Presented by Lori Olvera DNP, RNC-OB, EFM-C

EARLY RECOGNITION OF MATERNAL SEPSIS

Objectives

At the conclusion of this learning session the participant will be able to:

✓ Identify differences between Sepsis, Severe Sepsis, and Septic Shock
✓ Identify symptoms for early recognition and how to manage the septic patient
✓ Identify the importance of implementing OB sepsis screening in the perinatal setting
✓ Identify the importance of implementing protocols for early recognition and management of maternal sepsis
✓ Define 3-hour Sepsis Bundle and the rationale for each intervention

The Sepsis Initiative

Goal

Reduce mortality and morbidity from severe sepsis and septic shock in our OB populations
Sepsis History & Overview

- 2001 Rivers Study
- 2004 Sepsis Guidelines
- The Perinatal Population
- CMS Measure

Sepsis is one of the top four causes of maternal mortality.
Pregnant women are more vulnerable to infection and susceptible to serious complications.
Screening protocols are needed for early recognition and management of maternal sepsis. All perinatal staff must be trained on early recognition and management of maternal sepsis.

Acosta, Kurinczuk, Lucas, Tufnell, Sellers & Knight, 2014
What Can We Do?

Improve recognition of sepsis in the OB population
Adopt best practices
Provide recommended care

BEST PRACTICES:
– Based on organizations with lowest sepsis mortality
– Protocol driven, early recognition, ICU level care

Code Sepsis in OB: Let's Intervene before it hits!

Maternal Sepsis Video

• [http://bcove.me/sd6wl76t](http://bcove.me/sd6wl76t)
Megan died of Septic Shock while in labor

Incidence:
- Septic Shock is rare in pregnancy 0.002-0.01%
  - Of all septic patients, 0.3-0.6% are pregnant
- Overall increase in severe sepsis and septic shock due to changes in demographics of pregnant women:
  - Advanced maternal age
  - Obesity
  - Diabetes
  - Placental abruption
  - Placental abnormalities
  - Assisted Reproductive Technology (ART)

Pregnancy and Sepsis

Obstetric & Gynecology, 2012

Pregnant Patients need to be included in our Sepsis Protocols!

Pregnancies complicated by severe sepsis and septic shock are associated with increased rates of preterm labor, fetal infection, and preterm delivery. Sepsis onset in pregnancy can be insidious, and patients may appear deceptively well before rapidly deteriorating with the development of severe shock, multiple organ dysfunction syndrome, or death. The outcome and survivability in severe sepsis and septic shock in pregnancy are improved with early detection, prompt recognition of the source of infection, and targeted therapy.”

Barton & Sibai, 2012
### Causes of Severe Sepsis & Septic Shock in Pregnancy & Puerperium

- Acute Pyelonephritis
- Retained Products of Conception
- Neglected Chorioamnionitis or endometritis
- Pneumonia
  1. Bacterial
  2. Viral
    - Influenza
- Unrecognized or inadequately treated necrotizing fasciitis
  1. Abdominal incision
  2. Episiotomy/Perineal Laceration
- Intrapartum Etiology
  1. Ruptured Amnion
  2. Acute Cholecystitis
  3. Broad Infection
- Urinary Tract Infections
- Mastitis

### Risk Factors

<table>
<thead>
<tr>
<th>Antepartum</th>
<th>Intrapartum</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>Protracted Active Labor especially in nulliparous</td>
<td>Retained placental fragments</td>
</tr>
<tr>
<td>Lack of PNC</td>
<td>Active Labor</td>
<td>Cracked nipples</td>
</tr>
<tr>
<td>Anemia</td>
<td>Prolonged ROM</td>
<td>Operative delivery</td>
</tr>
<tr>
<td>Impaired immunity</td>
<td>More than 5 vaginal exams</td>
<td>C/S delivery</td>
</tr>
<tr>
<td>Hx of group B colonization or infection</td>
<td>Perineal manipulation during the 2&lt;sup&gt;nd&lt;/sup&gt; stage of labor</td>
<td>Failure to recognize severity</td>
</tr>
<tr>
<td>Invasive procedures, Multiple Gestation</td>
<td>Instrumentation</td>
<td></td>
</tr>
<tr>
<td>Diabetes/CHTN</td>
<td>Unscheduled C/S</td>
<td></td>
</tr>
<tr>
<td>Use of ABX 2 weeks prior to presentation</td>
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</tr>
</tbody>
</table>

### Sepsis Definitions...

**What is Sepsis?**
Systemic Inflammatory Response

Definition
A clinical manifestation resulting from an insult, infection, or trauma, that includes a body-wide activation of immune and inflammatory cascades.

