We feel pretty confident that you’ll not only pass, but kill the written exam.

Anonymous Group (2013 UBC Grads) – 2nd draft

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Learn because you want to know, not because you need to know.
And get enough sleep.

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Remember - it’s just an exam.
NEUROMUSCULOSKELETAL (50%)

01.01 MUSCLE CONTUSIONS/STRAINS/TEARS/WEAKNESS

**Muscle injury and repair**
- **Inflammation:** 24 hrs to 3-4 days after
  - Myofibers rupture and necrosis
  - Hematomas
  - Inflammatory cell reaction
- **Repair:** 5 days – 2 weeks
  - Phagocytosis of necrotic fibers
  - Regeneration of myofibers
  - Formation of scar tissue
  - Capillary ingrowth
- **Remodeling:** 14 days onwards to 21+ → complete will take sometimes up to 2 yrs (tendon)
  - Maturation of myofibers
  - Contraction and organization of scar tissue
  - Recovery of function

**Contusion**
- Muscle injury d/t sudden heavy compression force
- Result: bleeding in deep muscle regions
- **RX → 1st 48 hrs:**
  - PRICE, no HARM (heat, alcohol, running, massage)
  - Put muscle on as much stretch as possible (prevent healing in shortened range)
  - Crutches if necessary
  - Gentle pain-free ROM/stretch
  - Progressive ex after acute phase
- **Recovery time → dependant on grade:**
  - I → mild → 2-3 wks
  - II → moderate → 4-6 wks – may walk with limp, can continue sport
  - III → severe → 8 wks - immediate swelling, unable to walk
- **Complications**
  - Compartment syndrome → check capillary refill and sensation, muscle strength
  - Myositis ossification → suspect if haven’t improved after 2-3 wks

**Strains & Tears**
- Acute or chronic
- **Majority occur in bi-articular mm @ mm-tendon junction**
  - Mainly occurs during ECCENTRIC loading
- **Risk factors:**
  - Prior injury, age, no used to activity, training errors, biomechanics (poor control, inflexible)
- **Grading:**
  - I → microscopic tearing → pain, no weakness
  - II → macroscopic tearing → pain + structural change (laxity, decreased strength)
  - III → complete tear → painless + weak, may see lump
    - Ddx → neurological impairment (myotomal weakness)
- **AX:** RULE OUT OTHER CAUSES → look at A/PROM, STRENGTH, MUSCLE LENGTH, LIG/STABILITY TESTS
- **RX:**
  - Acute/Inflammation → PRICE, crutches if LEs
  - Repair → modalities (US, IFC), DTF, strength, stretching
  - Remodeling → strength (increase load, velocity) + stretching (static/dynamic)
  - Return to play if:
    - Symmetrical muscle length, strength, power, no s/s, core control
• completion of progressive fx progressions + sport specific drills + practice session

Laceration
• Require surgical repair
• RX:
  o Careful of muscle force going through sutures
  o Small + progressive loads
  o May need other footwear

Muscle weakness
• Differentiate btw weakness (no pain) vs. contractile lesion (sprain → pain) vs. myotomal weakness (step-like, no pain)
• Will see → compensation/altered mov’t patterns

DOMS → delayed onset muscle soreness
• after unaccustomed ex w/in 72 hrs
• possibly d/t local nerve endings response to altered env (acid, pH, swelling, inflammation)
• RX:
  o Light activity → cycling, walking, ankle pumps
  o Massage/bath
  o Avoid anti-inflammatories, if possible
PELVIC FLOOR DYSFX

- Innervation – PUDENTAL NERVE (S4-5) off sacral plexus
- Ax via:
  - Digital, EMG, manometric, dynamometer, real-time US, MRI, biofeedback

Chronic Pelvic Pain

- Pain > 3mo, btw diaphragm & knees
- Causes – MSK, neuro, gynecological, urogenital
- Age: 25-35 yrs
- Ax for: urogenital s/s, lumbar/pelvic/groin mechanical presentation, core activation difficulty
- RX:
  - ↓ pelvic floor resting tone
  - ↑ pelvic floor proprioception
  - ↑ motor control
  - ↓ pain sensitization

Pelvic Girdle Pain

- ~50% pregnancies → weakness/laxity of PFM during pregnancy/childbirth
- Risk factors – previous hx back pain/trauma
- Causes – laxity, asymmetry, inadequate motor control
- SYMPTOMS:
  - Pain - ant/lat/post pelvic, groin, ant/post thigh, abdomen, coccyx
    - With sustained positions (prolonged sitting/standing) OR
    - With transitional mov’ts → rolling, sit-to-stand, walking, stairs, dressing
  - SIGNS:
    - Posture → locked knees, Lspine lordosis, thoracic kyphosis, FHP
    - Asymmetry → standing & supine
    - Gait → shuffling, waddling, leg drag
- AX:
  - ASLR w/ force/form closure
  - Hip quadrants (ER/IR)
  - SIJ stability → P4, ganglens, FABERS, long dorsal lig palpation
  - TOP spinous processes
  - TOP piriformis
  - Resisted Hip ADD/ABD
- RX:
  - Education → positions to avoid, mov’t strategies
  - Posture
    - Standing – lift chest, soften knees, equal weight distribution
    - Sitting – lumbar support, knees at hip height or lower
    - Sleeping – pillow to maintain neutral neck, offer support
  - Manual therapy
  - Exercise → stabilize, symmetry
    - PFM exs (overload mm w/ longer holds, shorter rest, w/ fx mov’ts)
    - Maintenance – 8-12 contractions, 2x/wk
  - Mov’t strategies
    - Use glutes (NO rotation)
- Condition Progression:
  - Cystocele → herniation of bladder into vagina
  - Rectocele → ‘ ‘ of rectum into vagina
  - Uterine prolapse → ‘ ‘ uterus into vagina
LIGAMENT SPRAINS/TEARS

- Ligament → inert structure
  - If sprained → pain w/ activity + PROM, possible asymmetry (structure change)
- Grades:
  - I: minor rupture → few fibers torn, stability maintained
  - II: partial rupture → increased laxity, NO gross instability
  - III: complete rupture → gross instability
- AX:
  - Stability testing → LAXITY + END FEEL
  - Pain
- RX:
  - Acute
    - PRICE, structural support, offload area → orthotics, braces
  - Repair
    - Stability w/ muscle strength (esp if chronic sprain)
    - DTFM, modalities
    - Progressive loading (strength/stretch) → linear mov’t
  - Remodelling
    - DTFM
    - Progressive loads + dynamic mov’t (multidirectional)
    - Sport/function specific

Syndesmotic Ankle Sprain (High Ankle Sprain)

- MOI
  - Planted foot + IR of LE = ER of mortise OR
  - hyperDF, hyperPF
- Ligaments affected:
  - ATFL, PTFL, interosseous
  - Possible tearing of other ligs, #, bone bruise, OA
- S/S:
  - Not much swelling, limited DF, antalgic gait (pain w/ weightbearing)
  - TOP @ injury site → ATFL, PTFL, anterior distal tib-fib area
- DX:
  - foot ER stress test, squeeze test (proximal tib-fib), fibular post/ant translation
  - squat test → DF w/ pain, malleolus stabilization test decreases pain
  - heel thump test, one-legged hop test
- RX
  - Phase 1 (2wks) → PROTECTION PHASE
    - PRICE, ↓inflammation, modalities for edema
    - Light ROM
    - NWB with crutches
  - Phase 2 (2-4wks) → MANAGEMENT PHASE
    - Joint mobs
    - Regain mobility
    - ↑strength & fx
    - PWB ambulation, bilateral stance training
  - Phase 3 → MANAGEMENT
    - ↑function
    - unilateral balance & strength
  - Phase 4 → RETURN TO SPORT
    - cutting, jumping, more aggressive strengthening
- Recovery → 2x as long as regular ankle sprains
TENDONOPATHY, TENDON RUPTURES/TEARS, TENDONOSIS

- Tendon – composed of:
  - tenocytes (crave mech load) + ECM (collagen, glycosaminoglycan)
- Loading tendons:
  - ↑collagen synthesis, cellular proliferation, alignment
  - too much = fiber disruption

Tendonopathy/tendonosis  \((\text{i}tis = \text{inflammation})\)
- Chronic microtrauma → loss of collagen organization (≠ aligned)
- Don’t see: EVIDENCE OF INFLAMMATION → anti-inf drug won’t work
  - \(\text{i}tendinitis = \text{inflammation (d/t overloading} \rightarrow \text{pain} + \text{swelling from tendon tears})\)
- Do see: collagen disorganization, glycosaminoglycan, variable tenocyte density, ↑vessels/nerve
- RX: proper loading/resting of tissue

Achilles Tendonopathy
- Risk factors
  - Age, BMI/diabetes, MALE
  - Sport (running), training errors, footwear
  - Pronation, \(\downarrow\)DF, \(\downarrow\)LE strength, tight/weak calf mm
- S/S
  - Thickened tendon, TOP
- DDX
  - Achilles tendon partial rupture
    - hx → trauma
    - \(\varnothing\) respond well to training program
  - Sever’s disease (paeds)
    - Inflamed calcaneal apophysis → pulls on tendon at insertion
    - Effects growing, active children (9-14yrs)
    - RX → activity modification, gentle exs
- RX
  - NSAIDS (if acute)
  - Alter contributing factors → pronation, mm imbalance, myofascia restrictions, core
  - Progressive ex program → ECCENTRIC LOADING NECESSARY
    - Bilateral → unilateral
    - Only drop to neutral foot
    - Pain level <5/10
    - Don’t want pain next day or loss of fxn
  - Footwear w/ heel lift, orthotics/brace
  - Stretching, manual therapy

De Quervain’s Tenosynovitis
- Tendinosis of sheath/tunnel surrounding:
  - EXT POLLICIS BREVIS
    - O – post lower 1/3 radius
    - I – base of proximal thumb phalynx
    - F – ext + abd thumb
  - ABD POLLICIS LONGUS
    - O – ulna, radius, interosseous membrane
    - I – base of 1st metacarpal
    - F – abd thumb
- S/S
  - Chronic pain
  - Tendon thickening
  - Increased w/ repetitive hand/wrist mov’t
- AX/DX
Finkelstein test
- Tuck thumb in fist → ulnar wrist deviation → +ve if pain along distal radius

RX
- Acute → off load tissue, PRICE, risk factor education
- Corticosteroid injection (50% effective)

Lateral Elbow Pain / Tennis Elbow
- Age: 35-55 yrs
- Tendinosis (80%) or Partial Tear (20%)
- 90% cases involve ECRB - EXT CARPI RADIALIS BREVIS
  - O – lat epicondyle
  - I – post base of 3rd metacarpal
  - F – ext + abd hand
  - N – radial nerve (deep branch)
- 10% involve COMMON EXT TENDON & origin of ECRL
  - O – lat supracondylar ridge
  - I – 2nd metacarpal base (radial side)
  - F – ext + abd hand
  - N – radial nerve
  - Symp → with wrist/finger ext &/or gripping
- S/S
  - Worse w/
    - Gripping (hand tools)
    - Repetitive reach/grasp
    - Repetitive overload (typing)
- AX
  - TESTS: +VE if pain over lateral epicondyle
    - Resist 3rd finger PIP FLEX (elbow ext, shoulder @ 90)
    - Resist Wrist flex + ulnar dev (elbow @ 90)
    - Passively pronate forearm, flex wrist + ext elbow
  - TOP common origin, trigger points in muscle belly
  - NO nerve S/S – check w/ radial bias ULTT
- DDx
  - Cspine referred (C5-7), shoulder referred, nerve entrapment
  - Bursitis (radiohumeral bursae), LCL sprain, proximal radioulnar joint affected
- RX
  - Acute
    - PRICE - control P & inflammation
    - Modalities (US, TENS)
    - Maintain mm length/mobility (AROM @ elbow, wrist, hand)
    - Offload tissue – tennis strap
    - Education: avoid NSAIDs, posture, rest breaks
  - Repair
    - Gentle stressing of collagen → DTFM + stretching
    - Eccentric strength training
    - Manual therapy as indicated
    - Needling/Mulligans
  - Outcome measure
    - Hand grip dynamometer

Rotator Cuff Tendonopathy
- Usually long head of biceps tendon & supraspinatus (impingement)
• TYPES:
  o 1° impingement → NARROWED SUBACROMIAL SPACE (older pt)
    ▪ Intrinsic factors → anatomical abnormalities, degenerative change
    ▪ Extrinsic factors → muscle imbalances, postural faults
  o 2° impingement → INSTABILITY (pt <35)
    ▪ Microtrauma → instability → subluxation of humeral head → impingement
      ▪ Overhead activities/sports → microtrauma of stabilizers
      ▪ Ant capsule lax, Post capsule tight → ant humeral head sublux

• S/S
  o PAIN with overhead activity, repetitive shoulder motion, longstanding
• AX
  o Neers, Speeds, Empty can
• RX
  o Correct biomechanical faults, muscle imbalances
  o Modalities
  o DTFM
  o Manual therapy
  o Education (training errors, position, self-mgmt, stretches)

**Patellar Tendonopathy → Jumper’s Knee**
• Repetitive loading in extensor mechanism of knee
• Risk factors:
  o male, jumping athletes, jump height, reduced DF, age, BMI
• RX
  o slow heavy load (eccentric and concentric), scan (find muscle imbalances and biomechanical faults), knee may be in valgus position,

**Gluteal Tendonopathy**
• greater trochanteric pain syndrome

01.01.05
**FASCIITIS, FASCIAL TEARING, MYOFASCIAL RESTRICTION**
• fascia surrounds muscles (within muscle), tendons, ligaments, bone

**Myofascial Pain Syndrome**
• TOP → trigger point (focal irritation) found within a muscle
• Onset → sudden overload, over-stretching
  o &/or repetitive strain, sustained mm activities
• RX
  o dry needling (IMS), injections
  o flexibility, ROM, mm length
  o soft tissue massage
  o modalities, cryotherapy
  o manual therapy if poor joint mechanics

01.01.06
**JOINT DERANGEMENTS/DYSFUNCTION**

Loose body
- free floating piece of bone or cartilage
- often result of OA or chip fracture
- S/S
  - Locking / catching
- AX
  - ROM end feel as a bony block or may be springy

**HYPERMOBILITY**
- Excessive laxity or length of a tissue
  - ROM/neutral zone of joint
    - (neutral zone = ROM in position osteoligamentous structures provide minimal resistance → joint glide most free)
- Instability → excessive ROM of athrokinematics or osteokinematics
  - no muscular control
  - form vs force closure
- Causes
  - Trauma VS Non trauma (genetic, adjacent hypomobility, habitual movements)
- RX
  - mobilize stiff or hypomobile tissue/joint/segment
    - manual, IMS, massage, stretch
  - strengthen to stabilize the hypermobile segment/tissue
  - movement retraining → maintenance
  - supportive devices (brace/tape)

(ysis → pars #; listhesis → # or slip of cranial vertebrae anteriorly)

1. **Spondylosis**
   - OA of spine → degeneration of joints
     - can lead to disc herniation &/or stenosis

2. **Spondylolysis**
   - Pars interarticularis (fibrous tissue) defect
     - degeneration of spine joints
   - Seen in younger pt w/ hyperEXT & ROT sports
   - Most ASYMPTOMATIC
   - IF BILAT → may lead to spondylolisthesis

3. **Spondylolisthesis**
   - Slipping of one vertebrae on another
   - Common at L5/S1
   - MOI → hyperEXT, likely in young athelete
   - TYPES
     - Spondyloytic spondylolisthesis
       - Progressive period of rapid growth
       - Rarely progresses to adult life
       - Younger population
     - Degenerative spondylolisthesis
       - 2º to DJD + Z-joint subluxation → OA of joints in spine, foramina narrowing
       - Older population
   - Grading
     - I-IV → 25% of each grade of slippage
   - S/S
     - Central LBP +/- referred pain
     - Aggravating factor → EXT
     - Easing factor → FLEX
   - RX → Stability
     - FLEXION exercises
o Inner unit exercises → deep neck flexors or TA/multifidus/PF)
o Brace → if appropriate
o Never mobilize in direction of instability or if reactive spasm
o Work into painful range with proper stability
o Surgery with:
  • ↑ slippage or instability even with brace
  • hard neurological signs
  • evidence of spinal cord involvement
  • intractable pain despite tx

**HYPOMOBILITY** = ↓/restricted ROM

• MOI
  o adaptive shortening of soft tissue (tightness or contracture) or joint
  o inappropriate EF

• Structural:
  o Muscle → atrophy & weakness
  o Tendon → ↓ tensile strength
  o Ligament → ↓ tensile strength, ↑ stiffness/adhesions
  o Cartilage → ↓ synovial fluid, H2O content
  o Bone → ↑ resorption, ↓ bone mass/mineral content

• Contributing factors
  o prolonged immobilization
  o sedentary lifestyle, aging
  o postural dysfxn
  o paralysis or tone abnormality
  o muscle imbalance

• Capsular patterns
  o Pattern of ROM loss → implies joint capsule involvement

<table>
<thead>
<tr>
<th>AREA</th>
<th>CAPSULAR PATTERN</th>
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<tbody>
<tr>
<td>Spine</td>
<td>FLEX – full ROM, pain</td>
</tr>
<tr>
<td></td>
<td>Ipsi EXT + SF + ROT -- ↓ROM, pain</td>
</tr>
<tr>
<td>Glenohumeral</td>
<td>ER &gt; ABD &gt; IR</td>
</tr>
<tr>
<td>Acromioclavicular</td>
<td>Pain @ extreme ROM</td>
</tr>
<tr>
<td>Humeroulnar</td>
<td>FLEX &gt; EXT</td>
</tr>
<tr>
<td>Humeroradial</td>
<td>FLEX &gt; EXT &gt; SUP &gt; PRON</td>
</tr>
<tr>
<td>Proximal radioulnar</td>
<td>SUP = PRON equally limitation</td>
</tr>
<tr>
<td>Distal radioulnar</td>
<td>Pain @ extreme ROM</td>
</tr>
<tr>
<td>Radiocarpal</td>
<td>FLEX = EXT limitation</td>
</tr>
<tr>
<td>1st MCP</td>
<td>FLEX &gt; EXT</td>
</tr>
<tr>
<td>MCP 2-5th</td>
<td>FLEX &gt; EXT</td>
</tr>
<tr>
<td>IPs</td>
<td>FLEX &gt; EXT</td>
</tr>
<tr>
<td>Hip</td>
<td>FLEX &gt; ABD &gt; IR (order may vary)</td>
</tr>
<tr>
<td>Knee</td>
<td>FLEX &gt; EXT</td>
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<tr>
<td>Talocrural</td>
<td>PF &gt; DF</td>
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<tr>
<td>Subtalar</td>
<td>Inversion &gt; Eversion</td>
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<tr>
<td>1st MTP</td>
<td>EXT &gt; FLEX</td>
</tr>
<tr>
<td>MTP 2nd-5th</td>
<td>Variable</td>
</tr>
<tr>
<td>IPs</td>
<td>FLEX &gt; EXT</td>
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</tbody>
</table>

01.01.07

FRACTURES, DISLOCATIONS, SUBLUXATIONS

Dislocations (Grade I-IV)
• Usually result of instability
• S/S
  o ↑↑ ROM, soft end feel, +/-pain
• **Instability tests**
  - Scapula \(\rightarrow\) wall push up
  - ANT GH \(\rightarrow\) anterior apprehension test (ABD + ER)
    - Relocation test \(\rightarrow\) push GH head posteriorly
  - POST GH \(\rightarrow\) posterior apprehension test (ABD 90°, full horiz ADD, post humeral push)
  - INFERIOR GH \(\rightarrow\) sulcus sign

• **Complications**
  - Rotator cuff tears
  - Axillary nerve damage \(\rightarrow\) teres minor/delt innervation, sensation loss

• **DISLOCATION TYPES**
  - TUBS \(\rightarrow\) Traumatic onset, Unidirectional anterior, Bankart lesion, Surgery
    - MOI \(\rightarrow\) ABD/ER
    - Young males, high reoccurrence
    - Lesions
      - Bankart \(\rightarrow\) avulsion # of ant/inferior capsule & ligaments
        - s/s – clicking, apprehension, deep vague pain
      - SLAP \(\rightarrow\) superior labrum lesion ant \(\rightarrow\) post
        - Elevated position w/ sudden concentric + eccentric biceps contraction
        - Major cause of pain in throwers
      - Hill-Sachs \(\rightarrow\) compression # post/lateral humeral head
      - # dislocation
        - usually acromion, humeral head
        - s/s \(\rightarrow\) deformity, constant pain, systemic signs (nausea)
  - AMBER \(\rightarrow\) Atraumatic, Multidirectional, Bilateral shoulder findings, Rehab appropriate, INF capsule shift (if surgery performed)
    - Surgery often done d/t laxity

Subluxations
- AC joint (K&C pg 494)
  - Clavicle \(\rightarrow\) Post/Sup \(\rightarrow\) Acromion
  - Joint stabilization \(\rightarrow\) trapezoid + conoid ligs
  - S/S
    - step deformity, referral from shoulder, RA, multiple myeloma
    - osteolysis (bone resorption d/t repetitive microtrauma or post trauma
      - leads to \(\rightarrow\) vascular compromise, nervous system dysfx, micro#s
  - Q/surgical

**Growth plate closures** \(\rightarrow\) ?!Implications of break/\# <20yrs
- femur \(\rightarrow\) prox at 18 yrs, distal at 20 yrs
- tibia \(\rightarrow\) prox at 16-18 yrs, distal at 15-17 yrs
- humerus \(\rightarrow\) prox at 20 yrs, distal at 16 yrs
- radius \(\rightarrow\) proximal at 18 yrs, distal 20 yrs

**EPIPHYSIS**: end of long bone (where joint is)
Fractures

- **MOI**
  - TRAUMATIC
  - PATHOLOGICAL
    - OP, metastatic, infection, osteomalacia
  - STRESS/FATIGUE
- **TYPES**
  - Spiral → twisting injury
  - Transverse/oblique → direct blow
  - Compression/crush → longitudinal force
  - Comminuted → fragments of bone
  - Greenstick → young kids
    - malleable bones, # on only 1 side
  - Avulsion → piece of bone pulled off
    - de-attachment of soft tissue (lig)
  - Impact → d/t compression force (usually more stable)
- **COMMON #S:**
  - Colles
    - # distal radius + sublux of distal ulna
  - Bennetts
    - # dislocation of CMC thumb joint
  - Scaphoid
    - d/t FOOSH
- **HEALING TIME**
  - Kids 4-6wks
  - Adolescents 6-8wks
  - Adults 10-18wks RX
- **COMPLICATIONS**
  - Avascular necrosis → high rate in some areas
    - Proximal femur
    - 5th MT
    - scaphoid
    - proximal humerus
    - talus neck
  - Muscle weakness, contractures, re-#, infection, delayed union, malunion, CRPS
- **RX**
  - Joint mobility above/below
  - Isometric strength
  - CV fitness maintenance

**Hip fractures**

- **Locations**
  - femoral neck, intertrochanteric, subtrochanteric
- **RX**
  - Conservative
    - Less complications
    - ↑bed rest
    - ↓healing time
    - slower rehab
Surgery

- **Benefits:** ↓ length of stay, improved rehab

- **PROCEDURES**
  - Hemiarthroplasty → femoral head replacement
  - Total arthroplasty → femoral head + acetabulum replacement

- **TYPES**
  - Cemented
    - ↑ stability, better for sedentary elderly w/ poor bone quality
  - Uncemented
    - Components coated w/ beads → where new bone can grow
    - Better for younger pts
    - Revision in 10 yrs
  - Hybrid
    - femoral component → cemented
    - acetabular component → uncemented

*PRECAUTIONS FOR TOTAL ARTHROPLASTY*

⇒ POST-LATERAL APPROACH (75%):
- NO hip FLEX past 90°
- NO IR
- NO ER
- NO hip ADD past MIDLINE for 1st 3 mo

⇒ LATERAL APPROACH (25%):
- NO hip FLEX past 90°
- NO IR
- NO hip ADD past MIDLINE for 1st 3 mo

⇒ ANTERIOR APPROACH (rare):
- NO hip EXT
- NO ER
- NO hip ADD past MIDLINE for 1st 3 mo

*PRECAUTIONS FOR HEMIARTHROPLASTY, CANNULATED SCREWS, DHS & GAMMA NAILS*
- typically NO restrictions with movement & WBAT
- check MD orders!

01.01.08

OSTEOPOROSIS/OSTEOPENIA - (++hospital costs, esp w/ hip#)

**Bone**

- Components:
  - Osteoclasts → bone resorption → cut bone
  - Osteoblasts → build/form bone

- Types
  - Cortical → outside long bones
  - Cancellous → inside bone, more affected by OP
• LIKES LOAD
  o Intensity + duration → lots before 30yrs, esp puberty!

Osteoporosis

• Compromised bone strength: ↓bone density + ↓bone quality = risk of #
• WHO OP Categories:
  o normal → 0.0 – 1.0 SD of young adult mean
  o low bone mass → 1-2.5 SD below young adult mean → OSTEOPENIA
  o osteoporosis → 2.5+ SD below the young adult mean
  o severe/established O → presence of fragility #
• OP TYPES
  o 1° type 1 → menopausal women
  o 1° type 2 → 70+ yrs
  o 2° OP → d/t another med condition or tx, any age
• RISK FACTORS
  o FHMx, lifestyle
  o gender, age, lifetime exposure to estrogen, breast cancer
  o fragility # under 40 years
• DX
  o Bone scan
  o # assessment tools → FRAX, CAROC 2010
• AX
  o Vertebroplasty → fusing of 3+ segments → risk of subsequent #
  o Common Sites:
    ▪ Wrist
    ▪ Humerus
    ▪ Vertebrae
    ▪ Hip
• RX
  o Pharmacological → antiabsorption agents, anabolic bone formation (hormone tx)
    ▪ Side effects → VERTIGO, DIZZINESS, MUSCLE/BACK/UE/LE PAIN
  o Nutrition → Ca+, VitD
  o PT
    ▪ Posture
    ▪ Aerobic → weight bearing
    ▪ Resistance exs, core
    ▪ Balance
    ▪ Extension exercises
    ▪ CAUTION w/ MANUAL THERAPY
    ▪ NO SPINAL FLEXION or FLEXION + ROTATION!
TUMOR/PATHOLOGICAL FRACTURES

- Can manifest as sports/mechanical injuries
- S/S
  - Asymptomatic, but can show cancer signs:
    - Sudden weight loss/gain
    - Night pain
    - Night sweats
    - Malaise
    - Fatigue
- Primary malignant tumors of soft tissues/bone → RARE
  - May occur in youth
- TYPES:
  - Osteosarcoma
    - At ends of long bones
    - Pain → at joint, worse with activity
    - Imaging → x-ray – moth eaten appearance
    - RX → surgery (terry fox)
  - Synovial sarcoma
    - In larger joints → knee/ankle
    - Pain → @ night, w/ activity
    - Swelling/instability
    - RX → surgery, chemo/radiation
  - Malignant tumors
    - May metastasize to bone from breast, lung, prostate, kidney, thyroid
    - RX → thorough PMHx & FMHx
  - Osteoid osteoma
    - Benign bone tumor
    - Pain → in bone, @ night, w/ exercise (often mistaken for bone #)
      - Key sign: NO PAIN W/ ASPIRIN
    - Imaging → CT scan shows a central focus point
    - RX → ablation, ethanol, laser
DEGENERATIVE JOINT DISEASE

- Due to MECHANICAL CHANGE, JOINT DISEASE, JOINT TRAUMA
- Mostly seen in pts >40yrs
- Result → ++ loading on surfaces that are weight bearing (eg. facet, cartilage, disc, osteophyte)

TYPES:

- VERTEBRAL
  - SPINAL (lateral) STENOSIS
    - ↓ IVF space = ↑ radicular s/s (dermatome, myotome)
  - CENTRAL STENOSIS
    - ↑ spinal canal compression = ↑ central s/s (central cord signs, b/b)
  - SPONDYLOSIS
    - Spine OA → effects z-joints, foramen
  - SPONDYLOLYSIS
    - Pars interarticularis defect
    - May start as stress # → nut cracker effect on z-joint
  - SPONDYLOLISTHESIS
    - Grade I-IV anterior slippage of one vertebrae on another d/t hyperEXT
    - Outcome Measures:
      - pain w/ lumbar EXT in SLS
      - painfree lumbar EXT ROM
      - facilitated segment
      - lumbopelvic control

- JOINT
  - ARTICULAR CARTILAGE degeneration (eg. OA)
    - Hypertrophy of subchondral bone + joint capsule (WB joints)

- OA
  - ↓ joint space, ↑ cartilage height, ↑ osteophytes, ↑ subchondral bone sclerosis + proliferation

- RX
  - Joint protection
  - ↑ joint mechanics
  - aquatics = ↓ WB
MECHANICAL SPINAL DEFORMITIES

SCOLIOSIS (S-spine)
- Structural OR Functional (in standing only, related to LLD)
- **TYPES**
  - Idiopathic \(\rightarrow\) **most common** (gene identified)
  - Congenital \(\rightarrow\) vertebral deformities
  - Neuromuscular \(\rightarrow\) 2° to other conditions \(\rightarrow\) CP, spina bifida, physical injury
- **S/S**
  - ↓nerve conduction \(\rightarrow\) myotomes, derms, reflexes
  - ↓nerve mobility \(\rightarrow\) SLR, slump
  - Degree depends on **degree of constraint**
- **AX**
  - Forward Bend Test \(\rightarrow\) rib hump
  - Muscle imbalance
  - ↓Proprioception
- **RX**
  - Posture
  - Stretch, strengthen
  - CV training (↓pain)
  - IF severe \(\rightarrow\) bracing, surgery
LOW BACK PAIN

- **POSTURAL DYSFUNCTION**
  o Posture obtained from: **dynamic (muscle) + static stabilizers (bone, lig, fascia, jt)**
  o Normal Lspine lordosis → optimal for joints, disc, muscles
  o Postural back pain → caused by tissue creep!!
  o S/S
    i. pain increases w/ sitting or prolonged postures
    ii. poor posture/ergonomic set up
    iii. pain not specifically caused by FLEX or EXT
    iv. NO neurological s/s
    v. better in AM, worse as the day goes on
    vi. associated w/ decreased fitness
  o RX → Correct:
    ▪ posture and ergonomics
    ▪ muscle imbalances
    ▪ fitness issues
    ▪ spinal supports (obus forme)
    ▪ education on posture + rest/activity/breaks

- **DISC LESION**
  o Disc: inner nucleus pulposis + outer annulus fibrosis (pain fibres only in outer a.f)
  o Typical presentation: 25-40 yrs, muscle bulk not able to support disc segment
  o Healing time: ligs take 3mo to heal
  o S/S
    ▪ central back pain +/- leg pain
    ▪ +/- lateral shift → name relative to shoulders
    ▪ loss of normal lordosis → flat back → muscle supporting EXT
    ▪ b&b?
  o Aggravating factors
    ▪ FLEX (sitting, putting on socks/pants, bending forward)
    ▪ Coughing
  o Easing factors
    ▪ EXT (standing, walking, lying)
  o RX
    ▪ centralize pain, radiate
    ▪ correct shift
    ▪ support lordosis
    ▪ posture education
    ▪ avoid flexion postures with time
    ▪ traction (gentle!)
    ▪ correct → muscle balance, posture, ergonomics

- **STENOSIS** → Spinal (IVF) or Central (spinal canal) narrowing
  o Cause: swelling, disc, osteophyte, bony change
  o Population: older pt, back pain hx
  o S/S
    ▪ Bilateral radiation → legs/feet
    ▪ Xray changes → bony hypertrophy, DDD, spurs
  o Aggravating factors
    ▪ EXT activities = IVF (lateral st), spinal canal (central st)
  o Easing factors
    ▪ FLEX activities
  o RX
    ▪ posture avoidance, correct muscle imbalances (core, hamstrings)

- **SPONDYLOLISTHESIS**
Grade I-IV ant slippage of one vertebrae on another
- Population: young athlete (usually gymnast, dancer) + hyperextension activities
- S/S
  - central low back pain +/- referred pain
  - weak abdominal muscles
  - +/- tight hamstrings
- Aggravating factor → EXT
- Easing factor → FLEX
- RX
  - address lower quadrant muscle imbalance
  - abdominal strengthening
  - biomechanical counseling
  - avoid HYPEREXT activities

