### General Principles of Perioperative Neurosurgery

Last updated: December 20, 2020

#### MORBIDITY, MORTALITY

<table>
<thead>
<tr>
<th>TABLE 1: Clavien-Dindo Classification of Surgical Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade</strong></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>IV</td>
</tr>
<tr>
<td>V</td>
</tr>
</tbody>
</table>

Within 30 days:

<table>
<thead>
<tr>
<th>TABLE 2: A Summary of Statistically Significant Predictors for the 3 Primary Outcome Measures: Wound Disruption, Clavien-Dindo Grade IV Complications, and Death (as a summary of Table 1–6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predictor</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Level of resident training</td>
</tr>
<tr>
<td>Initial diagnosis</td>
</tr>
<tr>
<td>Preoperative variables</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
</tr>
<tr>
<td>Socioeconomic status</td>
</tr>
<tr>
<td>Anesthesiologist's experience</td>
</tr>
<tr>
<td>Operation type</td>
</tr>
<tr>
<td>Procedure complexity</td>
</tr>
<tr>
<td>Postoperative monitoring</td>
</tr>
</tbody>
</table>

Wound disruption (within 30 days):

<table>
<thead>
<tr>
<th>TABLE 3: Logistic Regression With Multiple Variables. Models include: Preoperative variables for Any Wound Disruption; Same Surgical Site for Intraoperative Variables; Specific Robust Model; Group 1; and/or, Organ-Specific Risk Model. Wound Disruptions Within 30 Perioperative Days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Level of resident training</td>
</tr>
<tr>
<td>Initial diagnosis</td>
</tr>
<tr>
<td>Preoperative variables</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
</tr>
<tr>
<td>Socioeconomic status</td>
</tr>
<tr>
<td>Anesthesiologist's experience</td>
</tr>
<tr>
<td>Operation type</td>
</tr>
<tr>
<td>Procedure complexity</td>
</tr>
<tr>
<td>Postoperative monitoring</td>
</tr>
</tbody>
</table>

### Clavien-Dindo Grade IV* complication (within 30 days):

*end-organ dysfunction, necessitating intermediate or intensive care unit management

DOI 10.1093/neuros/nyy277

Mack M et al. of General Principles of Perioperative Neurosurgery Op120 (1)
Death (within 30 days):

- Death (within 30 days):
  - DOI: 10.1093/neuros/nyy277

**IMAGING**

- repeat head CT if neurological status changes.
- routinely repeat plain head CT after 6 hours (or earlier if neuro status changes) for TBI with hemorrhage in observation; some prefer to document stable CT 24 hours apart.

**ANTI COAGULANTS / REVERSAL**

Doses and reversal strategies – see p. Rx0 >>

**ANTI AGGREGANTS / REVERSAL**

Doses and reversal strategies – see p. Rx0 >>

**Platelet function testing**

1. **PLATELET FUNCTION TESTING** (if result: < 40% or > 194 – no platelet inhibition; patient maybe nonresponding to Plavix – reload with 300–600 mg of Plavix)

2. **ASPIRIN**
   - **VerifyNow P2Y12** (result < 550 Aspirin Reaction Units = platelet dysfunction consistent with aspirin)
   - **PFA-100 test** - performed with the Collagen/Epinephrine membrane; normal Col/Epi closure time (< 188 seconds) excludes the presence of a significant platelet function defect. If > 188 seconds, the Col/ADP test is automatically performed:
     - normal Col/ADP (< 108 seconds) = aspirin-induced platelet dysfunction
     - prolonged Col/ADP (> 108 seconds) = hematocrit < 0.28, platelet count < 100, significant platelet function defect (von Willebrand disease, other inherited/acquired platelet dysfunction)

**ASPIRIN**

ASA in brain tumor resection. Cessation of ASA in patients with cardiovascular disease is associated with a known increased risk of thrombotic events, especially in patients with coronary stents.

Of the 452 patients analyzed, there were no statistical differences detected between the groups (stopped ASA preop or continued uninterrupted) for outcomes including bleeding complications, need for reoperation, or thrombotic complications.

**CONCLUSIONS:** In this analysis, perioperative low dose ASA use was not associated with increased risk of perioperative complications.