Insult: Can be from anything

- Burn
- Trauma
- Infection
- Surgery
- Myocardial Infarction
- Pancreatitis
- Anesthesia
- Allergic reaction

Why is diagnosis of sepsis difficult in pregnant patients?

1. Normal cardiovascular changes in pregnancy can MIMIC the systemic inflammatory response (SIRS)
2. Heart Rate and Cardiac Output are ↑ due to ↑ blood volume
3. Respiratory Rate ↑ are due to ↑ demand for oxygen and expanding abdominal girth
4. White Blood Cell Count is normally ↑ for women in labor as high as 20,000 unrelated to infection.
Sepsis Screening Criteria for Non-OB adults vs. OB Screening Tool - adjusted for the physiological effects of pregnancy

**Adult Screening Criteria**
- Temp > 38°C (100.4°F) or < 36°C (96.8°F)
- HR > 90 bpm
- Resp Rate > 20 Breaths/minute
- WBC > 12,000, < 4,000 or >10% Bands
- Blood glucose > 140 mg/dl in absence of diabetes
- New mental status change

**Perinatal Screening Criteria**
- Temp > 38°C (100.4°F) or < 36°C (96.8°F)
- HR > 110 bpm
- Resp Rate > 24 breaths/minute
- WBC > 15,000 or < 4,000 or > 10% immature neutrophils
- Blood glucose > 140 mg/dl in absence of diabetes
- AMS present

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**Community Standard for Adjusting SIRS Criteria**

<table>
<thead>
<tr>
<th>SIRS Criteria</th>
<th>Adults</th>
<th>OB</th>
<th>Newborn</th>
<th>Perinatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>&gt; 2°C</td>
<td>&gt; 2°C</td>
<td>&gt; 0.5°C</td>
<td>&gt; 0.5°C</td>
</tr>
<tr>
<td>Maternal Heart Rate</td>
<td>&gt; 100 BPM</td>
<td>&gt; 110 BPM</td>
<td>&gt; 100 BPM</td>
<td>&gt; 110 BPM</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>&gt; 20/minute</td>
<td>&gt; 24/minute</td>
<td>&gt; 20/minute</td>
<td>&gt; 24/minute</td>
</tr>
<tr>
<td>White Blood Cell Count</td>
<td>&gt; 12,000</td>
<td>&gt; 15,000</td>
<td>&gt; 100,000</td>
<td>&gt; 100,000</td>
</tr>
<tr>
<td>Blood Glucose</td>
<td>&gt; 140 mg/dl in absence of DM</td>
<td>&gt; 140 mg/dl in absence of DM</td>
<td>Not recommended</td>
<td>Not recommended</td>
</tr>
</tbody>
</table>

**Sepsis Definition:**
The presence of 2 or more SIRS criteria with a presumed or confirmed infectious process

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**SEPSIS: Want a Lactate with that?**
Severe Sepsis

**Definition:**
Sepsis + Organ Dysfunction (resulting from Tissue Hypo-Perfusion)

### Signs of Organ Dysfunction

- **Respiratory**
  - Inadequate respiration or ventilation

- **Neurologic**
  - Change in LOC

- **Cardiovascular**
  - Hypotension
    - SBP < 90 mmHg or MAP < 65

- **Hematologic**
  - Platelets < 100,000
  - Coagulopathy (INR > 1.5 or aPTT > 60 sec)

- **Renal**
  - U/O < 30 ml/hr
  - Elevated Cr. (>1.5)