01.01.12
INFLAMMATORY/INFECTIOUS CONDITIONS OF NEUROMUSCULAR SYSTEM

OSTEOMYELITIS
- Inflammatory response d/t infection in bone
  - Usually staph aureus infection
  - Often missed → serious consequences in/around jt
- Population:
  - Children → long bones
  - Adults → vertebrae, feet (if diabetic & have foot ulcers)
  - More common in:
    - M, children, immune suppressed pt
- S/S
  - * suspect if pt has localized swollen jt w/ NO trauma hx or NO other affected jts → ER!!
  - Prominent night pain
  - Effusion in/around joint
  - Weight loss
  - Appetite loss
  - Malaise
  -
- RX
  - Antibiotics
  - Surgery if in jt → remove dead bone
  - Maintain jt fx
  - Cast care

TENDONITIS
- Tendon inflammation d/t repetitive microtrauma

TENDINOSIS
- Chronic tendon dysfx → esp. supraspinatous, elbow extensor tendons, patella

BURSITIS
- Causes → overuse, trauma, gout, infection
- S/S → pain w/ rest, ↓AROM/PROM
- RX → flexibility, manual therapy, thermal agents

01.01.13
AMPUTATIONS
CAUSES
- Diabetes mellitus
- Peripheral Vascular disease
- Trauma
- Congenital/correction of deformity
- Tumors
- Infected TKR

EFFECTS OF AMPUTATION

- **TOE (Ray resection)**
  - push off power
  - balance d/t proprioception, BOS
  - Prosthesis
    - orthoses or filler to prevent migration
    - carbon fiber AFO → help with energy return at toe off

- **PARTIAL FOOT**
  - lose forefoot lever
  - balance
  - ↑pressure on remaining WB surface = ↑risk for tissue breakdown
  - Prosthesis
    - molded insole (shoe filler)
    - carbon fiber AFO
    - complete prosthesis

- **ANKLE (Symes)**
  - Surgery goes through joint → distal tib-fib intact
  - PROS: long lever, bulbous end, better than trans-tib, good fx outcome
  - CONS: high risk of skin breakdown
  - Prosthesis:
    - similar to trans-tib → partial patellar WB possible
    - trap door to fit over malleoli

- **TRANSTIBIAL**
  - WB through end
  - some achieve normal gait pattern
  - Prosthesis:
    - Socket → total surface bearing OR patellar tendon bearing
    - Pressure areas:
      - Sensitive → anterior/distal tib ends, fibular head/end, stump
      - Tolerant → post mm mass, patellar tendon, medial/lateral flares
    - Suspension → supracondylar, suprapatellar cuff, sleeve (need dexterity + strength),
      locking pin, suction (1 way valve)
  - GAIT DEVIATIONS
    - Stance → foot flat, foot slap, knee hyperext or buckling, early heel rise
    - Swing → ↓↑stride length, toe drag, lat/med whip, vaulting

- **KNEE DISARTICULATION (Qknee)**
  - Potential WB through stump → thigh mm preserved
  - Prosthesis:
    - trap door for condyles

- **TRANSFEMORAL**
  - WB on end → WB through ischial tuberosities + hydrostatic loading
  - Req. 60% more energy to ambulate with prosthesis (vs. able body walking)
Prosthesis
- Manual lock, mechanical/friction, hydraulic/pneumatic/microprocessor
- Pressure sensitive
  - Residual limb end, adductor tendon

GAIT
- Often asymmetrical
- Gait aid (may be needed)

GAIT DEVIATIONS
- Stance → ABD, LAT trunk shift, ↑ trunk lordosis, hip flex, ↓ stance time,
- Swing → med/lat whips, circumduction, hip hike, vaulting w/ good leg

HIP DISARTICULATION
- Gait aid (very likely needed)
- Gait → Asymmetrical
- 210% energy expenditure

HEMIPELVECTOMY
- High level pelvic amputation
- Likely d/t osteosarcoma, chondrosarcoma

PT EDUCATION:
- Contractures
  - POST-OP DAY 1 → knee/hip flex >20° ≠ prosthetic eligibility
  - Typical contractures
    - TT: knee flex, hip flex
    - TF: hip flex, hip abd
  - NO
    - pillows under legs/hips in supine
    - TF – pillows btw legs
    - Raising of foot of bed
  - YES
    - Laying flat, prone position if possible
  - In chair
    - TT - amp board with cushion
    - w/c - firm seat base

Prosthesis fit
- Liner → interface b/w socket and limb
- Suspension → system keeps prosthesis on residual limb
- Liners → gel (right next to skin, sock on top), foam (sock underneath)
- Socks → ensure proper fit
- Shank/pylon → connects socket to foot, provides height

Pain mgmt. for residual limb pain, phantom pain/sensation
- Exercise, relaxation/visualization, compression/massage, TENS, farabloc

Edema Control + Shaping
- Supplies → compression bandage, shrinker sock, silicon/gel liners, elevation
- distal > prox pressure, diagonal passes
- worn @ all times, changed every 4 hrs
- remove if pain, throbbing sensation, feels cold

- Falls prevention
  - NIGHT → nightlight, w/c by bed w/ brakes on, bed rails
  - Stump protector

- Foot care
  -旨 bare feet, 旨 diabetic socks, shoes w/ 旨 seams
  - protect from heat/cold
  - check feet w/ mirror + wash daily
  - use lotion, 旨 btw toes
  - trim nails straight across
  - circutation = 旨 smoking, 旨 ex, eat well
  - regular HCP visits
01.01.14
CONGENITAL MALFORMATIONS

DEVELOPMENTAL DYSPLASIA OF HIP (DDH)
- Abnormality in head of femur or acetabulum shape @ birth
  - Result → acetabulum & femur NOT in close contact → subluxation/dislocation
- Spontaneous recovery w/in 1st 2 wks of life is common
- Risk factors
  - F>M, famhx
  - breech position, LGA
  - tight swaddling
- S/S
  - Hip subluxed or dislocated
  - Hip is dislocatable
  - Might not show signs, but contact pediatrician if any of following, b/c can lead to degenerative hip arthritis
    - LLD
    - Muscle weakness
    - Waddling gait
- AX
  - Barlow maneuver → F then ABD then ADD w/ post pressure
  - Ortlani maneuver → F then ADD + slight traction
- RX
  - Keep hip in FLEX + ABD
    - Pavlik harness
    - double diapering

TALIPES EQUINOVARUS (Club Foot)
- D/T:
  - congenital bone deformity
  - cerebral palsy
  - calf mm contracture
- 2 TYPES
  - TALIPES EQUINOVARUS
    - Abnormal dev of talus head + neck
    - Hereditary or Neuromuscular disorder
  - POSTURAL
    - Feet squished in utero
- Presentation
  - PF (talocrural aka equinus)
  - ADD forefoot
  - INV/varus hindfoot
  - Small calcaneous
  - Smaller calf + foot on affected
  - Usually part of larger problem → myelomenigocele, arthrogryposis
- RISK → intrauterine restriction (baby doesn’t grow @ normal expected rate in uterus)
- RX
  - Manipulation
  - Serial casting + splinting → start right after birth
  - Surgery

OSTEOGENESIS IMPERFECTA
• connective tissue disorder (genetic)
  o issue w/ converting procollagen → collagen type 1
  o BONES = BRITTLE
• S/S
  o Joint laxity
  o Muscle weakness
  o Long bone bowing
  o Kyphosis
  o Diffuse OP
  o ↓ stature
• RX
  o Meds
  o Orthopedic → # prone, surgery
    ▪ immobilization
  o Social integration
  o Education
  o Prognosis – dependant on severity

LEGG CALVE-PERTHES DISEASE
• Avascular necrosis of femoral head
• Age: 3-12, M>F
• S/S
  o small for age
  o usually unilateral
  o hip, knee, groin pain
  o +ve tredenlenburg
  o limp
  o ↓ ROM (ABD, IR)
• RX
  o Controversial
    ▪ Containment to preserve femoral head
    ▪ ROM
    ▪ Bracing, casting, sx

DUCHENNE’S MUSCULAR DYSTROPHY (in neuro section)
NERVE COMPRESSION (eg. carpal tunnel, radiculopathy, spinal stenosis)

Radiculopathy → pain due to nerve root compression
- S/S → dependant on degree of compression
  o Pain
  o Tingling/numbness
  o ↓ nerve conduction = mm weakness, ↓ sensation, ↓ reflexes

Spinal Stenosis
- hypertrophy of spinal lamina, ligamentum flavum, facets
- vascular or neural compromise
- RX
  o Joint mobilizations
  o FLEX bias exs
    ▪ AVOID EXT
  o traction

Thoracic Outlet
- Due to impinged:
  o nerve bundle (brachial plexus)
  o vagus nerve between bony and soft tissue
  o subclavian artery/vein
- Common impingement sites
  o superior thoracic outlet
  o scalene triangle
  o btw clavicle + 1st rib
  o btw pec minor + thoracic wall
- S/S
  o Pain in arms/hands, neck, axillary, pecs, upper back
  o Tingling
  o Vascular → one hand colder than other
- AX - Tests
  o Adson
  o Allen/wrights
  o Military test
  o Costoclavicular test
- RX
  o postural re-education
  o functional training to restore normal muscle balances: endurance, strength, power, and coordination
  o biomechanical faults: joint restrictions
  o manipulations (typically first rib) to diminish pain and soft tissue guarding → treat symptoms

NERVE ENTRAPMENT
• **Ulnar nerve**
  - **Location** – cubital tunnel
  - **Cause** – trauma, compression, thickened FCU retinaculum
  - **S/S** – medial elbow pain
  - **TEST** – posterior tinnel sign

• **Median nerve**
  - **Location** – in pronator teres + under FDS
  - **Cause** – repetitive gripping activities
  - **S/S** – aching pain, likely in forearm
  - **Result** → **CARPAL TUNNEL**
    - **TEST** → Phalen’s
    - **S/S**
      - Altered sensory fx in median nerve distribution
        - vibration, 2-pt discrimination
      - Thenar mm atrophy (thumb → 3rd finger)

• **Radial nerve** → distal branches (post interosseous nerve)
  - **Location** – in radial tunnel

• **RX**
  - muscle imbalances
  - inspect neck!!
  - stretch tight muscles
  - brace at night
  - address predisposing factors → activity modification, breaks
  - reduce swelling at carpal tunnel (trauma, pregnancy, #)
01.01.16  
PERIPHERAL NERVE INJURIES

**NEUROPATHY** → any nerve disease characterized by ‡ neural fx

**TRAUMATIC PERIPHERAL NERVE INJURY**
- **S/S** → Motor, sensory, autonomic changes; Pain
- **DX** → MRI, nerve conduction test used to confirm

**TYPES:**

1. **NEUROPRAXIA**
   - Compression of the nerve
   - RESULT → transient disruption
   - RECOVERY → good prognosis (min → wks), as oedema resolves

2. **AXONOTEMESIS**
   - Disruption of axon, myelin sheath still intact, likely CRUSH INJURY
   - RESULT → may cause paralysis of the motor, sensory, and autonomic
   - RECOVERY → fair prognosis (months), wallerian degeneration
     - Axon re-growth: 1mm/day, upper arm 4-6 mo (up to 2 yrs), lower arm 7-9mo, up to 4 yrs

3. **NEUROTEMESIS**
   - Completely severed axon and sheath
   - RECOVERY → only w/ surgery with variable success → may never recover

**PATHOLOGICAL PATTERNS OF NEUROPATHY:**

1. **WALLERIAN DEGENERATION**
   - Process occurs d/t cutting/crushing of nerve → axon separated from cell body
     - Occurs with axonotmesis
   - Degeneration → in area distal to injury
   - Healing:
     - Macrophages remove debri
     - Proximal part → sprouting → grow + prune off → myelin regrowth

2. **SEGMENTAL DEMYELINATION**
   - Myelin breakdown (demyelination) for few segments, but axons are preserved
     - Mostly reversible b/c Swann cells make new myelin → fx restoration
     - Some axons may be permanently lost
   - Eg. **Guillain-Barre Syndrome**
     - Immune system attacks nerves → 1st s/s - weakness + tingling → entire body paralysis
     - Hospital → most pts recover, may have slight weakness/tingling/fatigue

3. **(Distal) AXONAL DEGENERATION**
   - Degeneration of axon cylinder and myelin possibly d/t inability of neuronal body to keep up w/ metabolic demands of axon
   - Develops: most distal part of axon → proximal
     - If abnormality persists → axon dies ‘backwards’
   - **S/S**
     - Characteristic distal sensory loss + weakness
**MYASTHENIA GRAVIS**
- Autoimmune attack of ACh receptors at the NMJ
  - signal can’t travel from nerve → muscle
- **Effects:**
  - progressive muscle weakness
    - ↓cardioresp fx
    - atrophy
    - fatigue
- **RX**
  - Medication → prevent ACh breakdown @ NMJ → remaining receptors will eventually activate
  - PT
    - Activity within tolerance
    - Prevent 2º conditions

**CHARCOT MARIE TOOTH DISEASE (HEREDITARY)**
- Result → extensive demyelination of motor & sensory nerves of the FOOT
- **S/S**
  - Symmetric mm weakness → slow progression
    - Foot intrinsics atrophy
    - ↓DF, EVER mm
  - ↓↓deep tendon reflexes
  - Pes cavus (hammer toes)
- **RX**
  - Contracture mgmt. → stretching
  - Foot care education

**BELL’S PALSY**
- D/T latent herpes virus
  - Pt reports pain few days prior around mastoid → virus causes inflammation response over facial nerve
- **S/S**
  - Unilateral facial paralysis
  - ↓ Facial nerve innervation:
    - **facial expression** mm
    - stapedius mm of **inner ear**
    - sensory + autonomic **taste** fibers for taste
    - tears, salivation
- **RX**
  - corticosteroids, estim?, protect eye

**THORACIC OUTLET SYNDROME**
- Entrapment syndrome d/t pressure on brachial plexus
  - Chronic compression → edema + ischemia of nerve roots → neuropraxia + wallerian deg
- **S/S**
  - Paraesthesia
  - UE weakness + pain, hand fatigue
  - Neck pain → may radiate into face, scapula, ant chest
  - Raynaud’s disease (↓UE artery size) + venous compromise → coldness
  - Edema
- **RX**
  - Correct posture; surgery (if vasculature gets compromised)

**DIABETIC NEUROPATHY**
Peripheral nerve disorder in diabetes \(\rightarrow\) occurs \textit{w/o} any other neuropathy cause

**Pathology**
- Chronic metabolic disturbance \(\rightarrow\) affects nerves + schwann cells
  - RESULT \(\rightarrow\) loss of both myelinated & unmyelinated axons

**S/S**
- Symmetric + distal sensory loss pattern
- Painless paraesthesia
- Minimal motor weakness

**RX**
- Control hyperglycemia
- Skin care
- Amputation
01.01.17
NEURAL TISSUE Dysfx / NEURO-DYNAMIC Dysfx

- **Dural Tension** (Kennedy)
  - SLUMP, SLR, PKB, ULTT
- **Double Crush**
  - Compress of N along several sites proximal and distal H

- **S/S**
  - Hx of ↑ speed/repetition of sport or work
  - Pain distribution match myotome/dermatome
  - Stretching feel good
  - Aggravated in neural tension positions
  - Describe/point to pain area well
  - Recurrent injury that change w/ rehab
KELOID SCAR
- thick scar
- extends beyond margins of original wound

HYPERTROPHIC SCAR
- thick scars
- extend beyond boundary of original wound
  - has excess tissue amount
    - (in comparison to what is actually needed to replace damaged dermis)
NEUROLOGY (20%±5%)

01.02.01 Cerebral Vascular Accident/Transient Ischemic Attack \(\rightarrow\) STROKE

**S/S**
- SUDDEN numbness or weakness of face, arm, or leg (especially one sided)
- confusion, dizziness
- trouble speaking or understanding speech
- trouble seeing out of one or both eyes
- trouble walking
- loss of balance or coordination
- severe headache with no known cause

**RISK FACTORS:**
- non modifiable \(\rightarrow\) age (doubles after 55 yrs), M>F, FMHx, PREVIOUS STROKE OR TIA
- modifiable \(\rightarrow\) HTN, cardiac disease, diabetes, cholesterol, smoking, obesity, cocaine/meth use, oral contraceptives (?)

**CLASSIFICATION:**
- ISCHEMIC STROKE (80%) \(\rightarrow\) caused by thrombosis, embolic, lacunar infarct (in deep area of the brain, related to diabetes and HTN)
  - **Response after injury:**
    - a) death of tissue where there is no blood (core death)
    - b) possible preservation of area surrounding core that is supplied by collaterals (ischemic penumbra) * cerebellum and hippocampus neurons ++ sensitive to ischemia
    - c) release of glutamate, Ca2+, edema, O2 free radicals, degeneration occurs
  - **RX**
    - get ppl to hospital right away, if ischemic they can get tissue plasminogen activator (TPA) which will dissolve the clots and restore blood flow (within 3 hours)*
    - NOT APPROPRIATE FOR HEMORRAGIC STROKE!!
    - surgery to remove clot
- HEMORRHAGIC (20%) \(\rightarrow\) caused by aneurysm and AV malformation, often occurs in younger people, majority occur in the cerebral cortex or basal ganglia*
  - **RX**
    - surgery to stop bleed
    - better long term prognosis for recovery of function (than ischemic)

**ABCD score** (for prediction of progression and risk of recurrence):
- A= age
- B = blood pressure
- C= clinical features (hemiplegia, speech problems)
- D= duration

**PREVENTION OF RECURRENTCE:**
- anticoagulation therapy (aspirin)
- lipid lowering agent
- lifestyle change
- exercise

**PROGNOSTIC INDICATORS:**
- location, extent, and duration of injury; can they voluntarily move fingers (pyramidal motor output intact, * white tracts are not plastic), cortical (most grey matter) vs subcortical (white and grey matter) \(\rightarrow\) grey matter is capable of functional reorganization

**TIA** \(\rightarrow\) transient blockage of circulation, mild S/S, resolves usually w/in 24 hours, huge recurrence (80% within a year), can results in lasting damage

**BRAINSTEM STROKE** very disabling \(\rightarrow\) will take out ascending and descending tracts
01.02.02 Acquired brain injury

1. TRAUMATIC BRAIN INJURY

- change in brain fx d/t external force
- can be accompanied by:
  - dec or loss of consciousness, impaired cognition, physical function, emotion or behavior (may be temporary or permanent)
- classification:
  - a) closed → no skull # or laceration of the brain, meninges not breached, does not require hitting head
  - b) open → meninges breached, exposed brain or laceration
- mechanisms:
  - coup (primary mechanical injury)
  - contracoup (secondary mechanical injury) including → ischemia, edema
  - DAI (diffuse axonal injury) → sheering/tearing from rotational forces in areas of density change (grey → white matter)
  - confusion
  - anoxic injury forces
- primary injury: direct damage from mechanical forces, focal or diffuse
- secondary brain injury: circulation deficits (blood flow usually 50% less then pre-injury), edema, inc ICP, epilepsy/seizure, glutamate, contusions,

HEMATOMAS:

EPIDURAL

- outside the dura, 90% assocd with skull fractures
- most often in temporal or temproparietal region
- arterial bleed

SUB-DURAL

- brain collects between arachnoid mater and dura
- often requires surgical intervention (burrholes or craniotomy)
- venous bleed

SUBARACHNOID

- bleeding between pia mater an brain, from circle of willis
- fatal

INTRACRANIAL

- most common
- blood within the brain → bleed under pia mater

Intracranial pressure:

- normal is 0-10mm Hg, 15 mm Hg usual cut off, >20mm Hg for over 5 minutes is not good
- monitor using:
  - extraventricular drain (EVD, most common), subarachnoid or subdural bolt, intraparenchymal monitor, epidural sensor
  - for EVD: have to close stopcock to avoid backflow of large amounts of fluid back into patient → *ALWAYS CHECK PHYSICAIN ORDERS!*

Cerebral perfusion pressure (CPP):

- MAP-ICP/cerebral vascular resistance * want between 70-100 mm Hg
- *HEAD OF BED AT 30 DEGREES to keep MAP at least 80 mmHg
  - also prevents ventilator associated pneumonia !!
- Basal skull fracture
  - signs are blood or CSF out of nose or ears, raccoon eyes, bruising over mastoid (battle sign)
- Coma
  - altered state of consciousness so that no amount of stimulus or only pain will cause Pt to respond, patient in not aware of self or others, lasts for short length of time and either turns to death or vegetative state
- Frontal lobe injury
  - poor planning and judgment, disinhibition
  - brocas aphasia (problem with language production)
  - altered manners, moral, and emotions
- Parietal lobe injury
  - somatosensory fnx alterations in touch, pressure, temp, and position awareness, language comprehension (wernickes), motor planning issues (apraxia)
- Temporal lobe
  - receptive aphasia, memory impairment, auditory processing, integration and regulation of emotion, motivation, and behavior
- Occipital Lobe
  - more damaged in contra-coup injury then coup
  - see visual problems and visual field deficits

**PT RELATED ISSUES & TX**

- Respiratory Issues:
  - decrease LOC, compromised respiratory centre, increased oral secretions
  - RX
    - manual techniques, suctioning etc should be used with caution
    - suction: pre and post O2 should be 100% , only suction for 10 seconds
- ICP control:
  - maintain neutral head at all times, keep Rx short and combine Rx with other procedures
  - RX
    - monitor ICP → HEAD DOWN POSTURE FOR DRAINAGE IS CONTRAINDICATED!!
- Abnormal Posturing → contributes to handling and contracture formation
  - Decerebrate posturing → indicates brain stem damage (lesions or compression in midbrain) and lesions in cerebellum → extension of UE and LE
  - Decorticate posturing → arms flexed, legs extended, damage to areas including cerebral hemisphere, thalamus, cord, corticospinal tract
  - RX → ICP< 15 mm Hg, regular 2 hrs turns, log roll alignment for head, look for amount of pillows in bed
- Decreased mobility
  - RX
    - sit up and dangle should begin as soon as medically stable , make sure tube feeds are off 20 mins prior to Rx, early mobilization to prevent heterotrophic ossification
    - other things to be aware of: hypermetabolism, DVTs, PEs
- Contractures
  - RX
    - place muscles in lengthened position, 20 minutes to 12 hours/day, use of resting splints; splinting and casting and passive ROM
- Confusion/agitation
  - RX
    - keep instructions short and simple, avoid over stimulation, be aware of mental and physical fatigue
    - protect joints especially if have flaccidity, transfers take more people, have environment prepared
- Fatigue
- Family/Caregiver Stress → need consistency between health care team

**2. NON TRAUMATIC BRAIN INJURY**

STROKE, ANEURYSM, TIA, LACUNAR (see above)
3. CONCUSSION

- complex pathological process affecting the brain, induced by traumatic biomechanical forces
- mild form of brain injury (most common TBI)
- S/S
  - loss of consciousness may or may not be present
  - behavioral change (overly emotional, cannot control them)
  - cognitive impairment (problems with thinking and planning ahead)
  - sleep disturbance, dizziness, irritability, memory and visual changes
- **Baseline cognitive Ax: SCAT 2** (will usually do training season)
- **Second Impact Syndrome**
  - rare/fatal uncontrolled swelling of brain
  - minor 2nd blow before initial symptoms are resolved
- **Post Concussion Syndrome**
  - persistent symptoms
  - 3+ concussions = 5X greater risk Alzheimers, 3x memory deficits
  - **GRADES:**
    - **grade 1**: does not lose consciousness, dazed
    - **grade 2**: no LOC, period of confusion, does NOT recall event
    - **grade 3**: loss of consciousness for short time, NO memory of event, requires eval asap, classic concussion
- **RISK**: contact sports, anti-coagulants, prior events

OUTCOME MEASURES/PROGNOSTIC INDICATORS

i. **Glasgow coma scale**:
   - 3 categories: eye opening, verbal response, motor response,
   - total score out of 15
   - done usually in acute injury

ii. **Rancho Levels Of Cognition**
   - good predictor of functional outcomes after injury (1-10 scale)
   - want a higher score
   - *note → pediatric scale is opposite, want a lower score*

iii. **Length Of LOC**
   - usually note 20 minutes or 6 + hours

iv. **Length Of Post Traumatic Amnesia**
   - 5 mins- 7 days; can be anterograde or retrograde

v. **Review Of Diagnostic Imaging**
   - most change in function occurs in first 6 months → unlimited time for functional improvement!!

vi. **Outcome Measure Not Totally Predictive Of Function**:
   - preinjury health, social support, age, nature of injury (location and extent), patient motivation → ALL PLAY FACTOR
SPINAL CORD INJURY

Causes of SCI:

1. Traumatic
   a. majority result in quadriplegia
   b. Causes ⇒ Falls (40%), transport, sports, other
   c. M>F, occur between age 15-35 yr range
   d. 17.37% are thoracic and lumbar complete
   e. 40% are cervical incomplete

2. Non-trauma
   a. majority result in paraplegia
   b. Causes: cancer, infection and inflammation (TB), motor neuron disorders, vascular diseases
      (spinal cord infarcts), congenital
   c. M>F, 50-60 yr +

- BONY INJURY DOES NOT EQUAL A SPINAL INJURY!!!

- Early management focus:
  o spinal stability
  o limiting neurological deficit and promote recovery
  o minimize complications
  o create environment for spinal column to heal

- Surgery if:
  o unstable # or soft tissue injury,
  o neuro symp getting worse
  o *consider comprehension, cooperation, consciousness of patient

Myelopathy ⇒ refers to pathology of the spinal cord ⇒ when due to trauma, it is known as spinal cord injury

Lumbar laminectomy ⇒ helps to decompress the cauda equine/roots

Goals:
  i) keep MAP between 80-100 mm Hg
  ii) because the ANS is interrupted regulation of BP, temp, and HR is altered:
     ⇒ if patient has fever make sure it’s not due to sepsis or other injuries

SHOCK:

1. Spinal shock
   a. temporary suppression of all reflex activity below level of injury
   b. can last weeks to months
   c. SYMPTOMS
      i. areflexia
      ii. flaccid paralysis
   d. thought that return of the sacral reflexes mark beginning of spinal resolution

2. Neurogenic shock
   a. body’s reaction to sudden loss of sympathetic control
   b. occurs with injuries above T6
   c. SYMPTOMS:
      i. dec vasomotor tone = hypotension and hypothermia despite normal blood volume
      ii. bradycardia (because of unopposed vagal stim of heart)
      iii. can lead to metabolic issues

MOBILITY ORDERS FROM DOCTOR
“Spine unstable”
- column is assumed unstable
- +/- neuro deficits
- definite risk for additional injury
- Pt must:
  - 1) maintain neutral spine at all times
  - 2) bedrest
  - 3) HOB at zero degrees
  - 2-3 person turns at all times

“Spine stable” but requires protection
- confirmed spinal column
- +/- neuro deficits
- Pt must maintain neutral spine at all times
- Pt can turn independent with neutral alignment
- mob and rehab begins

“Spine stable-no restrictions”
- injury decided stable by surgeon
- patient may do all mvmnts of spine within comfort limits
- Pt may be taught to log roll with neutral spine
- watch for changes in BP when first mobilizing
- may use stockings, binders, or meds to help with postural hypotension**

SCI CLASSIFICATION
- Important to classify to define level and extent of injury
- gives a baseline → used for prognosis and outcome measure

ASIA: ISNSCI
(international standards for neurological classification of SCI)
→ universally standardized, valid and reliable, well defined method

Sensory exam
- 28 dermatomes with bony landmarks, skin on cheek is the normal reference → light touch and pin prick tested on each point
- Grade 0: absent
- Grade 1: altered, including hyperesthesia
- Grade 2: Pt normal
- NT = not tested
- pin prick response: normal, impaired (different from reference point), absent (unable to differentiate)
- Sacral sensory:
  - Deep Anal Pressure (DAP): if present, Pt has a sensory incomplete injury ASIA B
  - Either absent or present

Motor exam
- 10 bilateral myotomes

ASIA IMPAIRMENT SCALE
- A = Complete: No motor or sensory function is preserved in the sacral segments S4-S5.
- B = Incomplete: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- C = Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- D = Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- E = Normal: Motor and sensory function are normal

CLINICAL SYNDROMES
- Central Cord
- Brown-Squard
- Anterior Cord
- Conus Medullaris
- Cauda Equina
• start with grade 3 and watch for compensation
  o grade 4 and 5 = static hold in a shortened position
  o whole numbers (not + or -)

• Movements:
  o C5 ABD/elbow flexors
  o C6 wrist extensors
  o C7 elbow ext
  o C8 thumb ext/ ulnar dev, long finger flexors
  o T1 finger abductors

• Sacral Motor → voluntary anal contraction → if present indicates MOTOR INCOMPLETE (ASIA C)
  o Present or absent

Level of lesion
• defined as the most caudal segment with normal sensory and motor Fx on both sides of body
• Sensory level → most caudal segment w/ bilateral score of 2 for both light touch and pin prick
• Motor level → most caudal segment with a grade greater than or equal to 3 provided ALL segments above are grade 5

Prognosis for neuro injuries
• pinprick preservation (LE and sacral) within 72hrs = good prognosis of motor function to return and ability to walk

SCI CLINICAL SYNDROMES
• Complete injury
  o no sensory or motor Fx is preserved in the sacral segments S4-S5
  o may be dermatomes below the sensory level and myotomes below the motor level that remain partially innervated → The Zone of Partial Preservation
    • the most caudal segment with some sensory defines extent of ZPP (within 3 segments below injury)
• Anterior Cord Syndrome
  o loss of motor Fx
  o P and temp below injury level
  o dorsal column is spared (i.e. kinesthesia, proprioception, vibration)

• Central Cord Syndrome
  o most common syndrome seen
  o upper motor and sensory Fx more impaired than LE
  o often associated with spinal canal stenosis

• Brown Sequard
  o one side of cord more damaged than the other
  o IPSILATERAL loss of motor Fx and dorsal column Fx (reason is they cross in medulla)
  o CONTRALATERAL loss of P and temp sensation a few levels below the lesion

• Cauda Equina
  o spinal cord terminates at L1-L2
  o more LMN lesion
  o areflexive and flaccid bladder and bowel

• Conus Medullaris
  o injuries at conus → can affect both conus and root resulting in a varied neuro picture
  o i.e. mixture of UM and LMNL

TRACTS
• Lateral spinothalamic tract → PAIN + TEMP
• Anterior spinthalamic tract → CRUDE TOUCH + PRESSURE
- Dorsal columns → FINE TOUCH, STEROGNOSIS, VIBRATION
- Lateral corticospinal → the 90% that cross in the pyramid motor
- Anterior corticospinal → the 10% cross at the level of innervations motor

**SCI EFFECTS ON RESP FX**
- **Cough Fx**
  - C1-C3 absent, C4-T1 non functional, T2-T4 poor, T5-T10 weak, T11 and below is normal
  - C4 is normally the level Pt’s need to breathe independently
  - T11 and below, normal vital capacity
- **Muscle innervation**
  - C2-C7 innervate accessory mm of breathing
  - C3-5 innervates diaphragm
  - T1-T11 intercostals
  - T6-L1 abdominals

**LEVELS OF INJURY**

**C1-C4**
- Patterns of weakness → paralysis of trunk and UE, probably diaphragm
- Possible mvmts: neck mvmts, slight sh retraction and addn
- Role of PT: ROM, spasticity management, neck strengthening, chest physio, prevent contractures
- Major mm innervated:
  - **FULL:**
    - C1-C3 SCM, neck extensors, neck flexors
    - C2-C4 traps
  - **PARTIAL:**
    - C3-C5 Lev scap, diaphragm, supraspinatus, infraspinatus
    - C4-C5 rhomboids

**C5:**
- Patterns of weakness
  - sig imbalance around sh girdle
  - absence of elbow ext, wrist pronation, ext, flex or any hand/finger movement
- Possible mvmt
  - sh abd, flex, ext, elbow flexion and supination, scapular add and abd
- Major mm innervated:
  - **FULL:**
    - all of the C4 mm plus diaphragm, rhomboids (C4-5 dorsal scapular), levator scapula (C3-4 and dorsal scapular)
  - **PARTIAL:**
    - Deltoid, biceps, brachioradialis, teres minor (C5-6)
    - at risk of contracture because of unopposed antagonist
- Hand Fx → use wrist splints and universal cuffs
  - may be able to use tenodesis grip with forearm supination and pronation to achieve wrist flexion and extension

