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- Increased ICP
    - Causes:
        - infections
        - tumors
        - stroke
        - aneurysm
        - epilepsy
        - seizures
        - hydrocephalus, which is an accumulation of spinal fluid in the brain cavities
        - hypertensive brain injury, which is when uncontrolled high blood pressure leads to bleeding in the brain
        - hypoxemia, which is a deficiency of oxygen in the blood
        - meningitis, which is inflammation of the protective membranes around the brain and spinal cord
    - Manifestations:
        - Early:
            - Changes in LOC
            - Any change in condition
            - Restlessness, confusion, increasing drowsiness, increased respiratory effort, purposeless movements
            - Pupillary changes and impaired ocular movements
            - Weakness in one extremity or one side
            - Headache: constant, increasing in intensity, or aggravated by movement or straining
        - Late:
            - Respiratory and vasomotor changes
            - VS: Increase in systolic blood pressure, widening of pulse pressure, and slowing of the heart rate; pulse may fluctuate rapidly from tachycardia to bradycardia; temperature increase
            - Cushing's triad: bradycardia, hypertension, bradypnea
            - Projectile vomiting
            - Further deterioration of LOC; stupor to coma
            - Hemiplegia, decortication, decerebration, or flaccidity
            - Respiratory pattern alterations including Cheyne-Stokes breathing and arrest
            - Loss of brainstem reflexes: pupil, gag, corneal, and swallowing
    - Pharmacologic treatment:
        - Mannitol

        - Dexamethasone
        - Barbiturates
        - Propofol
        - Fentanyl
    - CPP
        - What is it, what is a normal value?
        - CPP (cerebral perfusion pressure) is closely linked to ICP
        - CPP = MAP (mean arterial pressure) – ICP
        - Normal CPP is 70 to 100
        - A CPP of less than 50 results in permanent neurologic damage
    - Cushing's triad:
        - Hypertension
        - Bradycardia
        - Bradypnea
- Methods for keeping ICP within normal limits
    - Nursing interventions:
        - Head of bed 30
        - No coughing, bending over, sneezing
        - ICP pressure monitoring
        - Use of Mannitol
    - *Must know normal ICP*
        - 10-15
- ABC prioritization
- Altered LOC
    - Diagnostic tools:
        - Depends on the underlying cause of AMS
        - Dehydration (urine, sodium, electrolytes), recent fall (MRI, CT)
    - Manifestations:
        - Is not oriented
        - Does not follow commands
        - Needs persistent stimuli to achieve a state of alertness
    - Causes:
        - AEIOU TIPS:
            - **A**lcohol or AAA
            - **E**pilepsy, hepatic encephalopathy
            - **I**nsulin (hypoglycemia)
            - **O**piates or overdose
            - **T**rauma, temperature (hypothermia, hyperthermia)
            - **I**nfections (sepsis, meningitis)
            - **P**sychogenic, pulmonary embolism, poisoning
            - **S**pace occupying lesions, stroke, shock, seizure
        - I WATCH DEATH:
            - **I**nfection
            - **W**ithdrawal
            - **A**cute metabolic causes
            - **T**rauma

- **C**NS causes
- **H**ypoxia
- **D**eficiencies (nutritional)
- **E**ndocrinopathies
- **A**cute vascular causes
- **T**oxins or drugs
- **H**eavy metals

- GCS
  - Scoring:
    - Eye opening (E): best eye response
      - 4= eye opening occurs spontaneously
      - 3= eye opening occurs to sound
      - 2= eye opening occurs secondary to pain
      - 1= eye opening does not occur
    - Verbal (V): best verbal response
      - 5= conversation is coherent and oriented
      - 4= conversation is incoherent and oriented
      - 3= words are spoken but inappropriately
      - 2= Sounds are made, but no words
      - 1= vocalization does not occur
    - Motor (M): best motor response
      - 6= commands are followed
      - 5= local reaction to pain occurs
      - 4= general withdrawal to pain
      - 3= decorticate posture (flexion of elbows & wrists)
      - 2= decerebrate posture (extension of elbows & wrists)
      - 1= motor response does not occur
- Stroke
  - Hemorrhagic
    - Manifestations, signs/symptoms :
    - sudden severe headache
    - vision changes
    - loss of balance or coordination
    - becoming unable to move
    - numbness in an arm or leg
    - seizures
    - loss of speech or difficulty understanding speech
    - confusion or loss of alertness
    - nausea and vomiting
    - loss of consciousness
    - trouble swallowing
    - loss of bladder control

