Maternal Sepsis

Speakers:

Lori Olvera, DNP, RNC-OB, EFM-C
Perinatal Educator
Sutter Medical Center

Katarina Lannér-Cusin, MD, FACOG
Medical Director Women’s Services, Sutter Health
Alta Bates Summit Medical Center

Graciela Eldridge
Maternal Sepsis Survivor
Maternal Sepsis Fact Sheet

Definition: Sepsis is the body’s overwhelming and life-threatening response to infection, which can lead to tissue damage, organ failure, and death.

According to the World Health Organization maternal sepsis refers to sepsis that results from infection during pregnancy, childbirth, post-abortion, or postpartum period.

Who is Hurt: While sepsis is an equal opportunity killer, it injury the sickest, the well, and people of all ages, some groups are more likely to be affected. These include very young children, older adults, and those with a weakened immune system.

Prevention: The risk of sepsis can be reduced by preventing or quickly identifying and managing infections. This includes practicing good hygiene, clearing current with vaccinations, and seeking treatment when infections are suspected.

Treatment: Sepsis is a medical emergency that requires urgent attention and rapid treatment for survival. Sepsis can be treated and, in many instances, lives are saved by using existing and proven protocols.

Recovery: Many individuals fully recover from sepsis, while others may have long-lasting effects, such as amputations or organ dysfunction, like immune failure. Other after effects of sepsis are less obvious, such as memory loss, anxiety, or depression.

Maternal Sepsis infographic
Dr Katarina Lannér-Cusin
Lori Olvera DNP

Maternal Sepsis
Megan died of SEPTIC SHOCK while in Labor.
LeeAnna
Septic Shock Survivor......
History of Sepsis and the Perinatal Population

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

Maternal Deaths in Michigan

Method
Retrospective reviews of maternal deaths in Michigan

Results
- **15%** of deaths due to maternal sepsis (22/151)
- Of **22** deaths, **13** women presented to hospital with sepsis, **two** developed sepsis while in hospital, and **seven** developed sepsis at home without admission to hospital
- Hospital Records (15): **73%** revealed delays in initial appropriate ABX treatment
- **53%-delay** in escalation of care!
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”

What do we know about SEPSIS?

• Pregnant women are more vulnerable to infection and susceptible to serious complications
• Clinical signs may be insidious and patient appear deceptively well before rapidly deteriorating
• Early detection of sepsis is essential for best outcomes for the mother and her baby
• Septic patients, if left untreated, may progress to develop septic shock, multi-organ failure and death
• 50% of deaths from sepsis are related to Group A streptococcus
• E.Coli is the most common cause of maternal bacterial infection
• Sepsis can occur anytime during pregnancy and often associated with a delay in diagnosis
• The normal physiological changes may mask early signs of sepsis
• Maternal sepsis with or without hemodynamic instability may present with fetal distress as the uteroplacental circulation is not auto-regulated
• Consideration for treatment options has to be given to the impact of the condition as well as the effect on the fetus
SEPSIS:
Currently no gold standard diagnostic test exists to confirm the presence of sepsis
Broadly defined as life-threatening organ dysfunction caused by a dysregulated host response to infection

SEPTIC SHOCK:
Subset of sepsis with circulatory and cellular/metabolic dysfunction associated with higher risk of mortality

JAMA (2016). 315(8):801-810
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)
  - Emerging Infections Diseases

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

Infection + SIRS

- T > 100.4, < 96.8, HR > 110, R > 24
- WBC > 15,000, < 4,000 or < 10% bands

- Need 2 SIRS
  - Septic Work-up & Tx Begins here
  - Consider other etiology

SEPSIS

Infection + SIRS + 1 organ dysfunction

Septic Shock

Lactate $\geq$ 4 mmol/L
AND/OR Refractory Hypotension

SEPSIS PATHWAY
Suspected or documented Infection

- Chorioamnionitis
- Pyelonephritis
  - UTI
- Endomyometritis
- Pneumonia
- Other:
  - Necrotizing fascitis
  - Unknown
- Unknown
The Source of Infection in Perinatal Patients Diagnosed with *Sepsis* during Pregnancy