**C6:**
- **FIRST LEVEL OF SCI to have potential to live in community w/o care**
- **Patterns of weakness** → no wrist flexion, elbow ext, hand mvnt
- **Possible mvmt**
  - radial wrist ext, some horiz adduction
  - can extend elbow in some positions using ER of shoulder
  - have **tenodesis grip** which permits a weak grasp w/o any hand mm
- Slide board transfer possible, manual W/C possible
- **PT role:**
  - maximize strength for transfer to functional tasks, teach “trick” mvmt strategis, ROM and stretching, prescribe equipment
  - lats, serratus, and pecs allow weight bearing through extremity and appropriate hamstring length will allow them to sit upright and free up hands
C7-C8
- Patterns of weakness → limited grasp and release dexterity d/t lack of intrinsic mm of hand
- Mvmt possible
  - elbow ext (C7), wrist ext, DIP/PIP flex, MP flex (C8)
  - Triceps allow independent transfers, manual W/C, indep with most/all ADL’s
- Hand function
  - C7
    - Uses more of the tenodesis grip
  - C8
    - Have more finger flexors
    - gives finger and thumb flexors (which are weak) and no lumbricals
    - can get more hand fxn but fine motor control is still hard

T1-9 (Thoracic Paraplegia)
- intact UE Fx, mainly use W/C * living primarily in community*
- respiratory fxn compromised above T6
- can have spasticity in trunk that is worse the higher the lesion level
- can stand in standing frame

T10-L1
- respiratory fxn is intact, cough is normal
- community dwelling
- IND
- limited ambulation may be possible with bracing

L2-L5
- intact trunk
- sparing of LE muscles allows for potential of functional walking
- need brace and grade 3 quads to walk w/o KAFO
- cauda equina = hidden disability , areflexive bladder and bowel and flaccid paralysis
AUTONOMIC EFFECTS OF SCI ON HEART AND LUNGS

Sympathetic NS → FIGHT OR FLIGHT
- Chain T1-L1
- EFFECTS:
  - HR and BP and blood flow to skeletal mm
  - RELAXES bronchial mm
    - (one would think it would contract them BUT if a bear was chasing you, you would want
      the mm to relax to incr O2 supply)

Parasympathetic NS
- Craniosacral
- primary interest in Vagus nerve
- EFFECTS:
  - HR and contractility
  - blood flow to smooth mm
  - contracts bronchial mm

WITH LEVEL OF INJURY T6 AND ABOVE (IN GENERAL)
- Sympathetic effect → dependent on level of injury (b/c it goes from T1-L1)
- Parasymp effect → remains intact and UNOPPOSED via the vagus nerve in injuries T6 and higher
  - Heart response is d/t vagal withdrawal rather than sympathetic drive
    - (normally sympathetic ↑ HR but it is no longer intact, therefore must rely on removing
      parasymp)
- Limits cardiac output + shunting of blood from inactive → active ones
- Blunting of heart rate often to only 110 -120 bpm

AUTONOMIC DYSREFLEXIA
- caused by massive sympathetic discharge from a noxious or non-noxious stimuli below level of SCI (with
  injuries above T6)
- S/S:
  - BP of 20-30 mm Hg from normal
  - bradycardia
  - severe headache
  - blurred vision
  - feeling of anxiety or impending doom
  - dilated pupils
  - flushing, sweating skin above level of injury
  - cool, dry, pale skin (d/t vasoconstriction) below level of injury
  - penile erection
  - Common Causes:
    - urinary or colon irritation (full bladder, UTI, kink in catheter)
    - wound, painful stim
    - tight clothing
    - sex, pregnancy and labour
    - diagnostic or therapeutic interventions
- RX + Prevention:
  - place client in upright position!
  - remove noxious stim/triggers, if necessary use antihypertensive drugs
  - good bladder and bowel routines
  - skin care, nail care

ORTOSTATIC HYPOTENSION
- sudden drop of 20 mm Hg of sys BP or 10 mm Hg dia BP
- S/S
  - Asymptomatic
  - Dizziness, fainting
  - Light headedness
  - Headache
  - Fainting
- RX
  - mobilize slowly w/ therapy
  - use compression stocking or binders

**HEALTH RISKS WITH SCI**
- **DVT & PE**
  - d/t venous stasis, transient hypercoagulable state
  - **SIGNS:**
    - Sudden L/E swelling + ↑temp
  - **Prevention**
    - Anticoagulation meds
    - Compression stockings
    - Sequential compression devices
    - PROM/AROM
    - Early mobilization
  - **note for PE → tachycardia may be masked by parasympathetic dominance**
- **Heterotrophic ossification → 2 main contraindication for Rx are forced PROM and serial casting**
  - S/S
    - Pain (if sensory sparing)
    - ↑spasticity
    - warmth, low grade fever
    - erythema
    - local swelling
    - sudden ↓ROM with a abnormal firm or hard end-feel
  - RX
    - PROM within tolerable range → mobilize as able
    - Meds
    - Surgery if long standing
- **Osteoporosis**
  - d/t rapid ↑ calcium excretion within few days of SCI
  - large incidence of #, especially LE
- **Post Traumatic Syringomyelia**
  - formation of an abnormal tubular cavity in the spinal cord
    - dura tethers/scars to the arachnoid blocking CSF flow
    - CSF is forced into the spinal cord progressively enlarging the cyst
    - Leads to compression of cord + vascular supply
  - can occur years after the original injury
  - S/S → looking for differences or ↑presentation of the injury
    - pain at level and spreading upwards
    - sensory changes
    - motor weakness
    - ↑spasticity
    - B&B dysfxn
    - ↑autonomic dysreflexia,
    - hyperhydrosis;
  - RX + prevention → SURGERY → decompression or shunt

**SPASTICITY**
2 tests for spasticity → Modified Ashworth + Tardieu
Spasticity

- velocity dependent resistance to passive stretch
- Clinical characteristics:
  - ↑mrm tone/firmness
  - ↑stretch reflexes
  - uncontrolled movt’s
- Pros:
  - maintain muscle bulk, venous return, useful for transfers, moving limbs
  - reflex erection can be achieved
  - acts as warning sign
- Cons:
  - Lead to contractures
  - Possibly painful
  - Positioning difficulties
  - Fatigue
- RX
  - Meds
    - Intrathecal baclofen → makes muscles weak as well
    - botox → more local use
  - therapeutic exercise

1. BLADDER

Spastic bladder

- injuries above the conus
- messages will continue to travel btw bladder and spinal cord since reflex arc is still intact
- may be triggered by “tapping”
- bladder can be trained to empty on its own
- bladder mgmt → either intermittent catheters or condom/foley drainage

Faccid bladder (injury below T12)

- in conus and cauda equina injuries
- messages don’t travel btw spinal cord and bladder since the reflex centre is damaged
- bladder loses ability to empty reflexively
- bladder will continue to fill AND must be catheterized

2. BOWEL

Spastic Bowel

- peristalsis and reflex propulsion is still intact
- reflex contraction of sphincter can lead to stool retention
- need suppository or/& digital stim within anus for voiding → can be trained

Faccid Bowel

- peristalsis and reflex propulsion not intact
- slow stool propulsion
- risk of incontinence
- need to balance consistency of stool (usually go more solid)

UMN lesion sexual health → reflex and spontaneous erection, no ejaculation, fertility reduced

LMN lesion sexual health → psychogenic erection possible, reflex erection and ejaculation not possible

SCI & PAIN

- Pain is experienced by SCI + affect most of their ADLs
- TYPES
o **Neuropathic pain** → damage to nervous system
  - stabbing, burning, electric
  - normally not changed by position or activity
  - RX → medications

o **Nociceptive** → damage to viscera or MSK
  - dull, crampy, achy
  - altered by position and activity
  - RX → physical modalities, soft tissue, therapeutic exercise, education on posture and aggravating positions
  - **shoulder pain = big problem***

o **Chronic pain** → pain lasting for longer than 3 mo (expected healing time)
  - 2/3 SCI have chronic pain
  - RX → interdisciplinary team, education, appropriate exercise

### SCI & WOUNDS
- STAGES 1-4
- **Causes:**
  - pressure, sheering, friction, deep tissue damage from banging and bumping
  - sitting, lying high pressure areas
- **Wound description:**
  - Location
  - Size
  - Wound base/edge
  - Surrounding skin
  - Stage photos
- **Prevention:**
  - regular skin checks
  - change position regularly
  - skin care
  - exercise and eating well for skin health
  - no smoking

### SCI & EXERCISE
- ↓ symp impact
  - HR + BP will not have normal responses (levels will be relative to before exercise)
- use RPE and BORG
- watch for orthostatic hypotension

### SCI & RESPIRATION
- paradoxical breathing
- ideal length/tension relationship of diaphragm occurs in **lying**
- vital capacity ↓ from supine to sitting
- ↓ all lung volumes except residual volume

### MISC INFO
- CVD is major cause of death in people surviving 30 years+
- L ventricular myocardial atrophy seen in SCI
- 100x higher rate of bladder cancer in people with SCI

### 01.02.04
**TUMOUR**
- Benign or malignant neoplasm
- soft tissue or bone
- develop from or within tissue in a localized area
spreads through metastasis

**Etiology**
- viruses, chemical agents, physical agents (radiation, asbestos), drugs, hormones, alcohol

**Treatment**
- surgery, radiation, chemotherapy, bioterapy, antiangiogenic therapy, hormonal therapy

**Types**
- Epithelial → carcinoma
- Mesenchymal → sarcoma (undifferentiated loose connective tissue from the mesoderm)
- Glial → glioma (most common site of tumors in brain)
- Lymphoid → lymphoma
- Hematopoietic → leukemia
- Melanocytic → melanoma

**Areas**

**LUNG** carcinoma
- squamous metaplasia, squamous diplasia, carcinoma in situ, invasive carcinoma

**COLON**
- 2nd cause of death

**BREAST**
- hormonal and genetic risk factors, axillary node dissection

**PROSTATE**
- in men over 50 usually
- Tx: surgery, external beam radiation, brachytherapy, androgen deprivation therapy

**KIDS**
- acute lymphocytic leukemia
- non-hodgkins, hodgkins
- brain
- small round blue cell
- sarcoma (bone based - osteosarcoma, ewing’s sarcoma)

**Skin Cancers**
- **Basal Cell Carcinoma** (BCC)
  - most common form of skin cancer
  - **low risk of spreading**, translucent and red in color
- **Squamous Cell Carcinoma** (SCC)
  - solid skin tumor
  - often volcano shaped
  - **high risk for metastasis**
- **Malignant melanoma**
  - most dangerous form of skin cancer
  - **high potential for metastasis**
  - **ABCD rule** for melanoma- Asymmetry, Border, Color, Diameter
DEGENERATIVE NEUROLOGICAL/NEUROMUSCULAR DISORDERS

MUSCULAR DYSTROPHIES

• Duchenne’s Muscular Dystrophy
  o X-link mutation on chromosome 21, M>F, maternal carrier
  o dystrophin protein is not produced → structural component within muscle tissue → structural stability → tissue now prone to damage/necrosis
  o Effects:
    ▪ muscle cells are replaced by fat and CT
    ▪ progressive symmetrical wasting
    ▪ in w/c by 10-12 years, die by age 20
  o DX
    ▪ genetic testing, physical exam, CK levels
  o CLASSIC SIGNS
    ▪ Gowers Sign → pushing on thighs to stand up off the floor
    ▪ Calf Pseudohypertrophy → well defined calves but by fat and CT (Qmuscle)
  o S/S
    ▪ proximal muscle weakness
    ▪ waddling gait
    ▪ toe walking
    ▪ lordosis
    ▪ difficulty standing up and climbing stairs, frequent falls
    ▪ lower IQ
  o RX
    ▪ exercise by maintain strength and balance (avoid eccentric)
    ▪ respiratory therapy
    ▪ prevention of contractures, seating, equipment

• Other Muscular Dystrophies
  o Beckers → slower and progressive form of DMD but not as severe
  o Congenital
  o Fasciopulohumeral MD → rare and affects M=F
  o Myotonic MD: most common type after DMD
  o Emery-dreifus
  o Spinal muscle atrophy → skeletal muscles weaken when anterior horn degenerates
    ▪ S/S → hypotonia, ↓function, weakness (symmetrical, proximal > distal), fatigue

AMYOTROPHIC LATERAL SCLEROSIS (Lou Gerigs)

• motor neuron disease w/ gradual deterioration of BOTH UMN and LMN
  o can have both flaccid and spastic paresis
• M>F, etiology unknown
• Disease Course → 2-5 yrs after dx (only 10% survive 10 yrs)
• S/S
  o paresis in a single muscle group
  o corresponding muscle groups are asymmetrically affected (patchy distribution)
  o fasciculations (twitching)
  o metabolic involvement of the skin (papery, fragile, cold)
  o gradual involvement of striated muscle (bulbar = major concern)
  o progress to permanent paralysis
  o flaccidity + spasticity may co-exist
  o selective sparing (no ocular or cardiac, urethral & anal sphincter)
• DX
  o physical exam, medical history, muscle biopsy (not needed to confirm Dx)
• RX
  o meds, rehab for immobility, symptom relief (spasticity, secretions, psychological)

Essential tremor
• usually evoked by voluntary movement
Dystonia
- involuntary, sustained muscle contractions, writhing
- commonly linked to a single repetitive action (ie musicians)
- causes → genetic, originates from different parts of brain

PARKINSON’s DISEASE
- Chronic neurodegenerative disease in basal ganglia, M=F
- dopamine produced by substantia nigra
  - dopamine normally inhibits ACh
  - without dopamine = excessive excitatory output
- Possible causes:
  - viral (infection → swelling of brain)
  - genetic
  - toxic (drugs)
  - injury or focal ischemia → can cause PD-like symptoms
- S/S (classic)
  - bradykinesia → slowness of movement, can result in freezing
  - resting tremor
  - rigidity → velocity independent resistance to passive stretch
  - postural instability
- S/S (other)
  - loss of automatic movement (ie rolling over in bed)
  - micrographia
  - autonomic abnormalities
  - hypokinesia/akinesia
  - mask face
  - depression, dementia
  - postural hypotension
  - pain
  - sleep disturbance (restless leg)
  - fatigue
  - fine motor control
- RX
  - drugs (L-dopa + anticholinergic) → pt will have mot’r tremor b/c of meds
  - education (protective effects of exercise)
  - functional mobility exercise → FOCUS ON BIG MOVEMENTS
    - cueing (tactile, verbal, music)
    - address postural changes and cardiorespiratory fitness
    - transfers, balance and falls prevention
  - prevention of secondary sequelae
  - environment safety and checks
  - care giver involvement and training
  - equipment
- OUTCOME MEASURES:
  - UPDRS
  - Hoens & Yar (5 stages and Rx)

HUNTINGTON’S CHOREA:
- hereditary disorder → atrophy of basal ganglia structures, personality disorder, dementia
- *they can’t stop moving* → abnormal mov’ts
- RX → symptom mgnt, antipsychotic drugs, safety, nutrition
DEMYELINATING DISORDERS

MULTIPLE SCLEROSIS

- inflammatory disease → fatty myelin sheaths around brain + spinal cord axons are damaged
- leads to demyelination + scarring
- etiology: unknown
- typical onset 20-40y, F>M

**TYPES**

- Relapsing Remitting
  - new/old symptoms resurface or worsen
  - can be full or partial recovery relapses (days-months long) slow or instantaneous
  - each flare up may cause more loss of fxn
- Primary Progressive
  - gradual worsening of symptoms overtime
  - may stabilize but no remission
- Secondary Progressive
  - Begins as relapsing remitting → steadily worsens
  - does not remyelinate
- Progressive Relapsing
  - steady progression with attacks

**(Early) SYMPTOMS**

- mm weakness
- optic neuritis, diplopia
- sensory changes (paraesthesia)
- b/b incontinence
- vertigo
- fatigue
- impaired cognition/memory
- pain
- depression

**RX**

- Pharmaceuticals
  - anti-inflam + immunosuppressant
  - side effects → heat intolerance, photosensitivity
- PT Treatment for:
  - vestibular dysfunction
  - proprioception
  - exercise (posture, core, stretches, pool therapy, interval training?)
  - osteoporosis (?)
- CONTRAINDICATIONS/precautions to EXERCISE:
  - Heat
  - Fatigue
  - Pregnancy
FOR PT: MONITOR COG/BEHAVIOR CHANGE, ICP CONSIDERATIONS

LYME DISEASE
- from a bacteria, Borrelia burgdorferi, through ticks
- mimics other diseases like MS, fibromyalgia, chronic fatigue syndrome, guillian barre
- **STAGES:**
  - localized presentation → erythema, flu-like
  - neuro (headache and neck stiffness) **MSK** and **cardiac** (tachy, brady, arrythmia, myocarditis)
  - may have Bells palsy
  - final stage → **long term neuro + arthritis** (1/3) + **cognitive** deficits
- **RX** → antibiotics to treat
- **PT MGMT**
  - relieve pain
  - ↑ strength in deconditioned patients for home exs
  - FITT w/out exacerbating symptoms

GUILLAIN-BARRE SYNDROME
- Antibody mediated demyelination of Schwann cells in PNS from spinal nerves → terminating fibres
- May be in hospital for 6-8 mo
- **Causes**
  - immune disorder
  - 2/3 ppl had recent illness in last 30 days (flu vaccine)
- **S/S**
  - onset to peak 4 weeks
  - rapid ascending motor weakness and distal sensory loss
    - spreads to arms, trunk, and face
  - stocking and glove pattern of loss*
    - absent DTR
    - may require mechanical ventilation
- **RX**
  - **MEDICAL** → Plasmaphoresis, immunoglobin
  - **PT:**
    - joint protection
    - chest rx, mobilization
    - strength
    - ROM (usually opposite to ALS progression)

MENINGITIS
- infectious disease (bacterial or viral) \( \rightarrow \) can be fatal
- causes inflammation of meninges (all 3: pia, arachnoid, dura)
- blood-brain barrier can break down
- can lead to \( \rightarrow \) thrombosis, infarction, scars, edema
- commonly seen in:
  - under development countries
  - dorms
  - infants
  - immunosuppressed
- **TYPES**
  - aseptic (fungus, virus, parasite, can also get with: herpes syplex 2, ebstien barr, lupus)
  - tuberculosis: abscess or edema
  - bacterial: in child or infant is considered a medical emergency
- **S/S**
  - Brudzinski sign \( \rightarrow \) flexing hip + knee causes neck to involuntarily flex
  - fever, headache, seizure
  - vomiting
  - focal CNS signs (nerve palsies, deafness), * pain with neck, hip, or knee flexion*
- **SEVERITY**
  - acute (hrs-days)
  - sub acute (2wks plus)
  - chronic (1mo+)
- **RX (below)**

**ENCEPHALITIS**
- infection (1° or 2°) of the brain + spinal cord or brain parenchyma (nervous tissue in brain)
- **S/S**
  - headache, LOC, coma (may last for weeks)
  - nausea, vomiting
  - agitation
  - meningeal irritation
  - stiffness
- **RESULT**
  - can lead to necrosis, hemorrhagic necrosis, scarring

**MENINGITIS + ENCEPHALITIS MGMT**
- Investigate ASAP \( \rightarrow \) EEG, CSF tap, MRI
- **RX**
  - antibiotic (if bacterial)
  - viral (control of symptoms)

**CREUTZFELDT JAKOB DISEASE**
- movement disorder/dementia \( \rightarrow \) rapidly progressive + fatal
- occurs in young adults
- **Pathology**
  - caused by prions (misfolding proteins) \( \rightarrow \) bovine spongiform encephalopathy (mad cow disease)
  - contracted by ingestion or via the nose
  - incubates 5-Byrs
- cannot make final Dx until death*
01.02.08

**POST-POLIO SYNDROME**

- Attacks neurons in brainstem + anterior horn cells (spinal cord)
- **INITIAL EFFECT** → death of those **motor neurons** controlling **skeletal muscles**
  - Those that survive → sprout new nerve terminals to make up for loss
  - **RESULT** → some mov’t recovery + enlarged motor units
- **After years of use** → high metabolic stress on larger motor units → more than neuron can handle
  - **RESULT** → gradual deterioration of sprouted fibers & eventually neuron
  - **MUSCLE WEAKNESS + PARALYSIS**

01.02.09

**CEREBELLAR DISORDERS**

- MS
- hereditary ataxia, Friedreich’s ataxia
- neoplastic, metastatic tumors
- infection
- vascular → stroke
- developmental → ataxic cerebellar palsy, arnold chiari syndrome
- trauma → TBI
- drugs → heavy metals
- chronic alcoholism; acute alcohol poisoning, effects GABA receptors

**CEREBELLMUM LESIONS**

**Archicerebellum lesions**

- (vestib control of head and body position)
- central vestib system
- gait and trunk ataxia (incoordination of movement) → will fall towards side of lesion

**Paleocerebellum lesions**

- (synergy of agonists/antagonists/postural correction)
- hypotonia, trunk ataxia, ataxic gait → will lose core activity, jerky movements

**Neocerebellum lesions**

- (coordination of fine skilled movements)
- intention tremor, dysdiadochokinesia, dysmetria, dyssynergia
- errors in timing → loss of fine coordination
- additional impairments → asthenia (generalized weakness), hypotonia, motor learning impairments, cog deficits, emotional dysregulation

**TESTS**

- Coordination tests → UE/LE
- Romberg sign
  - to rule out sensory loss as cause of imbalance
  - if similar imbalance eyes open and closed likely cerebellar in origin
- **Falling to side of lesion**
  - remember cerebellar lesion are ipsilateral
- S/S
  - lurching gait, **falling to side of lesion**, stiff legged
  - intention tremor, dysdiadochokinesia, nystagmus, dysmetria (overshooting target)
  - cerebellar ataxia, decomposition of movement, pendular knee jerk
  - others → hypotonia, falling, dysphonia or dysarthria

01.02.10
VESTIBULAR DISORDERS
- cause of dizziness → cardiovascular, neurological, visual, psychogenic, cervicogenic, meds, vestibular

VESTIBULAR FUNCTIONS
- gaze stabilization
  - objects in visual field stay clear with head movement
- postural stabilization
  - maintain balance and equilibrium
- resolution of sensory motor mismatch
  - proprioception, vestibular and visual → sea sickness/motion intolerance

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ANATOMY
- SEMICIRCULAR CANALS x 3 → horizontal, anterior, posterior
  - Fx → gaze/angular displacement of the head
  - movement of endolymph will deflect hair cells and excite or inhibit neurons (CNVIII)
- OTOLITH x 2 → utricle- detects horizontal plane motion, and saccule- detects sagittal plane motion;
  - together detect acceleration and deceleration, gravitational pull= POSTURAL

HISTORY → highly important w/ vestibular disorder!!!

Common VESTIBULAR S/S
- vertigo= the subjective experience of nystagmus (room spinning around you) - get it with BPPV *
  - always vestib in origin
- dizziness= discrepancy between R and L side, patient can’t work out where they are in space
  - non-specific, may or may not be vestib in origin
- oscillopsia=blurred vision * NOT THE SAME A DIPLOPIA
- antibiotic= GENTOMYCIN = affects vestibular system

BPPV (benign paroxysmal positional vertigo)
- 90% present with crystal in posterior SCC, 80% canalithiasis (free floating in the canal)
- S/S
  - brief (< 30 sec), delayed, transient vertigo with looking up/down, rolling to that side of bed, sit to supine; +/- vertigo, nystagmus, vomiting etc
- AX
  - Dix Hallpike * look for down beating nystagmus
  - Contraindications: cervical spine instability, VBI, Arnold- chiari malformation, acute whiplash, RA, prolapsed IV disc with radiculopathy, cervical myelopathy
- RX
  - Modified Epley Manoeuvre*, Semont/Liberty manoeuvre, Brandt-Daroff → very good prognosis after first treatment, keep head down at end of manoeuvre because you can put the crystal in the horizontal canal

Menieres Disease
- overaccumulation of endolymph
- S/S → episodic vertigo, tinnitus, fullness of ears, hearing loss → don’t assume that pts will benefit from VR

UVL (unilateral vestibular loss)
- VOR
reflex that moves your eyes in the opposite direction that your head is turning
allows for visual fixation*
deficient in UVL and BVL

Causes of UVL
- infection, trauma, disease (Meniere’s Disease), surgery

Acute S/S
- spontaneous nystagmus away from the affected ear, reduced VOR, vertigo (resolves in a few days), dizziness, oscillopsia, imbalance, vomiting

Chronic S/S
- dizziness, oscillopsia, imbalance
- symptoms worse after rapid head movements → depends on compensation

TEST
- head-thrust, dynamic visual acuity test, balance and gait assessment + Dix-Hallpike

RX
- exercises to resolve conflict and symptoms (adaptation exercises, balance, walking programme, functional tasks)
- education on impact of stress on symptoms
- maintain general fitness
- address falls risk, mobility aids
- improve any balance deficits * 6-8 wks

BVL (bilateral vestibular loss)
- can be equal or unequal, NO DIZZINESS OR VERTIGO
- usually caused by ototoxic drugs (gentimicin)
- S/S → ↓↓balance with eyes closed + ↑ oscillopsia

Ototoxic Medications
- antibiotics (gentimicin), anticancer drugs, env. chemicals, loops diuretics, aspirin
- *BALANCE AX → static (Romberg, sharped Romberg (tandem stance)), dynamic (reach arm forward, movement with eyes opened and closed), composite tests (berg)
- *GAIT → eyes open/closed, head turns, different surfaces, negotiating objects

Central Vestibular Disorders
- CAUSES → stroke, TBI, MS, tumor, neurodegeneration, epilepsy, etc
- RED FLAGS → direction changing nystagmus, inconsistency in test results
- DX → by a collection of oculomotor tests
- RX → based on neuroplasticity
  - exercises (habitation, substitution, balance, walking program, functional tasks), 8-12 wks

Motion Sensitivity
- (1) sensitivity to head movement /// (2) sensitivity of moving environment
- RX → 8-12 weeks of sensorimotor mismatch exercises

Cervicogenic Dizziness
- DX of EXCLUSION
- RX → mgmt of vestib dysfxn, proprioception neck symptoms, ↑motor control and endurance (deep neck flexors)

Acoustic Neuroma (aka – Vestibular Schewannoma)
- intracranial tumor of myelin around CN VIII
- common later in life 50-60 yrs causes central vestibular loss

01.02.11 NEUROPATHIES

PERIPHERAL NEUROPATHY
• injury to peripheral N due to injury or illness
• mononeuropathy, mononeuritis, polyneuropathy, autonomic neuropathy, neuritis
• **CAUSES**
  o diabetes (most common)
  o lyme disease
  o HIV
  o Shingles
  o Guillain-Barre
• **Diabetic Neuropathy**
  o can be focal or diffuse, involving the somatic or autonomic PNS
  o **PRESENTATION**
    ▪ symmetrical distal pattern (diabetic polyneuropathy)
  o **CAUSES**
    ▪ hyperglycemia leading to abnormal microcirculation
    ▪ change in insulin levels after gene-regulation
    ▪ loss of myelinated + non-myelinated fibres
    ▪ vascular changes
    ▪ nerve growth reduced
  o **S/S**
    ▪ burning pain
    ▪ symmetrical sensory changes (paresthesia, burning)
    ▪ can be slow or rapid onset (people may not notice it)
    ▪ paraesthesia → impaired proprioception, touch, pressure
    ▪ minimal motor weakness
  o **RX/MGMT**
    ▪ control hyperglycemia
    ▪ symptoms management
    ▪ skin care checks* (risk of wound and amputation)
    ▪ exercises:
      • strength (ankle, hips → strategies for prevention of falling)
      • balance
      • prevention of damage to skin, joint, muscle, CT
• **COMPLEX REGIONAL PAIN SYNDROME** (Former name - Reflex Sympathetic Dystrophy)
  • chronic pain condition
  • result of dysfx in central or peripheral NS  *sympathetic facilitation*
  • **PRESENTATION**
    o change in color/temp of the skin over the affected limb or body part
    o intense burning pain
    o skin sensitivity
    o sweating
    o swelling
    o stiffness
    o *usually occurs after trauma or immobilization (cast)*
  • **STAGES**
    o Stage 1 (0-3 mo) puffy swelling, redness, warmth, stiffness, allodynia, pos bone scan
    o Stage 2 (3-6 mo) P and stiffness, firm edema, cyanosis, atrophy, osteopenia on xray
    o Stage 3 (6mo+) tight, smooth, glossy, cool, pale skin
      ▪ stiffness and contractures, nail and hair changes, severe osteopenia
  • **RX → prevention and early detection**
    o early ROM, P/edema mngmt (desensitization, contrast baths, modalities), education
• **01.02.12 DEVELOPMENTAL/BIRTH INJURIES**
• **CEREBRAL PALSY**
  • Non-progressive lesion of brain, occurs before 2yrs
• **COMORBIDITIES**
  - hearing and speech problems
  - hydroencephalus
  - microencephaly
  - scoliosis
  - hip dislocation
  - mental retardation

• **RISK FACTORS**
  - prenatal (maternal infection, malnutrition, maternal seizures)
  - perinatal ( prematurity, obstetric complications (breech))
  - low birth weight
  - low APGAR
  - multiple births
  - post natal: infection, environmental toxins, brain tumor, anoxia, CVA

• **CP CLASSIFICATION**
  - Spastic
    - monoplegia, diplegia, hemiplegia, quadriplegia
    - classification by physiology type ➔ stiffness, ↓ ROM, movements limited to synergies primitive movement patterns- trouble start/stop movement
  - Ataxic
    - rate, range, force, duration of movements
    - difficulty with rapid movts, coordinated gait, fine motor, balance
  - Dystonic
    - ↑ tone, can’t relax muscles easy
    - long sustained involuntary movements and postures
    - tend to lock joints at end range
    - usually have full ROM
    - mid control difficult
  - Hypotonia ➔ lack of tone, weakness
  - Athetoid
    - writhing movement, snake-like

• **PATHOLOGY** ➔ not consistent
  - intraventricular hemorrhage ➔ below lining of ventricles
  - periventricular leukomalacia ➔ common ischemic injury
  - small holes surrounding ventricles ➔ death of small areas of brain tissue

• **Risk Factors**
  - 27-30 weeks gestation
  - small for gestational age
  - rupture of membranes
  - intrauterine infection
  - loss of autonomic regulation of CNS blood flow until full term
    - (cycle of perfusion and reperfusion)

• **OTHER COMPLICATIONS**
  - hip subluxation
    - ++ painful, hard to stand/walk, spasticity of adductor longus and iliopsoas
    - dislocated posteriorly, pelvic obliquity and scoliosis
    - be suspicious if they cannot ABD leg more than 45 degrees

• **RX**
  - Medical
    - bacolfen pump, dorsal rhizotomoy (cut dorsal roots of SC), botox to ADDs, serial casting, tendon release, osteotomy
  - PT Management
    - manage atypical mm ➔ ROM, orthotics
    - habituation, not rehab
    - positioning, sitting modifications ➔ put pummel between legs
SPINA BIFIDA
- Neural tube defect → **RESULT**: vertebral and/or spinal cord malformation
  - **Spina Bifida Occulta** - no spinal cord involvement, may be indicated by hair tuft
  - **Spina Bifida Cystica** - visible or open lesion
  - **Meningocele** - cyst includes cerebrospinal fluid cord intact
  - **Myelomeningocele** - cyst includes CSF and herniated cord tissue
- link between maternal decreased folic acid + infection + exposure to teratogens (alcohol)
- **S/S**
  - flaccid or spastic muscles
  - muscle weakness
  - contractures
  - muscle wasting
  - dec/absent DTR
  - rectal/bladder incontinence
  - hydrocephalus (chiara malformation)
  - osteoporosis, lordosis, scoliosis, kyphosis
  - foot deformities → talipes equinovarus (club foot) esp with L4, L5 level
- **RX**
  - ROM, strengthen functional muscles
  - teach transfers
  - equipment (orthodics, early mob, standing and ambulation)
  - encourage awareness of sensory deficits (protection of feet, position of legs, check for sores)

ERB'S PALSY (waiters tip)
- C5, C6 injury in infants → usually coming out of birth canal
- **MM EFFECTs**
  - rhomboids, levator scapulae, serratus anterior, delts, supraspinatus, infraspinatus
  - biceps, brachioradialis, brachialis, supinator, long extensors of wrist, fingers, thumb
- **RX**
  - immobilization initially
  - gentle ROM
  - play exercises

KLUMKE (claw hand)
- C8, T1
- **MM EFFECT**
  - intrinsic hand mm, flex/extensors of wrist/fingers

MEDIAN N PALSY (ape hand)
- C6-8, T1 median N
- **THENAR MM THUMB** → Thumb ABD, oppose
DEMENTIA:

I. ALZHEIMER'S
- huge risk with age, genetic link
- etiology unknown
- IMPAIRMENTS
  - memory, language, visuospatial skills
  - cognition, personality
  - slow steady decline
- PRESERVED: implicit skills (Ex: piano playing
- DX: made at autopsy (neurotic plaques)

