



# PEDIATRIC SEPSIS

Amirah Daher Malkawi

M.B.B.S, MPH



An 18 month old female presents to the emergency department with 3 day history of fever, decreased activity and poor oral intake.

Review of system reveals rapid breathing, no cyanosis, no distress.

No Hx of vomiting or diarrhea

No history of abnormal urine color or smell , mom has changed several wet diapers per day

No skin rashes or joint swelling or redness

No loss of consciousness or abnormal movements, but there is hypoactivity

Her vaccinations are up to date



Physical exam reveals a sick looking child, hypoactive but responds appropriately to stimulation, not in distress.

There is no pallor or cyanosis. Growth parameters are on the 25<sup>th</sup> percentiles.

Temperature 39.5 C° rectally, RR 55/min, HR 160/ min, Bp 80/45.

Capillary Refill is 2 Sec, Blood Sugar 85mg/dl, and pulse oximetry is 94% on room air

Head and neck, Lung, Cardiac and abdominal exams are unremarkable.



What are the top three differential diagnoses?

- Pneumonia
- UTI
- Sepsis

# SEPSIS

Sepsis is a clinical syndrome that complicates severe infection and is characterized by

- the systemic inflammatory response syndrome (SIRS)
- immune dysregulation
- microcirculatory derangements
- end-organ dysfunction
- In this syndrome, tissues remote from the original insult display the cardinal signs of inflammation, including vasodilation, increased microvascular permeability, and leukocyte accumulation

# SIRS

**Systemic inflammatory response syndrome (SIRS)** is a widespread inflammatory response that may or may not be associated with infection. The presence of two or more of the following criteria (one of which must be abnormal temperature or leukocyte count) defines SIRS :

- Core temperature (measured by rectal, bladder, oral, or central probe) of  $>38.5^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$
- Tachycardia, defined as a mean heart rate more than two standard deviations above normal for age, or for children younger than one year of age, bradycardia defined as a mean heart rate  $<10^{\text{th}}$  percentile for age
- Mean respiratory rate more than two standard deviations above normal for age or mechanical ventilation for an acute pulmonary process
- Leukocyte count elevated or depressed for age, or  $>10$  percent immature neutrophils



The following factors have been associated with an increased risk for septic shock :

- Age younger than one month
- Serious injury (eg, major trauma, burns, or penetrating wounds)
- Chronic debilitating medical condition (eg, static encephalopathy with quadriplegia and frequent aspiration pneumonia, uncorrected congenital heart disease, short gut syndrome)
- Host immunosuppression (malignancy, human immunodeficiency virus infection, severe malnutrition, congenital immunodeficiency, sickle cell disease and other disease with splenic dysfunction, or immunomodulating medications [eg, chemotherapy])
- Large surgical incisions
- In-dwelling vascular catheters or other invasive devices (eg, endotracheal tube, Foley catheter, chest tube)
- Urinary tract abnormalities with frequent infection

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- Is your Patient in septic shock

NO

- Why Not?

Normal end organ perfusion ( Brain, Cap. Refil, Urine output, BP)



## WHAT WORK UP WOULD YOU ORDER?

- Blood Glucose
- Blood culture
- Blood Gas
- CBC
- PT, PTT, INR, D-Dimers
- Serum Lactate
- Kidney function
- Liver function
- Urine analysis and culture
- Chest X ray
- Serology for specific pathogens if appropriate

# BACTERIA

- *Staphylococcus aureus* including methicillin-resistant strains (MRSA)
- Coagulase-negative *Staphylococcus* especially in neonates or young infants with indwelling vascular catheters
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*
- Group B streptococcus in the neonate
- *Pseudomonas aeruginosa* including carbapenem-resistant strains
- *Escherichia coli*, including those with extended spectrum beta-lactamase activity (ESBL)
- Enterococcus species, including vancomycin-resistant species
- *Klebsiella* species, including those with ESBL activity
- Alpha streptococcus in children with acute myelogenous leukemia with mucositis and neutropenia

# VIRUSES

- Respiratory viruses ( influenza, parainfluenza, adenovirus, respiratory syncytial virus (RSV), and human metapneumovirus)
- While these viruses, especially pandemic H1N1 influenza strain and COVID-19 may cause the sepsis syndrome in isolation, the presence of bacterial co-infections, particularly methicillin-resistant *Staphylococcus aureus*, should be suspected in patients with severe sepsis or septic shock.
- Herpes simplex virus (HSV), enterovirus and adenovirus infection in neonates and young infants can be indistinguishable from bacterial sepsis.
- In immunocompromised patients, Epstein-Barr virus, cytomegalovirus, and adenovirus may also cause sepsis.
- Dengue virus, a mosquito-borne pathogen that can cause Dengue shock syndrome.

# FUNGI

- Fungal infections, especially candida species, have been reported in 10% of pediatric patients with severe sepsis and septic shock
- Fungal sepsis is more common in children with certain risk factors including :
  - Malignancy or other immunocompromising medical conditions
  - Indwelling vascular catheters
  - Prolonged neutropenia (>4 to 7 days)
  - Recent broad-spectrum antibiotic use

# PARASITES

- Parasitic (eg, malaria) and Rickettsial infections (eg, Rocky Mountain spotted fever) may present with sepsis and should be suspected based upon the local prevalence of disease and travel history.

# CULTURE-NEGATIVE SEPSIS`

- Approximately 30 – 75 % of children with sepsis have no infectious etiology identified
- This "culture-negative" sepsis may indicate host response to bacterial components, such as endotoxin, in the circulatory system or result from antibiotic treatment prior to obtaining bacterial cultures
- Current diagnostic tests may not be sufficiently sensitive to detect the inciting pathogen in all cases. Newer molecular diagnostic techniques, such as multiplex polymerase chain reaction (PCR), have the potential to improve the rate of organism identification.

## HOW WOULD YOU MANAGE THIS PATIENT?

- Admit to Hospital, monitor vital signs, pulse oximetry and urine output.
- Start IV fluids
- Start on Antimicrobials (Claforan and Ampicilline for patients less than 90 days old, Rocephin and Vancomycine for children above 3 months of age)
- Correct hypoglycemia and electrolyte abnormalities if present
- Consider Aminoacetophen to control fever
- Once results of cultures or serology identify a pathogen narrow the antimicrobial coverage