:
  - Conventional care group showed declines in lean body mass, thigh mass, treadmill test, cardiac and respiratory function

- MEDIAN LENGTH OF STAY: 2 vs. 12 days!!!

Basse; Ann Surg (2005)
surgical pathway comparing open vs. laparoscopic colon resection
NO Differences: hours of mobilization, motor activity, treadmill exercise
sleep quality, fatigue, return to normal GI function
post-op morbidity and mortality

It's the Pathway, not the surgical technique!!!

Prehabilitation

- Clear evidence that presurgery function translates into better outcome, but what about training?
- Significant benefits in cardiovascular and abdominal procedures (less complications, deaths, shorter LOS, improved QOL, lower rate of functional decline) [aerobic training]
- less benefit in published studies for elective hip and knee repair

SUMMARY

- Insult
  - infection, injury, illness
- Inflammation
  - Pain, heat, redness, swelling, loss of function
- Immobility
- Impaired physiology
- Iatrogeny
  - ICU, Intoxication, incarceration, impediments (restraints)
- Anorexia
- Dehydration