II. VASCULAR COGNITIVE DEMENTIA
- multiple small lesions 2° to poor blood flow (high BP)
- leads to degeneration of medial temporal lobes → “staircase pattern of functional losses”
- related to:
  - hypertension, small haemorrhages, atherosclerotic plaque,
- most patients die of pneumonia
- Outcome Measure: MMSI (Mini Mental State Exam)
- PT CONCERNS:
  - Falls prevention
  - Retaining motor activities
  - restlessness = support for caregivers
**ALTERED LEVEL OF CONSCIOUSNESS (E.G., COMA, SEIZURES)**

**COMA**  →  LOWEST level of consciousness
- assess w/ GCS (Glasgow Coma Scale)
- will not obey commands, open eyes, or interpret words
- short lived phase will either die or improve to vegetated state

**EPILEPSY/ SEIZURES**
- disturbances in CNS
- **S/S**
  - altered consciousness
  - motor activity (convulsions)
  - sensory phenomena
  - altered autonomic & cognitive fx
- **TYPES**
  - 1) primary generalized seizures - bilateral and symmetrical w/out local onset
    - tonic-clonic (grand mal)
    - dramatic, whole body - 2-5 mins
    - absence seizures (petit mal)
    - brief, almost imperceptible LOC
    - come back to full consciousness
    - no change in posture
    - can be up to 100/day
  - 2) partial seizures
    - simple partial seizure - usually one part of the body
      - focal motor → clonic activity on specific area of body
      - focal motor with march (Jacksonian) → orderly spread or march of clonic movements; can progress to whole side
      - temporal lobe seizure → episodic change in behavior, complex hallucinations,
    - complex partial seizure - simple partial seizures followed by impairment of consciousness
NEUROANATOMY

ASCENDING TRACTS:

Lat Spinothalamic
- tests pain, hot/cold of limbs and trunk
- receptors are free nerve endings
- sharp P is A delta fibers, slow/dull are type C fibers
- ascends in lateral white column of spinal cord, crosses w/i 1-2 segments
- finishes in parietal lobe (this lobe integrates sensory information from different modalities)
- F HALF THE CORD has lesion, at the level there ipsilateral loss, and contralateral loss below the lesion

Ant (ventral) Spinothalamic
- crude touch and pressure
- receptors are Merckel discs and Ruffini corpuscles and free nerve endings
- A delta and A beta
- ascends in ant white column
- crosses w/i 1-2 segments
- finishes in parietal lobe as well
- IF HALF THE CORD has lesion, at the level there ipsilateral loss, and contralateral loss below the lesion

Dorsal columns (medial lemniscus)
- 2-pt discrimination
- fine touch
- stereognosis
- vibration
- receptors are pacinian corpuscles (vibration), merckels’s disc, meissners (light touch), a beta
- fibers cross in the brain stem
- lesion below medulla $\rightarrow$ ipsilateral loss
- lesion above medulla $\rightarrow$ contralateral loss
- finishes in parietal lobe

DESCENDING TRACTS:

Lateral corticospinal
- primary motor tract
- 90% cross in pyramids (part of the brain stem)
- synapses in ant horn cell in grey matter of spinal cord, goes out on an alpha motor neuron, terminates at the neuromuscular junction
- LESION above level of medulla where they cross $\rightarrow$ loss of vol mvmt contralateral to the lesion

Anterior corticospinal
- primary motor
- 10% that cross at level of innervation
- target lower motor neurons; start in frontal lobe
- don’t cross in the pyramids
- travel in ventral white column
- IF LESION is on one side of the cord $\rightarrow$ loss of 10% voluntary mvmt contralateral to the lesion
CEREBRAL ARTERIES

Internal carotid artery
- collateral supply is possible thru ant. + middle cerebral arteries
- **Deficits:**
  - contralat. hemiplegia and hemisensory disturbance
  - global aphasia (if dominant side)
  - mentally slow
  - contralateral homonymous hemianopia
  - partial Horner’s syndrome
  - gaze palsy (eyes to opp side)
- is the main supply for ant, post, middle cerebral arteries

Anterior cerebral artery
- **Deficits:**
  - weakness and sensory loss of contralat limbs
  - self care problems
  - emotional lability

Middle cerebral artery
- **Deficits**
  - contralat hemiplegia, hemisensory loss, hemianopia
  - contralat neglect
  - aphasia (impairment of language ability) if on dominant side
  - apraxia (disorder of motor planning)
  - can’t carry out purposeful movements
  - impaired hearing
  - difficulty dressing
  - may also produce motor speech dysfunction (Broca’s area)

Vertebral artery
- two join to form basilar artery
- imp branches to watch for strokes → PICA (largest branch of vertebral a.), AICA, PCA

Post cerebral artery (PCA)
- supplies occipital lobes
- **Deficits**
  - vision problems, CN III palsy, contralateral hemiplegia, chorea (abnormal invol. mvmts, looks like dancing)
  - hemiballismas (involuntary flinging mvmts of extremities)
  - hemisensory impairment
  - contralateral homonymous hemianopia
  - difficulty with naming and colors

Superior cerebellar artery
- supplies cerebellum
- **Deficits**
  - limb ataxia
  - Horner’s syndrome (droopy eyelid, red face)
  - contralateral sensory loss

Ant inf cerebellar
- supplies cerebellum
- **Deficits**
  - ipsilateral limp ataxia
  - ipsilateral horner’s
  - sensory loss
  - facial weakness
  - paralysis of lateral gaze
  - contralateral sensory loss of limbs and trunk

**PICA**
- supplies cerebellum
- **Deficits**
  - dysarthria (poor articulation while speaking d/t motor issues)
  - ipsilateral limb ataxia
  - vertigo
  - nystagmus
  - ipsilateral horners
  - sensory loss (p and temp) of face
  - pharyngeal and laryngeal paralysis
  - contralateral sensory loss (p and temp) of trunk
  - visual sy’s (paralysis of vertical eye mvmts and decrd pupillary light reflex)

**Broca’s (expressive) aphasia**
- Broca’s area is located in the left frontal lobe → therefore:
  - problems with articulation of speech (dysarthria)
  - can understand speech fine

**Wernicke’s (receptive) aphasia**
- Wernicke’s area is located in the left temporal lobe, therefore:
  - problems with understanding speech
  - will speak normally but often doesn’t make sense → patient feels it does

1° somatosensory → located in both parietal lobes, resp for all sensation
1° visual → located in both occipital lobes
1° auditory → located in both temporal lobes
Olfactory area → located in both temporal lobes

**LEFT CVA** – DECREASED:
- most muscles on R side of body are affected. Also aphasias, used more reasoning, numerical and scientific skills, spoken and written language, sign language.

**RIGHT CVA** – DECREASED:
- musical and artistic awareness
- spatial and pattern perception
- recognition of faces
- emotional content of language (speak in montotnous voice)
- discriminating smells
- damage to right brodmann’s area have difficulty differentiating smells
- HEMINEGLECT

**CRANIAL NERVES**
1. Olfactory → smell
a. damage → anosmia (inability to detect smells, seen with frontal lobe lesions)

2. Optic → vision
   a. damage → can cause homonymous hemianopsia (hemianopic visual field loss on the same side of both eyes)
   b. Hemianopias occur because the right half of the brain has visual pathways for the left hemifield of both eyes, and the left half of the brain has visual pathways for the right hemifield of both eyes

3. Oculomotor → pupillary reflexes
   a. motor: medial rectus, superior and inferior rectus, and inferior oblique
   b. damage → can cause absence of pupillary constriction or Horner’s syndrome (combination of drooping of the eyelid (ptosis) and constriction of the pupil (miosis), sometimes accompanied by decreased sweating of the face on the same side; redness of the conjunctiva of the eye is often also present)

4. Trochlear
   a. turns adducted eye downwards → superior oblique

5. Trigeminal
   a. V1 sensory on face
   b. V2 ophthalmic branch (touch with cotton) → opthalmic division
   c. V3 motor mm of mastication → maxillary/mandibular division

6. Abducens
   a. turns eye out → lateral rectus

7. Facial → facial expression
   a. parasympathetic control of lacrimal, submandibular, and sublingual glands, taste to anterior 2/3 of tongue, innervates ant aspect of tongue
   b. damage → inability to close eye, droopy corner of mouth, difficulty speaking
      i. LMN lesion = ipsilateral side of face
      ii. UMN lesion = contralateral lower half of face

8. Vestibular
   a. balance, gaze stability, auditory
   b. damage → can cause vertigo, nystagmus, deafness

9. Glossopharyngeal
   a. phonation (voice quality), swallowing, innervates the back of the tongue
   b. damage → dysphonia (hoarse or nasal voice)

10. Vagus
    a. elevates the soft palate
    b. controls position of uvula, gag reflex
    c. muscles in larynx and upper esophagus

11. Accessory
    a. (spinal) - innervates traps and SCM
    b. damage → inability to shrug ipsilateral shoulder (traps) or inability to turn head to opp side (SCM)

12. Hypoglossal → tongue movement
    a. damage → dysarthria or deviation of tongue to the weak side

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**TREATMENT**

**OUTCOME MEASURES**
Impairment level
i. motor control/strength: muscle chart (MMT) or Fugl-Meyer
ii. cognition and perception: mini-mental status exam (MMSE) or Montreal Cognitive Assessment (MOCA)
iii. tone and spasticity: modified ashworth scale (pediatric: modified tardieu)
iv. sensation: sensation body diagram, Nottingham sensory assessment

Activity level
i. gait: 6MWT, TUG, 10 m walk, dynamic gait index, observational gait analysis, functional gait assessment
ii. balance: BERG, Fullerton balance assessment, community balance and mobility scale, BESTest measure, functional reach test
iii. upper extremity: DASH, action research arm test, upper extremity performance test for elderly, wolf motor function test
iv. other: Barthel index, chedoke mcmaster stroke assessment, clinical outcome variables scale (COVS), functional independence measure (FIM), motor assessment scale (MAS), patient specific functional scale, activities balance confidence scale (ABC), stroke impact scale (SIS), falls efficacy scale

Neurorehab Goals
1. maintain: participation, activity, body structure and function
2. prevent: complications
3. reversal of impairments: as appropriate, encourage neuroplasticity
4. adaption to impairments: adaptive aids, compensation

Always consider: vitals (BP, HR, RR, SpO2), lines, risk of DVT/PE, skin integrity, pain, risk of falls, medications, ability to communicate, relevant FMHx and PMHx, family/caregiver involvement, changes in outcomes (GCS), risk of bleed if on anticoagulants, risk of seizures, basal skull #, spine #, ICP, limb #, internal injuries, FATIGUE, resp status, perceptual/cognitive difficulties, autonomic dysreflexia,

* LOOK AT FIRST LECTURE FROM TARA NEURO REHAB ➔ CHARTS FOR SAFE PRACTICE*

Neuroplasticity: use it or loose it, use it and improve it, specificity, repetition**, intensity, time matters, salience matter, age matters, transference, interference * no drug alone will improve neuroplasticity, intervention needs to be paired with behavior; requires: task specific practice, dose? 6 hrs per day?

SENSATION AND VISION TESTS

VISION
  • Visual Field Testing
- Test quadrants with other eye closed, pt looking at you: superior (60 degree), inferior (75 degree), lateral (100 degree), medial (60 degree)

- **Papillary Light Reflex**
  - In on 2 and out on three, should see constriction of both pupils, direct and indirect (or consensual) reflex, test both eyes

- **Accommodation**
  - Bring finger slowly towards pt’s nose and look for convergence and papillary constriction, tests optic, oculomotor, trochlear, and abducens nerves

- **Ptosis**
  - Look for drooping of eye lids → oculomotor, ask patient to gaze upwards without moving head

- **Eye Movements**
  - Tests oculomotor, trochlear, and abducens *make sure you ax superior oblique and inferior oblique close to medial aspect of eye, and superior and inferior rectus at midline

- **Smooth Pursuit**
  - Range of 30 degrees side to side and up and down → look for nystagmus

- **Saccades**
  - Have finger 15 degrees to one side of nose, have patient look rapidly from your nose to your finger, do side to side and up and down; look for overshooting

- **Nystagmus**
  - Record direction, ax through eye movement, smooth pursuit * is normally elicited in extreme ranges of eye movement (ie looking to the side)

- **RX**
  - Environment modifications, instruct scanning of environment, balance exercises to improve other systems, referral to CNIB

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**SOMATOSENSATION TESTS**

- **Light Touch** (dorsal column medial lemniscus pathway)
- **Sharp And Dull** (lateral spinothalamic)
- **Thermal** (lateral spinothalamic)
  - Complete 3-5 times on specific areas
  - Record as intact, reduced, absent or hyperesthesia
  - *If light touch is intact do not go on to do sharp and dull
- **Vibratory Sense** (dorsal column medial lemniscus pathway)
  - Have 128 Hz tuning fork, start distally and move proximally, hit tuning fork against hand (each time, can quiet it if you aren’t wanting it to vibrate), hold to specific areas of skin for 2 minutes → intact, absent, or impaired
- **Joint Position Sense** (dorsal column medial lemniscus)
  - Start distal work proximal til you get normal, up/down → intact, impaired or absent
- **Two Point Discrimination** (dorsal column medial lemniscal tract)
  - Start with points 5 mm apart (normal: finger tips 2-5 mm, palm 8-12 mm, extremity and trunk 20-30 mm)
- **Sterogenesis**
  - Pick three objects, test one hand at a time, intact, impaired, or absent
- **Graphethesia**
  - Ax all systems and higher level planning
  - Draw numbers or letters on palm on hand, do both, intact, absent, or impaired
- **Double Stimulation** (perception)
  - Ask if you are touching them on both sides or one; intact, absent or present

- **RX**
  - Educate limp protection and skin care
  - Use available somatosensation (balance exercises, minimize edema, promote active movement, densensitize hypersensitivity, maximize visual and vestibular input (look at hand you are moving, use mirror to practice)
  - Adaptive equipment
  - Increase confidence
VESTIBULAR
- "sitting balance usually is not impaired"
- RX
  - walking program
  - exercises (habituation, accommodation, adaption)
  - balance
  - address risk of falls
  - aids

BIOMECHANICAL LIMITATIONS

Contraindications for STRETCHING ➔ bony block, recent #, acute inflamm process of the joint, sharp or acute joint pain, hematoma or tissue trauma, contracture or soft tissue is providing stability to area or function (ex tenodesis grip)

ROM (PROM, AROM, AAROM)
- shoulder ➔ approximate to see shoulder stability, ax scapular movement, keep arm close to your body, elevation (make sure thumb is pointing upwards), only go to 90 degree elevation
- ankle (watch for pressure on sole of foot ➔ can trigger plantar response, bend knee to check soleus
- do not use pulleys for ROM exercises in exercises above 90 degree flexion and abduction
- do three reps per movement, give prescription: 10-20 reps, 1-2 x per day

PNF
- INDICATIONS: increase ROM and strength in multi-joint/muscle involvement, used to ax abnormal movement patterns
- D1
  - shoulder ER (consider feeding, upper cut) ➔ IR
  - hip IR ➔ ER (cross leg/kick ball)
- D2
  - shoulder ER ➔ IR (reach and pick apple and then put in bag)
  - hip IR ➔ ER (fire hydrant)
- can add resistance to promote strength ➔ or a quick stretch at the beginning of movement to elicit contraction of a weak muscle
- don’t forget to add the head/neck, ankle patterns
- CONTRAINDICATIONS: any for resistant exercises
- PRECAUTIONS: avoid quick stretch on hypertonic muscles, gentle stretch and care on hypotonic muscles, care to not promote invariant movement patterns, watch for substitution

SPASTICITY AND TONE
- flexor synergy
  - UE = flexion of elbow, ER and ABD of shoulder, flex of wrist
  - LE = hip flex, knee flex, DF and INV of foot
- extensor synergy
  - UE = shoulder adducts and internally rotates, elbow extends and pronates, wrist extends
  - LE = hip extends and internally rotates, knee extends, ankle PF and inverts
• muscle tone
  o resistance force in response to lengthening (stiffness), a continuum
  o goes from flaccidity → rigidity
  o can occur from neural and non-neural factors
  o Types:
    ▪ non-neural
      • muscle length, thixotrophy (extra CT between muscles ), CT and muscle fibre changes; immobilization, weakness, abnormal postures, abnormal movement patterns
    ▪ neural
      • ↑ input to alpha motor neuron, emotion, fear, pain, infection, full bladder, altered excitability of alpha motor neurons, loss of functioning motor units, altered motor unit firing rate, loss of orderly recruitment, impaired motor unit synchronization (inappropriate co-contraction of agonist/antagonist

• spasticity
  o velocity dependant increase in passive stretch

• rigidity
  o velocity independent resistance to passive stretch
  o usually seen with a head injury (decorticate or decerebrate rigidity)

• LMN lesions
  o hypotonia or hyporeflexia

• UMN lesions
  o hypotonia and hyperreflexia OR hypertonia and hyporeflexia

• ASSESSMENT
  o modified ashworth scale → 0-5 scale
    ▪ ask them to AROM, feel muscle, then PROM, then PROM with quick stretch
  o exaggerated proprioceptive reflexes (spasticity)
    ▪ clonus, tendon jerk, and pendulum test
  o exaggerated cutaneous reflexes
    ▪ touch to palmar and plantar surfaces
    ▪ babinski response

• RX
  o postural control
  o prevent and treat biomechanical limitations (positioning, ROM, mobility, etc)
  o promote strength, endurance, and coordination
  o maintain extensibility/PROM
  o address potential factors contributing to tone (agitation, motivation, pain, infection, full bladder)
  o provide sustained pressure on tendons
  o referral to health care team (meds, botox, etc)

• TREATMENT FOR:
  • CLONUS (proprioceptive reflex)
    o teach them to contract the muscle with the clonus then relax
  • CUTANEOUS HYPERREFLEXIA
    o desensitize, promote active movements within limits of individuals capacity, strap legs when in wheelchair to prevent falling

CEREBELLUM LESIONS
• Ataxia → failure of muscle coordinations; irregularity of muscle action
• AX
  o coordination
    ▪ 1) UE: finger to nose (elbow straight), dysdiadochokinesia, (elbows not supported on lap), finger opposition
    ▪ 2) LE: toe tapping, heel on shin * do at same time , then separate; start slow then fast* record how many reps and quality
o balance
  ▪ Romberg (differentiate from somatosensory deficit).

o functional
  ▪ TUG, 10 m walk

• RX
  o postural control
  o prevent and treat biomechanical limitations
  o promote muscle strength, endurance, and coordination
  o start with specific strategies: small range near midline, work out, progress: dec guidance, cueing, number of fixed points, inc active ROM, speed, change direction

OROFACIAL
  o complete peripheral nerve injury (not recoverable), incomplete – potential to recover, UMN injury – recovery is variable
  o Ax:
    • facial expression: wrinkle forehead, tightly close eyes, smile widely, purse lips together, smile wide and protrude chin
    • look for asymmetry and differences in upper and lower face
    • Rx: exercises promoting symmetry, mouth care, face tapping, stretching active area

POSTURE
  • look at three sensory systems (test balance eyes open, closed, open on cushion, closed on cushion)
  • Strategies → ankle, hip, stepping
  • FUNCTIONAL MEASURES
    o BERG, Fullerton, ABC, community balance and mobility scale, functional reach test, chedoke
  • RX
    o start with sitting balance → standing
    o static then dynamic, change support surface, w/ and w/o perturbations

FUNCTIONAL MOBILITY
  • initially in rolling have patient roll towards unaffected side so therapist can guide the effected limb
  • always monitor vitals, dizziness, lightheadedness, change of status or disease symptoms
  • make tasks salient!!!
  • lie to sit, sit to stand, stand

LOCOMOTION
  • ensure they have essential movement for each gait phase
  • walking velocity:
    o <0.4 m/s household ambulation
    o 0.4-0.8 m/s limited community ambulatory
    o >0.8 m/s full community ambulation
  • make it task specific, salient, and representative of what the patient is returning to
  • consider → walking aids, orthoses, FES

REACH AND GRASP
  • Consider → postural control, transport, and manipulation (grasp) * all systems are parallel
    o Rx needs to integrate all systems
  • ballistic movements are preprogrammed and don’t require sensory feedback
    o manipulation does (needs to figure out grip force)
  • To Use Hand
    o move hand to object desired, look and pay attention to the hand and environment, make postural adjustments prior to and during arm movement, utilize somatosensory feedback required for manipulation
• Reach
  o trunk control, elbow extension, pronation, stable scap and shoulder, wrist extension, finger opening
• Grasp
  o radial deviation and wrist extension, thumb opposition
• Holding
  o sensation
• Manipulation
  o finger cupping/opposition

POSITIONING
• promote symmetry
• prevent secondary side effects of immobility → change position often, position based on which muscles are tight, flaccid, etc
• HOB should never be zero, aspiration risk
• Wheelchair: symmetrical posture, have a clear tray, ensure shoes and socks on,

SEATING AX IN SCI
• done sitting and lying
• ask them what they need it for**
• measure from surface to:
  o PSIS, inf angle of scap, spine of scap, elbow, top of head
  o trunk depth, thigh length, shank length, outer knee width, chest width, hip width
• cushions → foam, gel, air
CARDIOPULMONARY-VASCULAR (15%±5%)

01.03.01
HEART DISEASE/MALFORMATION/INJURY

VALVE HEART DISEASE
- failure of valve to open completely thereby **impede forward-flow** (stenosis)
- regurgitations (insufficiency) → fail valve to close → **reverse blood flow**

DILATED CARDIOMYOPATHY
- heart with ↑mass → ↑difficulty w/ pumping
- risks: third trimester, alcohol

HYPERTROPHIC CARDIOMYOPATHY
- hypertrophied heart, abnormalities in filling
- young athletes at risk of dying
- S/S
  - chest pain & SOB, sudden

CARDIAC TAMPOONADE
- compression of the heart due to blood or fluid buildup in the pericardial sac
- may occasionally be the **result of puncture wound** through the heart during a procedure
- SYMPTOMS
  - jugular distension
  - hypotension
  - muffled heart sounds

ARTERIOSCLEROSIS
- stiffening of the arteries → thickening, ↓elasticity → hardening of arteries
- Type:
  - ATERIOSCLEROSIS
    - Artery wall thickens d/t accumulation of atheromas (WBCs + cholesterol + triglycerides) in lumen
    - EFFECT → weaken underlying artery
    - AT RISK FOR → heart attack, stroke, aortic aneurism

AORTIC STENOSIS
- calcification d/t age or lipid accumulation
- CONSEQUENCES:
  - heart murmur
  - hypertrophy
  - angina
  - syncope → transient loss of consciousness

ANEURISM
- localized abnormal dilation of the wall of a blood vessel → may rupture
- CAUSES → atherosclerosis, trauma, congenital defects
- MOST COMMON SITE → **abdominal aortic aneurism**
- RESULT → **AORTIC DISSECTION**
  - Tear in inner wall of aorta → causes blood to flow btw layers of aorta wall → forces layers apart
  - S/S → chest or abdominal pain, dissecting aneurism (tear w/in wall of blood vessel)

BLUNT TRAUMA TO THE HEART
FLAIL CHEST
- When rib cage segments break → moves independently
  - Result of: multiple rib fractures, free floating rib section
- Accompanied w/ **pulmonary contusion** → lung tissue bruise
  - Usually main cause of respiratory failure
- **Paradoxical breathing:**
  - Inspiration
    - flail segment sucks in → lung, heart, mediastinum **shift away**, reducing air entry into the unaffected lung
  - Expiration
    - flail segments pushes outward → Lung, heart, mediastinum are **pushed toward flail segment**
- **RX**
  - pain control
  - intubation/ventilation if necessary
  - O2, airway clearance

PNEUMOTHORAX
- collapse of lung d/t air in **pleural space**
- due to → puncture of chest wall or lung spontaneously bursts
- percussion → hyperresonant percussion
- **RX**
  - aspirate or chest tube
- **TYPES**
  - open – stab wound → air into pleural space
  - tension - v.serious! → open wound becomes sealed on expiration, air goes from affected lung into pleural space - on inspiration **air will stay in pleural space**
    - increases pressure on heart → can stop beating!
  - spontaneous pneumothorax → spontaneous rupture of air-containing space of lungs
  - hemothorax → collapse of lung due to blood in pleural space
    - AX → ↓breath sounds

(image – arrow points to collapsed lung)
MYOCARDIAL ISCHAEMIA AND INFARCTION

TERRIBLE TRIAD: (3 I’s)

1. **Ischaemia**
   a. inverted T waves, poor blood supply and hypoxia
   b. occurs w/in seconds of onset
   c. REVERSIBLE

2. **Injury**
   a. Elevated ST segment
      i. myocardial tissue injured during MI occurs in 20-40mins
      ii. REVERSIBLE
   b. Depressed ST segment
      i. injury to myocardial tissue
      ii. can occur during angina

3. **Infarction**
   a. abnormal Q waves + QS complexes
   b. can also have R waves
   c. NOT REVERSIBLE → occurs 2hrs after onset

![ECG波形](image)

BRADYcardia <60bpm
TACHYcardia >100bpm

VENTRICULAR FIBRILLATION → incompatible with life = requires defib (shock!)

1st degree AV block
- caused by *prolonged conduction in AV node (PR)*
- P-wave normal

2nd degree AV block (2 types)
- MOBITZ type 1
  o block occurs at **AV node** and is **transient**
  o PR lengthens until totally blocked → then NO QRS follows a P causing a **missed beat**
- MOBITZ type 2
  o block occurs at **bundle branches/bundle of His**
  o abrupt drop of QRS, but PR interval normal

3rd degree AV block
- block at **AV node, bundle of His OR bundle branches**
- **complete disassociation** between atria and ventrices → independent atrial and ventricular rate (atrial faster)
- **bundle branch block** → in bundle branches and **QRS is longer**
HEART FAILURE

CONGESTIVE HEART FAILURE (CHF)
- heart unable to pump blood at rate required by tissues of the body OR able to but at elevated filling pressures
- TYPES
  - Systolic → deterioration of contractile function
  - Diastolic → can’t accommodate ventricular blood volume
- S/S
  - breathlessness
  - abnormal retention of sodium + water
  - Result → edema w/ congestion of lungs OR peripheral circulation OR BOTH

LEFT SIDED HEART FAILURE (Congestive heart failure)
- Cause → damming of blood in pulmonary circulation
- S/S
  - SOB when lying
  - Nocturnal gasp of breath when sleeping
  - ↓kidney and brain perfusion
  - exertional dyspnea
  - pulmonary congestion → cough, crackles, wheezes

RIGHT SIDED HEART FAILURE (Cor Pulmonale)
- Causes → L sided heart failure
- Resulting effects:
  - ↓flow in periphery
  - pitting edema (↑peripheral venous pressure)
  - congestion of the portal system → liver damage + enlarged spleen
  - kidney and brain issues
  - fatigue
- COR PULMONALE (R-sided heart failure)
- Causes:
  - long-term ↑BP in lung arteries + R ventricle
    - chronic severe pulmonary HTN → emphysema, chronic bronchitis (COPD)
    - cystic fibrosis
ISCHEMIC HEART DISEASE
- **Cause**: myocardial ischemia
- **S/S**
  - Angina
  - MI
  - Sudden cardiac death 90% due to atherosclerosis

ANGINA PECTORIS
- **paroxysmal** (sudden attack, short and frequent) recurrent episodes of **chest discomfort**
- **CAUSE**:
  - Transient ischemia of heart muscle → d/t obstruction/spasm of coronary arteries
    - CAN BE → stable, unstable, **prinzmetal** (variant angina) occurs at rest

MYOCARDIAL INFARCT
- **Blood** flowing properly to part of heart muscle → injury d/t lack of O2
- **Risk factors**
  - Previous cardiovascular disease
  - Old age
  - Smoking
  - High levels of certain lipids
- **Cause**
  - Coronary artery to heart develops blockage d/t **unstable atheromas** (WBCs + cholesterol + triglycerides)
- **S/S**
  - Sudden chest pain
  - L UE/neck pain
  - May have → SOB, sweating, nausea, vomiting, abnormal heartbeats, anxiety
  - M>F in having symptoms
- **AX:**
  - Blood test → for troponin + creatine kinase
  - ECG → differentiate btw types of MIs
    - STEMI → higher ST segment → requires more aggressive tx
- **RX**
  - Aspirin (immediate) → prevents further blood clotting
  - Nitroglycerin → treat chest pain + O2 delivery
  - Angioplasty (opening artery back up)
  - Thrombolysis (blockage removed w/ meds)
  - Bypass surgery (esp if have diabetes or multiple blockages)
LUNG CANCER
- d/t smoking, env exposures
- TYPES
  1) Small cell (20-25%)
     a. develops in bronchial cell mucosa
     b. spread rapidly → metastasizes early
  2) Non-small cell
     a. 1 → squamous cell → spread slow, arise in central portion near hilum, metastasizes late
     b. 2 → adenocarcinoma (35-40%) → slow to mod spread, early mets t/o lungs, brain, organs
     c. 3 → large cell → rapid spread, wide spread mets, kidney, liver, adrenals, poor prognosis
- PT MGMT
  o manage fatigue

BRAIN TUMOURS
- #2 cause of death for brain conditions (stroke #1)
- 50% chance of survival, sig cause of death in kids (intra-tentorial)
- TYPES
  o Intracerebral Primary
     ▪ tumor neurons don’t proliferate (other cells around proliferate)
  o Intracerebral Metastatic
     ▪ come from lung, breast, prostate
     ▪ compensate by ↓brain tissue vol, CSF vol + blood flow vol
  o Other:
     ▪ Medulloblastomas → freq metastasize to other areas in brain/spine
     ▪ Neuronomas → SCHWANNOMA (Cranial N 8 – Vestibular)
- S/S
  o N root pain, worse at night, pain with cough, radicular pain
  o headache and seizure, nausea, vomit, cognition and behavior
- RX
  o surgery or radiation
01.03.05

**PNEUMONIA** (primary or post-operative/preventive)
- inflammation of parenchyma of lungs (lung tissue)
- **CAUSES**
  - bacterial, viral or fungal (NORMALLY – airborne pathogens)
  - inhalation of toxic chemicals (smoke, dust, gas)
  - aspiration
    - impaired consciousness → alcohol abuse, after surgery, neuro disease
- **TYPES**
  - **Typical**
    - Sudden symptom onset → usually bacterial cause
    - Fever, sputum, physical consolidation signs
  - **Atypical**
    - No symptoms, little sputum, min chest signs
- **S/S**
  - most preceded by upper respiratory infection → followed by sudden + sharp chest pain
  - productive → green sputum
  - Tachypnea → rate of breathing
  - SOB
- **RX**
  - antibacterials/antibiotics
  - airway clearance techniques
  - antifungals (if fungal infection)
  - oxygen support
  - positioning
- HOSPITAL ACQUIRED PNEUMONIA HAS A HIGHER MORTALITY RATE THAN COMMUNITY

01.03.06

**ATELECTASIS** (primary or post-operative/preventive)
- collapse of normally expanded & aerated lung tissue involving all or part of the lung
- lung distribution → patchy, segmental or lobar distribution
- **CAUSES**
  - blockage of bronchus/bronchiole → lung is prevented from expanding due to:
    - paralysis, diaphragmatic disorders, mucous or airway obstruction, hypoventilation
  - compression due to pneumothorax, pleural effusion, space-occupying lesion (tumor)
    - prevents alveoli from expanding
  - postanesthetic → effects of anaesthesia and prolonged recumbency
- **S/S**
  - CXR → shifting of lung structures toward collapse → if entire lobe, may show shadow
  - Quiet breath sounds
  - Dyspnea
  - Tachypnea
  - Cyanosis → low O2 saturation → skin’s blue
- **RX**
  - identify underlying cause
  - suctioning if d/t secretions
  - chest tube if d/t pneumo/hemo thorax or extensive pleural effusion
**ADULT/INFANT RESPIRATORY DISTRESS SYNDROME**

**ARDS – Acute Respiratory Distress Syndrome**
- acute respiratory failure w/ severe hypoxema → result of pulmonary or systemic problem
- **PATHOLOGY**
  - lung injury characterized by ↑permeability on alveolar capillary membrane
    - leakage of fluid and blood into lung interstitium + alveoli
- **CAUSES**
  - severe trauma
  - aspiration
  - embolism
  - indirect → happen after viral infection or pneumonia
- **RESULT**
  - INFLAMMATORY reaction
  - alveolar edema and collapse
  - CXR → KEY feature = WHITE out
- **RX**
  - PEEP → keeps airways open
  - tackle underlying cause
  - PRONE position

