LABORATORY VALUES/ SEPSIS

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INTERPRETATION OF LABORATORY VALUES – CBC

- What's in a CBC?
  - Red Blood Cell Count
  - Hemoglobin
  - Hematocrit
  - Reticulocyte count
  - Red Blood Cell Indices
    - MCV (Mean Corpuscular Volume)
    - MCH (Mean Corpuscular Hemoglobin)
    - MCHC(Mean Corpuscular Hemoglobin concentration)
    - RDW (Red blood cell distribution width)

OBJECTIVES

- Identify 3 common risk factors that make both the normal and sick newborn vulnerable to infections
- List interventions that may be employed to retard the spread of infection in neonatal settings
- List 5 signs and symptoms of neonatal infection
- Outline a plan of care for the treatment of the septic infant
- List the 5 common bacterial and viral infections seen in newborn nurseries

INTERPRETATION OF LABORATORY VALUES –CBC

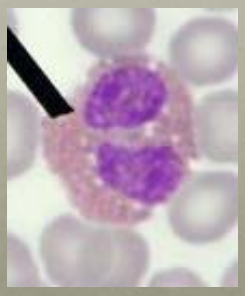
- Platelet Count
- MPV (Mean Platelet Volume)
- White Blood Cell Count
  - Neutrophils
    - Segs
    - Bands
  - Lymphocytes
  - Monocytes
  - Eosinophils
  - Basophils

INTERPRETATION OF LABORATORY VALUES –CBC

- What does it all mean?
  - Red Blood Cell Count:

The red blood cell count is a count of the number of red blood cells circulating in 1 mm cubed sample of peripheral venous blood.

Term infant = 5.8 (Day 1)



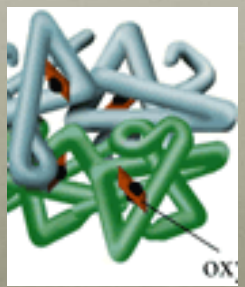
INTERPRETATION OF LABORATORY VALUES –CBC

- Hemoglobin (Hb)

A measurement of the concentration of Hb in the blood Measured in grams per deciliter (100 mls)

Hemoglobin is a protein-iron compound that carries oxygen to the cells and carbon dioxide away. Each RBC contains 200 - 300 molecules of Hb. Each molecule of Hb contains four groups of heme, and each group carries one molecule of oxygen

Term infant = 18.4 (Day 1)



INTERPRETATION OF LABORATORY VALUES –CBC

- Hematocrit

  A measure of the percentage of the total blood volume that is made up by the RBCs.

  Term infant = 58 (Day 1)

- Reticulocyte Count

  An indication of the ability of the bone marrow to respond to anemia and make RBCs. Expressed their percentage compared to mature RBCs, Reticulocytes are immature RBCs.

  Term infant = 3-7 (Day 1)

INTERPRETATION OF LABORATORY VALUES –CBC

- Platelet Count

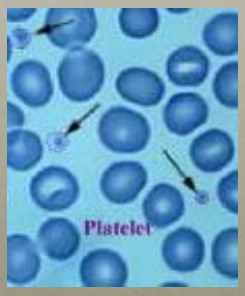
  An actual count of the number of platelets per cubic milliliter of blood.

  Platelets are formed in the bone marrow and stored in the spleen, platelets are essential for blood clotting.

  Term infant = 192 (Day 1)

- MPV (Mean Platelet Volume)

  A measure of the volume (size) of platelets. Immature platelets are large, inadequate bone marrow produces small platelets.



