

Unit V: Spinal Cord Injuries

Nursing 202: Advanced Concepts of Nursing

Review

Spinal Cord

- o About 18 inches long
- o The major bundle of nerves that carry nerve impulses from the brain to the rest of the body
- o Extends from the base of the brain to about the waist
- o **Upper Motor Neurons**
 - Lie within the spinal cord (above L1)
 - Carry messages back and forth from the brain to the spinal nerves along the spinal tract
 - Lesions: see spasticity, hyperreflexia below the level of lesion
- o **Lower Motor Neurons**
 - Spinal nerves that branch out from the SC to the body
 - Exit and enter at each vertebral level and communicate with specific areas of the body
 - **They activate the muscle they innervate**
 - Sensory and motor neurons
 - Lesions:
 - **Cause weakness, paralysis, flaccidity**

Vertebra

- o Function = protection & support
- o “Rings” of bone (33)
- o Named according to location:
 - Cervical (7)
 - Thoracic (12)
 - Lumbar (5)
 - Sacral (5) fused as 1
 - Coccygeal (4) fused as 1

Vascular Supply

- o Arterial
 - Anterior spinal and two posterior spinal arteries
 - Arise from Circle of Willis
 - feed the entire length of the spinal cord

Catastrophic Event

- o Most health care providers see SCI as the most devastating disability.
- o Changes the pt’s functioning & all physiologic systems.
- o Requires emotional & physiological adjustments.
- o Complex long term problems.

Significance:

Age

- o The average age of injury has increased from 29 years during the 1970s to 42 years
- o Most frequently between 16-30 years

Sex

- o Males 82%
 - More risk takers
 - Usually a hx of multiple injuries prior to SCI

🔧 Risk Factors

- Age
- Sex
- ETOH/Drug Use
- Time of year - summer

🔧 Research

- Costly!
- Can the gaps be filled in?
 - Neuroprotection- preventing further damage
 - Regenerate tissue- stimulate the regrowth of axons
 - Cell replacement- replacing damaged nerve
 - Robotic- assisted therapy
 - Stimulators
 - Brain-computer interfaces (BCI)
 - Bypasses the damaged circuits in the spinal cord

🔧 Etiology

🔧 Causes

- MVC = 42%
- Falls = 27.1% (usually in the over 75 group)
- Violence = 15.3%
 - Trauma (stabbings)
 - Gunshot Wounds
- Recreational sports 7.4%, 2/3 from diving
- Quadriplegia is slightly more common than paraplegia

🔧 Mechanism of Injury

🔧 Knowing the type of collision/accident can aid in assessment of injury (MOI)

- Forces responsible for hyperextension and hyperflexion
 - Acceleration (hit in the rear when stopped)
 - Deceleration (stopped while in motion)
 - Deformity (various alterations in the spinal cord and supporting structures)

🔧 Hyperextension (head snaps back)

- Usually fracture of posterior element of spinal column and disruption of anterior longitudinal ligaments.
- Rear End Collision (Whiplash)
 - Force from the rear
 - Theory for **20** years: head & neck thrust forward and then rebound back causing hyperextension, **BUT....**
- **Actual Mechanism**
- **Head erect → Collision → Seat pushed forward → Inertia keeps the head from moving so it moves backward into headrest → Rebound where head speeds up and catches up with the rest of the body → Flexion occurs**

🔧 Hyperflexion (head snaps forward)

- Head on collision
- Deceleration from the front
- Head and body continue moving forward until contact is made
- The head is forced forward until it rests on the chest.

🔧 Vertical Compression (axial loading)

