Postoperative Neurologic Dysfunction Across the Lifespan

PATHOPHYSIOLOGY AND REVIEW OF CURRENT EVIDENCE

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Objectives

By the end of the presentation, the audience will be able to:

✓ Compare and contrast at least two forms of postoperative neurologic complications.
✓ Describe the pathophysiology related to various forms of postoperative neurologic complications.
✓ Recall two perioperative interventions that may be used to prevent or treat such complications.
Postoperative Neurologic Dysfunction

- Administration of anesthesia can precipitate neurologic complications across the lifespan
- Primarily differentiated by time of onset and resolution of symptoms
  - Delirium
  - Postoperative cognitive dysfunction
  - Emergence agitation/delirium
Consequences of Postoperative Neurologic Dysfunction

**Delirium**
- Increased morbidity and mortality
- Increased nursing home placement
- Increased cost of care

**POCD**
- Decrease in quality of life measures
- Decreased likelihood to remain in the workforce
- Increased mortality

**Emergence agitation**
- Self-injury or injury to staff
- Surgical site disruption
- Dissatisfaction with anesthetic
Postoperative Delirium

- Altered attention and cognition that usually occurs 24-72 hours postoperatively
- Characterized by fluctuating hyperactive and hypoactive states
- Incidence is 5% up to 62% in high risk groups
Postoperative Delirium

**Risk Factors**

- Age > 70
- History of delirium or dementia
- Alcohol abuse
- Comorbidities
- Narcotics and sedatives
- Depression
- Blood loss, transfusion, and hematocrit < 30%
- Severe postoperative pain
- Anticholinergics
Postoperative Delirium

- **Differential diagnosis**
  - Withdrawal psychosis
  - Amphetamines
  - Toxic psychosis
  - Hypoxemia
  - Hypercarbia
  - Drugs
  - Anticholinergic syndrome
  - Acidosis
  - Alkalosis
  - Visceral distension
  - Anxiety
  - Hyperthermia
  - Hypothermia
Postoperative Delirium

- **Beers Criteria**
  - AGS list of medications deemed inappropriate for use in older adults

- **Perioperative management**
  - Avoid polypharmacy
  - A study comparing general anesthesia with propofol versus desflurane was unable to demonstrate change in incidence of postoperative delirium
Postoperative Cognitive Dysfunction

- Decline in cognitive function following exposure to anesthesia and surgery
- Cognition is a complex phenomenon involving memory, attention, problem solving, perception, and mental imagery
- Difficult to examine and quantify
Postoperative Cognitive Dysfunction

Incidence of POCD

- Cardiac Surgery
- Noncardiac Surgery Age > 60
- Noncardiac Surgery Age 40-59
Postoperative Cognitive Dysfunction

- Cardiac surgery
  - On versus off-pump
- Diabetes
  - Possible increased atherosclerotic burden
- Age
- Preoperative neurologic reserve
  - Subclinical brain abnormalities
  - Age-related decline in baseline brain rSO2
- Presence of delirium at discharge
- Genetics
- Education
- Anesthetic approach
Postoperative Cognitive Dysfunction

- **Methods to mitigate POCD**
  - Avoidance of drugs known to increase risk of POCD
  - Choice of anesthetic agent
  - C5 complement inhibitors
  - Low dose dexamethasone
Emergence Agitation

- EA is characterized by altered mental state in the period between emergence from general anesthesia and discharge from PACU
  - Characterized by hallucinations, delirium, and confusion
- Largely described in pediatric patients
- May also occur in adult patients, particularly in high-risk groups
Emergence Agitation

- Adult-onset EA is frequently associated with PTSD, which is prevalent in military service members
  - Also cited to have high frequency in trauma patients
  - PTSD pathophysiology creates susceptibility to EA
  - Preoperative screening/diagnosis for PTSD

- Pediatric patients are at a particularly high-risk for developing EA
  - Studies indicate incidence may be as high as 50%
  - Observable EEG changes
Emergence Agitation

- **Risk factors in pediatric patients**
  - Preoperative anxiety
  - Preoperative midazolam
  - Age < 6 years
  - Postoperative pain
  - Type of surgery (tonsillectomy, strabismus surgery)
  - Volatile anesthetics

- **Consequences of emergence agitation**
  - Self-injury
  - Surgical site disruption
  - Dislodgement of indwelling devices
  - Patient or parental dissatisfaction
Emergence Agitation Risk Scale

Table 3. EA Risk Scale

<table>
<thead>
<tr>
<th>Values</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>9 – age</td>
</tr>
<tr>
<td>Operative procedures</td>
<td></td>
</tr>
<tr>
<td>Strabismus surgery</td>
<td>7</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>7</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
</tr>
<tr>
<td>Preoperative behavior score</td>
<td></td>
</tr>
<tr>
<td>Screaming or shouting</td>
<td>4</td>
</tr>
<tr>
<td>Tearful and/or withdraw but</td>
<td>2</td>
</tr>
<tr>
<td>compliant with induction</td>
<td></td>
</tr>
<tr>
<td>Calm and controlled</td>
<td>0</td>
</tr>
<tr>
<td>Anesthesia time</td>
<td></td>
</tr>
<tr>
<td>Over 2 h</td>
<td>4</td>
</tr>
<tr>
<td>1–2 h</td>
<td>2</td>
</tr>
<tr>
<td>&lt;1 h</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>The EA risk score</td>
<td></td>
</tr>
</tbody>
</table>

Cutoff score 11, gray zone score 10-13

Pediatric Anesthesia Emergence Delirium Scale

<table>
<thead>
<tr>
<th></th>
<th>Not at All</th>
<th>Just a Little</th>
<th>Quite a Bit</th>
<th>Very Much</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>The child makes eye contact with the</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>caregiver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The child's actions are purposeful</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The child is aware of his/her</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>surroundings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The child is restless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>The child is inconsolable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Score > 10-12 suggests diagnosis of emergence agitation
Emergence Agitation

- Treatment and prevention in adult patients
  - Alpha-2 agonists
  - Ketamine
  - Promethazine
  - Droperidol
  - Avoidance of benzodiazepines
  - “Vocal/local” technique
  - Use of the same staff members for repeated procedures
  - Appropriate tactile stimulation
  - Avoidance of syringes in visual field
  - Cognitive behavioral therapy
  - Accurate documentation of incident
  - Referrals where appropriate
Emergence Agitation

- Treatment and prevention in pediatric patients
  - Alpha-2 agonists
  - Avoidance of volatiles (particularly sevoflurane)
  - Adjunct medication
    - Clonidine
    - Opioids
    - Propofol
    - Ketamine
    - Midazolam
  - Preoperative midazolam and parental presence are not effective in preventing EA
Postanesthetic Neurologic Changes in Children

- FDA issued a black-box warning in 2016 for general anesthesia in children
  - Based on animal experimental data
  - Label change was for general anesthesia from the maternal third trimester through age 3, especially if anesthetic duration is longer than 3 hours

- SmartTots is a partnership between IARS and the FDA and is in process of studying the negative impact on neural development in children following general anesthesia
  - High-risk anesthetic methods
  - Proposed mechanism
Summary

- We examined the incidence, pathophysiology, risk factors, and consequences of postoperative neurologic complications across the lifespan.
- We discussed pharmacologic and nonpharmacologic strategies to mitigate the risk of postoperative neurologic dysfunction.
References


References