INTERPRETATION OF LABORATORY VALUES –CBC

- White Blood Cell Count

  The total number of WBCs in 1 mm cubed of peripheral venous blood

- Term infant = 13.5-31 (12 hours of life)

  Preterm infant = 5.0 – 21 (12 hours of life)

  - Neutrophils

    Produced in 7 – 14 days in response to infection and remain in the circulation for only 6 hours. The stages of neutrophil development are: *myeloblast, promyelocyte, myelocyte, metamyelocyte, band, polymorphonuclear neutrophil.*

    - Segs/Polys (Polysegmented Cells)
    - A mature neutrophil
      - Term infant = 9.0-18 (12 hours of life)
      - Preterm = 5.0-21 (12 hours of life)
    - Band

      A precursor to a seg
      - Term infant = 0.4-2.0 (12 hours of life)
      - Preterm = 0.2-2.4 (12 hours of life)

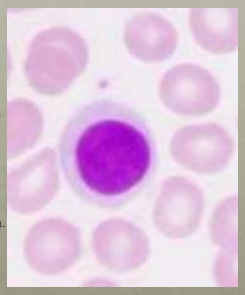
INTERPRETATION OF LABORATORY VALUES –CBC

- Lymphocytes

  Divided into T cells and B cells, T cells are involved with cellular-type immune reactions, and B cells participate in antibody production.

  Their primary function is to fight chronic bacterial infection and acute viral infections
  - Term infant = 3.0-7.0 (12 hours of life)
  - Preterm = 1.5-5.0 (12 hours of life)
- Monocytes

  Phagocytic cells capable of fighting bacteria. They remove necrotic debris and micororganisms from the blood. They produce interferon – an immunostimulant.
  - Term infant = 1.0-2.0 (12 hours of life)
  - Preterm = 0.3 – 1.3 (12 hours of life)



INTERPRETATION OF LABORATORY VALUES –CBC

- Eosinophils

  Increase in the presence of antigens or parasites. Release cytoplasmic granules which cause damage to microbes. Not responsive to bacteria or viruses
  - Term infant = 0.2-2.0 (12 hours of life)
  - Preterm = 0.1-1.1 (12 hours of life)
- Basophils

  Release histamine, heparin, and serotonin in response to antigens. Not responsive to bacteria or viruses
  - Term infant = <0.2
  - Preterm = <0.2

INTERPRETATION OF LABORATORY VALUES –CBC

IT Ratio

- This calculation will reveal what proportion of the circulating neutrophils released from the NSP in the bone marrow, are the immature forms.
- When the 20-25% of the neuotrophils in the blood are immautre neutrophils, suspicion should increase that the infant is responding to a bacterial infection

$$\frac{\text{Immature (I)}}{\text{Total (T)}} = \text{I/T ratio}$$

INTERPRETATION OF LABORATORY VALUES –CBC

- IT Ratio: Immature to total Neutrophil Ratio Term infant = <0.16 (12 hours of life)
  Used to determine the ratio of immature neutrophils to total neutrophils in a peripheral smear
  Generally: > 0.2 – suspect sepsis

I:T ratio =
% immature neutrophils (bands+metamyelocytes+myelocytes)
% mature neutrophils + % immature neutrophils

Ex. Bands = 23 Metas = 4 Myelos = 1 Segs = 48 WBC = 16.6 K

23+4+1 / 48 +28 = 28 / 76 = 0.37

INTERPRETATION OF LABORATORY VALUES –CBC

- Absolute Neutrophil Count (ANC)
- Why evaluate?
  - To determine how many neutrophils are available to fight bacterial infection
  - Premature infants commonly have lower ANC than term infants
- How to calculate?
- Neutrophils= Segs+Bands+Metamyelocytes
- White Blood cell count multipled by percentage of all neutrophils (immature and mature)
- WBC x Neutrophils=ANC
- Plot ANC on Manroe chart

INTERPRETATION OF LABORATORY VALUES –CBC

- ANC: Absolute Neutrophil Count Term infant = 7,800-14,400 (12 hours of life)

Used to determine the true neutrophil count in the infant. Norms vary widely over hours since birth

