SEPSIS IN CHILDREN: RECOGNIZING EARLY SIGNS & SYMPTOMS

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DISCLOSURE STATEMENT

• I have no conflicts of interest to disclose
OVERVIEW

• Sepsis continuum: SIRS, severe sepsis, shock, MODS

• Pathophysiology

• Management

• High risk pediatric populations

• Recognizing early signs and symptoms
CASE #1

• 12 yo M
  – 1 day of fever, vomiting, leg pain
  – Cut arm diving for ball in gym day before, otherwise healthy

• PCP
  – Febrile, tachycardic, vomiting, leg pain, arm looked ok
  – Per parents:
    • “skin became blotchy when they pressed a finger on it”

• Sent to ED
  – Likely gastroenteritis, dehydration
  – Given IVF, ondansetron
  – Discharged 2 hours later
DISCHARGE VITALS

- $T = 38.8$
- $HR = 131$
- $BP = 103/50 \ (67)$
- $RR = 22$
- $O2 \ sat = 99\% \ RA$
LABS

CBC: 14.7>14/42<117

Differential: 39N/53 bands/3L/5M

Electrolytes: 131/3.9/96/24/13/0.7<118
NEXT DAY

- Continued fever, moaning
- Diarrhea
- Difficulty walking

- Per parents:
  - “I can’t even get him to sit up” (to eat or drink)
  - “A slight touch would make him scream”
  - “Around his nose was gone blue, down his body side was gone blue”
RETURNED TO ED

• “Mom, my toes are really, really cold”

• Intubated, admitted to Pediatric ICU
  – “His skin blackened”
  – “He passed no urine”
  – “His blood would not clot”
  – “His heart had to be restarted twice”
TIMELINE

• Wednesday
  – Fell in gym class

• Thursday
  – Developed fever, vomiting, leg pain
  – Saw PCP in evening
  – Sent to ED, discharged

• Friday
  – Worsening symptoms
  – Returned to ED, admitted to PICU

• Sunday
  – Died from cardiac arrest
• Septic shock/toxic shock syndrome and multi-organ dysfunction secondary to Group A streptococcus
An Infection, Unnoticed, Turns Unstoppable

Rory Staunton taking his first flying lesson in 2011.

By JIM Dwyer

Published: July 11, 2012
The Rory Staunton Foundation

For Sepsis Prevention

Sepsis Kills

"Over 6 million Babies and Young Children Every Year"
SEPSIS

– Clinical syndrome related to severe infection
  • SIRS
  • Immune dysregulation
  • Microcirculatory derangements
  • End organ dysfunction

– Tissues remote from original insult
  • Vasodilation
  • Increased microvascular permeability
  • Leukocyte accumulation
HOST RESPONSE IN SEVERE SEPSIS

ORGAN FAILURE IN SEVERE SEPSIS

SIRS/Sepsis → Severe Sepsis → Septic Shock → MODS
SEVERE SEPSIS IN U.S. CHILDREN

- 75,000 children hospitalized with severe sepsis
  - annual incidence of 1 cases per 1000 population

- Mortality
  - 4-10% in severe sepsis
  - 13-34% in septic shock

- Majority of cases due to
  - respiratory infection
  - primary bacteremia
SEVERE SEPSIS IN U.S. CHILDREN

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  – 97% in 1960’s

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MANAGEMENT
2002: To reduce mortality from sepsis by 25% in 5 years

- Building awareness of sepsis
- Improving diagnosis
- Increasing the use of appropriate treatment
- Educating healthcare professionals
- Improving post-ICU care
- Developing guidelines of care
- Implementing a performance improvement program
SEPSIS MANAGEMENT

• Early goal-directed therapy
  – Restore tissue perfusion
  – Antibiotic administration
  – Source control
ALGORITHM HIGHLIGHTS

- Antibiotics within 1 hour
- Immediate fluid resuscitation
- Vasoactive infusions if fluid refractory
WHO DO WE NEED TO WORRY ABOUT?
SIRS/Sepsis → Severe Sepsis → Septic Shock → MODS
HOW DO WE ADDRESS THIS EARLY?

• Can’t send every child with a fever to the ED

• Except…
NEONATES

• Birth – 28 days

• Fever (≥38°F rectal)
  – Full sepsis workup: blood, urine, CSF
  – Admit for antibiotics while awaiting culture results
ONCOLOGY PATIENTS

• Fever requires immediate evaluation

• Fever + neutropenia (ANC ≤ 500):
  – Cultures + antibiotics
  – Follow protocol

• May not mount fever
  – Hypothermia, hypotension, confusion
Dear Community Provider:

This is a copy of our algorithm for “Fever in the Pediatric Oncology Patient”.

This algorithm was designed by the members of the pediatric oncology team at the University of Vermont Children’s Hospital for use in the care and treatment of our patients who may present to your center with a fever.

**Fever in a pediatric oncology patient is a medical emergency and prompt intervention and close monitoring is paramount to prevent mortality related to septic shock.**

Our goal is to increase awareness about the serious nature of fever in a pediatric oncology patient and streamline the care provided to these children.

We would like to thank you for all the support and care you provide to our patients and if you have any questions or concerns, please feel free to contact us.

