

Deconditioning : the consequence of bed rest

By: Colleen S. Campbell MSN, ARNP-BC,
CRRN-A

Geriatric Evaluation & Management (GEM)
Director

Geriatric Research Education Clinical Center
(GRECC)

Objectives

- Discuss deconditioning as a clinical entity resulting in a reduced functional capacity of multiple body systems
- Discuss the pathophysiology of prolonged bed rest
- List key interventions that prevent and treat the consequences of bed rest

Inactivity and prolonged bed rest are
unnatural states of the human body

Look at the patient lying alone in bed
What a pathetic picture he makes.
The blood clotting in his veins.
The lime draining from his bones.
The scybala stacking up in his colon.
The flesh rotting from his seat.
The urine leaking from his distended bladder
and the spirit evaporating from his soul.
Teach us to live that
we may dread unnecessary time in bed.
Get people up and we may save
patients from an early grave.

Dr. Richard Asher, 1942



Deconditioning: A Clinical Entity

- due to prolonged bed rest
- results in a reduced functional capacity of multiple body systems (especially the musculoskeletal system)

Adverse Clinical Manifestations

- Causes numerous physiologic adaptations in all organ systems, often with **negative consequences**

Levels of Deconditioning

- Mild - difficulty with maximal activity
i.e. swimming, running, or “exercising”
- Moderate – difficulty with normal activity
i.e. walking down the street, shopping, mowing the lawn
- Severe – difficulty with minimal activity & self care

Staircase to dependence

Weak, wobbly legs

More muscle weakness

Less ability to perform

More muscle weakness

Less ability to perform

Disuse atrophy

NO ability to perform

DEPENDENCE
A steep & rapid descent

Common Causes of Immobility

- Multiple trauma/orthopedic injury
- Spinal cord injury (SCI)
- Stroke
- Prolonged hospitalization

Common Causes of Immobility, conti...

- Multiple medical problems/multiple organ failure
- Myocardial infarction
- Restraints

Muscle Weakness & Atrophy

- Causes: disuse
- Pathophysiology: Loss of strength: Total inactivity -> 10-20% decrease in muscle strength per week (1-3% per day); in 3-5 weeks of complete immobilization can lead to a 50% decrease in muscle strength

Loss of muscle mass -3% loss within thigh muscles within 7 days (bed rest alone does not completely unweight the bones, and healthy young patients on bed rest use their back and leg muscles a significant amount in moving about in bed, compared to elderly, deconditioned patient without the ability to reposition themselves freely)

- Involvement: greatest in the postural muscles (i.e. low-back and weight bearing-bearing lower extremity muscles –quadriceps & gastrocnemius-soleus muscle groups

Causes of Musculoskeletal Changes Leading to the Development of Contracture

- Pain
- Improper bed positioning
- Paralysis/spasticity
- Casting/splinting

Contracture Involvement: Muscles That Cross Two Joints

■ Hips

■ Shoulders

■ Knees

■ Elbows

■ Ankles

■ Wrists

■ Fingers

Pathophysiology of Contracture Development

- Muscle fibers & connective tissues are maintained in a shortened position (5-7 days)
- Muscle fibers & connective tissues adapt to the shortened length by contraction of collagen fibers and a decrease in muscle fiber sarcomers
- Loose connective tissue in muscles and around the joint gradually change into dense connective tissue (occurs in approximately 3 weeks)

Disuse Osteoporosis

- Causes: Loss of bone density due to increased resorption caused by the lack of weight bearing, gravity, and muscle activity on bone mass
- Pathophysiology: An increase in the excretion of calcium in the urine and stool; after 12 weeks of bed rest bone density is reduced by almost 50%
- Involvement: bones, especially the long bones; develops from the bone marrow outward

Overview of Major Musculoskeletal Complications: Specific to Bone

- Osteoporosis (especially the long bones)
- Heterotopic ossification: a process by which the soft tissues surrounding a bone forms mature bone.
- Cortical thinning at ligament insertion sites

Overview of Major Musculoskeletal Complications: Specific to Joints

- Flexion contracture
- Cartilage degeneration
- Fusion
- Synovial atrophy
- Fibrofatty connective tissue infiltration
- Osteoarthritis

Cardiovascular Changes Within 24 Hours of Bed Rest

- Increase in resting heart rate (4-15 beats within the first 3-4 weeks then plateaus)
- Decrease in blood volume (5% in 24 hours, 10% in 6 days, 20% in 14 days)

Major Cardiac Complications of Immobility, conti...