        - high blood pressure
- Right versus left hemisphere
    - Manifestations of each:
    - Right Hemisphere:
        - Trouble remembering, impulsive behavior, or mood changes
        - Trouble paying attention or solving problems
        - Paralysis or weakness on the left side of your body
        - Trouble walking, or falling toward your left side
        - Not knowing how close an object is to your body
        - Lack of awareness of the left side of your body
        - Trouble swallowing, speaking, reading, writing, or understanding language
        - **Agnosia**: You may not be able to recognize objects, faces, voices or places.
        - **Anomia**: You may not recall the names of everyday objects.
        - **Attention span**: You may be unable to focus attention on a conversation or tasks for long periods of time.
        - Left-sided weakness or paralysis and sensory impairment
        - Denial of paralysis or impairment and reduced insight into the problems created by the stroke (this is called "left neglect")
        - Visual problems, including an inability to see the left visual field of each eye
        - Spatial problems with depth perception or directions, such as up or down and front or back
        - Inability to localize or recognize body parts
        - Inability to understand maps and find objects, such as clothing or toiletry items
        - Memory problems
        - Behavioral changes, such as lack of concern about situations, impulsivity, inappropriateness, and depression
    - Left hemisphere:
        - Trouble swallowing, walking, or remembering
        - Paralysis or weakness on the right side of your body
        - Falling toward your right side
        - Lack of awareness of the right side of your body
        - Trouble speaking, reading, writing, or understanding language
        - Changes in mood or the ability to pay attention or learn new information
        - Right-sided weakness or paralysis and sensory impairment

        - Problems with speech and understanding language (aphasia)
        - Visual problems, including the inability to see the right visual field of each eye
        - Impaired ability to do math or to organize, reason, and analyze items
        - Behavioral changes, such as depression, cautiousness, and hesitancy
        - Impaired ability to read, write, and learn new information
        - Memory problems
    - Thrombolytic therapy
        - Indications and contraindications:
        - Exclusion criteria
            - Stroke or head trauma in the previous 3 months
            - Previous intracranial hemorrhage
            - Intracranial neoplasm, AV malformation, or aneurysm
            - Recent intracranial or intraspinal surgery
            - Arterial puncture at a non-compressible site in the previous 7 days
            - Symptoms suggestive of subarachnoid hemorrhage
            - Persistent BP elevation (SBP >185 or DBP >110)
            - Active internal bleeding
            - Age >80
            - Oral anticoagulant use regardless of INR
            - Severe stroke (NIHSS score >25)
        - Inclusion criteria
            - Clinical diagnosis of ischemic stroke causing measurable neurologic deficits
            - Onset of symptoms <4.5 hrs before beginning treatment; if exact time not known it is defined as the last time the client was known to be normal
            - Age >18
- Methods of communication:
    - Speak slowly.
    - Use short, simple sentences.
    - Pause between sentences to give them one time to "digest" what you have said.
    - Give your loved one directions, questions or pieces of information one at a time.
    - Talk about things one can see. Use photos, hand movements or facial expressions.
    - Write down any request you have. This way he or she can read what you are asking.
    - Watch for signs they understand you. Repeat or rephrase what you are saying if needed.

        - Do not ask patient to talk and do another task at the same time.
        - Try not to switch topics too quickly or often.
        - Keep conversations short and to the point.
        - Be patient.
        - Do not interrupt. Give your loved one at least 30 seconds to respond. Try to look relaxed while you wait.
        - "I am not understanding you." When you don't understand someone
        - Using a communication board where they can write down or point to what they want.
- SCI
    - Autonomic dysreflexia interventions :
        - Autonomic dysreflexia
            - Occurs secondary to SNS stimulation and inadequate compensatory response by the PNS
            - Clients who have lesions below T6 do not experience dysreflexia
            - Stimulation of SNS → causes extreme HTN, sudden severe HA, pallor below the level of the spinal cord's lesion dermatome, blurred vision, diaphoresis, restlessness, nausea, and piloerection
            - Stimulation of PNS → bradycardia, flushing above the corresponding dermatome, and nasal stuffiness
    - Risk factors :
        - Male clients age 16-30
        - high risk activities (extreme sports or high speed driving)
        - participation in impact sports
        - acts of violence (GSW or knife wounds)
        - alcohol or drug use
        - disease (metastatic cancer or arthritis of spine)
        - falls (especially older adults)
    - PHYSICAL ASSESSMENT FINDINGS:
        - Inability to feel light touch when touched by a cotton ball, inability to discriminate between sharp and dull when touched with a safety pin or other sharp objects
        - Absent deep tendon reflexes
        - Flaccidity of muscles
        - Hypotension that is more severe when the client is in sitting upright position
        - Shallow respirations
        - Spinal shock, a complication of spinal cord injury, causes a total but temporary loss of all reflexive and autonomic function below the level of the injury, lasting for a period of days to weeks
- Head injuries:
    - Epidural hematoma
        - Manifestations:
            - EMERGENCY SITUATION

