The Expanding Role of the Anesthesiologist in Reducing Colon SSI

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Evolving Role of Anesthesiology

• In the mid 1980’s, mortality from anesthesia itself was about 1:15,000 anesthetics.
• Harvard and the ASA adopted universal standards for monitoring and over the next few decades, death under anesthesia dropped to as few as 1:200,000 anesthetics for ASA 1 and 2 patients.
• Anesthesiology was cited over eleven times as the model for safe patient care in the Board of Medicine’s provocative monograph, *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001).
Next Steps for Anesthesiology

• The Perioperative Surgical Home (PSH) is an innovative practice model that has been proposed by ASA as a potential solution to the disjointed and costly perioperative system currently found in the United States.

• This practice model is defined as “a patient-centered and physician-led multidisciplinary and team-based system of coordinated care that guides the patient throughout the entire surgical experience.”
Five major goals for the PSH

1. Provide a portal of entry to perioperative care and ensure continuity.
2. Identify and manage patients according to acuity, comorbidities and risk factors.
3. Deliver evidence-based clinical care before, during, and after the procedure.
4. Manage, coordinate, and follow up on perioperative care across specialty lines.
Perioperative Surgical Home Overview
Colorectal Surgery Bundle Concept

- Anesthesiologists can play a pivotal role in working with surgeons to reduce SSIs.
- Areas where anesthesiology providers can oversee and administer include:
  - Perioperative glycemic control
  - Perioperative normothermia
  - Perioperative tissue oxygenation
  - Intra/postoperative antimicrobial prophylaxis
Anesthesiologists have some control over six factors that can reduce surgical site infections:

1. Hypothermia
2. Hyperoxia
3. Perioperative Fluid Management
4. Hyperglycemia
5. Blood Transfusion and the Risk of Infection
6. Antimicrobial Prophylaxis
American Society of Anesthesiologists Recommendations for Infection Control for the Practice of Anesthesiology (Third Edition)¹

II C. Prevention of Surgical Site Infection

- i. Preoperative considerations
  - 1. Hair removal
  - 2. Glucose control
  - 3. Nicotine use
  - 4. Transfusion
  - 5. Antiseptic shower
  - 6. Antimicrobial prophylaxis

- ii. Intraoperative considerations
  - 1. Ventilation
  - 2. Cleaning
  - 3. Surgical attire
  - 4. Asepsis and surgical technique
  - 5. Normothermia

- iii. Postoperative considerations
  - 1. Postoperative incision care
  - 2. Surveillance
**Recommendation:** Consider control serum blood glucose levels preoperatively in all diabetic patients and avoid perioperative hyperglycemia, to an extent that would not place the patient at risk of hypoglycemia.

**Rationale:** ...data suggest that a significant relationship exists between increasing levels of hemoglobin (Hg) A1c and SSI rates. In addition, hyperglycemia (>200 mg/dL) has been associated with increased SSI risk in the immediate postoperative period\(^1,2\).

Normoglycemia promotes PMN bactericidal actions, immunoglobulin and complement functions.

Mauermann WJ, Nemergut EC. Anesthesiology 2006;105:413-421
Hyperglycemia - Anesthesiology 2006

- Diabetic patients are at increased risk for SSIs.
- Diabetic patients’ PMNs have impaired chemotaxis, decreased phagocytosis, and lower bactericidal ability.
- Glucose challenge in healthy volunteers showed a transient reduction in PMN and all lymphocyte subset counts.
- Hyperglycemia deactivates immunoglobulins and blocks complement C action.
- Insulin infusions work better than a sliding scale. A 66% reduction in sternal SSI seen in cardiac patients\(^1,2\).

Hyperglycemia:
Decreases PMN chemotaxis, phagocytosis and bacterial destruction
Decreases IgG fixation of complement
Decreases complement binding to bacteria

Mauermann WJ, Nemergut EC. Anesthesiology 2006;105:413-421
**Normothermia – ASA Recommendations 3ed**

**Recommendation:** Maintain patient normothermia.

**Rationale:** Hypothermia (core temperature <36°C) has been associated with an increased SSI risk\(^1,2\). Mild hypothermia seems to increase SSI risk by causing vasoconstriction, decreased oxygen delivery to the wound space, and impaired phagocytic leukocyte function\(^3,4\).

• 200 colorectal surgical patients were randomized in a double-blind, controlled trial into Normothermia v. Hypothermia groups
• Wounds evaluated daily until discharge and 2 weeks later in clinic
• Wounds with culture positive pus were considered to be infected

**Results:**
• Mean temp: Hypo – 34.7°C v. Normo – 36.6°C, p<.001
• Infections: Hypo – 18/96 (19%) v. Normo – 6/104 (6%), p=.009
• Sutures were removed one day later (p=.002) and 20% of patients were discharged 2.6 days later (p=.01) in Hypo group.

The major relationship between hypothermia and increased SSI is thought to be a decrease in subcutaneous tissue perfusion mediated by vasoconstriction.

Providing adequate oxygen delivery maintains oxidative killing by neutrophils.

Patients with subcutaneous oxygen tension ($P_tO_2$) greater than 90 mmhg had no infections while those with $P_tO_2$ of 40-50 mmhg had an infection rate of 43%.


Mauermann WJ, Nemergut EC. Anesthesiology 2006;105:413-421.
Hypothermia and Hypovolemic

Hypothermia causes vasoconstriction which produces inadequate tissue oxygen perfusion and reduced neutrophil (PMNs) migration to the site.