- Vertical force on the spinal columns

- o Diving accidents, falls on buttock
- 🔦 **Rotation**
 - o Wedge fx
 - o Extreme lateral flexion or twisting of the head and neck
 - o May result in posterior ligaments tear, dislocation or fracture
- 🔦 **Penetrating**
 - o Missiles, bullets, knives
- 🔦 **Types of Injuries/Classification**
- 🔦 **Vertebral Column Injury without SCI**
 - o Immobilize
 - o Protect from SCI – bone fragment or unstable vertebrae can injure the cord
- 🔦 **Vertebral Column Injury with SCI**
 - o Prevent more damage!
- 🔦 **SCIWORA Syndrome**
 - o SCI without radiographic abnormality
- 🔦 **Vertebral**
 - o **Fracture**
 - **Simple = singular break**
 - Alignment usually intact
 - Usually no neural compression
 - **Compression (wedge)**
 - Often caused when vertebral column is flexed
 - Hard collar for 2 months
 - **Comminuted (burst)**
 - Vertebral column is straight with shattered vertebral body
 - Fragments can damage the cord
 - May need rodding and removal of fragments
- 🔦 **Vertebral**
 - o Dislocation
 - One vertebrae overrides another
 - Supporting ligaments often injured
 - Tx = traction & immobilization
 - o Stable vs. Unstable
 - o Special Type Cervical Fractures / Dislocation
 - Jefferson
 - Rare
 - Fx of C1
 - Burst Fracture
 - Unstable
 - From vertebral compression (axial loading)
 - Atlanto – Occipital
 - Dislocation
 - Avulsion of C1 body from occipital bone
 - Rare almost always immediately fatal
 - Odontoid (Dens) Fx
 - Need to R/O in all pts in MVC with neck pain
 - Can be missed in X-ray – need an open mouth view
 - Standard of care is now CT
 - Hangman Fx
 - Most unstable with neuro deficit

- Separation body of C2 from posterior elements
- Classified by the amount of displacement in body of C2
- Often fatal

🔦 **Partial (incomplete) SCI**

○ **Brown-Sequard Syndrome**

- Lateral cord syndrome
- ½ cord is transected into north and south
- Ipsilateral paralysis or paresis
- Contralateral loss of pain and temperature
- Example
 - **Left** side of the cord has been transected
 - Paralysis of all voluntary muscles below the injury on the **left** side (ipsilateral)
 - Loss of the perception of touch, vibration and position on **left**
 - Loss of perception of pain and temp on the **right** side of the body (contralateral)

○ **Central Cord Syndrome**

- Injury/edema of the central cord
- Motor weakening or paralysis in upper extremities, lower intact
- Hyperextension injury
- Hemorrhage in the center of the cord
- Have bowel and bladder dysfunction

○ **Anterior Cord Syndrome**

- Injury at the anterior spinal artery
- Flexion injury
- Loss of pain, temp, motor function below the level of the injury
- Light touch, position, vibration intact

○ **Cauda Equina Syndrome**

- “Horsetail” below the spinal cord
- Lumbosacral nerve roots
- Affects lower motor neurons (Flaccid paralysis of lower limbs)
- Bowel and bladder dysfunction

○ **Posterior Cord Syndrome**

- Motor & sensory function intact
- Lose position sense & vibration (proprioception)

🔦 **Levels of Injury**

- **Dermatome** identifies specific areas of the **skin** supplied by sensory fibers.
 - Touch, vibration, position, pain, temp
- **Myotome** identifies **muscle** group innervated by nerves
 - Motor function
- Case Study:
 - EMS arrives on scene of a 23 y.o. male diving off the dock into the bay. The patient cannot move his fingers or hands.
 - What level is his injury?

🔦 **Pathophysiology**

- Injury to the spinal cord occurs most frequently as a result of trauma to the vertebrae
- Predisposed Areas = C5-6
 - This is where the maximum movement of the cervical spine takes place
 - Cord is the largest at that level

- Multiple nerve fibers that feed the upper extremities
 - **Types of Injuries/Classification**
- Vertebral injury vs. spinal cord injury
 - Can have a fx without cord injury
- Anatomical abnormalities or disease processes
 - Chronic = spondylosis produces narrowing of the canal
 - Arthritis
 - Spurs
 - Degeneration
- Initial Injury
 - First SCI guidelines published in March 2002
 - Chain of Events
 - 1 hour – petechial hemorrhage in gray matter
 - 4 hours – infarction in gray matter
 - Hemorrhage, edema, metabolites act together to produce ischemia which progresses to necrotic destruction of cord
 - Hypoxia results – decreases O₂ supply below the level to meet the metabolic needs of the cord.
 - Increase in lactic acid and ↑ vasoactive substances= vasospasm = more hypoxia = more necrosis
 - 24 hours – permanent damage because of the edema that developed secondary to inflammation – cord compressed!
 - When the cord is compressed more, then inflammation ↑ at the site- = ischemia.
 - Additional edema extends the level of the injury beyond the immediate level of the injury for 72 hours to 7 days.
 - Makes it difficult to assess the extent of the injury.