**SARS – Severe Acute Respiratory Syndrome**
- viral respiratory illness → caused by SARS coronavirus
- **S/S**
  - Flu-like → fever, myalgia, cough, sore throat, lethargy
- **RESULT**
  - Can lead to pneumonia

**LUNG ABSCESS**
- infection leading to necrosis of lung tissue and cavity formation w/ necrotic debris
- CAUSE → aspiration → predisposition to it occurring if alcoholic

**IRDS – INFANT RESPIRATORY DISTRESS SYNDROME**
- occurs in infants whose lungs have not fully developed
- lack surfactant → helps lungs inflate with air and keeps the sacs from collapsing
- **RISK FACTORS**
  - Prematurity
  - C-section
  - multiple pregnancies
  - blue baby
  - stops breathing, grunts
- **TX**
  - deliver artificial surfactant

**HYPOXEMIC RESP FAILURE**
• Gas exchange failure ➔ arterial hypoxemia = ↓blood O2, no increase in CO2
  • DUE TO
    o Pneumonia
    o ARDS
    o obstructive lung disease
    o pulmonary embolism

HYPERCAPNIC RESP FAILURE
• ++ CO2 in the blood ➔ ↓blood O2
  • DUE TO
    o ↓ventilation ➔ d/t drugs ↓resp control
    o acute upper/lower airway obstruction
    o weak/impaired resp mm
    o SCI

01.03.08
ASTHMA
• chronic inflamm of lungs ➔ variable airflow limitation + hyper-responsiveness
• chronic inflamm disorder of airways
  o airway hyper-responsiveness ➔ recurrent episode
  o wheezing, breathlessness, chest tightness, coughing (often reversible unlike COPD)
  o smooth mm contraction
• CATEGORIES
  o 1)Extrinsic ➔ allergic or atopic
    ▪ normally due to allergen
    ▪ mast cells release mediators which cause bronchospasm and hypersecretion
    ▪ KIDS > adults
  o 2) Intrinsic ➔ non allergic
    ▪ hypersensitivity to bacteria, virus, drugs, cold air, ex., stress
    ▪ ADULTS > kids
• During attack:
  o gas exchange normal
  o hyperinflated
  o normal elastic recoil
  o exercise capacity reduced
  o possibly d/t allergic exposure ➔ child or adults
• RX
  o prevent triggers
  o pharmacological - inhaled corticosteroids
  o if exercise induced ➔ smooth mm constrict ➔ upright, lean forward and pursed lip breathing
01.03.09 **CHRONIC OBSTRUCTIVE PULMONARY DISEASE**

**COPD**
- chronic resp condition
- **CHARACTERISTICS**
  - progressive airway obstruction that is *not fully reversible*
  - gas exchange is normal
  - always hyperinflated
  - elastic recoil
  - age of onset → middle aged to older adults
- **RX**
  - Pharmacological FOCUS:
    - 1. smooth mm relaxation
    - 2. reduce airway inflammation
  - **O2 therapy** → but ☞ for pts with pulmonary HTN, CHF

**BRONCHIECTASIS**
- irreversible destruction (necrosis) + dilation of airways with *chronic bacterial infection*
- caused by CF, TB, and endobronchial tumors
- **CHARACTERISTICS**
  - excess mucus
  - eventually **alveoli replaced with scar tissue**
    - due to chronic inflamm
- **RX**
  - bronchodilators, antibiotics
  - secretion clearance

**BRONCHITIS**
- excess mucus production

**EMPHYSEMA**
- **CAUSE** → smoking
- **RESULTS**
  - destruction of air spaces distal to the terminal bronchiole + destruction of alveolar septa
    - causes merging of alveoli into larger air spaces
    - surface area for gas exchange
  - loss of airways and capillaries as well
- **IMPACT**
  - **EXHALATION**
    - **Damaged alveoli** = old air becomes trapped
      - space available for O2-rich new air
    - Hyperventilation flattens diaphragm
      - now at mechanical disadvantage
- **TX**
  - Can slow down progression, but ☞ reverse damage
RESTRICTIVE PULMONARY DISEASE

INTERSTITIAL LUNG DISEASE
- Stiff, ↓ lung compliancy (not airway obstruction)
- S/S
  - Dyspnea
  - severe O2 desaturation
  - finger clubbing
  - scarring (CT)
- RX
  - O2 therapy
  - lung transplant
  - pulmonary rehab

PULMONARY FIBROSIS
- ⅔ no known cause; ⅓ TB
- CAUSE → inhaling harmful particles
- RX
  - radiation therapy
  - meds

IDIOPATHIC PULMONARY FIBROSIS
- scarring and fibrotic tissue

ASBESTOSIS
- caused by inhaling harmful particles

PNEUMOCONIOSIS
- coal workers lung

01.03.11
TUBERCULOSIS → (mycobacterium tuberculosis)
- infectious, inflamm systemic disease that affects lungs → airborne particles
- may disseminate to involve kidneys, growth plates, meninges, avascular necrosis of hip jt, lymph nodes + other organs
- TESTING
  - TB skin test → inject in forearm
    - determine of body’s immune response has been activated by TB before
- S/S
  - productive cough 3+wks
  - wt loss
  - fever
  - night sweats
  - fatigue
  - bronchial breath sounds
- RESULT → granulomas in lung tissue
- RX
  - Medical MGMT → 10 drugs
  - PT → thorough history + self protection (masks, etc)
**01.03.12 PLEURAL EFFUSION**

- accumulation of fluid in the pleural space due to disease
  - lung expansion
- CAUSES
  - Transudate → commonly due to heart fail
    - low protein, clear
  - Exudate → formation of fluid by inflammation or disease (infection or cancer of pleura)
    - opaque
- S/S
  - SOB
  - chest pain
  - percussion – dull
  - ↓ or ABSENT breath sounds
  - may hear a pleural rub
- CXR
  - possible mediastinal shift

**01.03.13 PULMONARY EDEMA**

- fluid in extravascular spaces of the lungs
- POSSIBLE CAUSES
  - ↑ hydrostatic pressure d/t heart or kidney failure
    - pushes fluid out of vessels
  - ↑ alveolar permeability
    - drug induced, ARDS, inhalation of noxious gas
- PRESENTATION
  - Stiff lungs → ↑ work of breathing
  - Dyspnea
  - Classic symptom → cough that produces a frothy pink tinged sputum
- AUSCULTATION
  - FINE CRACKLES

**PULMONARY EMBOLUS**

- S/S
  - bloody sputum
  - dyspnea
  - ↑ RR
  - SOB
  - cyanotic
01.03.14

**CYSTIC FIBROSIS**
- inherited autosomal disorder affecting ALL EXOCRINE GLANDS

**EFFECTS**
- defective Cl \( \rightarrow \) excretion and Na\(^+\) absorption = THICK MUCUS
- recurrent chest infections
- consolidation
- atelectasis
- thickened bronchial walls

**DX**
- Family history, gene testing (2 copies of abnormal gene)
- Sweat test - chloride content of sweat

**S/S**
- respiratory symptoms most common
- finger clubbing
- breathlessness
- delayed puberty
- skeletal maturity
- infertility in males
- symptomatic steatorrhea
- diabetes mellitus
- liver disease
- osteoperosis

**RX**
- airway clearance techniques
- bronchodilators
- aggressive antibiotics

01.03.15

**PERIPHERAL ARTERIAL DISEASE**
- account for 95% of arterial occlusive disease

**UNDERLYING CAUSE = ARTERIOSCLEROSIS**

**S/S**
- occur distal to site of narrowing or obstruction
- intermittent claudication
- acute ischemia (pallor, pain paralysis, pulseless)
- ulceration and gangrene
- skin (shiny, thin, hairless) \( \rightarrow \) often occurs in feet

**OUTCOME MEASURE**
- mobility d/t pain + loss of function or limb

**PERIPHERAL VASCULAR DISEASE** \( \rightarrow \) (same as peripheral artery disease)

**UNDERLYING CAUSE: ARTERIOSCLEROSIS**

**Artherosclerotic obstruction of blood vessels** supplying extremities + major abd organs
- IF iliac, femoral, and politieal arteries in the legs
  - feel pain during physical activity, most often in the calf

**S/S**
- intermittent claudication
- \( \downarrow \) pulses
- ulcers
- cool skin
- limit mobility
- pain or loss of function of limb

01.03.16 **VENOUS DISORDERS**
THROMBOPHLEBITIS
- partial or complete occlusion of a vein by a thrombus with secondary inflammation
- superficial or deep

DVT
- can become pulm emboli
- S/S
  - tender calf (d/t thrombus in calf vein)
  - fever
- RISK
  - may become a PE
- TEST
  - Homan’s sign (passive DF)

CHRONIC VENOUS INSUFFICIENCY
- inadequate venous return over a prolonged period
- CAUSE
  - DVT trauma
  - obstruction by tumor
- EFFECT
  - damaged or destroyed valves lead to venous stasis
  - edema
  - thickening brown skin and ulcers

VARICOSE VEINS
- faulty valves cause abnormal dilation of veins
- RESULT
  - twisting and turning of the vessel
  - at risk for thrombosis
**VOLUMES**

**TIDAL VOLUME (TV)** → 500mL
- Volume inspired or expired with each normal breath

**INSPIRATORY RESERVE VOLUME (IRV)** → 2-3 L
- Max volume that can be inspired (on top of tidal volume/normal breath)
- Used during exercise/exertion

**EXPIRATORY RESERVE VOLUME (ERV)** → 1L
- Maximal volume that can be expired after the expiration of a tidal volume/normal breath

**RESIDUAL VOLUME (RV)** → 1L
- Volume that remains in the lungs after a maximal expiration
- CANNOT be measured by spirometry

**CAPACITIES**

**INSPIRATORY CAPACITY (IC)** → 2.5L-4L
- Volume of maximal inspiration
- IRV + TV

**FUNCTIONAL RESIDUAL CAPACITY (FRC)** → 2L
- Volume of gas remaining in lung after normal expiration
- cannot be measured by spirometry because it includes residual volume:
- ERV + RV

**VITAL CAPACITY (VC)** → 3-4.5L
- Volume of maximal inspiration and expiration:
- IRV + TV + ERV = IC + FRC

**TOTAL LUNG CAPACITY (TLC)** → 4-6L
- Volume of the lung after maximal inspiration
- The sum of all four lung volumes
  - IRV + TV + ERV + RV = IC + FRC
- cannot be measured by spirometry because it includes residual volume

**DEAD SPACE** → 300ml in normal lungs
- Volume of respiratory apparatus that does not participate in gas exchange
  - ANATOMIC DEAD SPACE (150mL) → volume of the conducting airways
  - PHYSIOLOGIC DEAD SPACE (150mL normal lungs, greater if have lung disease)
    - Volume of the lung that does not participate in gas exchange

**FORCED EXPIRATORY VOLUME in 1 SECOND (FEV1)**
- Volume of air that can be expired in 1 second after a maximal inspiration
  - normal → 80% (0.8) of the forced vital capacity, expressed as FEV1/FVC
  - restrictive lung disease → ↓ FEV1 & ↓ FVC → ratio ≥ 0.8
  - obstructive lung disease → ↓↓FEV1 & ↓ FVC → ratio < 0.8
**DX of Respiratory Condition:**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Findings (based on postbronchodilator FEV1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>At risk</td>
<td>Risk factors and chronic symptoms but normal spirometry</td>
</tr>
<tr>
<td>I</td>
<td>Mild</td>
<td>FEV1/FVC ratio less than 70 percent&lt;br&gt;FEV1 at least 80 percent of predicted value&lt;br&gt;May have symptoms</td>
</tr>
<tr>
<td>II</td>
<td>Moderate</td>
<td>FEV1/FVC ratio less than 70 percent&lt;br&gt;FEV1 50 percent to less than 80 percent of predicted value&lt;br&gt;May have chronic symptoms</td>
</tr>
<tr>
<td>III</td>
<td>Severe</td>
<td>FEV1/FVC ratio less than 70 percent&lt;br&gt;FEV1 30 percent to less than 50 percent of predicted value&lt;br&gt;May have chronic symptoms</td>
</tr>
<tr>
<td>IV</td>
<td>Very severe</td>
<td>FEV1/FVC ratio less than 70 percent&lt;br&gt;FEV1 less than 30 percent of predicted value&lt;br&gt;or&lt;br&gt;FEV1 less than 50 percent of predicted value plus severe chronic symptoms</td>
</tr>
</tbody>
</table>

**Summary → S/S of Cardiopulmonary Disease**

- pain in chest, neck, jaw, arms
- SOB at rest or mild exertion
- dizzy or syncope
- orthopnea (SOB while lying flat) or nocturnal dyspnea
- ankle edema
- palpitations or tachycardia
- intermittent claudication
- known heart murmur
- unusual fatigue

**Cardiothoracic Index →** size of heart in relation to thorax
CARDIAC REHAB

PHASES
PHASE 1: inpatient
PHASE 2: outpatient 12 week program
PHASE 3: in the community

GOALS
1. restore optimal function
2. prevent progression of underlying processes
3. reduce risk of sudden death and re-infarction

EXS TO AVOID
- NO VALSALVA! (or Hulk imitations)
- extensive upper body activity
- isometric/ static exercises

FIT PRESCRIPTION
F: 3-5 days per week,
I: 60-80 % of HRR, talk test, RPE (around 4-6, but not in ppl who are on beta blockers , pacemakers
  - for pacemakers stay 30 bpm below level that it starts at OR 10-15 bpm below onset of abnormal
    symptoms or angina
T: work up to 45-60 minutes in 5-10 minute intervals
T: whole body dynamic movement
HRR: (hr max- resting hr) x intensity % + resting HR
*should include a warm up: 5-10 minutes and cool down (warm up, aerobic, resistance, cool down)
**MEDICATIONS**

- **beta blockers**
  - **USES** ➔ CAD, angina pectoris, hypertension, irregular heart rhythms
  - **CONSIDERATIONS** ➔ blunted response to hr and bp, ↓ resting bp and with exercise, postural hypotension, dose and time related, ↓ ischemia with exercise, ↑ exercise capacity in ppl with agina ➔ USE RPE! Not age predicted hr range
  - ensure gradual warm up and cool down

- **nitrate and nitroglycerin**
  - relaxes smooth muscle in blood vessels, ↑ blood flow and ↓ workload & O2 supply of heart muscles
  - **USES** ➔ rx angina, CHF, acute MI
  - **CONSIDERATIONS** ➔ ↑ resting HR and possible exercise heart rate, ↓ resting BP and maybe exercising BP, may cause postural hypotension with postural changes, ↑ exercise capacity with angina pts
  - ensure warm up and cool down ➔ nitro doses 3-5 minutes apart
  - **WHAT TO SAY TO THOSE USING NITRO**: storage, expiration date, cool dry space, prime before taking first does ➔ sit down, wait 5 minx3 then go to hospital or return at lower rate

- **ACE inhibitors** (angiotension converting enzyme)
  - block conversion of angiotension I to II, prevents vasoconstriction, ↓ peripheral resistance, ↑ urine output
  - **USES** ➔ HTN, CHF and CVD, MI, kidney fxn in diabetics
  - **CONSIDERATIONS** ➔ ↑ exercise tolerance in clients with CHF, ↓ resting and exercising BP , gradual warm up and cool down

- **anticholesterol agents**
  - ↓ mortality in heart disease patients even if cholesterol is normal, ↓ cholesterol levels (especially LDL) and triglycerides
  - niacin (postural hypotension, need gradual warm up and cool down), statins (muscle aches and joint stiffness)

- **antiplatelet agents**
  - ↓ platelet aggregation at site of tissue damage
  - **USES** ➔ reduces risk of MI, TIA, brain attacks or ischemic strokes
  - no contraindications to exercise or effect on pulse or BP
  - **CONSIDERATIONS** ➔ caution with bruising, or incr bleed
1. HISTORY AND DX OF LUNG DISEASE
   i. History
      a) risk factors: smoking, allergens, occupational exposures (asbestos, coal), genetic risk factors, biomass fuels, infection, previous respiratory history, extra-pulmonary disorders (cardiac)
      b) acuity and progression: rapid onset vs slow onset, time since exposure
      c) PMHx: surgery, travel to areas of risk (bacteria), recent trauma
   ii. Symptoms
      a) dyspnea (can be measured by Borg Scale of Perceived Breathlessness*)
      b) cough (productive vs non productive, hemoptysis)
      c) wheeze: inspiratory, expiratory, low or high pitched
      d) cyanosis: blue or purple in skin that has mucous membranes (nail beds, lips)
      e) finger and toe clubbing: seen in conditions like COPD and CF due to chronic hypoxia
      f) \(\bullet\) oxygen saturation: below 90% O2 you may need some supplementary O2
   iii. Physical Exam
      a) IPPA (inspection, palpation, percussion, auscultation)
   iv. Dx Tests
      a) flow volume loop: contraindications is any condition prohibiting a max maneuver
         i. simple spirometry: typically the first test to be ordered; give FEV1 and FVC
            i. Contra: MI in last month, recent stroke/abdominal/thoracic surgery, uncontrolled HTN, recent pneumothorax
            ii. Indications: Dx lung disease, quantify extent of known disease, measure effect of occupational/environmental exposure, Ax for risk of respiratory complications during surgery, evaluate disability or impairment
               a. can be done before and after using a bronchodilator (ventolin) to see if there are changes
               b. Obstructive Pattern: \(\uparrow\)l lung volumes, \(\downarrow\)FVC, \(\downarrow\downarrow\)FEV1, \(\downarrow\)ratio
               c. Restrictive Pattern: \(\downarrow\)lung volumes, \(\downarrow\)FVC, \(\downarrow\)FEV1, ratio is normal or even increased
      b) plethysmography: just provides more details
      c) diffusing capacity: provides dx of emphysema
      d) respiratory muscle strength
      e) methacholine and other challenge tests: dx asthma and other occupational asthma
      f) chest x ray
      g) VQ scan: used for perfusion disorders (pulmonary embolism)
      h) brochoscopy
      i) blood tests and ABGs
      j) exercise testing
IPPA

- trachea starts at cricoid cartilage to T4 spinous process posterioly, R bronchi is more steeply angled and gets more things caught in it
- sternal angle between manubrium and body – where rib 2 attaches and carina of trachea is at this level
- diaphragm is at the level of the 8th thoracic vertebra, moves 1-2 cm in quiet breathing
- quiet inspiration: diaphragm and external intercostals; forced: SCM, scalene, pec minor
- quiet expiration: passive recoil of lung tissue; forced: internal intercostals and abs
- basic principles: positioning, draping, room set up, and biomechanics of therapist

INSPECTION:
- lines, monitors (HR, RR, SPO2, BP)
- position of patient
- head: facial expression, orientation to place, person, and time x3, speech, skin (colour, sweat, temp), lips, nose (flaring), neck (accessory muscle use, jugular vein distension), chest (deformity, shape, muscle wasting), breathing type (apical, diaphragmatic, accessory muscle use), chest movement, limbs (colour, clubbing, edema), cough (weak vs strong, productive vs nonproductive), sputum (colour, smell, amount, and texture)

PALPATION:
- chest wall expansion(upper, middle, lower x2 (front and back)), take deep breaths
- tactile fremitus (use ulnar border of hands, feel for vibration), same locations as above
- tracheal position: base of sternum
- RATES: HR (15 seconds), BP (use cuff), RR (30-60 seconds, not 15!!)

PERCUSSION:
- middle finger over intercostals space with non-dominant hand , ax right vs left anterior to posterior upper, middle, and lower lobes
- SOUNDS:
  - 1) resonant (normal)
  - 2) dull = consolidation, pleural fluid
  - 3) hyper-resonant = air

AUSCULTATION:
- diaphragm of stethoscope picks up high pitch better, the bell picks up low pitch better
- EXPOSE THE SKIN!!
- instruct patient to take a deep inspiration/expiration
- points: 6 in front, 10 in the back * look up diagram for lobes*
- BREATH SOUNDS :
  - 1) normal
  - 2) diminished
  - 3) absent
  - 4) bronchial = hollow, short pause between inspiration and expiration, normal sound over trachea
  - 5) adventitious
    - a) crackles = inspiratory vs expiratory (early (airway obstruction) late (edema, fibrosis, partial consolidation)
    - 6) wheeze : inspiratory vs expiratory, high (uniformly narrowed) or low pitch (intermittently narrowed)
    - 7) stridor = loud musical constant pitch with larangeal or tracheal obstruction
    - 8) pleural rub = creaky, leathery sound due to pleural irritation
CHEST X RAY

FRONTAL
1. IS IT PA OR AP?
   - PA is usually standard, AP usually if it has to be done on bedside (mediastinum is magnified, dec inspiration, patient position is compromised)

2. IS IT OVER OR UNDEREXPOSED?
   - overexposed will be completely back, has to be uniform, no patches!

3. IS IT SATISFACTORY INSPIRATION?
   - 9 ribs post or 6 ribs anterior above the dome of the left diaphragm

4. IS THE PATIENT ROTATED?
   - draw vertical line from T1-4 and measure line to medial end of clavicle

5. IS THE HEART ENLARGED?
   - look at A/B ratio \( A = \) width of heart \( B = \) width of inside of lung cavity; should not be over 50%

6. ARE BOTH DOMES OF DIAPHRAGMS CLEARLY SEEN AND WELL DEFINED (SIHOUETTE SIGNS); costophrenic angles, costocardiac angles, and right dome * indicates what lobe the pathology is in

7. WHAT IS THE POSITION OF THE MEDIASTINUM?
   - tracheal shift: should be in line with the T1-4 vertebrae
   - SHIFTING RULE= shift away from inc volume, shift towards dec volume
   - position of mediastinum: \( 2:1 \) R: L

8. LANDMARKS IN MEDIASTINUM?
   - look for pulmonary artery, look at cobweb appearance of blood vessels

9. ARE HILA AND FISSURES NORMAL?
   - want hila to be the same height or within 1-2 levels of eachother, close to brochi bifurcation
   - fissures are seen only in about 50% of xrays

10. ARE BONES NORMAL? LOOK FOR #

11. CLINICAL REASONING
   - Atelectasis: will usually result in shifting of the landmarks, silhouette signs, lobar collapse can be white because no air is in it, full of secretions
   - Consolidation Or Pleural Effusion: lung fields will be opaque, usually will have signs of atelectasis with consolidation as well, pleural effusion may have blunting of the costophrenic angle, and sometimes mediastinal shifts to opposite side
   - Pneumothorax: dark area because of air, absence of lung markings, fine line showing outline of the collapsed lung
   - Pulmonary Edema: enlarged peripheral vessels, opacities, and fluffy shadows
   - Copd: flattened diaphragm, pear shaped heart, enlarged chest cavity

LATERAL CHEST X RAY * always to be interpreted with a frontal chest x ray
1. ARE THE VERTEBRAL BODIES GETTING BLACKER FROM SUPERIOR TO INFERIOR? \( \rightarrow \) lower lobe pneumonia
2. ARE THE DOMES OF THE DIAPHRAGM WELL DEFINED? \( \rightarrow \) L higher than R, curved or flattened?
3. ARE THE HILA NORMAL?
   - pulmonary arteries and bronchi are grey because they have air in them
   - RALS: right pulmonary artery – right anterior; left p.a. – left superior
4. CHANGE IN DENSITY ACROSS THE CARDIAC SHADOW?
5. CONFIRM WITH FRONTAL CHEST X RAY

ARTERIAL BLOOD GASES (ABGS)
PO2 only measures free unbound O2 molecules, is the driving force for Hb saturation with O2;
- PO2 is determined by 1) alveolar ventilation 2) V/Q 3) FIO2

**ABGs:** measure of partial pressure and pH of O2 and CO2 in the blood
- gas moves from high → low pressure, PCO2 is controlled by ventilation
- H + HCO3- ↔ H2CO3 ↔ H2O + CO2

**NORMAL RANGES:**
1. pH 7.35-7.45
2. PaCO2 35-45
3. HCO3- 22-28
4. PaO2 80-100 mm Hg
5. SaO2 95-100 %

- metabolic and respiratory acidosis = the pH is lower then normal
- metabolic and respiratory alkalosis = the pH is higher than normal
- respiratory acidosis = pH dec, PaCO2 inc, HCO3 normal
- resp alkalosis = pH inc, PaCO2 dec, HCO3 normal
- metabolic acidosis = pH dec, PaCO2 normal, HCO3 dec
- metabolic alkalosis= pH inc, PaCO2 normal, HCO3 inc

**RULES**
1. look at pH first to see what primary process it is
2. remember clinical context
3. respiratory compensation can take minutes to hours
4. renal compensation can take 1-5 days to occur
5. compensation can be partial or total
6. for alveolar hypoventilation the PO2 should only dec 1 mm Hg for every 1 mm Hg inc in PaCO2

**LINES**
- ECG – electrical activity of heart
  - sternotomy – limitations in lifting (10 lb above waist, no pushing STS, and no pull/push over 5 lbs)
- PATIENT CONTROLLED ANALGESIC = self administered meds, will preset how much they can get
  - look for BP drop , RR less then 10, altered mental status
- EPIDURAL – careful with movements of trunk, hips, LE – can be very uncomfortable
  - always check orders
  - if dislodged get help immediately
- NG tube
  - fed is kept above site of insertion, need feeds turned off before start of therapy ,HEAD OF BED NOT FLAT FEED WILL FLOW BACK!
- CHEST TUBE
  - keep below site of insertion to prevent backflow
- URINARY CATHETER
  - foley- keep below site of insertion to prevent backflow
1. INDICATIONS
- SaO2 less than 90% or PaO2 less than 80 mm Hg
- ↓ work of breathing
- acute MI or to decrease myocardial work
- short term post surgery for recovery
- RT for O2 greater than 40%, acute respiratory distress, transport with O2, and artificial airway (trach)

2. SYSTEMS
- LOW FLOW SYSTEM: supplemental O2 to tidal volume
  - naso prongs (6 L max), simple mask, partial rebreathing, and non rebreathing mask
- HIGH FLOW: enough O2 to supply the entire tidal volume
  - venturi face mask, face tent, tracheostomy mask
- 1 L/MIN = 24 % O2 * goes up by 4% every L ↑

INCENTIVE SPIROMETRY
- PURPOSE: inspiratory muscle retraining particularly in patients with ATELECTASIS
- NEED: reliable measure of max inspiratory pressure + max expiratory pressure (pulmonary tests), use a threshold trainer
  - monitor: O2 saturation, BP, HR, RR, and other SSx of respiratory distress
- INITIAL SESSION: 5 minutes progress over 2-3 weeks to training duration to 2x 15 minutes or 1 30 minute sessions, train 4-5 days per week, begin at 20-30% of MIP and progress to 50% MIP over 3-4 weeks as tolerated, fit individuals can progress to 70% carefully
- CONTRAINDICATIONS: COPD, asthma (obstructive diseases – already hyperinflated)

VQ MATCHING
- can have shunting → alveoli is collapsed and the cap is expanded, or dead space unit: where the cap is completely collapsed and the alveoli is enlarged, silent unit: both are collapsed
- for atelectasis → to encourage re-expansion, put the diseased lung in the non-dependant position and do unilateral breathing exercises in this position

<table>
<thead>
<tr>
<th></th>
<th>NORMAL</th>
<th>ABNORMAL</th>
<th>EFFECT OF MECHANICAL VENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation</td>
<td>Greatest in dependant regions</td>
<td>Usually preferentially will vent the non diseased areas of lung</td>
<td>Air follows path of least resistance, usually non dependent region</td>
</tr>
<tr>
<td>Perfusion</td>
<td>Greatest in dependant regions</td>
<td>Unless restricted it will flow to gravity dependent regions</td>
<td>Increased pressure can restrict blood flow to non dependent regions</td>
</tr>
<tr>
<td>Treatment principle</td>
<td>Lower regions of lungs has greatest VQ matching in upright lung</td>
<td>Generally place the affected area in the non dependent position to increase VQ matching</td>
<td>Regular position changes, no one best position, experiment</td>
</tr>
</tbody>
</table>
**BREATHING EXERCISES**

**Why?**

- ↑ ventilation, to prevent atelectasis, ↓ WOB and O2 consumption, to removal secretions,
- ↑ chest wall mobility and for relaxation
- BREATHE THROUGH NOSE AND OUT THROUGH MOUTH!!

