Rehabilitation In Surgical Patients

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Overview

- Definition of Rehabilitation
- Disablement process
- Rehabilitation team
- Immobility syndrome
REHABILITATION

- A relearning process in which skills and patterns of habilitation are reorganized into relevant and purposeful activities that can be performed within the limits of the patient’s potential.
DISABLEMENT PROCESS

- IMPAIRMENT
- DISABILITY
- HANDICAP

WHO 1980

- IMPAIRMENT
- ACTIVITY
- PARTICIPATION

WHO 1998
Disease/Injury

Impairment

Disability

Handicap
DISABLEMENT PROCESS

Health condition (disorder or disease)

Body Functions and Structures

Activities

Participation

Environmental Factors

Personal Factors

WHO: ICF framework, 2001
DISABLEMENT PROCESS

- **Body functions**
  - The physiological functions of body systems - mental, cognitive and psychological functions.

- **Body structures**
  - The anatomical parts of the body - organs, limbs and their components.
IMPAIRMENT

- Motor impairment
  - weakness
  - contracture
- Sensory impairment
- Cognitive impairment
- Structure impairment
  - facial disfigurement
  - loss of limb
DISABLEMENT PROCESS

- Activity  ➔ Activity Limitation
  - The execution of a task or action by an individual and represents the individual perspective of functioning.

- Participation  ➔ Participation Restriction
  - The involvement of an individual in a life situation and represents the societal perspective of functioning.
Osteoarthritis, rheumatoid arthritis or functional musculoskeletal condition

Body functions:
- pain
- range of motion
- muscle weakness
- coordination deficits
- problems with energy and drive functions and sleep disturbances

Activities:
- mobility: standing, walking, use of transportation
- grasping, handling of objects
- activities of daily living, such as washing, dressing, shopping, preparation of meals

Participation:
- vocational performance
- family relations
- recreation and leisure
- social life
- participation in political and religious activities

Environmental factors:
- workplace
- housing and transportation facilities
- family and friends
- health service and insurance
- societal attitudes

Personal factors:
- health behaviour
- coping strategies ("Sense of Coherence")
- multi-morbidity
- age and gender
The Rehabilitation Team

Physiatry

Psychology

Speech therapy

Social service

Orthotics Prosthetics

Nursing

Physical therapy

Occupational therapy

Patient & Family
Goals of a Rehabilitation Program

- To optimise both activity and participation
  - To overcome or to work around their impairments
  - To remove or reduce the barriers to participation in the person’s chosen environments
  - To support their reintegration into society
Principles of Rehabilitation

- Identify an individual’s impairments, activity limitation, and participation restriction
- Individualized goal setting
- Educational and learning process
- Patient and family centered
- Rehabilitation teamwork
- Active and dynamic process
Rehabilitation Interventions

- Physical Therapy program
- Occupational Therapy program
- Prosthesis/Orthosis
- Mobility aids and adaptive devices
- Environmental modification
- Speech Therapy
DEFINITION

- **Immobilization, Immobility**
  - Physical restriction of movement involving a body segment or the entire body.
  - Physical restriction or limitation of body members and of the body in turning, sitting and ambulation
DEFINITION

- **Deconditioning**
  - A reduced functional capacity of multiple body systems, especially the musculoskeletal system
  - The multiple, potentially reversible changes in body systems brought about by physical inactivity and disuse
Common Causes of Immobilization

- Neuromuscular disorders and injuries
- Orthopedic casts, body jackets, splints after trauma or fracture
- Critically illness requiring bed rest
- Prolonged stays in a recumbent position or sitting position
Immobilization

Deconditioning
Deconditioning

- Musculoskeletal
- Respiratory
- Cardiovascular
- Genitourinary
- Gastrointestinal
- Integumentary
- Metabolic
- Neurological
Musculoskeletal System
Muscle Weakness and Atrophy

- With total inactivity
  - 10-20% decrease in isometric muscle strength per week or about 1-3% per day
- In 3-5 wks, complete immobilization can lead to a 50% decrease in muscle strength
- The loss was greatest during the 1st wk of inactivity and gradually plateaued at a 25% loss
Muscle Weakness and Atrophy

