



Certified Pediatric Nurse Review Course: Hematology, Oncology & Immunology

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Objectives

- Discuss normal composition and function of blood
- Discuss conditions that affect the red blood cell
- Discuss conditions that affect the clotting cascade
- Discuss blood product administration and nursing interventions associated with transfusion reactions
- Plan nursing care and interventions for patients with anemia and clotting disorders
- Discuss the most common pediatric cancers
- Plan nursing care and interventions for patients with cancer
- Discuss the psychosocial and palliative care needs of the child and family impacted by cancer
- Discuss death and dying and nursing implications
- Discuss conditions with alterations in white blood cell function and immune functioning
- Plan nursing care and interventions for the child with immune suppression

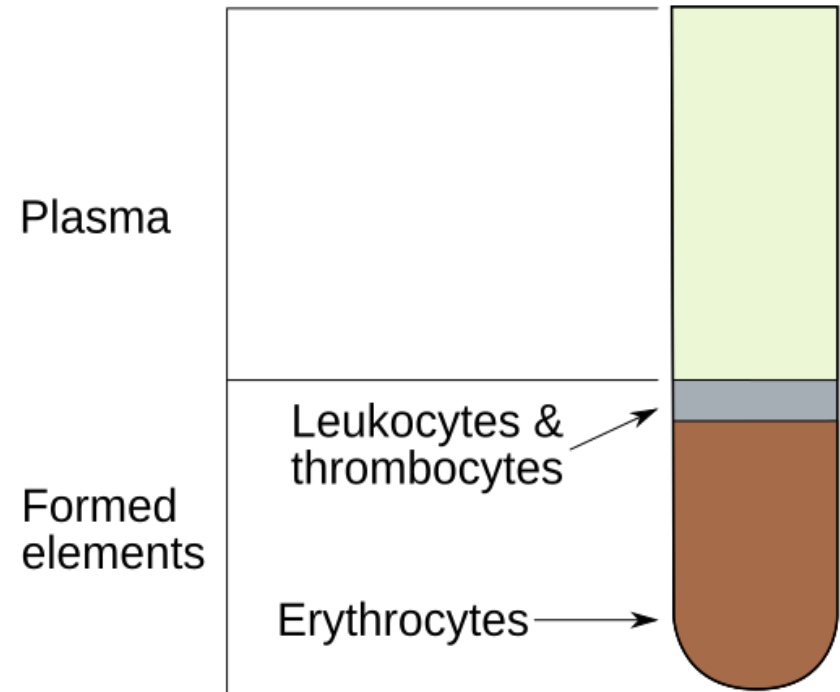


Hematology

Composition and Function of Blood

Blood contributes to the oxygenation of tissues, cellular nutrition, excretion of waste, acid-base balance, body temperature, defense against foreign antigens, & transport of hormones

- Blood composition: **erythrocytes**, **thrombocytes**, and five types of **leukocytes**
 - Formed in the bone marrow from the hematopoietic stem cell
- Blood composition: **plasma**
 - Plasma is primarily composed of water and other solutes



Erythrocytes (red blood cells or RBCs)

- Transport oxygenated hemoglobin from the lungs to the tissues of the body and deoxygenated blood from the tissues to the lungs
- Decreasing levels of oxygen in the tissues (hypoxia) signal the kidneys to produce erythropoietin, which signals the bone marrow to release RBCs
- Normal RBCs live 120 days**
- Hemolysis- RBC dies or is destroyed
- Reticulocytes are immature RBCs
- The number of circulating reticulocytes can indicate if the bone marrow is overproducing (**polycythemia**) or underproducing RBCs (bone marrow suppression).



Hemoglobin (Hgb) and Hematocrit (Hct)

-Hemoglobin F (fetal life) and A (postnatal life)

- **The lowest point of hemoglobin F and A is 4-6 months of age. Infants who are exclusively breast fed need iron supplementation at this time.**

-Normal Hbg levels in children are 11.5 to 14.5 g/dl

- **Anemia is low Hgb count**
 - **Symptom rather than a diagnosis**

-Hematocrit is the % of packed RBCs to whole blood

- Normal Hct levels for a child are 35-45%



Conditions Affecting RBCs

- Anemia-  in the amount, size, or lifespan of RBCs or from a  in the amount of Hgb
- Iron deficiency anemia- iron levels are insufficient in the body, causing RBCs to be small and ineffective at carrying oxygen
- Aplastic anemia- bone marrow's failure to produce RBCs
- b-Thalassemia- impaired production of hemoglobin, which results in a Hgb molecule that is unable to hold oxygen efficiently, is easily destroyed, and has a shortened lifespan
- Sickle cell disease- predominance of abnormal hemoglobin s (HbS)
- Hyperbilirubinemia- high rate of hemolysis of RBCs containing hemoglobin F in the days following birth

Anemia

-Causes:

- **Nutritional deficiencies**
- **Increased RBC destruction**
- **Decreased production by the bone marrow**
- **Decreased erythropoietin release from the kidneys**
- **Blood loss**

-Assessment:

- **Diet history, check urine/stool/emesis for blood**, pulse, respiratory rate, neuro status,

-Interventions:

- **Determine and eliminate cause**
- **Decrease oxygen demands**
- **Hand washing and mouth care**
- **Maintain normal body temperature**

Clinical Manifestations

Acute anemia	Chronic anemia
muscle weakness	growth delay
fatigue	delayed sexual maturation
pallor	increased cardiac output
headache	Increased heart rate/heart murmur
lightheadedness	
Increased heart rate/heart murmur	

Iron Deficiency Anemia

-Causes:

- **Excessive whole milk consumption in a child over 12 months**

-Risk factors:

- Prematurity, infants of a multiple pregnancy, food insecurity, adolescents

-Assessment:

- Dietary history, signs of acute anemia, CBC

-Interventions:

- **Iron supplementation**, dietary changes
 - **Stains teeth, good med reconciliation, stools should be dark black or tarry, keep out of reach of children**



Aplastic Anemia

-Causes:

- Can be congenital, acquired, or idiopathic



autoimmune process, medications,
radiation, benzene

-Assessment:

- Symptoms of anemia, platelet and WBC deficiency
- Bone marrow aspiration

-Interventions:

- Transfusion support
- Immunosuppressive medications
- Bone marrow transplant



b-Thalassemia

-Cause:

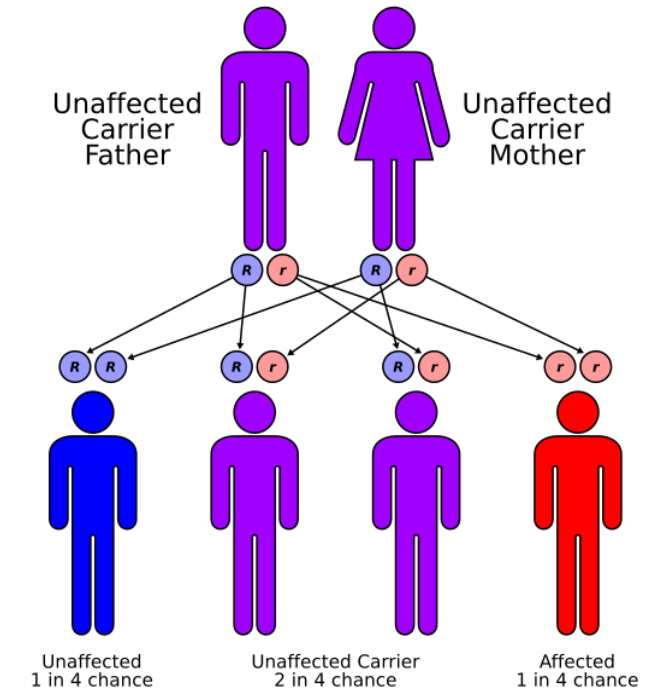
- A child receives a thalassemia gene from each parent

-Assessment:

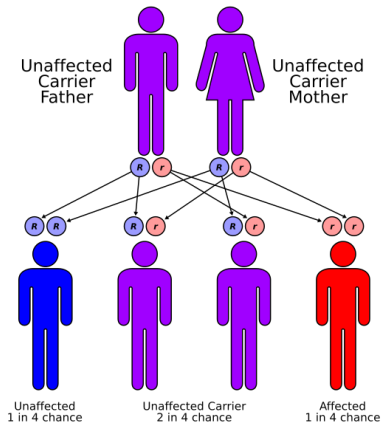
- Chronic hypoxia and exercise intolerance
- **Hemosiderosis** → **hemochromatosis** → **bronze skin & cardiac status**
- **Bone pain**
- Skeletal deformities and frontal bossing (protruding forehead)