**Diaphragmatic Breathing**

- **INDICATIONS:** post op patients, respiratory failure, chronic respiratory distress
- **WHY?**
  - ↑ lung expansion and compliance, reduces VQ mismatch, ↑ respiratory muscle strength
- **HOW?**
  - Slow inspiration to lower lung lobes (start with patient in lying or sitting, you use your hand then they use their own hand for feedback), expansion of belly is PASSIVE monitor upper chest movement, do 3-4 cycles of deep breaths, prescription: 10 breaths per hour
- **ADDITIONS**
  - End expiratory hold (hold 3-5 seconds before relaxed expiration), single percussion, sniff, lateralcostal breathing (use hands for feedback)

**Pursed Lip Breathing**

- **INDICATIONS:** good for COPD patients
- **HOW?** Inhale with lips in pucker position for 2 counts, exhale for 4 counts (exhalations 2x longer then inhalations)

**Segmental Breathing**

- **INDICATIONS:** healthy individuals can direct O2 in the upper or lower lung fields upon instruction
- **HOW?** Tactile stim or pressure to increase expansion of specific areas, pressure on inspiration and relax on expiration

**Incentive Spirometry/Sustained Max Inspiration**

- **INDICATIONS:** same uses as diaphragmatic breathing, just as good
- **HOW?** Sustain inspiratory effort for 3 seconds, then relax expiration, max inspiration to TOC, give a visual reminder and an incentive goal; can be flow or volume sensitive

**Breath Stacking**

- **INDICATIONS?** When breathing is painful, vent dependant patients NOT COPD PATIENTS!!
- **HOW?** Take a breath, hold, add another breath, hold and repeat until capacity is reached (can follow up with pursed lip breathing), slow exhalation

**SOS FOR SOB**

- **INDICATIONS?** For respiratory distress in COPD patient
  1. stop and rest in comfortable position
  2. get head down
  3. get shoulders down
  4. breathe in through mouth
  5. breathe out through mouth
  6. breath in and out as fast as you can
  7. begin to blow out longer, but not forcibly, used pursed lip breathing if you find it effective
  8. begin to slow breathing
  9. begin to use nose
  10. begin diaphragmatic breathing
  11. stay in position for 10 minutes longer

**COUGHING AND HUFFING**
1. ASSISTED COUGH
- **INDICATIONS**: an ineffective cough seen in patients SCI, NMD, chemically paralyzed, weak respiratory muscles
- **CONTRAINDICATIONS**: inferior vena cava filter and rupture diaphragm
- **PRECAUTIONS**: rib #, abdominal or thoracic surgery, pneumothorax, perforated bowel * use clinical judgment, may only have to change hand position
- **PROCEDURES**
  - consent
  - hand placement (1-2 people, landmark xiphoid process and umbilicus), or upper chest
  - position as indicated
  - palpate breathing pattern, tell patient plan for 3 big inspirations then on the 4th you will cough *
  - watch body mechanics
  - after coughing, ensure proper secretion removal (suction or patient spit)

2. PLAIN COUGH
- look at positioning, combining it with manual techniques, splinting (for pain, use pillow), tracheal tickle

3. HUFFING (FORCED EXPIRATORY TECHNIQUE, FET)
- **INDICATIONS**: For improving secretion clearance, as an adjunct to manual techniques
- **PROCEDURE**:
  - 2 reps of huffing (not forceful enough to cause pain, just to move tissue away from you if you held one up), mouth is in “O” shape, glottis remains open
  - arms can be by side or in chicken wing position
  - abdominals and chest wall will tighten
  - follow with diaphragmatic breathing

POSTURAL DRAINAGE /POSITIONING
- always make sure you know the unique contraindications of the patient: spinal injury, blood pressure
- upright and mobile is the best position
- for optimal coughing positions: upright vs supine (better for SCI), sidely vs supine
- **INDICATIONS**: to put patient in position that drains the airway in gravity directed movement
- **TIME**: 3-10 minutes, dependent on patient
- **CONTRAINDICATIONS/PRECAUTIONS**
  - untreated pneumothorax, hemoptysis, unstable CV status, inc ICP
  - esophageal anatomosis, aneurism, PE or CHF, patient upset or agitated
  - recent laminectomy
  - large PE

**LOOK AT POSTURAL DRAINAGE POSITIONS**
- apical segments-
- LUL anterior- sitting upright
- RUL anterior- long sitting
- LUL posterior – semiprone or sitting leaning over table
- RUL posterior – prone
- LUL/ RML lingual- side lie/semi supine table 30 degree inverted
- RLL/LLL superior segments- prone
- RLL/LLL anterior segments – supine table inverted 30 degrees
- RLL/LLL lateral segements- side lying table 30 degrees
- RLL/ LLL posterior segments – prone table inverted 30

PRONING
- **INDICATIONS**: for patients in ARDS (last ditch effort to get VQ matching)
PROCEDURE: requires 4-6 ppl

CONTRAINDICATIONS: facial trauma, or open wound in chest or abdomen, unstable spinal cord injury, controlled cerebral hypertension

PRECAUTIONS: hemodynamic instability, active intra-abdominal processes

HOW TO?
- slide patient away from ventilator side
- position arms close to or slightly on top of body
- place 4 pillows on legs, hips, belly and chest, wrap all together in sheet
- two way roll to prone, untangle arms and sheet
- place arms in cactus position, head in R or L rotation, change position every 2 hours, can be prone for 2-10 hours

PERCUSSIONS AND VIBRATIONS AND RIB SPRINGING

PERCUSSIONS: will remove secretions
- PROCEDURE: used cupped hands, in conjunction with other techniques, check skin before and after for redness; duration: 2-5 minutes
- CONTRAINDICATIONS/PRECAUTIONS: # ribs, prone to hemorrhage, metastatic bone cancer, osteoporosis, burns, subcutaneous emphysema of neck and thorax, poor/unstable CV condition, recent skin graft or flap, resectable tumor, pneumothorax

VIBRATIONS: remove bronchial secretions and improve tidal volume
- PROCEDURE: done on exhalation, in conjunction with other techniques, duration: 5 minutes * can use mechanical vibrator machines but they are not very effective (may be appropriate for fragile patients: osteoporotic, or elderly

RIB SPRINGING
- chest compression followed by overpressure and quick release at end expiration, can be combined with percs and vibes, thought to increase chest expansion and therefore a bigger inspiration

MANUAL HYPERINFLATION

INDICATIONS: acute lobar collapse and sputum clearance
- need: ambu bag, O2 tubing, pressure manometer (cannot go over 30-40 cm H2O), skill
- CONTRAINDICATIONS: acute pneumectomy (unless surgeon says yes), undrained pneumothorax, proximal tumor or obstruction, unstable head injury, HFOV
- PRECAUTIONS: hemoptysis, bulae, high RR or PEEP, severe bronchospasm, CVS instability,

ACTIVE CYCLE OF BREATHING

INDICATIONS: for secretion removal, allow inc pressure behind the huff, not forceful at all
- PROCEDURE: have patients do this 15-20 minutes per day
  - normal breathing for 1 minute
  - deep breathing for 3-4 breaths, and hold 3 seconds,
  - normal breaths for 2-3 breaths
  - huff: medium breath in and repeat 2-3 times
  - if sputum not produced go back to normal breathing and repeat, if sputum, then repeat huff 2-3 times
  - repeat 10-15 x or for 15 minutes * if two have gone by and have not been productive don’t continue*

AUTOGENIC DRAINAGE

INDICATION: alter rate and depth of breathing to produce highest possible airflow in bronchi while maintain stability
• **PHASES**: unsticking, collecting, and evacuating
• **PROCEDURE**:
  o slow diaphragmatic breathing slow breaths, take slightly deeper breaths then normal then exhale normally for 10-20 breaths, then take 10-20 breaths at a higher lung volume
  o try not to cough, then practice coughing and huffing, takes longer 30-45 mins, 2x a day

**POSITIVE EXPIRATORY PRESSURE (PEP)**
• **INDICATIONS**: one way valve mask that creates resistance on expiration, to keep airways open to get behind mucus via collateral airways and help secretion
• **PROCEDURE**: Inspiration 5-10 times with active exhalation at 1:3 or 1:4 usually followed by huffing or FET
• can also do two cycles then go back to percussion

**OSCILLATING PEP**
• handheld device that oscillates and vibrates during inspiration that will help dislodge mucous in the small and large airways
• *used in CF patients a lot* (acapella, PEP with flutter)

**HIGH PRESSURE PEP**

**HIGH FREQUENCY CHEST WALL OSCILATION**

**INTRA-PULMONARY PERCUSSION VENTILATION (IPPV)**

**SUCTIONING**
• can be indwelling or not
• trach, nasopharangeal, or oral pharageal
• can be sterile, modified sterile, or clean technique
• suction parameters
  o adults 120-150 mm Hg
  o children: 80-120 mm Hg
  o infant 60-80 mm Hg
• **INDICATIONS**: patient can’t clear secretions, loss of airway control, lung pathologies, obtain sputum sample
• **CONTRAINDICATIONS**: worsening clinical conditions, nasopharangeal: basal skull #, nasal bleeding or bleeding disorders, epiglottitis or croup, CSF leakage, nasal stenosis

**PULMONARY REHAB** *(exs, educ, beh therapy → +cure/halt disease or change airway obstruction*
1. **SCALES**:
   • Dyspnea scale (0-4) measure of functional dyspnea; BORG breathlessness scale (0-10) dyspnea during activity; rate of perceived exertion (0-10 , fatigue or breathlessness in muscles)
2. **AEROBIC EXERCISE PRESCRIPTION**:
   • 1-2 x per day to 3-5 days per week, interval training (5-10 minutes, 2-5 min rest work up to 10-40 mins of continuous exercise), dynamic activity using large muscle groups
3. **STRENGTH**:
   • 1, 3, or 10 rep , respiratory muscle retraining, functional (TUG, BERG)
   • light weight higher reps, 1-5 lbs (tubing) for 8-10 reps , 50-80% max strength

* for all exercise, Spo2 should not fall under 88% , BORG should not go above 5, no abnormal changes in rhythm, heart rate; no pain, nausea, dizziness or headache, monitor blood sugar
MULTISYSTEM CONDITIONS (15%±5%)

01.04.01 EPISODIC DISEASE (oncology, HIV/AIDS, autoimmune dis, rheumatic diseases, haemophilia)

**ONCOLOGY**

- 2 of 5 Canadians will get cancer, 1 in 4 will die from cancer
- **Cancer incidence**: males (prostate, lung, colon), females (breast, lung, colon)
- **Cancer mortality**: males (lung, colorectal, prostate, pancreas), females (lung, breast, colorectal, pancreas)
- **Staging Cancer**: TNM System
  - Tumor (extent/spread) → TX (cannot be evaluated), T0 (tumor in situ), T1-4
  - Nodes (lymph) → Nx, N0 (no lymph nodes involvement), N1-3 (extent of spread or # involved)
  - Mets (distant ones) → Mx, M0 (no), M1 (distant metastasis present)
- **Stages**:
  - Stage 0 = carcinoma in situ
  - Stage 1-3 (cancer has extended beyond organ in which it first developed)*?
  - Stage 4 (cancer has spread to different organs)
- **MEDICAL TX**
  - Surgery
  - Chemotherapy
    - Side effects → alopecia, mucositis, pulmonary fibrosis, cardiotoxicity, renal failure, sterility, myalgia, neuropathy
  - Radiation
    - Side effects → skin irritation, scar tissue, hair loss (permanent or transient), temp change in skin colour, FATIGUE, swallowing discomfort
  - Hormone replacement surgery
  - Biological or genetic treatment to destroy cancer cells
- **CLINICAL PRESENTATION**
  - ROM limitations (need shoulder range for radiation in breast cancer)
  - fatigue
  - myalgia
  - arthralgia
  - chemotherapy induced peripheral neuropathy
  - deconditioning
  - look for any recurring signs of cancer
- **PT RX**
  - fatigue mngt
  - fxn and mobility mngt
  - physical symptom mngt
  - psychological symptom mngt
  - REHAB
    - preventive, supportive, or restorative
  - ACUTE SETTING
    - mobility (including eqp), general strength and mobility, and bed positioning
- **EXERCISE PRECAUTIONS**
  - swollen ankle, fatigue, vomiting and diarrhea, unexplained weight loss/gain, SOB with low level of exertion
- **EX CONTRAINDICATIONS**
  - racing pulse, fever, pain in back or neck or bone, calf pain, chest pain
  - nauseated while exercising, confused or disorientated, dizzy or faint
  - blurred vision, sudden SOB, very weak or tired
SAFETY GUIDELINES

METASTATIC DISEASE
- follow protocols from MD (need weight bearing order not just AAT)
- ask about any new neurological symptoms (B/B, unrelenting pain)

ANEMIA
- normal Hb levels → males (14-18 g/dl) / females (12-16 g/dl)
- effects the amount of O2 that can be carried to the cells
- EXERCISE NEEDS TO BE SCALED BACK IF BELOW 8 G/DL!

NEUTROPENIA
- WBC
- relates to body’s ability to fight infection
- should be > 1000 mcL
- RISK OF INFECTION INC IF ABSOLUTE NEUTROPHILS FALLS BELOW <500 MCL
- avoid public fitness or areas, facilities and activities with inc exposure to viral and/or bac infection
- avoid exercise if have fever (temp greater then 37.5 degree F)

THROMBOCYTOPENIA
- low platelet count (normal = 150-400, 000/mcL)
  - ↑risk of bruising or bleeding (report any unusual bruising or symptoms to MD)
  - if <50,000 MCL → avoid activities with contact or risk of falling
    - RX → 40-60, 0000 MCL
      - low weights (1-2 lbs), stationary bike low resistance, walking or ADLs
    - RX → 20-40, 0000 MCL
      - low intensity exercise, low weights (0-2 lbs), stationary bike no resistance or minimal, walking, and ADLS
  - if <20,000 MCL → ↑risk of spontaneous bleed unrelated to trauma
    - RX → 10-20, 0000 MCL
      - doctor approval, active ROM exercises, walking, ADLS (may need supervision)
  - if <10,000 MCL → spontaneous CNS, GI, or respiratory tract bleeding may also occur
    - RX → <10, 000 MCL
      - no exercise, only essential ADLs, prevent falls and injury
LYMPHEDEMA

- **Lymph System Fx**
  - removal of fluid, proteins, bacteria, viruses
  - smooth mm in walls contract to move lymph

- **TYPES**
  - **Primary**
    - rare, inherited condition that development problems occur in lymph vessels
  - **Secondary**
    - D/T damage to or obstruction to normally functioning lymph vessels and nodes

- **RISK FACTORS**
  - Radiation
  - axillary node dissection
  - arm infection/virus (primary thought cause)
  - weight gain since operation
  - obesity (BMI >25)
  - older age

- **PREVENTION**
  - skin care
  - activity/lifestyle (body weight gradual build up of activity)
  - avoid limb constriction (jewelry, clothes, BP cuffs on that side)
  - avoid extreme temp

- **MEASURES**
  - circumferential (greater then 2 cm difference side to side)
  - water displacement
  - perometer and bioelectrical impedance

- **PT ROLE**
  - Prevention → weight loss through exercise
  - Education
    - what to avoid, S/S to watch for

- **PHYSICAL ACTIVITY**
  - prior, during, and post treatment is **safe, however** may have other variable to consider & check of change daily
  - **ACSM GUIDELINES**
    - prescription must be individualized according to cancer survivors
    - **CONSIDER:**
      - PRE-RX aerobic fitness
      - medical comorbidities
      - response to RX → -ve side effects

- **PALLIATIVE CARE**
  - **Goal** → provide comfort, support, maximize independence
  - Can aid w/ → respiratory, stress reduction, education
**AIDS → Acquired Immunodeficiency Syndrome**

- (AIDS-Related Complex → precursor to full blown AIDS)
- **CAUSE** → HIV 1 or 2
  - Transmission through contact with infected body fluids:
    - blood, saliva, semen CSF, breast milk, vaginal/cervical secretions, mucous membranes, mother to child during pregnancy
    - transmitted through urine, sweat, vomit
- **RESULT** → Loss of immune system function, ↓ CD4+ helper T cells
- **DX**
  - Clinical findings
  - Systemic evidence
  - Lab evidence → HIV-1 antibody test, CD4 cell count 200-500/ml (normal = 800-1200/ml)
- **↑ SUSCEPTABILITY TO DEVELOP following conds:**
  - Pneumonia, TB, Malignancy, Encephalitis, Meningitis, Dementia, Herpes zoster
- **TX**
  - No cure → Want to keep viral load as low as possible
  - **MED RX**
    1) Multidrug antiviral therapy
      - different drugs w/ different location of action → adherence is difficult
    2) Symptomatic treatment
      - maintain nutrition, maintain functional mobility, education
  - **PT RX**
    - Check precautions
    - **EXS:**
      - mod aerobic, strength
      - avoid exhaustive exs
      - **ACUTE** → focus on mild exs levels, activity pacing, energy conservation, stress management

1. **AUTOIMMUNE DISORDERS**

- Antibody mediated demyelination of Schwann cells in PNS from spinal nerves → terminating fibres
- May be in hospital for 6-8 mo
- **Causes**
  - immune disorder
  - 2/3 ppl had recent illness in last 30 days (flu vaccine)
- **S/S**
  - onset to peak 4 weeks
  - rapid ascending motor weakness and distal sensory loss
  - spreads to arms, trunk, and face
  - stocking and glove pattern of loss*
  - absent DTR
  - may require mechanical ventilation
- **RX**
  - **MEDICAL** → Plasmaphoresis, immunoglobin
  - **PT:**
    - Positioning → ulcers
    - joint protection
    - chest rx, mobilization
    - strength
    - ROM (usually opposite to ALS progression)

2. **SYSTEMIC AUTOIMMUNE DISORDERS**
CONNECTIVE TISSUE DISORDERS THAT MAY INVOLVE SKIN AS WELL AS ORGANS:

a. LUPUS ERYTHEMATOSUS
- can involve skin and other multisystem → organs (kidney, CNS, cardiac, pulmonary), arthritis
- S/S
  - skin → may find BUTTERFLY (malar) RASH
  - localized erythema
  - localized edema
  - alopecia (loss of hair)
  - photosensitivity
  - mucosal ulcers
  - Raynaud’s (fingers are cold sensitive)
  - Joint effusion
- DX
  - +VE serum “antinuclear antibodies” (ANA) symmetric arthritis

b. SCLERODEMA → Systemic Sclerosis
- chronic disease primarily affecting skin, characterized by sclerosis → hardening of skin
  - provokes massive fibrotic tissue response
- CAN CAUSE:
  - joint contractures, pulmonary fibrosis, HTN
  - renal, GI dysmotility (esp esophagus), Raynaud’s

c. DERMATOMYOSITIS (skin + muscle) & POLYMYOSITIS (muscle only)
- inflam CT disorders characterized by proximal limb girdle weakness, often w/o P
- DERMATOMYOSITIS
  - affects both skin + mm
  - associated w/ photosensitive skin rash, purplish erythematous eruption over face, U/E
- POLYMYOSITIS
  - Affects muscle only
HAEMOPHILIA

- **Hereditary bleeding disorder** → body unable to control blood clotting/coagulation

- **CAUSES**
  - vascular abnormalities
  - platelet abnormalities
  - coagulation cascade abnormalities

- **Type A** → most common of hereditary clotting factor deficiencies
  - X-linked recessive → males have condition, females carry gene
    - If mother is carrier, father doesn’t have it
      - Male child has 50% chance of having disorder
      - Female child has 50% chance of carrying gene
    - If mother isn’t carrier, father has haemophilia
      - Male child → not affected by haemophilia, can’t carry gene
      - Female child → will be carrier → known as **obligate carrier**

- **PRESENTATION**
  - profuse post circumcision bleeding
  - joint and soft tissue bleeding
  - excessive bleeding
  - operative & post-traumatic hemorrhage

- **S/S**
  - **Bleeding in the joints is the most common problem.**
  - large bruises
  - bleeding into muscles and joints (esp. knees, elbows, and ankles)
    - **JOINT BLEED SYMPTOMS**
      - JT tightness + no pain → tightness + pain, no bleeding → swollen + hot to touch, hard to move → all ROM lost + severe pain → bleeding slows in few days (joint full of blood)
    - prolonged bleeding after a cut, tooth removal, surgery, or an accident
    - serious trauma causes **serious internal bleeding** into vital organs

- **IF NOT TREATED**
  - Arthritis → disabling

- **RX**
  - recombinant factor VIII infusion (in the 80s, got blood products → died of AIDS, Hep C)
  - desmopressin → mild haemophilia
RHEUMATIC DISEASES \(\rightarrow\) QUESTIONS TO ASK:

1. **RED FLAGS**
   - 
   - 
   - 

2. **INFLAMMATION** in joint or **around** joint?
   - 
   - 

3. **FOCAL** (<3 joints) or **WIDESPREAD** (>3 joints)

4. **ACUTE** (< 6wks) or **CHRONIC** (> 6 wks)

<table>
<thead>
<tr>
<th>INFLAMMATORY CONDITION</th>
<th>NON INFLAMMATORY CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes worse in AM</td>
<td>Pain worse after use</td>
</tr>
<tr>
<td>Moderate to severe swelling</td>
<td>Mild swelling</td>
</tr>
<tr>
<td>Sometimes present erythema</td>
<td>Often absent</td>
</tr>
<tr>
<td>Warmth sometimes present</td>
<td>Absent</td>
</tr>
<tr>
<td>Morning stiffness usually =/&gt; 1 hr</td>
<td>Morning stiffness usually less then 30 minutes</td>
</tr>
<tr>
<td>Systemic features are sometimes present</td>
<td>Very rare/absent</td>
</tr>
<tr>
<td>Frequent inc ESR (erythrocyte sedimentation rate)</td>
<td>Uncommon</td>
</tr>
</tbody>
</table>

**RHEUMATOID ARTHRITIS**

- **MAIN FEATURE** \(\rightarrow\) **SYNOVITIS** \(\rightarrow\) symmetrical pattern
  - Synovium becomes swollen and cells proliferate
    - dense cellular membrane (pannus) spreads over articular cartilage
    - erodes underlying cartilage and bone
    - w/ time \(\rightarrow\) pannus may extend to the opposite articular surface creating:
      - 1) fibrous scar tissue
      - 2) adhesions
      - 3) bony ankylosing

- **LEADS TO:**
  - immobility + consolidation (bones form a single unit) of a joint
  - bones can become osteopenic
  - ligaments/tendons become damaged or ruptured
  - surrounding mm deteriorate \(\rightarrow\) joint instability + deformity prone

- **RA CRITERIA:**
  - morning stiffness >1hr (6 weeks)
  - arthritis of \(\geq\) 3 joints (6 weeks)
  - arthritis of hand joints
  - symmetric arthritis (6 weeks)
  - rheumatoid nodules
  - serum rheumatoid factor
  - radiographic changes
  - abnormal antibody HLA-DR4 (80% those w/ RA)
    - also found in pts with interstitial lung disease, chronic hepatitis, idiopathic pulmonary fibrosis, normal aging adults, SLE

- **\(\uparrow\) RISK w/**
  - giving birth
  - cigarette smoking
  - pollution

- **S/S**
  - pain, fatigue, stiffness (\(\downarrow\) ROM)
  - swelling, joint deformity, mm atrophy, extraarticular features
• MANAGEMENT
  o MEDS
    ▪ DMARDs/biologics → stop disease process
    ▪ Methotrexate → prevent permanent joint damage/premature death
      • educate pt on effects on liver and reproductive organs
    ▪ NSAIDs, tylenol, cortisone → stop disease process but ↓inflamm/pain, ↑ROM
  o REHAB
    ▪ Acute phase:
      • energy conservation, ice, splints, gentle ROM, NO STRETCHING (may stretch the synovial membrane & cause irreversible damage)
    ▪ Chronic phase:
      • relieve pain, i.e. modalities, heat
      • splints, exercise (gentle ROM)
      • relaxation/rest
      • ↓stiffness → gentle ROM
      • aquatic ex (endurance exercise)
      • functional ex’s
      • prevent deformity
      • fall prevention
      • moderate intensity physical activity
  o LIFESTYLE MODIFICATION/SELF MGMT
    ▪ need to be informed, problem solve, self monitor, and communicate
    ▪ education → what the drugs do, what health care team does, resources, exercise and physical activity
  o SURGERY
    ▪ 4 Rs
      • remove (MTP resection)
      • re-align (tendon rupture)
      • rest (arthrodesis)
      • replace (arthroplasty)

JOINT COUNT ASSESSMENT → indicator of RA disease activity of RA → “STOP”
1. joint effusion → 2 finger/4 finger technique
2. joint line tenderness
3. stress pain

COMMONLY AFFECTED JOINTS IN RA:
• Atlanto-Axial joint
  o Esp transverse lig
  o S/S → clunking in repositioning in Sharp Purser test, dysphagia, dizziness, blurred vision
• TMJ → end stage may result in fusion of open bite
• Shoulder → humeral head moves superiorly
• AC joint
• Elbow → loss of extension, i.e. flexion deformity
  o superior radioulnar joint commonly involved → erosion of radial head
• Hip → groin P, flexion deformity
• Knee → baker’s cyst, flexion deformity, valgus deformity, quad wasting

RA DEFORMITIES
• Hallux valgus
- 1st MTP synovitis, big toe is lateral, lig laxity and erosion
- sublux \(\rightarrow\) dislocation, prox phalanx drifts lat, causes pronation of midfoot

**MTP subluxation**
- synovitis, displacement of the flexors, unopposed extensors pull the prox phalanx into hyperext, metatarsal head prolapses and get dislocation and lat drift of toes
- Sign = callouses

**Claw toe**
- MTP synovitis, MTP ext, PIP+DIP flex, often all toes except big toe

**Hammer toe**
- MTP and PIP synovitis, usually involves 2nd toe, flex of PIP and hyperext of DIP (similar to boutonniere)

**Mallet toe**
- flex of DIP, affects longest toe

**Swan neck**
- flex of MCP (not always), hyperext of PIP, flex DIP
- TEST \(\rightarrow\) Bunnel Littlers
- RX \(\rightarrow\) able to actively flex & ext deformed joints, stretch interosseous muscles

**Boutonniere**
- zig zag deformity \(\rightarrow\) MCP hyperext (not always), flex of PIP, hyperext of DIP
- TEST \(\rightarrow\) central slip tenodesis
- RX \(\rightarrow\) able to flex and ext deformed joints

**Ulnar drift deformity**
- most common hand deformity
- involves synovitis of MCP + structural differences \(\rightarrow\) cause volar subluxation/laxity of MCP in radial collateral ligaments
- TEST \(\rightarrow\) radial collateral ligament test, extensor tendon subluxation test
- RX \(\rightarrow\) radial finger walking, joint protection
  - (prevent ulnar deviation forces in getting up from chair, turn on/off taps, holding a book)

**Thumb deformities \(\rightarrow\) BD thumb (90/90 position) or swan neck**
- TEST \(\rightarrow\) grind & crank test
- RX \(\rightarrow\) webspaces massage/stretch, opposition and abduction exercises

**Wrist \(\rightarrow\) DRUJ instability**
- synovitis at joint, stretches ulnar carpal ligaments, ulnar head will sublux dorsally, ECU is displaced and more becomes a flexor tendon
- TEST \(\rightarrow\) ballottement test

**Overall Hand Exercises**
- tendon glides
- active ROM for IPs with MCP in extension to protect from ulnar deviation forces

**Splints**
- Static \(\rightarrow\) to rest or \(\uparrow\) hand fxn
- Dynamic \(\rightarrow\) to provide controlled motion

**GOUT**
- genetic disorder of purine metabolism
- ↑serum uric acid (hyperuricemia)
- Acid \(\uparrow\) to crystals and deposits into joints
- Most affected JOINTS \(\rightarrow\) KNEE, GREAT TOE

**RX**
- Meds \(\rightarrow\) NSAIDS, cox2-inhibitors, corticosteroids, ACTH
- PT goals \(\rightarrow\) injury prevention, education, fast intervention

**OSTEOARTHRITIS**
- release of enzymes + abnormal biomechanical forces = fibrillation + articular cartilage damage
  - RESULT:
- Cartilage Loss
  - ↑bone turn over → Osteophytes

**RISK FACTORS**
- Age
- F>M
- Obesity
- Physical inactivity
- Injury
- Joint stress (occupation)

**MAIN AFFECTED JOINTS**
- Spine → osteophytes in facet jts of l-spine → STENOSIS
- Hand
  - PIP → Bouchard node
  - DIP → Heberden's node
  - CMC joints (esp thumb)
- Knee → most common jt affected by OA → varus, flexion contracture, crepitus
- Hip → walk with trendelenburg, groin pain, osteophytes, flexion deformities
- Foot → 1st MT joint → osteophytes cause hallux valgus + rigidius, bunions
- Uncommon sites:
  - Shoulder/Elbow, Wrist (except if have scaphoid # or avascular necrosis), ankle

**DX**
- X-ray findings → **4 main features**
  - 1) joint space narrowing
  - 2) osteophytosis
  - 3) subchondral cysts
  - 4) subchondral sclerosis
  - (Grading → Kellgren – Lawrence System (0-4)
- 4 QUESTIONS
  - Pain most days of the last month?
  - Pain over the last year?
  - Worse with activity → stairs (doing down worse), overdoing it
  - Relieved with rest → may have ‘gelling’ after inactivity period
- TESTS INDICATIVE OF KNEE OA
  - Flexion contracture
  - Abnormal gait
  - Swipe test/patellar tap test +ve

**PAIN SOURCES**
- Bone
- Soft tissue
- Inflammation
- Muscle spasm

**RX**
- Weight loss → 1lb weight loss = 4lb ↓knee joint stress per step
  - Aim = ↓10% body weight
- Exercise
  - 30 min mod aerobic training (most days) → 10 min bouts
  - L/E resistance training
- Protective Aids
  - braces, orthodics, adaptive aids (canes/walking poles)
- Medications → acetaminophen (since non-inflammatory)
- Electromodalities → TENS

**FEMORAL ACETABULAR IMPINGEMENT**
**TYPES**
- Cam
  - ↓/absent waist of the jx of femoral neck and head
- w/ hip flex → abnormal femoral head drives into acetabulum
  - young men
    - Pincer
      - abnormal acetabulum provides excessive cover of femoral head
        - retroverted or deep acetabulum
      - impingement when femoral neck pushes against overarching acetabulum
  - women 30-40 years

**SPONDYLOARTHRITIS** (Ο Rheumatoid Factor)
- Common site → SPINE
- CHARACTERISTICS
  - Spine inflammation → spondylitis and sacroiliitis
  - Synovitis → unilateral peripheral joints
  - Eye inflammation → iritis/uveitis & conjunctivitis
  - NO rheumatoid factor (seronegative)
  - Can be hereditary HLA-B27

**PSORIATIC ARTHRITIS** → Pt w/ psoriasis
- M=F, can begin with kids
- CHARACTERISTICS
  - Chronic, erosive, inflammation
  - Affects digit joints + axial skeleton
- TYPES
  - Dactylitis
    - sausage like fingers d/t swelling
  - Enthesitis
    - usually in heels and back
- RX
  - Meds → acetaminophen, NSAIDs, DMARDs, corticosteroids, biological response modifiers
  - PT Goals
    - joint protections strategies
    - maintain joint mechanics
    - endurance

**ENTEROPATHIC SPONDYLITIS**
- Related to:
  - Inflammatory conditions of the bowel (cause diarrhea):
    - Ulcerative colitis (affects lower half of bowels)
    - Crohn’s disease (affects whole digestive system → worse)
- ↑bowel disease = ↑arthritis
- Can also affect → Spine, SI joint, limb joints

**REACTIVE ARTHRITIS**
- triggered by infection (possibly STI) in bowel or GI tract
- hot swollen joints
- may go away and return
- PRESENTATION
  - L/E
  - Symmetrical

**ANKYLOSING SPONDYLITIS (AS)**
- [QUICK OVERVIEW]
  - onset before 40, M>F
  - low back pain, sacroiliitis
  - kyphotic deformity → Csp, Tsp, ↓lumbar lordosis
Diagnosis – HLA-B27
- Meds -- NSAIDS, corticosteroids, cytotoxic, tumor necrosis factor (biologics)
- PT goals -- trunk flexibility, endurance, increase resp function (relaxation)

- **stiffness/fusing of spine d/t inflammation**
- **usually bilateral disease**, but may start initially as **unilateral then migrate**
- **onset BEFORE 40 → disease of young adults (M>F) → 8.9 yrs delay in diagnosis**
- **associated with genetic marker HLA B27, unknown cause**

- **FEATURES**
  - **MSK**
    - **SACROILIITIS** – **HALLMARK SIGN**
      - SI joint inflammation, may cause deep/dull buttock pain
    - **ENTHESITIS**
      - Entheses inflammation → where tendon, ligs + joint capsule attach to bone
      - Result → bony erosion + overgrowth
      - Osteopenia → Osteoporosis + fusion/rigidity = ↑ # risk
      - Effects rib cage + ↓ chest expansion
      - COMMON SITES → spine, hip, peripheral regions
      - Syndesmophytes → bony spurs on 2 sides of a joint → cause bony fusion/rigidity
    - **SYNOVITIS**
      - usually affects peripheral jts → shoulders, hips, knees, ankles
  - **Lungs** → apical fibrosis, restrictive lung disease, avoid smoking
  - **Heart** → inflamm/scarring of conduction system, aorta inflammation
  - **Eyes, Bowels**

- **CLINICAL CRITERIA**
  - **LBP + stiffness for more than 3 months**
    - Improves with ex, worse with rest
  - **AM stiffness**
  - **Altered posture/muscle imbalances → deformities/instability**
    - HFP, thoracic kyphosis, flattening of anterior chest wall, protrusion of abdomen, flattening of lumbar lordosis, slight hip flex
  - **↓ strength → deconditioning**
  - **↓ L-spine ROM in sagittal + front planes → flexion posture**
    - d/t pain, tissue contractures, mm guarding, fusing
  - **Altered breathing mechanics → ↓ chest expansion compared to normal values**
    - diaphragmatic breathing pattern
    - ↓ vital capacity
  - **Fatigue d/t disease process**

- **PHYSICAL AX**
  - posture (tragus to wall), lateral trunk flexion, trunk flexion (modified schobers), trunk extension (smythe test), trunk rotation, chest expansion, cervical mobility, muscle length and strength, enthesitis sites, peripheral joint scan

- **RX**
  - **MEDS → DMARDs, NSAIDs, corticosteroids, biologics**
  - **PHYSICAL MANAGEMENT**
    - control/decrease inflammation
    - P management
    - ↓ stiffness/↑ ROM (pool therapy is great)
    - posture correction (ergonomics, frequent position changes)
    - ↑ mm strength and endurance, ↑ cardio

- **OUTCOME MEASURES**
  - **BASFI** (impact of disease on fxn in last week)
  - **BASDAI** (how disease is managed)
<table>
<thead>
<tr>
<th>Duration</th>
<th>&gt;60 min</th>
<th>&lt;40 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of onset</td>
<td>12-40 yrs</td>
<td>20-65 yrs</td>
</tr>
<tr>
<td>Max P/stiffness</td>
<td>Early AM</td>
<td>Late in day, w/ activity</td>
</tr>
<tr>
<td>Type of condition</td>
<td>Chronic</td>
<td>Acute/chronic</td>
</tr>
<tr>
<td>X-ray</td>
<td>Sacroiliitis, syndesmophytes, spinal ankylosis</td>
<td>Osteophytes, disc space, misalignment</td>
</tr>
</tbody>
</table>

**JUVENILE IDIOPATHIC ARTHRITIS**

Lifetime disease

**AX**
- Pain, ROM, Joint count, Muscle strength/length, fatigue
- Orthotics, gait aids

**DX**
- S/S must be present for 6 weeks
- Subtype determined by presentation in 1st 6 months

**S/S**
- pain, fxn, AM stiffness, fatigue, ROM, muscle strength and length, growth abnormalities, asymmetrical posture + movement patterns
- eyes (uveitis)
- effects synovium, tendon sheath synovium, entheses

**RX**
- impact of disease
- want child to be physically, socially, and emotionally as normal as possible
- co-RX w/ OT
- **complete remission in 75% kids if occurs before 16**

**DISEASE STAGE**
- Acute → maintain ROM and fxn
- Subacute → ↑ ROM and strength
- Chronic → complex activities/ balance
**EXERCISE IN RA AND OA**

RA → primarily affects MCP + PIP, rheumatoid cachexia (breakdown of muscle fibres), fatigue!!!