- **Global Hypoperfusion**
  - Lactate > 2 mmol/L

### Organ Dysfunction

<table>
<thead>
<tr>
<th>Sutter Health Parameters</th>
<th>Surviving Sepsis Campaign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td>SpO2 &gt; 90% or PaO2/FiO2 &gt; 300</td>
</tr>
<tr>
<td>Inotropic</td>
<td>SBP &gt; 90 mmHg or MAP &gt; 65</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Increase O2 requirements to maintain SpO2 &gt; 90% or PaO2/FiO2 &gt; 300</td>
</tr>
<tr>
<td>Global Hypoperfusion</td>
<td>Lactate &gt; 2 mmol/L</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>SBP &lt; 90 mmHg or MAP &lt; 65</td>
</tr>
<tr>
<td>Renal</td>
<td>U/O &lt; 30 ml/hr</td>
</tr>
<tr>
<td>Hematologic</td>
<td>Platelets &lt; 100,000</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>INR &gt; 1.5 or aPTT &gt; 60 sec</td>
</tr>
<tr>
<td>Elevated Cr.</td>
<td>&gt; 1.5 mg/dL</td>
</tr>
<tr>
<td>Altered Mental Status</td>
<td></td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>MAP &gt; 65 mmHg</td>
</tr>
<tr>
<td>CVP</td>
<td>CVP &gt; 6</td>
</tr>
<tr>
<td>Urine Output</td>
<td>U/O &gt; 0.5 ml/kg/hr</td>
</tr>
<tr>
<td>Creatinine</td>
<td>Creatinine &gt; 2 mg/dL</td>
</tr>
<tr>
<td>Altered Mental Status</td>
<td></td>
</tr>
<tr>
<td>Blood Pressure</td>
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Septic Shock

**Definition**
Persistent arterial hypotension despite 30ml/kg volume resuscitation or an initial lactate > 3.9 mmol/L (Both may be present)

Sepsis Syndrome

SIRS = Systemic Inflammatory Response Syndrome

PATHOPHYSIOLOGY OF SEPSIS

A Review.....
Pathophysiology of Sepsis

https://www.youtube.com/watch?v=o5sYBUarpml

Metabolic Acidosis
Increased Respiratory Rate
Cardiac Depression
Confusion

If Oxygen Demand of the tissues is not met by oxygen delivery

Anaerobic Respiration Occurs
Lactic Acid is a by-product (serum lactate)

Increased Respiratory Rate
Cardiac Depression
Confusion

CAN’T OXYGENATE TISSUES......Leads to Alternate Pathway Lactate Acid production....

Dismissing Abnormal SIRS as a Decoy

1. Abnormal SIRS criteria are often seen and disregarded in postpartum states
2. Fever due to elevated metabolic demand
3. Tachycardia due to relative hypovolemia
4. Leukocytosis due to stress of delivery
5. Even mild hypotension can be dismissed in the possibly hypovolemic, young female with physiologically low blood pressure.
RECOGNITION AND MANAGEMENT IS KEY!

• Delay in diagnosis and treatment of sepsis has been shown to ↑ mortality
• Pregnant patients look deceptively well before rapidly deteriorating
• Early recognition and treatment of maternal sepsis will improve survival, decrease length of stay, and length of stay in the ICU

Why do we Need Protocols for Early Recognition?

Why do we Need Protocols for Early Recognition?

Surviving Sepsis Campaign

Bundles
Elements when used together, improve outcomes more than when used separately!
Evidence based
Severe Sepsis Bundle: TO BE COMPLETED WITHIN 3 HOURS

- Time zero = time of confirmed positive sepsis screen
- Measure lactate level
- Obtain blood cultures prior to administration of antibiotics
- Administer broad spectrum antibiotic(s)
- Administer 30 mL/Kg crystalloid for hypotension or lactate > 3.9 mmol/L

Let's look at each of intervention in the Sepsis Bundles......

“The Whys” of Why we need to do it!

Do we delay giving broad-spectrum antibiotics while waiting for blood cultures to be drawn?

- One study shows that for every hour delay in antibiotic administration for a hypotensive septic shock patient, the mortality rate increases by 7.6% per hour.
- Advantages of drawing appropriate cultures prior to antibiotic administration must be weighed against the evidence showing that delaying appropriate antibiotic therapy causes an increase in mortality.

Broad Spectrum Antibiotics – (administer as soon as possible) within 3 hours of T-0

- Administration of APPROPRIATE antibiotics reduces mortality in patients with Gram-positive and Gram-negative bacteremias
- Although restricting antibiotics is important for limiting super-infection and decreasing development of antibiotic resistance, patients with severe sepsis and septic shock warrant broad spectrum antibiotic therapy until antibiotic susceptibilities are defined.
- Combination therapy is more effective than monotherapy until causative organism is found.