-Interventions:

- Transfusions, **iron chelation therapy (deferasirox)**, splenectomy



Sickle Cell Disease



Hemoglobin gene has an abnormal amino acid substitution → Defect in HbS



RBCs containing HbS change to a sickle cell shape after losing oxygen to tissues of the body (in response to dehydration, hypoxia, temperature extremes)



Sickled RBCs are stiff and get trapped in small vessels



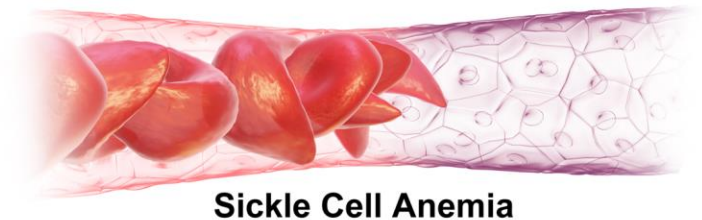
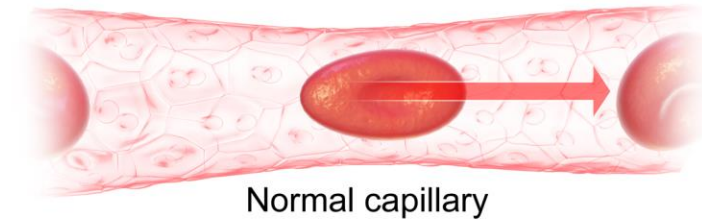
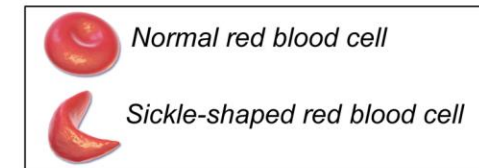
Blood flow is compromised (vaso-occlusion), tissue ischemia, infarction → Pain

RBC lifespan reduced from 120 days to 20 days → Anemia

Sickle Cell Disease

-Assessment:

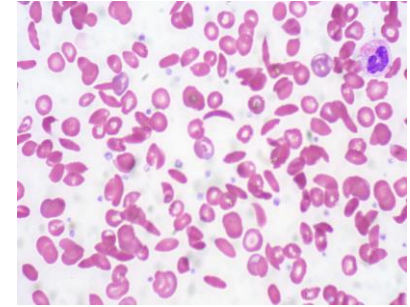
- **Signs and symptoms of anemia**
- **Pain**
- **Dactylitis (hand-foot syndrome) in infants**
- Acute chest syndrome
 - **Pneumococcal pneumonia**
- **Infection**
 - **A temperature of 101.5 or greater requires immediate medical evaluation**
- **Splenic Sequestration**
- Stroke
- **Poor wound healing**



Sickle Cell Disease

-Interventions:

- Supportive Care
- Pain/VOC- nonsteroidal anti-inflammatory drug + opioid,  **hydration, promote oxygenation**, hydroxyurea
- Acute chest syndrome- antibiotic therapy, **pulmonary hygiene**, packed RBCs, I&Os
- Infection- IV antibiotics (**fever requires immediate medical intervention**)
- Splenic sequestration-assess for hypovolemia, administer IV fluids and packed RBCs, splenectomy (**to reduce or eliminate hemolysis and profound anemia, will need to be revaccinated**)
- Stroke- exchange transfusion, maintain circulation and oxygenation, rehabilitation, regular transfusion therapy/chelation therapy, good patient and family education
- Other- **avoid aspirin as it enhances acidosis and promotes sickling, avoid activities that promote sickling**



Hyperbilirubinemia

-Cause:

- A normal process as the liver isn't mature at birth
- High rate of hemolysis of RBCs containing hemoglobin F

-Assessment:

- Jaundice of the skin and eyes
- Indirect bilirubin level
- Neuro status
- Hydration and stooling
- Temperature

-Interventions:

- Initiate phototherapy
 - Reposition frequently, maintain normal body temp and hydration, keep lights at least 12 inches from the infant, protect their eyes, remove infant only for feeding, keep infant naked



Platelets and Normal Clotting Mechanism

- Platelets (thrombocytes)
 - **Live 4-10 days**
 - **Normal values in children 150,000-400,000/mm³**
 - **Cause capillary hemostasis by adhering to the inner service of a vessel and sticking to each other**
 - **Produce a temporary mechanical plug via a process called adhesion when they identify damage to a blood vessel**
- Normal clotting mechanism
 - Prothrombin time (PT) and Partial thromboplastin time (PTT)- how long does it take for blood to clot
 - Thrombin- the time it takes for a blood clot to form after adding thrombin



Conditions Affecting the Clotting Cascade

- Idiopathic/Immune thrombocytopenic purpura (ITP)- acquired disorder that results in the autoimmune destruction of platelets in the spleen
- Hemophilia- X-linked recessive genetic disorders that results from a deficiency in one of the clotting factors
- Venous Thromboembolism (VTE)- blood clot within a deep vein that can compromise blood flow

Idiopathic/Immune thrombocytopenic purpura (ITP)

-Assessment:

- **Petechial rash**
- Bruising, blood in the urine or from gums

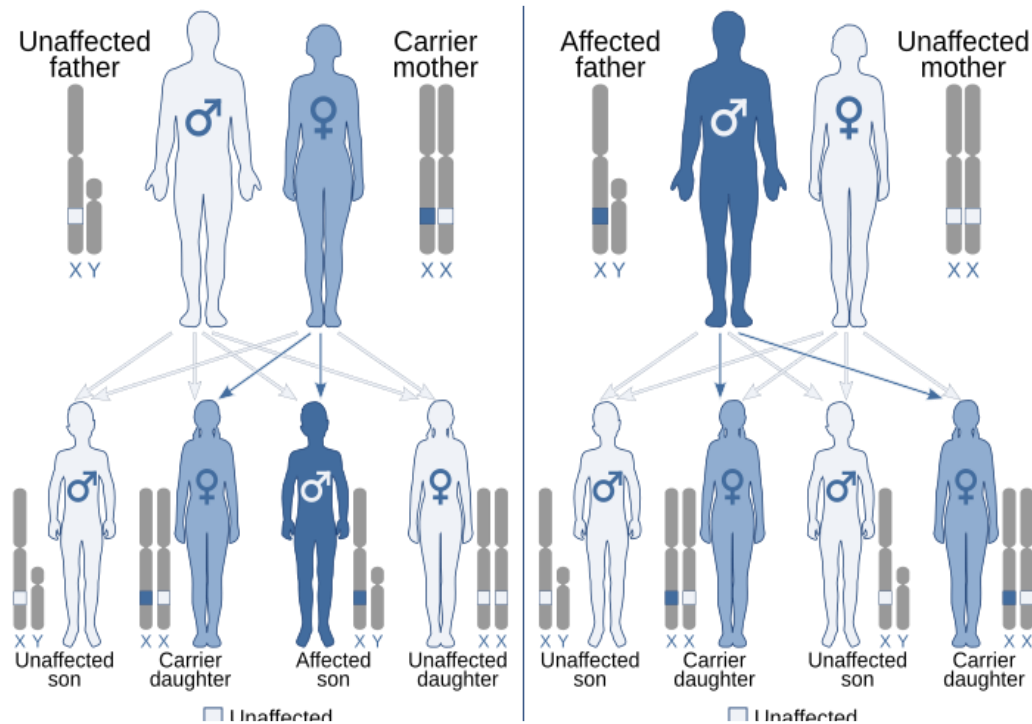
-Interventions:

- May resolve without treatment
- Steroids, IV immunoglobulins (IVIG), anti-D globulin
- Splenectomy
- **Avoid Injections**
- **No aspirin- increases bleeding**



Hemophilia

X-Linked Recessive



-Hemophilia A- factor VIII deficiency or classic hemophilia (most common)

-Hemophilia B- factor IX deficiency or Christmas disease

-Genetics

-Assessment:

- Signs of bleeding
 - **multiple bruises**
 - **hemarthrosis (joint bleeding)**
 - **bleeding of the neck, mouth, and thorax**
 - peripheral neuropathies
 - decreased clotting factor levels and prolonged PTT

