Maternal Sepsis

Objectives

- Identify risk factors for maternal infections
- Recognize signs and symptoms of maternal infections
- Discuss medical and nursing management of maternal infection
- Recognize risk factors and signs and symptoms of maternal sepsis
- Discuss medical and nursing management of maternal sepsis
incidence


Note: The cause of death is unknown for 6.4% of all pregnancy-related deaths (CDC, 2020)

Why are pregnant & postpartum women at risk?

• Normal vaginal flora
• Pregnancy is an immunosuppressed state
• Changes in physiology during pregnancy/postpartum can mask early s/s of sepsis
• Interventions during labor/postpartum
• Maternal alkaline state favors growth of microbes

(Davidson et al., 2020; Lowdermilk et al., 2020)
Pregnancy Physiology - review

- Temperature can be affected by
  - Increased exertion during labor
  - Magnesium administration
  - Epidural anesthesia
- Heart rate increases 10-15 beats above baseline
- Respiratory rate may increase
- PaCO2 decreased due to compensated respiratory alkalosis
- WBCs increase

Postpartum infections

Common Types:
- Chorioamnionitis
- Endometritis
- Wound infection – cesarean or perineal
- Urinary tract infection (UTI)
- Breast infection
- Respiratory Tract

Diagnostic Lab Orders:
- CBC
- Urine cultures
- Blood and uterine tissue cultures
Infection risk factors - Antepartum

- History of previous venous thrombosis, UTI, mastitis, pneumonia
- Obesity
- Diabetes
- Preeclampsia
- Preexisting infection (bacterial vaginosis, HSV, chlamydia, etc.)
- Immunosuppression
- Anemia
- Malnutrition
- Smoking, alcoholism, and/or substance use disorder

(Davidson et al., 2020; Lowdermilk et al., 2020)

Infection risk factors - Intrapartum

- Cesarean birth
- Operative vaginal birth
- Episiotomy or lacerations
- Hematomas
- Prolonged ROM
- Chorioamnionitis
- Prolonged labor
- Bladder catheterization
- Internal FHR monitoring or IUPC monitoring
- Multiple vaginal exams after ROM
- Epidural analgesia/anesthesia
- Manual removing of placenta and/or retained placental fragments
- Uterine exploration after delivery
- Postpartum hemorrhage

(Davidson et al., 2020; Lowdermilk et al., 2020)
Chorioamnionitis/ intra-amniotic infection

- Historically: an infection of the chorion, amnion, or both
- “Intra-amniotic infection" (IAI): infection with inflammation with any combination of the amniotic fluid, placenta, fetus, fetal membranes, or decidua
- Usually occurs from ascending bacterial invasion from the lower genital tract to the typically sterile amniotic cavity

Intra-Amniotic Infection (IAI) - Incidence

- Occurs in 2-5% of term deliveries
- Significant risk reduction associated with intrapartum antibiotic treatment
  - GBS + mothers
  - Signs and symptoms of infection in labor
- Increased risk related to:
  - > 41 weeks gestation
  - Low parity
  - Long labor duration
  - Long ROM duration
  - Multiple digital exams
  - Use of internal monitors during labor
  - Meconium stained fluid
  - Genital tract pathogens
Intra-Amniotic Infection (IAI) - Presentation

- **Suspected intraamniotic Infection:**
  - Maternal temp ≥ 39 degrees Celsius (102.2 Fahrenheit)
  - Or 38-38.9 degrees Celsius (100.4-102.1 Fahrenheit) with at least 1 additional risk factor

- **Isolated maternal fever:**
  - Any maternal temperature 38-38.9 degrees Celsius (100.4-102.1 Fahrenheit)
  - With no additional risk factors
  - With or without persistent fever

- ↑ WBCs
- Purulent cervical drainage
- Fetal tachycardia

May be confirmed by:
- + amniotic fluid test result (gram stain or cultures)
- Placenta pathology

(ACOG, 2017)

Intra-Amniotic Infection (IAI) - Management

- Treatment should not be delayed if IAI is suspected
- Cesarean rarely indicated for infection alone
- Intrapartum antibiotics
  - Suspected infection
  - Isolated fever - unless a different source for fever identified and documented

- Antibiotics continued postpartum based on evaluation of risk factors
  - Persistent fever
  - Bacteremia
  - Antipyretics
  - Comfort measures

(ACOG, 2017)
ACOG Antibiotic treatment recommendations

Pyelonephritis

- Results from untreated cystitis
  - Infection progresses to the kidneys
- Most common causative agent is Escherichia coli

