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**

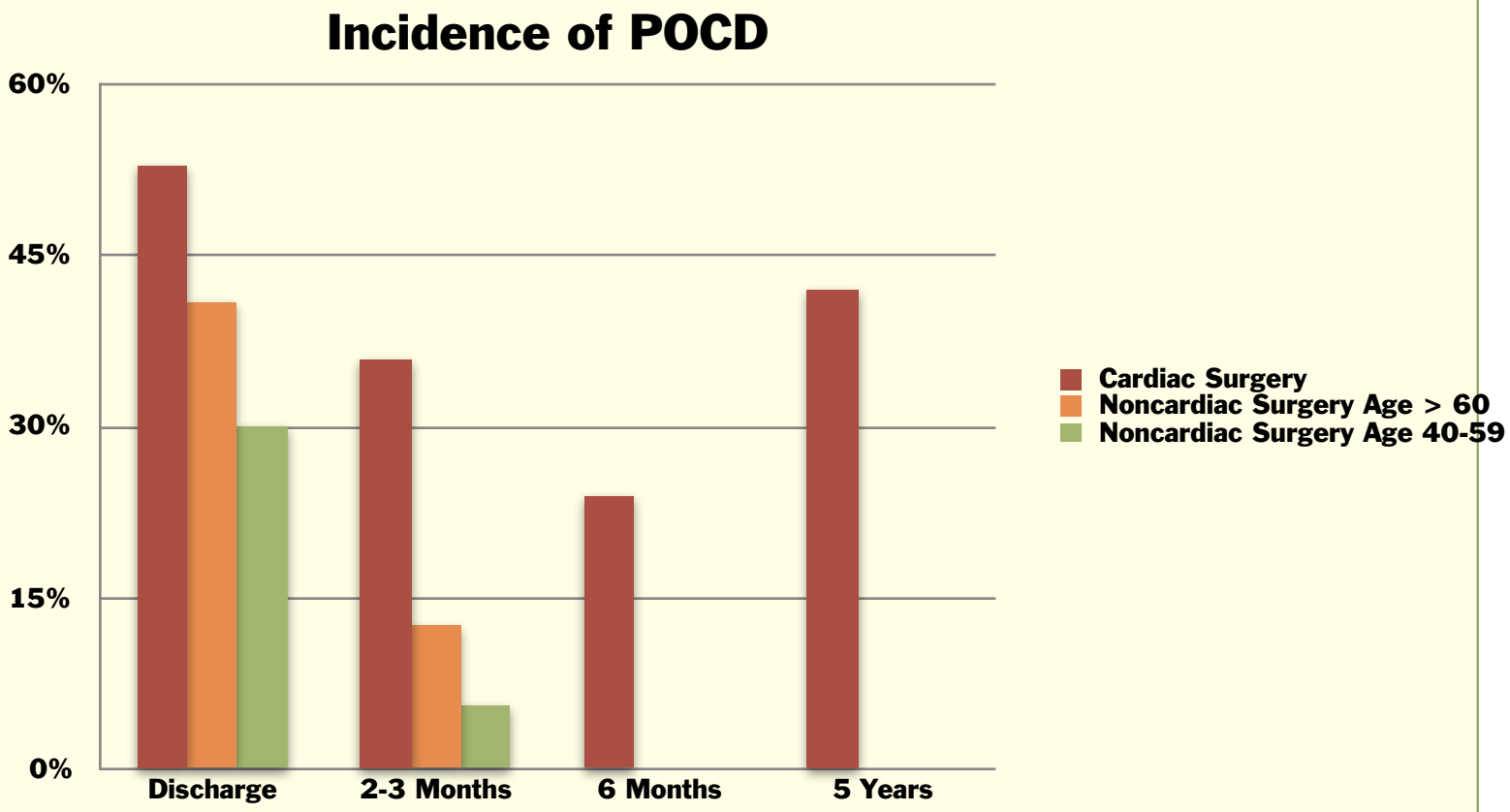
Postoperative Delirium

- **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



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

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

Cutoff score 11, gray zone score 10-13

Hino, M., Mihara, T., Miyazaki, S., Hijikata, T., Miwa, T., Goto, T., & Ka, K. (2017). Development and validation of a risk scale for emergenve agitation after general anesthesia in children: A prospective observational study. *Anesthesia & Analgesia, 125*(2), 550-555.

Pediatric Anesthesia Emergence Delirium Scale

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

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 nonpharmacolgic strategies to mitigate the risk of postoperative neurologic dysfunction**

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