Hemophilia

-Interventions to prevent bleeding:

- **Helmet use in toddler with moderate to severe hemophilia**
- **Recommend toothettes and stool softeners**
- **Encourage non-contact activities**
- Discourage weight gain (increases load on joints)
- Factor replacement

-Interventions when bleeding occurs:

- Give factor as soon as possible
- RICE
- **Elevate extremity above the heart**
- **Immobilize site**
- Avoid medications that increase bleeding
- Good assessment

-Interventions for hemarthrosis:

- Give factor as soon as possible
- **Immobilize the affected extremity**
- Promote vasoconstriction- ice and pressure
- Treat pain
- **Avoid excessive movement or weight bearing after bleed**
- Once bleeding has stopped, the joint should be mobilized

Venous Thromboembolism (VTE/DVT)

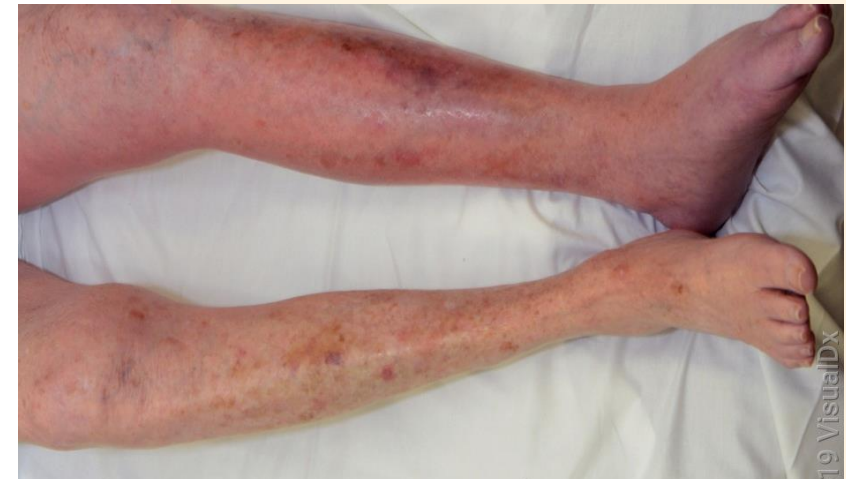
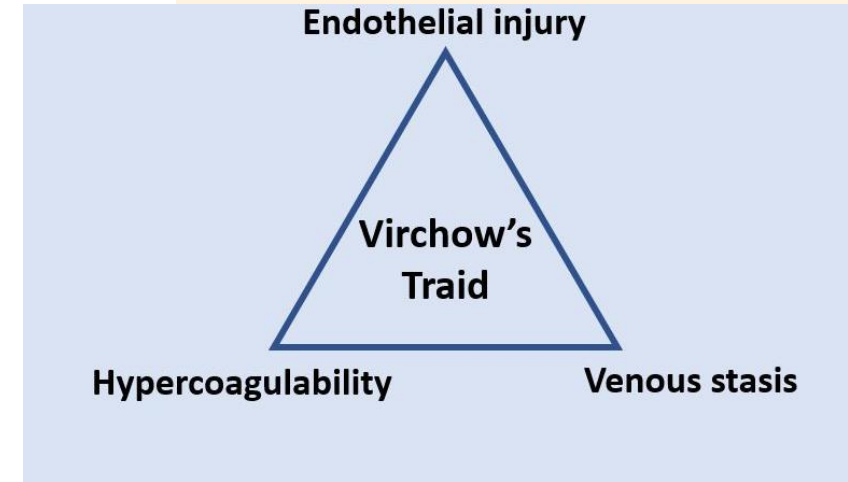
-Risk factors- Virchow's triad

-Assessment:

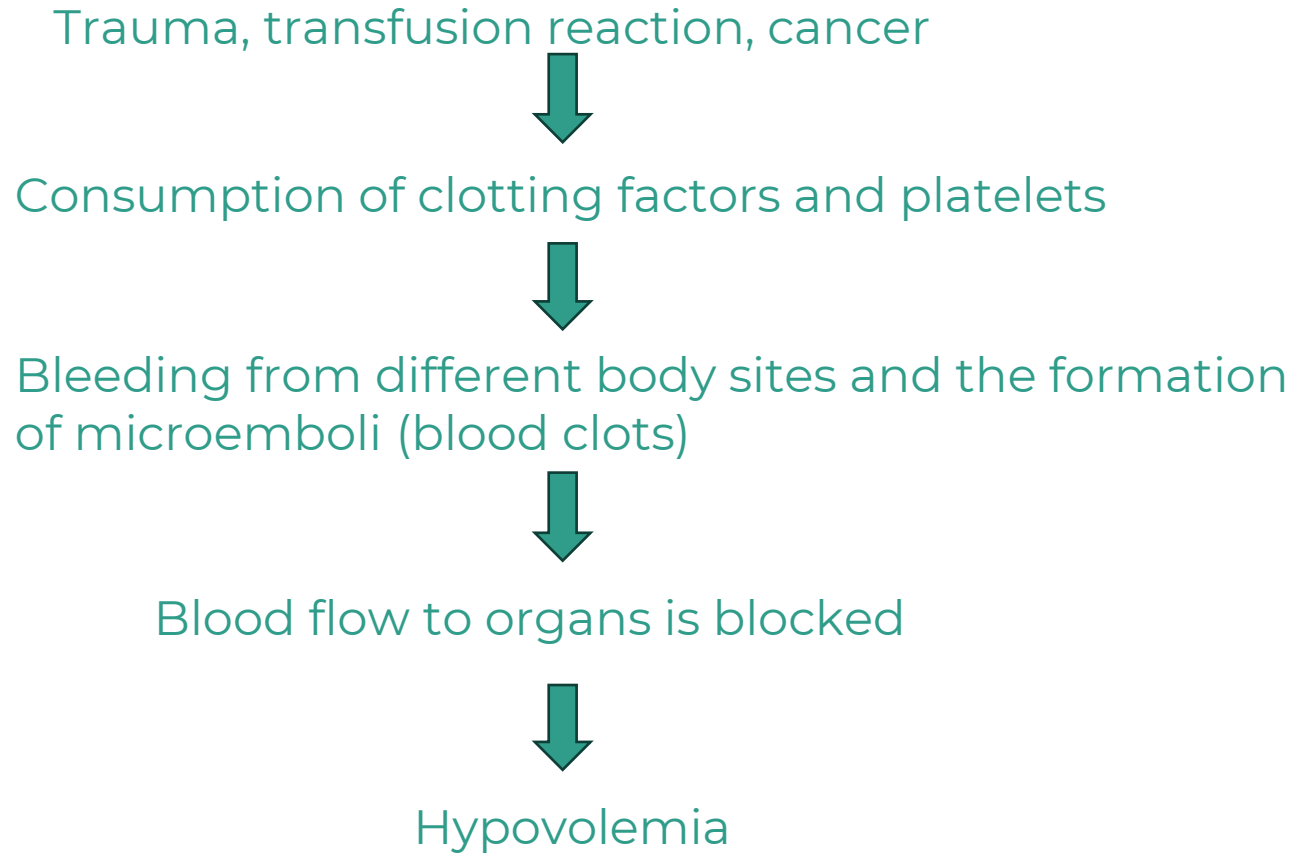
- Unilateral pain, swelling, discoloration, altered blood flow/return
- For blood clots in other locations, correlate with associated organs

-Interventions:

- Prevention
- Anticoagulants



Disseminated Intravascular Coagulation (DIC)



Blood Product Administration

- Take vital signs as per your institution's policy
- Verify consent, right patient, right blood type, compatible type and cross match between donor and patient, expiration, appearance, unit identification number
- Specific blood tubing
- Reaction:
 - **Hemolytic- flank pain, headache, dyspnea, signs of shock and renal failure, fever/chills, nausea/vomiting, dark or red urine**
 - **Allergic- hives/pruritic, flushing, wheezing, airway edema**
 - **Febrile**
 - **Circulatory overload- dyspnea, rales, cough, cyanosis, chest pain, distended neck veins**