(Davidson et al., 2020; Lowdermilk et al., 2020)
UTI – May First present to unit as cystitis

- Frequency and/or urgency
- Dysuria
- Urinary retention
- Hesitancy and dribbling
- Nocturia
- Suprapubic pain
- Hematuria
- Pyuria

[Davidson et al., 2020; Lowdermilk et al., 2020]

Cystitis progress to Pyelonephritis

- Lower UTI/Cystitis signs and symptoms plus
- Flank pain (unilateral or bilateral)
- Costovertebral angle tenderness
- High fever
- Chills
- Nausea, vomiting

[Davidson et al., 2020; Lowdermilk et al., 2020]
Urinary Tract infection (UTI) management

- Diagnosis – clean catch urine sample
- Usually treated outpatient
- Antibiotic therapy
- Analgesia
- Hydration
- Antispasmodic or urinary analgesic agents (Pyridium)

- Education:
  - Worsening signs and symptoms
  - Importance of completing antibiotic therapy
  - Hand and perineal hygiene
  - Increasing fluid intake
  - Frequent voiding Q2-4H
  - Unsweetened cranberry juice or supplements for prevention

(Matthews et al., 2020; Lowdermilk et al., 2020)

Maternal sepsis

- Sepsis is an overexaggerated, systemic inflammatory response to an invasive organism
  - Resulting in organ dysfunction
  - If treatment is delayed may result in septic shock
- Occurs most commonly within 42 days postpartum
- 63% maternal deaths from sepsis are preventable
- Pregnancy related immunocompromised state increases risk

(Building U.S. Capacity to Review and Prevent Maternal Deaths, 2018; CMQCC, 2019)
Maternal sepsis - etiology

- Often polymicrobial
- Common pathogens: escherichia coli, group B Streptococcus (GBS), staphylococcus aureus, group A Streptococcus pyogenes (GAS)
- Group A Streptococcus pyogenes (GAS)
  - Postpartum at 20-fold increased risk vs. non-obstetric population
  - Exotoxins cause widespread tissue necrosis of major organs
  - 60% mortality rate
- May also be viral

(Parfitt et al., 2017)
Maternal sepsis - Potential Etiologies

<table>
<thead>
<tr>
<th>Antepartum</th>
<th>Intrapartum/ Immediate Postpartum</th>
<th>Post-discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Septic abortion</td>
<td>• Intraamniotic infection (IAI)/Chorioamnionitis</td>
<td>• Pneumonia/influenza</td>
</tr>
<tr>
<td>• Intraamniotic infection (IAI)/Chorioamnionitis</td>
<td>• Endometritis</td>
<td>• Pyelonephritis</td>
</tr>
<tr>
<td>• Pneumonia/influenza</td>
<td>• Pneumonia/influenza</td>
<td>• Wound infection/necrotizing fasciitis</td>
</tr>
<tr>
<td>• Pyelonephritis</td>
<td>• Pyelonephritis</td>
<td>• Mastitis</td>
</tr>
<tr>
<td>• Appendicitis</td>
<td>• Wound infection/necrotizing fasciitis</td>
<td>• Cholecystitis</td>
</tr>
</tbody>
</table>

(MatQCC, 2019)

Maternal sepsis - pathophysiology

• Toxins release by gram-negative (e coli) and gram-positive(staph, strep, pneumo) organisms cause *heightened inflammatory response* resulting in:
  • Increased endothelial dysfunction
  • Vascular permeability
  • Septic shock

(Parfitt et al., 2017)
Maternal sepsis - pathophysiology

- These changes lead to:
  - Hypotension
  - Hemoconcentration
  - Edema

- May show changes in cardiac function:
  - Systolic and diastolic changes in BP
  - Decreased mean arterial pressure (MAP)

- Exaggerated inflammatory process can also lead to clotting abnormalities and DIC

Maternal sepsis - pathophysiology

- Impaired oxygenation to tissues
  - Sepsis can also change mitochondrial function
  - This inhibits cellular extraction of oxygen even with normal hgb sat levels

- Problems with end-organ perfusion
  - Can lead to end-organ damage and death
maternal sepsis - risk factors

- Non-Caucasian race
  - African American and others
- Medicaid or no insurance
- Delivery at a low-volume hospital
  - < 1000 births per year
- Lack of access to prenatal care
- Low socioeconomic status
- Greater than 35 years of age
- Poor nutrition
- Tobacco use