OA → affects weight bearing joints → hip, spine, DIP, PIP, first CMC, first MTP

**BOTH BENEFIT FROM** → aerobic, resistance, and stretching/ROM → pool is great for both

- follow ACSM general but based on individual pat presentation

**CONTRAINDICATIONS/RED FLAGS**
- ↑ pain, fatigue or AM stiffness
- sudden pain at joint or joint deformity
- joint becomes red, swollen and hot after doing exercise (within 24 hrs)
- ↓ muscle strength and function (local myositis)
- neurological SSx (CV involvement)
- SOB on mild exertion

**PRECAUTIONS**
- watch out for inappropriate exercise → can harm joints (RA → deforming forces)
- swollen joints at risk for capsular stretch and rupture
- OP bone at risk for #
- use machine and resistance bands rather than free weights

---

### Rheumatology Outcome Measures

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>What it measures</th>
<th>Scoring</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Assessment Questionnaire (HAQ)</td>
<td>- difficulty performing ADLs over the past week - good measure of disease activity</td>
<td>- 5 dimension - ordinal scale: 0-3 - want a lower score</td>
<td>- most widely used functional measure in rheumatology - RA - there is a modified version</td>
</tr>
<tr>
<td>EuroQoL – 5D (EQ-5D)</td>
<td>- QoL profile - looks at: self care, ADL, pain/discomfort, anxiety &amp; depression</td>
<td></td>
<td>- general population, RA, and OA</td>
</tr>
<tr>
<td>MACTAR</td>
<td>- assess disability in RA patients (specific patient- picked activities that are effected by RA)</td>
<td>- 5 activities - questionnaire administered by PT - 10-15 minutes - -1 → 1 score (worse → better)</td>
<td>- RA (patient centered measure) - better for short term follow up vs long term</td>
</tr>
<tr>
<td>Time Chair Stand Test</td>
<td>- lower body strength in older adults as an indicator of functional status - some predictive validity for falls</td>
<td>- standardized chair - time for 1, 5, or 10 reps ; or reps in 30 second period</td>
<td>- older patients with polymyositis, proximal LE weakness, RA, TJA, lower limb OA (orthopedic or arthritis conditions)</td>
</tr>
<tr>
<td>Knee Injury and OA Outcome Measure (KOOS) or HOOS</td>
<td>- short and long term patient relevant outcome measure of knee (or hip) injury that can result from traumatic OA</td>
<td>- 5 dimensions: → pain, other symptoms, ADLs, sport and recreation fxn, knee (or hip related) QOL</td>
<td>- persons with ACL injury, meniscus injury, or post traumatic OA (same for hip injuries) aka hip or knee pathologies and post surgical</td>
</tr>
</tbody>
</table>

- *be aware of what fits under each domain of the ICF
  - i.e. body structure and function, activity, and participation)
- remember other outcome measures like: VAS, SF-36, DASH, walking speed, TUG
METABOLIC DISORDERS/CONDITIONS

DIABETES

- INSULIN
  - regulates glucose levels
  - promotes glucose uptake into the cells for storage (as glycogen)
    - muscle, liver, adipose tissue
- DIABETES TYPE I
  - juvenile onset
  - require insulin
  - immune mediated attach of islet cells in pancreas
  - ↓ circulating insulin
  - PRESENTATION:
    - weight loss, ↑ urination, dehydration
- DIABETES TYPE II
  - adult onset
  - don’t need insulin → b/c doesn’t respond to it
    - causes insulin resistance in peripheral tissues (don’t respond to insulin)
  - PRESENTATION:
    - obese
    - acanthosis nigricans (hyperpigmented skin in axilla, groin, back of neck)
    - HTN
- RX
  - DIET
  - MEDS → to stimulate insulin secretion
- HYPOGLYCEMIA
  - dizzy, nausea, weak, sweating profusely (this rules out orthostatic hypotension)
  - fatigue, irritability, confusion, fainting
- HYPERGLYCEMIA
  - blurred vision, fatigue, thirst, frequent urination, weakness, abnormal breathing, acetone breath
  - LONG TERM EFFECTS
    - damage to small blood vessels (retinopathy and diabetic nephropathy)
    - damage to large blood vessels → abnormal glucose metabolism causes ↑ cholesterol levels → vessel wall damage → atherosclerosis and myocardial infarction, stroke, gangrene
    - damage to peripheral nerves → diabetic neuropathy
- NORMAL GLUCOSE LEVELS
  - fasting plasma glucose: 5.6 mmol/L, diabetes >7 mmol/L
  - impaired fasting plasma glucose: >5.6 mmol to <7 mmol/L
- LONG TERM CONSEQUENCES
  - peripheral (diabetic neuropathy—ulcers—amputation)
  - kidney failure (diabetic nephropathy—congestive heart failure—a swelling—HTN—protein urea)
  - diabetic retinopathy (blindness)
  - heart disease (heart attack, stroke, atherosclerosis)
  - infection
- RX
  - regular exercise = very important
  - talk to MD about insulin levels for exercise
  - have snack before (have raisins/ juice available to boost sugar levels if necessary)
  - monitor blood sugar levels pre, during, and post exercise
  - avoid exercise at night → person may go to sleep and slip into a hypoglyemic coma and die
  - PT always monitor pt for SSx hyper or hypoglycemia

Classification of diabetes mellitus
(American Diabetes Association 1998)

1. Type 1: β-cell destruction usually leading to absolute insulin deficiency.
2. Type 2: Variation from insulin resistance and increased insulin levels to a dominant defect in insulin secretion with insulin resistance.
3. >40 well-defined types of diabetes.
4. Gestational diabetes:
   - Any degree of glucose intolerance first noted in pregnancy.
**CHRONIC PAIN/FIBROMYALGIA**

**CHRONIC PAIN**
- pain that persists past the normal time of healing (usually 3 months)
- SCI → 2/3 of pt develop chronic pain
- **RX** → interdisciplinary team, medications, education, and appropriate exercise
- **PAIN**
  - TRANSMITTED BY
    - A delta fibres (high threshold, sharp prickling, localized, fast adapting)
      - meds work well
    - C fibres (low threshold, dull, aching, diffuse, slow adapting and persistent)
      - meds work
  - DUE TO
    - tissue damage (stimulation of nociceptors)
    - inflammatory mediators → inflamm and swelling
    - release of cells in plasma (bradykinin, prostaglandins, sub P)
      - stimulate pain receptors
  - CONDUCTION
    - at spinal cord goes up lateral spinothalamic tract to thalamus and to the cortex
    - periaqueductal grey → releases endorphins → inhibits subs P and glutamate release
      (therefore ↓pain)
- **CHRONIC PAIN**
  - actual chemical changes occur in the tissue and in the brain (limbic)
  - receptors become hypersensitive → RESULT → allodynia or hyperalgesia
    - ↑ activity in pain pathways; these people’s pain is real
  - **RX**
    - have to desensitize the area
    - educate them that it’s not in their head
    - restore normal function to the area
      - **variety of techniques:** chemical (medications), physical (electrotherapy),
        cryotherapy, thermotherapy, exercises/stretch (reduce pain caused by muscle spasm))

**CHRONIC FATIGUE SYNDROME** (possibly viral)
- **DX**
  - by exclusion
  - persistent or relapsing fatigue for at least 6 months
  - not resolved with bed rest
  - reduces daily activity by at least 50%
- **RX**
  - Analgesics, anti-inflamm, NSAIDS, nutrition, psych support
  - **PT RX** → check ex tolerance

**FIBROMYALGIA** → Etiology unknown (F>M)
- chronic pain syndrome affecting mm + soft tissue (non-articular rheumatism)
- **S/S**
  - headaches, sensitivity to stimuli, fatigue, myalgia (mm pain), generalized aching, sleep disturbances, anxiety/depression
  - 11 of 18 points → Occiput, low cervical (C5-C7), Traps (mid-pt of upper border), Supraspinatus (at origin), Second rib, lateral epicondyle, gluteal, greater trochanter, knee
- **RX**
  - anti-inflamm, mm relaxants, pain meds, psychological support, nutrition, can respond well to dry needling
    (this is from my own (Erika) personal experience), they like heat and not ice
  - **PT RX** → energy conservation, aquatic therapy

01.04.04 **LYMPHODEMA** (in oncology section)

01.04.05 **SEPSIS**
• presence of whole body inflammatory state (SIRS) + presence of known or unknown infection

**SEPTIC SHOCK**
- severe sepsis but hypoperfusion abnormalities in spite of adequate fluid resuscitation
- immune system spirals out of control
- **normal response to infection is local** but then causes **widespread vasodilation and vascular permeability**

**SHOCK**
- poor distribution of blood at the microcirculation level
- ↓ tissue perfusion = Q meet cellular needs → CELL DEATH
- **TYPES**
  - hypovolemic (blood loss)
  - cardiogenic (heart damage)
  - distributive (hypotension and general tissue hypoxia)
  - obstructive (great vessels of heart, usually goes with cardiogenic shock)

**SIRS → SYSTEMIC INFLAMMATORY RESPONSE SYNDROME**
- whole body inflammatory state
- **DX**
  - WITH body temp, HR, RR, WBC count
  - 2 or more following signs
    - (HR>90)
    - temp >38 or <36
    - RR>20 OR PaCO2 < 32
    - WB count > 12000 or < 4000

**01.04.06**

**OBESITY**
- Excess body fat
- **BMI** = weight (kg)/height (m)^2
  - overweight BMI= 25-29.9
  - OBESITY= BMI > or = to 30
  - morbidly obese > or = to 40
- **Skin caliper test** = fat greater than 1 inch is excess
- **CAUSE (MULTI-FACTORIAL)**
  - excess calorie intake
  - psych/enviro factors
  - genetic factors
  - endocrine and metabolic disorders
- **Health risks associated with obesity**
  - HTN, hyperlipidemia, type 2 diabetes, cardiovascular disease, glucose intolerance
  - gallbladder disease, menstrual irreg, infertility, cancer
  - **Abdominal Obesity**
    - independent predictor of morbidity and mortality
- **RX**
  - lifestyle modifications, behavior therapy, pharmacology, surgery
  - **EXERCISE**
    - moderate intensity → 40-60% progress to 50-70% HRR, 5-7d/wk, 45-60mins, circuits or aquatics
    - mindful of response to heat (used therapeutically) or in response to exercise
      - excess fat leads to heat insulation → lead to overheating
PREGNANCY AND POST PARTUM CONDITIONS

- NORMAL ➔ gain 20-30lbs
- Pregnancy = 40 weeks from conception to delivery
  - Preterm = <37 weeks
- PT RX ➔ relaxation + breathing exs, education
- POSTURE CHANGES
  - thoracic kyphosis
  - forward lean in Csp (HFP)
  - lumbar lordosis
  - breast size
  - shoulder protraction
  - form and force closure ➔ pelvic floor on stretch
  - balance change
  - lig laxity (hypermobile SI - teach jt protections)
- INCONTINENCE ➔ 67% from vaginal delivery
- PT ANTEPARTUM (BEFORE BIRTH) CONCERNS:
  - antepartum bleed
  - preterm labor (irritable uterus) ➔ “mini contractions”
  - ruptured membrane ➔ slow trick of fluid (not water breaking)
  - incompetent cervix/changes

PELVIC GIRDLE PAIN * seen elsewhere

DIASTASIS RECTI ABDOMINIS

- lateral separation/split of rectus abdominus
  - separation from midline >2.5 cm sig, may be detected in 2nd trimester
- EFFECTS
  - weak abdominal wall
  - support for back and viscera
  - related to lumbo-pelvic pain
- RX
  - education (what you can improve and what you can’t improve)
  - posture and body mechanics
  - movement patterns and recruitment strategies
  - exercises (TA, multifidus, pelvic floor)
  - abdominal binders (proprioceptive feedback)
  - recovering usually 2-6 months, surgery in severe cases

CARPAL TUNNEL SYNDROME/DE QUERVAINS

- fairly common but often not diagnosed ➔ usually seen in 2nd trimester
  - D/T ➔ fluid (therefore pressure), hormone changes, poor lifting or carrying technique of toddler or newborn
- RX
  - education (what to avoid, ergonomics, movements strategies)
  - ice, electrotherapy, stretching
  - good prognosis

VARICOSE VEINS

- S/S
  - heaviness, dull pain/ache in legs with standing and walking, may be incapacitating pain
  - apparent vein distension, reported tenderness, usually in lower legs (can be uvular)
- RX
  - posture, positioning elevation, limit cross legged time
  - pressure graded stockings/tights/underwear, circulatory exercises

INCONTINENCE (stress, urge, mixed)

- ↑risk in vaginal delivery
• ↓ abdominal recruitment with ↑ intraabdominal pressure (cough, sneeze) or strong need to urinate when on way toilet

• CAUSES
  o injury to connective tissue
  o damage to pelvic nerves and muscles
  o direct injury to urinary tract
  o changes in pelvic floor anatomy
  o urethral weakness
  o vaginal relaxation

• RX
  o PF exercises (10 second holds, 10 contractions, 2-3x per week) → w/ fx tasks
  o co-contraction of TA and PF
  o posture and body mechanics (poor lifting technique)
  o urgency techniques (perch, PF contractions, walk to bathroom)
  o diet changes (coffee intake, water, gradually inc time between urination from 2-4 hrs)

GESTATIONAL DIABETES
• Abnormal blood sugar reading 1st seen during pregnancy
  o undetected or mismanaged can lead to very high risk to baby and to mom

• RX
  o team (physician, nurse, dietician → insulin, diet, exercise) → 20 mins walk post-meal

• OVERALL RX → AVOID:
  o valsalva, exercise techniques that stress the PF and abdominals
  o rapid uncontrolled movements
  o positions of inversion
  o deep heat modalities or electrical stimulation
  o manual therapy (or take care with end feels )
  o positioning: supine is not contraindicated for short periods of time, prone is not well tolerated
  o give posture tips in lying, standing, sitting, lifting/carrying
  o glut strategy for rolling and sit to stands

• RED FLAGS FOR REPRODUCTIVE PROBLEMS
  o change in B&B fxn, sexual fxn, often, not always at condition onset
  o non mechanical low back pain
  o suprapubic or groin pain (may or may not occur with the above)

PELVIC FLOOR DISORDERS
• D/T stretching → can lead to partial or total organ prolapse
  o cystocele: herniation of bladder into vagina
  o rectocele: herniation of rectum into vagina
  o uterine prolapse: bulge of uterus into vagina

• S/S
  o Increase with activity/at end of day
  o Pelvic pain
  o urinary incontinence
  o pain with sexual intercourse
  o heaviness in saddle region,
  o incomplete B&B emptying

• PT RX → if unresolved in 6 weeks
  o PT= pelvic floor mm ex, postural re-ed, pessary, surgery

PREECLAMPSIA
• preg induced, acute HTN after 24wks gestation
• S/S
HTN, edema, headache, visual disturb, hyperreflex → PT to AX

C-SECTION
  - PT TX
    - TENS for incision pain
    - breathing ex
    - gentle ab ex
    - pelvic floor ex
    - postural ex, ambulation
    - prevent incisional adhesions (scar massage)
01.04.08 BURNS

- 1st degree: Superficial, erythema appearance
- 2nd degree: Partial Thickness, blistering appearance
- 3rd degree: Full thickness, necrosis (black, part of skin falling off)
- RULE OF 9s → to determine body surface area involvement (Qinclude 1st degree burns)
  - head = 9
  - torso = 36
  - each arm = 9
  - each leg = 18
  - pubic area =
- RULE OF 9s in KIDS → same torso and same arms but head = 18, each leg = 14
- SCARRING
  - ONLY occurs if significant damage to dermis (i.e. with 3rd degree)
- PHASES OF WOUND HEALING
  - inflammed (up to 2 days)
    - vascular and cellular effects to eliminate the necrotic tissue and deliver materials for healing
  - proliferative (days to months)
    - rebuild the dermis and epidermis, fibroplasias and neovascularization that produce granulation tissue (early angiogenesis)
  - remodeling (months)
    - wound contracts and increases strength, scar
- CLASSIFICATION OF WOUND HEALING
  - acute vs chronic
  - partial vs full thickness
  - primary (closed by surgery) vs secondary intention healing (wound left to heal on own)
- ZONES
  - Zone of coagulation → pt of maximum damage, irreversible tissue loss
  - Zone of stasis → ↓ tissue perfusion, potentially salvageable
  - Zone of hyperemia → ↑ perfusion, will recover unless sepsis occurs
- EFFECTS OF BURNS
  - CV
    - ↑ capillary permeability → interstitial edema
    - peripheral vasoconstriction
    - hypovolemia
    - myocardial depression → hypotension and decreased organ perfusion
    - ↓ cardiac output
  - Resp
    - bronchoconstriction, ARDS, carbon monoxide (dec O2 carrying capacity of blood)
  - Metabolism → ↑3x
  - Immune system → compromised
  - Renal → b/c of loss of fluids → vasoconstriction, ↓ GFR, ↑myoglobin gets processed by kidneys and can block tubules
- SIGNS OF INHALATION INJURY
  - singed eyebrows/nasal hairs/burnt face, black oral/nasal discharge, swollen lips, hoarse voice, abnormal oxygenation, Hx of being enclosed in closed room
  - Inhalation injury process → w/in 24hrs upper airway obstruction/pul edema
    - 24-48 just pulmonary edema; 48 hrs plus bronchiolitis, alveolitis, pneumonia, ARDS
  - Mngmt of inhalation injury → early mobilization, breathing ex's, post drainage
- PT RX
  - keep wound moist, electrotherapy (HVPC), good health (diet, exercise (for circulation)
  - debride wounds (whirlpool), pain mngt,
  - first 2-3 weeks AROM and PROM to maintain range, positioning, edema management, encourage ambulation
  - scar management BECAUSE as early as 1-4 days can get a scar tissue contracture
- CONTRAINDICATIONS TO EXERCISE
exposed joint, fresh skin graft, DVT, compartment syndrome

**SKIN GRAFT**
- **Split Thickness Skin Graft**
  - uses skin graft, stitched, glued or sutured in place; immobile for 5 days
- **Full Thickness Skin Graft**
  - skin transplant

**SKIN GRAFT RX:**
- scar massage, sun protection, ROM, pressure garments
- strengthening can begin in 3-4 weeks

**SCAR FROM BURNS**
- **3 stages**
  - 0-4 weeks *fibroblastic/proliferative*
  - 4-12 weeks *early remodeling*
  - 12-40 weeks *late remodeling/maturation*
- Factors influencing scar → age, smoking, type of tissue, nutrition
- Therapeutic mgmt of scar → pressure garments, massage, moisture
WOUNDS/ULCERS

- RISK FACTORS
  - Modifiable:
    - autonomic dysreflexia
    - incontinence
    - smoking
    - obesity
    - poor nutrition
    - comorbidities (renal, cv, pulmonary, diabetes)
    - depression
  - Nonmodifiable:
    - ↓ sensation
    - activity, and mobility
    - muscle atrophy
    - completeness of injury
    - age
    - hx of previous wounds
    - ↑ tissue temp, moisture
    - spasticity

- AREAS AT RISK IN:
  - Lying: occiput, elbows, sacrum and coccyx, heel (in side lie: shoulder, greater trochanter, anterior knee, malleolus)
  - Sitting: shoulder blade, sacrum and coccyx, ischial tubs, posterior knee, foot

ULCERS

- CAUSES:
  - Pressure (round sore)
  - shearing (abrasion/scrape)
  - friction (blisters can be a sign → spasticity are common causes)
  - deep tissue damage from banging or bumping (purple or bruising)

4 STAGES OF WOUNDS:
  - Stage 1 → reddened (non blanchable)
  - Stage 2 → skin is broken, small crater
  - Stage 3 → deep crater, might be infected, may be black, dead tissue
  - Stage 4 → deep through mm to the bone or joint

- DESCRIBING WOUNDS
  - location, size, wound base, wound edges, surrounding skin, stage, photos

- SKIN PROTECTION:
  - regular pressure relief techniques, excessive cold or heat, from bumps, scrapes and any shear friction, red area should be blanchable when touched, red area should disappear after 20-30 mins

- CLIENT EDUCATION FOR WOUND PREVENTION
  - look at skin 2X/day, check all bony prominences, use a mirror and attendants
  - look for change in temp, colour, temperature, texture, persistent erythema, discoloration
  - Braden scale for ax risk of wound

- RX
  - multidisciplinary team, dressings, mobility restrictions
  - PT → HVPC level 1 evidence for wound healing
01.04.10 **SKIN CONDITIONS** (e.g., dermatitis, psoriasis)

### PSORIASIS
- **autoimmune disease** that affects the skin
- faulty signals that speed up the growth cycle of skin cells → profound cutaneous inflammation and epidermal hyperproliferation
- **5 CARDINAL SIGNS:**
  - plaque (raised lesion)
  - well circumscribed margins
  - bright salmon red colour
  - silvery micaceous scale
  - symmetrical distribution
- **SITES**
  - extensor surfaces over bony prominences (elbows, knees), scalp, retroauricular, ears, palms and soles, umbilicus, penis, lumbar, shins, nails plaques, **but can affect any area**
- **COMPLICATIONS**
  - physical (pruitis, bleeding of lesions)
  - emotional and psychological (isolation, loss of self esteem)
  - economic (cost of meds, time away from work)
  - severe psoriasis is associated with risk of cardiovascular disease and death, psoriatic arthritis
- **RX**
  - Topical creams containing glucocorticoids
  - Tars
  - vitamin D or A
  - phototherapy with UV light
  - systemic therapy with immunosuppressive drugs

### ECZEMA (means “boiling over”)
- form of dermatitis or inflammation of the epidermis (skin outer layer)
- itchy, red, scaly disorder
- **2 TYPES:**
  1. **ATOPIC DERMATITIS** (“endogenous” eczema)
     a. intensely itchy inflammatory skin disorder associated with “atopy”
        i. predisposition toward developing certain allergic hypersensitivity reactions
           1. asthma, hayfever, and allergic conjunctivitis
     b. **PRESENTATION**
        i. itchiness is the most outstanding feature (pruitis)
        ii. lichenification (thickening skin lines)
        iii. excoriations (scratching or picking at skin)
        iv. crusting
     c. **3 PHASES:**
        i. Infantile (2mo-2years)-facial and extensor distribution
        ii. Childhood-dry skin, flexural distribution (popliteal and cuboid fossa)
        iii. Adult-atopic dermatitis generally improves with age, less flexural distribution, primarily affect the hands
     d. **RX**
        i. avoid irritating factors, moisturizers, topical glucocorticoids, oral antihistamines, UV therapy for resistant or severe cases
  2. **CONTACT DERMATITIS** (“exogenous” eczema)
**Allergic contact dermatitis**
- immune hypersensitivity to an allergen in contact with the skin (e.g. nickel, poison ivy)

**Irritant contact dermatitis**
- contact of skin with something that primarily causes direct local irritation (harsh detergents, chemicals)

**RX**
- usually topical steroids, clears up in 7-10 days

**SEBORRHEIC DERMATITIS** (dandruff)
- occurs in areas of *higher sebaceous gland activity* (oily areas)
  - scalp, face, central chest and back
- probably due to an *excessive immune response to a yeast*
- ill defined areas of erythema with greasy-appearing scale
- **Associated disorders**
  - seen frequently in PD, neurologic disorders (stroke, TBI, SCI), HIV pts that ↓ mobility

**RX** → antifungals

01.04.11 **TUMOURS** (in next section)
01.04.12 **COMPETING DIAGNOSES** *(management of 1° diagnosis is changed by 2° diagnosis)*

**HEPATITIS** → liver disease
- **THE LIVER’S MAIN FXN IS PRODUCING:**
  - ALBUMIN (FLUID TRANSMISSION)
  - CLOTTING FACTORS (BLEEDING)
  - AMMONIA METABOLISM (BREAK DOWN PROTEIN BY-PRODUCT → UREA → EXCRETION BY KIDNEY)
- **S/S**
  - yellow, itching (pruitis), big belly(ascities), bleeding, and esophageal varices

- **HEP A**
  - virus transmitted by fecal oral route, usually self limiting bout
  - **RISK FACTORS**
    - international travel, daycare, vaccine available
  - **S/S**
    - jaundice, fatigue, weakness, anorexia, nausea, vomiting, abdominal pain
  - **NOTE** → children are usually asymptomatic

- **HEP B**
  - infection of liver, can persist and become chronic, long standing can lead to cirrhosis and hepatocellular carcinoma
  - high (Africa) to low risk (north America) regions of countries
  - can be spread → **high risk** (mother to child) to **low risk** (sexual transmission and injection drug use)
  - **LONG TERM COMPLICATIONS**
    - cirrhosis and hepatocellular carcinoma
  - **RX**
    - antiviral agents, vaccine, NO CURE

- **HEP C**
  - **Transmission**
    - percutaneously (needle stick, drug use)
    - non percutaneous (sexual)
    - hemodialysis
  - higher risk of it turning chronic from acute then in hep B but it can take decades for chronic complications to occur (20 yrs)
  - **RX**
    - interferon and anti-viral agents

- **AUTOIMMUNE**
  - unknown cause, tests to positive antibodies
  - **RX**
    - prednisone and other immunosuppressents
GRAVES’ DISEASE  ➔ hyperthyroidism, F>M
- autoantibodies stimulate the thyroid (TSH receptor), T3 and T4 (these inhibit the secretion of TSH) will be high
- S/S
  - fever, wt loss, exercise intolerance, goiters, bulging eyes (exophthalmos), tachycardia, decrd fertility
- RX
  - betablockers for HR, anti-thyroid drug therapy, radioactive iodine, Sx removal of thyroid

HASHIMOTO THYROIDITIS  ➔ hypothyroidism, F>M
- autoimmune destruction of thyroid gland, T3 and T4 are low, TSH is high
- S/S
  - wt gain, cold intolerance, round puffy face, bradycardia, constipation, depression
- RX
  - thyroid hormone replacement

ADDISON’S
- autoimmune process against the adrenal cortex, fatal if not treated, great prognosis if treated
- S/S ➔ weakness, fatigue, anorexia, hyponatremia, hypoglycemia, hyperpigmentation
- RX
  - replace missing adrenal hormone with aldosterone and cortisol

CUSHING’S DISEASE
- chronic glucocorticoid (cortisol) excess
- can also get from cancer of adrenal gland
- S/S
  - moon face, central obesity, abdominal striations
- RX
  - surgical if caused by tumor (tumor in pituitary or adrenal gland)

INFLAMMATORY BOWEL DISEASE
1. CROHNS
- affects the entire GI tract from mouth to anus, small and large intestine,
  - can have skipped lesions (normal segments)
  - ulcers, fissure, and fistulas, get alterations in digestion and absorption ➔ malnutrition
- RX
  - anti inflamm drugs for bowel not systemically, prednisone (immunosuppressant)
  - anti-biotics, biologic therapies

2. ULCERATIVE COLITIS
- same as crohns but no skipped lesions
- affects only the colon
- can have significant bleeding and anemia

TRANSPLANTS
- Main Concerns
  - donor factors (disease)
  - coagulation products at time of transplant (will they bleed out)
  - function, immunosupression, rejection, infection
# TUMORS

<table>
<thead>
<tr>
<th>TUMOR</th>
<th>Neoplasm, benign or malignant, soft tissue, bone or develop from within tissue in localized area and can met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epithelial</td>
<td>Carcinoma</td>
</tr>
<tr>
<td>Mesenchymal (loose CT)</td>
<td>Sarcoma</td>
</tr>
<tr>
<td>Glial</td>
<td>Gioma</td>
</tr>
<tr>
<td>Lymphoid</td>
<td>Lymphoma</td>
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<tr>
<td>Hematopoietic</td>
<td>Leukemia</td>
</tr>
<tr>
<td>Melanocytic</td>
<td>Melanoma</td>
</tr>
<tr>
<td>TNM staging</td>
<td>Tumor( extent/spread), Nodes, Mes (distant/local)</td>
</tr>
<tr>
<td>Clinical presentation of cancer survivor</td>
<td>Fatigue, myalgia, arthralgia, bone health, peripheral neuropathy, deconditioned</td>
</tr>
</tbody>
</table>

## LUNG

- **Squamous metaplasia** → **squamous diplasia** → **carcinoma in situ** → **invasive carcinoma**
- **Small cell** 20-25% develop into bronchial cell mucosa spread rapid and met early
- **Squamous (non sm cell)** Slow spread arise in central portion near hilum, mets late
- **Adenocarcinoma (non sm cell)** 30-4-% slow to mod spread earl mets through lungs/brain other organs
- **Large cell** Rapid spread wide spread mets, kidney, liver, adrenals other organs poor prognosis

## BRAIN

- **2nd cause of death in brain** 50% survival
- **Intracerebral primary**
  - **Intra cerebral metastatic** Come from lung, brast prostrate, compensate by dec brain tissue, CSF and blood flow volume
  - **Intra spinal** Nerve root pain, worst @ night, cough, radicular pain Tx surgery or radiation
  - **Low grade astrocytoma** Benign, good survival if Tx early
  - **Medulloblastoma** Freq mets to other areas brain/spine
  - **Neuromas** Schwannoma → CN 8 (vestibular) head ache seizure nausea vomit cognition and behaviour

## CONNECTIVE TISSUE

- **Osteosarcoma** End of long bones, produce pain (tibia/femur near knee), XRay moth eaten appearance usually secondary, primary is rare (can occur in youth) Tx surgery
- **Synovial sarcoma** Usually in larger joints, swelling and instability, Tx, surgery +/- chemo/rad may met to bone, may come from breast, lung, prostate, thyroid
- **Osteoid Osteoma** Benign tumor, exercise related bone pain and tenderness, abolition of Sy with aspirin, Tx ablation, ethanol, laser

## SKIN

- **Prostate** Men >50 tx surgery, external beam radiation, brachytherapy, androgen deprivation therapy

## ABCD rule

**Basal cell carcinoma** Most common form low risk of spreading, translucent and red in colour

**Squamous cell carcinoma** Solid skin tumor, often volcano shaped, high risk for mets

**Malignant melanoma** Most dangerous, high potential for mets

**ABCD rule** Assymetry, border, colour, diameter

# PAEDIATRICS
mother’s mental and physical health will influence brain development and behavior of infant

APGAR: neonatal ax → 5 aspects, score 0-2, want a high score: appearance, pulse, grimace, activity, and respiration

GOALS OF PEDS PHYSIO: participation, motor abilities, functional mobility, health & prevention

FAMILY CENTERED CARE!! Parents know kids best, family are different and unique, optimal child fxning occurs with supportive family and community

**REFLEXES:**
- sucking reflex
- asymmetrical tonic neck reflex (ATNR) 0-4 months: head turn to one side, extension of arm at that side and flexion of the contralateral arm
- moro reflex: when feeling like they are falling the child will open their arms then bring them back to their ches
- grasping reflex 0-4 months: grasp when pressure is put on palm of hand, will relax if you stroke back of hand
- stepping reflex: body weight shift and the baby will make stepping motions (first 2 months)
- babinski: normal in babies (fanning of toes).
- symmetrical tonic reflex 6-9 months: stim neck flexion or extension, will flex UE and extend Le with neck flex and when neck extended UE will extend and LE are flexed
- plantar grasp reflex: present at 28 wks to 9-10 months, stim: pressure to base of toe, toe flexion
- rooting reflex (up to 3 months): stroke side of cheek they will turn their head to side of stim with mouth open

**POSTURAL REACTIONS** → the beginnings for adult postural reactions (strategies)
- righting reactions: hold baby diagonal and they will right their head to the vertical
- equilibrium reactions:
- protective reactions: if you push them they will put out their arms

**DEVELOPMENTAL MILESTONES:**
- Birth to 3 months: able to turn head side to side, brief head righting, random kicks in supine, maintain head midline, hand fist will reflex grasp
- 4-5 months: able to prop with extended elbows, head control, rolls, supported sitting (good head control, turns head), weight bears in standing when supported , 3-5 months: grasp/hold small toys, release toys, inc frequency of reaching
- 5 months: head control in sitting
- 6 months: sitting independently, uses hands for play, stands with support , 6- 8 months: radial grasp, rake to grasp, reaching path is straight
- 7 months: anticipate and orient hand for reach and grasp (7.5 months), commando crawling
- 8-9 months: 4 point kneel (start with rocking to crawl backwards to crawl forwards), moves from sit to prone, pivots in sitting, may pull to stand, 9-11 months: points and pokes with index finger, uses pincher grip
- 10-11 months: does like prone or supine (will get out of it), sitting bum scoot, standing (transfer from stand → sit without falling, picks up objects from floor w/o support, stands hands free for a few secs), mobility (crawls up stairs, cruising, walking w/ hands held, can start walking indep.)
- 12-18 months: walks independently, transitions to stand at mid floor, squats, picks up toys without support, walks up stairs with hand held or rail, initiates ball kick, throws ball, walks backwards and sideways a few steps ; opens books, puts pellets in bottle, handedness usually established
- 2-2.5 yrs: propels or steer push toys, walk on tiptoes, jumps, stand on one foot, kick ball, throw and catch, ascend and descend stairs IN;
- 3-5 yrs: climb stairs independently, run faster and more controlled, walk in straight line, throw under and over head, somersaults, gallop and skip, dress and eat independently ; uses mature tripod grasp (4.5 yrs)