If you suspect a reaction



STOP transfusion



**Keep IV patent with
NS**



**Monitor patient closely and
provide supportive care**



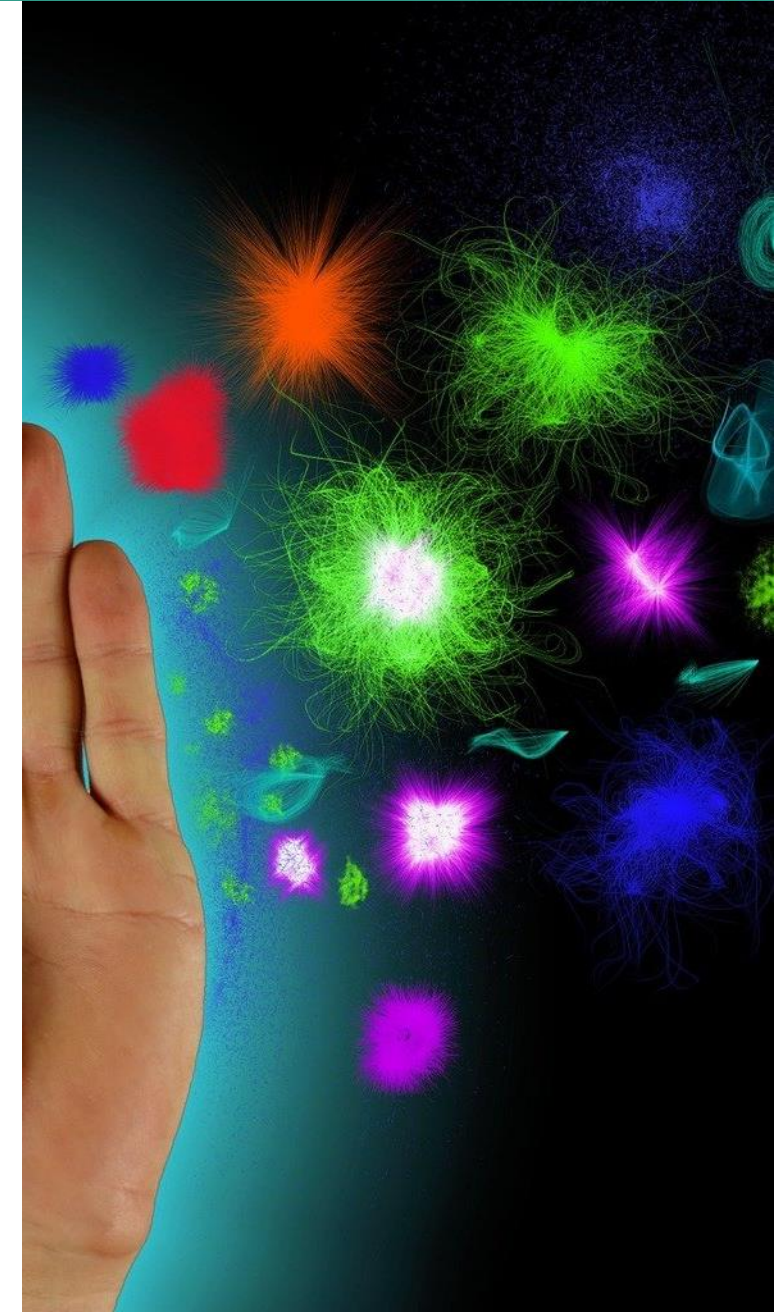
**Notify provider and blood
bank**



Immunology

Immune System Components

- Primary and secondary lymphoid organs
- Human leukocyte antigen (HLA)
 - Found on the surface of every cell
 - Allows the immune system to recognize self vs. nonself
 - **Contains a genetic predisposition to a disorder; does not pass the disorder itself**



Immune System Functions

-Functions:

- Defense against nonself, homeostasis, surveillance
- **1st line of defense against infection- skin, body secretions, nasal hairs and cilia, body temperature**

Immune cells

Neutrophil	1 st immune cell at the site of inflammation
Eosinophil	phagocytizes parasites
Basophil	-releases histamine -causes many symptoms of anaphylaxis -AKA mast cells (eyes, ears, nose, throat, under skin)
Monocyte	phagocytizes antigens and presents antigen markers so antibodies can be made
B lymphocyte	IgM- protects against bacterial and viral infections IgG-protects against bacterial and viral infections, only one that passes through the placenta (newborn passive immunity) IgD-?? IgA-prevents viruses from entering through mucous membranes IgE-allergic response by stimulating basophils
T lymphocyte	releases lymphokines that stimulate the immune system and destroy antigens (CD4 and CD8)

Inflammatory Reaction

basophils release histamine



vasodilation occurs and granulocytes and monocytes swarm the site



cells leave the blood and enter the damaged site



redness, warmth, swelling, pain

Fever

-Fever is a normal response when the body detects an unknown antigen

-Interventions:

- Comfort measures
- **Provide cool fluids and cool compresses to the skin**



-Special considerations that require medical assessment

- Fever in a baby under 2 months of age
- Immunocompromised patient
- Fever greater than or equal to 40.5 C



Neutropenia

-Neutropenia is a decreased number of neutrophils **which leads to increased susceptibility to infections**

-Assessment

- **Neutropenia may affect the child's ability to mount an immune response**
- ANC of 500-1000=moderate risk
- ANC of less than 500=severe risk

-Interventions:

- **Hand** and oral **hygiene**
- **Private room**
- Antibiotics
- Avoid crowds and sharing food/drinks
- Masks
- Flu vaccine

Hypogammaglobulinemia

Acquired or congenital



B cell development fails



Body is unable to defend itself

-Assessment:

- Medical history
- Signs and symptoms of malabsorption

-Interventions:

- Monthly gamma globulin injections



Acquired Immunodeficiency Syndrome (AIDS)/Human Immunodeficiency Virus (HIV)

-Virus (HIV) attacks CD4/helper T cells

- HIV- time of infection → until the immune system cannot mount a response
- AIDS- CD4 cell count is less than 200 per uL of blood and/or the CD4 % is less than 20%

-Spread by the exchange of body fluid

-Assessment:

- Fatigue, malaise, myalgia, night sweats, diarrhea, weight loss, FTT, lymphadenopathy, frequent infections, neuro impairment

-Interventions:

- PREVENTION against HIV/AIDS, opportunistic infections, adequate nutrition, patient and family education
- **Standard precautions, effective hand washing**





Oncology

Cancer Overview

- Uncontrolled division of abnormal cells in the body
- Cause can be genetic, viral/environmental, associated with other conditions
- Goal of treatment is remission
- Pediatric cancers grow more rapidly than adult cancers and are considered malignant until proven otherwise**

1. Leukemia

2. Central nervous system tumors

3. Lymphomas

4. Neuroblastoma

5. Wilm's tumor

6. Bone Tumors

- Treatment protocols and roadmaps

↑age=↑incidence of cancer

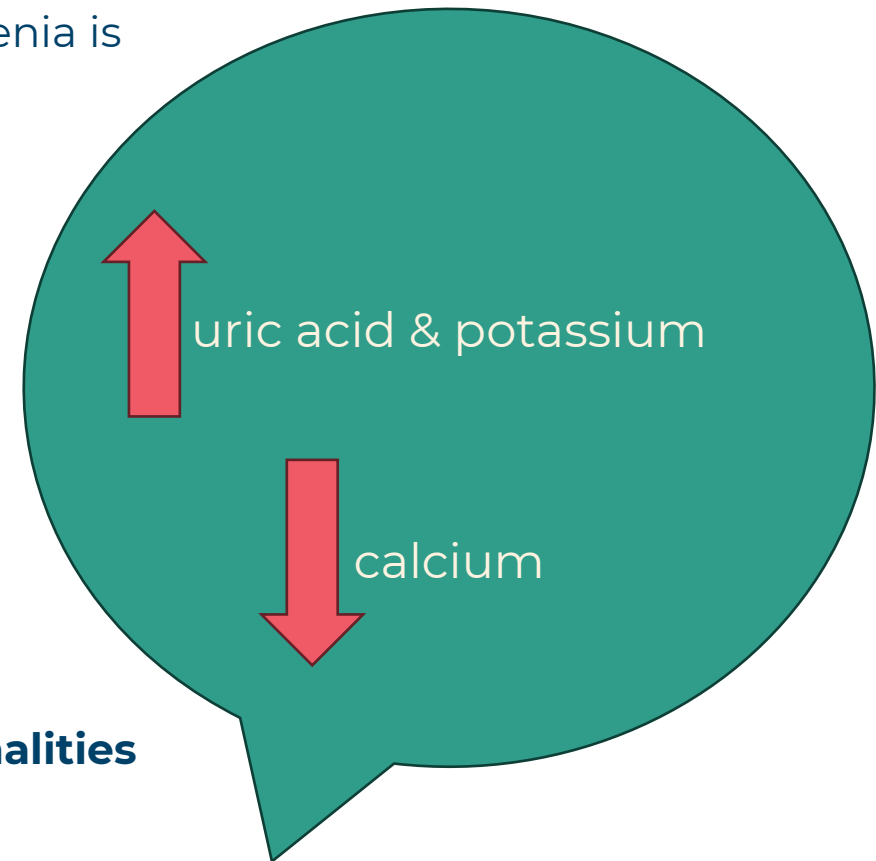


Assessment and Interventions

-Assessments differ based on the location and type of cancer

-Interventions:

- Treatments can be multimodal
- Side effects of treatment, especially **signs of infection** when neutropenia is present
- **Anticipate and prevent complications of chemotherapy**
 - Functioning IV (central line)
 - Intake/output and hydration
 - **Mucositis- good oral hygiene and provide a bland, soft diet**
 - Hair loss
 - **Nausea and vomiting- Zofran**
 - **Blood products for anemia and thrombocytopenia**
 - **Tumor Lysis Syndrome- symptoms arise from electrolyte abnormalities**



Leukemia

-Unregulated cell division → immature and abnormal white blood cells (WBCs) that are released and accumulate in the body

AKA-blast cells,
which can
reach up to 95%
in the bone
marrow

-The bone marrow is unable to make all normal cells → anemia, thrombocytopenia, immunosuppression

-Assessment:

- Leukemia symptoms arise when the bone marrow fails to produce healthy cells

-Interventions:

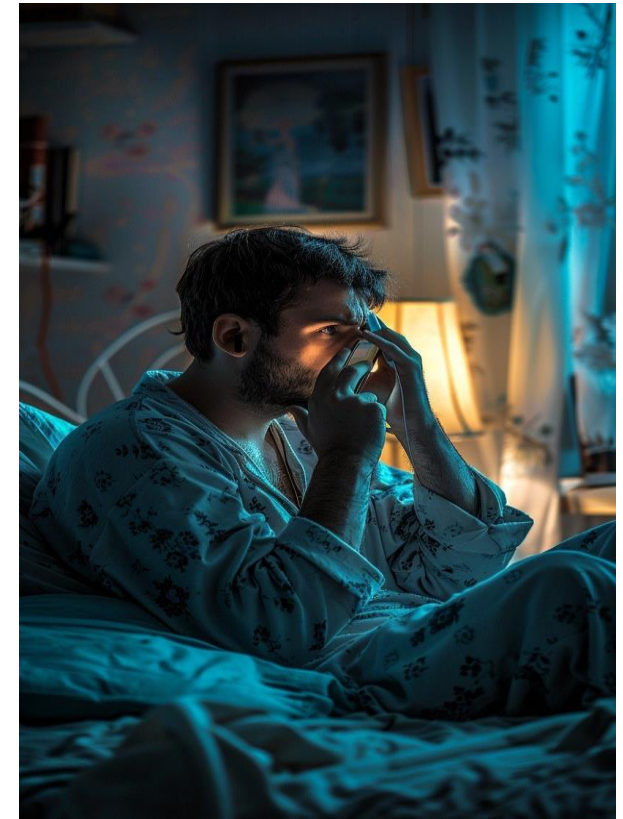
- Prepare for lumbar puncture (LP)
- Prevent infection
- Patient and family education
- Anemia and thrombocytopenia
- Increase fluids
- Diet
- Pain and other symptom control
- Emotional support
- Resources for family

Acute lymphoblastic leukemia (ALL)	Acute myelogenous leukemia (AML)
most common leukemia and cancer in children	More common in adolescents
2-5 years	5-year survival 67%
5-year survival >92%	infection

Hodgkin's Lymphoma

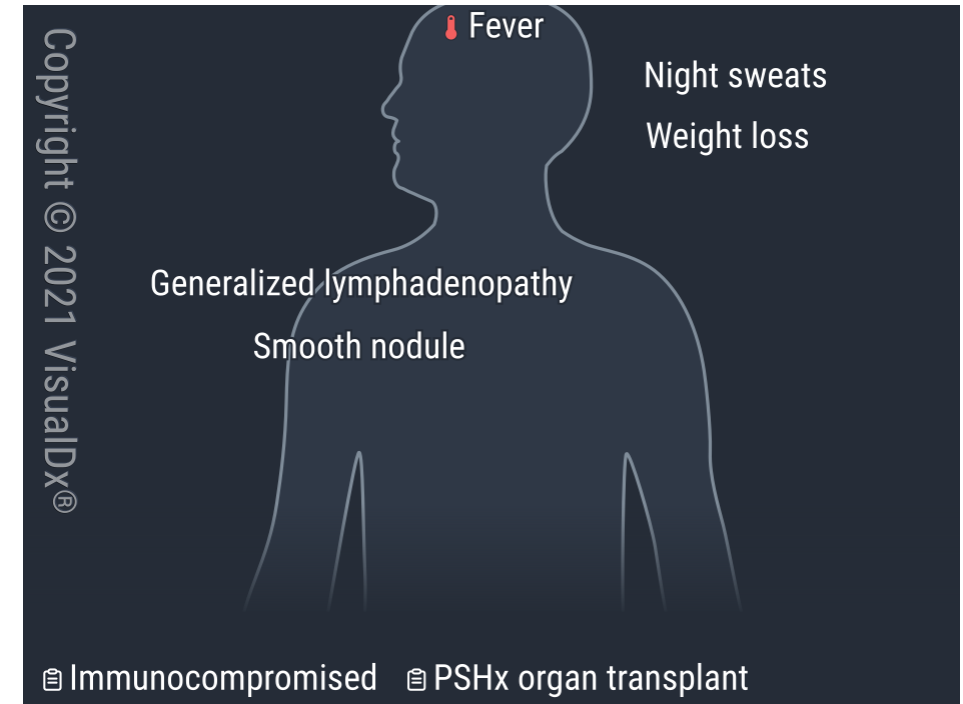
- Malignancy that involves the lymphatic system (spleen and all lymph nodes)
- Most common among adolescents
- 90-95% cure rate
- Assessment
 - Lymph nodes
 - **Pruritus**
 - Fevers
 - Weight loss
- Interventions:
 - Prepare patient and family for chemotherapy and radiation
 - Manage side effects of disease and side effects of treatment

assess for
night
sweats



Non-Hodgkin's Lymphoma

- Begins in the cells and organs of the immune system
- More systemic and metastasizes faster than Hodgkin's Lymphoma
- 75%-90% survival depending on staging
- Assessment:
 - Symptoms depend on the organ or organs involved
 - Enlarged lymph nodes
 - Night sweats, fatigue, malaise, weight loss, fever
- Interventions:
 - Nursing care like that of the child with leukemia
 - Aggressive chemotherapy
 - Manage side effects of disease and side effects of treatment



Brain Tumors

-50%-67% occur in the cerebellum or brain stem

-Assessment:

- **Changes in neuro function**
- **Headaches**
- **Nausea and vomiting**
- **Hypotonia, posturing, seizures, changes in vital signs**
- **Ataxia, cranial nerve palsies, anorexia, head tilt, nystagmus, decreased reflexes, vertigo, changes in dexterity**
- **Craniopharyngioma (pressure on pituitary gland)**

-Interventions:

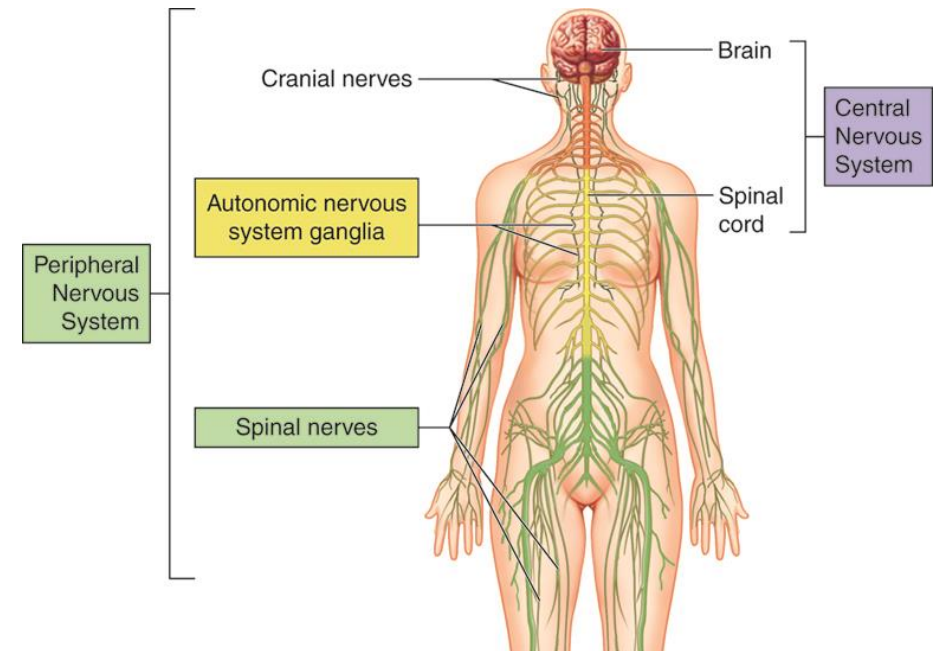
- Preoperatively
- Postoperatively

- patient should be placed on nonoperative side**
- patient should lay flat if tumor was in the posterior fossa region**
 - pain management
 - incision care
- patient should avoid straining or coughing forcefully**
- seizure precautions



Neuroblastoma

- Malignancy of the sympathetic nervous system
- Tumors normally being in the adrenal gland
- Poor prognosis
- Assessment:
 - Location and stage of tumor
 - 24-hour urine
 - Location and staging
 - Symptoms arise from the compression of tumor on other structures
- Interventions:
 - Depend on where the tumor is located, treatment always includes chemotherapy



most
common in
children less
than 2

Nephroblastoma (Wilms' Tumor)

-Cancer of the kidney that begins during fetal life

-2-4 is the average age at diagnosis

-Excellent prognosis if no metastasis

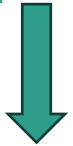
-Staging

Assessment:

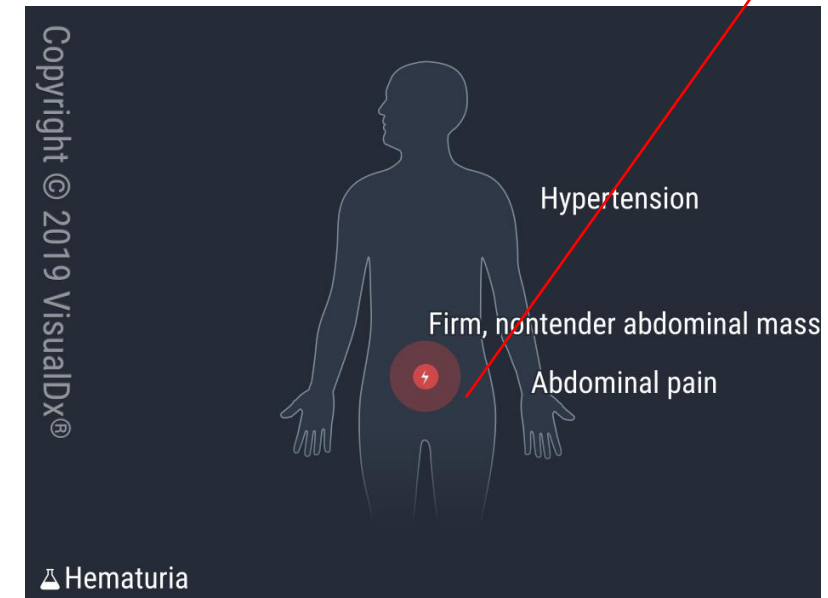
- Nontender mass

-Interventions:

- Nephrectomy happens within 24-48 hours of diagnosis
- Preoperative vs. postoperative



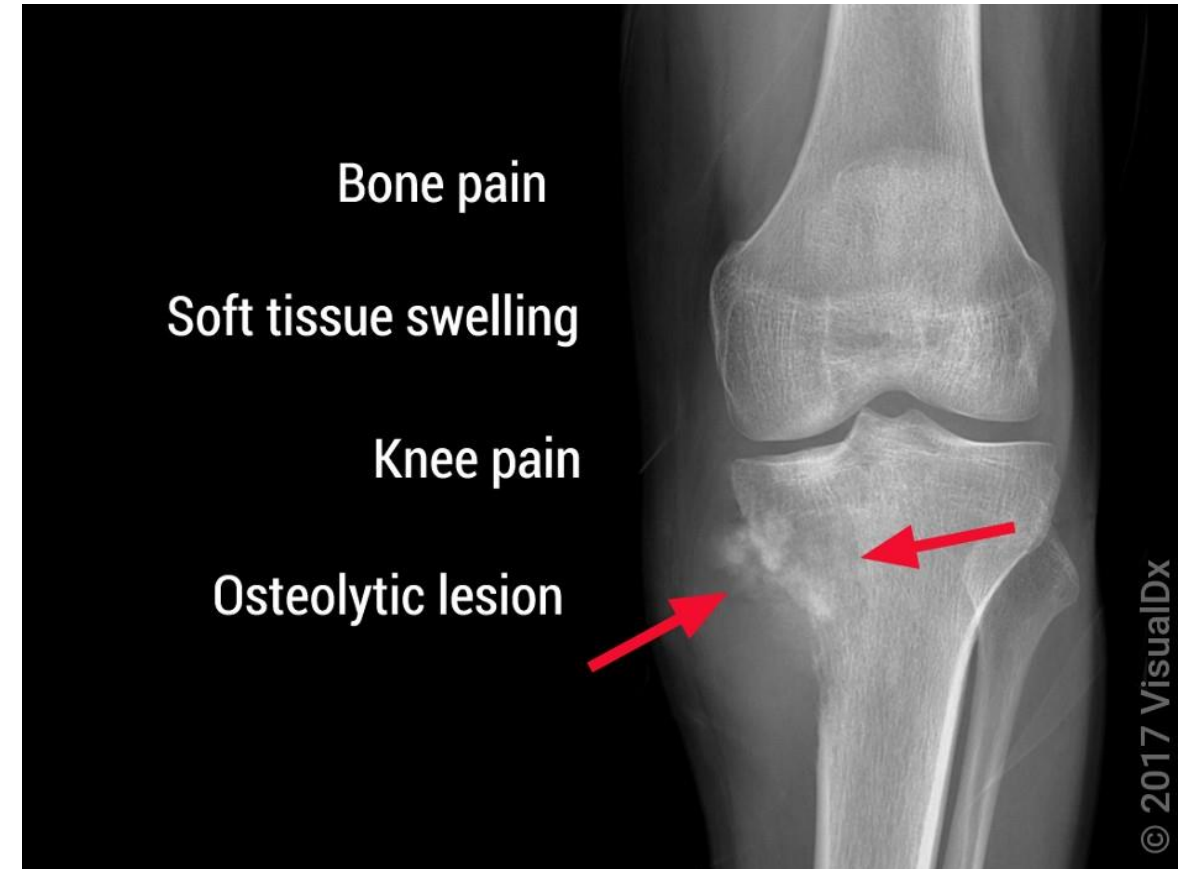
NEVER PALPATE ABDOMEN



tumor
favors
left
kidney

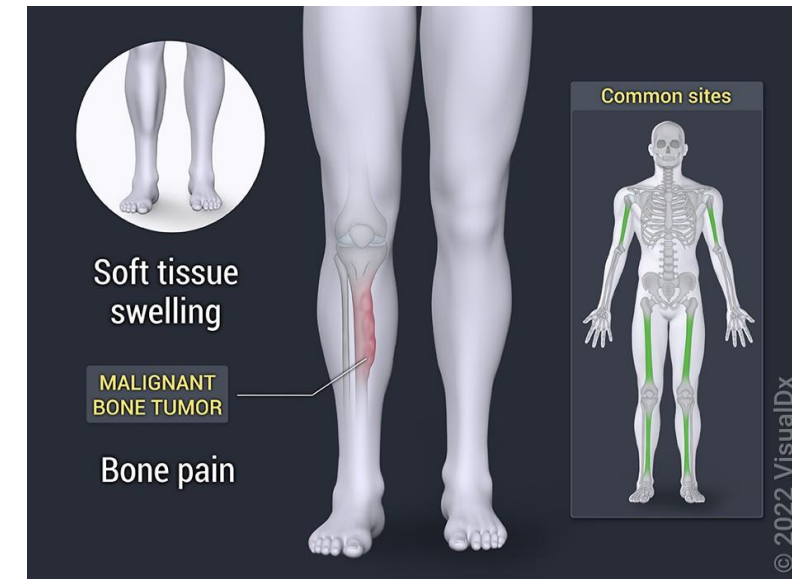
Osteosarcoma

- Most common bone cancer in children, arises from osseous tissue
- Occurs most often in late adolescence
- Long bones
- Very malignant, spreads quickly to the lungs
- Survival rate of 60%
- Assessment:
 - Xray
 - Pain and swelling
 - Pathologic fractures
- Interventions:
 - Psychosocial considerations
 - Surgery- amputation, limb salvage if possible
 - Chemotherapy