- History of group B strep colonization or infection
- A patient who presents
  - with a fever resulting from an infection prior to delivery, or
  - the use of antibiotics 2 weeks prior to admission
- Anemia
- Immunosuppression
- Transfusion
- History of diabetes, obesity, HTN

(Albright et al., 2016)

maternal sepsis - risk factors

<table>
<thead>
<tr>
<th>Antepartum</th>
<th>Intrapartum</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>Prolonged ROM</td>
<td>Retained placental fragments</td>
</tr>
<tr>
<td>Poor nutrition</td>
<td>Lengthened active labor stage</td>
<td>Hemorrhage</td>
</tr>
<tr>
<td>Chronic hypertension</td>
<td>&gt; 5 vaginal exams during second stage of labor</td>
<td>Cracked nipples</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Operative vaginal birth</td>
<td>Mastitis</td>
</tr>
<tr>
<td>Anemia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased spleen function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunosuppression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invasive procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of GBS infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of prenatal care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwhite ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primipara</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics w/in 2 weeks of delivery (includes cesarean prophylaxis)</td>
<td>Unscheduled cesarean</td>
<td></td>
</tr>
</tbody>
</table>

(Parfitt et al., 2017)
Maternal Sepsis - Challenges

- Physiologic changes related to pregnancy/postpartum mask sepsis indicators seen in the non-OB population
- Early warning systems are used for non-obstetric patients
  - SIRS, qSOFA
- Modified MEWS scored poorly in detecting sepsis
- Early recognition of risk factors and signs/symptoms is critical

(Sparrow et al., 2017)

---

Maternal Sepsis – Challenges

<table>
<thead>
<tr>
<th>SIRS</th>
<th>qSOFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any two of the following:</td>
<td>Any two of the following:</td>
</tr>
<tr>
<td>• Temp &lt;96.8°F or &gt;100.4°F (&lt;36°C or &gt;38°C)</td>
<td>• RR &gt;22</td>
</tr>
<tr>
<td>• WBC &lt;4 or &gt;12</td>
<td>• SBP &lt;100</td>
</tr>
<tr>
<td>• HR &gt;90</td>
<td>• Neuro changes</td>
</tr>
<tr>
<td>• RR &gt;20</td>
<td></td>
</tr>
</tbody>
</table>
Maternal Sepsis - Management

1. Early recognition
2. Notify provider
3. Prompt treatment
4. Confirm sepsis and evaluate for end organ injury
5. Escalate to higher level of care

Early recognition - Clinical Presentation

- Temperature
  - >38.0 C (100.4 F) or
  - <36.0 C (96.8 F)
- Heart rate
  - <50 or
  - >110-120 BPM
- Respiratory rate
  - <10 or
  - >24-30 breaths/min
- BP
  - SBP <85-90 mmHg or
  - MAP <65 mmHg or
  - >40 mmHg decrease in SBP
  - SpO2 less than 95%

(Council on Patient Safety in Women’s Healthcare, 2017; DMQCC, 2019)
Early recognition - Clinical Presentation

- Flushed, clammy or mottled skin
- Nausea and/or vomiting
- Edema (generalized)
- Oliguria or anuria
  - <35ml/hr x 2 hr or
  - <0.5ml/kg/hour x 2 hrs
- Clotting abnormalities
- Pain
- Foul odor of body fluids or exudate
- Altered mental state

(Brown, 2018)

OB Specific Tools for initial sepsis screen

<table>
<thead>
<tr>
<th>MEWS</th>
<th>CMQCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any one of the following:</td>
<td>Positive if any 2 of 4 criteria are met:</td>
</tr>
<tr>
<td>• SBP &lt;90 or &gt;160</td>
<td>• Temp &lt;36.0 C (96.8 F) or ≥38.0 C (100.4 F)</td>
</tr>
<tr>
<td>• DBP &gt;100</td>
<td>• HR &gt;110 bpm and sustained for 15 minutes</td>
</tr>
<tr>
<td>• HR &lt;50 or &gt;120</td>
<td>• RR &gt; 24 breaths per minute and sustained for 15 minutes</td>
</tr>
<tr>
<td>• RR &lt;10 or &gt;30</td>
<td>• WBC &gt;15,000 or &lt;4,000 or &gt;10% immature neutrophils (bands)</td>
</tr>
<tr>
<td>• O2 sat &lt;95</td>
<td>• Agitation, confusion, unresponsiveness</td>
</tr>
<tr>
<td>• Oliguria &lt;35ml/hr x 2hr</td>
<td>• HTN + unremitting headache or SOB</td>
</tr>
</tbody>
</table>