- Strength loss varies among muscles
  - 1 month bed rest caused 8-13% loss of cross-sectional area of selected leg muscles by MRI
  - Quadriceps m. declined 27% with 4 wks cast immobilization by CT

- Antigravity muscles lose strength disproportionately and large ones lose twice as quickly as smaller ones

- Strength that lost in 1 wk may take 4 wks to regain even with a maximal strengthening program
Prevention

- Daily isometric contraction of 20-30% of maximal tension for 10 seconds
- Muscle exertion at 50% of maximum capacity, 1 sec/day → more effective
- Use of electrical stimulation
- Early mobilization and ambulation
Contracture

- The lack of full active or passive range of motion (ROM) due to a joint, soft tissue, or muscle limitation
- Conditions producing limited joint ROM:
  - pain
  - muscle imbalance
  - spasticity
  - capsular or periarticular tissue fibrosis
  - primary muscle damage
  - mechanical factors (improper bed positioning, casting or splinting in a foreshortened position)
Contracture

- With immobilization as little as 1 wk
  - The soft tissue is replaced by more dense material with more collagen cross-links
  - Adapt to the shortened length by contraction of collagen fibers and a decrease in muscle fiber sarcomeres
Contracture

- With immobilization as 3 wk or more
  - The loose connective tissue in muscles and around joints gradually change into dense connective tissue → contracture on the relaxed side
Contracture

Most commonly involvement of muscles that cross two joints in the

- hips
- knees
- ankles
- shoulders
- elbows
- wrists and fingers
Shortened calf muscles cause a tight heel cord that keeps the foot in a ‘tiptoe’ position.

Shortened muscles-that-bend-the-knee cause tight cords behind the knee. This keeps it bent.

Shortened muscles causing hip contracture
Prevention

- Proper positioning
- Active or passive ROM exercises
- Splinting
- Early mobilization and ambulation
The trochanter roll should reach from above the hip to just above the knee.
Treatment

- Passive ROM with terminal stretch at least twice daily
- Prolonged stretch using low passive tension and heat
- Sustained stretch using CPM
- Progressive, sustained stretching of 2 hours or more
- Treatment of spasticity
- Surgical release
LIGAMENTS AND TENDONS

- Ligaments and tendons
  - longitudinally parallel type I collagen fibers
- While lacking longitudinal stress (immobilization) newly formed collagen is laid down in a haphazard array
- In primate model
  - ligaments lose 1/3 strength in 8 wks of immobilization
Ligaments and tendons

- Immobilization causes
  - ↑ collagen turnover
  - ↓ collagen mass
  - ↓ glycosaminoglycan and water content
  - ↑ soft tissue stiffness
  - alteration in fibroblast function
  - ↓ collagen-bone interface strength, bone resorption below insertion site
Disuse (immobilization) osteoporosis

- The loss of bone density due to increased resorption caused by lack of stimulus (e.g., weight bearing, gravity, muscle activity) on bone mass.

- Ratio of bone formation to resorption is influenced by stresses on bone → Wolff’s law.
Disuse (immobilization) osteoporosis

- More marked in the subperiosteal region, in contrast to senile osteoporosis, which develops from the marrow outward.
- Initially involves the cancellous bone at the metaphysis and epiphysis, later extends to the entire diaphysis.
- Reduced 40-45% after 12 wks of bed rest.
- By the 13\textsuperscript{rd} wk, more than 50% of bone density lost.
Disuse (immobilization) osteoporosis

- Osteoporosis of short duration (3 to 6 months) can be reversed nearly completely; longer ones can’t.
- While exercising might not reverse bone loss, it will slow its progression.
Prevention

- Weight-bearing standing:
  - standing frame or tilt table
  - Standing in parallel bar
- Active muscle contraction
- Early ambulation
Skeletal muscle pulls against the bone, causing it to rebuild and become denser.

Weights used as resistance.
Immobilization Hypercalcemia

- A condition often associated with osteoporosis, esp. in adolescent males who have had traumatic injuries.
  - symptomatic after 2 to 4 wks of immobilization
  - nausea, vomiting, abdominal pain, lethargy, muscle weakness and anorexia
  - If not treated, death can occur.