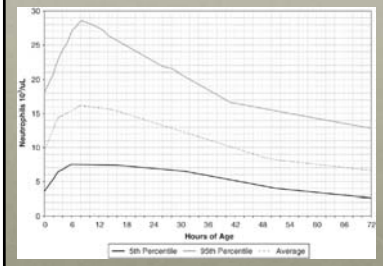
ANC = % Segs + % Immature cells x WBC

EX: (.48 + .23 + .04 + .01) x 16.6 = 12.616

Norms for ages =

Birth	12 hr	24 hr	48 hr	72 hr
1.8-5.4	7.8-14.4	7.2-12.6	4.2-9	1.8-7

ANC



- Normal ranges for the ANC in the first 60 hours of life
- Values below 1800 would be abnormal for term and preterm infants.
- Progressively declining values would also be cause of concern

ADDITIONAL LABS TO IDENTIFY INFECTION

- CRP: C-reactive Protein

  An acute phase reactant (inflammation) to destruction. May be due to infection or trauma.

  Synthesized by the liver within 4-6 hours of an inflammatory stimulus. CRP doubles every 8 hours, peaking at 36 – 50 hours.

  Norms: Day 1-2: <1.6

  Beyond: <1.0

  More accurate for late sepsis than early onset sepsis

- Blood Cultures:
  - Bacteria:
    - Cocci – Streptococci and Staphylococci
    - Bacilli - Streptobacilli
    - Spirals – Spirillum
  - Staining:
    - Gram Positive: Thick cell walls, keep the (crystal)violet stain
    - Gram Negative: Thin cell walls, violet stain washes away and is replaced by the red counterstain (iodine)
  - Flagellated vs non-Flagellated: Flagellated bacteria move about more freely and therefore reach more areas of the body

ADDITIONAL LABS TO IDENTIFY INFECTION

- Viruses

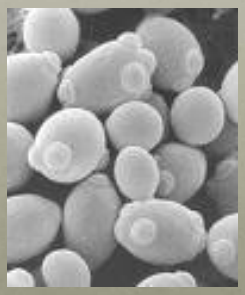
  Viruses are obligate intracellular parasites which recognize, attach and invade the host, depositing their DNA or RNA into the cytoplasm or nucleus of the host. The host cell replicates the virus's genetic material and releases them for further invasion. Each infected cell can produce 100,000 new viral particles.

  Viruses are either RNA or DNA viruses. RNA viruses replicate in the cytoplasm, are prone to mutation, and leave their hosts; DNA viruses replicate in the host's nucleus and remain in the host cell.

ADDITIONAL LABS TO IDENTIFY INFECTION

- Fungi

  Must live on dead or decaying material or in coexistence with another organism
  - Yeasts (Candida)
  - Molds (Histoplasmosis)
- Parasites (Protozoa – Toxoplasmosis)



SEPSIS

- Clinical Signs Include:
  - General
    - Poor Feeding*
    - Irritability
    - Lethargy
    - Temperature Instability*
  - Respiratory
    - Grunting
    - Nasal Flaring
    - Intercostal Retractions
    - Tachypnea/Apnea*

SEPSIS (CONT.)

- Clinical Signs (cont.)
  - Central Nervous System
    - Hypotonia
    - Seizures
    - Poor Spontaneous Movement or Alteration in Behavior*
  - Skin
    - Petechiae
    - Pustulosis
    - Sclerema
    - Edema
    - Jaundice

- Clinical Signs (cont.)
  - Gastrointestinal
    - Diarrhea
    - Hematochezia
    - Abdominal distension*
    - Emesis
    - Increasing gastric aspirates
  - Circulatory
    - Bradycardia or Tachycardia
    - Hypotension
    - Cyanosis
    - Decreased Perfusion

SEPSIS (CONT.)

