SEPSIS

IS A SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS) IN THE PRESENCE OF SUSPECTED OR PROVEN INFECTION.

- International consensus on pediatric sepsis 2005

INFECTION CAN BE CONFIRMED BY:

- POSITIVE CULTURE
- BLOOD, URINE, OR CSF
- TISSUE STAIN
- POLYMERASE CHAIN REACTION
SO WHAT IS SIRS?

**WIDESPREAD INFLAMMATORY RESPONSE THAT MAY OR MAY NOT BE ASSOCIATED WITH INFECTION.**

SIRS:

**THE PRESENCE OF TWO OR MORE OF THE FOLLOWING CRITERIA (one must be abnormal temperature or leukocyte count):**

- CORE TEMPERATURE >38.5 OR <36 C
- LEUKOCYTE - ELEVATED OR DEPRESSED FOR AGE OR >10% PERCENTILE IMMATURE NEUTROPHILS
- TACHYCARDIA - MEAN HEART RATE MORE THAN 2 SD ABOVE FOR AGE
- BRADYCARDIA MEAN HEART RATE <10TH PERCENTILE FOR AGE
- TACHYPNEA - MEAN RR MORE THAN 2 SD ABOVE FOR AGE OR MECHANICAL VENTILATION

**GRAPHICS**

Pediatric systemic inflammatory response syndrome criteria

<table>
<thead>
<tr>
<th>Age group</th>
<th>Heart rate (beats/minute)</th>
<th>Respiratory rate (breaths/minute)</th>
<th>Leukocyte count (10^3/mm^3)</th>
<th>Systolic blood pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 month</td>
<td>&lt;100</td>
<td>&gt;100</td>
<td>&gt;50</td>
<td>&gt;24</td>
</tr>
<tr>
<td>&lt;6 month</td>
<td>&lt;100</td>
<td>&gt;100</td>
<td>&gt;50</td>
<td>&gt;24</td>
</tr>
<tr>
<td>&lt;12 month</td>
<td>&lt;100</td>
<td>&gt;90</td>
<td>&gt;34</td>
<td>&gt;15</td>
</tr>
<tr>
<td>&lt;2 year</td>
<td>&lt;100</td>
<td>NA</td>
<td>102</td>
<td>&gt;10.5</td>
</tr>
<tr>
<td>&lt;5 year</td>
<td>&lt;100</td>
<td>NA</td>
<td>10</td>
<td>&gt;10.5</td>
</tr>
<tr>
<td>&gt;5 year</td>
<td>&gt;110</td>
<td>NA</td>
<td>&gt;14</td>
<td>&gt;11 or &lt;4.5</td>
</tr>
</tbody>
</table>

Note: NA = not applicable.
SEVERE SEPSIS

SEPSIS ASSOCIATED WITH:
CARDIOVASCULAR DYSFUNCTION OR ACUTE RESPIRATORY DISTRESS SYNDROME OR DYSFUNCTION IN TWO OR MORE OTHER ORGAN SYSTEMS.

SEPTIC SHOCK

SEPTIC SHOCK IS CARDIOVASCULAR DYSFUNCTION THAT PERSISTS DESPITE THE ADMINISTRATION OF >60ML/KG OF ISOTONIC FLUID.
FLUID-REFRACTORY
- CARDIOVASCULAR DYSFUNCTION DESPITE AT LEAST 60ML/KG OF FLUID

CATECHOLAMINE-RESISTANT SEPTIC SHOCK
- DESPITE THERAPY WITH DOPAMINE > 10 MCG/KG/MIN AND OR DIRECT CATECHOLAMINES

EPIDEMIIOLOGY
- APPROXIMATELY 75,000 CHILDREN HOSPITALIZED FOR SEVERE SEPSIS EACH YEAR IN THE USA
- THE INCIDENCE IS RISING SINCE MID-1990 AND IS AROUND 0.9 CASES PER 1000 POPULATIONS
- RESPIRATORY AND BLOODSTREAM INFECTIONS ARE FOUND IN ALMOST 2/3 OF SEVERE SEPSIS
- THE MORTALITY FROM PEDIATRIC SEPSIS HAS DECREASED FROM 97% TO APPROXIMATELY 4-10% AND TO 13-34% IN PEDIATRIC SEPTIC SHOCK
**RISK FACTORS**
- No immunization
- Urinary tract abnormalities
- Genetic polymorphism
- Age younger than one month
- Serious injury (trauma or penetrating wound)
- Chronic medical conditions
- Host immunosupression
- Large surgical incisions
- In-dwelling vascular catheters