Blood and fluid loss (hypovolemia) also leads to inadequate tissue oxygen perfusion.

Less oxygen and lower PMN migration reduces bacteria killing effect by neutrophils.

Bacterial infection occurs.

Mauermann WJ, Nemergut EC. Anesthesiology 2006;105:413-421
Normothermia, Euvolemia and Hyperoxia Benefits

Normothermia – maintains normal blood flow and oxygen delivery to tissue.

Euvolemia – maintains adequate tissue perfusion.

Hyperoxia – delivers sufficient oxygen for PMN cytotoxic and phagocytic activity.

Bacterial growth is thwarted.

Mauermann WJ, Nemergut EC. Anesthesiology 2006;105:413-421
Perioperative Supplemental Oxygen Therapy and Surgical Site Infection

A Meta-analysis of Randomized Controlled Trials

Motaz Qadan, MBChB, MRCS(Edin); Ozan Akça, MD; Suhal S. Mahid, MRCS, PhD; Carlton A. Hornung, MPH, PhD; Hiram C. Polk Jr, MD

- Objective: High $O_2$ vs. Standard $O_2$ and incidence of SSI
- Sources: MEDLINE, EMBASE, Cochrane
- Selection: 5 RCTs (from 2167 articles) applied to objective
- 3001 patients assessed
- SSIs: 12% in control, 9% in high $O_2$. RRR=25%, ARR=3%, CI=95%
- Conclusion: “...significant beneficial effect...recommend its use”
- Limitations:
  - Variable use of antibiotics and blood loss among studies.
  - No standard definition of infection.
  - Significant improvement in all but one study, where SSI rate increases.
<table>
<thead>
<tr>
<th>Surgical Service</th>
<th>Routine Pre-Operative/Intra-Operative*</th>
<th>Penicillin or Cephalosporin Allergy</th>
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</thead>
<tbody>
<tr>
<td>Colorectal/Hepato-biliary</td>
<td>Ertapecin Intravenous 1 gram every 7 hours</td>
<td>Levofloxacin Intravenous 500 milligrams once AND Clindamycin Intravenous 900 milligrams every 6 hours</td>
</tr>
<tr>
<td>Esophagectomy and other Upper Gastrointestinal</td>
<td>Ertapecin Intravenous 1 gram every 7 hours</td>
<td>Levofloxacin Intravenous 500 milligrams once on call AND Clindamycin Intravenous 900 milligrams every 6 hours</td>
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<tr>
<td>Genitourinary</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Levofloxacin Intravenous 500 milligrams once</td>
</tr>
<tr>
<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ertapecin Intravenous 1 gram every 7 hours</td>
<td></td>
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<tr>
<td>Gynecology</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Clindamycin Intravenous 900 milligrams every 6 hours</td>
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<tr>
<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
<td>For Bowel Involvement: Ertapecin Intravenous 1 gram every 7 hours</td>
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<tr>
<td>Neurosurgery</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Vancomycin Intravenous 1 gram once</td>
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<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
<td></td>
</tr>
<tr>
<td>Head &amp; Neck Skin incisions</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Clindamycin Intravenous 900 milligrams every 6 hours</td>
</tr>
<tr>
<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
<td></td>
</tr>
<tr>
<td>Head &amp; Neck Mucosal incisions</td>
<td>Unasyn Intravenous 3 grams every 2 hours</td>
<td>Levofloxacin Intravenous 500 milligrams once and Clindamycin Intravenous 900 milligrams every 6 hours</td>
</tr>
<tr>
<td>Plastic, Reconstructive, Breast, Head &amp; Neck, Soft tissue</td>
<td>Cetazolin IV 2 grams every 4 hours</td>
<td>Clindamycin Intravenous 900 milligrams every 6 hours</td>
</tr>
<tr>
<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
<td></td>
</tr>
<tr>
<td>Dental</td>
<td>Amoxicillin oral 2 grams by mouth 1 hour before procedure -OR- Cetazolin Intravenous 1 gram within 30 minutes before procedure</td>
<td>Clindamycin Intravenous 900 milligrams within 30 minutes before procedure</td>
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<tr>
<td></td>
<td>If patient greater than 80 kilograms: Cetazolin Intravenous 2 grams within 30 minutes before procedure</td>
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<tr>
<td>Orthopaedic</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Vancomycin Intravenous 1 gram once</td>
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<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
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<tr>
<td>Thoracic</td>
<td>Cetazolin Intravenous 2 grams every 4 hours</td>
<td>Clindamycin Intravenous 900 milligrams every 6 hours</td>
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<tr>
<td></td>
<td>If patient greater than 120 kilograms: Cetazolin Intravenous 3 grams every 4 hours</td>
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In patients with MRSA Colonization undergoing procedures that only require prophylaxis against skin flora, Vancomycin should replace cefazolin. If the procedure requires prophylaxis against other flora (e.g. GI and Head & Neck Mucosal surgeries), then Vancomycin should be added to prophylactic regimen (e.g. Vancomycin & ertapecin). Consult infectious disease regarding other patients with infection or colonization with resistant organisms.

References: ASHP Clinical practice guidelines for antimicrobial prophylaxis in surgery 2013
Summary

• Anesthesia personnel can play a key role in the perioperative setting to help surgical patients and surgeons in reducing surgical site infections.

• There are six ways where SSI reduction may be accomplished by prophylactic maneuvers of anesthesia personnel. The evidence is so strong for some of these factors that implementation have become quality measures. As always, teamwork and effective communication among caregivers is essential for optimal patient outcomes.