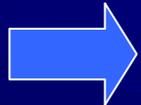
- Fluid shifts
- Orthostatic (postural) hypotension
- Increased risk of clot formation -> deep vein thrombosis -> pulmonary emboli

Understanding Normal Healthy Fluid Shifts

Laying to standing



500-700 cc of blood volume shift from the thorax into the legs due to gravity
(Also known as a **functional hemorrhage**)



The body adapts to this shift of fluid by compensatory mechanisms: carotid/aortic baroreceptors & cardio-pulmonary baroreceptors

- Because there is less blood in the chest, there is a decreased “stretch” in the baroreceptors, which in turn causes an increase in heart rate & contractility
Vasoconstriction, venoconstriction & antidiuresis
- The combined responses of the baroreceptors maintain adequate systolic blood pressure and cerebral perfusion

Understanding Normal Healthy Fluid Shifts, conti...

Standing to laying
the reverse occurs



500-700 cc of blood volume shifts from the lower body to the central thorax
(Also known as **the central shift**)



Immediate effect of increasing venous return to the heart which in turn causes an increase in ventricular and diastolic volume and consequently stroke volume.

- Because there is more blood in the chest, there is an increased “stretch” in the baroreceptors, which in turn causes a decrease in heart rate & contractility, vasodilatation, venodilatation & diuresis
- The combined responses of the baroreceptors maintain adequate systolic blood pressure and cerebral perfusion

Understanding Cardiovascular Adaptations & Fluid Shifts to Bed Rest

CONFINED TO BED REST



500-700cc of fluid from the lower extremities shift to the thorax
(also known as central fluid shift)



Increased stroke volume/cardiac output/left end-diastolic volume

PROLONGED BED REST



Depressed levels of aldosterone & antidiuretic hormone -> diuresis
(net effect is decreased blood & plasma volume)



Increased heart rate & stroke volume to maintain cardiac output



Increased **ORTHOSTATIC** hypotension

The Downward Respiratory Cascade Related to Bed Rest

Immediate decrease in all pulmonary function parameters
(related to central fluid shift & the diaphragm moves to a more cephalad position)



Overall reduced muscle strength & endurance ->reduced movement of the diaphragmatic, intercostals, and abdominal muscles



Pooling of mucous & impaired ciliary function in affected airways



Impaired cough



Mucous plugging & atelectasis



Development of pneumonia
(may be life-threatening especially in the frail elderly)

Skin Changes

- **Pressure ulcers** (extrinsic pressure is greater than capillary perfusion pressure 30mm/Hg for a prolonged period of time ->ischemia to the affected tissue)
- **Dependent Edema** (can predispose to cellulitis)
- **Subcutaneous bursitis**

Gastrointestinal Changes

- Decreased appetite
- Constipation
- Decreased gastric secretion
- Slower rate of absorption
- Atrophy of the intestinal mucosa & glands
- Distaste for protein-rich food

Urinary Changes

Increased diuresis & mineral excretion

Stone Formation

(seen in 15-30% of patients: due to incomplete bladder emptying)

Urinary Tract Infection



Major Cardiac Complications of Immobility

- Increased heart rate
- Decreased stroke volume
- Atrophy of the heart muscle
- Decreased maximum oxygen consumption

Metabolic & Nutritional Changes

- Decreased lean body mass
- Increased body fat
- Disorder of nitrogen balance
- Loss of mineral & electrolytes

Major Psychosocial Complications of Immobility

- Depression
- Loss of control
- Loss of motivation
- Feeling of helplessness

Major Psychosocial Complications of Immobility, conti...