**MOST COMMON CAUSES:**
- MRSA
- Coagulase negative staphylococcus (newborns and patients with indwelling vascular caths)
- Streptococcus pneumonia
- Group B strep in neonates
- E coli

**MOST COMMON CAUSES:**
- Pseudomonas aeruginosa
- Klebsiella
- Meningococcus
- Group A streptococcus
- Other bacteria
- Fungi: especially candida
- Viruses
- Parasites
NEGATIVE CULTURE SEPSIS MAY INDICATE HOST RESPONSE TO BACTERIAL COMPONENTS SUCH AS ENDOTOXIN OR EXOTOXIN

INFECTION

THE NORMAL HOST RESPONSE TO INFECTION IS A COMPLEX PROCESS:
- ACTIVATION OF CIRCULATING AND FIXED PHAGOCYTIC CELLS
- GENERATION OF PROINFLAMMATORY AND ANTI-INFLAMMATORY MEDIATORS.

SEPSIS = WHEN THE RESPONSE TO INFECTION BECOMES GENERALIZED
AND INVOLVES NORMAL TISSUES REMOTE FROM THE SITE OF INFECTION

THE HOST RESPONSE TO AN INFECTION IS INITIATED WHEN INNATE IMMUNE CELLS, PARTICULARLY MACROPHAGES, RECOGNIZE AND BIND MICROBIAL COMPONENTS
- PATTERN RECOGNITION RECEPTOR SUCH AS TOLL-LIKE RECEPTORS
- THE TRIGGERING RECEPTOR ON MYELOID CELL AND MYELOID–ASSOCIATED RECEPTORS ON HOST CELLS
The engagement of these receptors elicits a signaling cascade via activation of cytosolic nuclear factor – κB. This induces activation of a large set of genes that are involved in the host inflammatory response. Neutrophils become activated and express adhesion molecules. This process is highly regulated by a mixture of proinflammatory and anti-inflammatory mediators secreted by macrophages.
SEPSIS OCCURS WHEN THE RELEASE OF PROINFLAMMATORY MEDIATORS EXCEEDS THE BOUNDARIES OF THE LOCAL ENVIRONMENT.

WHY??
LABS:
- CBC WITH DIFF-RAPID GLUCOSE
- BLOOD GAS, LACTIC ACID, LFT, CHEM 7
- PT, PTT AND D-DIMERS
- CULTURES (blood, urine e.g.)
- CRP, PROCALCITONIN AND PRESEPSIN (COMING SOON)
- IMAGING

PROCALCITONIN
- THE PRECURSOR OF CALCITONIN (116 amino acid)
- UNDETECTABLE IN NORMAL PERSON (<0.5 ng/ml)
- IT GETS SYNTHESIZED AND SECRETED BY ALMOST EVERY CELL IN RESPONSE TO VARIOUS CYTOKINES AND LIPOPOLYSACCHARIDE
- IT IS CHEMOTACTIC

PRESEPSIN
- SOLUBLE CD 14 SUBTYPE (64 amino acid)
- RELEASED BY SHEDDING FROM IMMUNE CELLS
- IT IS BELIEVED TO INTERACT WITH B AND T CELLS TO MODULATE IMMUNE RESPONSE
TREATMENT:

SEPSIS TREATMENT

- **ABC ALWAYS**
- **RAPID IV ANTIBIOTICS**
  - CEFOTAXIME AND VANCOMYCIN
- **PENICILLIN ALLERGIC OR NEUTROPENIC PATIENTS:**
  - USE VANCOMYCIN WITH MEROPENEM OR CIPROFLOXIN

SEVERE SEPSIS TREATMENT

- **RAPID IV ANTIBIOTICS AND RAPID FLUID**
TREATMENT OF SEPTIC SHOCK:
EARLY GOAL-DIRECTED THERAPY

- **AGGRESSIVE IV FLUID THERAPY AND INOTROPS IN ADDITION TO IV ANTIBIOTICS WITH THE GOAL OF RESTORATION OF TISSUE PERFUSION**
- **CAPILLARY REFILL, QUALITY OF THE PULSES, MENTAL STATUS, URINE OUTPUT, BLOOD PRESSURE, LACTIC ACID, CENTRAL VENOUS OXYGEN SATURATION**
DO NOT USE ETOMIDATE FOR INTUBATION IN SEPSIS

REFERENCES

14. Simon A, Baudua D, et al: Assessment of hypovolemic shock: initial evaluation of effective and clinical therapy is the...