Sutter Medical Center Sacramento  
April 2014-January 2015

<table>
<thead>
<tr>
<th>Frequency (N=99)</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Chorioamnionitis</td>
<td>45</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>14</td>
</tr>
<tr>
<td>Endometritis</td>
<td>5</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>5</td>
</tr>
<tr>
<td>Unknown</td>
<td>29</td>
</tr>
</tbody>
</table>
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.
Because of the physiology of pregnancy, the screening criteria was adjusted for perinatal population

- Increase in blood volume increases maternal heart rate by 10-20 bpm
- Minute volume (RR x Tidal Volume) increases 50% due to an increase in respiratory rate and tidal volume
- The position of the diaphragm decreases lung volume and increases the respiratory rate
- Increase in WBC (leukocytosis) in labor and immediate postpartum
- Increase in perfusion to the kidneys causes a decrease in the creatinine level
Sepsis 1 Screening Criteria

**SEPSIS 1 Screen**
- Suspected source of clinical infection
- Two or more SIRS Criteria
  - Temp >38.3 C/101 F or < 36 C 96.8 F
  - HR >90/min
  - RR >20 breath/min
  - WBC > 12,000 mm$^3$ or < 4,000 mm$^3$ or > 10% bands

**Center for Medicaid and Medicare Services OB Screen**
- Suspected or known infection
- Two or more SIRS Criteria
  - Temp≥38 C/101.4 F or <36 C/96.8 F
  - HR>110/min
  - RR>24 breaths/min
  - WBC > 15,000 mm$^3$ or < 4,000 mm$^3$ or > 10% immature neutrophils (bands)
  - Altered Mental Status

93% Sensitivity
63% Specificity
Organ Dysfunction Assessment

SEPSIS 1 Values
• SBP < 90 mmHg, or more than 40 mmHg below baseline -OR- MAP < 65 mmHg
• Acute respiratory failure evidenced by a new need for invasive or non-invasive mechanical ventilation
• Cr ≥ 2 mg/dL or UO < 0.5 ml/kg/hour for 2 hours (excludes ESRD)
• Bili > 2
• Platelet count < 100,000
• INR > 1.5 or PTT > 60 (excludes anticoagulation)
• Lactate > 2