Measure Lactate Level

Why is it important
1. Increases in serum lactate level may represent tissue hypoxia
2. Elevated levels in sepsis support aggressive resuscitation
3. Mortality is high (46.1%) in septic patients with both hypotension and lactate > 3.9 mmol/L
4. Mortality in severely septic patients with Lactate >3.9 mmol/L alone is 30%

Lactate Acid Measurement to Identify Risk of Morbidity from Sepsis in Pregnancy

- This study assessed risk of morbidity associated with maternal lactic acid in women with possible sepsis in pregnancy
- Design: Retrospective cohort of pregnant and postpartum patients with signs of sepsis (159 had lactic measured out of 850 women)
- Conclusion: Elevated lactic Acid in pregnancy is associated with adverse maternal outcomes from presumed sepsis. In this cohort, lactic acid measurement was a marker of a more severe infection.

SMCS Lactate Level in Ante-, Intra- and Post-partum
Beth Stephens-Hennessy CNS, RNC

52 Patients
Inclusion criteria: Healthy women admitted for induction and C/S
Lactate levels:
• Upon admission-Inductions and C/S patients
• Transition, 7-10 cm dilated-Induction patients
• 6 hours postpartum-Inductions and C/S patients
  96% Lactate< 4 mmol/dl
  88% Lactate< 2 mmol/dl

96% Lactate< 4 mmol/dl
88% Lactate< 2 mmol/dl

Fluid Resuscitation
✓ Administer 30ml/kg Crystalloid for Hypotension or Lactate > 3.9 mmol/L
✓ NS or LR
✓ Patients with severe sepsis/septic shock experience ineffective circulation due to the vasodilation associated with infection or impaired cardiac output
✓ Poorly perfused tissue beds result in global tissue hypoxia, which result in ↑ serum lactate level
Code Sepsis in OB: Let’s Intervene before it hits!

Initiate Sepsis screening every shift (Nursing Staff)
Create Protocols with Adjusted SIRS criteria for Maternal Sepsis
Early intervention implemented for all patients who screen positive for sepsis
Arrival of Rapid Response Team followed by physician/ intensivist evaluation

Perinatal Sepsis Standard Work

Addressing the Barriers

✓ Our patients are young & healthy, did not look septic
✓ The bundles would result in over-treatment
✓ Risk of Pulmonary Edema
✓ Women with epidurals have fevers
✓ Antibiotic Resistance
✓ Lactate is normally elevated in the laboring woman
✓ To avoid doing Sepsis Screening during second stage of labor
Screening Difficult During Stage 2 of Labor

• Screening for sepsis is difficult when a mother is actively pushing
• For the laboring patient, the following considerations must be included when screening for sepsis:
  – Maternal heart rate and respiratory rate are typically elevated – like with any exercise- and does not constitute SIRS criteria.

When should I perform the sepsis screening?

• Upon arrival to the unit (triage or direct admit)
• EVERY SHIFT and/or assuming care of patient
• PRN for suspicion/indication of new infection
Sutter Health
Maternal Sepsis
Recommendations

The impact of implementation of a project locally at SMCS and regionally at Central Valley Sutter Health

The Source of Infection in Perinatal Patients Diagnosed with Sepsis during Pregnancy Sutter Medical Center Sacramento April 2014-January 2015

<table>
<thead>
<tr>
<th>Source of Infection</th>
<th>Frequency (N=99)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chorioamnionitis</td>
<td>45</td>
<td>46.4%</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>14</td>
<td>14.4%</td>
</tr>
<tr>
<td>Endometritis</td>
<td>5</td>
<td>5.2%</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>5</td>
<td>5.2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>29</td>
<td>29%</td>
</tr>
</tbody>
</table>

Frequency of Sepsis, Severe Sepsis and Septic Shock Sutter Medical Center Sacramento April 2014-January 2015*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Observation</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>0.12% (8/4660)</td>
<td>94% (57/60)</td>
</tr>
<tr>
<td>Severe Sepsis</td>
<td>0.02% (6/4660)</td>
<td>48.5% (27/55)</td>
</tr>
<tr>
<td>Septic Shock</td>
<td>0.002% (1/4660)</td>
<td>1.2% (4/350)</td>
</tr>
</tbody>
</table>

* Deliveries ~4000
Let’s Begin the Campaign to promote Early Recognition & Management of Maternal Sepsis

Think Sepsis. Save a Life.