- Loss of independent activities of daily living (ADLs)
- Loss of hobby and/or social pursuits
- Loss of job/career

Central & Peripheral Nervous System

- Peripheral nerve compression (especially peroneal nerve and ulnar nerve)
- Secondary factors of sensory deprivation and loss of independence

Secondary Factors Contributing Sensory Deprivation

- Inability to effectively manipulate one's environment secondary to
 - ✓ Neurological sequelae from primary disease (i.,e., stroke, SCI/TBI, or severe deconditioning)

Inability to Effectively Manipulate One's Environment, conti

- ✓ **Common findings** (i.e., decreased visual acuity, hard of hearing)
- ✓ **Lack of social stimulation**
- ✓ **Loss of sensation secondary to primary disease**

Consequences of Bed Rest & Imposed Sensory Deprivation

■ Changes in affect

- ✓ Anxiety, fear, depression, neurosis

■ Changes in cognition

- ✓ Decreased concentration
- ✓ Impaired judgment & problem solving

Consequences of Bed Rest & Imposed Sensory Deprivation, conti...

■ Changes in perception

- ✓ Disorientation to time and space (may perceive time passing slowing)
- ✓ Appearance of hallucinations
- ✓ Lowered pain threshold
- ✓ Increased auditory threshold

Consequences of Bed Rest & Imposed Sensory Deprivation, conti...

■ Changes in behavior

- ✓ Increased psychotic behavior (thought to be related to increased environmental stress in the form of **poor caretaker-patient relationship**)

- ✓ Increased apathy

Changes in Behavior, conti...

- ✓ Increased irritability
- ✓ Increased self isolation
- ✓ Decreased motivation and ability to participate in activities

Urinary Changes: Functional Incontinence

- 40-50% of elderly become incontinent after 1 day of hospitalization
- Leads to **significant** psychological distress
- Leads to significant increase in cost & is labor intensive

Factors Directly Related to Marked Increase in Functional Incontinence, conti....

- Immobility
- Environmental barriers (i.e., placement of bedpan or urinal out of reach, IV lines, inability of staff to respond quickly enough)
- Direct effect of medications
- Medications that alter sensorium

Endocrine Changes Due to Altered Responsiveness of Hormones & Enzymes

- Glucose intolerance
- Altered circadian rhythm
- Altered temperature & sweating response
- Altered regulation of hormones: PTH, thyroid, adrenal, pituitary, growth, androgens, and plasma renin activity

Glucose Intolerance

- By the 3rd day of bed rest there are reduced insulin-binding sites
- Can be improved by isotonic exercise of the large muscles groups of the lower extremities
- After 2 weeks of bed rest, it takes 2 weeks of resumed activity before the glucose response returns to normal

Staircase to Independence



Interventions to Minimize the Effects of Bed Rest

- Early mobilization
- Frequent changes in position
- Maintaining functional position of head, trunk, arms, hands, legs, feet
- Deep breathing, coughing & incentive spirometry
- Adequate hydration

Interventions to Minimize the Effects of Bed Rest, conti...

- Active or passive ROM exercises
- Prevent pressure development
- Adequate nutrition (starting day 1 of admission)
- Proper skin care
- Maintenance of continence

Specific Interventions for the Prevention & Treatment of Contractures

- Passive ROM with a terminal stretch BID
- Progressive stretching
- Dynamic splinting or serial casting
- Treatment of spasticity
- Surgical release (i.e., tendon lengthening, joint replacement)

A Key to the Treatment of Sensory Deprivation

- Keep the patient stimulated, oriented, and socialized

Interventions to Treat Sensory Deprivation

- Maintain a normal wake-sleep cycle
- Encourage family/friends to visit
- Arrange visits from clergy & volunteers
- Take the patient outside even if in a bed
- Take time to assure the patient's room is adapted prior to leaving
- Take extra care of eyeglasses & hearing aids to assure they are not lost
- Arrange books on tape, favorite music, family photos

Specific Treatment of Incontinence

- Appropriate evaluation of incontinence
- Pharm-D review of medication list
- Prompt treatment of UTI based on culture & sensitivity to prevent urosepsis

Treatment Incontinence, conti...

- Provide adequate fluid intake
- Institute time void schedule
- Have the patient void on the commode or upright whenever possible

Specific Interventions for the Treatment for Disuse Osteoporosis

- Standing frame
- Progressive tilt table conditioning
- Standing in the parallel bars
- A general exercise program including strengthening, endurance and coordination exercises

Post-Test