Spinal Shock

- **Occurs after traumatic injury to the spinal cord (30-60 mins) parasympathetic response**
- Temporary syndrome
- Decreased reflexes, loss of sensation, and flaccid paralysis below level of injury
- Lasts days to months
- May mask post injury neurological function
- Active rehab can be started in the presence of spinal shock
- Results
 - Flaccid paralysis – complete loss of motor, sensory, reflex, and autonomic function below the level of injury.
- Signs & Symptoms
 - Flaccid → total paralysis
 - Loss of all spinal reflexes
 - Loss of all sensation – pain, temp, perspiration, etc.
 - Absence of somatic & visceral sensations
 - Unstable – ↓ B/P, ↓ HR
 - Flaccid bowel & bladder
 - ***Nursing Function = **need to ↓ distension and prevent kidney damage**
- Treatment
 - To decrease duration – basic principles to decrease or prevent edema

- Steroids!
- Recovery
 - Can last weeks – average 1-6 weeks
 - Ends when spastic paralysis replaces flaccid paralysis
- Prognosis
 - A person who gradually loses neurological functioning after an accident has some chance of recovering at least partial function when spinal shock dissipates.
 - Return of function is not due to regeneration
 - Spinal shock masks the function which may still be intact
 - Patient and family will ask about recovery but **there is no way to know at first!!**

🚨 Neurogenic Shock

- Second shock state that can occur after SCI above T6
- Injuries above this level disrupt sympathetic nervous system fibers (fight or flight)
- Since parasympathetic pathway is now dominant the end result is vasodilatation and decreased heart rate
- Decreased B/P from decrease venous return
- Produce classic S&S of shock
 - Hypotension, bradycardia

🚨 Management of SCI

🚨 Emergency Management – at scene and ongoing

- Goals:
 - Sustain life
 - Prevent further cord shock
- Suspect SCI in any patient with:
 - Wounds of the face, neck, head, and shoulders
 - Any unconscious patient
 - Head injuries
 - Neck pain
 - Any motor or sensory losses
 - Signs of spinal shock
- Treatments: A-B-C-D-E
 - **Airway**
 - C1-4 phrenic nerve does not function = loss of ability to cough & deep breath
 - Jaw thrust
 - No head tilt or chin lift
 - No flexion or extension of the neck
 - May need to trach
 - Stabilize the head
 - **Management of SCI**
- Treatments: A-B-C-D-E
 - **Breathing**
 - **Above C4 = loss of respiratory muscle**
 - **Below C4 = diaphragmatic breathing if phrenic nerve functioning**
 - Hypoventilation r/t decrease vital capacity
 - **Management of SCI**
 - **Circulation**
 - Hypovolemia
 - External bleed – can see and control
 - Internal bleed – more difficult

- o Remember neurogenic shock!!
- **Disability**
 - Baseline neuro status
 - Estimate cord involvement
 - Need to avoid flexion, extension, rotation of the spine.
- **Exposure**
 - Remove clothing
 - Log Roll
 - o Spine must be kept in neutral alignment
 - Patient must be placed on a longboard with cervical collar– WE move the pt!
 - o Meyer-Cervical Orthosis – provides constant cervical spine traction & reduces the risk of injury during resuscitation and transport
 - Temperature instability may occur, keep covered
 - Also remember other injuries – usually have multiple injuries (internal and head)

Emergency Dept Management

- o Assessment
 - Airway
 - Cervical Injury –**can identify if they are unable to move their fingers and hands**
 - Clear the C-Spine
 - Vital Signs
- o Obtain HX of accident
 - Mechanism of injury
 - Immediate neuro status
 - Treatment at the scene
 - Mode of transport
 - All vital data
- o General Hx
 - Pre-existing diseases
 - Medications
 - Allergies
- o Labs
 - Lytes
 - BUN – Creatinine (kidney assess)
 - ABG's
 - Urine (blood)
 - H&H – blood loss



- o Radiologic Exam
 - CT Neck is standard of care
 - May scan Head too depending on MOI
 - Ensure neutral alignment with transfer to scanner
 - Later:
 - Myelogram – check flow of CSF and locates blockage when CSF is interrupted
- o Treatments
 - IV = RL, do not overhydrate – this leads to ↑ cord edema, CHF

- Foley
 - Atonic bladder
 - Prevent urinary distension and retention
- NG Tube
 - ↓ gastric distension
 - Prevent aspiration of vomitus
 - Often have paralytic ileus
 - Give antacids
 - Get stress ulcers
 - Usually give with corticosteroids
- Steroids IV to ↓ cord edema and ↓ autodestruction
 - Solu-medrol → if given >8 hour after injury the outcomes are worse
 - Bolus (30mg/Kg) then drip (5.4mg/kg/hr)
 - **Calculations must be EXACT!** (weight based)
 - D/C on 10th day
 - Newer Therapy
 - Sygen = naturally occurring compound in cell membranes
 - Thought to help nerve cells regrow
- Use care in giving any analgesic – resp depression
- Maintain SBP > 90 (improve spinal cord perfusion)
- One episode of SBP < 90 could send the patient into spinal shock and cause permanent damage!