        - Patient may have a brief loss of consciousness with return of lucid state; then as hematoma expands, increased ICP will often suddenly reduce LOC
    - Subdural hematoma
        - Manifestations:
            - Collection of blood between the dura and the brain
            - Acute or subacute
                - Acute: symptoms develop over 24 to 48 hours
                - Subacute: symptoms develop over 48 hours to 2 weeks
                    - Requires immediate craniotomy and control of ICP
                - Chronic
                    - Develops over weeks to months
                    - Causative injury may be minor and forgotten
                    - Clinical signs and symptoms may fluctuate
                    - Treatment is evacuation of the clot
    - Basal Skull Fracture
        - Nursing interventions:
            - CSF leakage from nose and ears can indicate **basilar skull fracture** ("halo" sign: yellow stain surrounded by blood on a paper towel; **fluid tests positive for glucose**)
        - Support family → if brain death consider whether or not to donate organs
        - Assess/monitor the client at regularly scheduled intervals:
        - Respiratory (priority assessment)
        - Cranial nerve function
        - Assess pupils (PERRLA)
        - Bilateral sensory and motor responses
        - If increased ICP:
        - Elevate HOB at least 30 degrees (promote venous drainage)
        - Avoid extreme flexion, extension, or rotation of head, maintain the body in a midline neutral position
        - Maintain patent airway
        - Administer O2 to keep PaO2 >60
        - Consider hyperventilation to decrease ICP
        - Maintain c-spine stabilization
        - Maintain safety and seizure precautions
- Craniotomy
    - Post-op monitoring/identifying signs of complications:
        - Removal of nonviable brain tissue that allows for expansion and/or removal of epidural or subdural hematomas
        - Also used to decrease ICP and remove brain tumors; involves drilling a burr hole or creating a bone flap to permit access to the affected area

        - This is a life-saving procedure, and is associated with many potential complications, such as a severe neurological impairment, infection, persistent seizures, neurological deficiencies
        - Nursing Actions:
            - Goal is to decrease cerebral edema; medications such as mannitol and dexamethasone can be administered every 6 hrs for 24-72 hrs postoperatively
            - Monitor ICP; If elevated, requires intervention
- Meningitis
    - Nursing interventions:
        - Place patient of seizure precaution and droplet
        - Keep a quiet environment
        - No bright lights
        - If patient had lumbar puncture they need to remain supine for 6 hours
    - Pharmacologic treatment options:
        - Penicillin's
        - Ceftriaxone
        - Cefotaxmine
    - Prophylactic treatment if exposed:
        - Rifampin
        - Ciproflaxin
        - Minocycline
        - Ceftriaxone
        - spiramycin
- Traction
    - Contrast skeletal versus skin traction
        - Skeletal Traction:
            - Skeletal traction involves placing a pin, wire, or screw in the fractured bone. After one of these devices has been inserted, weights are attached to it so the bone can be pulled into the correct position. This type of surgery may be done using a general, spinal, or local anesthetic to keep you from feeling pain during the procedure.
            - The amount of time needed to perform skeletal traction will depend on whether it's a preparation for a more definitive procedure or the only surgery that'll be done to allow the bone to heal.
            - Skeletal traction is most commonly used to treat fractures of the femur, or thighbone. It's also the preferred method when greater force needs to be applied to the affected area. The force is directly applied to the bone, which means more weight can be added with less risk of damaging the surrounding soft tissues.
            -
        - Skin Traction:

        - Skin traction is far less invasive than skeletal traction. It involves applying splints, bandages, or adhesive tapes to the skin directly below the fracture. Once the material has been applied, weights are fastened to it. The affected body part is then pulled into the right position using a pulley system attached to the hospital bed.