Sutter OB Values
• SBP < 90 mmHg or 40 mmHg below base line -OR- MAP < 65 mmHg
• Increased O2 requirements to maintain SpO2 > 92%
• Creatinine > 1.5 –OR-UO ≤ 30 ml/hour for 2 hours
• Altered mental status
• Bili > 2
• Platelet Count < 100,000
• INR > 1.5 or PTT > 60 seconds
• Lactate > 2
## System Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Surviving Sepsis Campaign</th>
<th>Sutter Health</th>
<th>Dignity</th>
<th>Kaiser</th>
<th>UC Davis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td>&gt; 38 (100.4) or &lt; 36°C (96.8°F)</td>
<td>&gt; 38 (100.4) or &lt; 36°C (96.8°F)</td>
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<td>&gt; 38 (100.4) or &lt; 36°C (96.8°F)</td>
</tr>
<tr>
<td><strong>Maternal Heart Rate</strong></td>
<td>&gt; 90 BPM</td>
<td>&gt; 110 BPM</td>
<td>&gt; 110 BPM (Excluding during pushing)</td>
<td>&gt; 110 BPM</td>
<td>&gt; 110 BPM</td>
</tr>
<tr>
<td><strong>Respiratory Rate</strong></td>
<td>&gt; 20 BPM</td>
<td>&gt; 24 BPM</td>
<td>&gt; 24 BPM</td>
<td>&gt; 24 BPM</td>
<td>&gt; 24 BPM</td>
</tr>
<tr>
<td><strong>White Blood Count</strong></td>
<td>&gt; 12,000, &lt; 4,000, &gt; 10% Bands</td>
<td>&gt; 15,000, &lt; 4000 or &gt; 10% Bands</td>
<td>&gt; 15,000, &lt; 4000 or &gt; 10% Bands with normal CBC</td>
<td>&gt; 15,000, &lt; 4000 or &gt; 10% Bands</td>
<td>&gt; 15,000, &lt; 4000 or &gt; 10% Bands</td>
</tr>
<tr>
<td><strong>Altered Mental Status</strong></td>
<td>AMS Present</td>
<td>AMS present</td>
<td>Confusion, Agitation, Combativeness</td>
<td>AMS present</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>&gt; 140 in absence of DM</td>
<td>&gt; 140 in absence of DM</td>
<td>&gt; 140 in absence of DM</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Fetal Tachycardia</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>FHR &gt; 160 bpm (gest age &gt; 20 wks)</td>
<td>&gt; 160 BPM X 10 minutes</td>
<td>N/A</td>
</tr>
</tbody>
</table>
• Suspected infection
• Hypotension (systolic blood pressure < 90 mmHg or MAP < 65 mmHg) unresponsive to 30 ml/kg fluid bolus -and/or-
• Lactate ≥ 4
<table>
<thead>
<tr>
<th>Observation</th>
<th>Observation</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis Screen Positive</td>
<td>0.024% (99/4000)</td>
<td>Sepsis Screen Positive, confirmed</td>
</tr>
<tr>
<td>Severe Sepsis</td>
<td>0.012% (47/4000)</td>
<td>Severe Sepsis Screen Positive</td>
</tr>
<tr>
<td>Septic Shock</td>
<td>0.002% (7/4000)</td>
<td>Septic Shock Screen Positive</td>
</tr>
</tbody>
</table>
Bundles

Elements when used together, improve outcomes more than when used separately!

Evidence based
Severe Sepsis Bundle:
TO BE COMPLETED WITHIN 3 HOURS

Goal = 1 hour

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 ≥4mmol/L

CMS GUIDELINES
Treatment

Shock - Goal < 6 hours

- Fluid resuscitation (if not already completed)
- Vasopressors for hypotension
- Focused exam or Tissue Perfusion assessment
  - CVP
  - Central venous oxygen measurement
  - Bedside CV ultrasound
  - Passive leg raise or fluid challenge
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

The mortality rate for those who received antibiotics within 1 hour of diagnosis was 8.3%. The mortality rate was 20% for the patient who received antibiotics after > 1 hour.

Common organism were E.Coli (14.6%), Gram-Negative rods (9.8%), and group Strep A (7.3%).

Antibiotics are selected according to the source of infection.

Source control is a priority and may involve abscess drainage or delivery of the fetus.

For unknown source, use ANTIBIOTICS with broad spectrum coverage.

De-escalate to appropriate ANTIBIOTICS when source is identified.
• We recommend that in the resuscitation from sepsis-induced hypoperfusion, at least 30ml/kg of intravenous crystalloid fluid be given within the first 3 hours.

(Strong recommendation; low quality of evidence)

• We recommend that following initial fluid resuscitation, additional fluids be guided by frequent reassessment of hemodynamic status.

(Best Practice Statement)

Surviving Sepsis Campaign, 2018
Viral Conditions-Influenza

Tamiflu 75 mg PO BID X 5 days

Low rate of transplacental transfer

In the setting of H1N1, early antiviral therapy in pregnant women is associated with 84% reduction in admissions to ICU

Non-Invasive Cardiac Output Monitoring

- Non-invasive Cardiac Output Monitoring
- Is used to obtain hemodynamic values *without* an invasive line
- Measures stroke volume index and cardiac output
- Is used to objectively guide fluid resuscitation
- Meets criteria for Reassessment of Perfusion per CMS guidelines for sepsis (6 hour bundle element)
Most often, ED, ICU and RRT nurses are trained to use the Non-Invasive cardiac Output Monitoring. In your unit, you might see RRT bring the monitor and perform a dynamic assessment on your septic OB patient. This is done if there is a concern for giving the initial full 30ml/kg bolus -or- If the patient has received the initial 30ml/kg bolus and there is a continued perfusion issue (i.e. BP, lactates) -or- RRT will document, interpret and relay the results to the physician to discuss additional orders, if needed.
Maternal Sepsis Pathway

Screen in triage, upon admission, every shift (within first 2 hours of shift) and PRN suspected infection
Document in OB Sepsis Summary Flowsheet.