🔧 **Management of SCI**

🔧 **Early Management**

○ **Team Approach**

- Neurosurgeon
- Orthopedic surgeon
- Urologist
- Pulmonary MD
- Nursing
- PT / OT
- Psych
- Social Worker
- **Management of SCI**

🔧 **Early Management**

○ Immobilization

- To achieve as normal an anatomical alignment as possible
- Cervical injury – skeletal traction
 - Cervical tongs:
 - Gander Wells
 - Crutchfield-Vinke
 - Halo Device
- Tongs
 - Areas of insertion are shaved, prepped and local anesthetic is used
 - Drill burr holes over each parietal region
 - Insert points of tongs into skull – **traction from the skull**
 - Apply sterile dressing
 - Traction: extend rope from the center of tongs over a pulley and attach weights
 - Very frightening for the patient

- Daily care: dressing change, assess site
- Daily neuro exams
- Halo Device
 - Adjustable stainless steel hoop around the patients head
 - Secured to the skull with 2 occipital and 2 temporal screws
 - Steel bars anchor device to the patient's body cast or sheep skin lined vest
 - Allows patient earlier and greater mobility
- Immobilization
 - The patient with cervical traction:
 - Weekly x-ray
 - Hard collar follows traction
 - Soft collar follows the hard collar
 - Bed
 - Regular hospital bed with bedboard and firm mattress
 - Use alternating pressure mattresses to prevent pressure ulcers
 - Thoracic Injury
 - Immobilize with 3 possible methods
 - Halo device with femoral traction used when neuro deficit present
 - Body Cast – patient neurologically intact
 - Prolonged bedrest in the hyperextended position then brace
 - Sacral or Coccygeal Injury
 - Bedrest
 - Support with low girdle of adhesive strapping
 - Evaluate bowel and bladder

Surgical Management

- Spinal Cord Cooling
 - Cold saline irrigation to treat edema of traumatized segments
 - Cord is surgically exposed and cooling is initiated in the extradural space for approx 3 hours.
 - Results vary → increase in use with publicity from injured Buffalo Bills tight end. (September 2007, fx C3-C4)
 - Immediately cooled in the ED with ice packs, a cooling blanket, & cold saline
 - Hypothermia maintained in the OR and a few days post-op via a catheter.
 - Not indicated as a primary treatment
 - Need surgical decompression too
- Surgical Indications
 - Controversial!
 - Based on MD judgment
 - Contraindications
 - Pt who has demonstrated rapid and significant improvement in neuro function
 - Pt has life threatening injury or disease
 - Skilled personnel and equipment is not available
 - Indications
 - Evidence of cord compression
 - Progressive neuro deficit
 - Compound fracture with bony fragments
 - Penetrating wounds
 - Goals

- Stabilize the spinal column
- Procedures
 - Decompression laminectomy/ reduce the fx
 - Posterior laminectomy
 - Harrington rods – stabilization of thoracic deformities

🦋 **Autonomic Dysreflexia**

○ **Definition**

- Hyper-reflexia
- Occurs in persons with SC lesions above most of the sympathetic nerve outflow of the cord (T6)
- Occurs after spinal shock and return of reflex activity
- Occurs in response to visceral stimulation

○ **Pathology**

- Stimulation of the sensory receptors below the level of the cord lesion
- The intact autonomic system below the level of the lesion responds to stimulation with reflex arterial vasoconstriction = ↑ BP
- High BP is sensed by the baroreceptors in the carotid sinus and the aorta response is ↓ HR
- Visceral and peripheral vessels do not dilate because the efferent (motor) impulses cannot pass through the cord lesion.
- Most common cause is **distension of the bladder** or rectum, other causes can be stimulation of the skin or pain receptors.