DIABETES

- **Metformin** should be held 48 hours before any surgery, and should not be restarted post-op until patient has fully recovered and is eating and drinking normally.

  N.B. especially important in angiography – risk of **lactic acidosis** - hold metformin 48 hours after angiography.

**ANTIHYPERTENSIVES**

Doses – see p. Rx0 >>

- **β-Blockers** – continue periop!

**SEDATION**

Doses – see p. Rx0 >>

- in intubated patients who are sufficiently alert to experience discomfort from endotracheal tube, low doses of short-acting anesthetics such as **propofol** or **dexmedetomidine** can be used to avoid marked hypertension, anxiety, or dysynchrony with ventilator.

**SEIZURE PROPHYLAXIS**

Doses – see p. Rx0 >>

A) **Phenytoin** / **Topiramate** (check serum level after 3rd dose; goal 1-2; reload if needed)

B) **Levetiracetam**

- for 7 days, then stop (unless documented seizures or paralyzed – continue until TOF 4/4 and no seizure activity noted).

**NAUSEA AND VOMITING**

Doses – see p. Rx0 >>

- post-operative nausea and vomiting may:
  1) adversely affect ICP
  2) may negatively impact recent cervical surgical procedures

**FEEDING**

- Dobhoff tube – see p. 2209 >>

**STOMACH PROTECTION**

1) **PPI**
2) **H2-Blockers** – risk of thrombocytopenia

**ALCOHOL**

- if signs of alcohol abuse: CIWA scale with phenobarbital PRN, thiamine 100 mg IV STAT, “goody” bag IV, substance abuse consult.

**CARDIOVASCULAR AND PULMONARY**

- keep normotensive (SBP goal 100-160 mmHg); exceptions:
  1) ischemic stroke
  2) IPH
  3) SAH

- keep euvoletic (esp. avoid hypotension).
- goal pO2 > 100 mmHg, SaO2 > 90-93%, pCO2 35-40 mmHg.

**MINIMALLY INVASIVE HEMODYNAMIC MONITORING**

**VIGILEO MONITOR**

- volemia monitoring in mechanically ventilated patients without arrhythmias.
- requires central line and A-line.

**Goals**

- CO (cardiac output) > 3
- SV (stroke volume) > 70
- SVV (stroke volume variation) < 10

- intrathoracic pressure changes due to ventilation – it is reflected in systolic BP, in normovolemia that fluctuation should be < 10
GENERAL PRINCIPLES OF PERIOPERATIVE NEUROSURGERY

Op120 (4)

POSTOPERATIVE PAIN

- KETOROLAC (Toradol) - safe for postoperative pain management in pediatric population - there is no association between ketorolac use and clinically or radiographically significant hemorrhage.


- avoid NSAIDs where bone fusion is needed.

DVT PROPHYLAXIS

- SCD
- prophylactic heparin (some delay until 24 hours postop or TBI)

A) HEPARIN 5000 units subQ q8h (head problems); if < 60 kg use q12h

B) Enoxaparin 30 mg subQ q12h (sci, trauma with long bone fx)

C) Enoxaparin 40 mg subQ daily (ischemic stroke); if morbidly obese use 40mg q12h

INFECTION PROPHYLAXIS

Doses – see p. RX0 >>

Intraoperative antibiotics – see p. Op100 >>

Spine aspects – see p. Op220 >>

Skull fractures (incl. triple abx) – see p. ThH5 >>


Advise patients to shower or bathe (full body) with soap (antimicrobial or nonantimicrobial) or an antiseptic agent on at least the night before the operative day. (Category IB – strong recommendation; accepted practice.)

- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the optimal timing of the preoperative shower or bath, the total number of soap or antiseptic agent applications, or the use of chlorhexidine gluconate washcloths for the prevention of SSI.

- application of a microbial sealant immediately after intraoperative skin preparation is not necessary for the prevention of SSI. (Category IA – strong recommendation; high-quality evidence.)

- the use of plastic adhesive drapes with or without antimicrobial properties is not necessary for the prevention of SSI. (Category II – weak recommendation; low-quality evidence suggesting a trade-off between clinical benefits and harms.)