**ADDITI**

**ONAL CONDITIONS**

DOWN SYNDROME: alteration on chromosome 21
**S/S** → identifiable facial features, hypotonia, dec strength and lig laxity, short arms and legs, heart defects, AA instability, scoliosis, pronated feet, and hip dislocation

**RX** → try to attain developmental milestones, discourage compensatory patterns, improve muscle strength (antigravity muscles), monitor ortho issues, provide oral-motor fxn, sensory and gross motor stim, monitor cardiovascular and respiratory health

**PRADER – WILLI SYNDROME**: related to disturbance in hypothalamus, genetic deletion (chrom 15 usually)

**S/S** → infants (hypotonia, delayed motor and learning development, little spontaneous movement, resp difficulties, and oral motor or feeding difficulties;

**RX** → gross motor development, compensatory postures, nutritionist)

**older kids**

**S/S** → hypotonia, intellectual impairment, short stature, hyperphagia *extreme obesity, behavior problems;

**RX** → weight management, increase activity level, orthodics, improve postural control, behaviorist)

**NEONATAL RESPIRATORY DISTRESS SYNDROME**

< 37 weeks gestation, due to lack of surfactant

**S/S** → tachypnea, in drawing, cyanosis, occurs soon after birth

**RX** → corticosteroids

**SIDS (SUDDEN INFANT DEATH SYNDROME)**: death of infant under 1 yr with unexplained cause, peaks at 3-4 months and usually occurs at night, M>F, can also be caused by infection,

**RISK FACTOR** → prone sleeping

**FETAL ALCOHOL SYNDROME**: exposure to alcohol during gestation, can lead to facial changes, brain damage, hypersensitivity, poor concentration, poor feeders/eaters, need routine, ↓ stim, learning strategies

**ARHROGRYPOSIS MULTIPLEX CONGENITAL (AMC)**

rare non progressive neuromuscular syndrome (unknown etiology)

**S/S** → joint contractures (due to lack of fetal mvmt), muscle weakness, poor muscle development and

**Fibrosis** → can lead to scoliosis, heart defects, resp problems

**SALTER HARRIS #**: fractures that occur in children, determined by growth plate development → immobilization usually between 3-6 weeks

**AUTISM**:

- developmental delay in social/language/motor and/or cognitive development, more common in M>F, avg age of onset is 4 yrs
- **S/S**
  - have stereotyped and repetitive play skills, avoid eye contact, dislike change in routine, and have strong sensory preferences, dyspraxia (needs time to plan movement and execute goal related fxn), gait (waddling, abnormal weight distribution), cerebellar involvement
- **OUTCOME MEASURES**
  - use M-ABC, Bayley -3, PDMS-2
**PEDIATRIC EXAMINATION**

1. **HX:** prenatal, birth, general health, milestones, procedures/interventions, goals

2. **SYSTEMS REVIEW:** cardioresp, integumentary, MSK, neuro, communication/cognition/learning, level of consciousness, orientation, emotional/behavioral

3. **INTERVENTION** – back appropriate outcome measures* look at sheet from class
   - **FMS** (*functional mobility scale*): age 4-18 with CP, rates walking ability at 5, 50, 500 m (for home, school and community), questions not observation, used to figure out what devices they will need. N-6 (you want a high score)
   - **GMFCS** (*gross motor functional classification system*): 5 levels (I= high func, V= limited), for kids with CP, based on self initiated movement, good for communication between families and health care professionals and goal planning
   - **GMFM** (*gross motor functional measure*): standardized test for gross motor func for children with CP, all items that a 5 year old (normal development) would do, can measure over time to see change and set realistic goals
   - **COPM:** identifies goals in self care, productivity, leisure, → family centered

4. **RE-EXAMINATION**
   - **RX, CONSIDER:** the environment, the task activity, the instructions you give, and other things like breaks, choices and control
   - **TONE:** muscle palpation, prom, quantifying tone, and primitive reflexes (clonus and Babinski), use modified Tardieu (assess ROM at R1 (high velocity) and R2 (end of ROM and slow speed), 0-5 (want a lower score)), or modified Ashworth (5 point scale, 0-4)

**EXTRA**

Developmental milestones Sullivan pg 247
TX: IMPLEMENTATION OF INTERVENTIONS (02.02)

ASSESSMENT
- LE reflexes: knee jerk (L3/4); Achilles reflex (S1/S2)

02.02.04.01.01
Exercise with or without equipment
➔ training principles: specificity, overload (rule of 2’s), reversibility, individuality

RESISTED:
- Improves muscle performance, balance, delays bone loss, muscle strength/endurance/power, ability to do ADL and recreation
- CONTRAINDICATIONS:
  - acute inflammation
  - joint effusion
  - severe CVD
  - joint/muscle pain during AROM or isometric testing
- Precautions: osteoporosis/osteopenia, fatigue, medications, inappropriate temp and clothing
- Avoid: valsalva, ballistic uncontrolled movements, pain, dizziness, unusual SOB
- Variety: manual resisted, isometric, isotonic elastic, isokinetic (same speed), body weight, circuit
- Progress ➔ by desired outcome (strength, power, endurance, etc), increase by 2-10 %
- Different populations:
  - older adults: focus on body weight exercises, ADL, walking program, endurance, major muscle groups
  - kids: bone loading, endurance not hypertrophy, body weight,

<table>
<thead>
<tr>
<th>Open chain</th>
<th>Closed chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal segment moves in space</td>
<td>Distal segment is fixed or stabilized</td>
</tr>
<tr>
<td>Typically NWB</td>
<td>Typically WB</td>
</tr>
<tr>
<td>Muscle isolation</td>
<td>Activation of multiple muscles</td>
</tr>
<tr>
<td>External stabilization usually required</td>
<td>Internal stabilization</td>
</tr>
<tr>
<td>Better isolation</td>
<td>Easier to cheat with compensation movements</td>
</tr>
<tr>
<td>More joint shear</td>
<td>Inc joint approximation (dec joint shear) ➔ greater co-contraction and proprioception and kinesthetic feedback is debateable</td>
</tr>
</tbody>
</table>

STRETCHING
- can be active or passive
- CONTRAINDICATIONS:
  - acute inflammation or infection
  - unhealed # that can't be protected
  - joint effusion
  - recent corticosteroid injection to involved tissue
  - specific to certain surgeries
  - hypermobile segment
- Precautions: known or suspected osteoporosis, elderly patients, newly united # must be protected, vigorous stretching of recently immobilized tissue, avoid stretching edematous tissue
- Prescription: slowly applied, low intensity stretch (comfortable), 30-60 seconds static duration, 2-4 reps, at least once per day * can be self, mechanical, therapist assisted, etc

PNF (proprioceptive neuromuscular facilitation)
• requires normal innervations and voluntary control of either shortened muscle or it’s opposing muscle (relaxes contractile structures)

• **Types:**
  - **Hold-relax:** target muscle passively lengthened, isometric contraction of target muscle (6-10 secs) then relax and passively move into new range
  - **Agonist-contract:** target muscle passively lengthened, concentric contraction of opposing muscle (antagonist) hold 5-10 seconds, relax and passively move into new range
  - **Hold-contract agonist contract:** target muscle moved passively into lengthened position, isometric contract of target muscle then relax and concentric contraction of antagonist muscle

**FITT PARAMETERS**

**Strength:** >85% of 1RM, <6 reps, 2-6 sets, 2-5 min rst

**Power:** 75-90% of 1RM, 1-5 reps, 3-5 sets, 2-5 min rest

**Hypertrophy:** 67-85% 1 RM, 6-12 reps, 3-6 sets, 30-90 second rest

**Endurance:** <67% of 1 RM, > 12 reps, 2-3 sets, < 30 second rest

**PROM/AAROM:** 10-20 reps, 1-2 sets, 1-2 times per day, everyday, into available ROM (joint stiffness should be limiting factor not muscle tightness)

**Stretching:** 2-3 sets, 30 second hold, at least 1 per day if not multiple times per day

**02.02.04.01.02 Joint mobilization**

• Accessory joint motions:
  - occur naturally during active movement
  - required for proper osteokinematics and arthokinematics (distraction, compression, roll, spin, glide)

• **INDICATIONS:** decrease passive movement of joint, early capsular EF, mechanical pain

• **CONTRAINDICATIONS:** #, neoplasm, acute inflammation process, apparent hypermobility or instability in direction of technique, bone/joint infection, spinal cord signs or symptoms, spasm or bony end feel

• **PRECAUTIONS:** impaired circulation or sensation, osteoporosis or compromised health, haemophiliacs, poor skin condition, open wounds, discomfort in treatment position, marked skeletal deformity

• Based on concave/convex rule of arthokinematics (movement at joint surface) and osteokinematics (movement of long bones):
  - if concave surface is moving it will move in the same direction as the long bone, if the convex is moving it will move in the opposite direction of the long bone

• grade based on palpation findings, PIVMs, PAVMs, quality of movement and EF * never mobilize through a spasm EF

• **Grades I- V: Maitland**
  - I - small amplitude movement at beginning of range:
    - with pain before resistance or at resistance (or use traction)
  - II - large amplitude movement from beginning to middle of range (before resistance) usually into R1 when tissues start to tighten (when pain before resistance or at resistance)
  - III - large amplitude movement from middle to end of available range (into resistance) R2 where limitation is usually due to a tight capsule (when you get resistance before pain)
  - IV - small amplitude movement at end of available range into resistance (when you get resistance before pain or resistance and no pain)
  - V - small amplitude high velocity movement at end of available range (when you have resistance and no pain)

**Kaltenborn Grading (sustained)**

i. small amplitude distraction
ii. distraction or glide to take up the slack
iii. distraction or glide to stretch the tissues
- cycle 6-10 second hold

RX:
- 3x 10 second bouts, checking in with patient
- then re-ax active movement, passive (PIVM or PAVM)
- then repeat 2 more times; always re-ax
- warn patient about treatment soreness and temporary after effects

EFFECTS:
- grade 1 and 2: neurophysiological (dec muscle tone, endorphin and enkaphaline release), mechanoreceptor stimulation (pain gaiting), vascular effect (joint nutrition), mechanical effect (mobilize collagen and neuromeningeal tissue, joint lubrication)
- grade 3 and 4: same as grade 1 and 2 plus: greater mechanical effect and enhanced joint lubrication, elongate shortened capsuloligamentous tissue
- grade 5: same as pervious grades but with greater neurophysiological and more mechanical effects, joint cavitation

02.02.04.01.03
Joint manipulation
- only talocrural manipulation

INDICATIONS:
- to restore full ROM at end range of DF and PF when the progressive mobilizations are no longer effective (last 5 degrees)
- to gain last few degrees of DF and PF when a non-capsular limitation of motion is present *
- ALWAYS SUSPECT AN UNDERLYING HYPERMOBILITY AND RE-AX STABILITY

EFFECTS:
- tearing of the scar tissue
- quick stretch to joint capsule
- stim of mechanoreceptors- neurophysiological effects

CONTRAINDICATIONS: fracture, joint instability in direction of manipulation, inflammatory joint disease, malignancy, bone disease, osteoporosis, open wound or skin lesion in area, poor circulation or sensory deficit in the area, spasm or increased pain with test pull, unsure of health or diagnosis, patient doesn’t want to be manipulated (informed consent), patient is on anticoagulants, haemophiliacs, inability of patient to relax, physio factors

CAUTIONS/CONTRAINDICATIONS FOR NOVICE MANIPULATORS: pain or instability proximally in the lower kinetic chain, uncertainty about indications of technique, children (skeletal maturity), diabetics, elderly, positive straight leg raise (for talocrural manip) on effected side

FOLLOW –UP RX: ROM exercise (assuming joint is stable), post – treatment soreness can occur (suggest use of ice), balance, proprioception, strength, protected function, taping/bracing if joint is unstable

02.02.04.01.04
Soft tissue techniques
DTFM:
• PURPOSE → To maintain/regain mobility, prevent scar tissue adhesions, create hyperemia (inc blood flow), create analgesia
• EFFECTS → Hyperemia, mechanical stress to break adhesions and align collagen, mechanoreceptor stim and dec pain
• RX → 2-3 cycles per second, at least 3 minutes (or until numbing effect occurs) → 5 minutes, literature says 10-20 minutes, find lesion, friction perpendicular to tissue
• muscle is only done when subacute (5-10 days+) or chronic, tendon and ligament can be done in acute to chronic
• MUSCLE → have muscle belly relaxed, follow with active contractions in inner range
• LIGAMENT/TENDON → have on pain free stretch, f/u with exercise
• CONTRAINDICATIONS:
  o Infection
  o skin breakdown
  o ossification/calcification
  o CT or inflamm joint disease
  o neural irritation
  o bursitis, recent local injection
  o long term steroid
  o anticoagulant or anti inflammatory drug use
• PRECAUTIONS: elderly, children, diabetes (dec sensation)

02.02.04.01.05
Fitness/conditioning/endurance exercise programs
Metabolic Syndrome → >3 diagnostic criteria:
  o inc blood pressure, fasting blood glucose, waist girth, triglycerides, dec HDL

02.02.04.01.06 Functional activity training
• PURPOSE:
  o isolate deficits in muscle performance, compensatory movement, give athlete psychological reassurance, determine the presence of pain
  o do as part of prescreening, in rehab process, and before return to sport
• THINGS TO CONSIDER
  o stage of healing (not during acute), ROM, strength/power/endurance, neuromuscular control, proprioception, core control, prophylactic taping/bracing/padding, responsibilities of the athlete
• CONTRAINDICATIONS:
  o persistent joint effusion
  o joint instability
  o poor motor control
  o lack of ROM
  o muscle length and appropriate muscle strength and power (at least 90%)
• CRITERIA FOR RETURN TO PLAY:
  o abolition of acute SSx, full AROM and PROM of joints involved, adequate muscle strength, power and endurance (90%). Correct movement mechanics, adequate cardiorespiratory fitness, have successful completed progressive functional tests, psychologically ready
• CONCEPTS:
  o load, stability, velocity, direction changes, test environment, correct movement mechanics throughout, energy systems

02.02.04.01.08 Positioning - cardioresp section

02.02.04.01.07
Posture training
→ lengthen what’s tight, strengthen what is weak
→ down grade activation in muscles that aren’t supposed to be firing
correct muscle imbalance or postural faults?

02.02.04.01.09 Gait/mobility education and training with or without equipment

WALKERS: increase balance and relieve WB, most stable device, bad for small spaces or going up stairs, can get no wheel, 2 or 4 wheel; measurement: stand inside, handles to wrist crease or 20-30 degree elbow flexion holding the handles

CANE - widen base of support, help balance, least stable type of aid, measurement: cane parallel to leg with tip in line with ankle, hand position as per walker

QUAD CANE - not that good for stairs

CRUTCHES - help with lateral stability and improve balance (inc BOS), helps dec WB; measurement: have distal end 2 inch lateral and 6 inch in front anterior to foot , hands placed as per walkers

FOREARM CRUTCHES - allows for use of hands, but need more arm strength to use, usually used in more higher functioning patients or may or may not use them for longer term use; measurement: cuff on prox 1/3 of forearm, 1-1.5 inches below elbow

NORMAL GAIT: stance 60%, swing 40%
- WB can be non-wb, feather (wouldn’t break an egg under foot), partial (~50% of total WB), weight bearing as tolerated (usually without any undue discomfort, 50-90 % total body weight)

STEP TO, or STEP THROUGH, can be done with CRUTCHES OR WALKER

4 POINT GAIT – 3-4 points of support on ground at all times;
- 1 aid advanced, then opposite LE advanced, can be done with CRUTCHES OR CANES, slow stable gait

2 POINT GAIT - similar to 4 point only 2 points of contact maintained at all times, less stable, req better balance CRUTCHES OR CANES
- one leg and contralateral aid advance at same time
  - ex. R cane and L leg together, then L cane and R leg together

3 POINT GAIT - 3 points of support on floor
- NWB, PWB (<80% cant use CANE), FeWB on affected LE
- pt1) affected LE advanced, pt2) wt transferred to floor through aid (both crutches at the same time or walker), pt3)unaffected leg advanced, and wt returned to unaffected leg

02.02.04.01.10 Neurodynamic techniques
- do not assess or treat if hard neurological signs
- do assess if peripheral conduction signs are present but be careful,
- do not treat if peripheral conduction signs are present
- CONTRAINDICATIONS:
- undiagnosed condition
- conditioning worsening
- severe irritably
- presence of hard neurological signs

• can do with both slump and SLR → PKB: tests L2-L4; SLR: L4/5-S2

• INITIAL TREATMENT → think sliders (both ends are moving) then go to tensioners (one side is not moving)
  - start movement at remote area and indirect Rx (tx interface)
  - then move proximal area with or without mobilization of interface
  - go further into resistance, don’t provoke pain (just moderate stretch)
  - add repetitions

02.02.04.01.11 Balance training/propiroceptive training
  • proper core and pelvic control?, start double leg support to single leg support, eyes opened and eyes closed, on flat ground and on solid ground, increase levers, perturbations, whole body movement, expected and anticipatory

02.02.04.01.12 Sensory training (e.g., desensitization, protective education, sensory integration)
  • desensitization → lots of education on how pain becomes chronic and how you get allodynia or hyper/hypo-algesia
  • talk to interprofessional team about medications (pharmacist)
  • appropriate exercises that increase stimulus but not too rapidly or to cause more damage
  • mirror therapy very good (CRPS, amputations)
  • compression/support ?
  • start with soft fabrics, move to more rough fabrics to get sense to change of sensation, contrast baths
  • sterogenesis: sensory and motor integration
  • WITH ALL: they need to watch, connect sensory and motor and make it salient for the individual
  • JOINT PROTECTION: if amputation (see section), educate on areas where they may get injured, how to change/modify movements or their set up

02.02.04.01.14 Mechanical agents (e.g., traction, continuous passive movement, compression garment and devices, vasopneumatic devices)

TRACTION:
- Separation of vertebral bodies, increased IVF diameter, mobilization of the z joints (distraction and gliding), flattening of spinal curves, mechanoreceptor stimulation/pain inhibition, decreased muscle spasm, mobilization of muscle and CT, improved circulation (blood and lymph)
- TYPES: manual, mechanical, traction using gravity, traction by positioning, autotraction
- INDICATIONS: joint dysfxn (hypomobility), degeneration (associated hypomobility), nerve root compression or disc pathology, pain (effect on mechanoreceptor)
- CONTRAINDICATIONS: acute, patient can’t tolerate the traction position, bad response to manual traction, recent surgery, underlying hypermobility or instability, malignancy, SSX of spinal cord or cauda equina compression, vascular compromise additional for cervical: Ssx VBI, TMJ dyfxn, RA, down syndrome, cervical myelopathy, glaucoma,
- PRECAUTIONS: pregnancy, respiratory problems, osteoporosis, spondylolisthesis, hypermobility/instability, claustrophobia, extremely restricted ROM, little improvement with rest
* ALWAYS CHECK VBI, NEUR TEST, NEUROMOBILITY AND CONDUCTION, STABILITY
- forces that are required are usually 10-20 % of body weight, do manual first then if good responses for 2-3 sessions then put on mechanical

COMPRESSION GARMENT: make sure proper fit, instruct pt to put on properly, ensure pressure is greater distal then proximal, education on signs of too much pressure (cold, swelling, pain, capillary refill on toes 2-3 seconds normal?), instructed them to look for any wrinkles in garment to prevent pressure areas

02.02.04.01.15 Conductive thermal agents (e.g., contrast baths, whirlpools, paraffin wax, hot packs, ice/cold)
  • Major source of heat gain = metabolism (also absorption of radiation from environment, etc.)
  • Major source of heat loss = radiation (also exhalation, evap. of sweat, urine)
- **Heat**: reduces muscle spasm, relaxes patient, facilitates fine movement and increases ROM and exercise tolerance in some pt
- **Cold**: post op swelling, chronic oedema and joint effusions, dec muscle spasm, dec spasticity, mild cooling enhances muscular isometric contraction and endurance, chronic inflam; both can dec pain
- **Heat/Cold movement in body**: radiation, convection, conduction, evaporation
- greatest effect in tissues is 1-2 mm, after that it’s about a 2 ° celcius change, if you want deeper you have to wait 20-25 mins and you need short wave diathermy or prolonged thermal US
- **BEFORE RX**: test sensation (hot and cold)
- **APPLICATION**:
  - **paraffin** (lower heat capacity, kept usually at 45 + °): dip hands 6 times, wrap in wax paper with glove, leave for 15 min
  - **hot pack**: use 1-2 cm or 4-6 towel between pt skin and hot packs, takes 8 min for skin to reach max temp so do an objective and subjective test then, 15-20 mins duration* never lie on a hotpack (ha!)
  - **contrast baths**: inc blood flow to skin (no real temp change), 37-43 ° and 5-20 ° tub, ratio 4:2, 5:3, 3:1, repeat 3-4x, 15-20 min total
  - **whirlpool**: can also help with wound debridement
- **CONTRAINDICATIONS**: acute inflam, skin conditions (dermatitis), altered thermal sensation, hemorrhagic disease, malignancies, gonads, open wounds, unreliable pt
- **APPLICATION**: → check cap refill
  - **cold packs**: don’t lie on, chip ice better then gel pack for cooling, 15 mins, check at 1 and 5 minutes
  - **cryo-therapy**: monitoring this is key, can be more dangerous then ice
  - **local immersion**: 15-20 mins,
  - **ice towels**: replace every 2-3 minutes, repeat up to 20 minutes
  - **ice massage**: use on small area, dec local pain (5-10 minutes)

Check for allergic reaction to cold after 1 minute and after 5 minutes
- **Dangers/contraindications**:
  - ice burn
  - peripheral nerve damage
  - frostbite
  - reduced peripheral blood supply (can further damage tissue)
  - cold sensitivity (Reynaud’s, cold urticaria)
Electrical agents

**EMG feedback:**
Why? Nerve conduction testing – estimates velocity of depolarization along an alpha motor neuron
- In skeletal muscle, normally silent at rest (short burst of electrical activity during needle insertion)
  - Reduced insertional activity seen in fibrotic or severely atrophied muscle (when put needle in)
  - Increased activity when a muscle is irritable
- **Abnormal electrical activity at rest** suggests neuropathy or myopathy and is indicated by fibrillation potentials (rapid, irregular contractions of muscles), positive sharp waves, or fasciculation potentials
- **Surface EMG** – provides information about muscle activity (in order to uptrain or downtrain activity)
- **Used to:** improve control over defective muscles or improve control over stressed muscles (ex: hemiplegia, SCI, spasticity, dystonia, recovering peripheral nerve injuries)
- Used as a tool not a treatment

**TENS:**
Why? Used for acute and chronic pain, muscle twitch, muscle strengthening and spasticity mgnt
- have segmental mechanism gating at spinal cord (conventional setting) OR extrasegmental mechanism (release of opioid and serotonin receptors)
- **PLACEMENT:** right over area of pain in best
- **RX:** conventional: 8-150 Hz, 60 microsecond, to comfortable tingle modulated or not, 30 min; acupuncture like: 200 microseconds, 10 Hz, muscle twitch, on motor point/myotomal, 40 min to 1 hr
- **Contraindications:**
  - electronic devices
  - low back or ab of pregnant woman
  - malignancy
  - DVT or thromboembolis
  - infected tissue (tb)
  - impaired sensory awareness
  - cognitive or communication impairments
  - cardiac disease or arrthymias

**NMES:**
Why? Can be used for pain, produce muscle twitch, inc muscle strength, spasticity mgnt
- **PAIN:** settings for pain are like TENS
- **EDEMA MNGT:** over extraarticular edema, 5-10 Hz, 200 microseconds, motor intensity to twitch
- **MUSCLES STRENGTHENING:** >35<65 Hz, intensity to tetany, rise and fall (usually nice to have a 2 sec ramp and 1 sec off with a 6 sec contraction = 9 sec total), on/off depending on strength of muscle (I: 1:5 III: 1:3 IV: 1:1) 12-15 contractions per second
- **Contraindications:**
  - electrical devices
  - pregnancy ANYWHERE
  - active DVT or thromboembolis
  - infected tissue
  - chest with cardiac disease or arrthymias or heart failure
  - neck or over eyes
  - impaired circulation
  - unstable (recent surgery, osteoporosis, #)
  - intercostal muscles, lower abdomen

**Interferential Current:**
• WHY? Used for pain, edema, increases blood flow, muscle stimulation (really not effective)
  • Low voltage, medium intensity, 2 sinusoidal waves – alternating current
    o Each wave = slightly different frequencies and interfere with one another in tissues creating new
      wave (linear super-position) that varies in shape, frequency, and amplitude
    o Series of wave packets (beats)
  • Balanced, symmetrical, biphasic, amplitude modulated, pulse duration 250 usec, phase duration 125
    usec
  • Can output 50-90mA (other machines = much lower) – NO THORACIC APPLICATION OVER 50mA
    o Motor = 1-10Hz
    o Sensory (pain) = 80-150Hz,
    o Motor + Sensory = 80-150 Hz for both
  • Tx time: 20-40mins
• CONTRAINDICATIONS:
  o thoracic application
  o electronic devices
  o malignancy
  o low back or abdomen of pregnant women
  o DVT of TE, active bleed or infection
  o recently radiated tissue
  o impaired sensory awareness
  o seizures, gonad, eyes, neck
  o open wounds
• Precautions:
  o active epiphysis in children, skin disease, impaired circulation, fragile skin(elderly if suction cup)

HVPC:
High voltage, high peak intensity (current), low average intensity
• Monophasic (can build up a bigger net charge)
  • Frequency = 1-200Hz, pulse width fixed (5-65microsec.), peak current is high (higher risk of burning), but
    long interpulse interval so charge has a chance to dissipate allowing safer application (total current is
    very low)
• MAINLY USED FOR: decreased pain, decreased edema, increased wound healing, muscle stim.
  o (enhances oxygenation, blood flow and tissue formation)
• High voltage = more comfortable & large punch (better @punching away/bringing in molecules
• TX:
  o PAIN = same parameters as TENS, not any better then
  o WOUND HEALING = 50-100Hz (submotor), 30-60 mins, 3-7 days/wk, polarity based on stage of
    healing
    ▪ macrophages/epidermal cells/epithelial cells all neg , fibroblasts positive
    ▪ one electrode in wound, one 10-20cm away
  o (subacute) EDEMA REDUCTION = 5-20Hz (want twitch, usually start at negative polarity
    ▪ active red on edema (set as negative – pushes away +ve proteins) OR put it on muscle
      twitch on motor point & nerve trunk (chronic)
  o MUSCLE STIM = 35-65Hz,
• Galvanotaxis – can repel molecules or attract desired cells based on polarity
• CONTRAINDICATIONS:
  o the usual
  o transcranially
  o person with cognitive or communication difficulty
  o impaired circulation
  o Inflammation (don’t want to add energy to injury)

IONTOPHORESIS –Rx method using current flow btw 2 electrodes to push ions through the skin barrier
• Current is direct current
• Positively charged drug can be made to cross the skin away from positive electrode (anode)
  o under anode → possible acidic rxn → skin hardening over time (sclerotic)
  o under cathode → possible alkaline reaction (softening and burning of skin)
• Keep the cathode larger (current density is therefore lower and skin is less likely to burn)
  o MD ALWAYS PRESCRIBES THE DRUG!!!
• current density is limited to 1.0 mA/cm² under anode and 0.5 mA/cm² under cathode
• USED FOR:
  o hyperhidrosis, MSK inflammatory disorders, plantar fasciitis, TMJ disorders, ischemic skin ulcer, fungal infections, bursitis and tendonitis
• CONTRAINDICATIONS
  o over damaged skin or open lesions
  o allergy to therapeutic ions
  o impaired sensation
  o over electric implants

02.02.04.01.17 Electromagnetic energy agents
Short Wave Diathermy
• Therapeutically heat body tissues at any depth
• 2 types of electromagnetic fields producing the heat (electrostatic and electromagnetic) –
  o thermal and non-thermal effects
• Physiological effects of pulsed SWD: increased tissue healing, enhance nerve regeneration, pressure ulcers, chronic low back pain, soft tissue injuries (some evidence it can be used for pain, muscle spasm, chronic inflammation, delayed wound healing, chronic infection)
• 2 main INDICATIONS FOR APPLICATION = OA and ankle sprain
• DOSAGE IS BASED ON
  o Sensation → want moderate heat (20-30 min)
  o Tissue healing phase
• Contraindications (main) → metallic implants & pacemakers (implanted devices)
• Can get burns (unequal spacing, perspiration, etc.) – patient should just feel mild, comfortable warmth

LASER **eyewear
• 3 features of a laser:
  o Monochromaticity (all photons have a single wavelength)
  o Coherence (all photons travel in same phase and direction)
  o Collimation (minimal divergence over distance)
• Used to increase tissue healing, decrease pain, decrease inflammation (wound management)
• Laser head → based on depth of lesion (red-near infrared = 1-5mm; near-mid infrared = 5-10mm)
• Dose: acute = 2J/per point; chronic = 4 J/per point (look at WALT)
• Frequency: acute = <1000kHz; chronic = >1000kHz
• Continuous or pulsed (laser lasts longer)
• Contact or noncontact (scanning/grid)
• CONTRAINDICATIONS:
  o Eyes
  o Malignancy
  o low back or abdomen of preggo women
  o hemorrhage or severe vascular disease
  o tissue effect by TB or bacteria
  o reproductive tissue
• Precautions: recently radiated tissue, infected regions, anterior neck, photosensitivity, cognitive impairments

UV
• TREAT: psoriasis, eczema, vitilago, pruritus (secondary to liver/kidney disease), acne, photodermatoses, wound healing, atopic dermatitis
- **Dosage based on MED**: then start at 70% then work up by 5-10 % as tolerated (combo of UVB and UVA)
- **CONTRAINDICATIONS** = photosensitivity, skin cancer, and CT disorder (be aware of drugs causing photosensitivity)
  - On eyes → can cause conjunctivitis or photokeratitis (inflammation of cornea) – cataracts are caused by chronic exposure to UV

02.02.04.01.18 **Acoustic agents** (e.g., ultrasound)
- Sound waves
- Maintain contact and keep head moving and perpendicular to tissue
- **Used for:**
  - **thermal effects**: decreased pain, decreased joint stiffness, improved blood flow, promote healing (decreases inflammation)
  - **non-thermal effects**: wound healing, inflammation and soft tissue healing, altered scar tissue formation, stim of collagen synthesis, angiogenesis, repair of articular cartilage
- **Parameters:**
  - frequency 1MHz (deep) and 3MHz (superficial)
  - intensity (0.5W/cm² acute and 2 W/cm² = high for chronic while 1-1.2 W/cm² = moderate for chronic)
  - pulsed (acute) and continuous (chronic)
  - acute = 5-10mins, chronic = 20 minutes
  - pulse ratio: 1:1 to 1:8
- **Apply to area not larger than 2-2.5xERA** (ERA = area producing 5% or more of max. power output – higher = better)
- **CONTRAINDICATIONS**: implantable devices, malignancy, bleeding disorder, infection, DVT, don’t use on Medtronic stimulation system, myositis ossification, #, the usual ones, impaired circulation and sensation,
- **PRECAUTIONS**: spinal cord or superficial nerves, regenerating nerves, epiphyseal plate unfused

02.02.04.01.19 **Protective, adaptive, or assistive devices** (e.g., tape, splints, orthotics, prostheses)
- **Tape**: used for proprioceptive feedback, warning to stay out of posture, to maintain biomechanical gains of treatment, provide external stability; always check allergies to tape/product, keep on for 2-3 days then take off, take off if inc pain, red, itchy
- **Splint**: as above, use more in acute phase or prophylactically for return to play
- **Orthotics**: used as support for structure or off loading, are the imbalances or biomechanical faults flexible or static? Can they be corrected with exercises?
- **Prostheses** * see amp section

02.02.04.02 **Recognize and respond to the adverse effects of intervention** (e.g., pain, deterioration in client status) and/or non-adherence

**SIGNS OF OVERTRAINING**: increased pain that does not resolve within 12 hours, pain that increases over the previous session or comes on earlier in the subsequent exercise session, increased warm and swelling or redness in the area of injury, dec ability to use the involved area

* cervical scan* lumbar spine scan* special tests for all associated areas*