        - Skin traction is used when the soft tissues, such as the muscles and tendons, need to be repaired. Less force is applied during skin traction to avoid irritating or damaging the skin and other soft tissues. Skin traction is rarely the only treatment needed. Instead, it's usually used as a temporary way to stabilize a broken bone until the definitive surgery is performed.
    - Skeletal traction

        - Nursing interventions: Assess neurovascular status of the affected body part every hour for 24 hrs and every 4 hr after that
        - Maintain body alignment and realign if the client seems uncomfortable or reports pain
        - Avoid lifting or removing weights
        - Ensure that weights hang freely and are not resting on the floor
        - If the weights are accidentally displaced, replace the weights; if the problem is not corrected, notify the provider
        - Ensure that pulley ropes are free of knots, fraying, loosening, and improper positioning at least every 8 to 12 hrs
        - Routinely monitor skin integrity and document
        - Use heat/massage as prescribed to treat muscle spasms
        - Use therapeutic touch and relaxation techniques

    - Expected findings of patient:
        - Patient should be free of pain
        - Should be comfortable
        - Should be laying supine
    - Expected findings of traction system:
        - Avoid lifting or removing weights
        - Ensure that weights hang freely and are not resting on the floor
        - If the weights are accidentally displaced, replace the weights; if the problem is not corrected, notify the provider
        - Ensure that pulley ropes are free of knots, fraying, loosening, and improper positioning at least every 8 to 12 hrs
    - Ideal outcomes/goals:
        - Prevent soft tissue injury
        - Realign of bone fragments
        - Decrease muscle spasms and pain
        - Correct or prevent further deformities
- Neurovascular assessment
    - Components of assessment :

        - pulses, capillary refill, skin color, temperature, sensation, and motor function
- When to perform assessment :
    - Perform when they first get admitted to the floor and during every shift
    - Some may need Q2 hours
- Normal versus abnormal findings :
    - Pulses:
        - Assess upper extremity peripheral pulses (brachial, radial, and ulnar) and lower extremity peripheral pulses (femoral, popliteal, posterior tibialis, and dorsalis pedis) bilaterally. Be sure to assess for the presence of pulses distal to any injury.
        - Use a 0-4 point scale (0=absent and 4=strong/bounding), noting also if the pulse is weak, diminished or absent.
        - Use a marker to indicate a pulse palpation site that is difficult to locate; this can help others with their assessment and provide consistency.
        - A manual Doppler scan should be utilized if a pulse palpation site is challenging to find or if the pulse is weak.
        - If palpable pulses are not assessable due to casting, assess all other parameters.
        - Document if a change in the pulse is detected and notify the appropriate health care provider.
    - Capillary Refill:
        - Assess capillary refill by pressing on the nailbeds to evaluate the peripheral vascular perfusion.
        - Note how long it takes for the distal capillary bed to regain its color after pressure has been applied to cause blanching
        - Capillary refill time of two seconds or less is normal for an adult; prolonged capillary refill time can indicate abnormal perfusion. January 2019
        - Capillary refill time can be affected by age, temperature, ambient light, and pressure application
    - Skin Color:
        - Compare the color of the skin bilaterally.
        - Consider the patient's usual skin tone and any skin conditions when performing this assessment; cyanosis can present differently in different skin tones.
        - Pallor or cyanosis may indicate inadequate arterial supply; dusky, cyanotic, mottled, or purple black coloration may indicate inadequate venous return.
        - Shiny and pale skin, suggesting pressure in the affected area, may be a sign of compartment syndrome and requires immediate intervention to prevent vascular compromise that can result in muscle and nerve ischemia
    - Temperature:
        - Use the back of your hands to assess skin temperature bilaterally.