Ewing's Tumor or Sarcoma

- Arises from cells within the bone marrow
- Ages 4-25
- Very malignant to the lungs and bones
- Assessment:
 - Pain and swelling
- Interventions:
 - Radiation and chemotherapy
 - Amputation is not an option

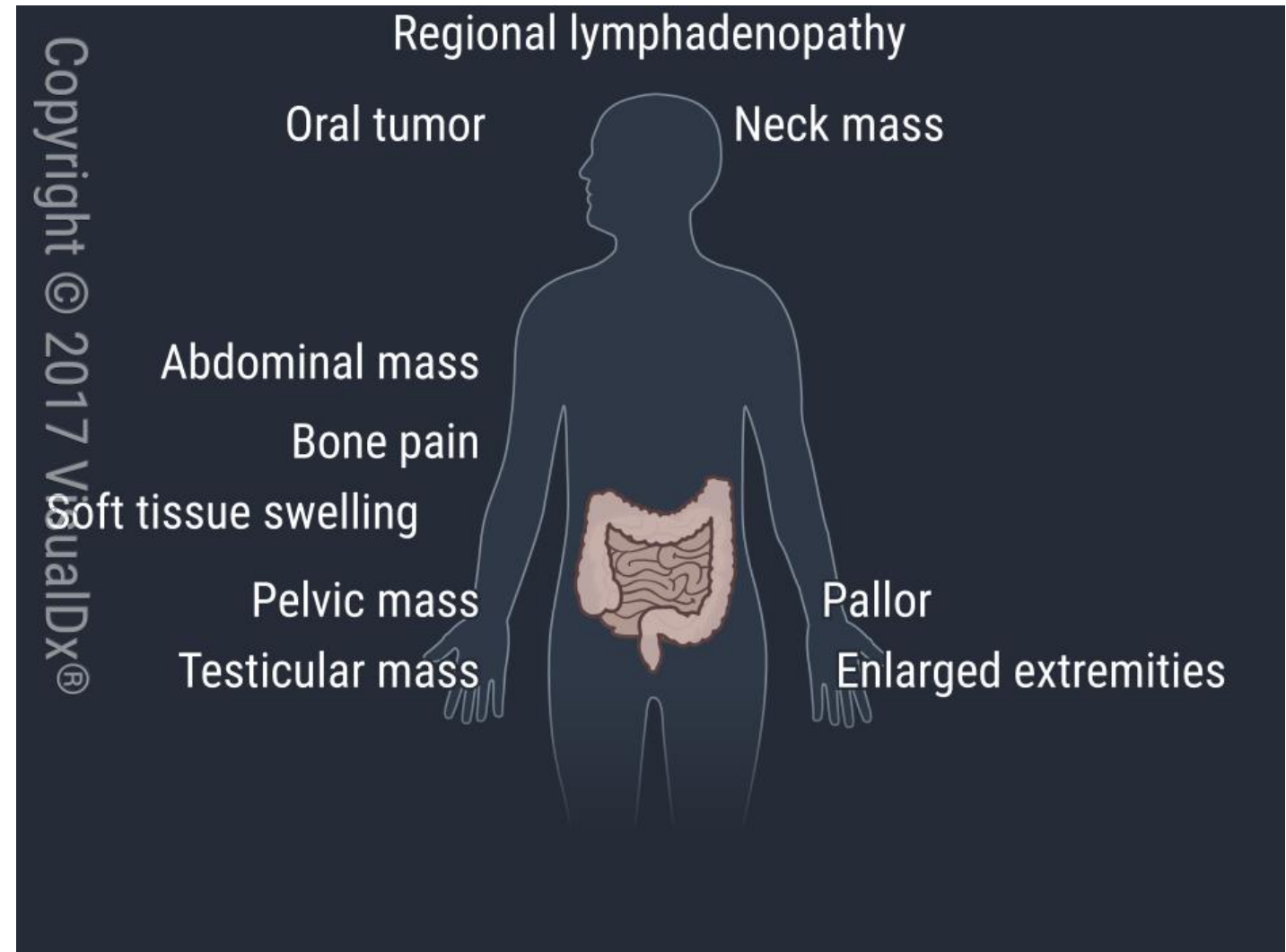


Rhabdomyosarcoma

- Soft tissue sarcomas

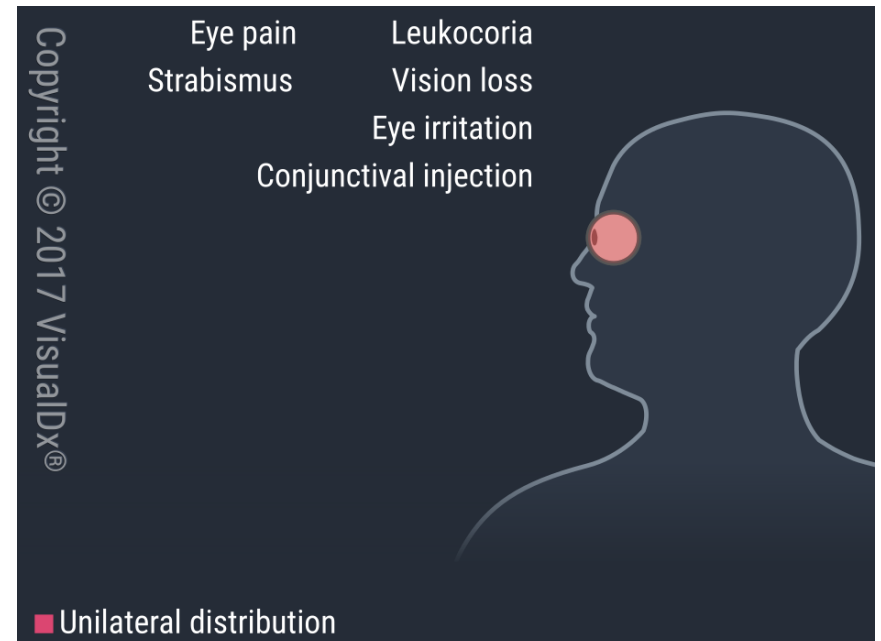
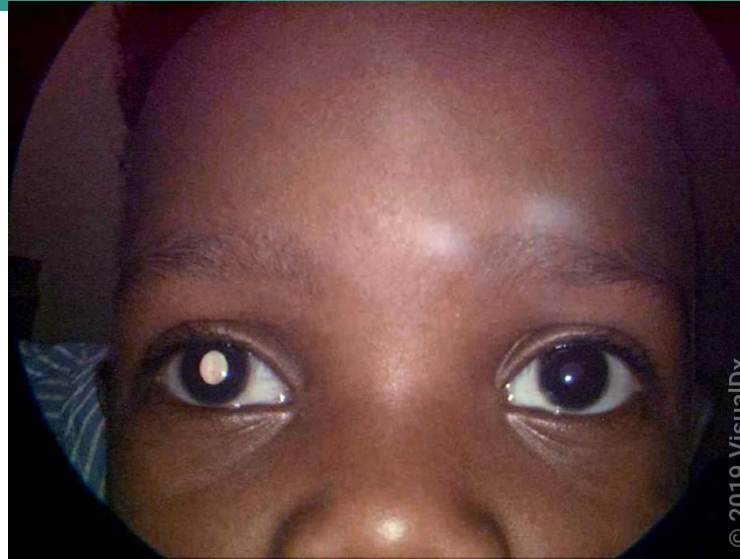
- Muscles, tendons, connective tissues, vascular tissue