○ **S & S**

- Life Threatening!! ⇒ requires immediate intervention
- BP 20mm above baseline (baseline is usually lower)
 - SBP can be up to 300 mmHg!!!
- **Headache!**
- Flushing & diaphoresis
 - **Skin becomes pale below the level of the lesion!**
- Bradycardia
- Piloerection (Goose Bumps)
- Nasal congestion
- Vision changes
- Anxiety

○ **Treatment**

- Elevate HOB 45 degrees
- Monitor BP every 3-5 minutes
- Loosen abd. Binder – decreases stimulation to the skin receptors
- Remove TEDS
- Assess bladder status – cath prn
- Notify MD
- BP > 140
 - 1 inch 2% nitro above level of injury
- BP > 160
 - Procardia SL every 20-30 mins
- Teach the pt and family to recognize S&S

🦋 **Horner's Syndrome**

- Paralysis of cervical sympathetic nerve trunk
- S/S
 - Ptosis of eyelid

- Loss of sweating over the affected side of face
- Recession of eyeball into orbit

Research

- **Transplant cells from embryos**
 - These cells ignore the nervous system's regeneration opponents
 - Stem cell research is very controversial
- **Regeneration of Axons**
 - Massachusetts General, 1999
 - Implanted tissue grafts into the spinal cord
 - Act as “Bridges”
 - Nerve cells are tricked into a growing state
- **Neural Prosthesis**
 - Electrical and mechanical device used to supplement lost motor/sensory function
 - Subcortical electrodes inserted
 - External device operated by the pt’s brain signals

Medications

- Fampridine
 - Enhances nerve conduction
 - Also used for MS
- MI monoclonal antibodies
 - Remyelinate axons
 - Pre-clinical stage
- CNS Stem Cells

How it Affects Each System

Cardiovascular

Effects

- Any transection above T5 greatly ↓ the influence of sympathetic nervous system
- Bradycardia
 - Result of unopposed effects of parasympathetic
- Decreased BP
 - Due to vasodilation
- Meds
 - Atropine
 - Vasopressor – dopamine
 - IV fluids
- Any procedure that increases vagal stimulation (turning, suctioning) ↓ the HR more and can cause cardiac arrest
 - May need a pacemaker

Chronic Low BP

- Improves when spinal shock dissipates
- Spasticity can help keep BP increased
- Postural Hypotension

DVT

- Caused by venous stagnation due to vasodilation and ↓ muscle tone, paralysis
- 15-20% develop DVT
- 5-15% of these develop PE
- Usually occurs in the 1st 3 months
- Assess

- Warmth, redness
 - Measurements
- Prevention
 - Low dose heparin
 - TEDS/EPC's
 - Passive ROM

Respiratory

Pulmonary Complications are the #1 Cause of Death With SCI!!

Review

- Diaphragm and intercostals are the major muscles of respiration
 - Impulses delivered to the intercostals by spinal nerves in the thoracic segments of the cord
 - Diaphragm receives its motor impulses via the phrenic nerve which arises from the cervical plexus (C1-C4)

Level of Injury

- **C4** = total loss of respiratory function
 - **Lose ability to cough and deep breathe**
- Both phrenic nerves (diaphragm) and intercostals do not function
- Injury lower than C4 can have edema that causes respiratory distress
- If only the intercostals are involved:
 - ↓ cough reflex
 - ↓ inspiratory ventilation
 - Pneumonia and atelectasis
 - ↓ expiratory pressure due to loss of abd. muscles passively pushing diaphragm upward

Assessment/Care

- Changes in rate, rhythm or quality of respirations
 - Resp suddenly become rapid and shallow with flaring nostrils = poor sign
 - Ask the pt to count up to 30, if he can't count to 10 then call and MD!
- Note anxiety, cyanosis, or mental confusion
- ABG's
- Intubation and later tracheostomy
- Ventilator may be needed
- Chest PT
- Quad Coughing
 - Stimulate action of abdominal muscles during expiratory phase of cough
 - Place heel of hand between umbilicus and xiphoid process and apply firm pressure during expiration
- Turning every 2 hours – postural drainage if possible

Research

- Phrenic nerve stimulation (diaphragm pacer)
 - MD surgically implants electrode around each of the two phrenic nerves
 - Each electrode is attached to separate Sub-Q receivers
 - Over one receiver an antenna is taped to the pt's skin and attached to a transmitter
 - Transmitter is set and controls rate and intensity of stimulation to diaphragm
 - Antenna is alternated to opposite receiver every 12 hours = allows for resting and activity periods of each phrenic nerve.
 -