APPLYING WHAT WE HAVE LEARNED

Case Scenarios

Case Scenario #1
Preterm with PPROM X 8 days

- 0848- T-97.8, BP 115/62, P-100, 98%, FHR 160
- 1110-MD here to consent for C/S
- 1200-C/S, Apgar 1/8. Baby to NICU
- 1230. OBRR- Temp 101.8, P-120, SOB, 88/40. RRT called. CBC, blood culture, lactate drawn. IV Fluids 2 L given. Zosyn started.
Questions

- At what point did she meet SIRS criteria?
- What signs of organ dysfunction did she have?
- List the standard work that was done in response.

Leanna presents to triage at 24 weeks....

8/3/13 @2216
Pt presented L&D triage with R sided flank pain, fever of 101, and vomiting X2.
OB Inc.
- No risk factors; GA: 24 weeks, G-1, P-0
Vital Signs:
- HR=120, bp-103/58, FHR 165-170.
Labs:
- UA: 2+ nitrites, Pos for leukocyte esterase, 1+ protein, 2+ ketones,
  >100 WBC 4 RBC, 4+ bacteria
Outcome:
- Macrobid and DIC home.
- T-99.8,FHR=165, MD would call pt when UA culture returns in 48 hrs.
Culture…………Cx results: E.Coli >100,000

LeeAnna.....

8/4/13 @1900
Pt returns with fever, R sided flank pain, aches, N&V, chills, feeling dizzy, SOB..POSITIVE SEPSIS SCREEN
VS
- P=130, BP 85/52, Map 64. O2 sat 99%
- FHR=140’s.
Treatment
- Ampicillin 2 gm given, 1 liter LR given, RRT At bedside, serial lactates, NS Solusi. Gentamycin given.
Response:
- 55 minutes later: T=98.2, P=102, BP101/61, O2 Sat 100, lactic Acid 1.6. Patient transferred to L&D
6 hours later:
- Pt shivering, C/O SOB, O2 at 3L, O2 sat 95%, T=99.2, P=114, BP=100/61. Remains SOB. Lactic Acid 2.6

6 1/2 hrs:
- RRT at BS. Clammy, O2 sat 94%, required O2 administration

7 hrs:
- Orders to transfer to ICU. Central line placed.

12 hrs:
- chest Xray indicated fluid overload/interstitial edema

17 hours:
- pt intubated and sedated, VSS; CRP-264.7; albumin 1.8, WBC-21.1, Hgb 7.8

Day 3:
- R nephrostomy tube, foley catheter. VSS. Transferred to HRM

Day 5:
- Central line d/c; D/C home at 1230!

3 months later
- Admitted for SROM
- Nephrostomy tube in place.
- On Cipro 500mg Q12h
- 11/22@1430-delivered healthy baby girl!
Questions

• At what point did she meet SIRS criteria?
• What signs of organ dysfunction did she have?
• List the standard work that was done in response.

LeeAnna Septic Shock Survivor......

Scenario #3
2nd stage of Labor

• 0900-Twin gest 38.1 weeks, pushing in 2nd stage of labor. No other risk factors. Temp spiked to 102.1, P-130, R-22. Pt screened positive for sepsis. RN called MD in which MD gave orders to follow sepsis protocol.
• 0940-Lactate 5.6. WBC 26. LR 2 Liter bolus NS given, Zosyn ordered and administered.
• 0955,0958-patient delivered healthy twins. Health care team decided to manage care in L&D for recovery. Orders to redraw lactate at 1200. RN's did not want to separate the mom-baby couplet. BP stable, P-110, Temp 100.1, R-20.
• 1130-Lactate drawn (1200)-3.9, 1 liter of NS given. Lactate drawn every 6 hours until lactate <2.
Questions

• At what point did she meet SIRS criteria?
• What signs of organ dysfunction did she have?
• List the standard work that was done in response.
• List the standard work that was not done.
• Does lactate increase during labor and increase with length of pushing?

REFERENCES