Pediatric Oncology Division
University of Vermont Children’s Hospital
FEVER IN A PEDIATRIC ONCOLOGY PATIENT = MEDICAL EMERGENCY

UPON ARRIVAL:
- IMMEDIATELY SCREEN FOR SIGNS OF SEPTIC SHOCK AND ISOLATE
  - If clinically indicated begin rapid fluid resuscitation with crystalloid IVF
- CONTINUE WITH Q15MIN VITAL SIGNS (T, HR, BP, O₂ Sat, RR)
- CLOSELY MONITOR FOR CHANGES IN CLINICAL STATUS PRE AND POST ANTIBIOTICS
- ADMINISTER ANTIBIOTICS WITHIN 60 MINUTES OF CONTACT AS OUTLINED BELOW

Pedi-Oncology patient presents with Fever ≥ 38.5 x 1 or 38.0 x 2 in past 24 hours

STAT CBC with differential & Bacterial Blood Cultures
WITHIN 30 MINUTES OF CONTACT
(All lumens of central line or peripheral if no central line)

DO NOT WAIT FOR CBC RESULTS
Antibiotics must be administered within 60 minutes of initial contact
(May substitute appropriate alternative drug when allergies exist)
RISK FACTORS FOR SEPTIC SHOCK

- Age < 1 month
- Immunosuppression
- Serious injury: burns, penetrating wounds
- Surgical procedures
- In-dwelling devices
CASE #2

• 5 mo M, unimmunized per parental request

• 4 days fever, decreased PO, decreased UOP, increased sleepiness

• Became difficult to arouse

• Parents noted clenched fists and body stiffness
CASE #2

- On arrival to ED, noted to be in status epilepticus
- Multiple anti-epileptics given
- Intubated, placed on mechanical ventilation
- Given ceftriaxone and vancomycin
- Fluid responsive
  - Metabolic acidosis resolved with fluid boluses
CASE #2

- CSF with pleocytosis and GPC
- EEG – moderate focal cerebral dysfunction
- MRI – leptomeningeal enhancement, increased T2 of left parietal lobe
- CSF and blood grew Streptococcus Pneumoniae
CASE #3

• 16 yo M with history of autism, seizure disorder well-controlled on keppra

• 1 day of:
  – fever to 103.9
  – cough
  – “blue lips”
  – Lethargy

• Few hours of:
  – diarrhea
  – hemoptysis
  – poor color
ED

- T: 102, HR: 152, BP: 89/34, RR: 52
- Sat: 70% RA, 80% NRB

- Awake but listless
- Severe respiratory distress with decreased BS R>L
- Cyanotic, poor perfusion, cap refill 6 sec

- VBG: 7.11/47, Lactate 12.2
- Elevated BUN/Cr
- Leukopenia/neutropenia
- Influenza B positive
• Catecholamine-resistant septic shock with multi-organ dysfunction secondary to Influenza B with superimposed streptococcal pneumonia
  – ARDS
  – AKI progressing to oliguric renal failure
  – DIC
  – Liver dysfunction
TIMELINE

• 2 days PTA
  – Went to school, bed early

• 1 day PTA
  – am: fever, lethargy, stayed home from school
  – Called PCP for fever of 103.7
  – Called PCP for persistent fever, cough, “blue lips”

• Day of admission
  – 6am: presented to ED
  – 11am: transferred to PICU
  – 6pm: cardiac arrest, resuscitation x 20mins

• Day after admission
  – 3pm: redirection of goals of care and death
OTHER HIGH RISK POPULATIONS

- Unimmunized
- Families hesitant to seek medical care
- Children with developmental delay
  - Difficulty communicating
RECOGNIZING EARLY SIGNS & SYMPTOMS
# COMPARISON OF TWO CASES

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age/sex</strong></td>
<td>5 yo F</td>
<td>5 yo F</td>
</tr>
<tr>
<td><strong>Chief complaint</strong></td>
<td>fatigue, fever, decreased PO intake x 1 day</td>
<td>fatigue, fever, decreased PO intake x 1 day</td>
</tr>
<tr>
<td><strong>Temp</strong></td>
<td>104°F</td>
<td>102°F</td>
</tr>
<tr>
<td><strong>HR</strong></td>
<td>135</td>
<td>137</td>
</tr>
<tr>
<td><strong>BP</strong></td>
<td>106/60</td>
<td>112/63</td>
</tr>
<tr>
<td><strong>RR</strong></td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><strong>O₂ sat</strong></td>
<td>97% RA</td>
<td>99% RA</td>
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</tbody>
</table>
INTERVENTION

• Acetaminophen
• Encourage fluid
# REASSESSMENT

<table>
<thead>
<tr>
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<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temp</strong></td>
<td>100.1°F</td>
<td>100.2°F</td>
</tr>
<tr>
<td><strong>HR</strong></td>
<td>95</td>
<td>135</td>
</tr>
<tr>
<td><strong>BP</strong></td>
<td>106/60</td>
<td>112/63</td>
</tr>
<tr>
<td><strong>RR</strong></td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><strong>O2 sat</strong></td>
<td>97% RA</td>
<td>99% RA</td>
</tr>
<tr>
<td><strong>PO Challenge</strong></td>
<td>Drank, +void, now asking for food</td>
<td>Vomited x 2, no UOP</td>
</tr>
<tr>
<td><strong>Mental status</strong></td>
<td>Bored of choices on ipad</td>
<td>Sleeping, responds to questions then goes back to sleep</td>
</tr>
</tbody>
</table>
PATIENT B

- Risk factors?
- Last UOP?
- Intermittent vs progressive worsening
- Labs?
- Response to further fluid
- Antibiotics?
- Parental input
SUMMARY

• Recognition of sepsis is critical

• Goal of sepsis management:
  – Restore tissue perfusion
    • Goal-directed therapy
  – Antibiotics within the hour

• Communicating concern for sepsis will improve outcomes


• Black R et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis, Lancet 2010


THANK YOU