Gastrointestinal

Spinal Shock Stage

- No involuntary or voluntary emptying of bowel
- Constipation and Impactions occur
- All of the bowel except the lower 1/3 of the colon is innervated by the vagus nerve and will function normally
- Watch for paralytic ileus
- Distension – NG tube with intermittent suction
- SSE or saline enemas every 3rd day to wash out the bowel
 - Long term – avoid enemas
 - Intestines distend easily, use with caution

Stress Ulcers

- H2 blockers – Zantac, Pepcid for 6-14 days
- Assess stool for blood
- Steroids increase potential for ulcer

Bowel Retraining

- After spinal shock dissipates, the pt begins to have reflex emptying of the bowel following a stimulus
 - Meal or abdominal effleurage
- Maintain accurate I&O
- Establish routine patterns of bowel elimination through use of suppositories
- Plan diet to avoid diarrhea/constipation
- Have pt sit on toilet or commode
- Maintain privacy
- *Goal: BM every day or every other day and will not be incontinent at other times!*

Genitourinary

Normal Voiding

- Voiding may be involuntary or voluntary
 - Involuntary when only the spinal reflex mechanism operates
 - occurs when not potty trained
 - Voluntary when the sensation of the need to void is carried to the brain and the person is able to relax the muscles of the perineum & contract the abd muscles to help initiate voiding.

After SCI

- Urinary retention is common during spinal shock
- All reflex activity, motor, and sensory functions are lost below level of injury
- Bladder is atonic and over distended causing hydro-ureter and hydronephrosis, infections, & kidney damage
- Need foley cath or cath program to prevent distension & kidney damage

Complications

- Urinary Stones:
 - Pt is not weight bearing = loses Ca⁺ from bones
 - Ca⁺ is excreted via urinary tract
 - Stones form from excess Ca⁺
 - Prevention:
 - 3000ml fluid/24hrs
 - Cranberry juice to help keep urine acidic

- Use of internal acidifiers – Vit C
- Avoid alkaline/ash foods
- Weight bearing ASAP
- o UTI
 - Can lead to renal damage, one of the leading causes of death
 - Prevention:
 - Aseptic technique during cath
 - Individualized bladder training program
 - 3000-4000ml fluids in 24 hours
 - Keep urine acidic
 - Prevent traction and irritation to meatus – secure cath properly
 - May use proph antibiotics

Nursing Measures

- o I&O
- o Force fluids
- o Observation: urine color, conc, sediment
- o Cath care
- o Meticulous perineal washing

Integumentary

Decubitus Ulcers

- o Lifelong Risk
- o 1/3 of all SCI patients will develop pressure ulcers in the first year
- o Causes
 - Inability to move
 - Sensory losses prevent sensations of discomfort
 - Cannot recognize need to be moved
 - Circulation to areas below the level of injury is ↓ by the depressed autonomic nervous function and ↓ muscle tone
- o Prevention: Skin care measures are imperative!
 - Turn frequently – max time is 2 hours
 - Mobilize asap
 - Beds
 - Stryker and circoelectric – set turning schedule
 - Reg. Bed – alternating pressure mattress
 - Keep dry
 - Do not use incontinence pads
 - Careful and ongoing skin assessment

Poikilothermism

- o Adjustment of body temp to environmental temp
- o Cause
 - Interruption of sympathetic nervous system prevents temp sensations from reaching hypothalamus & ↓ control of cutaneous blood vessels
 - ↓ heat generation due to minimal movement
 - ↓ ability to sweat and shiver
 - Vasodilation
 -

Musculoskeletal

Initial & advanced changes

- o Bone

- Initial
 - Skeletal mal-alignment
 - Loss of Ca⁺ = lack of weight bearing leads to decalcification
 - ↑ risk of fx and kidney stones
- Advanced
 - Skeletal deformities
 - Generalized osteoporosis

Initial & advanced changes

- Joints
 - Joint stiffness
 - Shortening or stretching of ligaments
- Muscles
 - Initial
 - Muscle weakness
 - Shortening or stretching of muscles
 - Advanced
 - Muscle atrophy
 - Fibrotic changes and muscle contractures
- After Spinal Shock
 - Lack of control from the brain
 - Acute Phase – flaccid then into spastic phase
 - Reflexes may be inappropriate and excessive
 - **Musculoskeletal**
 - Spinal Automatism = spinal reflex activities that automatically occur following severance of the cord
 - They are primitive spinal mechanisms normally kept inactive by higher centers
 - Following transection of the cord, the lower part of the cord works automatically on its own
 - The brain can no longer influence those reflex movements that are built into the cord
 - Response to Stimuli:
 - Persistent abnormal erection of the penis, generally w/o sexual desire – stimulation of the skin of the lower abdomen and thighs
 - Autonomic bladder – stimulation of the lower abdomen; reflex emptying of the bladder
 - Mass flexion