Ob Sepsis screening considerations

- If suspected infection present, MAP <65 mmHg is sufficient to initiate sepsis protocol/treatment
- Vitals + O2 sats should be repeated after 15 minutes if abnormal assessments are present and verified
- Sustained maternal HR >130 bpm is highly concerning for end organ injury
- WBCs peak 24 hours after antenatal corticosteroid administration
  - Return close to baseline by 96 hours of age

Notify Provider

- Notify provider of:
  - Vital sign changes
  - Assessments
  - Notify provider of sepsis alert
  - Consult with core nurse and other team members
  - Lab findings if available
- Prompt *bedside* evaluation by provider


Prompt treatment

• Initiate treatment within 1 hour of sepsis diagnosis or suspicion (while waiting for lab confirmation)
  1. IV fluid resuscitation (1-2L bolus)
  2. Administer antibiotics
  3. Antipyretics
• Order labs
• Monitor intake and output
• Increase vitals/assessment frequency
• Supportive measures

[Image: TELL ME AGAIN HOW YOU WENT ON WERMA AND YOU THINK YOU KNOW WHAT’S WRONG]

Confirmation of Sepsis

• Lab values:
  • CBC (including immature neutrophils-bands and platelets)
  • Coagulation status (prothrombin time-PT, international normalized ratio-INR, partial thromboplastin time-PTT)
  • CMP (including bilirubin, creatinine)
  • Lactic acid
• Bedside assessment
  • Urine output (foley ideal)
  • Pulse oximetry
  • Mental status

[Image: Blood samples in test tubes]
Confirmation of sepsis - Additional values/assessments

- Hyperglycemia in the absence of diabetes
- Elevated liver enzymes
- Disseminated intravascular coagulation
- Positive culture from infection site or blood

(Evaluate for end organ injury)

<table>
<thead>
<tr>
<th>Measure of End Organ Injury</th>
<th>Criteria (one is sufficient for diagnosis)</th>
</tr>
</thead>
</table>
| Respiratory Function        | • Acute respiratory failure – need for mechanical ventilation (invasive or noninvasive)  
                               • PaO2/FiO2 <300 |
| Coagulation Status          | • Platelets 100,000 or  
                               • INR > 1.5 or  
                               • PTT > 60 seconds |
| Liver Function              | • Bilirubin > 2mg/dL                      |

(Brown, 2018; CMQCC, 2020)

(CMQCC, 2019)
Evaluate for end organ injury Cont.

<table>
<thead>
<tr>
<th>Measure of End Organ Injury</th>
<th>Criteria (one is sufficient for diagnosis)</th>
</tr>
</thead>
</table>
| **Cardiovascular Function** | • Persistent hypotension after fluid administration  
• SBP < 85 mmHg or  
• MAP < 60 mmHg or  
• >40 mmHg decrease in SBP |
| **Renal Function**         | • Creatinine > 1.2 mg/DL or  
• Doubling of creatinine or  
• UO <0.5ml/kg/hr for 2 hours |
| **Mental Status**          | • Agitation, confusion, unresponsiveness |
| **Lactic Acid**            | • 2mmol/L |

Interpretation of Lab values for end organ injury

<table>
<thead>
<tr>
<th>Laboratory Value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial pH &lt; 7.39 to 7.45</td>
<td>Reflects an increase in lactic acid</td>
</tr>
<tr>
<td>Lactate level &gt; 2.0 mmol/dL</td>
<td>Reflects decreased perfusion of oxygen to cells</td>
</tr>
<tr>
<td>Creatinine &gt; 1.0 mg/dl</td>
<td>Reflects decrease in kidney function</td>
</tr>
<tr>
<td>Bilirubin &gt; 4 mg/dl</td>
<td>Reflects decrease in liver function</td>
</tr>
<tr>
<td>Platelets &lt; 100,000 mm$^3$</td>
<td>Reflects endothelial damage</td>
</tr>
<tr>
<td>INR &gt; 1.5 or aPTT &gt; 60 seconds</td>
<td>Reflects coagulopathy</td>
</tr>
<tr>
<td>Glucose &gt;120 mg/dl</td>
<td>Reflects the stress of critical illness</td>
</tr>
</tbody>
</table>
Postpartum Infection/Sepsis prevention

- Most effective treatment is prevention
- Hygiene
- Nutrition
- Strict aseptic technique during labor, birth, postpartum
- Anticipatory education
- Support after discharge

(Davidson et al., 2020)
References