- Orbits
- Nasopharynx
- Sinuses
- Middle ear
- Abdomen
- Perineum



Retinoblastoma

- Cat's eye reflex
- 95% survival rate
- Treatment includes surgery, radiation, laser therapy



Graft-versus-Host Reaction

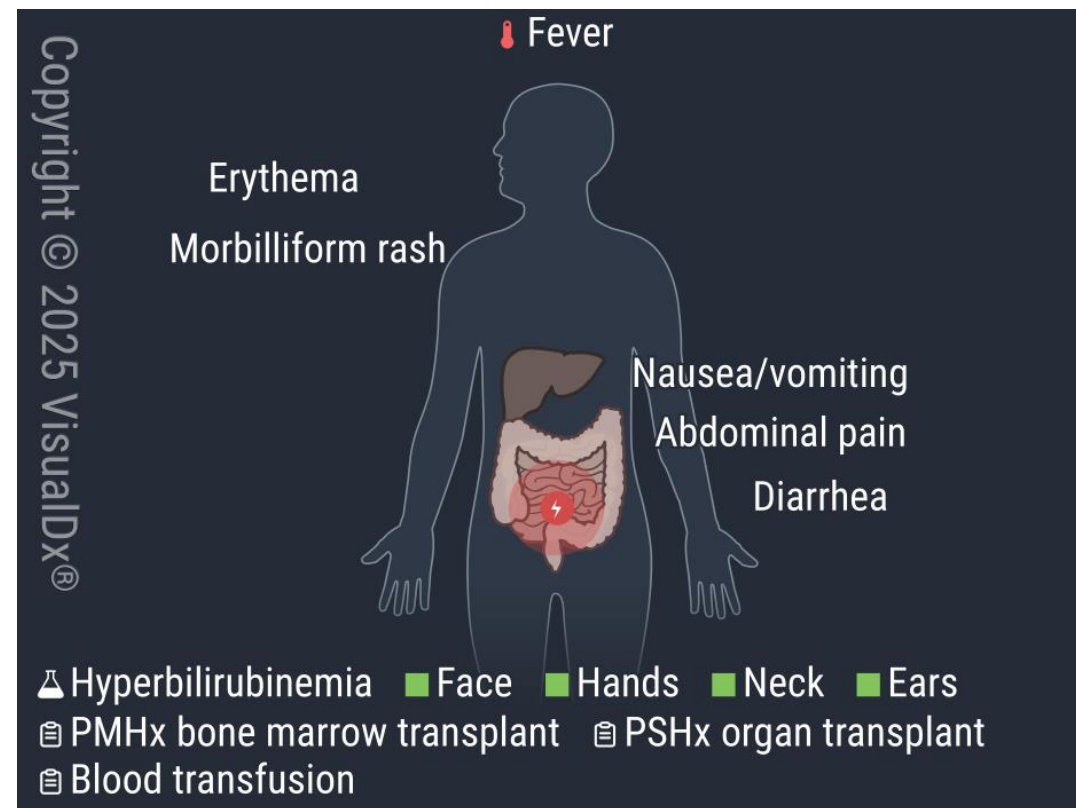
- Occurs when donated cells attack the recipient's body
- Graft rejects the entire host
- Can occur 10 days to months after transplant
- Liver, GI tract, skin

-Assessment:

- ↑ bilirubin
- Diarrhea
- Rash

-Interventions:

- Immunosuppressive medications
- Protective isolation



Death and Dying

-General considerations

- Facts and feelings
- Perceptions of death are related to child's development and cognitive age
 - Toddler- **here and now based, fear separation from parent(s)**
 - Preschooler- views death as **temporary, relate death to sleep, fear separation from parent(s)**
 - School-age- **illness as punishment, fears pain and abandonment**, rituals of death, **give child as much control as possible, and assurance they won't be alone**
 - Adolescent- **anger, funeral planning, finishing projects, messages to others, belongings**

Death and Dying

-DNR orders

-CPR

-When death is near

- **Someone should always remain with child**
- Encourage touching, hugging, laying in bed with child
- Support family's emotions (parents, grandparents, siblings)
- Spiritual/religious assessment
- Focus on what would benefit the child the most

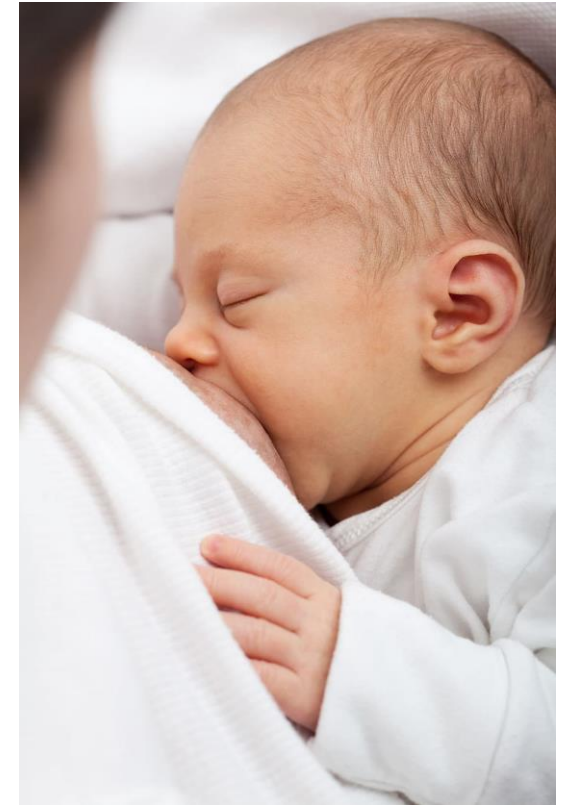
-Palliative Care and hospice

-Support the child and family with grief and loss

Knowledge Check 1

At what age do infants who are exclusively breast fed need iron supplementation?

- a.) 3-6 months
- b.) 6-9 months
- c.) 4-6 months
- d.) 9-12 months



Knowledge Check 1

At what age do infants who are exclusively breast fed need iron supplementation?

- a.) 3-6 months
- b.) 6-9 months
- c.) 4-6 months**
- d.) 9-12 months

Knowledge Check 2



After splenectomy in a patient with sickle cell disease, which vaccines should be readministered?

- a.) haemophilus influenza type b, haemophilus influenza type a, measles, mumps, rubella
- b.) varicella, meningococcal, pneumococcal
- c.) inactivated polio virus, haemophilus influenza type b, meningococcal
- d.) pneumococcal, meningococcal, haemophilus influenza type b

Knowledge Check 2

After splenectomy in a patient with sickle cell disease, which vaccines should be readministered?

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- b.) varicella, meningococcal, pneumococcal
- c.) inactivated polio virus, haemophilus influenza type b, meningococcal
- d.) **pneumococcal, meningococcal, haemophilus influenza type b**

Knowledge Check 3

What should be the **first** intervention if you suspect your patient is having a blood transfusion reaction?

- a.) stop transfusion
- b.) keep line open with NSS
- c.) support the patient's airway, breathing, circulation
- d.) call for help

Knowledge Check 3

What should be the first intervention if you suspect your patient is having a blood transfusion reaction?

- a.) stop transfusion**
- b.) keep line open with NSS
- c.) support the patient's airway, breathing, circulation
- d.) call for help

Knowledge Check 4

In which condition should the nurse **never** palpate the abdomen?

- a.) splenic sequestration
- b.) Wilms' tumor
- c.) rhabdomyosarcoma
- d.) non-Hodgkin's lymphoma

Knowledge Check 4

In which condition should the nurse never palpate the abdomen?

a.) splenic sequestration

b.) Wilms' tumor

c.) rhabdomyosarcoma

d.) non-Hodgkin's lymphoma

Knowledge Check 5

During tumor lysis syndrome which electrolyte abnormalities should the nurse expect?

- a.) increased uric acid, increased potassium, decreased calcium
- b.) increased calcium, decreased potassium, increased uric acid
- c.) increased potassium, decreased uric acid, decreased calcium
- d.) decreased potassium, increased calcium, increased uric acid

Knowledge Check 5

During tumor lysis syndrome which electrolyte abnormalities should the nurse expect?

- a.) increased uric acid, increased potassium, decreased calcium**
- b.) increased calcium, decreased potassium, increased uric acid
- c.) increased potassium, decreased uric acid, decreased calcium
- d.) decreased potassium, increased calcium, increased uric acid

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