Musculoskeletal

Muscle Spasms

- Spasms and spasticity occur after spinal shock dissipates and when lower motor neurons are intact
 - Lower motor neuron fires impulses that result in contraction of skeletal muscles
 - Normal control from the cerebellum and brainstem structures have no influence over these lower motor neurons below the level of injury
 - The higher the cord injury the greater the body area involved in spasms.
- Can occur spontaneously or in response to stimuli and often continue until the stimulus is identified and removed
- May develop 2 weeks to several months following injury
- Mild spasticity can benefit: prevents atrophy and osteoporosis

- Extensor spasticity allows for weight bearing
- Severe spasticity – detrimental effects exceed benefits
 - Difficult to stay in wheelchair
 - Reflex resistance to ROM = improper positioning

🔦 **Contractures**

- Connective tissue changes from disease can produce muscle shortening within 3 days
- Muscles used to flex are stronger than those used to extend so pt is more likely to contract in a flexed position than in an extended one

🔦 **Muscle Weakness/Fatigue**

- Need to counteract force of gravity on weakened muscles

🔦 **Pain**

- Often have pain present at the level of the injury which radiates along the spinal nerves originating in that area
- Ex: CP may occur following thoracic injuries while leg pain may follow an injury at the lumbar level
- Treat with analgesics
- Pain with spasms
 - Medications
 - Opiates
 - Sedatives
 - Antispasmodics

🔦 **Neurogenic Heterotopic Ossification**

- Osteogenesis in a part of the body which does not normally form bone – such as: soft tissue
- Cause is unknown
- 30% severe SCI patients develop – more in quads
- Found below the level of injury

🔦 **S&S**

- Redness- warmth
- Decreased ROM
- ↑ alkaline phosphatase
- Swelling
- X-ray – shows osseous formation 3-4 weeks after S&S (dx w/bone scan)

🔦 **Treatment**

- No definitive treatment exists
- Position changes, splinting, ↑ ROM, Indocin
- Didronel – regulates bone metabolism, slows new bone formation

🔦 **Care & Treatments**

- Alignment most important
- Prevention:
 - Why?
 - Seriously limits pts ability to make an optimal recovery
 - Ex. Hand/arm contracture may keep them from dressing, feeding, grooming themselves
 - Splints for wrist drop and foot drop
 - Props – pillows, rolls, footboards, etc.
 - ROM – start asap

🔦 **Treatments for Muscle Spasms**

- Relaxation

- o PT
- o Hydrotherapy – whirlpool baths
- o Medications
 - Dantrolene – skeletal muscle relaxant
 - Baclophen
 - Robaxin
 - Valium
- o Drastic Measures
 - Obliterate or sharply decrease lower motor neuron functioning (↓ spasm)
 - Rhizotomy
 - Blocks
 - If spasticity is eliminated also sacrifice activities that the intact lower motor neuron allowed person to have – reflex bowel, bladder, sexual function

Psychological Care

Factors

- o Loss of body image
- o Dependency
 - Need others for feeding, turning, bathing

Psychological Care

Stages

- o Initial Shock/Denial
 - Disaster has struck
 - Reaction is disbelief
 - Denial is main defense
 - Others may go along with their denial
 - Will appear bright
 - Don't push him into reacting and don't go along with their denial

Anger

- o Reality hits and hits hard
- o Lashes out at anyone and anything
- o Blames anyone
- o Verbal assaults (often sexual)
- o Be prepared:
 - Accept the pt but not their behavior
 - Don't alienate
 - Don't allow manipulation
 - Try to get the pt involved in their own care!!
- o Staff will suffer during this phase
- o Family needs support

Factors that affect progress during these phases

- o Previous personality difficulties
- o Alcohol/drug dependencies
- o Compulsive personalities
- o Importance of appearance
- o Livelihood – were they an athlete, dancer, etc?