- Laboratory Signs Include:
  - WBC count <5K or >30K
  - I.T. Ratio > or = 0.2
  - Thrombocytopenia (< 150K)
  - Hypoglycemia
  - Increased CRP
  - Hyperbilirubinemia
  - Metabolic Acidosis
  - Positive Blood Cultures

OMPHALITIS

- Staphylococcus; Streptococcus.
- Invasion of the bloodstream or peritoneal cavity by micoroorganisms via the umbilical vessels

PNEUMONIA

- Risk Factors:
  - Immaturity of the lungs and immune system
    - Absence of secretory immunoglobulin A during the first days after birth
    - Decreased number of lung macrophages until 48-72 hours
    - Transplacental transmission
    - Ascending infection
  - Fetal asphyxia – gasping of amniotic fluid introduces bacteria into lungs
  - Colonization of skin and mucous membranes with vaginal bacteria followed by aspiration of oropharyngeal secretions
  - Nosocomial – invasive procedure, poor handwashing by health care workers

PNEUMONIA - PATHOLOGY

- Inflammation of the bronchioli and alveoli
- Vascular congestion
- Edema
- Leukocyte infiltration
- Epithelial damage
- Exuadate of plasma proteins

- Destruction of type 2 cells
- Alterations in surfactant
- Alveolar damage, edema, hemorrhage
- Group B strep; E-Coli; Haemophilus influenzae; Klebsiella; Enterobacter.

MENINGITIS

- Acute inflammation of the membranes lining the brain and spinal column
- Viral or bacterial, may be fungi
- Purulent exudates cover the meninges and ventricles
- Inflammation of cerebral vessels

- Occlusion of blood vessels supplying brain tissue
- Inflammation of the ventricles
- CSF leukocytes > 32 K (12 with RBC of 32)
- CSF glucose < 50-75% of serum level (81% of serum)
- Protein > 100-180 (73)
- Positive culture (B-strep; E Coli; listeria)

SEPTIC SHOCK

1. Infectious agents release endotoxins
2. Endotoxin release produces an immune response leading to changes in vascular tone and permeability leading to vasodilation & increased vascular permeability & third spacing of fluids
3. The polysaccharide component of the endotoxin produces a release of histamine and serotonin causing further dilation, hypotension and subsequent decreased oxygenation at the cellular level
4. Hypotension impairs normal blood flow and oxygen delivery to tissues
5. Decreased oxygen delivery leads to the production of lactic acid and subsequent metabolic acidosis
6. Endotoxins further affect the metabolism of substrates such as glucose and protein and lead to further impaired cellular functioning.

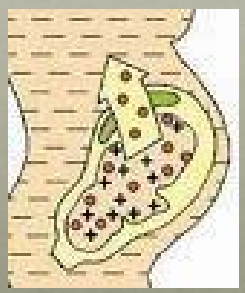
SEPTIC SHOCK

7. Anaerobic metabolism decreases ATP production and release of catecholamine and glucagon is stimulated blocking glucose metabolism and further reducing energy stores
8. Lack of oxygen and energy affects cells' metabolism and leads to cellular damage, decreased mitochondrial function, decreased cell wall integrity, and failure of the potassium-sodium pump, and release of lysosomes – releasing digestive enzymes within the cell.

THE CORD SCREEN

- RH factor
  - An antigenic substance present in the erythrocytes of 85% of the population
- Coombs: Detects the presence of antibodies against the RH positive blood cell
  - Direct Coombs: The antibody is attached to the antigen (the RH positive cell)
  - Indirect Coombs: The antibody is circulating in the serum sample

THE CORD SCREEN



RHOGAM

- Rhogam is also called anti-Rh immunoglobulin.
- It is given soon after delivery to Rh-negative women after pregnancies in which they carried Rh-positive fetuses to prevent the mother's immune system from reacting to the Rh-positive blood of any subsequent fetus

THE NEWBORN SCREEN

ABO Incompatabilities

A	(A antigen)
	(B antibody)
B	(B antigen)
	(A antibody)
AB	(A and B antigen)
	(No antibodies)
O	(No antigens)
	(Antibodies to A, B, and AB)