- randomized controlled trial evidence was insufficient to evaluate the trade-offs between the benefits and harms of repeat application of antiseptic agents to the patient’s skin immediately before closing the surgical incision for the prevention of SSI.

- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding antimicrobial dressings applied to surgical incisions after primary closure in the operating room for the prevention of SSI.

The search did not identify randomized controlled trials that evaluated soaking prosthetic devices in antiseptic solutions before implantation for the prevention of SSI.
Antimicrobial prophylaxis should be administered only when indicated based on published clinical practice guidelines and timed such that a bactericidal concentration of the agents is established in the serum and tissues when the incision is made. (Category II–strong recommendation; accepted practice.)

- no further refinement of timing can be made for preoperative antimicrobial agents based on clinical outcomes. (No recommendation/unsolved issue.)
- literature search did not identify randomized controlled trials that evaluated the benefits and harms of intraoperative antimicrobial prophylaxis dosing and its effect on the risk of SSI.
- search did not identify sufficient randomized controlled trial evidence to evaluate the benefits and harms of intraoperative resuming of parenteral prophylactic antimicrobial agents for the prevention of SSI.
- for clean and clean-contaminated procedures, additional prophylactic antimicrobial agent doses should not be administered after the surgical incision is closed in the operating room, even in the presence of a drain. (Category IA–strong recommendation; high-quality evidence.)

Consider intraoperative irrigation of deep or subcutaneous tissues with aqueous iodophor solution for the prevention of SSI. Intraperitoneal lavage with aqueous iodophor solution in contaminated or dirty abdominal procedures is not necessary. (Category II–weak recommendation; moderate-quality evidence suggesting a trade-off between clinical benefits and harms.)

- do not apply topical antimicrobial agents (i.e., ointments, solutions, or powders) to the surgical incision for the prevention of SSI. (Category II–strong recommendation; low-quality evidence.)
- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding intraoperative antimicrobial irrigation (eg, intra-abdominal, deep, or subcutaneous tissues) for the prevention of SSI.

During surgery, glycemic control should be implemented - target levels < 200 mg/dL in all patients, with and without diabetes. (Category IA–strong recommendation; high to moderate–quality evidence.)

- search did not identify randomized controlled trials that evaluated the optimal hemoglobin A1C target levels for the prevention of SSI in patients with and without diabetes.

Maintain perioperative normothermia. (Category IA–strong recommendation; high to moderate–quality evidence.)

Increased fraction of inspired oxygen should be administered during surgery and after extubation in the immediate postoperative period for patients with normal pulmonary function undergoing general anesthesia with endotracheal intubation.

- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the administration of increased fraction of inspired oxygen (FiO2) via endotracheal intubation during only the intraoperative period in patients with normal pulmonary function undergoing general anesthesia for the prevention of SSI.
- to optimize tissue oxygen delivery, maintain perioperative normothermia and adequate volume replacement. (Category IA–strong recommendation; moderate-quality evidence.)
- to optimize tissue oxygen delivery, maintain perioperative normothermia and adequate volume replacement. (Category IA–strong recommendation; moderate-quality evidence.)
- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the administration of increased FiO2 via face mask during the perioperative period in patients with normal pulmonary function undergoing general anesthesia without endotracheal intubation or neurectomy anesthesia (ie, spinal, epidural, or local nerve blocks) for the prevention of SSI.
- randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the administration of increased FiO2 via face mask during the perioperative period in patients with normal pulmonary function undergoing general anesthesia without endotracheal intubation or neurectomy anesthesia (ie, spinal, epidural, or local nerve blocks) for the prevention of SSI.
- the search did not identify randomized controlled trials that evaluated the optimal target level, duration, and delivery method of FiO2 for the prevention of SSI.

Do not withhold transfusion of necessary blood products from surgical patients as a means to prevent SSI. (Category II–strong recommendation; accepted practice.)

Application of autologous platelet-rich plasma is not necessary for the prevention of SSI. (Category II–weak recommendation).

Consider the use of triclosan-coated sutures for the prevention of SSI. (Category II–weak recommendation).

Available evidence suggested uncertain trade-offs between the benefits and harms of systemic corticosteroid or other immunosuppressive therapies on the risk of SSI in prostatic joint arthroplasty.