        - Skin should be warm to touch. Cool skin may indicate inadequate arterial supply; warmth may indicate inadequate venous return
    - Sensation:
        - Ask the patient about changes in sensation, such as tingling, numbness (paresthesia), pressure, or burning.
        - A pressure sensory exam often consists of assessing light touch with a cotton swab and assessing temperature discrimination with warm and cold stimuli; pinprick sensation can be tested using the sharp end of a disposable safety pin.
        - If indicated, consider using the 2-point discrimination test.
        - Complaints of numbness or tingling in an extremity should be investigated immediately, with the assessment proximal and distal to the site of injury or surgery (if not precluded by a cast or splint).
        - Nerve involvement, compromised blood flow, or the use of ice can alter a patient's sensory function.
    - Motor:
        - Assess range of motion and strength. The patient's ability to perform specific movements is a key indicator of motor function of specific nerves.
        - Loss of motor function is often a late sign of neurovascular compromise; thus, frequent assessment and careful attention is required to detect these subtle changes in the patient.
    - Pain can also be included in this:
        - Complications can be prevented when pain is identified and treated early.
        - Pain can be caused by sensory nerve damage and/or diminished blood flow.
        - Use a pain assessment tool to assess severity of pain.
        - Note the location, severity, and areas of radiating pain.
        - In sedated patients or those who can’t verbalize information, be aware of non-verbal pain cues including grimacing, guarding, tachycardia, and hypotension.
- Compartment syndrome
    - Risk factors:
        - Usually affects extremities and occurs when pressure within 1 or more of the muscle compartments (an area covered with an elastic tissue call fascia) of the extremity compromises circulation, resulting in an ischemia-edema cycle
        - Pressure can result from external sources, such as a tight cast or a constrictive bulky dressing
        - Internal sources, such as an accumulation of blood or fluid within the muscle compartment, can cause pressure as well
        - **Age.** Although people of any age can develop chronic exertional compartment syndrome, the condition is most common in male and female athletes under age 30.

        - **Type of exercise.** Repetitive impact activity — such as running — increases your risk of developing the condition.
        - **Overtraining.** Working out too intensely or too frequently also can raise your risk of chronic exertional compartment syndrome.
    - Manifestations:
        - Pain
        - Paralysis
        - Paresthesia
        - Pallor
        - Pulselessness
        - Increased **pain** unrelieved with elevation or by pain medication; intense pain when passively moved
        - **Paresthesia** or numbness, burning, and tingling are early manifestations
        - **Paralysis**, motor weakness, or inability to move the extremity indicate major nerve damage and are late manifestations
        - Color of tissue is pale (**pallor**), and nails beds are cyanotic
        - **Pulselessness** is a late manifestations of compartment syndrome
        - Palpated muscles are hard and swollen from edema
        - If untreated → tissue necrosis can result; neuromuscular damage occurs within 4-6 hr.
- Fat embolism
    - Manifestations:
        - Early manifestations:
            - Dyspnea, increased RR, decreased O2sat
            - HA
            - Decreased mental acuity r/t low arterial O2 level
            - Respiratory distress
            - Tachycardia
            - Confusion
            - Chest pain
        - Late manifestations:
            - Cutaneous petechiae (pinpoint-size subdermal hemorrhages that occur on neck, chest, upper arms, and abdomen from blockage of capillaries by fat globules)
            - This is discriminating finding from pulmonary embolism
- ABC- prioritization
- Amputations
    - Complications:
        - Cardiopulmonary complications r/t co-morbid conditions
        - DVT
        - Stump hematoma
        - Infection
        - Need for re-amputation (revision)
        - Phantom limb pain
        - Flexion contracture

- Nursing interventions:
  - ROM exercises and proper positioning immediately after surgery
  - To prevent knee or hip flexion contractures → may elevate extremity for 24-48hrs to reduce swelling/discomfort, then no more elevation
  - Have client lay prone 20-30 min several times a day to help prevent hip flexion contractures
  - Incisional pain
    - Treat w/ analgesics
  - Phantom limb pain
    - Sensation of pain in the location of the extremity following the amputation
    - Related to severed nerve pathways
    - Can be experienced immediately after surgery, up to several weeks, or indefinitely
    - Treat by administering calcitonin, beta-blockers, antiepileptics (gabapentin), antispasmodics (baclofen)
    - Teach client how to push the residual limb down toward the bed while supported on a soft pillow; this helps reduce phantom limb pain and prepare the limb for a prosthesis
  - Prevent post-complications (hypovolemia, pain, infection)
    - Assess surgical site for bleeding
    - Monitor tissue perfusion of end of residual limb
    - Monitor for manifestations of infection and non-healing of incision; infection can lead to osteomyelitis
- Preparing for prosthesis
  - Shrinkage interventions:
    - Wrap the stump, using elastic bandages (figure-8 wrap) to prevent restriction of blood flow and decrease edema
    - Use a stump shrinker sock (easier for the client to apply)
    - Use an air splint (plastic inflatable device) inflated to protect and shape the residual limb and for easy access to inspect the wound
  - Nursing interventions
    - Residual limb must be shaped and shrunk in preparation for prosthetic training