Depression

- o May exhibit regression or severe crying spells

- Suicidal but unable to complete
- Family needs compassion and support
- Vent feelings
- 🔦 **False Hopes of Cure (4th stage of adjustment)**
 - Builds unrealistic hopes for a new discovery
 - Religion may become important
 - Clergy is usually beneficial
- 🔦 **Acceptance**
 - Comes with a mature feeling of interdependence
 - Functions within limits of disability
- 🔦 **Rehabilitation**
 - Most therapeutic setting is an environment that assesses, treats, and empowers the pt & family
 - Recovery and limitation depends on the level of injury and motivation
- 🔦 **Sexuality**
- 🔦 **Sexual Beings**
 - The patient may not express concerns even though he/she is experiencing them
 - May make inappropriate comments
 - May seem crude
 - Make a pass
 - Their attempt to be acknowledged.
 - Don't be offended, reprimand or put down
 - Be matter-of-fact that you'll discuss or find someone who will
- 🔦 **Lesions**
 - Damage depends on type of lesion
 - Complete UMN
 - Cannot ejaculate
 - Can't have orgasm
 - Cannot father children
 - Incomplete UMN
 - Depends on the extent of the lesion
- 🔦 **Lesions**
 - Complete LMN
 - 75% unable to have erections of any kind
 - 25% can have psychogenic erections
 - Incomplete LMN
 - Up to 83% can have psychogenic erections.
 - 50-70% may be able to ejaculate
 - 10% may have children
- 🔦 **Counseling**
 - Wait until the person is ready
 - Involve the family (as appropriate)
 - Encourage open talk with partner
- 🔦 **Sexual Function**
 - Psychogenic Erection
 - Requires intact spinal cord and parasympathetic nervous system
 - Stimulus originates in the brain, travels to the thoracic cord (T12-L2), then to the parasympathetics going to the penis(S2-4)
 - Any interruption in this pathway will interfere with psychogenic erection

- o Reflex Erection
 - Requires intact sacral cord and S2-4
 - Utilizes spinal reflex arc
 - Stimulation by light touch or friction elicits this type of erection
 - 90% males with cervical cord injuries experience reflex erections
 - 75% males with lumbar injuries cannot because of involvement of sacral reflex arc
- o Fertility
 - Males = most become infertile related to testicular atrophy and impaired spermatogenesis
 - Sperm usually lower in number and poorer quality
 - Don't move well or as fast
 - Many dead sperm present
 - Not abnormal at the DNA level
 - Female usually remains fertile
- o Female Issues
 - Lubrication
 - Menses – amenorrhea up to 9 months
 - Pregnancy can occur
 - Precipitous delivery risk
 - Specific complaints for women with SCI:
 - o ↑ urinary incontinence
 - o Autonomic dysreflexia
 - o Resp insufficiency
 - o Thrombophlebitis
- o Female Issues
 - High Risk for Autonomic Dysreflexia from uterine cx
 - Higher if using pit
 - May need epidural and vac extraction (can't push)
 - Usually don't need an episiotomy – pelvic floor relaxed
 - Breastfeeding – physiology of lactation may be affected with injury T6 or higher

Spinal Cord Tumors, Abscesses & Vascular Disorders

Spinal Cord Tumors

S&S

- o Pain
- o SC compression with pain
- o Numbness & tingling in extremities
- o Bowel & bladder dysfunction
- o Paralysis

Spinal Cord Abscesses

- o **Rare**
- o **Cause**
 - Staph and Strep organisms most often cause from open trauma of spinal cord or osteomyelitis
- o **S&S**
 - S&S of infection – fever, chills, erythema, warmth over SC region
- o **Dx**
 - Myelogram – dx and pinpoint the location
 - CT spine

- MRI spine
- o Tx
 - Goal: halt the growth of the organisms and restore neuro function
 - IV antibiotics
 - Steroids
 - Decompressive laminectomy – aspirate, irrigate, drain; drain is often left in place post-op
 - Possible recurrence so follow-up assessment!

Vascular Disorders

- o Possible to have rupture, thrombosis, or embolism of SC vessels – usually secondary to meningitis or compression
- o Myelomalacia
 - Softening or infarction of SC resulting from spinal artery occlusion
 - Poor prognosis
 - S&S:
 - Motor and sensory deficits below the level of infarction
- o Embolism is rare
- o Thrombosis – usually secondary to meningitis or cord compression
- o Nursing Interventions:
 - Maintain body functions
 - Prevent complications of immobility
 - Pain relief

Hematomyelia

- o Hemorrhage into the substance of the spinal cord
- o Almost always caused by trauma, but may be from bleeding disorders
- o S&S
 - Usually develop suddenly – immediately after injury
 - Depend on size of hemorrhage and level of hemorrhage in spinal cord
- o Treatment
 - Surgery – stop bleeding & relieve compression