- Treatment:
  - IV furosemide and hydration
  - etidronate disodium
  - IV pamidronate and calcitonin
Heterotopic Ossification

- Abnormal bone growth location, usually around joints
- Not caused by immobilization, but generally found in persons who have trauma Hx (ex. SCI or direct m. contusion)
Joints

- **Hyaline cartilage**
  - no vascular blood flow
  - receiving nutrition from synovial fluid with imbibition (drawing fluid into and out of cartilage)

- **During immobilization** → simple diffusion → not adequate → joints begin to deteriorate → contact areas develop necrosis and erosions

- **Noncontact surfaces**: fissures and lose smoothness

- **Proteoglycan imbalance** → stiffer
  - compensatory cartilage proliferation and osteophyte formation;
  - fibrofatty infiltration with atrophic synovium;
  - subchondral bone deterioration;
The cardiovascular system
Cardiac deconditioning

- **Deconditioning-induced changes occurring at rest**
  - ↑ HR 1 beat/min 2 days for the first 3-4 wks of immobilization
  - ↓ resting stroke volume up to 15% after 2 wks of bed rest
  - ↓ blood volume 7% after 20 days of bed rest
  - ↓ Cardiac size by up to 11%
  - ↓ left ventricular end diastolic volume
  - CO remains unchanged or slightly decreased
  - Cardiac muscle atrophy may occur
  - Unchanged resting systolic and mean BP, total peripheral resistance, VO\(_2\) at rest and Arteriovenous oxygen difference
Cardiac deconditioning

Deconditioning-induced changes occurring during exercise

- ↑ 30-40 beats/min with submaximal exercise after 3 wks
- ↓ Stroke volume 30% at maximal and submaximal exercise
- cardiac output slightly declines at submaximal exercise and 26% mean drop at maximal exercise
- ↓ VO$_2$max 27% in maximal and submaximal exercise
Cardiac deconditioning

- **Recovery from deconditioning**
- It can take up to twice as long or more (with intensive training) to reverse VO$_2$max by 20 days of bedrest in previously active subjects
- After 3-4 wks of immobilization
  - HR recovery after exercise is 50% of normal by 16 days and is normal by 36 days
  - submaximal VO$_2$ recovers to normal between 16 and 36 days
Orthostatic (postural) Hypotension

- Impaired ability of the circulatory system to adjust to the upright position
- Prolonged bed rest → lose this adaptation → tingling, burning in the lower limbs, dizziness, lightheadedness, fainting, vertigo
  → ↑ PR (≥ 20 beats/min)
  ↓ SBP (≥ 20 mmHg)
Orthostatic (postural) Hypotension

- Most of the effects occur in 4-7 days of bed rest
- Developed rapidly in the elderly and medical illness
- More conditioned before bed rest had greatest deterioration
- Reversed after remobilization for twice or more time
Prevention

- Early mobilization (ROM exercises, strengthening exercises, ambulation)
- Abdominal strengthening and isotonic-isometric exercises of the legs
- Use of tilt table
- Use of Ace bandage wraps, full length elastic stockings, abdominal binders
- Adequate salt and fluid intake
Changes in Fluid balance

**Bed rest**  \(\rightarrow\) fluids shift from legs to thorax (central fluid shift)

\(\downarrow\)

\(\uparrow\) venous return to the heart

\(\downarrow\)

stretched carotid and aortic baroreceptors and cardiopulmonary mechanoreceptors

\(\downarrow\)

\(\downarrow\) aldosterone and antidiuretic hormone

**DIURESIS**

\(\downarrow\)

\(\downarrow\) plasma volume

(10% after 1 wk, 15% by 4 wks, plateaus around 70% of normal plasma volume and 60% of normal blood volume)

\(\downarrow\)

\(\uparrow\) Viscosity
Prevention

- Isotonic exercise: more twice as effective as isometric exercise
- Early ambulation
Venous Thromboembolism

- Immobilization → venous stasis, increased blood viscosity, and hypercoagulability

- Virchow’s triad of clot formation
  - factors intrinsic to blood
  - blood vessel injury
  - stasis of blood flow
Assessing Thromboembolism

- Inflammation
- Tenderness
- Aching
- Positive Homans’ Sign – calf pain when toes are dorsoflexed towards the body.
Prevention