OB Screening Criteria
- □ Temp > 100.4°F (38°C) OR Temp < 96.8°F (36°C)
- □ HR > 110
- □ RR > 24
- □ WBC > 15,000
- □ WBC < 4,000 OR > 10% bands (CBC differential)

ACUTE ORGAN DYSFUNCTION EVALUATION
Evaluate for 1 or more ACUTE ORGAN DYSFUNCTION Criteria due to infection
- □ Lactate ≥ 2 mmol/L
- □ Oxygen Sat < 92%
- □ SBP < 90 mmHg* or MAP < 65
- □ SBP decrease ≥ 40 mmHg from baseline
- □ Urine output ≤ 30 ml/hr for 2 hours
- □ Creatinine ≥ 1.2 mg/dL OR doubling of creatinine
- □ Platelet count < 100,000
- □ Coagulopathy (INR > 1.5 or PTT > 60 sec)
- □ Agitation, confusion, unresponsiveness
- □ Bilirubin > 2 mg/dL

Time Zero

SEPSIS + 1 or more positive acute organ dysfunction = dx of SEPSIS

SEPTIC SHOCK CRITERIA
Evaluate for SEPTIC SHOCK Criteria
- □ Lactate ≥ 4 mmol/L OR
- □ BP Systolic < 90, MAP < 65 despite fluid resuscitation
- □ Clinical features are the same as SEPSIS

SEPTIC SHOCK INTERVENTIONS
- □ MD eval/bedside assessment/escalation of care
- □ RN Call RRT
- □ Broad spectrum antibiotic
- □ RRT/ICU MD determine if ICU admission required
- □ IV fluids NS or LR bolus 30ml/kg NOW for lactate ≥ 4 mmol/L or hypotensive (if not previously done)
  - Use pressure bag
  - Vital signs q 30 min

SEPSIS INTERVENTIONS
- □ Consider IV Fluids N/S or LR 30 mL/kg; each liter over 60 min (Lactate 2-3.9)
- □ Blood Cultures X2 (before ABX)**
- □ MD eval/bedside assessment
- □ Give broad spectrum antibiotic**
- □ Implement pulse oximetry, strict I/O
- □ Chest XRAY (if suspected lung infection)
- □ Collect UA if suspect urinary source of infection
- □ Vital Signs Q30 x 2, Q1H x 2, Q2 x 2, then Q4H
- □ Give 1 liter of NS/LR
- □ Mental status assessment

INTERVENTIONS for 1st HOUR
- □ Notify RRT and OB provider
- □ Draw Lactate, CBC, CMP, PT, PTT**
- □ Blood Cultures X2 (before ABX)**
- □ MD eval/bedside assessment
- □ Give broad spectrum antibiotic**
- □ Implement pulse oximetry, strict I/O
- □ Chest XRAY (if suspected lung infection)
- □ Collect UA if suspect urinary source of infection
- □ Vital Signs Q30 x 2, Q1Hx2, Q2 x 2, then Q4H
- □ Give 1 liter of NS/LR
- □ Mental status assessment

SEPSIS INTERVENTIONS
- □ Consider IV Fluids N/S or LR 30 mL/kg; each liter over 60 min (Lactate 2-3.9)
- □ Blood Cultures (if not previously drawn)
- □ Repeat lactate every 3 hours until lactate < 2 mmol/L
- □ SpO2 per protocol, titrate oxygen to ≥ 92%
- □ Consult with RRT
- □ MD eval/bedside assessment
- □ Vital signs Q30 x 2, Q1H x 2, Q2 x 2, then Q4H