- Active exercise: ankle pumps
- Use of elastic stockings or elastic wraps
- Proper position
- Use of low molecular-weight heparin in high risk
18mmHg Anti-embolism Stockings
☐ WHITE
Treatment Of Thromboembolism

- Anti-coagulant therapy
- Bed rest
- Anti-embolic stockings
- Avoid popliteal pressure
- Vital signs
Respiratory Changes

Caused by

- Mechanical restriction of breathing (reduced chest excursion due to progressive reduction of ROM in the costovertebral and costochondral joints) → rapid, shallow breathing
- Overall reduction in muscular strength and endurance → reduced movement of the diaphragmatic, intercostal, and abdominal muscles
- Ciliary malfunction and weakness of abdominal muscles → impaired cough
Respiratory Changes

- ↓ Tidal vol., residual vol., and vital capacity
- ↓ Diaphragmatic and chest wall movement
- ↑ Ventilation/Perfusion ratio mismatch,
- ↑ RR
- Hypersecretion and impaired cough mechanism
- Risk for atelectasis and pneumonia
Respiratory Changes
Prevention

- Frequent change in position
- Early mobilization
- Chest PT (deep breathing, incentive spirometry, assisted coughing, percussion/vibration)
- Adequate fluids intakes
- Adequate pulmonary hygienes
Genitourinary Changes

- ↑ diuresis and mineral excretion
- Calculus formation: 15-30% due to urinary stagnation, hypercalciuria
- UTI
- Long-term immobilization decreased GFR and urine concentration ability
Genitourinary Changes

Figure 41-6  Pooling of urine in the urinary bladder: A. The bladder is relaxed and the flow of urine is interrupted. B. The bladder is filled with urine and the flow of urine is continued. The detrusor muscle contracts to expel the urine from the bladder.
Prevention

- Adequate fluid intake
- Upright position for voiding
- Strict avoidance of bladder contamination during instrumentation
Gastrointestinal Changes

- Constipation
  - due to ↓ mobility, ↓ peristalsis, ↓ fluid intake, ↓ loss of plasma volume
    - Embarrassment of using bedpan causes delayed defecating
- ↓ GI secretion and ↑ GE reflux → ulcer
- ↓ appetite and malabsorption → malnutrition
Prevention

- Adequate fluid intakes and fiber-rich diet
- Stool softeners and bulk-forming agents
- Avoid using bedpan and narcotics medication
- Regularly-timed bowel program
Neurological system, emotions, and intellectual function

- Sensory deprivation: decreased attention span, confusion, disorientation to time and space, decreased hand-to-eye coordination
- ↓ intellectual capacity
- Emotional and behavioral disturbance
- ↓ balance and coordination
- Lack of motivation
- Critical illness neuropathy
  - symmetrical axonal sensorimotor neuropathy
  - mimics weakness of deconditioning
- Compression neuropathies
  - peroneal n. below fibular head
  - ulnar n. at retrocondylar groove
Prevention

- Encouraging the patient to interact with staff, other patients, and family members
- Recreational therapy for psychosocial integration, resocialization, adjustment to independent functioning
- Proper positioning
Integumentary system

- **Pressure ulcers**
- Capillary BP around 30 mmHg
- Position:
  - Sitting: ↑ ischial tuberosities pressure
  - Supine lying: ↑ sacral pressure, heels and occiput pressure
  - Side-lying: ↑ greater trochanter pressure
Metabolic and nutritional changes

- ↓ lean body mass
- ↑ body fat
- Disorder of nitrogen balance
- Mineral and electrolytes (nitrogen, calcium, phosphorus, sulfur, potassium) losses
Determining the Effects of Immobility

- Duration of inactivity
- Health status
- Sensory awareness
Bed rest, inactivity, disease

Deconditioning / Immobility syndrome

↓ Function
↑ LOS, Cost
Risk to Dead
- Pulmonary embolism
- DVT

- Pressure sore
- Infection: pneumonia, atelectasis, UTI

- Weakness
- Joint contracture
- Orthostatic hypotension
Summary of Preventative Treatments

- Early mobilization
- Strengthening
- ROM
- Maintain skin integrity
- DVT prophylaxis
- Pain management
- Psychological assessment / treatment
- Aggressive Respiratory management
- B/B assessment & care