Lactate in labor
- □ Not used in diagnosis of SEPSIS
- □ Used to trend, give fluids, & closely monitor

Start Here

Lori Olvera DNP, RNC-OB, EFM-C, May 5, 2019

*Consider source of infection
- Chorio - Pyelonephritis
- Endometritis - UTI
- Pneumonia - Other
- Intrauterine Fetal Demise

*Notes for OB provider:
- Add “Sepsis” to problem list.
Sara’s Sepsis

- 25 year-old prime
- GBS negative, no risk factors
- Admitted for labor-4cm, SROM-clear fluid
# Sara’s Sepsis

<table>
<thead>
<tr>
<th>Time</th>
<th>VS</th>
<th>Labor</th>
<th>Treatments/labs/meds</th>
<th>Notes</th>
</tr>
</thead>
</table>
| 1106 | 100.4, 112, 22, 101/56  
(NOTE: +Sepsis Screen) | FHR 160, min var., cat2, SVE 8 cm epidural | Lactate 2.4  
WBC 22.4  
Tylenol 1000mg IV  
NS 1000ml  
Cefoxitin | MD refuses additional labs and RRT |
| 1200 | HR-126, 111/56, 22 | FHR 150, mod, accels, var, UC 14/30, mod SVE 9cm | Pitocin started- 8cm | MD at bs |
Let’s look at the baby’s response..

T- 101.8,
BP-118/53, RR-26
-SVE 10cm
-FSE, Pitocin off
Oxygen @10L
mask continuously

-UO 30 ml/2 hr
-Fluid bolus 500 ml
RRT Called- Lactate 4.6
NS 1000 ml
RRT Called. Lactate 4.6
NS 1000 ml
Sinusoidal?? Mom vs. Baby’s heart rate?
Trial of pushing with MD
Head too high for vacuum
C/S called for fetal intolerance to labor
Baby Condition

- Outcome Baby: Apgars 4/7,
- Venous Cord Gas: pH 6.9
- NICU; abnormal neuro; admitted to NICU for Encephalopathy workup
## In the PACU

<table>
<thead>
<tr>
<th>Time</th>
<th>Vitals</th>
<th>Treatments</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1531</td>
<td>T-101.7, HR-166, BP-103/56,</td>
<td>RRT called, O2 placed at 5L per mask, NS bolus</td>
<td>Lactate 3.3; altered mental status Pt thought her nurses were dog-</td>
</tr>
<tr>
<td></td>
<td>RR-22, O2 sat-92%</td>
<td>2100ml</td>
<td>walkers!!! WBC 15.6 (later increased to 30.2) Blood cultures drawn;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RRT stayed at bedside; Amniotic fluid was cloudy and foul-smelling</td>
</tr>
<tr>
<td>1700</td>
<td>T-102.9, 134, 89/55(67), RR-34,</td>
<td>Cefoxitin and clindamycin given</td>
<td>ICU MD at bedside to arrange transfer to ICU/assessment</td>
</tr>
<tr>
<td></td>
<td>O2 sat 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1800</td>
<td>HR-131, 85/45(58), 95%</td>
<td>NICOM was done; indicated patient was fluid</td>
<td>Blood cultures WERE POSITIVE FOR GROUP B STREPTOCOCCUS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>responsive</td>
<td></td>
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<tr>
<td>1830</td>
<td>Transferred to ICU</td>
<td>Hypotensive, tachycardic with altered mental</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>status</td>
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</tbody>
</table>
Let’s Begin the Campaign to promote Early Recognition and Management of Maternal Sepsis
References


Graciela: "I believe that we experience moments in our lives that define who we will become. For me, that moment happened when I coded 5 days after my C-Section from septic shock."
Any Questions?
Sepsis: Across the Continuum of Care
Webinar series

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